Tracking Shoreline Change Using Archaeology:

A Case Study From Copano Bay, Texas

by

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A Thesis

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CHAPTER I

INTRODUCTION

This thesis focuses on the erosion of archaeological sites around the shores of Copano Bay, on the central Gulf Coast of Texas in Aransas and Refugio Counties. The research data for this project began to be accumulated during July of 2005 when archaeological work was conducted at the shoreline site of El Copano (41RF18). Subsequent archival research and oral interviews have resulted in the incorporation of sites 41AS3, and 41AS109 into this research project. The primary goal of this thesis is to portray the eroded condition of these Copano Bay shoreline sites and produce beneficial information gathered from studying the erosion of these archaeological sites. Research presented here calculates annual rates of erosion for archaeological sites that are located on Copano Bay. These rates of erosion can be used for property owners and those interested in preserving archaeological sites.

Figure 1.1. Archaeological sites on Copano Bay that are the focus of this thesis. Base map courtesy of Robert P. Drolet.
Site 41RF18 is where the majority of the field data for this thesis project were collected during July 2005. The project was a field school conducted through Texas A&M Kingsville, jointly with the Corpus Christi Museum of Science and History (CCMSH). This project was directed by Dr. Robert P. Drolet of CCMSH. For clarity this project will be referred to as the El Copano Archaeological Project (ECAP) in this thesis. Sites 41AS3 and 41AS109 were incorporated using archaeological records to identify shoreline change at these two sites.

This thesis is divided into eight chapters. Chapter 2 presents the research questions on which this thesis focused. Chapter 3 discusses the natural environment around the Copano Bay area. Chapter 4 provides background information about the prehistoric and historic people who lived around Copano Bay. Chapter 5 discusses the methods used in the fieldwork conducted at 41RF18, calculating rates of erosion, and the oral interviews conducted. Chapter 6 describes the results of the 2005 fieldwork at 41RF18. Chapter 7 describes the results of the historic maps, photographs, and oral interview analyses. Finally, Chapter 8 concludes the findings of this thesis.

All records from the fieldwork conducted at 41RF18 are housed at CCMSH in Corpus Christi, Texas. The information discussed here has also been presented at: the 76th Annual Meeting of the Texas Archaeological Society in Austin, Texas (Barrera 2005); the 77th Annual Meeting Texas Archaeological Society in San Angelo, Texas (Barrera 2006); and at the 72nd Annual Meeting of the Society for American Archaeology in Austin, Texas (Barrera 2007).
CHAPTER II

RESEARCH ISSUES

Introduction

The research issues presented here focus on the loss of history and property along the shore of Copano Bay. These two issues are introduced in this chapter with discussions on solutions and the benefits that addressing these concerns bring to the archaeological community. The solutions focus on the preservation of archaeological sites that are being impacted by natural and human induced erosion. Benefits from this research project can aid modern landowners along the Gulf Coast of the United States and those concerned with the loss of archaeological resources. The following research goals are listed in order of importance based on the benefits provided for each goal.

Research Goals

1) Determine erosional rates and preventive measures for shoreline erosion in modern communities around Copano Bay.
   a) Highlight the importance of applying archaeological data to modern settlements around Copano Bay.
   b) Identify methods to prevent erosion at archaeological sites and modern settlements (Barrera 2005).
   c) Propose volunteer efforts towards endangered archaeological sites around Copano Bay.

2) Develop an annual rate of erosion for archaeological sites 41AS3, 41AS109, and 41RF18 based on archaeological evidence, using historic resources available to aid the archaeological data.
3) Describe and define the critically eroding condition of El Copano and other sites around Copano Bay, including an estimate of how many years each site has before completely eroding away.

**Natural Factors Leading to the Disappearance of Archaeological Sites**

A discussion of how archaeological sites disappear is a necessary prelude to a discussion about the problems of archaeological site and property loss. Erosion observed at the archaeological site 41RF18 (El Copano) resulted in an archaeological project to preserve information from this site. Various agencies including the Texas Historical Commission (THC), Texas Parks and Wildlife Department (TPWD), the Rockport Museum of Nautical History, and CCMSH were concerned with the critically eroding condition of 41RF18. Initial observation of 41RF18 identified historic shell-crete structures collapsing on top of the bluff on which they were constructed, and collapsing off the bluff into Copano Bay. An archaeological project was organized by Dr. Robert P. Drolet of CCMSH in July 2005 to begin recording the historical information that was rapidly eroding into Copano Bay.

Major natural processes observed impacting the shoreline of Copano Bay include: wind, currents, major storm surges, and rainfall runoff. Wind action is a typical daily impact on Copano Bay as predominately southeasterly winds drive waves and currents directly into the western shoreline of Copano Bay. Observations made in 2005 and 2006 of shoreline erosion recorded rapid and severe erosion along Copano Bay. During peak wind on a normal day, bluff sections of up to 5 m³ in size were observed slumping off into the high energy water of Copano Bay. Hurricane Emily during July 2005 created
winds in excess of 60 mph during fieldwork at 41RF18, the erosion observed from this storm was very severe.

Currents in Copano Bay are responsible for moving sediments away from the nearshore portion of the bay. Currents can be impacted by storms, wind, temperature, and human modification to the natural environment. During greater than normal current activity, coarser grained sediments (i.e. shells, sand) can be moved away from the nearshore area and these sediments can be deposited into lower lying areas of the bay (Paine and Morton 1993:24–25). The removal of sediments from the nearshore shore bay bottom weakens that area of the bay and makes terrestrial areas along those portions of the bay more susceptible to erosion. Increasing the depth of the bay near the shoreline through sediment removal increases the wave base and decreases the wave drag, which will result in more intense daily erosion from wave action along the shoreline.

The largest single events of erosion along the Gulf Coast occur from major storm episodes. Large storms produce major storm surges that can inundate and remove large portions of coastline including archaeological sites. The Texas Gulf Coast from 1900 to 1989 averaged 0.82 storms per year with sustained wind speeds greater than 39 mph (Paine and Morton 1993:25). Direct evidence of major storm surges impacting the western side of Copano Bay was recorded during July 2005 at 41RF18 in the form of large storm-surge shell deposits. These deposits reflect storm intensity, with the lowest elevation of the deposit in relation to sea level containing the finest grained sediments, and the highest elevation of the deposit containing the largest grained sediments (Barrera 2007). The shell deposits at 41RF18 reflect greater storm surge energy at higher
elevations (coarser grained sediments) and less energy at the lower elevations of the shell deposit (finer grained sediments).

Rainfall runoff on the shoreline along the Gulf Coast is seen as a minor contributor to erosion in comparison to the other natural factors previously listed in this chapter. Runoff from precipitation affects the amount of sediment transport that comes down the river systems into the Gulf of Mexico, therefore supplying the Gulf Coast with sediment to initiate accretion in actively accumulating (depositing) areas. However, cooler, moister Terminal Pleistocene conditions provided river systems with five to ten times more water transported down the channels than today (Paine and Morton 1993:21), and when compared to the warmer drier conditions today river sediments supplying coastlines are not as substantial. Precipitation runoff along the bluffs of Copano Bay was observed eroding the bluff line during July 2005. Local residents of Bayside with property along western Copano Bay also supported this observation by providing information about the amount of erosion that rainfall runoff is responsible for versus accretion along their bluff line property (Herman Smith, personal communication 2007). Local residents of Bayside have observed rainfall runoff incising the bluff line portion of their property and eroding property along bulkheads, which is an interesting observation considering the large investment required to construct a bulkhead. The natural factors listed here are primarily responsible for all natural erosion that has occurred along the Gulf Coast and Copano Bay in particular.
**Human Impacts to Archaeological Sites**

Impacts to the shoreline observed along Copano Bay include: construction of bulkheads, mechanical clearing of vegetation, dredging, and the construction of homes and roads. Of these developments, bulkhead construction had the greatest direct impact to archaeological sites observed during the fieldwork for this research project. In December of 2006 bulkhead construction removed approximately 75 percent of 41AS109 through mechanically excavating the archaeological site out of the bluff line. Prior to the direct removal of 41AS109 with heavy machinery, the site was eroding at an artificially rapid rate due to bulkheads in close proximity forcing wave energy to dissipate along the unprotected bluff line containing the majority of the archaeological site. Through the construction of bulkheads, archaeological sites can be directly impacted if they are in the area of construction, or the archaeological sites can be impacted after the bulkheads have been installed and the wave energy is reflected toward the unprotected shoreline that contains the site.

Mechanically clearing vegetation along a shoreline environment can have a direct and indirect impact on archaeological site erosion and land loss. Clearing vegetation with bulldozers and chains has partially destroyed 41RF18. The heavy machinery had moved historic structures from their original positions, moved and destroyed portable artifacts, and destroyed architectural features through crushing. The vegetation removal also led to a temporarily weakened root system that does not resist large storm surges, large amounts of rainfall, and daily wind/current activity until a stronger root system develops.

Dredging in the Copano Bay area is primarily occurring in the large waterways within Aransas and Redfish Bays, which immediately border Copano Bay to the east. By
artificially maintaining a greater than natural depth in certain parts of the bays, humans may be responsible for increasing wave base and decreasing wave drag that can lead to a greater rate of erosion than natural. Dredging within Copano Bay was observed during the 1920s and 1930s by local Bayside resident J. D. Derrough (personal communication 2006), who stated that, once the oyster shell dredging began in Copano Bay, erosion increased drastically along the western side of Copano Bay. Mr. Derrough also stated that he observed a very large portion of the bluff line on which 41RF18 is located eroding into Copano Bay after the oyster shell dredging began in the immediate area.

The construction of homes along Copano Bay impacts the shoreline through the installation of shoreline stairways, clearing of vegetation for housing, and the erection of bulkheads. The removal of large amounts of vegetation is the greatest impact observed to shoreline erosion through development due to the increased runoff that flows over the bluff line eroding the edges of the bluff line more rapidly. Stairway installation is a minor impact to the shoreline with vegetation and sometimes portions of the bluff line removed to install stairways. Bulkheads as described above can have a major direct impact on archaeological sites located along the shoreline and on property loss in general for unprotected property neighboring bulkheads.

Road development impacts the shoreline in ways similar to house construction through the removal of large areas of vegetation, which increases erosion by increasing the precipitation runoff along the bay bluff line. Road and house construction along 41AS3, which is located along Copano Bay, resulted in the disturbance of 50 percent of the 800-m long site by heavy machinery.
Why is Shoreline Erosion a Problem?

Shoreline erosion is presented as a problem here because it affects archaeological sites and shoreline property owners. Depending on a shoreline’s location along the Gulf Coast, the shore may be eroding, stable, or accreting. Erosion prevention for property owners is becoming a important business, and an expensive investment. During the fieldwork conducted for this research project, property owners along the shoreline of Copano Bay were interviewed or consulted. Almost every single property owner contacted had either invested in erosion prevention measures or intended to invest in erosion prevention for their property.

Understanding the amount of erosion per year that occurs along a specific section of shoreline is critical for property owners who are trying to decide if they should invest in erosion prevention and what type of erosion prevention they should invest in. Providing detail for specific areas along Copano Bay is one of the major goals of this research project by using archaeological information and producing a methodology to demonstrate the process. Producing up to date rates of erosion, stability, or accretion would aid in archaeological site preservation and property management.

Research focused on shoreline erosion will help provide solutions for the preservation of eroding archaeological sites along the Gulf Coast. These archaeological sites are unique and irreplaceable cultural resources worthy of study and preservation. And fully understanding how fast these unique sites are disappearing, and how much longer these sites are going to be around are critical issues on which to focus research.

The loss of these cultural resources is addressed in two ways: by predicting how much longer these archaeological sites will contain intact deposits based on their rates of
erosion, and by developing a series of proposals for preservation of these important cultural resources. Proposals for preservation of these archaeological sites are discussed in Chapter 8 in detail.

Archaeological sites have been observed in various states of erosion along the Gulf Coast for a relatively long period of time (Campbell 1958; Cox and Smith 1988; Martin n.d.). However, archaeologists have not extensively addressed various topics related to the erosion of archaeological sites including: loss of cultural information, developing rates of erosion from archaeological sites, and the preservation of cultural resources.

**Similar Projects That Have Tracked Shoreline Erosion**

The following research projects were used as models from which the research design for this thesis project was formed. The Bureau of Economic Geology (BEG) at The University of Texas at Austin developed a system for tracking shoreline change without using archaeological sites (Paine and Morton 1993). Saul Aronow and Rich A. Weinstein (2002) used one archaeological site to track shoreline change by measuring from a permanent datum. Torben C. Rick, Jon M. Erlandson, and René L. Vellanoweth (2006) used stakes placed on archaeological sites to track shoreline change over a 1-year period. These three research projects are summarized below due to their importance for this thesis.

In the 1990s a model for Gulf Coast erosion was developed for the Copano Bay area by the BEG, at The University of Texas at Austin (Paine and Morton 1993). This model projected topographic charts, aerial photographs, and photomosaics onto a base
map to develop rates of erosion based on shoreline position over time in the Copano Bay area.

The BEG model discusses various natural and artificial processes that erode shorelines such as major storms (hurricanes), wind and wave action, current (e.g., littoral drift), and dredging. Of the storms listed, only hurricane Carla in 1961 was mentioned during oral interviews as having severely eroded the shoreline of Copano Bay (D. Derrough personal communication 2006). Paine and Morton (1993) list Hurricane Carla as having produced a storm surge height of 2.83 m at Port Aransas, Texas. It should be noted that Port Aransas sits along the open Gulf of Mexico, while El Copano is situated at the rear or inland side of a back bay, separated by a barrier island, and peninsula (relict barrier island) from the Gulf of Mexico. So a storm surge from Hurricane Carla at El Copano would have been substantially smaller in height than that recorded at Port Aransas. The BEG model lists rates of shoreline change where the three archaeological site used in this thesis are located: 41RF18 -1.65 m/yr – +0.55 m/yr, showing a land loss and land gain along this site; for site 41AS3 -0.79 m/yr; and for site 41AS109 -1.28 m/yr (Paine and Morton 1993:62–63). The BEG model determined that the Copano Bay shoreline is receding particularly along the southern and northwestern areas.

Saul Aronow and Rich A. Weinstein (2002) published a report on the Guadalupe Bay site (41CL2) located in the San Antonio Bay system, which is the estuarine bay system immediately north of the Copano Bay system. The 41CL2 research project is an example of tracking shoreline change using archaeology along the central Gulf Coast of Texas. A permanent datum was established at 41CL2 in 1989 and measurements of the bank or bluff line edge were taken during this archaeological investigation. A subsequent
archaeological investigation of 41CL2 in 1992 showed that the bluff line had eroded between 1.5 m and 3 m over the 3-year period (Aronow and Weinstein 2002:27).

A more recent archaeological project included tracking shoreline change on archaeological sites located on California’s Channel Islands (Rick et al. 2006). These researchers established stakes on archaeological sites and took shoreline measurements at the stakes over a 1-year period. Erosion was observed occurring at one site at a rate of 0.5 m/yr and proposals for salvage excavations and collecting radiocarbon samples are proposed (Rick et al. 2006:571–573).

