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CLOVIS ORIGINS
AND
UNDERWATER PREHISTORIC ARCHAEOLOGY
IN
NORTHWESTERN FLORIDA

by

Michael Kent Faught

A Dissertation Submitted to the Faculty of the

DEPARTMENT OF ANTHROPOLOGY

In Partial Fulfillment of the Requirements
For the Degree of

DOCTOR OF PHILOSOPHY

In the Graduate College

THE UNIVERSITY OF ARIZONA

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entitled Clovis Origins and Underwater Prehistoric Archaeology
in Northwestern Florida

and recommend that it be accepted as fulfilling the dissertation

requirement for the Degree of Doctor of Philosophy

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Final approval and acceptance of this dissertation is contingent upon the candidate's submission of the final copy of the dissertation to the Graduate College.

I hereby certify that I have read this dissertation prepared under my direction and recommend that it be accepted as fulfilling the dissertation requirement.

Vance Haynes Dissertation Director	29 Sept 1995 Date

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A special participant of this research was my good friend Michael Daley, of Tucson, a gentleman with autism who labeled and analyzed the artifacts in the lab. He also participated as field crew in 1989 and 1991, both on and offshore. Good job, Michael.

DEDICATION

This dissertation is dedicated to the preColumbian people of the New World, to their progeny and to my wife Anna, and my children, Cecilia and Meghan.

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ABSTRACT

The first four chapters of this dissertation revisit the principles, doctrines and data involved in determining how the New World was peopled. I investigate the pattern and trajectory of Paleoindian colonization by analyzing a robust sample of isolated fluted points, Paleoindian and Early Archaic archaeological sites and their associated radiocarbon chronologies. I also look at late Pleistocene and early Holocene geological processes, seeking an explanation for Paleoindian population movements, and to reveal the geological processes that may have concealed or altered portions of the relevant archaeological record. The result of these studies is a proposal that the pattern and apparent trajectory of colonization by people who made fluted points is in contradiction with current models and that significant segments of early human settlement patterns are obscured by Holocene sea level rise. I present the hypothesis that fluted point Paleoindian, and related Early Archaic, archaeological sites will be present on the continental shelves of the East Coast and Gulf of Mexico and that the discovery and sampling of these sites might help to resolve the modeling discrepancies.

In the last four chapters I outline the character, principles and methods of underwater prehistoric archaeology and present the results of an underwater archaeological research project designed to find and sample such sites in the Apalachee Bay of Northwestern Florida. The results of remote sensing, coring, survey, collection and excavation of three marine inundated sites are presented. The past

drainage system is partially reconstructed. The context and character of the chipped stone artifacts are described and the reduction strategies are examined by various analytical methods. I conclude with interpretations and syntheses of these marine inundated archaeological sites, and their functions, and I present proposals for future offshore research. The sites exhibit artifacts diagnostic of Paleoindian, Early and Middle Archaic periods, confirming the hypothesis that such sites exist offshore. The relationship of these sites to the larger issue of the Peopling of the New World is also discussed and an alternative, testable model of fluted point colonization originating from the continental shelves of the Gulf of Mexico and the Eastern Seaboard is presented.

Chapter One

INTRODUCTION

Background

"There is nothing here that has not been explained before and I have no skill in the art of rhetoric; therefore... I write this in order to acquaint it to my mind."
(Batchelor, 1979:3)

This dissertation is about the terminal Pleistocene colonization of the New World by people who made fluted points and about searching the continental shelves of North America to find more of their early sites. It is driven by the realization that after more than 500 years of Euro-American inquiry, the origins of the indigenous people of the New World remain puzzling because there are conflicting estimations of when they migrated from Northeast Asia, or how many times they came in, or both. These conflicting estimates can be found in recent professional and popular publications.

The traditional model of how the New World was "Peopled" (colonized), is that human groups came in from Northeastern Asia, on foot, by way of a connecting land mass known as Beringia. From there they trickled or spread throughout the continent afterward by gradually expanding through a corridor - the ice free corridor - between two major glacial lobes located in what is now Alberta, Canada. The only orthodox alternative to this land bound corridor model is the proposal that some groups of people were drawn southward, along the western continental margins, by combinations of marine, coastal and land based subsistence resources. This coastal model proposes that these groups employed boats for travel. Regardless, both of these models (the corridor model and the Northwest Coast model) imply that early archaeological sites should be frequent in the north and northwest portions of North America, as well as beneath the waters of the Bering Strait and possibly the West Coast continental shelf.

However, the distribution of the earliest unequivocal evidence for human occupation, isolated fluted points and fluted point sites, are not arrayed in the expected pattern. The major diagnostic chipped stone artifacts of this time frame are distinctive and aesthetically pleasing bifacially flaked Clovis projectile points. These artifacts, and many subsequent varieties, were made by removing flakes from a biface preform, fabricating concave based projectile points with thinned bases as the result of one or more channel flakes on each face. These remains are weighted to the eastern and southern portions of North America, as are the early Archaic aged assemblages and sites related, as progeny, to fluted point assemblages. Furthermore, the Clovis (fluted point) material culture exhibits a mature bifacial chipped stone industry from its first appearance, along with a geographically extensive colonization pattern. There are no unequivocal traditional antecedents for the Clovis material culture in the Northeast Asian homeland where they are supposed to have come from.

There are several early sites that do have similarities with Northeast Asian assemblages. These sites have been found in the Northwestern and Great Basin portions of North America and their traditional chipped stone assemblages exhibit distinctive bifacially chipped projectile points with convex bases. These other chipped stone traditions also have distinct geographic boundaries, early chronologies and apparent ancestral - progeny traditional continuity with early Holocene aged sites, just as the fluted point assemblages farther east. These assemblages offer the possibility of ancestral connections with Asia and do seem to track early human entry from Northeast Asia. These sites and their assemblages reflect the pattern of distributions predicted by both the corridor and Northwest Coast via Bering Strait models. However, their relationship to fluted point assemblages, or their position in the migration sequence, is not considered in most colonization models.

Just who all of these people were, therefore, is an important question to answer. Archaeological cultures of late Pleistocene and early Holocene times are defined on the basis of morphological (stylistic) aspects of their chipped stone tools. It is common to envision that the people who made fluted points, and other items of that chipped stone assemblage, were the ancestors of the majority of indigenous people of North, Central, and South America (excluding the Na-Dene and the Eskimo-Aleut). This assumption is due in part to the fact that fluted points are found throughout North, Central and South America and on the overwhelming similarities of Amerindians to peoples of Asiatic descent. There are only two other populations confirmed to have migrated into the New World from eastern Asia after initial colonization (e.g. Na-Dene and Eskimo-Aleut).

The biological and linguistic results of interactions among and between these last two groups in the milieu of indigenous New World biological, linguistic and cultural diversity is well documented. However, the diversity of the broader spectrum of New World populations (North, Central and South American) remains complex and unsatisfactorily explained by these three proposed ancestral populations (i.e. late Pleistocene Clovis, early Holocene Na-Dene and middle Holocene aged Eskimo-Aleut). Neither is the diversity explained by increasingly insupportable proposals of more than 12,000 years of archaeological time involved in the Peopling problem.

Thus, the current anthropological puzzle of how the New World was peopled is like a widget. On the early, archaeological end of the widget, unequivocal archaeological evidence exhibits an restricted (terminal Pleistocene) chronology and a distinctive, but generally a singular, initial artifact tradition known as Clovis and two Holocene age migrations (Na-Dene and Eskimo-Aleut). On the ethnographic end of the widget there are diverse native American languages, cultures and biological characteristics. The diversity of these groups implies either lengthy *in situ* evolution from a few early migrating populations, or multiple (more than three) populations who could have come in at various times. However, hypotheses of either earlier (Pre-Clovis) populations, or multiples of Holocene migrations are currently equivocal or unacceptable.

If these problems were not enough, various kinds of geological processes have altered and obscured much of the past land mass which might be relevant to the archaeological record over the course of the late Pleistocene to middle Holocene time frame of concern. Not only did the massive ice age glaciers retreat, producing both alluvial erosion and sedimentation, but the continental shelves, exposed during the latest portions of Pleistocene epoch, were inundated by the meltwater flow. These continental shelves were probably traversed and occupied by people during the major pulses of colonization of the New World at the end of the Pleistocene and by their progeny throughout the early and middle Holocene times, as sea levels gradually rose. These sites, if they are recognizable, lie virtually untouched by previous archaeological research or artifact collection by amateurs.

Thus, land masses relevant to the reconstruction of early human migration into the New World, and possibly a significant portion of the cultural history of the progeny of those people, lay hidden by post glacial sea level rise on the continental shelves that ring North, Central and South America. I present a research program which proposes that prehistoric aged archaeological sites can be found underwater on the continental shelves, and that these sites can be excavated and analyzed with principles from both terrestrial and marine archaeology. I present this with the expectation that these sites might resolve some of the dilemmas regarding the earliest colonization patterns and chronology.

Objectives

This dissertation is arranged in two parts. In the first four chapters I question both migration models (Corridor or Northwest Coastal) and show that neither explain current archaeological evidence for the distributions of isolated fluted points and fluted point sites, nor the problems of diversity between both early archaeological assemblages and ethnographically known indigenous peoples. In Chapter Two, I attempt to disentangle relevant aspects of these problems by separating out the conceptual issues of determining *when* the people came into the continent, determining *who* they were and then determining *where* they came in. Because these issues have facets of biologic and linguistic information which relate to the relationships between and among the social groups of indigenous people of the New World, and others worldwide, a review is presented in Appendix A which addresses specific directions, results and problems of those research domains.

In Chapter Three the character and distributions, in time and space, of fluted points, fluted point sites, and other Paleoindian and Early Archaic chipped stone traditions are presented. I assume that a way to demonstrate the Beringian pathway is to reconstruct the pattern of sites of precursors in Siberia, progeny in Alaska and the Ice Free Corridor, and then to show how these groups dispersed across the High Plains and into the rest of the continent. By this model, sites should be generally earlier in the north and become gradually younger as people fanned out southward from the southern margins of the corridor. I will present an argument that current radiocarbon control of Paleoindian sites indicates that the earliest fluted point sites are in the southern portions of North America and that fluted point sites show up slightly later in the High Plains and other areas. Moreover, while it is true that fluted point artifacts have been located almost everywhere in the Western Hemisphere, the frequency and diversity of artifacts and sites, and the evidence for the survival of progeny cultural traditions, are most robust in the Eastern and Southeastern regions of North America. The geographic locations, chronologies, and continuities of these sites offer the alternative possibility that at least some and possibly many of the people who made fluted points were dispersed along the continental shelves of the Eastern seaboard and the Gulf of Mexico at the end of the Pleistocene, regardless of the location of their ultimate homeland.