**Thesis Research Design to Track Erosion**

This research project demonstrates the ability to develop rates of shoreline change based on the recorded information from archaeological sites and to predict how long sites will have before completely eroding. Archaeological and historical data are combined to demonstrate an annual rate of erosion for specific areas around Copano Bay. Historic maps, photographs and archaeological records are used to track shoreline erosion at three archaeological sites along Copano Bay. Chapter 5 discusses in detail the research project methods to develop a rate of erosion using archaeological sites. Proposals for archaeological site preservation are included in Chapter 8. These methods can be applied to any archaeological sites that contain similar recorded information.
CHAPTER III

ENVIRONMENTAL SETTING

Geographically this research project focuses on the coast of the Gulf of Mexico, particularly the Gulf Coast of Texas. The shoreline along the majority of the Gulf of Mexico is composed of soft sediments that create a fairly gentle topography from the shoreline inland. The latest depositional episodes along the Gulf Coast have created a variety of land forms from sand/shell barrier islands to deltaic features that feed large amounts of sediments into the Gulf of Mexico. Geologically the Coastal Plain along the Gulf of Mexico is a clear reflection of various depositional episodes associated with past shorelines for the Gulf and various environmental conditions. These depositional episodes usually mirror the modern coast line in shape and are typically exposed from most recent to oldest heading from the shoreline inland. The Gulf Coast of Texas is diverse because of modern environmental conditions such as variation in precipitation and in temperature due to the large area both latitudinally and longitudinally that the Gulf Coast of Texas encompasses (Carr 1967). The data gathered in this research project came from Copano Bay, which is located along the Central Gulf Coast of Texas (Figure 3.1).

Paleoenvironment

This section details the evolution of the Gulf Coast, the Central Texas Coast in particular, and how the relatively stable modern Gulf Coast developed from a fluctuating coastline over the past 20,000 years. During the Terminal Pleistocene period (ca. 18,000–10,000 B.P.) climatic conditions were generally cooler and moister than the current climate along the Gulf Coast of the United States (Ricklis 2004b:182–183). With
much more ice contained in the world’s ice reserves during the end of the Pleistocene, sea level along the Gulf Coast was much lower during this time. The glacial maximum during the last glacial period occurred around 20,000 B.P. when the shoreline was up to 200 km farther eastward and southward of the present Gulf Coast shoreline (Ricklis 1996:13–14). The Gulf Continental Shelf is a physiographic feature that extends from the current shoreline to the point approximately 200 km seaward where the shoreline was located during the last glacial maximum (Fenneman 1938:1). This submerged portion of the North American continent is a relatively shallow (maximum 300 m depth) submerged shelf that contains paleoenvironmental features from the last 20,000 years, which

Figure 3.1. State of Texas and Copano Bay along the central Gulf Coast of Texas. From About.com 2008.
geologists and archaeologists continue to investigate to develop a better idea of conditions during this time period (Curry 1960; Faught 2004).

The terrestrial or emerged portion of the Gulf Coast is referred to as the Coastal Plain (Fenneman 1931:1) and has a fluctuating shoreline location depending on environmental conditions observable through the geological record (Curray 1960). The portion of the Coastal Plain nearest the modern shoreline that is 80 to 120 km wide along the Texas Gulf Coast is a Pleistocene geological deposit with more recent Holocene deposits overlying the earlier deposits (Fenneman 1931:112–113). During the Terminal Pleistocene period, a warming trend began to occur ca. 20,000 B.P. resulting in a rising sea level and, therefore, receding shoreline and the inundation of river valleys that eventually resulted in the formation of bays and inlets along the Gulf of Mexico. During this warming trend as the sea advanced inland, terrestrial deposits were eroded by marine processes and then redeposited through longshore drift along the Gulf Coast. This process has created a distinct geological record that indicates where the shoreline was in the past and when it was located at specific positions (Curray 1960:259).

Rapid sea level change began at the end of the Pleistocene/beginning of the Holocene ca. 10,000 B.P. The rate of sea level rise was so rapid that by 9000 B.P. the shoreline was into the vicinity of modern bays, having inundated river valleys up to the point where modern bays are developed today (Ricklis 2004a:157). From 9000–7000 B.P., a period of slowed sea level rise occurred followed by a period of rapid rise from 7000–6000 B.P. (Ricklis 2004a:157). Around 6000 B.P. a cooling trend reinstated stable sea levels, and increased precipitation, which led to the development of more productive bay (semi-estuarine) environments. A major climatic change occurred during a time
period known as the Hypsithermal Interval (ca. 8000–4000 B.P) when more arid conditions became established leading to a vegetation shift along the Gulf Coast (Ricklis 2004b: 183). The period is also referred to as the Altithermal in archaeological literature (Nickels et al. 2002:27; Vierra et al. 1998:9). It was during the warmest time of the Hypsithermal Interval that sea level was at the highest point it reached during the Holocene, which is referred to as the Holocene highstand (Ricklis et al. 1995:20; Ricklis and Weinstein 2005:109). The highstand during the Holocene is the point in time when sea level reached the highest level it has attained during the Holocene, approximately 1 m higher than modern sea level. The highstand occurred around 5000–4200 B.P. based on research along the central Texas Gulf Coast (Albert 2006; Prewitt and Paine 1987; Ricklis 2004a; Ricklis 2004b). This period of higher than modern sea level lasted until approximately 3500 B.P., at which time the modern configuration along the Gulf Coast began to fully develop.

During the Early and Middle Holocene (10,000–3000 B.P.), periods of relatively stable sea-level alternated with periods of fluctuating sea level, preventing the Central Gulf Coast of Texas from developing the highly productive estuarine bay systems that are seen today (Ricklis et al. 1993:7–8). The current configuration of the Central Gulf Coast of Texas developed around 3000 years ago when local sea levels stabilized and the barrier islands began to grow into a large chain of islands (Ricklis and Blum 1997:306). By 2500–2000 B.P., the barrier islands off the Gulf Coast of Texas had formed their current configuration through a combination of a stable sea level and continual deposition brought to the island chain from longshore drift and constant onshore wave action. The development of the barrier islands created a series of well-protected estuarine bays and
inlets along the Texas Gulf Coast that further developed with the barrier islands to become highly productive estuarine environments that sustained increasingly large human populations. The barrier islands continue to be the greatest protection along the Gulf Coast from daily wind and wave erosion, as well as from large storms.

**Modern Deposits along the Gulf Coast**

Modern submerged deposits under the Gulf of Mexico come from a variety of river systems. The Mississippi and the Rio Grande Rivers are two of the largest sediment producers along the current Gulf of Mexico shallow nearshore areas (Curray 1960:247). After the various river systems along the Gulf of Mexico deposit sediments into the sea these sediments are not carried very far seaward (not farther than 16-km for smaller river systems) before they are finally deposited onto the bottom of the Gulf or a bay/inlet (Curray 1960:256). Littoral drift is subsequently responsible for the large amount of movement that occurs to the submerged deposits that rest in the nearshore areas of the Gulf of Mexico (Morton et al. 2004:25).

The modern submerged deposits along the Central Texas Gulf Coast in the Copano Bay area, including re-worked Pleistocene deposits, are transported by littoral drift from the Colorado River and by smaller river systems (Curray 1960:246–247). Various river systems that bring sediments into bays, inlets, and the Gulf of Mexico are in various stages of delta development. This means that some rivers (smaller rivers) have a delta that is an enclosed bay or inlet with a peninsula or barrier island on the seaward side of the bay/inlet protecting the estuarine environment from the open sea. Larger river systems along the Gulf Coast (i.e., Mississippi, Rio Grande, and Brazos Rivers) have deltas that have fully formed, meaning they do not have enclosed bay systems that are
receiving the bulk of the sediment and freshwater flow. The larger river systems have aggrading deltas that continue to advance seaward due to the larger volume of sediments transported in these larger river systems, versus eroding delta areas that occur along smaller rivers (Aronow and Weinstein 2002).

Marine and eolian deposits are found in terrestrial areas surrounding Copano Bay that indicate periods of sea level that were higher and lower than today’s local mean sea level (Prewitt and Paine 1987:164–166). Pollen data from Copano Bay supports these geological finds with evidence of periods that had higher-salinity requiring vegetation, and periods that had lower-salinity requiring vegetation (Albert 2006). These pollen data indicate that alternating time periods were cooler or warmer than it is now, supporting previous findings of a middle Holocene high stand around 4500 B.P., and a modern still stand around 3000 B.P. (Albert 2006). Archaeological and geological work around Copano Bay allows us to understand when the modern physical configuration of the bay was established, and therefore a point in time to which long-term erosional rates can be referenced.

Vertisols soils are the most common soil order along the Central Gulf Coast of Texas. These are clayey soils that exhibit pronounced shrinking and swelling, depending on the moisture content. According to Guckian (1988:1), soils along Copano Bay are clayey loams from alluvial processes and marine deposits. All of these soils overlie older Pleistocene clays that compose the Beaumont Formation (Ricklis and Blum 1997:291). The eastern side of Copano Bay is bordered by Live Oak Peninsula and Lamar Peninsula, each of which are composed of Pleistocene sands that formed an ancient barrier island. The soils on which 41RF18 lies (Figure 3.2.) are alluvial and marine Holocene deposits
that sit on top of the Beaumont clays (Barrera 2005). The depths of these soil formations vary with the changes in this archaeological site’s topography.

Modern Environment along the Texas Gulf Coast

The coastal zone along the Texas Gulf Coast is divided into three biotic provinces defined by Blair (1950). The eastern most biotic province, with a western boundary at Galveston Bay, along the Texas Gulf Coast is the Austroriparian province. The Austroriparian province is characterized by hard wood and piney wood forests that extend into this area of Texas due to the relatively large amount of precipitation each year in East Texas (Carr 1967). The central biotic province of along the Texas Gulf Coast is the Texan province, which extends from Galveston to San Antonio Bay. The Texan province is characterized by sandy soils that contain hard wood trees, such as post oaks, live oaks, pecans, and highly productive riverine environments. The third biotic province that is found along the Gulf Coast of Texas is the Tamaulipan province extending from San Antonio Bay southward along the Gulf Coast of northern Mexico. This is the most arid biotic province along the Texas Gulf Coast and receives 25–36 inches of rain annually, decreasing southward along the coast (Carr 1967). Various species of thorny brush are the dominant vegetation type encountered in the Tamaulipan province, along with cactus, cord grass, and live oak mottes along the coastal areas.

Sea level is directly related to the diversity in vegetation along the Gulf Coast according to Albert (2006:161). The longer sea level is stable, the more diverse vegetative ecosystems become due to continual development during stable periods. Directly related to sea level stability is the development of barrier islands. With barrier islands developing or developed as we see them today along the Texas Gulf Coast,
vegetation within estuarine ecosystems are extremely diverse due to the stable protected environments aided by the barrier islands. Interestingly Albert (2006:161) states that the higher the level of fresh water influx into an estuarine bay, the higher the diversity in vegetation types due to the higher photosynthetic activity occurring. Higher levels of freshwater influx into Texas Gulf Coastal bays will not only support more vegetation, but also more abundant wildlife. Estuarine bays along the Texas Gulf Coast vary in salinity levels according to the amount of freshwater they receive from tributaries and their proximity to open Gulf of Mexico high salinity water. Lower salinity estuarine bays that have barrier islands will tend to have more diverse flora and fauna within the ecosystem.

Vegetation around the Copano Bay perimeter has been documented historically as being open grassy plain (J.D. Derrough, personal communication 2006). The vegetation is believed to have become brushier around 1900 (J.D. Derrough, personal communication 2006). This vegetation change is attributed to the increase in livestock and development around this time. Modern vegetation for the Copano Bay area consists of short, thorny bushes and trees along with various grasses along the upland landforms. The lower lying marsh, shoreline, and tributary vegetation consists of estuarine reeds, grasses, and shrubs that are generally no higher than 1-m. Based on observations during July 2005, these environments appear to be eroding in various parts of Copano Bay today. Vegetation is very important for preventing erosion, particularly against normal wind and wave activity.

Copano Bay is an estuarine bay comprising inlets, peninsulas, and shell reefs, to list some of the major features. Copano Bay is fed with freshwater primarily from the Aransas River, the Mission River, and Copano Creek. Mission River is the largest
freshwater inflow of these three and probably is mostly responsible for the formation of Copano Bay. Inlets to the Gulf of Mexico are located approximately 32 km outside of Copano Bay, coming through Redfish, Aransas, and Mesquite Bays. There are two major passes that primarily supply Copano Bay with saline water. The larger of the two passes, Aransas Pass, is artificially maintained and divides Mustang Island from San Jose Island. The other major pass is Cedar Bayou, which divides San Jose Island from Matagorda Island. These three islands are long narrow barrier islands that buffer the mainland from open-sea storms and winds (Figure 3.2). The barrier islands are composed of fine sands and marine shell deposits (Paine and Morton 1993).

Figure 3.2. Central Gulf Coast of Texas and geographical features. Base map courtesy of Robert P. Drolet.

El Copano (41RF18) lies on Copano Bay, which is one of five major bays along the Central Gulf Coast of Texas. The five shallow bays are protected from the open
waters of the Gulf of Mexico by a long chain of barrier islands. Composed of sand and shell, these islands developed their current configuration approximately 2,000 years ago (Ricklis and Blum 1997:306). The protected bays are highly productive due to the freshwater inflow that each estuarine system has. An example of this productivity is the fishing and shell fishing industries today along the Central Gulf Coast of Texas. These industries rely on the stable bay systems to continually provide natural resources year after year. Renewable resources are dependent on the processes that continually stabilize and rejuvenate the bay systems each year, including freshwater inflow, saline inflow, protection from open-sea turbid water, shallow bay depths allowing high photosynthesis productivity, and warm water temperatures due to latitude and warm Gulf currents.

Today, land use around Copano Bay is primarily ranching, closely followed by domestic residences. No large industrial development lies along the shores of Copano Bay. The ranch lands along Copano Bay are the best sample of undeveloped land on Copano Bay today. However due to the intensive erosion along many of Copano Bay’s bluffs, stable habitat is very rare along these shorelines. During July 2005, the ranch land on which 41RF18 is located had recently been mechanically cleared, which disturbed the upper 30 cm of soil and damaged the historic structural remains along a 2 km stretch of Copano Bay. Land modification such as this may be contributing to the intense erosion around Copano Bay.

Residential land along Copano Bay also has on-going modifications that were observed during July 2005 and the fall of 2006. Residents of Bayside experience very intense erosion along large portions of the town. To combat this erosion, Bayside has planted large amounts of gulf cordgrass (*Spartina patens*) as a relatively inexpensive
means of combating the continual wind, waves, and storm surging that erode bluffs throughout Copano Bay. Other means of erosion prevention that were observed include: rip rap, erosion control fencing, and gabions. To install each of these requires destroying natural habitat, and these methods disturb the natural environment by deflecting wind and waves elsewhere. These types of modification to the Copano Bay shore have occurred at every residence in Bayside that was observed during 2005 and 2006.