However, it is unfortunate but true that radiocarbon control for fluted point occupation is lacking from both the Southeastern and Northwestern regions of North America, two of the most important areas to test for the trend or trajectory of the migration pattern. Secondly, there other lithic traditions in the late Pleistocene and early Holocene in the New World, already alluded to, and to be discussed, which beg the question of how many "kinds" of Paleoindians may have existed back then, how they may have been related to each other, and how they came to be the diverse groups of people evident to Europeans a little more than 500 years ago.

The possibility that some environmental event or process was pushing or pulling these people into the continent at the end of the Pleistocene cannot be overlooked. Chapter Four concludes the first part of the dissertation with a discussion of the conditions pertainant to the terminal Pleistocene / early Holocene time frame. This discussion includes glacial margins, pluvial lakes, overfit streams and lowered sea levels. These issues are inventoried to contribute to the issues of *how* and *why* people might have come into the continent in the first place. The regularities of various stratigraphic occurrences of North American Paleoindian sites are reviewed, the condition of the Ice Free Corridor is assessed and the rate and magnitude of late Pleistocene and early Holocene sea level transgression is characterized. These discussions are presented to gain insight into the changing environmental parameters, to seek explanations for initial, or distinct pulses of entry, and to evaluate the potentials for determining migration pathways involved in the colonization process.

Combination of the distributions of early isolated fluted points and fluted point related sites with the great extent of *terra incognita* underwater, it is hypothesized that at least some people who made fluted points were gathered near major drainage systems out on the continental shelves. It is also suggested that they were drawn or driven into the continent sometime around 11,000 rcybp for Younger Dryas climatic fluctuations which interrupted deglaciation. The growth of glaciers would have resulted in temporary sea level lowering which would have precluded the possibilities of coastal occupation, if such existed. The conclusion of the first four chapters is that appropriate locations need to be identified to begin searching underwater for proof of these occupations and to inventory and date the changing settlement patterns. Such an area is identified off the coast of Northwestern Florida.

The next four chapters present a specific attempt at finding *in situ,* marine inundated Paleoindian sites underwater. Simply put, the research is based on the premise that land masses inundated by rising post-glacial seas were probably exploited by early Amerindians. Therefore, the archaeological record of their activities should exist in an altered state, underwater, out there. These land masses include Beringia, the West and East Coasts of North America and the Gulf of Mexico. These areas represent probable locations of evidence for the very initial pulses of the colonization of the continent.

To actually find sites, specific archaeological methods and procedures had to be researched, developed and tested. In Chapter Five, I examine the nascent discipline of marine inundated, or continental shelf, prehistoric archaeology, briefly examining its history and pointing out several major contributing personalities. I also review known site occurrences and the techniques and principles that have developed out of these research projects. From these other research projects, and by direct research, I submit that the intentional discovery of <u>any</u> archaeological site inundated on <u>any</u> continental shelf rests on identifying terrestrial analogues in areas where archaeological sites of sufficient age exist in high enough frequency to offer the possibility of sufficient site densities offshore. The exposure of these sites rests on discovering local geomorphological settings with potential for site preservation after transgression and on the application of various common marine technologies.

Northwestern Florida was chosen for this research because the numbers of early artifacts and sites known from there indicate that it was a region of substantial Paleoindian activity. A significant portion of these sites and discoveries are associated with karst geologic features. The karst features continue offshore onto an extensive continental shelf area which was a wide expanse of dry land at the end of the Pleistocene and into the early Holocene. Therefore, it is probable that early Paleoindian sites exist offshore and that these sites can be discovered, excavated and analyzed given both terrestrial and marine inundated archaeological principles.

In Chapter Six the specific geological, environmental and archaeological backgrounds are given to describe the changing geologic character of the Floridian research area and its prehistory. Next, a narrative account of the dissertation research history is presented which puts in chronological order the various methods used and developed and the site discoveries made over the course of five years of diver survey and collection, remote sensing, coring, and underwater excavations undertaken in the Apalachee Bay.

Chapter Seven focuses on the reconstruction of the paleodrainage system of the research area using bathymetric and remote sensing data. It presents the geographic and stratigraphic settings of the three major archaeological sites discovered, and it discusses the effects of marine inundation on the condition of the artifacts. Chapter Eight illustrates and describes the artifacts found at the three sites and presents the results of various analytic procedures which were applied to them with the purpose of elucidating both function and cultural history. Chapter Nine Concludes the dissertation with interpretations of the data presented in both parts and with recommendations for future research.

The specific goal of finding an *in situ* Paleoindian site was not met by this dissertation research. However, an inundated river sinkhole, a karst geologic feature potential for the discovery of *in situ* items, was found and probed offshore. We did encounter isolated Paleoindian artifacts and Early Archaic aged archaeological materials around its margins during the course of the research. Two other Archaic aged sites and several possible quarry locations were located near and around other paleofluvial features in the research area. These sites ranged from five to almost ten kilometers (three to six statute miles) offshore in three to six meters of water (10 to 20 feet). Future research may yet uncover the intended target of *in situ* items in the targeted sinkhole, or in other situations. Much of the experience and data gathered during the course of this research will be useful to that goal.

As stated, this dissertation is about the development of a continental shelf, marine inundated prehistoric archaeology to discover more about the distributions of the fluted point tradition, and possibly its origins. In the following chapters, I hope at the least to cast doubt on our entrenched beliefs regarding the pattern and process of Clovis colonization and at the most to expand the possibilities for perceiving that process by looking for evidence in marine inundated, continental shelf situations.

Chapter Two

THE PEOPLING OF THE NEW WORLD

Issues

The derivation of the indigenous people of the New World from Asia by way of the Bering land bridge is a probable, logical and parsimonious explanation of how people initially came into the continent. It is substantiated by such facts as the biological similarity of Amerindians to Asiatics and the lack of any other land bridge connecting the Western Hemisphere. Historically, the only factor in need of resolution was the timing of the intrusion(s). However, supporting evidence for this Beringian entryway is currently equivocal. This chapter will express the view that there is actually less doubt regarding the timing of Upper Paleolithic people colonizing the New World than there is growing doubt about the ancestors, the route, and the process of those migrating groups.

Regardless of how confidently we anthropologists recite this simplistic model of people's intrusion into the Western Hemisphere, many arguments use logic, assumptions and possibilities to estimate the timing, source and route of the colonization of the New World. These arguments do not hold up in the light of some recent terminal Pleistocene settlement pattern data. In addition to this accumulating contradictory archaeological evidence, the exercise of identifying and timing separate intrusions of people into the Western Hemisphere is also under review and revision in other anthropological subdisciplines (Gutin, 1992; Nichols, 1990; Rothhammer and Silva, 1992; Schanfield, 1992; Suarez et al., 1985; Swadesh, 1964; Wallace and Torroni, 1992; Weiss, 1994).

For example, the doctrine of the biological similarity of Amerindians and Northeast Asians is almost legendary (Hrdlicka, 1925; Turner, 1985; 1986; Willey, 1966:12-16). Probably one of the more widely cited researchers in this biological domain is Christy Turner II. Building on attributes initially outlined by Dahlberg (1951), Turner has, over a number of years, recorded 28 to 34 crown and root traits from more than 15,000 historic and prehistoric crania (Greenberg et al., 1986:480; Turner, 1985:33; 1986:37; 1994:132). In a plethora of publications, and using a sample dominated by late Holocene archaeological remains, Turner claims to have demonstrated that all Amerinds are most similar to Northeast Asians (Sinodonts) (e.g. Turner, 1971; 1983; 1985; and 1994). From this base, he separates the groups into three separate migration pulses: Paleoindian, Na-Dene and Eskimo-Aleut.

In his most comprehensive publications, and those in which he presents more data (1983; 1985; 1986), Turner splits Northeast and Southeast Asians into two distinct dental groups: Sinodont and Sundadont, respectively. He emphasizes that Northeast Asians (Sinodonts) are most similar to all indigenous Americans and that Na-Dene and Eskimo-Aleut groups represent two distinct clusters of dental characteristics within. Each of these groups is proposed to be the result of distinct migrations, with Macro-

Indians the progeny of the first migrating Northeast Asians, and Na-Dene and Eskimo-Aleut following in that order. He suggests that the Macro-Indian ancestors made fluted points. His selected examples of North American Paleoindians is a mixed bag of early to middle Holocene aged remains (Turner, 1983; 1985). However, Turner only used early biological representatives in one of his clustering algorithms (1985). More details of this "Paleoindian" sample are presented in Appendix A.

Depending on the composition of the samples uses, different conclusions have been reached by other biological researchers. For instance, a recent study of cranial characteristics compared samples from North America which date from 11,000 to 8,000 years ago with like aged skeletal samples in Asia. This is the first time such a temporally controlled study has been attempted and it showed that the New World Paleoindians shared more characteristics between late Pleistocene/early Holocene Southeast Asians and possibly even Europeans, than with similar aged Northeast Asians (Steele and Powell, 1992:324). In another study based on cranial and facial attributes of late Holocene skeletal remains, Brace and Hunt shrugged off the fact that their clustering algorithm linked the Amerindian sample with Europeans rather than with Northeast Asian representatives or a combined sample cluster of Southeast Asian - Polynesian - Australian remains (Brace and Hunt, 1990:353).

Another method, of determining the relations between biological populations, albeit of modern age, is blood group genetics. In particular, GM allotypes have been used to estimate the number of migration pulses. Wallace et al. (1985) and Greenberg et al. (1986) saw three migratory pulses with their GM allotypic data, whereas Schanfield (1992) interpreted four because he sampled more extensively in South America.

Recent interpretations of mitochondrial DNA variability (mtDNA) estimates as many as five founding populations, or migration pulses, confirms similarities with Northeastern Asians and exposes relationships with Southeastern Asians (Torroni et al., 1993; 1994). These samples include more North, Central and South American representatives than any previous study and Torroni et al. (1994) have gone so far as to infer trans-Pacific transit(s) to South America from these data.

If the biology of the indigenous people of the New World exhibits conundrums of classification, what is the relationship of these physical samples with the more abstractly interpretive problem of the relationships between New World languages? Specifics of the classification of New World languages are presented in Appendix A. Compendiums of North Central and South American linguistic stocks focused on classifying this diversity taxonomically have resulted in the reconstruction of several related language stocks (Campbell and Mithun, 1979; Greenberg, 1987; Key, 1991; Landar, 1979; Ruhlen, 1987; Sebeok, 1979). One obvious conclusion from these documents is that there is well more linguistic variation among Amerindians than biological variation. Nichols proposes that there is enough linguistic diversity in the

New World for 40,000 to 60,000 years of occupation, without using an appeal to the alternative that multiple migratory pulses can generate variation as well (Nichols, 1990).

Greenberg's (1987) eleven major stocks, excluding Na-Dene and Eskimo-Aleut, probably represent the most simplified, internal division of New World linguistic variability. Whether these linguistic groups are accurately portraying patristic relations, or not, the more linguistic representatives that biological samples incorporate, the more the evidence for additional migratory pulses. This is particularly true with the most recent GM allotype data (Schanfield, 1992) and mtDNA research presented by Torroni et al. (1993; 1994). Tables A.02 and A.03 list some examples of the linguistic domains for major biological studies showing this fact. The point here is that new data and revisions are accumulating with various types of data which clarify and expand our understanding of human biologic and linguistic diversity in the New World.

Given these other developments, archaeologists are left with several problems. For instance, if there were more than three pulses of linguistically and biologically related social groups migrating into the continent, what is the archaeological evidence for these other groups? When did each one came in, where did they come from and to whom were they most closely related at those times? What are the archaeological patterns and processes by which people settled and populated the Western Hemisphere after their entry? How did these initial groups evolve into the complex arrays of societies observed at contact? A comprehensive model of the Peopling of the New World should include the timing, route and trajectory of colonizing populations, the source(s) of the people and the subsequent transformations and interactions among and between them which might alter the original patterns - archaeologically, biologically and linguistically (cf. Bonnichsen and Steele, 1994).

Thus, a principled methodology is needed to ascertain how any area becomes populated and this methodology should focus on the disentanglement of two domains of information. The first domain includes three determinations: *when* people came in, *who* they were related to (material culturally, biologically, and linguistically) and *where* they came from, geographically. It is, at once, a multidisciplinary exercise taking into account interpretations of both anthropological and geological (i.e. geographical source) data. This exercise might expose several "pulses" of material cultural and perhaps related biological populations, depending on the evidence. Furthermore, the pertinent geographical areas may have to be reconstructed from land forms altered during Holocene environmental progression (i.e. withdrawn glacial margins, dried Pluvial lake beds, buried or eroded alluvium, and elevated freshwater and sea levels).

The second domain is the clarification of changes among populations interacting from varying degrees of relatedness and to varying pressures of natural and social environmental progression. In general, similarities between populations can be due to ancestry (homology), parallel evolution (analogy) or hybridization (reticulation).

Changes brought about across time are the results of invention (mutation) within related populations, sharing (gene flow) or adaptation (convergence) (cf. Appendix A). That all of these principles can be acting simultaneously, depending on the characteristics observed, shows that this is a complex anthropological milieu. Archaeologically, this milieu is compounded by changing land forms and environments and other site formation processes which obscure the relevant evidence.

Ideally, such a detailed model would substantiate the similarities and locations of source populations and evince the colonization process with specific site arrays and biological samples. Chronological control is vital to determine the direction of early population growth patterns and taxonomic classification is needed regarding the evolution and movements of progeny populations through time. This kind of evidence could then be buttressed from two directions by connecting known material cultural, biological and perhaps even linguistic attributes back and forth in time, resulting in explanations for diversity of attributes observed at the time of contact (Faught, 1990a; cf. Tables A.04 through A.13 in Appendix A).

Determining the Timing

Concern with when people came into the New World developed in the 19th century as the biblical portrayal of a short geologic time crumbled and the remains of extinct animals and people were confirmed in Europe -- and assumed in the New World (Grayson, 1986; Meltzer, 1983; 1991). In many senses, this has been the pivotal theme in the debate on the peopling of the New World. Currently, the most abundant and unequivocal archaeological, stratigraphic and radiometric evidence for the colonization process clusters at the Pleistocene/Holocene geologic/epochal boundary. This is to say that archaeological sites in the New World are rare until about 11,200 radiocarbon years before present (rcybp)[1], and they become much more frequent and widespread by about 10,500 rcybp, a period of 700 years (Dincauze, 1984; Haynes, 1967; 1987; 1990; Jelinek, 1992; Lynch, 1990; Thompson, 1985; Waters, 1985; West, 1983; Wormington, 1964. This is due, in the main, to the appearance of many fluted point related sites during this period.

This fact, to be discussed more in Chapter Three, is bothersome to many researchers who believe in the possibilities of earlier entry into the continent (Bryan, 1978; 1986; 1991; Butzer, 1991; Dillehay, 1984; MacNeish, 1976; Nichols, 1990; Wallace and Torroni, 1992; Whitley and Dorn, 1993). Regardless, Haynes (1988), Lynch (1990) and others (e.g. Marshall, 1990; Meltzer 1989) note a characteristic "rise and fall" of pre-Clovis aged sites in the literature. Interested scholars are often mislead by the excitement and apparent validity of initial reports of very early sites, but find doubt and error upon further inquiry or with publication of more details.

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[1] The acronym "rcybp" will be used throughout this document to mean "radiocarbon years before present". The acronym "BP CAL" will be used to imply sidereal or absolute years before present as currently calibrated by tree ring and U-Th comparisons (Stuiver and Reimer, 1993). Estimated time ranges are usually presented as if considering rcybp. The relationship of the problem of when people came into the continent and the recent calibration of radiocarbon dates will be discussed in Chapter 3.

For instance, Kunz and Reanier initially reported the discovery of projectile points of possible fluted point ancestry with associated, early radiocarbon dates in Alaska in the popular media, but retreated from this position when the context of the points and the dates were clarified and the stylistic relationship of the points with concave based fluted point cultural materials, as opposed to convex based Stemmed Point materials, became less clear (Kunz and Reanier, 1994).

Regardless of these kinds of possibilities and false leads, replicated evidence, including repeated stratigraphic occurrences, contemporaneous radiocarbon dates and stylistic similarity of chipped stone industries, represent reliable or unequivocal scientific evidence for accurate cultural historical contexts. Meadowcroft Rock Shelter, in Pennsylvania and Pedra Fruada in Brazil remain as lingering examples of very early sites in which some believe and some don't. These sites lack the benefit of other, similar sites or recurring radiocarbon data (Meltzer et al., 1994).

In this light, fluted points and their associated artifact assemblages are the most stratigraphically secure, well dated and abundant chipped stone assemblages in the New World. Furthermore, current developments in ^{14}C dating technology, combined with statistical averaging of multiple dates from identical stratigraphic contexts, allows their temporal resolution to as little as +/- 50 years in some cases (Haynes, 1992; 1993; Long and Rippeteau, 1974). Chapter Three will present this chronology and show that while it begins around 11,500 rcybp, a major pulse of colonization took place between 11,100 and 10,800.

Remember, however, that explaining the substantial diversity of languages, physical characteristics and ethnographic cultures in the New World requires either proposing more migrating populations than past archaeological evidence or doctrine allows, or stretching the time frame. The common tactic is to stretch time. Some of these kinds of "possibilist" age estimates are shown in Table 2.01.

Table 2.01 A sampling of timing estimates by various researchers

References	Estimate (bp)
Spinden, 1917	10,000 - 15,000
Hrdlicka, 1925	10,000 - 15,000
Turner, 1986	14,000
Cavalli-Sforza and Bodmer, 1971	15,000
Williams et al, 1985	16,000 - 40,000
Cassells, 1983	18,000 - 20,000
Harper, 1980	19,000
Wallace et al, 1985	20,000 - 40,000
Willey and Sabloff, 1974	20,000
Griffin, 1976	30,000 - 40,000
Nei and Roychoudhury, 1982	30,000 - 40,000
Schanfield, 1992 (Two initial migrations, then Na-Dene and Eskimo)	1st migration = 17-25,000 2nd migration = 10-13,000
Neel and Ward, 1970 (based on genetic calibration)	130,000

Archaeologists have contributed to these "modeling possibilities" by proposing the existence of pre-Clovis, pre-projectile point or even early bone tool technologies with little unequivocal archaeological data in support (Bonnichsen, et al., 1987; Irving et al., 1986; Kreiger, 1964). These proposals have some of their justification in the attempt to explain later diversity.

Explaining the Diversity

The determination of who the people in the New World most resembled became doctrine as early as 1590 when Acosta deduced that the indigenous people of the New World most looked like people from Asia and he proposed that they must have come into the continent via a connecting land mass, known today as Beringia (Hopkins, 1982; Huddleston, 1967). This doctrine has been carried through the 19th and 20th centuries as a "received view" or as "derived wisdom" (Haven, 1856; Howells, 1945:259; Willey and Sabloff, 1974:40).

Today, the reconstruction of any colonization patterns or processes requires an ability to identify groups of people moving across space (the pattern) and through time (the process). As it has developed within anthropology, research addressing group identities (i.e. "ethnicity" or "affinity") compares biological, linguistic and archaeological data, in search of congruity (Ammerman and Cavalli-Sforza, 1979; Bateman et al., 1990; Bellwood, 1987; Cavalli-Sforza et al., 1988; Croes, 1989; Faught, 1990a; Gibbons, 1990; Greenberg et al., 1986; Renfrew, 1987; Rouse, 1986; Shaul and Andreson, 1989; Zegura, 1975).

These studies assume that past social cohesion leaves patterns of linguistic, biological, and material culture attributes. In Analytical Archaeology, Clarke (1978:358-398) includes a particularly useful and clear exposition of this viewpoint, along with examples. The postulation of past groups based on information from only one sub-discipline can be -- and often is -- ambiguous, particularly with increasing depth or distance in time. Therefore, and as I envision it, affinity (ethnic, identity) research exploits data from more than one discipline and has the potential to reconstruct sophisticated culture histories of value to processual and post-processual archaeologists alike. Dumond's (1987) tracking of the Eskimo-Aleut biological, linguistic and ethnoarchaeological record from the middle Holocene to the time of contact is an excellent example of this kind of compilation.

On a larger scale, and alluded to in the previous paragraphs, the most well integrated model of New World colonization envisions three pulses of migration into the Western Hemisphere by way of Beringia (Greenberg, et al., 1986). This model is based on linguistic and biological characteristics observed between and among Eskimo-Aleuts, Na-Dene, and all other Amerinds. Early propositions of this model can be traced back to Hrdlicka (1925:493); Greenberg (1960); and Willey and Sabloff (1974:172). However, Greenberg et al. (1986) represents the most recent and advanced demonstration of this model by combining data from several sub-disciplines, and including at least some appeals to archaeological congruity.

Their narrative proposes that the first pulse of Asians (Paleoindians) came into the continent approximately 12,000 years ago, and proceeded to populate North, Central and South America. Fluted point chipped stone assemblages are interpreted as the archaeological markers of these people. They propose that there was a biological connection between the people who made fluted points and Northeastern Asians primarily on the basis of Turner's previous interpretations of his late Holocene dominated dental data (Turner, 1983).