**Natural Setting of 41RF18 (El Copano)**

El Copano has a bluff line that runs for approximately 2 km from the southwestern side of the port settlement to the northeastern outlying structures of the settlement. This bluff line is highest in the southwest part of the site, reaching approximately 7 m above sea level. The land gradually slopes downward to the northeast, where the lowest elevation of the site is approximately 1–2 m above sea level. The entire site is covered in small trees, thorny brush, succulents, and various upland and marsh grasses. El Copano (Figure 3.3) is bordered by Copano Bay on the eastern side of the site, Plummer’s Slough along the northern part of the site, and Power’s Point at the southern part of the site. To the west of El Copano lies undeveloped ranch land that is primarily open and grassy, due to recent heavy mechanized clearing. The majority of the erosion observed during the field season in July 2005 was occurring along the southwestern portion of the site where the land is highest and had the most undercutting of the bank occurring. This undercutting is probably responsible for the greater land loss in the areas with the highest elevation. This may be due to the greater weight of soil above the undercut portions of bluff where the elevation is highest.
Another prominent feature that appears to play a part in shoreline erosion is Copano Reef. This shell fish reef is very large, extending from Power’s Point across Copano Bay to Rockport for a distance of approximately 6.5 km. Depending on the tide, the top of the reef is alternatingly exposed and submerged. While the reef is exposed, it is clear that prevailing southeasterly wave action is deflected on the reef. This wave deflection is probably heavily responsible for the erosion at El Copano. Mr. J. D. Derrough (personal communication 2006), who spent a lifetime crabbing on Copano Bay, remarked that these massive reefs are just like bulkheads, meaning that when waves are deflected, the energy is going to collide somewhere else, that place being the western shore of Copano Bay where El Copano has sat for over 200 years. The intense erosion
along Power’s Point, just west of Copano Reef, may be a result of the continual wave energy being redirected towards Power’s Point in particular. A combination of greater sediment weight (highest point of elevation in Northwest Copano Bay) and receiving the redirected wave energy from Copano Reef may explain why Power’s Point has been eroding more rapidly than other areas along northwestern Copano Bay.
CHAPTER IV

ARCHAEOLOGICAL BACKGROUND

Introduction

The following chapter lists and describes the rapidly eroding important archaeological resources around the Copano Bay area on which this research project focuses. Describing the settlement of the Central Gulf Coast of Texas is necessary for understanding what types of archaeological sites are eroding and which of these sites are the most critically endangered. This thesis does not attempt to add new information to any specific cultural component. Rather, the conclusions of this project aim to assist people in understanding how much longer we have until all cultural components located along the Gulf Coast disappear as a result of erosion. A chronology from the earliest human occupation along the coast to the most recent historical occupation is discussed in this chapter. Finally, the archaeological investigations within the Copano Bay area are summarized since the archaeological sites within Copano Bay are used as the primary data source for this project on site erosion.

Cultural History for Central Gulf Coast of Texas

The cultural and ecological history of the Texas Gulf Coast has been poorly documented and not extensively researched until very recently. The archaeology along the coast is not well-understood relative to other regions in the state, possibly due to the nature of coastal shell middens and the lack of preservation that have traditionally posed problems for archaeological interpretations. Coastal archaeological work by Martin and Potter (ca. 1930), T.N. Campbell (1947, 1952, 1958, 1960, 1961), J. E. Corbin (1963, 1974, 1976), D. A. Story (1968, 1985), and R. A. Ricklis (1996, 2004) has developed the
models and current understanding that we have of human settlement along the central Texas Gulf Coast. Ricklis (1996, 2004) in particular, has recently developed the most concise current understanding of human development and interaction with the environment along the Texas Gulf Coast.

**Paleoindian Period (12,000–8,000 B.P.)**

Humans settling along the Gulf Coast of Texas 12,000 years ago were occupying a shoreline that is now located approximately 100-km offshore, completely submerged under the waters of the Gulf of Mexico. The global climate began to warm around 12,000 years ago and the Gulf of Mexico’s shoreline advanced inland, quickly submerging permanently any shoreline occupation older than 8000 B.P. Occupations along the current shoreline of the central Gulf Coast of Texas did not occur until around 8000 B.P. because rising sea levels continued to move the coastal zone inland until this time (Ricklis 2004:157). Therefore the earliest recorded coastal occupations along the Texas Gulf Coast post-date the Paleoindian period.

**Early Archaic Period (7500–4500 B.P.)**

A period from 7500–6800 B.P. is identified by Ricklis (2004:161–162) as the earliest coastal occupation along the current Texas Gulf Coast. During this early period reliance on shellfish for subsistence and raw materials occurred, along with the use of common diagnostics to the Early Archaic period such as lithic dart points. From 8000–7000 B.P. relative sea level stability allowed for the initial coastal occupations in the vicinity of the modern coastline to occur. These early coastal occupations were small, temporary occupations that relied on fairly saline resources due to the developing conditions of the bays along the central Gulf Coast of Texas around that time (Ricklis et
Interestingly, the few sites that have been dated to this time period are located close to the river deltas of the modern bay systems on which they are found. The location of these Early Archaic sites near the river deltas suggests the early bay environments lacked large contiguous barrier islands and did not have sufficient periods of sea level stability to produce high levels of biotic productivity away from the river deltas. The earliest coastal occupations that have been investigated are particularly not well understood due to the small sample size and poor preservation of perishable material (Ricklis and Weinstein 2005:116–117).

After 6800 B.P. a global warming trend led to an environment that was not nearly as biotically productive and, therefore, could not as easily support human populations due to the rising sea level preventing bay development (Albert 2006; Ricklis 2004). This relatively unproductive coastal environment resulted in the apparent abandonment of coastal occupation from 6800–5800 B.P. that is reflected in the archaeological record along the central Gulf Coast of Texas. A cooling trend began around 6000 B.P. that led to more productive bay (semi-estuarine) environments than during the early part of the Early Archaic period allowing for humans to begin re-occupying the coast by 5800 B.P.

From 5800–4200 B.P. human occupation at coastal sites is seen again along the central Texas Gulf Coast. Sites become more abundant than previously; however, occupations are still brief with apparently small populations (based on sparse occupational strata and relatively few sites). Importantly, the increase in archaeological sites does allow for more information to be gathered about these early settlers of the Texas Gulf Coast. From 5800–4200 B.P. people were clustering around the river deltas due to the still fairly undeveloped bay areas compared to estuarine bays today. Sites
dated between 5800–4200 B.P. do contain a small amount of perishable material (fauna
and flora) that allow archaeologists to determine that the occupation of these coastal sites
occurred primarily during the cooler months of the year (Ricklis 2004:165).

Towards the end of the Early Archaic period another warming trend occurred
around 5000–4200 B.P. Albert (2006) discusses pollen data from Copano Bay as an
indicator that the warming trend began closer to 4900 B.P., resulting in the Holocene
highstand. The archaeological evidence suggests that the highstand took place closer to
4200 B.P. (Ricklis 2004a) due to the absence of any archaeological sites from the central
Gulf Coast of Texas that have been dated between 4200–3100 B.P. (Middle Archaic
period). The lack of archaeological sites from this time period is not believed to reflect a
sampling bias, but rather the environmental conditions during this time period that did not
allow for coastal reliance. However, the pollen data is difficult to argue against, and the
Holocene highstand probably did occur closer to 4900 B.P. since saline plant species
were more abundant at this time than closer to 4200 B.P. (Albert 2006). From 4900–
4200 B.P. humans were still occupying the coastal environments relying on
coastal/estuarine resources. What occurred was a lowering in environmental productivity
as sea level became more unstable, and over this period of time humans moved away
from a reliance on coastal resources until approximately 4200 B.P., when it appears that
people ceased relying on the central Texas Gulf Coast for subsistence entirely.

**Late Archaic Period (3100–950 B.P.)**

After at least a millennium of no reliance on coastal resources (ca. 4200–3100
B.P.-Middle Archaic period), people began to occupy the coast again, according to
radiocarbon data. Pollen records from this time show cooler periods with greater stability
intermixed with warmer more turbid periods up to 3100 B.P., at which time the pollen record indicates a stable climatic period began (Albert 2006). Around 3100 B.P. Late Archaic period groups began to re-occupy coastal sites with some very different lifestyles exhibited through the archaeological record.

Late Archaic archaeological sites are much larger than Early Archaic sites, and they contain a much greater variety of artifacts and a more extensive faunal record. Late Archaic period sites along the central Gulf Coast of Texas reflect much larger populations living for longer periods of time at coastal sites (Ricklis and Weinstein 2005:118). Heavy reliance on shellfish and fishing is clearly evident during the Late Archaic period, due to these archaeological sites containing better faunal preservation than older sites. The faunal material from Late Archaic sites is well analyzed compared to earlier sites, and a pattern of long seasonal occupation along the central Gulf Coast of Texas is clearly evident based on the data. Late Archaic period sites were occupied by fairly large populations during the cooler months (December through March), which corresponds with the spawning season of certain fish species in the estuarine bays.

Around 2000 B.P. much heavier reliance on fishing is seen in the faunal record and this is related to the full development of the modern estuarine bays around this time. By 2000 B.P. the barrier islands developed their current configuration, and the now fully-sheltered bays had stable sea level long enough to develop the highly productive environments seen today of shellfish reefs, shallow grass beds, and spawning grounds (Ricklis et al. 1993:67).

Assemblages from the Late Archaic are more diverse in the types of fauna and the tool assemblages. A wide variety of shell tools appear including: ground shell
perforators, gouges, adzes, and hammers; chipped shell knives, scrapers, and points; modified shell net weights, and decorative items. Non-shell tools include various chipped stone tool types, modified bone artifact types, ground stone milling implements, and smoking implements. Hard stone that is suitable for cutting, projectiles and grinding is not naturally found along the central Gulf Coast of Texas. Stone artifacts are typically from raw material sources that are located far from the coastal archaeological sites at which they are deposited. The abundant assemblages help identify the growth of human populations and establishment of a limited mobility pattern that occurred along the central Gulf Coast of Texas during the Late Archaic period (Ricklis and Weinstein 2005:127).

During the period known archaeologically as the Late Archaic period (3100–950 B.P.) major developments in population size, technology associated with subsistence, and social complexity become more evident. Other developments that have been identified in the Late Archaic period are the use of coastal sites as cemeteries, and the use of basketry (Campbell 1947, 1952; Ricklis and Weinstein 2005:127). These are two behavioral practices that imply a longer period of time spent at these seasonal sites. Besides a greater reliance on fishing beginning during this period (Ricklis and Weinstein 2005:118), changes began to occur with the use of the bow and arrow and pottery becoming common around 950 B.P (Ricklis 2004a).

**Late Prehistoric Period (950–250 B.P.)**

The earlier part of the Late Prehistoric period is identified by the presence of coastal sites with shellfish gathering, fishing, and hunting of terrestrial fauna associated with arrow points and plain-ware pottery. During the beginning of the Late Prehistoric
period coastal sites have a dominance of white-tailed deer in the terrestrial assemblages (Ricklis 2004a:171). The transition to the later period of the Late Prehistoric period occurred around 700 B.P., which is termed the Rockport Phase (Ricklis 1996:26; 2004a:172). This phase is most commonly identified by different diagnostic lithics (e.g., Perdiz arrow points, prismatic blades, and unifacial scrapers) and distinctly decorated types of pottery. Most significantly in the terrestrial sample of the faunal assemblages, a dominance of bison is seen during the later part of the Late Prehistoric period at coastal sites (Ricklis 1996; 2004a).

A cooling trend occurred around 800–700 B.P., which spread the extent of the grassland and allowed bison to wander down into the central Gulf Coast of Texas. Human populations in this area seasonally alternated between harvesting coastal resources in the cooler months and moving inland to hunt in smaller, more mobile groups during the warmer months of the year (Ricklis 1996:101–104). Faunal assemblages from the coast support this seasonal pattern. For example the growth rings observed in fish otoliths and the umbo found on shell fish are indicators of a cooler season at coastal sites. Growth indicators such as teeth, horn cores, and joint plates, as seen on terrestrial species at smaller inland sites, reflect a warmer season. Human populations during this later part of the Late Prehistoric period likely reached maximum numbers for mobile hunter and gatherers based on early historic accounts of populations observed living along the coast (Ricklis 1996:127). Dense populations of people from this part of the Late Prehistoric are evident by the large number of diagnostic artifacts characteristic of this time period and the faunal assemblages that reflect large amounts of food being consumed. These populations congregated in large sites along the coast during the cool months, then
migrated inland in smaller groups to occupy smaller sites during the warmer months. The social and cultural pattern reflected in the archaeological record provides information about the complexity that was occurring amongst coastal groups just before European contact (Ricklis and Weinstein 2005:152).

**Historic Period (A. D. 1528–1880)**

The central Gulf Coast of Texas has two subperiods that make up the Historic period: the Proto-Historic period (A.D. 1528–1722), and the Historic period (A.D. 1722–1880). The difference between these two periods is defined as the lack of continual or substantial written records during the Proto-Historic period (Perttula 2004:8–9), while the Historic period (A.D. 1722–1880) marks the establishment of permanent settlements and written records. Much of what is known about the Late Prehistoric peoples comes from the earliest historic accounts along the coast of Texas.

Alvar Núñez Cabeza de Vaca was the survivor of a 1528 Spanish shipwreck along the Gulf Coast of Texas. Cabeza de Vaca lived among the coastal groups of Native Americans that were known as the Karankawa Indians (Campbell and Campbell 1981; Covey 1983; Ricklis 1996). Cabeza de Vaca’s account of life among the coastal groups was written when he arrived in Mexico City, after six years of living among Native Americans on the Gulf Coast of Texas and in the interior of southwestern North America. Cabeza de Vaca spent approximately one year amongst coastal groups on the central Gulf Coast of Texas. His account of lifeways includes: subsistence patterns, demographics, religious practices, interaction amongst various native groups, and environmental conditions. Other interesting observations Cabeza de Vaca wrote of the Karankawa include: that the Karankawa people lived along the central Gulf Coast of Texas during the
cooler months of the year, and would congregate in larger groups that fished during this
time of the year (Covey 1983:61). This is particularly important since faunal and floral
seasonality evidence from coastal Late Prehistoric period archaeological sites supports
Cabeza de Vaca’s account of mobility patterns. Ricklis (1996:111–113) lists other early
historical accounts that refer to how the Karankawa dispersed into smaller more mobile
groups that lived inland along the upland/riverine environments in the warmer months of
the year.

There was little to no contact during the Proto-Historic period on the Gulf Coast
of Texas from 1529 until 1685 when the French explorer René Robert Cavelier, Sieur de
La Salle began to explore and briefly settle along the central Gulf Coast of Texas. La
Salle built a fort along the Gulf Coast that struggled to survive until 1688 when natives
attacked and destroyed the fort (Minet 1987). Around this time the Spanish began to
make a strong effort to control the Gulf Coast of Texas and to ensure their claimed
territory was fully under their control (Ricklis 1996:126). By 1722 the Spanish had
decided to build permanent missions near the central Gulf Coast of Texas in order to
provide solid footholds along their eastern frontier. Mission Espíritu Santo, the first
permanent European settlement near the central Gulf Coast of Texas, was located just
inland from Lavaca Bay along Garcitas Creek, near present day Victoria, Texas (Ricklis

In 1785, El Copano (41RF18) was first occupied by the Spanish as a port
established to conduct trade and commerce in the Copano Bay area of the central Gulf
Coast of Texas (Huson 1935:6). The port is also believed to have been used as a point
from which Spanish missions at Nuestra Señora del Refugio, La Bahia de Espíritu Santo,
and San Antonio could be supplied or contacted if needed. A road connected El Copano to Mission Nuestra Senora del Refugio, located approximately 30 km from El Copano. No evidence of any Spanish occupation at El Copano has been located archaeologically, probably because the lone structure noted in records is reported to have been built from wood and located near the beach (Guthrie 1986:16). One resident interviewed in the nearby community of Bayside reported that late eighteenth century Spanish artifacts were privately collected from the shoreline of El Copano during the past 40 years (B.P. Fricks, personal communication 2006). Other than a verbal report of artifacts, no material evidence of a Spanish occupation at El Copano has been found (Drolet 2005a).