The second proposed pulse of migrating Asians are biologically and linguistically represented by Na-Dene speakers, in particular the Athapaskans. This migration pulse is marked archaeologically by a distinctive lithic technology known as Microblade, Diuktai, or Denali by Greenberg et al. (1986); Turner (1986) and others (Bonnichsen et al., 1987; Powers and Hamilton, 1978). According to the tripartite model, these people came in possibly by 10,500 rcybp. Most of the Na-Dene have remained in Northwestern North America - with the exception of some groups who migrated southward after A.D. 1000. This pulse gave rise to various groups of Athapaskan characteristics in the Plains ares, and the Apache and Navajo people known in the Southwest today (Wilcox, 1988; Suarez et al., 1985). These propositions are, perhaps, the longest clear trace of biological, linguistic and archaeological associations in the New World (Bryan, 1980; Carlson, 1983; Turner, 1986).

The third, and final, pulse of migration across Beringia was that of the Eskimo-Aleuts around 6,000 rcybp. Most of these people settled in the Circumpolar region of North America, and several internal pulses of migration are documented. Archaeological, linguistic and biological evidence for Thule movements across Canada to Greenland is a good example (Dumond, 1987; Rouse, 1986). The Eskimo-Aleut are, by the way, the only people in the New World with known linguistic / biologic / cultural relatives in Northeastern Asia (Fitzhugh and Crowell, 1988; Mourant et al., 1976). However, the Eskimo-Aleut and the Na-Dene are more similar to each other, than either is to the rest of Amerindians, suggesting their ultimate ancestors could be located on either side of the straits, or both (Szathmary and Ossenberg, 1978; Ossenberg, 1994).

This elegant model represents a substantial accumulation of linguistic and biological data integrated into a unified model of the sources of pre-Columbian peoples, a significant scientific contribution to the development of the principles of affinity research and a structure for further testing and inquiry. However, it has several flaws. In particular, it is weak in controlling and ordering temporal, linguistic and (material) cultural contexts of the biological samples, leaving the sources of variability (i.e. homology, analogy or reticulation) in question. Turner is particularly guilty of this problem.

The specific biological affinities of Paleoindian skeletal remains are unclear. Details of this domain of research are given in Appendix A, but the salient aspect at issue for this discussion regard the biological affinities of Paleoindian skeletal remains. Recent publications connect similarities between chipped stone technologies of New World fluted point and Old World Kostenki mammoth hunter artifacts. These proposals unwittingly connect the European chipped stone assemblages with human skeletal remains of apparent Caucasian ancestry in the Upper Paleolithic of Central and Western Europe (Bonnichsen, 1991:319; Haynes, 1987; Soffer and Praslov, 1993; Turner, 1986). This is in contradiction to the understanding that all New World people are essentially of Asiatic biological origins. Turner (1983:156) rejected the idea that these Central European mammoth hunters were involved in the Peopling of the New World precisely on the basis of the extreme dental differences between those European mammoth hunter people and his related Sinodont and Macro-Indian samples. More confusion is wrought by recent analyses by Steele and Powell (1992) which propose that there are more similarities between Southeast Asian (Sundadont) Upper Paleolithic skeletal remains and North American Paleoindian crania, rather than between Northeast Asians, as already mentioned.

From an archaeological perspective, the attempt to correlate the biological and linguistic variation of most North, Central and South Americans to a single Paleoindian population represented by a singular Clovis Paleoindian material culture is unsuccessful because the differences either between early archaeological assemblages, such as convex based western stemmed points and concave based fluted points are not considered. The possibilities of cranial or dental variation within or among the full range of early New World skeletal samples have not been addressed with modern research across the full sample set. The assumption and conclusion of singular Clovis Paleoindian skeletal characteristics represent circular arguments.

Furthermore, there has been no attempt to describe the structure of cultural developments from the Pleistocene through the middle Holocene Archaic, across the late Holocene Formative and Classic aged cultures to the linguistic, biological and material cultural patterns of the societies observed by the first Europeans (Faught, 1990a; Willey and Phillips, 1958). Aspects of tracking the development of cultures in North America are discussed more fully in Appendix A. Sorting out and tracking the variability of Paleoindian and Early Archaic chipped stone assemblages will be discussed in Chapter Three.

Historical linguists and biological anthropologists can refer to much more dialogue regarding the principles of affinity and its determination, than can archaeologists (Greenberg et al., 1986; Hennig, 1986; Hoenigswald and Wiener, 1987; Mayr, 1986; Sokal and Sneath, 1963). From these principles it is clear that flaws in the tripartite hypothesis combine to handicap distinguishing between homology (ancestry), reticulation (hybridizing or borrowing) and mutation (invention) (Campbell, 1988; Faught, 1990a; cf Appendix A). This fact isn't so much a mistake, as it is the result of developments -- or the lack of developments -- within anthropology itself.

I suggest that the construction, deconstruction and refinement of cultural identities and their material cultural, biological and linguistic correlates -- those aspects of anthropology pertinent to the study of group identity (ethnicity, or affinity) -- have been somewhat dormant during the past few decades. Archaeological reconstruction of adaptation to changing environments is more practiced than reconstruction of population identity (ethnicity, affinity). The result is a lag in the development of disciplined principles for taxonomy and procedures for assessing similarities, or lack thereof, between linguistic, biological and archaeological data (cf. Soffer and Praslov, 1993:7)[2].

This weakness results in the fact that we can't locate and identify Clovis ancestors and progeny if our concepts of prehistoric people are simply faceless actors on different functional stages (Bonnichsen, 1991:324). Instead "identity-laden" human histories have better chances of revealing the complexity of past social groups, thereby reflecting the process of change in a fuller anthropological sense. This comment extends to the term "Paleoindian" itself. Paleoindian is used as a chronological distinction, a

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[2] Perhaps the most useful archaeological publications for this purpose are those which struggle with the meanings of artifact style (Conkey, 1990; Conkey and Hastorf, 1990; Dunnell, 1986; Meggars and Evans, 1965; Read, 1982; Sackett, 1990; Shennan, 1989). Holistic research (archaeology, biology and langurage synthesis) is useful for the determination or demonstration of migrations (for instance, Anthony, 1990; Renfrew, 1987; Rouse, 1986; Shennan, 1989; cf. Meltzer, 1989 and for an early exposition of taxonomic discussion see McKern, 1939).

reference to subsistence base, or to an ethnic affiliate. Unclarified, this mixing of metaphors confuses issues.

The methods and principles needed to estimate identity (ethnicity, affinity) include extensive trait lists, classification of sites over both space and time, and determination of degrees of similarity over various attributes, and across time. These studies can be principled with analog modeling, constructed with attention to context and association, ordered by the most precise dating possible (stratigraphic or radiometric), disciplined by the use of statistical clustering algorithms, and manipulated and displayed by GIS and CAD computer graphic techniques (Clarke, 1978:358-398).

There are specific issues in Paleoindian research which depend on the resolution of these kinds of issues. For instance, were the technological and morphological attributes of fluted point lithic assemblages assimilated by diffusion (reticulation) by groups of people who were already in place on the landscape (Bryan, 1988:56; Young and Bonnichsen, 1984; Bonnichsen, 1991)? Were these attributes simply technological solutions developed independently (analogy) by different groups already on the landscape ? Another possibility is that these implements represent the accoutrements of a large social group connected by linguistic and biological sharing and whose remains reflect distinct migratory pulses and processes (i.e. homology) (e.g. Storck, 1988; 1991). It is my position that the latter is the most reasonable hypothesis, that fluted points and fluted point sites represent culturally, linguistically and perhaps biologically related sets of social groups. This remains untested.

Another issue which demands that identity (ethnicity, affinity) be assessed with archaeological data is the presence of convex based stemmed point chipped stone assemblages, already alluded to, and that appear to be roughly contemporaneous with the concave based fluted point chipped stone assemblages. These convex based point assemblages not only have different stylistic morphologies, but also possibly distinct lithic reduction strategies and bounded spatial distributions, as well. Specifically, various traditions are known throughout the western hemisphere which can be lumped into a generic convex based stemmed point tradition. Specific examples of these include the Nenana complex in Alaska, the Western Pluvial Lakes Tradition in the Great Basin, and several traditions represented in Central and South America, such as Lerma, El Jobo and Ayamptin (Bryan, 1980; Carlson, 1983; Dillehay et al., 1992; Powers and Hoffecker, 1989; Rouse, 1976; Stanford, 1991; Warren and Phagan, 1988; Willey, 1966; 1971).

This variability might exist because these are the remains of either ancestors of fluted point makers, or their progeny, who changed the form of their implements in response to different environmental variables. It also might exist because these assemblages represent wholly different social groups? If they were separate groups of people, what was their ultimate relation to the people who made fluted points and how did their biological and linguistic attributes add to New World variability in general? Is there variation in early skeletal biology congruent with the differences seen in early lithic assemblages - namely fluted and stemmed point? Are any Amerindian language stocks, sensu Greenberg (1987), specifically traceable to fluted point makers? To stemmed point makers? Some of these questions are treated again in Chapter Three and others in Appendix A. In general, however, these remain questions needing additional research and resolution.

A final comment on this issue regards the principle that cultural, biological and linguistic diversity is the sole result of branching evolution from distinct groups of linguistically and biologically related people (Dumond, 1987; Greenberg, et al., 1986; Turner, 1983; Willey, 1966). Modern human diversity worldwide is partly, if not substantially, the result of unions of groups of people with differing degrees of ancestry and the image is probably better expressed as an anastomosing stream bed (cf. Clarke, 1978). The same is surely true of the indigenous people of the New World. How did late Pleistocene and early Holocene archaeological traditions evolve over time into specific mid-Archaic and then later Formative cultures? Could mixing (reticulation), during Holocene time, result in the kinds of variation observed at contact given the three proposed migrants (Paleoindian, Na-Dene, Eskimo-Aleut)? How many initial groups are necessary to add to the milieu to exhibit this kind of development? These remain open questions.

The Na-Dene and Eskimo-Aleut are the only accepted Holocene migrants into the New World, after Paleoindians and with the exception of the Viking forays to the far northeast around A.D. 1000. Some researchers have presented evidence for Holocene age migrations which could have added to the "stew" of the New World variability, for instance: Celtic (Fell, 1976), Jomon (Meggars et al., 1965), Chinese (Shao, 1983), and Polynesian (Heyerdahl, 1950). However, none of these proposals have had the benefits of linguistic or biological testing and they are never appealed to for explaining New World biological and linguistic diversity. This may be particularly unfortunate in the case of Meggars et al., (1965) hypothesis of migration from Southern Japan into the continent in the middle Holocene. Recent developments in mtDNA research (Torroni et al., 1994) may prove to be in agreement with this hypothesis. The evidence by Meggars et al. was well supported, and the chronology is middle Holocene of time frame, well within the time considered appropriate for lexical inquiry. There should be biological correlates to test for as well.