Dr. James Hewitson and James Power were awarded a contract (The Hewitson and Power Grant) by the government of Mexico in 1828 that granted them land along the Central Gulf Coast of Texas from the Guadalupe to the Nueces River (Davis 2002; Guthrie 1986). The men used the land to settle colonists primarily from Ireland (Power and Hewitson were Irish). El Copano was the only port located within the Power and Hewitson Grant, and the colonists that landed there ended up settling in the vicinity of this port landing (Huson 1935:11–18). James Power was nominated Empresario of the land grant, and from 1828 until 1836 continued to bring in colonists through the port of El Copano from primarily Ireland but also Mexico. Many descendants in South Texas today can trace their ancestors to colonists that arrived through the port of El Copano (see Huson [1935] for detailed history).

During the early stages of the Texas Revolution, El Copano played a part in the landing of both Mexican and Texan forces (Huson 1935; Guthrie 1986). El Copano switched hands depending on which force landed there, typically occupying it for brief
periods before moving inland. No recorded battles during the Texas Revolution took place at El Copano; however, one account of Texan forces capturing Mexican troops that landed at El Copano is recorded (Huson 1935). During the years of the Republic of Texas, El Copano developed into a settlement starting with the first home built there in 1840 by Joseph Plummer. Plummer built his home on the most prominent point at El Copano, what is today known as Power’s Point (Huson 1935:34). This point has the highest elevation and greatest vantage of the area due to a geographical feature protruding out from the rest of the shoreline into the bay a short distance.

El Copano was constructed on and occupied as a port settlement from 1840 until its eventual abandonment in 1880. The settlement was small, containing approximately 10 houses, two stores, one school house, one post office, two cemeteries, one warehouse, three wharves, and approximately six cisterns. This information comes from a survey conducted in the 1930s by Neil Imon (Huson 1935), and the intensive archaeological survey at El Copano in 2005 by ECAP. Notably the intensive archaeological survey conducted in 2005 did not cover 100 percent of the land area that contains the historic archaeological site of El Copano due to time constraints, and at the time this thesis was written no additional work was conducted. Therefore, some structures and other features related to the historic component of El Copano were not recorded. The eventual abandonment of El Copano in 1880 is believed by Huson (1935) to have been due to the lack of a permanent water source at El Copano and the rise in importance of other settlements in the area. It was suggested by ECAP that the continual erosion of property along the permanently established settlement may have also influenced the decision to abandon El Copano (Drolet and Gillaspie 2005).
Previous Investigations

Archaeological research in the Copano Bay area was limited due in large part to the relatively small amount of public development along the shores of Copano Bay in comparison to most bays along the Texas Coast. The earliest recorded archaeological work in the Copano Bay area was conducted by George C. Martin and Wendell H. Potter from 1927–1929 (Martin and Potter ca. 1930). To this day, Martin’s and Potter’s survey of the Copano Bay area remains the most extensive compilation of archaeological data from a single project in the area. These pioneer archaeologists recorded 92 sites along the shores of back bays, around river deltas, and on islands providing one of the most important archaeological studies of the Texas Coast. Martin and Potter recorded three of the most well-known archaeological sites in the Copano Bay area: 41AS1, 41AS2 and 41AS3 (Martin and Potter ca. 1930, site numbers 52, 40, and 46; see Figure 4.1.). Small excavations were conducted at each of these sites during this early period of archaeological work in the area. 41AS3 is one of the archaeological sites used to calculate rates of shoreline change in this coastal erosion research project (see Chapter 7).
Figure 4.1. Map insert with numerous archaeological sites along Copano Bay including #46 (41AS3), which is used in this coastal erosion research project. Part no. 2 from Martin and Potter ca. 1930.

The earliest archaeological and historical work at El Copano (41RF18) was accomplished by Hobart Huson and Neil C. Imon sometime around 1935 when Huson (1935) published his history of El Copano. The extent of field work at El Copano is not clear from Huson’s publication, but Imon generated a survey map, photographs were taken of 41RF18 sometime around 1935, observations were made of skeletal remains and prehistoric artifacts at 41RF18, and vivid descriptions of the natural environment are included in the publication (Huson 1935). Unfortunately the mention of skeletal remains consists of a brief, general description that does not include specific location or other contextual information. Oral interviews during August 2006 provided similar information about skeletal remains at El Copano (J.D. Derrough, personal communication 2006). Mr. J. D. Derrough of Bayside Texas recalled that the museum from Refugio, Texas conducted excavations at El Copano to remove skeletal remains
during the early 1930s. No record of this work was found, probably because these were amateur excavations that may not have filed records.

Huson’s El Copano publication (1935) remains the best historical research and description of the port settlement written to this day. The survey map (Figure 4.2.) of the settlement created by Neil C. Imon provided extremely valuable information for this master’s thesis. In particular, the map provided locations for each structure and the distance between the structures and Copano Bay. Huson combined archival research with oral interviews and fieldwork to develop his history of El Copano; for this reason his history is viewed as a thorough, detailed research project. However, Huson’s reliance on

![Figure 4.2. 1935 Survey Map of El Copano created by Neil C. Imon. Numbers labeled as follows: 1 cemetery, 2 cistern, 3 original Plummer house, 4 Power house, 5 W. Wilson house, 6 Walter Lambert store, 7 Walter Lambert house, 8 James Lambert house, 9 Nicholas Lambert house, 10 Christopher Smith house, 11 Charles G. Norton house, 12 Henry D. Norton store and post office, 13 Norton’s warehouse, 14 school house, 15 Francis Adams house, 16 Moses Simpson house, 17 second location of Joseph L. Plummer house, 18–19 cattle pens (Huson 1935:16).]
local lore is apparent in his publication, and, combined with the benefits of modern research methods, a new research project into the history of El Copano would be very beneficial.

The next major period of archaeological work in the Copano Bay area was carried out by The University of Texas-Works Progress Administration (WPA). During 1940, excavations were conducted at 41AS1, 41AS2, and 41AS3 by WPA crews who removed large portions of these sites and learned ground breaking information about the prehistoric and early historic occupants of the area. These excavations were published by T.N. Campbell (1947, 1952, 1958), who first recognized a major transition in prehistoric lifeways between the Archaic and Late Prehistoric periods along the central Gulf Coast of Texas. The excavations in 1940 at 41AS3 are used for this thesis project to track shoreline change at this shoreline archaeological site. As archaeologists return to archaeological sites repeatedly over a long period of time, it is apparent based on measurements how the sites are changing in relation to the shoreline.

A few decades after the WPA work around Copano Bay, archaeological work in the area re-commenced with investigations conducted along the southern shore of Copano Bay at site 41AS16 (Figure 4.1 Site #74; Figure 4.3.). In 1985, Prewitt and Associates, Inc. of Austin, Texas performed archaeological testing on this prehistoric occupation site (Prewitt and Paine 1987). The work marked the first archaeological research along Copano Bay to incorporate geomorphology (Figure 4.4). Important for this thesis project, research at 41AS16 shows a period of higher sea level between 4500–2500 B.P. (Prewitt and Paine 1987:168). Understanding past environmental conditions through archaeological investigation was pioneered on Copano Bay through Prewitt’s and
Paine’s (1987) work at 41AS16. Figure 4.4 shows the shell hash lenses recorded at 41AS16 that resemble the very large shell deposit recorded at 41RF18 (Barrera 2005). The shell hash deposits at 41AS16 are described as a result of the Holocene high stand’s inundating this part of Copano Bay’s bluff line.

Figure 4.3. Copano Bay area with archaeological sites discussed in this chapter (modified from Campbell 1947:48).

(Prewitt and Paine 1987). In 1986 Kim A. Cox and Herman A. Smith investigated 41AS3 once again (Cox and Smith 1988). Their investigation focused on obtaining material for radiocarbon dating and artifacts associated with those dates. This project
produced good maps of 41AS3, profiles, an assessment of disturbance at the site, and a description of erosion based on the WPA excavation unit’s location to the shoreline (Cox and Smith 1988). Perhaps the most significant contribution from this project was the field recording of the amount of erosion that had occurred to 41AS3 along with recording of the dimensions of the archaeological site and where all work and disturbance had occurred. Site 41AS3 is an extremely important archaeological site that has unfortunately been subjected to significant destruction from both natural forces and modern development.

**2005 El Copano Archaeological Project (ECAP)**

Texas A&M Kingsville and CCMSH held an archaeological field school, referred to here as ECAP, at El Copano (41RF18) during July 2005. Dr. Robert P. Drolet, an archaeologist at CCMSH and Adjunct Professor at Texas A&M Kingsville, directed ECAP, and the staff for ECAP consisted of a number of graduate students (including the author of this thesis) and undergraduate students. ECAP was assisted by TPWD-
Rockport office, the THC, and individual volunteers from the local communities of Bayside and Fulton. The project came about in response to concern from TPWD officials, who contacted the THC, about preserving the historical remains at El Copano. The THC then contacted Dr. Robert Drolet at CCMSH, and a scope of work was created to begin immediate preservation efforts at El Copano.

**ECAP Research Design**

ECAP first focused on intensively surveying the entire land and water area on which El Copano is located. The goals of this intensive survey were to record all historical and prehistoric resources within the known El Copano site area. The known area of El Copano was defined by the extent of visible structural remains along the Copano Bay shoreline that were eroding into the bay, and also by the map of El Copano made in 1935 by Neil Imon (Huson 1935:16). Recording of features included drawing plan and profile maps of all features recorded in the survey.

A secondary goal of ECAP was to investigate through archaeological survey and testing, a 700-m long shell deposit that is located on the bluff line toward the northern end of El Copano. The purpose of the shell deposit investigation was to assess any cultural (i.e., prehistoric) deposits that may have been associated.

**ECAP Investigations in 2005**

Initial investigations by ECAP consisted of a reconnaissance-level survey around El Copano’s land border to identify an area for the intensive-level survey. The survey located the majority of El Copano’s historic structural remains, and assessed the shell deposits for further investigations. The ECAP staff oversaw all surveying that took place on land at El Copano and the testing that took place on the shell deposits at El Copano.
THC staff conducted an underwater magnetometer survey which covered the full extent of the bay bottom that El Copano originally encompassed. TPWD staff provided boat transportation during work at El Copano. Due to arrangements with the family that owned the site of El Copano, it was necessary for ECAP to access the archaeological site by water each day.

**ECAP Publication and Presentations**

A short 2005 field season summary was published in the THC’s semiannual publication *Current Archaeology* (Drolet 2005). To date this is the only publication from the 2005 field season at El Copano. However, papers have been presented at various conferences about El Copano, that report on its relation with other historic settlements in the area (Drolet and Gillaspie 2005; Gillaspie 2006, 2007). Current research into the erosion of archaeological sites around Copano Bay was recently presented at state and national archaeological conferences (Barrera 2005, 2006, 2007). The erosion and preservation of archaeological sites around the central Gulf Coast of Texas, and hopefully the entire Gulf Coast, is a topic that will gain more importance since these archaeological sites are rapidly disappearing.
CHAPTER V

METHODS

This chapter describes the methods used in fieldwork at El Copano (41RF18), archival research, and oral interviews. A discussion of the methods used to compare the field data and historic maps for calculating rates of erosion is also presented. Original field records for the fieldwork conducted at El Copano during July 2005 are housed at CCMSH. The purpose of the survey and testing used by ECAP was to record information about El Copano before the site is lost to erosion. The archival and oral interviewing data gathered for this project were collected to better understand the rate at which archaeological sites along the Central Gulf Coast of Texas are eroding. Information gathered from this project also includes various types of factors that are contributing to the erosion of archaeological sites along the central Gulf Coast of Texas.

Surveys Methods

The archaeological survey at El Copano began on July 6, 2005. The reconnaissance-level pedestrian surveys (survey area 1, survey area 4, survey area 5) were conducted along Copano Bays shoreline, Mission Bays shoreline and in Plummer’s Slough (Figure 5.1). This method was the most efficient surveying process due to time constraints (three weeks was the maximum amount of time available for fieldwork at El Copano).

Formal pedestrian survey transects were completed in four separate survey areas (Figure 5.3) in a mechanically cleared area that was inland from the brush line bordering the shoreline of El Copano (survey area 2). Using a transit and tape measure, a
Figure 5.1. Highlighted areas are reconnaissance level surveys, an intensive survey, and a magnetometer survey conducted at El Copano. Base map courtesy of Robert P. Drolet.

Figure 5.2. ECAP staff members intensively surveying the site of El Copano. Photo courtesy of CCMSH.
gridded survey area was established over the recently cleared pasture. The survey area began with a datum established north of Power’s Point approximately 50 m from the shoreline. From this datum a 325 m north-south baseline was established with individual transects marked every 25 m. This created 13 individual survey transects aligned due east from the established baseline. Individual transect length varied, with the shortest closest to the shoreline and the longest farthest from the shoreline. Each transect was walked and features recorded based on visual observation of surface remains (Figure 5.2).

Figure 5.3. Location of the four survey baselines and areas of intensive survey. Base map courtesy of Robert P. Drolet.

Transect 13, the last transect on the first baseline, was approximately 350 m long and terminated at the dense brush line that borders the shoreline of El Copano.

At the termination of Transect 13, a second baseline datum was established, and Transects 14–26 were laid out 25 m apart. The length and shape of the second baseline area mirrored the first baseline area (Figure 5.3). The shortest transect (Transect 14) was
closest to the shoreline and the longest (Transect 26) was farthest from the shoreline.

Transect 26 was approximately 350 m long, terminating at the dense brush running along
the El Copano shoreline (Figure 5.3).

At the end of Transect 26, a third baseline datum was established, with Transects
27–39 laid out 25 m apart. The length of the third baseline transects mirrored the first
and second baseline transects (Figure 5.3). At the termination of Transect 39, a fourth
baseline datum was established, and Transects 40–52 spaced 25 m apart were laid out.
The shape of the fourth baseline survey area mirrored the first, second, and the third;
however the lengths of these transects were shorter because they terminated at Plummer’s
Slough (Figure 5.3). The termination of Transect 52 marked the limits of the formal
pedestrian survey conducted at El Copano. Along these 52 pedestrian survey transects,
three historic archaeological features were recorded (Features 7, 17, 18; Figure 6.2).

**Feature Recording**

Once these three separate survey areas were completed, mapping of the
archaeological features began, and efforts began to survey the settlement remains of El
Copano that was largely covered with dense brush. Cutting the brush using chainsaws,
machetes, and branch trimmers was the only means of accessing the features.
Archaeological features that could be seen through the brush could not be mapped until
the process of clearing each feature was completed (Figure 5.4). Clearing towards
observable features resulted in the recording of more archaeological features and feature
components (2–3, 10, 14). Not all of the recorded archaeological features were mapped
due time limits in July 2005, and because future work at the site was denied by the
landowners. Further work at El Copano to complete mapping and surveying is
highly recommended. The brush along El Copano was not completely surveyed, and, therefore, it is likely that not all of the archaeological features were discovered and recorded.

**Mapping**

The archaeological features found on the surface were mapped based on accessibility. The mapping method used to create individual feature maps involved metric tape measurers and hand-held compasses. Plan views were drawn on metric graph paper in the field and digitally transferred into CorelDraw to create a uniform appearance for all features mapped. Intact and collapsed portions of structural features were included on each plan map. The collapsed portions commonly continued from the inland side of each structure into the water of Copano Bay. THC personnel used a total data station to

Figure 5.4. ECAP field school member clearing thick brush from Feature 3 at El Copano. Photo courtesy of CCMSH.
map a few structural features, but as of March 2008, these maps had not been provided to ECAP.

*Aerial and Magnetometer Surveys*

Two volunteers conducted a 1-day aerial flight in July 2005 over El Copano and the immediate surrounding area. The volunteers who conducted the aerial survey provided the two-seater prop plane, fuel, photography equipment, and their personal time, all donated to ECAP. Photographs were taken from various altitudes and angles on this flight. The aerial survey resulted in the discovery of Feature 20 (Figure 5.5), the home of Joseph Plummer, which is submerged beneath Copano Bay.

Two personnel from the THC conducted an underwater magnetometer survey in Copano Bay over a 2-day period (survey area 3). The magnetometer was towed behind a
boat from the most southwestern point of El Copano (Power’s Point) to beyond the northeastern limit of the site (Plummer’s Slough). Orientation of the transects for this survey ran parallel to the Copano Bay shoreline and were conducted between 50–500 m from the shoreline (see Figure 5.1). The notes and results of this survey remain in the care of the THC.

**Profiling**

One of the major goals of ECAP was the investigation of a large shell deposit that was eroding into Copano Bay along the northeastern side of El Copano. During reconnaissance-level surveying six locations along the 700-m long shell deposit were selected for profiling (see Figure 5.6). The eroding vertical bluff, in which the shell deposits are located, made for ideal profiling conditions. Shovel scraping was conducted at each profiled location to produce a clean vertical profile of the deposit prior to mapping. Photographs were taken of each profile (Figure 5.7), and profiles drawn on waterproof paper. Additionally, two structural features at El Copano were profiled, Features 2 and 3, in order to document the type of foundation construction.
Figure 5.6. Generalized cross-section of the El Copano bluff line showing approximate location of historic features, shell deposits, and six ECAP profiles placed along the shell deposits.

Figure 5.7. Profile # 3 containing dense shell with homogenous sand in between. Deposits are same as current bay bottom, evidence of storm surges depositing along the bluff line. Photo by James E. Barrera.
Excavation

Five 1-x-1-m units were excavated with shovels and trowels, then screened through ¼-inch wire mesh at El Copano during July 2005. Three of these units were placed along the 700-m long shell deposit on the northeastern side of El Copano. These excavation units were located at Profiles #2, #3, and #4 (Figure 5.6) and were labeled Excavation Unit Profile #2, #3 and #4. Excavations were carried out to determine the origin of the large shell deposits. Excavation unit levels were removed according to the natural stratigraphy found in the deposits unless the natural layers exceeded 10 cm in depth. If an excavation unit level exceeded 10 cm in depth than the level was terminated and another began. These excavation units were terminated approximately 10 cm into the sterile underlying homogenous clay-loam below the shell deposits.

Two more excavation units were placed on two shell-hash features, Feature #s 17 and 18, which were located inland at the southwestern end of the site. These two circular deposits of shell hash were tested with one 1-x-1-m excavation unit each to determine their origin. These two units were excavated according to natural or cultural stratigraphy unless a layer exceeded 10 cm, in which case the level was terminated and another begun. Excavations in these two units were terminated on the underlying clay-loam on which these two circular shell hash features were deposited. The deepest excavation unit walls were profiled; these were the walls closest to the center of the shell hash features. All materials collected and records from the five excavation units conducted by ECAP are housed at CCMSH.
Archival Research and Oral Interviews

Data collection for El Copano and other archaeological sites in the area was conducted at various times during 2006. During March 2006 the archaeological records housed at the Texas Archeological Research Laboratory in Austin, Texas were researched for information about El Copano and sites 41AS1, 41AS2, and 41AS3. Copies of all records pertaining to these sites were procured for this master’s thesis, and a brief artifact analysis of each site’s collection was conducted.

The Texas State Library and Archives Commission was visited during July 2006. This archive contains the largest number of nautical maps that show the Copano Bay area found during this research project. Maps housed here are both originals and copies made from the early seventeenth through the late twentieth centuries. Digital photographs were made of selected maps housed in the Texas State Library. Good facilities for viewing maps and photographing allowed for rapid collection of this information.

Oral Interviews

When archaeologists are working with descendent communities and landowners that have archaeological sites, interviews can provide important information that could not be gathered through standard archaeological field work. Thus, oral interviews were conducted to collect information on shoreline change around Copano Bay. A typical problem encountered with using interviews is the lack of accuracy when relying on interviewee’s recollection of events, which is often vague in detail. Interviews were informally conducted during 2005 and 2006. Seven people were interviewed during this time from local communities, specifically the town of Bayside, where ECAP was based. General questions were asked about how much erosion had occurred at archaeological
sites 41AS3, 41AS109, and 41RF18. Questions were also asked about what types of erosion prevention people have used and are using today along the shoreline. One of the problems encountered while interviewing people during this project was the discrepancies in the amount of shoreline change that people remembered when compared to historical records of the same areas. Information gathered from these interviews is discussed in Chapter 7.

**Calculating Rates of Shoreline Change**

The methods used in this research project to track shoreline change are a combination of methods used in previous research projects (Aronow and Weinstein 2002; Paine and Morton 1993; Rick et al. 2006) and methods developed here. These previous research projects used both geographical features (Aronow and Weinstein 2002; Paine and Morton 1993) and archaeological sites (Aronow and Weinstein 2002; Rick et al. 2006) to track shoreline change. The methods used in the research for this master’s thesis relied on archaeological sites to calculate rates of shoreline change.

Three archaeological sites were used in this master’s thesis (41AS3, 41AS109, 41RF18) to develop rates of shoreline change. Measurements taken from historic structures at 41RF18 in 2005 were compared with historic maps (Table 5.1) to develop rates of shoreline change in relation to the structures. All measurements from maps were converted into meters and compared with the metric measurements gathered from 41RF18 during 2005.
Table 5.1. Historic maps used to collect measurements for change along Copano Bay shoreline.

<table>
<thead>
<tr>
<th>Date</th>
<th>Description of Map</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1833</td>
<td>Copano Bay and Aransas Bay Areas</td>
<td>(Guthrie 1986:9)</td>
</tr>
<tr>
<td>1845</td>
<td>Corpus Christi Bay through Copano Bay Areas</td>
<td>(Texas State Library and Archives Commission, Austin [TSL], map # 0024)</td>
</tr>
<tr>
<td>1884</td>
<td>Corpus Christi Bay through Copano Bay Areas</td>
<td>(TSL, map # 1058)</td>
</tr>
<tr>
<td>1935</td>
<td>Copano Bay through San Antonio Bay Areas</td>
<td>(TSL, map # 1622)</td>
</tr>
<tr>
<td>1935</td>
<td>Survey Map of El Copano</td>
<td>(Huson 1935:16)</td>
</tr>
</tbody>
</table>

A rate of shoreline change at archaeological site 41AS3 was developed using archaeological records from two different investigations 45 years apart. The measurements taken at 41AS3 in relation to the shoreline were used to develop an annual average rate of erosion for this part of the Copano Bay shoreline. Site 41AS109 was used to develop an annual average rate of erosion using photographs taken of the archaeological site over a nine year period. The photographs are accurate records of the shoreline change at 41AS109 from 1997 to 2006.
CHAPTER VI

RESULTS OF ARCHAEOLOGICAL INVESTIGATIONS AT 41RF18 (El COPANO)

Introduction

The archaeological investigation of 41RF18 in July 2005 resulted in the recording of structural remains at the abandoned settlement of El Copano. ECAP recorded data from archaeological surveys, mapping and excavations. ECAP survey data was used to create a record of structural remains, and profiles. Furthermore excavations at El Copano provided a record of natural and cultural depositional processes along this part of Copano Bay.

The data from the 2005 fieldwork are derived from five separate surveys, six profiles, five 1-x-1-m excavation units, tape and compass maps of six archaeological features (Features 1–3, 9–10, and 14), photographs, and field notes. The following sections describe the results of each archaeological process used at El Copano during 2005, and how the data are important to this research project.

Survey Description

The ECAP survey of 41RF18 was accomplished using four separate pedestrian surveys, one magnetometer survey, and one aerial photography survey. The first survey was a reconnaissance-level pedestrian survey conducted along the shoreline area between the bluff and high water line of Copano Bay (Figure 6.1). Starting at Power’s Point and continuing 3 km to the northeast, this survey identified features eroding along the bluff very close to the shoreline. The first survey recorded nine historic features (Features 1–3,
9–10, 12–14, and 19) that constitute the majority of the structural remains used to calculate rates of erosion along 41RF18.

The second area was an intensive pedestrian survey in a section that was mechanically cleared west of the brush line that runs along the shoreline (Figure 6.1). This area was surveyed using baselines and individual transects from Power’s Point northeast to Plummer’s Slough. Eight historic features were recorded as a result of the intensive pedestrian survey (Features 4–8, 11, 17, and 18).

Figure 6.1. Survey areas are reconnaissance-level surveys, an intensive survey and a magnetometer survey conducted at El Copano (41RF18). Base map courtesy of Robert P. Drolet.

The third area surveyed was the bay bottom in Copano Bay along the section of bay immediately in front of El Copano. This survey was conducted by employees of the THC using an underwater magnetometer to locate any historic features on the bottom of Copano Bay. The magnetometer survey did not find any historic features along the bottom of Copano Bay. This is surprising because the magnetometer survey was
conducted where the 1935 mapping of El Copano identified wharf pilings visible above the waters surface at that time (Huson 1935). In July 2005 local fisherman and TPWD boat technicians identified the underwater location of some pilings, which pose a danger for boating in the area.

The fourth area along the eastern shore of Mission Bay, was surveyed using a reconnaissance-level pedestrian survey. The survey was conducted along the shoreline from the southeastern corner of Mission Bay northward for 2 km. The survey also covered a ranch road, which parallels the eastern shore of Mission Bay. No archaeological features were identified on the fourth survey. Observation of the bluff line along East Mission Bay indicates intense erosion.

The fifth area surveyed was completed using a reconnaissance-level pedestrian survey in Plummer’s Slough (Figure 6.1) in an attempt to locate the community cemetery. Two features were recorded (Features 15 and 16) in the fifth area surveyed. Finally, a one-day aerial photography flight over the El Copano area identified Feature 20, which is located east of Feature 9 and is now submerged under Copano Bay.

**Features Recorded in 2005**

Twenty archaeological features were recorded during the work conducted at 41RF18 (El Copano) by ECAP in July 2005 (Figure 6.2). Eighteen of these features are attributed to nineteenth-century or earlier occupation of 41RF18, and two features are from twentieth-century ranching activities. It is important to state here that due to time constraints not every feature had the same amount of information recorded, and only six of the 20 features were mapped. In this section features are described as groups, not corresponding with the numerical order in which the features were recorded.
Figure 6.2. Satellite image of 41RF18 with Features 1–20 shown in black. Base Map from Google Earth 2005.
Feature 1 is on the southwestern boundary of 41RF18 on the southern side of Power’s Point (Figure 6.3). This large structure is made out of shellcrete and is square in shape measuring approximately 9 x 9 m (originally an enclosed square, as of 2005 approximately one-third of the feature had eroded into Copano bay). Hobart Huson (1935:32) describes this structure as a square cistern. The feature has multiple layers of horizontal shellcrete beams that make up the walls of the cistern. The shellcrete beams that were used to construct the cistern are more robust than any other structure recorded at 41RF18. Each shellcrete beam was 1 m wide, 1 m high, and 9 m long. The floor of the cistern is a shellcrete layer covered in mortar. The southern side of the cistern is severely eroding into Copano Bay, and all the walls of the cistern are collapsing.

Figure 6.3. Features 1 and 14 along Power’s Point. Redrawn map courtesy of CCMSH.
Feature 14 is located at the highest point on Power’s Point, approximately 15 m east of Feature 1 (Figure 6.3). Feature 14 is most likely the remains of Joseph Plummer’s first home constructed on Power’s Point ca. 1840 (Huson 1935). The feature consists of only the landward corner of a structure and no other structural remains were identified in the immediate area. Therefore, it is believed that Empresario James Power’s home has completely eroded off of Power’s Point. Huson (1935) lists Plummer’s first home as later being used by the Power family as a kitchen or smaller secondary home located inland (behind) from the Power family house. The most severe erosion of 41RF18 appears to be taking place along Power’s Point, rapidly destroying Features 1 and 14 (Figure 6.4.). See Chapters 7 and 8 for a detailed discussion on the erosion calculated at Power’s Point.
Feature 2 is located along the bluff edge, approximately 300 m northeast of Feature 14. The feature (Figure 6.5) is an eroded square structure that is probably the remains of William Wilson’s home (Huson 1935). The structure is heavily damaged by erosion and interestingly was not identified near any other historic features. Features 17 and 18 are the closest recorded features near Feature 2, located 100 m to the west.

Features 17 and 18 are low (30-cm high) circular mounds of shell hash, each approximately 10 m in diameter. One 1-x-1-m test unit was excavated on each of these shell hash features to determine the origins of the deposits. Feature 17 Test Unit and Feature 18 Test Unit did not yield any cultural material. These features likely represent piled shell hash for construction purposes. The primary construction material used on all

Figure 6.5. Feature 2 probable remains of William Wilson’s home. Redrawn map courtesy of CCMSH.
the recorded features at 41RF18 is shell used in a concrete. Therefore, it is believed that Features 17 and 18 are related to the construction of the structures at this site.

Directly along the bluff approximately 200 m northeast of Feature 2 is Feature 3. Feature 3 (Figure 6.7) is a cluster of at least three structures, and most likely four since a circular depression in the cluster is probably a filled cistern based on the dimensions compared to Feature 10 (see Figures 6.9, 6.10). Feature 3 is heavily eroded, and the western boundary was damaged by bulldozing activities related to brush clearing, yet this feature contains some walls that consist of multiple courses of shellcrete beams high in vertical dimension (Figure 6.8). According to Huson (1935) the structures recorded as Feature 3 would have belonged to Judge Walter Lambert and Nicholas Lambert, one of which was a two-story store.
Figure 6.7. Feature 3 probable Lambert family complex. Redrawn map courtesy of CCMSH.

Figure 6.8. South to Feature 3. Note: multiple shellcrete beams. Photo by James E. Barrera.
Figure 6.9. Feature 10 probable Norton family complex. Redrawn map courtesy of CCMSH.

Feature 10 is located approximately 50 m northeast of Feature 3, and lies directly along the bluff. Feature 10 (Figure 6.9) contains at least three structures, one multi-room building and two circular cisterns (Figure 6.10). Severe erosion along the bluff line has destroyed much of Feature 10. Vertical shellcrete beams are still intact in some walls of Feature 10. The multiple room structure is probably the remains of Henry D. Norton’s and Charles G. Norton’s residence and store (Huson 1935). Archaeological work at Feature 10 consisted of clearing the brush from the feature, drawing a tape and compass map, and taking field notes. Interestingly the cisterns at Feature 10 did not appear to be filled (Figure 6.10.) as was the cistern at Feature 3.
Nearby Features 3 and 10 are Features 4–8, 11, and 19, which were described but not mapped due to time constraints (Figure 6.11). Feature 4 is a square structure located 20 m west of Feature 3 and is probably related to the Lambert’s complex of houses and a store. Feature 4 was heavily damaged by bulldozing during brush clearing activity. Feature 11 is 25 m west of Feature 3 and is a small cluster of bulldozed shellcrete blocks that may be a bulldozed portion of Feature 3. Feature 5 is a historic scatter of artifacts that includes shellcrete construction material, ceramics, glass, metal, bone, and slate. The feature may be the remains of a small structure, although Feature 5 was heavily damaged from bulldozer activities related to brush clearing, and structural boundaries were not identified.
Feature 6 is northeast of Feature 11 and approximately 25 m west of Feature 10. Feature 6 is a small scatter of shellcrete construction material and other historic artifacts including: ceramics, glass, bone, and slate. The feature was heavily disturbed by bulldozing activities related to brush clearing, and probably represents the remains of a house once belonging to Christopher Smith (Huson 1935).