From yet one more perspective, it is ironic that the very concept of migration has been in disfavor within the discipline of archaeology for some time now, due in part to a backlash from its unbridled use as an explanation of diversity and similarity between and among various archaeological cultures in the 1950s and early 1960s (Adams et al., 1978; Anthony, 1990; 1994; Soffer and Praslov, 1993:12, although cf. Willey et al., 1956). The fact is that the reconstruction of migration processes and patterns requires the ability to identify groups of people moving across space (the pattern) and through time (the process), links this issue directly with the exposition of identity (ethnicity, affinity) (Adams et al., 1978; Anthony, 1990; Greenberg et al., 1986; Meggars et al., 1965; Renfrew, 1987; Rouse, 1986; Willey et al., 1956).

Distinguishing between data which reflect ancestral relationships, or adaptations to social and natural environments, or interactions between groups pushed together by population growth and environmental fluctuations throughout the Holocene is a task which remains to be formalized in American archaeology (although see Tuck, 1975; Carlson, 1983; Faught, 1990a; Mason, 1981; and Moratto, 1984; Rouse, 1986; and Willey, 1958; cf Appendix A).

Exposing the Colonization Patterns

The image of people walking across a land bridge from Northeast Asia was codified by Acosta by 1590 when he deduced that they (and various animal species shared on both continents) must have migrated via a connecting land mass, now known as Beringia (Hopkins, 1982; Huddleston, 1967). It is a logical and parsimonious explanation of how people could come into the continent, substantiated, by the lack of any other connecting terrestrial route to the Western Hemisphere. In the past, a land based route was considered necessary because the technological expertise for water travel was not considered possible for Upper Paleolithic staged hunter-gatherers. Recent publications question this doctrine and present examples of circumstantial evidence for pre-12,000 year old ocean crossings between isolated islands in Southeast Asia and Melanesia (Dixon, 1993; Bellwood, 1994; cf. Greenman, 1963).

Regardless, there are two generally accepted routes that pre-Contact humans could have taken from Beringia into the New World: overland through the ice free corridor or down the Northwestern coastal margins (Haynes, 1964; Fladmark, 1979; 1983). W.A. Johnston first published the geological facts of the ice free corridor in 1933, after the specifics of the Laurentide and Cordilleran glacial margins had become known. However, C. Vance Haynes publications in the 1960s brought this fact to the attention of the archaeological community (Haynes, 1964; 1967). This route brings people initially up the Mackenzie river, across and along the eastern and western flanks of the Rocky Mountains, and then down various river systems into the rest of the continent, particularly the High Plains (Burns, 1990; Catto and Mandryk, 1990, cf. Chapter 4).

Initially, the process and pattern of migration was envisioned as continuous waves of people spilling or trickling over the Bering Straits, and pressing earlier migrants into marginal regions. However, these ideas have not been substantiated by archaeology <u>or</u> by analogy with other known migrations (Acosta, 1590; Anthony, 1990; Hrdlicka, 1925; Meltzer, 1989; Neumann, 1952; Swadesh, 1964). Today, the process by which the New World was peopled is commonly represented as distinct pulses of migrating groups, spreading out through out the hemisphere by a gradual "wave of advance" or

WOA settlement pattern (Anderson, 1990; 1991; 1992; Anthony, 1990; Haynes, 1987; Fladmark, 1979; Frison, 1990; Mosimann and Martin, 1975).

This density dependent process envisions pioneers on a favorable frontier having high birth rates which result in incremental movements toward less settled locations (Ammerman and Cavalli-Sforza, 1979; 1984; Anthony, 1990; Haynes, 1966; Kelly and Todd, 1988; Martin, 1973; Mosimann and Martin, 1975; Fladmark, 1979). The WOA implies a diffuse -- sometimes even concentric -- pattern of expansion across the landscape and an incremental growth of population through time (e.g. Martin, 1973:179; 1982). In fact, different rates of advance have been proposed for various idealized conditions in order to estimate the amount of time necessary to populate the continent, and examples of these estimates are presented in Table 2.02.

As will be more fully documented in Chapter Three, unequivocally early archaeological sites are known from Alaska, down to the southern tip of South America over a period from 12,000 to 10,800 rcybp, with sites rare or equivocal before 11,200 or 11,100 rcybp, and they accumulate robustly afterward. Thus the major pulse of colonization took place over a period as little as 300 or 400 radiocarbon years. Furthermore, the pattern is disjunct, because the three earliest unequivocally dated sites are arrayed in the exact opposite direction (Monte Verde in southern South America, Aubrey in Texas and Walker Road in Alaska, in that order).

This apparent increase of archaeological sites in North and South America at the very end of the Pleistocene creates an image of rapid population growth at a time when that growth should - by analogy to known reproduction rates of hunter-gatherer societies - be slow and incremental. Explaining this rapid radiation with a WOA migration pattern would result in a rate of 37 km per year, more than twice as fast as the most rapid rate proposed or known by analogy (Jaffe, 1992; Mosimann and Martin, 1975). Whitley and Dorn (1993) used these rates to cast doubt on a short archaeological chronology, I would favor using them to cast doubt on the WOA process itself.

Table 2.02 Some proposed migration rates

adapted from Whitley and Dorn, 1993			
Reference	Growth Rate	Migration Rate	Time Involved
Ammerman and Cavalli-Sforza, 1979	not given	1 km per yr	14,600 yrs
Hassan, 1981	0.1 % per yr	> 1 km per yr	< 14,600 yrs
Haynes, 1966	0.7 - 1.3% per yr	6.4 km per yr (4 mi)	2,281 yrs
Mosimann and Martin, 1975	3.4% per yr	16 km per yr (10 mi)	913 yrs
400 year colonization estimate from Chapter Three[3]		37 km per yr (23 mi)	400 yrs

In a recent, and useful, rhetorical treatment of migration theory, Anthony (1990) has shown that to understand and identify migrations the archaeologist must determine both the cause and the character of the migratory event or process (ibid.:898; cf.

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[3] My rate is based on an estimated distance of 14,600 km from Alaska to Tierra Del Fuego (Source: 3218 km (2000 mi) from Alaska to Texas in Haynes (1966), 5945 km (3694 mi) from El Paso to the Columbia/Panama border in Whitley and Dorn (1993), and I estimate a distance of 7700 km from the Columbia/Panama border to Tierra del Fuego. Szathmary (1994) estimated a total of 13,000 km from Alaska to tip South America.

Rogers et al., 1992:294-5). He presents examples of two kinds of migration patterns, Short and Long Distance, and the differences of subsistence \ economic strategies commonly associated with them. He states that short migratory moves result in scattered, WOA patterns and that "push and pull" factors for short migrations are density dependent movements that are more likely to occur within groups exhibiting diffuse subsistence / economic strategies (sensu Cleland, 1976; or Binford, 1980). This concept is paralleled in Beaton's (1991:215) term "estate settler". Long Distance migrations, on the other hand, are more often associated with more focused subsistence / economic strategies (sensu Cleland, 1976 or Binford, 1980) and they are not, necessarily, density dependent moves. Beaton's parallels this concept with his "transient explorers" (Beaton, 1991:215). Anthony says that migrations of focally adapted populations are often long-distance, highly directed processes based in the exhaustion of resources in, or near, the homeland (push) or richness in the target area (pull) (Anthony, 1990:902).

Thus, colonization of the continent by the makers of fluted points, who are often considered to be seekers out of fine cherts and, perhaps, specialized hunters, are more likely to exhibit Long Distance migration patterns resulting in clustered, but possibly well spaced patches of settlement (see Meltzer, 1984; 1988; Smith and Meltzer, 1986 regarding the notion of specialized hunting on the part of fluted point Paleoindians). Some site distribution phenomena predicted by long distance migrations, which "fit" the patterns of fluted point distributions, include: leapfrogging, migration streams, and islands of settlement in desirable or attractive locations. These islands can be separated by significant expanses of unsettled, less desirable territory (Anthony, 1990:903; 1994; Anderson, 1990; 1992; Kelly and Todd, 1988).

However, a disturbing fact remains behind of all of this modeling. Namely, there is a lack of evidence in Siberia or Beringia confirming the presence of people using fluted points, or even items apparently ancestral to fluted point lithic technology (Bonnichsen, 1991; Bonnichsen et al., 1987; Clark, 1984; 1991; Haynes 1987b; Goebel et al., 1991; Klein, 1971; Lynch, 1990; Meltzer, 1989). Furthermore, there is no unequivocal and sequential pattern of fluted point archaeological sites earlier in the north and later in the south. Chapter Three will illustrate that fluted points, fluted point sites and possibly fluted point related progeny sites are clustered and frequent in the eastern and southeastern portions of the North American continent, giving rise to the alternative interpretation that the New World homeland for those groups is nearby (Mason, 1962; Stanford, 1991; Williams and Stoltman, 1965).

The problem revolves back to the point that the fluted point chipped stone industry appears as a mature and familiar bifacial lithic industry at first glance (i.e. at sites like Blackwater Draw, Aubrey, and Domebo; cf. Chapter Three). The late Pleistocene aged sites that are known Beringia have more apparent similarities with convex based stemmed point styles and related chipped stone assemblages and reduction technologies or with Diuktai (Microblade) sites assemblages (Chard, 1974; Dikov, 1988; although cf. Haynes, 1982:396 regarding Berelekh, a Kostenki related, late Pleistocene archaeological site in Northeast Siberia). Confusion is simply amplified by these facts.

Discussion

In this chapter I have attempted to present a revisionist assessment of the problem of the peopling of the New World. This assessment shows that there is increasing confidence regarding the timing of people's entry into the New World and decreasing confidence regarding linguistic, biological and material cultural affinities of the people, their routes into the continent, and the processes by which this took place. Images of the walking Asians were set long ago, with different world views and much restricted data bases. Proposals based on logic, parsimony and possibility have not been substantiated by discoveries of specific fluted point archaeological sources, nor the actual routes taken by the makers of fluted points.

Therefore, what *is* the pattern of fluted point archaeological data, in time and space by which we might review and possibly resolve this dilemma? Might some clarity be obtained by mapping the distribution of these items and sites as they have been published in the discipline? Has enough chronological data accumulated to infer the trajectory and pattern of colonization by people making fluted points? Have enough sites been documented to determine stylistic and other kinds of social boundaries? Can tracing the patterns of progeny related sites through time be helpful in resolving the location(s) of initial (or substantial) occupation(s)? Can our current knowledge of Paleoindian settlement patterns offer insights into new areas potential for future research? Specifically, can they help to determine where to search for sites which might be inundated by Holocene sea level rise on the continental shelves?

Chapter Three illustrates that fluted point distributions exhibit a robust pattern of settlement in the southern and eastern portions of North America, and that chronological control of the trajectory of this distribution does not fit the models of entry from Beringia. It points out that there are artifact traditions in the New World at the end of the Pleistocene that do appear to come from Beringia, but that they are not apparently related to fluted point traditions. It concludes that early Paleoindian archaeological sites must be inundated on the continental shelves of the Atlantic Seaboard and the Gulf of Mexico, and that some of these sites might exhibit the earliest of fluted point sites.

Chapter Three

PALEOINDIAN ARCHAEOLOGY

The Fluted Point Tradition

Fluted points are distinctive artifacts which define the most widespread and abundantly dated Paleoindian tradition in the New World (Haynes, 1967; 1982; 1987a; 1992; Meltzer, 1984; 1988; Mason, 1962; Sellards, 1952; Stanford, 1991; West, 1983; Wormington, 1964). The initial discovery of fluted points in secure stratigraphic contexts with extinct fauna at Folsom, New Mexico in 1926 not only confirmed the presence of people in North America during the last Ice Age, but also presaged the abundance of these fluted bifaces on a continental scale (Meltzer, 1983). The resolution of the stratigraphic positions of Clovis, Folsom, and subsequent artifact types at the Blackwater Draw in New Mexico and Hell Gap in Wyoming serve as the foundations for the construction of the "Clovis Culture" as it is now known (Haynes, 1970; 1980; Irwin-Williams et al., 1973; Sellards, 1952; Stanford, 1991).

Based on the logic that their precursors should be found in the Beringian region, specific archaeological research has been expended to discover the earliest examples of these artifacts in Siberia, Alaska, and at the southern end of the corridor by Nels Nelson (1937); Froehlich Rainey (1940); R.S. MacNeish (cf 1964); John F. Hoffecker (1988); George Frison (1991) and others (e.g. Irwin-Williams et al., 1973), but to no avail so far.

While there are other recurrent items of the fluted point material cultural assemblage, which will be discussed below, the projectile points are the most distinctive aspects of it. Reduced from very large flakes of high quality (very fine grained) silicified (chert) lithic materials, through a sequence of bifacial reduction procedures, they were most often made with attention to regular morphology, symmetry and fine workmanship (Frison, 1990:102; Goodyear, 1989; Haynes, 1982).

These concave-based, bifacially flaked points had their bases thinned by the peculiar removal of either one or more channel flakes from the base of each face. These flutes were produced by the removal of long, longitudinal flakes struck from specially prepared platforms at the base of the biface by percussion and possibly later by component part leverage techniques (Frison and Bradley, 1980). Almost invariably the basal edges of these points are ground. These implements are usually considered as projectile points used for thrusting, but some have suggested their function as knives (Bradley, 1993; Goodyear et al., 1983; West, 1983; Haynes; 1980; 1982; 1990; Meltzer, 1988). Fluted points fabricated from obsidian sources are known from Alaska, western North America, and South America.

A comprehensive classification of fluted points, incorporating all the regions of North America that pertain, has not been published. Publications focused on regional variability do exist, and they reveal several variations on the fluted theme. In the East and in the Plains these variations are demonstrated or hypothesized as time sequential, in the West the variants are unnamed and their chronological position is unclear (Clark, 1984; Fitting, 1965; Gardner and Verrey, 1979; Goodyear et al., 1990; Meltzer, 1984; Sellards, 1952; Stothers and Abel, 1991; Willig and Aikens, 1988; cf. Tompkins, 1994). Examples of concave based fluted point, or concaved based, unfluted but supposedly progeny related lanceolate varieties include the Classic Clovis, Folsom, Goshen-Plainview; Gainey, Parkhill, Barnes; Redfield, Cumberland, Dalton, Suwannee/Quad, Simpson. The areal distributions of these, and other varieties are presented below.

Classic Clovis fluted bifaces remain the earliest diagnostics known of the cultural assemblage both by stratigraphic and radiocarbon dating, as will be discussed further in the section on chronology below. They usually exhibit straight to incurvate (waisted) sides, moderate (i.e. sinusoidal) concavities at the base, singular flutes which do not extend the full face of the point, and, often and perhaps diagnostically, robust percussion flaking scars with regular blow sequence patterns. They often exhibit fine percussion flaking around the margins, but do not exhibit pressure flaking (Bradley, 1993:252-54; Goodyear et al., 1990; Haury et al., 1959; Hester, 1972; Howard, 1990; Justice, 1987; Sellards, 1952).

Sites that exhibit, perhaps define, Classic Clovis points include: Blackwater Draw, Lehner Ranch and Murray Springs (San Pedro sites), Dent, and Domebo (Table B.02). However, the points found in the San Pedro sites array exhibit several variations on the Classic Clovis theme, even within one mammoth, as at Murray Springs. This shows that any attempt to split or lump kinds is subject to equivocality. They are also known, but remain undated, from localities in the Southeast, such as Wells Creek Crater (Dragoo, 1973) or the Adams Site (Sanders, 1990) and in the East at such sites as Thunderbird (Gardner, 1974) or Shawnee-Minisink (McNett, 1985). In the Northwest and Great Basin good examples include Borax Lake (Meighan and Haynes, 1968) and Richie-Roberts (Wenatchee) (Mehringer, 1989; 1990).

Classic Clovis points are apparently low in frequency in the High Plains (Frison, 1991:146), but fluted and other lanceolate projectile points, unfluted, with silhouette similar to Clovis include frequent Folsom, Goshen-Plainview points and a less frequent variety known as Colby (Frison, 1983). The chronological relationships between these varieties is in some question, but convention has it that Folsoms follow Classic Clovis, and Goshen is possibly contemporaneous or subsequent to Folsoms (Frison, 1991; Haynes, nd).

In the Great Lakes, a time sequential series has been defined which includes Gainey, Parkhill, Barnes and Crowfield varieties, respectively (Storck, 1991). The Gainey resembles the deep concave and recurved basal ears of the Debert, Vail, and Bull Brook varieties, but radiocarbon control for the series is unclear (Deller and Ellis, 1988). Storck (1991:154) has likened Barnes and Cumberland varieties to Folsoms on the basis of style and technological attributes of flute removal. The Barnes and

Crowfield varieties, the latest in the series, have bulging, excurvate sides with flat to concave bases and multiple basal flakes or flutes.

In Alaska fluted points are almost exclusively made of obsidian, and they exhibit multiple fluting (basal thinning) flakes (Clark, 1991). These points are generally smaller than Classic Clovis points. Fluted points known from the ice free corridor including some possible Classic Clovis representatives. However, more common finds include Folsom and a stubby, concave based and multiply fluted (basally thinned) variety Kehoe calls "atypical", but others have called "triangular" (Kehoe, 1966; Fladmark et al., 1988). These stubby, excurvate sided varieties resemble points found at another corridor site, Sibbald Creek (Fladmark et al., 1988), as well as being similar to some examples in the Northwest and Great Basin, from such sites as Fort Rock Cave (Carlson, 1983:79, his Figure 6.03), Dietz (Willig, 1989) and Danger Cave (Homer, 1986:94-95). Haynes has also commented on this similarity of fluted point morphology as existing from Alaska to the Great Basin (Haynes, 1982:396; cf. Goebel et al., 1991:74).

Willig (1991:105) has observed that all 6 of the large concentrations of fluted points known from the Northwest and Great Basin are located around the lowest strandlines of dried Pluvial lake beds (i.e. China Lake, Tulare Lake, Alkali Lake (Dietz Site), Borax and Clear Lakes, Tonopah and Mud Lakes, and the Sunshine Locality (see Figures 3.05 and 3.08). Classic Clovis points are known from this region, but it is my impression that the majority of fluted points in the West are not of this variety. Fluted points in the Northwest and Great Basin tend to have a sharp angled basal concavities and they are sometimes smaller or more narrow than Classic Clovis points. There is less regularity of shape, the edges and silhouette of these bifaces are often irregular. There is less attention to detail. Many of these examples are heavily reworked, either by the people who made them or by later prehistoric peoples. They are made from both chert and obsidian. Some points known from Sonora Mexico fall in this category, although apparent examples of Classic Clovis points are also present down there (Ortiz, 1974; Ortiz and Taylor, 1972).

The Southeastern and Central United States exhibit Classic Clovis varieties and more distinct varieties of other fluted and unfluted lanceolate bifaces than any other region. Dalton points, which are occasionally fluted, are clear relatives of Clovis fluted points and probably the most familiar fluted point variant besides Folsoms (Goodyear, 1982:383). Other varieties exist however, like Ross, Cumberland and Redstone, the flutes of which extend along the entire face, not unlike techniques familiar with Folsom points. These kinds of points often represent examples of accomplished, even artistic, flint knapping skills.

Other varieties of Paleoindian points in the Far Southeast (Alabama, Florida, Georgia, South Carolina), with morphology (silhouettes) similar to Classic Clovis fluted points, include unfluted varieties like Suwanne/Quad and Simpson (Dunbar, 1991; Goodyear et al., 1990). Suwannee/Quad varieties often exhibit concave sided morphologies, known as waisted, and both occasionally exhibit fluting of the base. Simpson points are extremely waisted and occasionally fluted. These could also be classified as Classic Clovis points. Examples of other waisted Classic Clovis examples are known from the Lange-Ferguson Site, South Dakota (Hannus, 1990), Lehner Ranch and Murray Springs, Arizona (Haury et al., 1959), and McFadden Beach Texas (Long, 1977; cf. Goodyear et al., 1990:16). All three sites have radiocarbon control that puts them at the beginning of the main pulse of fluted point colonization, as will be discussed below.

Classic Clovis points are reported from Central America, but other concave sided, concave based vanities known as "fish tailed" points, are more frequent (Ardilla Calderon, 1991; Ranere and Cooke, 1991). Fluted points with concave bases, and both concave and excurvate sides are found in Columbia, Ecuador (Mayer-Oakes, 1984; 1986), and in the Southern and Southeastern margins of the South American Continent (Chile, Argentina, and Uruguay) (Politis, 1991). Often the blades of these concave based, basally thinned points are shouldered, and exhibit a narrow basal stem, a fact which allows for their being called stemmed or tanged points[1]. Some Suwannee/Quad

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[1] Clearly the use of the term "stemmed" is unfortunate given the allusion already made to convex based stemmed points, as a distinct tradition, discussed above and again below. Regardless, the bases of these shouldered South American varieties are concave based, basally thinned by the removal of single flake or multiple flakes, and often concave sided. If the base of one of these were found without the blade it would be indistinguishable from one broken from a fluted lanceolate biface. I will make every effort to clarify these distinctions where appropriate below.

points, from Florida and Texas, also resemble concave based points from Central and South America which are concave based, concave sided points. No Classic Clovis points are reported from South America to my knowledge (although cf. Ardilla Calderon, 1991:272, his Figure 6, El Cayude, Venezuela).