Feature 7 lies northeast of Feature 6 approximately 45-m from the bluff line. The feature consists of a partially bulldozed structure containing a dense concentration of historic artifacts and some intact wall sections. Feature 7 was the only feature recorded where a refuse area was observed along with a structure (perhaps because it was not looted as frequently as those that were more easily accessed on the bluff line). The
structure of Feature 7 may have belonged to a family named Adams, or it may be the remains of the small school house located at 41RF18 (Huson 1935).

Feature 19 is a large shellcrete structure 50 m northeast of Feature 10 along the bluff line: it probably belonged to Moses Simpson (Huson 1935). Larger shellcrete beams were used to construct Feature 19 than other structures besides the large square cistern (Feature 1). Due to limited time in July 2005, Feature 19 was not cleared of brush or mapped, this feature was only observed during reconnaissance surveying of the bluff line.

Feature 8 is a small shellcrete structure located 50 m north of Feature 19 with intact wall sections and scattered historic artifacts. Feature 8 is approximately 50 m northeast of Feature 7 in the bulldozed clearing. Feature 8 was also damaged from bulldozing activities related to brush clearing and probably represents the remains of the Adams family home or the small schoolhouse noted by Huson (1935).

Feature 15 is a scattering of marble fragments that probably represents the remains of El Copano’s community cemetery (Figure 6.2). Feature 15 is along the edge of Plummer’s Slough approximately 500 m west of Feature 9 (see below for description of Feature 9) and was heavily disturbed. Feature 15 contained one rectangular piece of marble that measures approximately 0.3 x 0.5 m, and smaller bulldozer crushed pieces of marble were scattered in the immediate vicinity. No inscriptions on the marble were observed.

Feature 16 is located 200 m northeast of Feature 15 along the edge of Plummer’s Slough and is a light scatter of oyster shells that is a possible prehistoric scatter of shell (Figure 6.2). No artifacts besides unmodified oyster shells were recorded in Feature 16.
Feature 9 is the Plummer family cemetery located approximately 75 m from the shoreline of Plummer’s Slough. Feature 9 (Figures 6.13, 6.14) consists of a shellcrete-walled enclosure with an engraved headstone and small marble footstones. The names of Joseph E. Plummer and Joseph E. Plummer, Jr. are engraved on the sides of the headstone. Feature 9 is in the best condition of any feature recorded at 41RF18 because of its location approximately 75 m from the shoreline, and this feature had not been bulldozed.
The identification of Feature 20 underwater in the aerial survey is one of most important findings from the 2005 El Copano field season (Figure 6.14). Based on the 1935 map created by Neil Imon (in Huson 1935), Feature 20 is probably the second location of Joseph Plummer’s house.
Figure 6.14. Aerial photo of Feature 20 underwater of Copano Bay. Photo courtesy of CCMSH.

Feature 12 is located 500 m northeast of Feature 9 along the shoreline. The feature is believed to be associated with a later time period, probably twentieth-century ranching activity in the area around 41RF18. It consists of concrete blocks and bricks that resemble steps and are partially submerged in Copano Bay.

Feature 13 is located 30 m south of Feature 12 and consists of a concrete block with bricks around it that resembles the materials of Feature 12. Feature 13 is also believed to be from twentieth-century ranching activities around 41RF18.

**Profiles and Excavations of Shell Deposits**

The profiles conducted at El Copano were located along the 700 m long natural shell deposit at 41RF18. The shell deposits are termed shell hash, which is defined here as water-worn shell with rounded edges and smoothed surfaces all around that are naturally occurring deposits around shell fish reefs. This large deposit is on the bluff stretching from a point located 300 m northeast of Feature 8 for 700 m until the deposits
cease at Plummer’s Slough. Six 2-m long profiles were recorded, and three 1-x-1-m excavation units were dug along the shell deposit (Figure 6.15). The locations were selected based on the variations in the shell deposit in an attempt to locate any cultural deposits that may be present.

These six profiles identified major variation in the shell deposit from the far northeastern side to the far southwestern end. The northeastern side, with the lowest elevation of the entire 700-m long shell deposit, was the closest to Copano Bay’s water level at approximately 1 m above sea level (Figure 6.16). This contrasted with the far

Figure 6.15. Satellite image showing the locations of profiles and excavations along natural shell deposits southwest of Plummer’s Slough. Base map from Google Earth 2005.
southwestern end of the shell deposit, which was 3.5 m above sea level. Profile 1 (Figure 6.16) recorded relatively low energy storm surge deposits in the form of small grain-size deposits (Barrera 2006, 2007).

Moving southwest along the shell deposits, Profile 2 and Profile 2 Test Unit (Figure 6.17) recorded larger grain-size deposits, which resulted from greater energy during storm surging. No cultural materials were recovered in the 1-x-1-m excavation unit of Profile 2 Test Unit.
Profile 3 and Profile 3 Test Unit (Figure 6.18) were located southwest of Profile 2 along the shell deposit. Profile 3 contained multiple layers of natural shell deposits intermixed with natural soil layers. It revealed a complex mixture of shell layers and soil layers from multiple storm surges. Based on the different grain-sizes, this profile is a good example of high energy deposits (shell layers) and low energy deposits (soil layers). Such a mixture of grain sizes may represent an elevation along the sloping bluff that collected deposits from both large and small storm surges. Higher elevations contain mostly large grained deposits, and lower elevations contain smaller grained deposits. Profile 3 appears to be a point (or elevation) along the bluff at which both high energy storms and low energy storms reached and kept inundated for periods of time as represented by the small grained deposits (sand/loam mixture).
A core sample was taken in Copano Bay 50 m east of Profile 3 to assess the bay bottom deposits. The 50-cm deep sample encountered apparently the same sandy-loam and shell hash deposits that was recorded in Profile 3. The core sample was used to support the conclusion that the 700 m long shell deposit did originate from the bottom of Copano Bay during storm surge depositions.
Profile 3 Test Unit was a 1-x-1-m excavation unit dug in natural layers unless these exceeded 10-cm and then an arbitrary boundary was made. Two artifacts were recovered: one lithic flake, and a plain pottery fragment. Both of these artifacts exhibited heavy wear from water transport, as did all of the surrounding shell deposits (shell hash) in which the two artifacts were recovered. The two artifacts recovered from Profile 3 Test Unit were apparently in secondary context based on the heavy water transport wear.

The single diagnostic piece of native-ware pottery identifies the western side of Copano Bay as having aboriginal occupation during the Transitional Archaic and/or Late Prehistoric periods. Two other isolated diagnostic artifacts were recovered at 41RF18 along the surface of the shoreline beach southwest of Profile 3 Test Unit: one Perdiz arrow point (recovered near Feature 2) and one trimmed prismatic blade fragment (recovered near Profile 3 Test Unit), both of which are characteristic of the Late Prehistoric period along the central Gulf Coast of Texas and both of which exhibited wear from water transport. These three diagnostics from 41RF18 support the finding that a Late Prehistoric occupation did occur somewhere around or on 41RF18. Heavy erosion along the western side of Copano Bay is probably responsible for the lack of prehistoric shoreline sites identified in the areas surveyed during July 2005.

Profile 4 and Profile 4 Test Unit (Figure 6.19) were located approximately 150 m southwest of Profile 3. Profile 4 is located along a section of the bluff that is approximately 3 m above sea level, approximately twice the height of the bluff line on which Profile 3 was located. Profile 4 is identified as containing multiple layers of natural shell deposits intermixed with very thin lenses of sediment deposits. The size of the shells deposited at Profile 4 were larger than those recorded in Profiles 1–3, and the
deposits in Profile 4 had a weaker structure than Profiles 1–3. Profile 4 Test Unit was a 1-x-1-m excavation unit excavated at Profile 4. No cultural material was recovered from Profile 4 Test Unit. The loose deposits and larger grain size of the deposits is a result of greater energy storm surges along the higher elevation at which Profile 4 was located. Lower energy during periods of inundation would result in denser, compacted deposits as recorded in Profiles 1–3.

Figure 6.19. Above: Profile 4. Below: Profile 4 Test Unit during excavation. Note: large grain-size deposits and increased elevation. Photos by James E. Barrera.
Profile 5 is located near the southwestern end of the 700 m long natural shell deposit and near the highest elevation along the shell deposits in relation to sea level (3.25 m) compared to Profiles 1–4. This is an interesting profile due to the elevation of the deposits recorded here and the very loose structure of the deposits (Figure 6.20). The highest elevation the storm surging along 41RF18 reached is very significant as a marker against which to compare modern storm surge measurements. The crests of storm produced waves would have deposited the shell deposits recorded at Profile 5, since the very loose structure of the deposits indicates rapid and brief inundation of this part of 41RF18. The lack of layers of silty-loam also indicate that the Profile 5 area was rapidly inundated by wave crests, since a longer inundation would have resulted in the silty-loam layers recorded in Profiles 1–4. One layer of clay-loam in Profile 5 is probably from fluvial surface runoff that deposited the clay-loam from higher elevations along 41RF18.

Figure 6.20. Profile 5 located near highest elevation of shell deposits. Photo by James E. Barrera.
The highest profile located along the natural shell deposits was Profile 6 on the far southwestern edge of the deposits. This profile was recorded at an elevation of 3.5 m above sea level and found similar deposits to those at Profile 5. The shell deposits were very loose with a weak structure throughout the shell deposit and a thin layer of dark clay-loam. The shell deposits recorded in Profile 6 resulted from rapid deposition during high energy storm surging cresting into this area and fluvial depositing of clay-loam.

Figure 6.21. Profile 6 located along highest elevation of shell deposits at 3.5 m above sea level. Photo by James E. Barrera.

**Summary of Profiles and Excavations along Shell Deposits**

The information gleaned from the Profiles 1–6 and Profiles 2–4 Test Units provides an interesting record of very large storm surges along a back-bay shoreline (up to 3.5 m above sea level). Dating these natural deposits would be an intriguing future research question to address. Potentially it could provide information about the
formation of the Copano Bay area. No evidence of mining the shell deposits for construction material was observed; however, the shell deposits are in close proximity to a settlement constructed from shellcrete. The shells used in the shellcrete structures had very sharp edges that are characteristic of coming from primary context (shell fish reef). This would support a location closer to a shellfish reef (e.g. Copano Reef) as the likely source for the shell used for construction at 41RF18, rather than shell from the water worn deposit recorded along the bluff.

The most beneficial data from the three test units along the shell deposit is the realization that the shell deposit is actually a natural marine deposit. This close observation of the interior of the shell deposit confirmed the origins of the deposit. Throughout the 700 m shell deposit, excavations and profiles revealed layers of shell hash and bay bottom sediment that are identical to the modern bay bottom deposits in Copano Bay. As large storms came from the Gulf of Mexico westward across Copano Bay, the bay bottom was naturally dredged by the wave base and redeposited on top of the bluffs that border the bay by the wave swells. The shell deposits are termed shell hash, which is defined here as water-worn shell with rounded edges and smoothed surfaces all around that are naturally occurring deposits around shell fish reefs. The marine deposits varied along the 700 m long deposit according to the elevation of the bluff. The higher the bluff the higher the storm surge needed to be to deposit bay bottom sediment. Therefore, higher energy deposition is evident on the highest points of the deposit. This resulted in less consolidated deposits that were loosely resting on top of the bluff at the highest elevations. Lower elevations contain dense deposits of shell and bay
bottom sediment that are smaller in size—reflecting a smaller amount of energy during longer periods of inundation.
CHAPTER VII

CALCULATING SHORELINE CHANGE USING HISTORIC MAPS, PHOTOS, AND ORAL INTERVIEWS

Introduction

This chapter describes the results of the archival map, photos and oral interview research for 41RF18 (El Copano), along with the research conducted regarding shoreline changes at sites 41AS3 and 41AS109. Using these records to position these archaeological sites in relation to the shoreline in past compared to the modern position of these archaeological sites is the basis for the calculations of shoreline change. The majority of the data to support this research was accumulated from 41RF18, including all the historic maps. However, data collected for 41AS3 and 41AS109 demonstrates how a variety of records can be used to demonstrate shoreline changes when using archaeological sites as the reference point to the shoreline. The research presented in this chapter contributes information about the erosion of archaeological sites around Copano Bay and demonstrates a method for studying eroding archaeological sites in any setting. The oral interviews with residents from the communities of Bayside and Fulton provided valuable information about the need to incorporate the public into the study of eroding archaeological sites and property.

Shoreline environments are where the two major areas of archaeological research intersect, terrestrial archaeology and underwater archaeology. The impacts that dynamic marine processes, as well as human modification of the coastal environment, have on archaeological sites are not a common topic in shoreline archaeology. During the research for this thesis it became apparent that very few researchers have paid particular
attention to the natural and man-induced processes that affect coastal archaeological sites or ways to preserve these archaeological sites. A recent article by Rick et al. (2006) highlights the need for more emphasis on understanding processes that can destroy and alter coastal archaeological sites permanently. These researchers monitored shoreline archaeological sites over a short period of time using stakes to record shoreline movement. This proved to be an effective method to measure the amount of erosion that is occurring every year on these Channel Island archaeological sites. This article highlights the lack of emphasis that researchers are putting into understanding how much longer these sites may remain intact in their shoreline bluff settings. Similar to Rick (et al. 2006), this thesis research project provides a model for calculating shoreline erosion using archaeological sites, and highlights the importance this research can have for the preservation of eroding archaeological resources.

**Description of Historic Maps and Photos Used**

The maps showing 41RF18 were selected based on the accuracy the maps displayed and the type of information that was gathered from these maps. Selected maps had 41RF18 plotted as a single symbol or multiple symbols, and some maps selected were chosen because the geographic features associated with 41RF18 were also accurate. Some maps were not selected because 41RF18 was plotted incorrectly or key geographical features were drawn inaccurately. In this section, the relevant maps are described and rates of erosion calculated based on each map. To calculate rates of erosion, the distances from key features (identified by ECAP) to Copano Bay as measured in 2005 are compared to the distances from relevant features on the maps to
Copano Bay. Table 7.1 lists the features identified by ECAP that also appear on one or more of the maps used in the study, as well as their distances to the bay in 2005.

Table 7.1. 41RF18 features and measurements used for calculating rates of shoreline erosion

<table>
<thead>
<tr>
<th>Feature #</th>
<th>Discussion</th>
<th>Direction and Distance to Bay in 2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Possibly oldest recorded feature at 41RF18</td>
<td>8 m, south</td>
</tr>
<tr>
<td>3</td>
<td>Lambert family complex</td>
<td>5–20 m, southeast</td>
</tr>
<tr>
<td>14</td>
<td>Original Plummer family house on Power’s Point</td>
<td>1.5 m, southeast</td>
</tr>
<tr>
<td>20</td>
<td>Second Plummer family house at Plummer’s Slough</td>
<td>-20 m (under bay), northwest</td>
</tr>
</tbody>
</table>

The oldest map located with structures listed for El Copano is the 1833 nautical map by Captain Monroe of the “Amos Wright” ship (Figure 7.1). A very sharp point is drawn for Power’s Point on this map with hatching covering the point and a roofed structure located just northeast of the hatched area. The structure is located northeast of the point with soundings following a channel directly toward the structure. This indicates that during this early period of El Copano’s occupation the structure was approached from the eastern side of Copano reef, and the soundings also indicate that a wharf was probably present at this structure. Two historic accounts of a perishable structure near the shoreline were recorded around the time of the “Amos Wright” map
Figure 7.1. 1833 map and inset showing single structure with hatching on Power’s Point. From Guthrie 1986:9.