Distribution of Isolated Fluted Points

In 1962 Ronald Mason published an important paper regarding the varieties, frequency and distribution of fluted points in the eastern portions of North America. He pointed out the high frequency of these artifacts in the East and Southeast, and suggested their derivation in the Southeast. Since then, published reports of fluted point inventories at the state level have accumulated across the nation and two different compendiums exist for large portions of the eastern United States (AENA, 1982 and Anderson, 1990; 1991). Previous to this dissertation project, no compendium existed for states inventories published for areas west of the Mississippi. Given the amount of published information pertaining to these areas, it seemed feasible to construct a graphic image which would reflect our current understanding of the distribution of these distinctive bifacial implements[2]. These references are shown in Table 3.01.

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[2] David Anderson, of the United States Park Service, was instrumental in this task. Anderson not only contributed his data base for the eastern portions of the country, but his expertise, contacts and encouragement, as well. I compiled the remainder of the sample from published and unpublished documents gathered throughout the project by library research and contact with key contributors (Anderson, 1991; Faught et al., 1994).

Table 3.01 Primary references used to construct Figure 3.01

State	N	Primary Reference	Comments / Inclusion
Alabama	1654	Futato, 1982	
Alaska		Clark, 1984; 1991	Not on map
Alberta	78	Gryba, 1985; 1988	Not on map
Arizona	135	Huckell, 1982	Includes Clovis excavated, isolated, mixed contexts, Folsom, and "intermediate forms"
Arkansas	102	D.F. Morse: Pers. Comm. to DGA 6/30/89	
California	146	Davis and Shutler, 1969	
Colorado		No Data	
Connecticut	18	Moeller, 1982:41	
Delaware	55	Griffith, 1982:37	
Florida	537	Dunbar, 1989	
Georgia	126	Anderson et al., 1990	
Idaho	34	Titimus and Woods, 1988	Includes Folsom
Illinois	167	Winters, 1962:15; Koldehoff, 1983; Koldehoff, Pers Comm, 1989	
Indiana	583	Tankersley et al., 1990	
Iowa		No Data	
Kansas	38	Brown and Logan, 1987:191	Includes Folsom
Kentucky	261	Rolingson, 1964:23	
Louisiana	20	Rivet, pers. comm. to DGA: 6/29/89	
Maine	96	Sanger, 1982:43-44; Gramly 1982: 22	
Maryland	100	Tyler Bastion: Pers comm. to DGA 6/15/89	
Massachusetts	428	Grimes and Bradey, 1982:41	
Michigan	64	Lepper, 1984; 1986; Shott, 1986:160; Fitting, 1975:41; H.T. Wright pers comm to DGA 7/7/89	
Minnesota		No Data	
Mississippi	70	McGahey, 1987:2	
Missouri	300	Chapman, 1975:67	Includes Folsom
Montana	64	Leslie Davis, 1988; pers. comm. to MKF 1/5/94	Includes Folsom
Nebraska	75	Meyers, 1987:68	Includes Folsom

State	N	Primary Reference	Comments / Inclusion
Nevada	149	Willig and Aikens, 1988; Davis and Shutler, 1969	
New Hampshire	10	Sargent, 1982:43	
New Jersey	264	Kraft et al.. 1982:38	
New Mexico	240	Judge, 1973; Hester, 1972; Haynes, 1955	Includes Folsom
New York	297	Wellman, 1982:40	
North Carolina	444	Peck, 1988	
North Dakota		**No Data**	
Ohio	1056	Seeman and Prufer, 1982:165	
Oklahoma	189	Hofman and Wyckoff, 1991	
Oregon	54	Willig and Aikens, 1988:17	(Dietz site only)
Pennsylvania	256	Kent, 1982:39	
Rhode Island	4	Turnbaugh, 1982:42	
South Carolina	317	Charles, 1986:16	
South Dakota		**No Data**	
Tennessee	379	Broster, pers. comm. To DGA 6/1/89	
Texas	537	Meltzer, 1986; Largent et al., 1991	Includes Folsom
Utah	42	Copeland and Fike, 1988	
Vermont	32	Basa, 1982:42	
Virginia	805	McCary, 1984; 1988	
Washington	36	Avey, nd	Includes Richey-Roberts Clovis Cache
West Virginia	27	Dunnell, 1972	
Wisconsin	51	Stoltman and Workman, 1969	Includes Folsom
Wyoming		No Data	

Figure 3.01, shows the frequency of reported fluted points per 1000 mi^2 in the coterminous United States[3]. The sample includes a total of 10,198 fluted points, of

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[3] Individual data values were determined by dividing the area of the county (CA), by the number of fluted points tallied (F), and then multiply by 1000 (mi^2). e.g. CA/F*1000 = VALUE
The data set (x & y coordinates, # points per square 1000 miles) was then fed into SURFER, a griding

which 727 (seven percent) are inventoried Folsom points. Six states had no estimable sample data at the time of this writing (Colorado, Wyoming, Iowa, North Dakota, South Dakota, and Minnesota). The map was constructed by digitizing the outline of the United States and coordinates for the approximate centers of the 3075 counties in the 48 contiguous United States. I estimated the counts from published data from New Mexico and Oregon,, and both are surely underestimated

Because of regional differences in the definition of "Clovis" fluted points, the sampling procedure for this map evolved to include all "fluted" points. This allowed inclusion of all Western fluted points (both multiple fluted specimens as well as any true Clovis varieties). Folsom fluted points were inventoried from Arizona, Idaho, Kansas, Missouri, Montana, New Mexico, Oklahoma, Texas, and Utah.

Most of these fluted points were discovered as isolated surface finds, but some come from controlled surface collections or excavated contexts (cf. Meltzer, 1988). No distinction has been made for these different contexts in this version of the distribution map. For instance, all points from the San Pedro sites (excavated and isolated discoveries) are included in the sample, but some excavated context fluted points may be missing from the eastern samples. Given data to be presented below, the time span probably includes as much as 1200 ^{14}C years (i.e. approximately 11,200 rcybp for Clovis to about 10,000 rcybp for Folsom and other Eastern fluted points).

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and contouring program. The griding method used was "Inverse Distance", with a weight of 2.

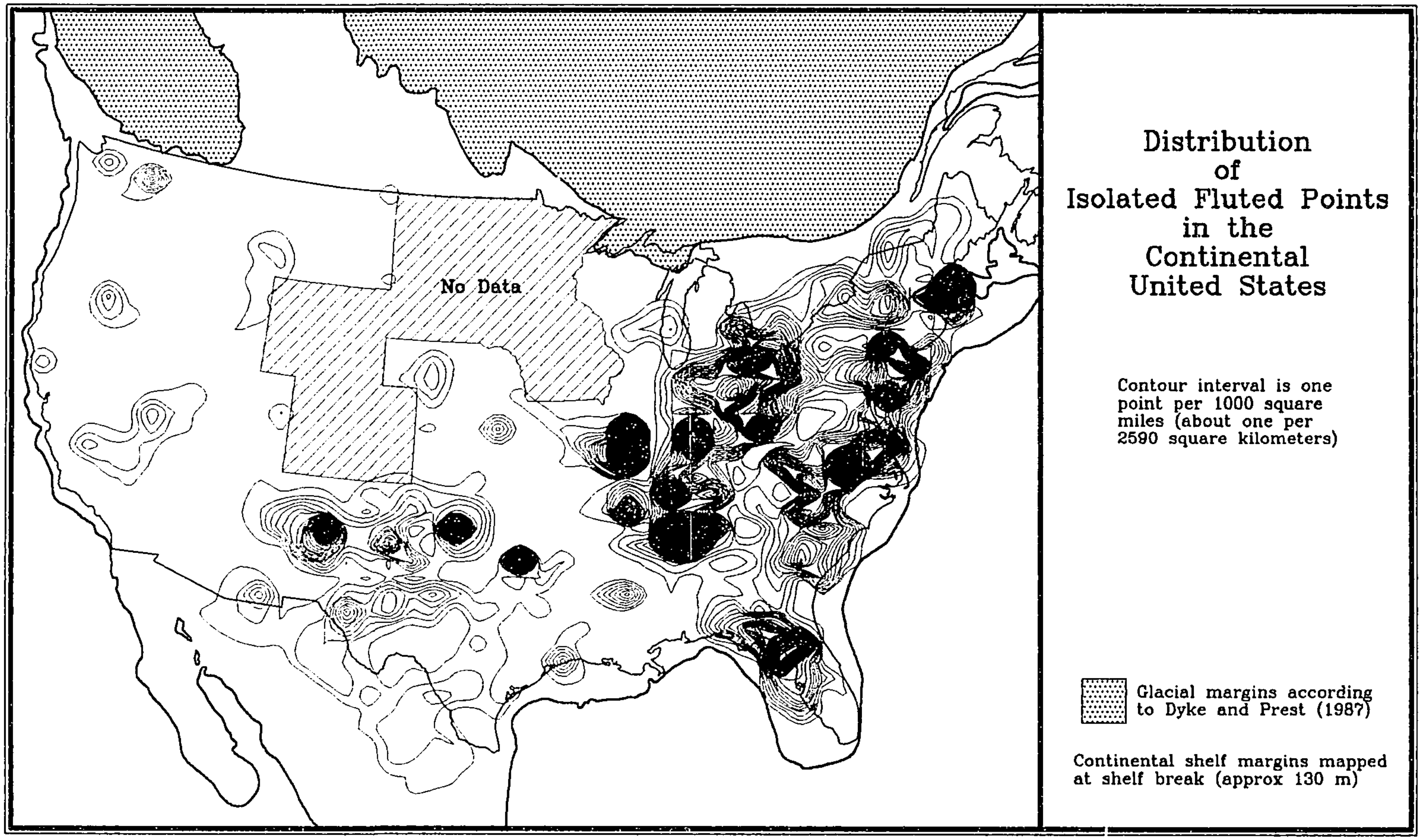


Figure 3.01 Distribution of isolated fluted points in the United States

I suggest that this map probably represents a statistical estimate of the "real" distribution of fluted points and possibly of past population densities of people who made them. However, alternative explanations for these densities can be offered including: differential geological visibility, modern population density and farming activities and differences in lithic resource availability. Circumstances and comments regarding each of these alternatives are presented in Table 3.02 below.

Given this broad view, it is immediately apparent that there are significantly more fluted points east of the Mississippi River than west of it. The highest density area for fluted points is in northern Alabama, with eastern Massachusetts following closely. Other particularly high density states include: Virginia, Illinois, Ohio, New Jersey, and Florida. Texas and New Mexico have relatively dense clusters, due in part to higher frequencies of Folsom fluted points.