(Guthrie 1986). However, no sign of a perishable structure was located during 2005, and any portion of that early shoreline has probably completely eroded away. The most significant information from this early map is the location of the structure plotted at Power’s Point where ECAP recorded Features 1 and 14. Feature 1 is a large square cistern that, according to Hobart Huson (1935), is the oldest shellcrete structure at 41RF18, which would place its construction pre-1840 when Feature 14 was built according to Huson. The location of a structure on Power’s Point in 1832 does support
that Feature 1 was probably in use during this time and was most likely related to a perishable structure that has since eroded away.

In 1845, a map of the Copano Bay area was drawn and labeled as “Sketched by an Unnamed Settler and Verified as Correct by Captain Crossman” (Figure 7.2). Two structures are shown, one directly on or inland from Power’s Point and one just northeast of the point. The two structures, based on the scale of the map, are located approximately 1,000 m from the shoreline. The positions of the structures in relation to the geographical features shown coincide with the 2005 field season’s findings of structures located on Power’s Point and northeast of the point. The two early structures depicted on the 1845 map may be Features 1 and 14.

Another map that shows El Copano structures was published in 1884 by the United States Coast and Geodetic Survey and is labeled “Coast Chart No. 109, Aransas Pass, Aransas and Copano Bays, Texas” (Figure 7.3). This map shows good detail for the settlement of El Copano near the time of occupation at the settlement (settlement was abandoned ca. 1880). The map shows 18 individual dots for structures and one wharf. Some structures have square outlines to represent their sizes. Three of these structures are located along Power’s Point and probably correspond with the three separate structures that would have been located on Power’s Point in 1884 (Huson 1935; ECAP Features 1, 14, and Power’s house which was completely eroded into the bay by 2005). Fourteen structures are drawn northeast of Power’s Point in the area that had the greatest feature concentration recorded during 2005. ECAP recorded 10 features along the stretch of El Copano that corresponds with the dense concentration of structures on the 1884
Figure 7.2. 1845 map and blown-up image of 41RF18 on the left. TSL, map # 0024.

map (Features 2–8, 10–11, and 19). Since the ECAP survey was not completed in this area the existence of more than 10 features is likely.

There are eight square outlines on the 1884 map with seven of these concentrated in the dense central area of El Copano (Figure 7.3). Perhaps these were structures that still contained an intact roof or were the locations where the last residents of El Copano resided and worked. ECAP recorded approximately 15 roofed structures, or structures that were roofed at one time.
The 1935 Neil Imon map of El Copano published in Huson (1935) is used to calculate rates of shoreline change for three different areas. They include: the area at Features 1 and 14, which is Power’s Point; the central area of El Copano at Feature 3; and the area along Plummer’s Slough at Feature 20. This map was compiled from surveys and interviews with descendants of El Copano residents. A photo taken of Empresario James Power’s house is also used to calculate shoreline change at 41RF18 (Huson 1935:22), and a comparison to this photo is made from a 1935 U.S. Coast and Geodetic Survey map (TSL, map # 1622).

**Calculating Rates of Erosion at 41RF18 Using Historic Maps and Photos**

Based on the ECAP map of Features 1 and 14, which were still intact along Power’s Point (Figure 6.3) the 1845 location of these two features would provide a rate of erosion that equals 6.24 m/yr Table 7.2).
Table 7.2. Rates of erosion calculated for 41RF18 using historic maps and photos

<table>
<thead>
<tr>
<th>Feature # Used</th>
<th>A. Original Distance</th>
<th>B. 2005 Distance</th>
<th>C. Difference (A-B)</th>
<th>D. Date of Original Map/Photo</th>
<th>E. Years of Erosion (2005-D)</th>
<th>Rate of Erosion (C/E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14 (landward side)</td>
<td>1000 m</td>
<td>1.5 m</td>
<td>998.5 m</td>
<td>1845</td>
<td>160</td>
<td>6.24 m/yr</td>
</tr>
<tr>
<td>3 (landward side)</td>
<td>100 m</td>
<td>5–20 m</td>
<td>95–80 m</td>
<td>1884</td>
<td>121</td>
<td>0.79–0.66 m/yr</td>
</tr>
<tr>
<td>3 (seaward side)</td>
<td>33 m</td>
<td>5–20 m</td>
<td>27–13 m</td>
<td>1884</td>
<td>121</td>
<td>0.22–0.11 m/yr</td>
</tr>
<tr>
<td>3 (landward average)</td>
<td>72 m</td>
<td>5–20 m</td>
<td>67–52 m</td>
<td>1884</td>
<td>121</td>
<td>0.55–0.43 m/yr</td>
</tr>
<tr>
<td>20 (landward side)</td>
<td>133 m</td>
<td>-20 m</td>
<td>153 m</td>
<td>1884</td>
<td>121</td>
<td>1.26 m/yr</td>
</tr>
<tr>
<td>14 (landward side)</td>
<td>83 m</td>
<td>1.5 m</td>
<td>81.5 m</td>
<td>1884</td>
<td>121</td>
<td>0.67 m/yr</td>
</tr>
<tr>
<td>14 (seaward side)</td>
<td>15 m</td>
<td>0 m</td>
<td>15 m</td>
<td>1935 (photo)</td>
<td>70</td>
<td>0.21 m/yr</td>
</tr>
<tr>
<td>14 (landward side)</td>
<td>91 m</td>
<td>1.5 m</td>
<td>89.5 m</td>
<td>1935 (map)</td>
<td>70</td>
<td>1.28 m/yr</td>
</tr>
<tr>
<td>3 (landward side)</td>
<td>46 m</td>
<td>5–20 m</td>
<td>41–26 m</td>
<td>1935</td>
<td>70</td>
<td>0.59–0.37 m/yr</td>
</tr>
<tr>
<td>20 (landward side)</td>
<td>46 m</td>
<td>-20 m</td>
<td>66 m</td>
<td>1935</td>
<td>70</td>
<td>0.94 m/yr</td>
</tr>
</tbody>
</table>
Figure 7.3. 1884 map. Top: full map. Bottom: blow-up of 41RF18. TSL, map # 1058.
Most importantly for this research is the location of the structures plotted on the 1884 map in relation to the shoreline. On the map along the dense cluster of structures in the central area of El Copano, the structure’s landward sides are located 100 m from the shoreline. The features recorded in the central area of El Copano during 2005 contained 5 m of intact structure from the landward side to the bluff edge. An average rate of erosion of 0.79–0.66 m/yr (Table 7.2) is occurring at the central portion of El Copano. However, this measurement seems a bit exaggerated given the fact that the same map indicates the seaward sides of these structures was located approximately 33 m from the shoreline, meaning the buildings would have been 67 m long, northwest to southeast. This estimate appears to be too long when compared with the dimensions of the 2005 mapped features. The structures located at El Copano are much more likely to have had a seaward-to-landward dimension of somewhere around 10 m for the smaller structures. If the seaward side of the structures was used to calculate a rate of erosion then the structures are eroding at a minimum rate of 0.22–0.11 m/yr (Table 7.2). If the center of the structures on the 1884 map were used as a reference point this would mean that perhaps the structures landward sides were located closer to 72 meters from the shoreline in 1884. This would place the seaward sides around 62 meters from the shoreline in 1884. Using this adjusted point of reference on the 1884 map, a rate of erosion of 0.55–0.43 m/yr is determined for the shoreline at Feature 3 (Table 7.2).

The landward side of the one feature plotted on the 1884 map along Plummer’s Slough is 133 m from the shoreline. This feature could be one of three located along Plummer’s Slough during 2005. Feature 9 is the Plummer cemetery located approximately 75 m from the shoreline; this is a very small cemetery consisting of two...
graves and is probably not the feature depicted on the 1884 map. Feature 15 is the much larger El Copano cemetery that was located approximately 300 m from the shoreline in 2005 and is also probably not the structure depicted on the 1884 map because that structure is shown directly along the shoreline. Most likely the 1884 map is depicting Feature 20, which was located during the aerial survey underwater approximately 20 m out from the shoreline along Plummer’s Slough. This feature is believed to be the remains of Joseph Plummer’s second home built along Plummer’s Slough. If Feature 20 is the same feature plotted along Plummer’s Slough on the 1884 map that would mean the shoreline had eroded approximately 153 m along that area of El Copano. This creates an annual rate of erosion along Plummer’s Slough of 1.26 m/yr from 1884 to 2005 (Table 7.2). The final rate of erosion calculated from the 1884 map is from the shoreline area at Features 1 and 14, which were located 83 m from the shoreline based on this map. This would produce a rate of erosion along Power’s Point of 0.67 m/yr (Table 7.2).

Dated 1935, a U.S. Coast and Geodetic Survey map contains a point labeled “E. CHY.” along Power’s Point (TSL, map # 1622). This abbreviation is not explained but may be “East Chimney”, and the figure is not included since it is not used to calculate a rate of erosion. The interest in the 1935 TSL map is based on Huson’s 1935 photograph of Power’s Point (Huson 1935:22; Figure 7.4), where the TSL map plotted the abbreviation “E. CHY”.
Figure 7.4. Photo of The Power Family House Remains on Power’s Point. From Huson 1935:22.

Huson’s photo is of the eroded two-story wall of James Power’s home located along this point (Huson 1935:22; Figure 7.4). Possibly, by 1935 understanding of El Copano was minimal due to its abandonment 55 years before and that the Power’s house remains resembled a chimney to the creator of the 1935 U.S. Coast and Geodetic Survey map. Significantly, it is also possible to develop an estimate for the amount of erosion that occurred at Power’s Point based on historic photographs. The cross-section dimension of construction material used on homes at 41RF18 was a uniform 30 cm². The photograph published by Huson (1935) can allow for approximate shoreline location using the dimensions of the construction material. A minimum of 15 m of land is visible (Figure 7.4) and with the 100-percent removal of Feature 14 by erosion from 1935–2005 an estimate for an amount of erosion can be calculated. A minimal rate of erosion equaling 0.21 m/yr along Power’s Point is developed for this portion of 41RF18 (Table 7.2).
Neil Imon produced a survey map of El Copano that was published in 1935 (Huson 1935; Figure 7.5). The map contains many of the same features that were recorded by ECAP at 41RF18. Using Feature 14 as a reference point, the rate of erosion based on Imon’s 1935 map is 1.28 m/yr for Power’s Point. Using Feature 3 as a reference point, the rate of erosion along central El Copano is 0.59–0.37 m/yr. Using Feature 20 as a reference point, the rate of erosion a Plummer’s Slough is 0.94 m/yr.

Figure 7.5. Neil Imon’s 1935 survey map of El Copano. From Huson 1935:16.

Rates of Erosion for 41AS3 and 41AS109

The Kent Crane archaeological site (41AS3) is a very large prehistoric archaeological site along the western side of Live Oak Peninsula on the Copano Bay shoreline (Figure 7.6). This 800 m long shell midden has been investigated multiple times. Initially, in 1930, 5 m² was excavated; in 1941, 800 m² was removed; in 1982, 0.5
m² was excavated; and, in 1986, 9 m² was excavated from 41AS3 (Campbell 1952:41–42; Cox and Smith 1986:30; Martin and Potter ca. 1930, Site 46; Texas Archaeological Research Laboratory [TARL], Austin, 41AS3 1982 site form). In 1986 observations of the 1941 WPA excavation unit locations identified that approximately 5 m of 41AS3 had eroded off the bluff during the intervening 45 years (Cox and Smith 1988). This is a rate of approximately 0.11 m/yr eroding into Copano Bay (Table 7.3).

Table 7.3. Rates of erosion calculated for 41AS3 and 41AS109 using historic maps and photos

<table>
<thead>
<tr>
<th>Feature and Site Used</th>
<th>A. Original Distance</th>
<th>B. Distance at time of Second Map/Photo</th>
<th>C. Difference (A-B)</th>
<th>D. Date of Original, and Second Map/Photo</th>
<th>E. Years of Erosion</th>
<th>Rate of Erosion (C/E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Largest WPA Excavation Unit at 41AS3</td>
<td>22.85 m</td>
<td>17.85 m</td>
<td>5 m</td>
<td>1941, 1986</td>
<td>45</td>
<td>0.11 m/yr</td>
</tr>
<tr>
<td>Bluff line at 41AS109</td>
<td>0 m</td>
<td>10 m</td>
<td>10 m</td>
<td>1997, 2006</td>
<td>9</td>
<td>1.11 m/yr</td>
</tr>
</tbody>
</table>

It should be noted that the conditions affecting the 41AS3 shoreline are different from El Copano, because these two sites are on opposite sides of Copano Bay. El Copano receives steady southeasterly wind and waves all year long, while 41AS3 is positioned on the opposite side of the bay, where it is much more sheltered from the prevailing wind and wave action.
A portion of site 41AS109 is on property owned by Harry and Marsha Krenek and has been eroding out for at least 10 years according to the Kreneks (personal communication 2006). Based on photographs taken of the archaeological site in 1997, approximately 10 m of 41AS109 had eroded by 2006. Based on this 9 year period, 41AS109 is eroding out at a rate of 1.1 m/yr (Table 7.3). The erosion of 41AS109 was increased by the presence of bulkheads along two parts of the site, leaving a portion of the site exposed to the wind and waves. A portion of 41AS109 was removed during bulkhead construction. Prior to removal of this section of 41AS109, the same section of the site had eroded 10 m inland compared to the Krenek’s property and another bordering property (Figure 7.7).
Figure 7.7. 41AS109. Top view: (1997) oval outlines area shown in bottom view. Bottom view: (2006) bulkheads established and site impacted from bulkhead construction. Photos by Harry Krenek and James E. Barrera.

With a bulkhead across sections of 41AS109 it cannot be determined how much time 41AS109 may have left before it completely erodes. The bulkheads will protect the site for now from everyday erosion along Copano Bay, but a major storm that could breach the bulkheads would be capable of removing the site.

Oral Interview Results

Oral interviews about the shoreline along El Copano and two other archaeological sites along Copano Bay were conducted in 2005 and 2006. Interviews conducted during August 2006 produced some good information about erosion that has occurred at El Copano. Mr. J. D. Derrough and his son Mr. Deke Derrough were kind enough to be interviewed by the author in Bayside, Texas. Mr. Deke Derrough has spent his life on the
water in Copano Bay and recalled that in 1961 Hurricane Carla heavily eroded the shoreline of El Copano. According to Mr. Deke Derrough Hurricane Carla removed approximately 75 m of shoreline along El Copano.

Mr. J. D. Derrough moved into Bayside and started working on Copano Bay in 1929. He stated that around this time the seaward sides of El Copano’s structures were located 300 m from the shoreline. This distance is probably exaggerated based on the location of the structures on the 1884 map and Neil Imon’s 1935 survey map of El Copano. Mr. J. D. Derrough recounted that in the 1930s a road construction company was dredging along Copano Reef, which extends from Power’s Point approximately 6 km towards Live Oak Peninsula. According to Mr. J. D. Derrough, the dredging was responsible for an intensification of erosion along El Copano (possibly due to deepening the bay which would increase wave strength), and probably is responsible for the creation of the channel that now exists between Power’s Point and Copano Reef. Mr. J. D. Derrough also stated that Copano Reef acts like a bulkhead directing Copano Bay’s constant wave action toward the El Copano shoreline which naturally increases the erosion along this shoreline. This last statement may be supported by the fact that erosion on Power’s Point is supposed to be much greater than any other portion of El Copano’s shoreline (Paine and Morton 1993). Power’s Point is located in line with Copano Reef, and, therefore, prevailing southeastern wind and waves would deflect on the reef toward Power’s Point.

Mike and Julie McKain are two residents in the community of Bayside along Copano Bay that provided information concerning modern erosion prevention. The McKains live on a bluff that is approximately 3 m above Copano Bay and stated that the
vegetation along the shoreline edge is a modern effort to prevent erosion. The vegetation was identified as a native species called cordgrass (*Spartina alterniflora*), which effectively absorbs the normal wave energy directed towards the Bayside shoreline. The McKains stated that since Bayside has been planting cordgrass to prevent erosion, no major storms have hit. They believe that the cordgrass is a very good method of preventing erosion for normal conditions, but that a major storm would not be impeded by the vegetation and would remove it along with some shoreline.

Another Bayside resident, United States Merchant Marine Captain Donald Foxhall, provided information about another type of erosion prevention currently being used in the community. Captain Foxhall uses riprap along his shoreline property to reduce erosion. Riprap is broken or crushed stone, cement, or some other very durable material that is used to line shorelines and absorb the continual wave energy to reduce erosion. Riprap is more durable than cordgrass, but has a downside in that it is not natural and is impacted violently by wave energy due to its density and therefore does not dissipate the energy as efficiently as cordgrass.

Marsha and Harry Krenek, two residents of Fulton, Texas, were informally interviewed about their shoreline property and archaeological site (41AS109) on Copano Bay. The Kreneks own property that contains a multi-component prehistoric/historic archaeological site, which is eroding out into Copano Bay. The Kreneks provided information about the increasing cost and durability of methods of erosion prevention they used, as erosion continued to remove their property over a 10-year period. Ten years ago the Kreneks had cordgrass as the only erosion prevention method along their Copano Bay shoreline. At this time they decided to construct a small wooden bulkhead
that was destroyed after a minor storm hit their property. Interestingly, in photographs from the construction of this bulkhead the neighboring properties do not have any erosion prevention methods in use. Natural shorelines existed on either side of the Kreneks 10 years ago.

After the small wooden bulkhead was destroyed, a larger concrete and steel bulkhead was constructed that contains riprap along the exposed base. During the interview in late 2006 it was observed that the neighboring properties on either side had constructed bulkheads or were constructing bulkheads. An adjacent neighbor that was constructing a bulkhead in late 2006 had removed a portion of 41AS109 that extends eastward from the Kreneks property. This is a clear example of how erosion prevention can be destructive to archaeology when large-scale construction is used for erosion prevention.
CHAPTER VIII

DISCUSSION

This chapter fully relates the results of this research project to the research goals. The following research goals are described with the archaeological findings, and a brief conclusion ends the chapter.

**Research Goals**

1) Develop an annual rate of erosion for archaeological sites 41AS3, 41AS109, and 41RF18.

2) Describe and define the critically eroding condition of El Copano and other sites around Copano Bay, including an estimate of time remaining for intact portions of these sites.

3) Determine erosional rates and preventive measures for shoreline erosion in modern communities around Copano Bay.
   a) Highlight the importance of applying archaeological data to modern settlements around Copano Bay.
   b) Identify methods to prevent erosion at archaeological sites and modern settlements (Barrera 2005).
   c) Propose volunteer efforts towards endangered archaeological sites around Copano Bay.

**Research Goal 1**

The archaeological work at El Copano (41RF18) in July 2005 recorded the latest condition for the site of El Copano. During this season the majority of the site was surveyed and the archaeological features were recorded and their states of preservation
were noted. Site 41RF18 was not completely surveyed due to time constraints, and future work at the site was denied by the landowners. The structural remains at El Copano were heavily eroded; meaning that most of the walls were completely collapsed, and most buildings had partially eroded off the bluff. During the one month that ECAP spent recording 41RF18, sections of sediment up to 5 m³ were observed eroding into Copano Bay as continual intense erosion occurs at the site.

Table 8.1. Calculated rates of erosion from three archaeological sites around Copano Bay.

<table>
<thead>
<tr>
<th>Year of Source Map/Photo</th>
<th>Description</th>
<th>Calculated Rate of Erosion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1845 map</td>
<td>Power’s Point at 41RF18</td>
<td>6.24 m/yr</td>
</tr>
<tr>
<td>1884 map</td>
<td>Power’s Point at 41RF18</td>
<td>0.67 m/yr</td>
</tr>
<tr>
<td>1884 map</td>
<td>Central area at 41RF18</td>
<td>0.55–0.43 m/yr</td>
</tr>
<tr>
<td>1884 map</td>
<td>Plummer’s Slough at 41RF18</td>
<td>1.26 m/yr</td>
</tr>
<tr>
<td>1935 Imon map</td>
<td>Power’s Point at 41RF18</td>
<td>1.28 m/yr</td>
</tr>
<tr>
<td>1935 Imon map</td>
<td>Central area at 41RF18</td>
<td>0.59–0.37 m/yr</td>
</tr>
<tr>
<td>1935 Imon map</td>
<td>Plummer’s Slough at 41RF18</td>
<td>0.94 m/yr</td>
</tr>
<tr>
<td>1935 Huson photograph</td>
<td>Power’s Point at 41RF18</td>
<td>0.21 m/yr</td>
</tr>
<tr>
<td>1986 map of 41AS3</td>
<td>WPA excavation unit</td>
<td>0.11 m/yr</td>
</tr>
<tr>
<td>1997 and 2006 photos of</td>
<td>Recording erosion and construction</td>
<td>1.1 m/yr</td>
</tr>
<tr>
<td>41AS109</td>
<td>impacts</td>
<td></td>
</tr>
</tbody>
</table>

Less than 5 m of many structures at El Copano from the landward to seaward sides were intact as of July 2005. The archaeological rate of erosion for El Copano varies from 6.24 m to 0.21 m/yr based on comparisons between the 2005 data and the historic
Rates of erosion were determined for various parts of El Copano (41RF18) based on the data collected by ECAP in 2005 compared to historical records. Three structures are shown located on Power’s Point on the 1884 U.S. Coast and Geodetic map (TSL, map # 1058) and on the 1935 survey map created by Neil Imon (Huson 1935:16). In 2005 only two of these structures remained on Power’s Point (Features 1 and 14), both of which were partially or almost completely eroded off the point by July 2005. The landward sides of these features remained intact allowing for a rate of erosion to be developed based on the wall locations when compared with the same locations on the historic records of these structures.

Using the 1884 U.S. Coast and Geodetic Survey map measurement of 83 m, a long-term rate of erosion is estimated at 0.67 m/yr for Power’s Point (Table 8.1). Using Neil Imon’s 1935 survey map a rate of erosion estimated at 1.28 m/yr is determined for Power’s Point (Table 8.1). The 1884 map is believed to have greater accuracy based on the expertise of the agency that created the map, and therefore a long-term rate closer to 0.78 m/yr is more likely for Power’s Point.

Along the central area of El Copano the 1884 map indicates the landward side of the structures was an average of 72 m from the shore. Based on this figure, a rate of erosion of 0.55–0.43 m/yr is calculated for the central area of El Copano. Using the 1935 Imon map, the landward side of the structures in central El Copano was located 46 m from the shore providing a rate of erosion of 0.59–0.37 m/yr. The estimates based on the 1884 and 1935 data is interesting since it shows a long term, consistent rate of erosion for this area of El Copano.
The second site included in this research project is 41AS3, known as the Kent-
Crane site, which is an eroding archaeological site located along the western side of Live
Oak Peninsula. The rate of erosion for 41AS3 is based on archaeological field records
kept from 1941–1986. Based on the archaeological field records kept over a 45 year
period, 41AS3 was eroding at a rate of 0.11 m/yr as of 1986. Interesting comparisons
with 41AS3 are the rates of erosion determined for 41RF18, which sits opposite 41AS3
in a more exposed area of Copano Bay. Looking at prehistoric adaptation along the Gulf
Coast and areas that are less prone to erosion could be an interesting research topic
considering the very large size and repeated occupation of a coastal archaeological site
such as 41AS3. This is in direct contrast to the almost complete lack of prehistoric
occupation found during ECAP surveys along approximately 4 km of Copano Bay and
Mission Bay shorelines (see Chapter 6: Feature 16 was recorded as a possible prehistoric
scatter, and a secondary prehistoric deposit was located at the natural shell deposits on
41RF18).

41AS109 is the archaeological site that belongs to Harry and Marsha Krenek and
has an estimated erosion rate of 1.1 m/yr. This is based on photographs of the site taken
in 1997 compared to observations made of the sites length and width in 2006. As of 2006
41AS109 has been temporarily protected from erosion by bulkheads, and also heavily
disturbed by the construction of bulkheads. This is an unfortunate example of the impact
that modern populations can have on coastal archaeological sites.

The limitations with these data are errors involved in measuring distances from
maps and photos. The maps and photos selected were chosen based on the highest degree
of accuracy found for each area where a rate of erosion was calculated. Using
archaeological unit locations is a more accurate means of tracking shoreline change (i.e., 41AS3 rate of erosion). Photos also produce very accurate rates of shoreline change when referenced to known points located later in time (i.e., 41RF18, 1935 Huson photo of Power’s house; 41AS109 photos). The rates of erosion determined in this thesis are long-term rates that encompass large storm events which can remove large sections of shoreline very rapidly. Removing the amount of shoreline erosion caused by large storm events would lower the annual rate of erosion for a particular section of shoreline. But, including large storm event erosion in the final rate of erosion was selected for this project because it produces a realistic pattern with which to predict how long a particular archaeological site or section of shoreline may have before it disappears.

Research Goal 2

El Copano has various rates of erosion calculated for the 2-km long stretch of shoreline on which the site lies. The rates of erosion that are most accurate are between 1.28 m/yr to 0.37 m/yr. Based on this rate of erosion it is estimated that the majority of El Copano’s structures have from 5 to 10 years before the intact portions erode off the bluff.

Site 41AS3 as of 1982 was recorded as 20 m in width, meaning from landward to seaward sides (TARL 41AS3, 1982 site form). This 800 m long archaeological site is composed primarily of shell, which may erode faster given the loose porous nature of shell middens. However, with an archaeological erosion rate of 0.11 m per year, 41AS3 is estimated to have at least 156 years before the site completely erodes into Copano Bay. The major difference in erosion rates between 41RF18 (1.28–0.37 m/yr) and 41AS3 (0.11 m/yr) is due to their different locations around Copano Bay and therefore different
exposures to prevailing wind and wave energy. In 2006 site 41AS109 was in the process of being completely protected by bulkheads, which would prevent the site from eroding under normal conditions. However, at the rate of erosion recorded in 2006 the site would have 14–5 years left before the deposits are completely eroded out. The unfortunate consequence of constructing bulkheads along 41AS109 however, was the destruction of a portion of the archaeological site.

**Research Goal-3**

Bayside, Texas is located along the southwestern shore of Copano Bay. The BEG has developed shoreline rates of erosion for Bayside varying from 0.09 m to 0.45 m/yr (Paine and Morton 1993). In order to combat this high rate of erosion per year the residents of Bayside use a variety of erosion preventing methods. Planting cordgrass vegetation is one of the common methods of combating erosion along their shoreline, as is laying riprap along the bluff. The other form of erosion prevention observed during the 2005 field work in Bayside was the occasional use of bulkheads. Based on material and labor costs, the order in which these three erosion control methods are listed reflects the cost of these from least expensive to most expensive.

Fulton, Texas along the very northern portion of Live Oak Peninsula was another community visited on Copano Bay during this project. Fulton is eroding at a rate of 0.98 m to 1.28 m/yr according to the BEG (Paine and Morton 1993). The archaeological rate of erosion determined by examining site 41AS109 is 1.1 m/yr along this part of Fulton. Erosion prevention methods observed along Fulton included: cordgrass, riprap, bulkheads and bulkheads with riprap. Archaeological site 41AS109 is in the city on the edge of Copano Bay. The site is also on private properties that have well-maintained erosion
control methods in use. It was observed that 41AS109 was in a part of Fulton subject to heavy erosion, and the residents there were actively upgrading the types of erosion control being used. This was observed to be beneficial in protecting parts of 41AS109 from erosion for now, but also destructive due to the removal of a large part of this site for the construction of erosion control.

Based on the observations made of how modern communities along Copano Bay combat erosion, it would be best to use the least destructive method of erosion control if one was interested in constructing erosion control along a shoreline archaeological site. The least destructive method is planting cordgrass along the shoreline for erosion protection. Cordgrass was observed along the communities of Bayside and Fulton where the wave and wind energy was largely diminished by the time it reached the shoreline after passing through the dense stands cordgrass. The Kreneks in Fulton stated that the cordgrass was not very effective against high energy storms that could easily pass through the cordgrass without losing much energy and destroy the stands of cordgrass along with eroding the shoreline the stands were intended to protect (Harry and Marsha Krenek, personal communication 2006). Using cordgrass to protect an archaeological site is the least expensive method of erosion protection and is the least destructive to install.

Riprap seems to be slightly destructive due to its density, deflective property and how it is installed along the shoreline. The wave energy along riprap was observed deflecting in various directions including towards the shore where the wave energy would dissipate against the soil of the shoreline. This was due in part to the various sizes of riprap including pieces of concrete from 30 cm³ to 2 m³ and not being placed in an
organized and efficient manner. The riprap observed along the shores of Bayside was placed in an inefficient manner allowing a fair amount of wave energy between spaces in the concrete pieces and underneath the concrete pieces. These two weaknesses in riprap observed around Copano Bay can be destructive to an archaeological site due to the wave energy moving through or underneath the riprap and eventually removing a portion of the shoreline. The soft sandy shorelines of Copano Bay along with the massive weight placed on top of this by installing riprap creates a situation that increases undercutting erosion from waves when the riprap is not installed most efficiently (Jesse B. Malone, personal communication 2007).

The third type of erosion control observed around Copano Bay is the use of bulkheads, the most expensive method of erosion control observed. These vertical walls require a more complex construction process. For example, knowledge of engineering the amount of materials, time, and equipment required all become issues. Bulkheads were observed to be the best erosion control in use along Copano Bay: however, unfortunate destructive effects from the installation of these bulkheads were also observed. If bulkheads were to be installed along an archaeological site for the purpose of preserving the site the process of increased erosion from the bulkheads, as observed at 41AS109, could occur.

A very positive aspect of this research is that 41AS109 was recorded and brought to the author’s attention by the regional archaeological steward Pat Braun (Pat Braun, personal communication 2006). The regional steward created a permanent record of the site and also a history of the archaeological site’s erosion and protection. The actions by
this archaeological steward are a great example of the public and archaeological communities becoming involved in the preservation of archaeological sites.

**Conclusion**

To help preserve sites such as El Copano, archaeological stewards that work in coastal settings such as Copano Bay should inform local archaeological organizations of eroding sites in an attempt to aid in site preservation. Local archaeological organizations could, with relatively little cost, record and investigate archaeological sites that are quickly disappearing. Gathering any information possible through the involvement of a regional, state, or national society that can invest time and money into the preservation of these sites would prove extremely valuable for coastal archaeology.

Minimally, individuals or groups could record eroding coastal archaeological sites and collect samples such as carbon or diagnostics that would provide temporal information about these disappearing sites. Focusing large volunteer efforts, such as the Texas Archeological Society annual field school, on sites that are endangered from intense erosion would be a great use of large avocational groups.

The rates of erosion discussed in this research project provide an estimate on how long these archaeological sites may have before they completely disappear. These rates will hopefully serve as an incentive to preserve disappearing archaeological sites as the alarming rate of erosion continues to destroy these valuable resources.
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