There are fewer fluted points recorded in the High Plains, where early populations are presumed to have arrived by the ice-free corridor model and they should accumulate there according to the WOA colonization models (Frison, 1990; Fladmark et al., 1988; cf. Chapter 2). While this determination is handicapped by the six state area of missing data, the inventories of the surrounding states are reliable, but exhibit low frequencies (Davis, 1994; Titimus and Woods, 1988; 1991; Copeland and Fike, 1988; Meyers, 1987. These data contribute to the perception of low isolated fluted point frequencies, as Frison has stated (Frison, 1978; 1984; 1991:146).

Table 3.02 Possible explanations for differential fluted point distributions

Differential geologic visibility
Eastern states exhibit more exposures of relevant Pleistocene surfaces, Western states are more concealed by alluviation in the drainage channel systems where fluted point peoples may have left evidence of their activities (Frison, 1978:114; Bettis and Benn, 1989). Evidence favoring this explanation are that areas around the Mississippi River are notably void of fluted points which probably is an artifact of intense sedimentation during Holocene sea level rise.
Modern population densities and farming activities
There are many more and denser populations in the East, as well as a much longer history of farming (i.e. plowing). Largent et al., 1991 tested this hypothesis in Texas and found population density not correlated with increased numbers of points.
Differences in lithic resources
There is much more fine grained cryptocrystalline chert available in the East, possibly drawing fluted point making peoples to this area (Goodyear, 1979). Where obsidian is frequent there are also higher densities of points on the landscape. However, these facts still may reflect population densities.
Movement of points by subsequent populations
It is probable that fluted points were moved and removed by subsequent indigenous inhabitants throughout 11,000 years of time (Lepper, 1988; Meltzer, 1988; 1984). However, it is assumed that points will not move extremely far from their point of origin, that people finding them would live in that area keeping the fluted points in relative proximity. On the other hand, surface context points picked up by subsequent populations and reworked to serve as other tools would mask our perceptions of distributions.
Higher population densities of fluted point peoples.
This is, of course, the question being asked of the data and may, through other filters, be the ultimate reason for the distributional differences.

Three clusters seen in the West represent individual localities, e.g. the Richey-Roberts (Wenatchee) Clovis Cache site in Washington (Mehringer, 1990), the Dietz site in eastern Oregon (Willig, 1988), and Borax Lake in California (Meighan and Haynes, 1968). The cluster on the northeast coast of Texas is caused by the high numbers of points known from the McFadden Beach site (Long, 1977).

The fluted point clusters east of the Mississippi River are split by the Appalachian Mountains, with five major clusters occurring along the eastern seaboard and in Northwestern Florida. These clusters may reflect potential offshore areas to search for Paleoindian sites underwater, a subject to be discussed more fully in Chapter Four. The Borax Lake cluster on the west coast of California might also predict points to be found offshore there, perhaps in the San Francisco Bay. Fluted points found in the Great Basin (Oregon, California, Nevada, Utah) are commonly found near extinct pluvial lake beds (Davis and Shutler, 1969; Meighan and Haynes, 1968; Mehringer, 1988; Willig, 1988; Willig et al., 1988). In general, few of these points, or other artifacts of the fluted point assemblage, come from excavated contexts (although cf. Homer, 1986; Basgall, 1988; Meighan and Haynes, 1968).

Fluted points in the Southwest reflect Clovis, Folsom and other variants found in controlled excavations at the well known San Pedro river kill sites in Southern Arizona, such as Lehner Ranch and Murray Springs, as well as isolated occurrences in the east-central area of the state (Huckell, 1982; Longacre and Graves, 1976). Farther east, the Folsom and Clovis type sites are major contributors to the sample in New Mexico (Hester, 1972; Judge, 1973; Stuart and Gauthier, 1981).

Anderson has suggested that these clusters of fluted points might represent the domains of social groups (Anderson, 1990:195; cf. Anderson and Hanson, 1988). More research is necessary to distinguish which of these regularities represent social boundaries, which reflect differences in time and traditional ancestry, or which might even be clusters exhibiting functional purpose (Anderson, 1991; cf. Price, 1991). It will be exciting as future research reveals the meanings of the attributes associated with these clusters (cf. Meltzer, 1984; Tompkins, 1994).

Other Items of the Assemblage

In addition to projectile point morphology, the fluted point tradition can be characterized by other varieties of artifacts and their morphological attributes (Haynes, 1971, 1980; Stanford, 1991). One of the first to list these characteristics was Sellards (1952:17). This "Llano Culture" contained "bone implements, hammerstones, Clovis fluted and smaller non-fluted points and scrapers". Today, the salient characteristics -- seldom found together at any one site -- include the bifacial projectile points, bifacial and unifacial chipped stone tools, blades, cylindrical foreshafts of ivory or bone, and ceremonial caches. The chipped stone tools include large biface preforms from which unifacial end scrapers, side scrapers, knives, spokeshaves and gravers were removed (Grimes and Grimes, 1985; Marshall, 1985). End scrapers are often "spurred", and there are often bipolar flaked items, called *pieces esquilles*, or "wedges" (Goodyear, 1993; Haynes, 1982; Lothrop and Gramly, 1982; MacDonald, 1968). Burins are rare in fluted point assemblages, but they do exist. Murray Springs and Aubrey are both examples.

Davis and Shutler, 1969:157 included heat treated chert raw materials, crescents, gravers ("spiked beaks"), round steep sided scrapers ("biscuits"), and pressure retouch to the fluted point assemblage from extensive collections made at China Lake, a fluted and stemmed point locality in California. However, the fact that these are surface finds of fluted point related artifacts mixed with convex based stemmed point assemblage artifacts makes the associations equivocal.

Examples of long curved prismatic blades are documented as part of the Classic Clovis assemblage (Green, 1963; Hammatt, 1970; Haynes, 1982; Sanders, 1990; Stanford, 1991). Thus, the distribution of these artifacts may contribute to the understanding of fluted point colonization. Sites with blades reported were drawn out of the site inventories to be presented below and these are shown in Figure 3.02. However, the reliability of blade production as a characteristic which evinces ancestral relationships is somewhat equivocal. These items are common elements across various late Pleistocene Upper Paleolithic traditional assemblages throughout Europe. It is also true that, in Americanist archaeology, the distinction between true prismatic blades and long, specially prepared flakes or blade-like flakes is not consistent between researchers (cf. Adovasio et al., 1987; Adovasio, 1993; Rule, 1983:194-201). Consequently, blades are reported from Alaska to South America (Goebel et al., 1991; Mayer-Oakes, 1986).

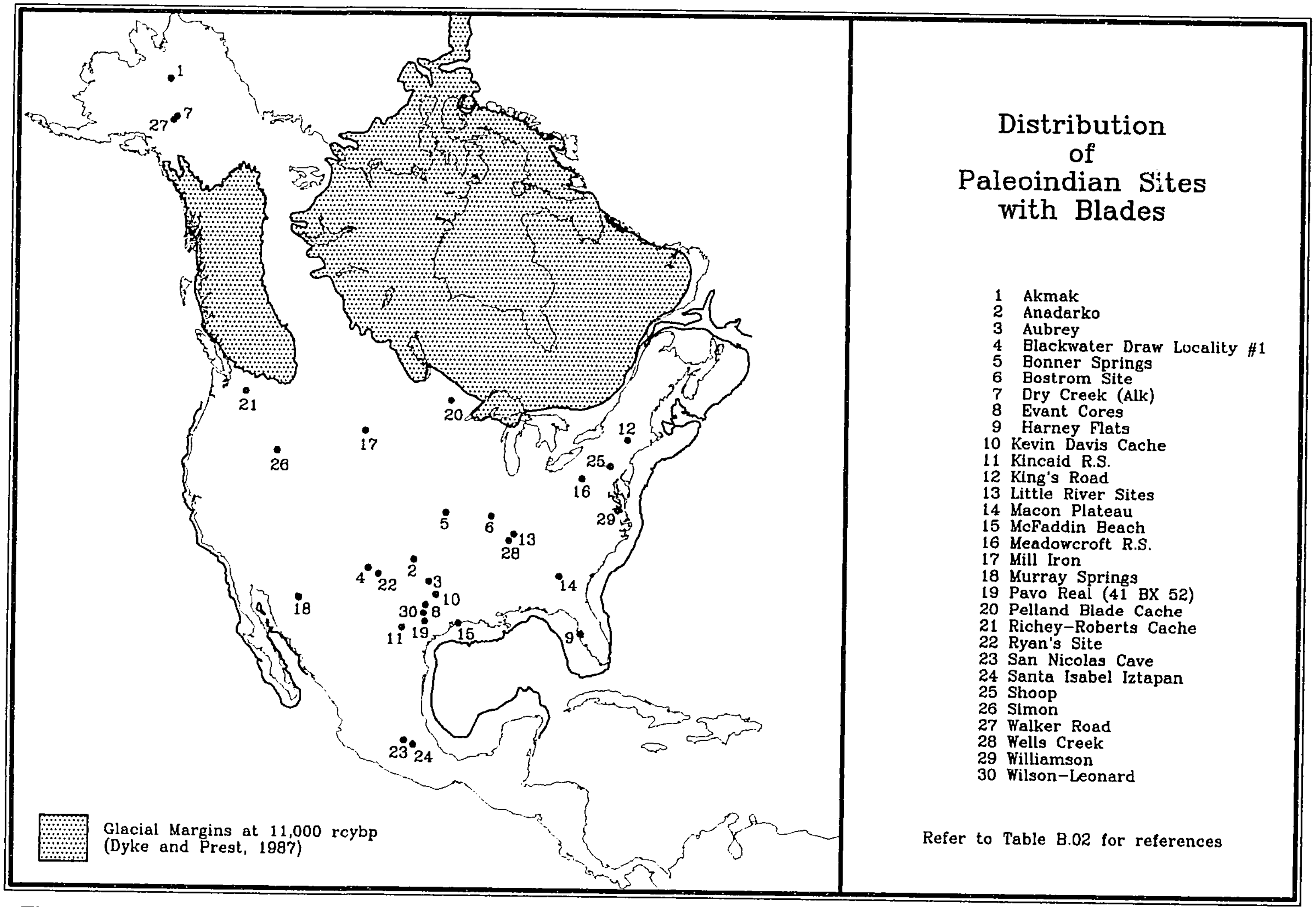


Figure 3.02 Distribution of Paleoindian sites with blades

The Nenana sites in Alaska, early Paleoindian occurrences discussed more below, include true prismatic blades, blade cores, and retouched blades. Anagula Island presents a record of blade production in Alaska at approximately 8,000 rcybp, and this assemblage has been associated with early Eskimo-Aleut settlement (Turner, 1986). Regardless, long, curved prismatic blades, in areas of dense isolated fluted point occurrences, are known to be associated with fluted point sites and these tend to be in the southern and southeastern portions of North America.

Chipped stone tools made from blades, long flakes or "blade-like" flakes (including both unifacial and bifacial tools) are known from late Paleoindian and Early Archaic sites in the South and Southeast (Kimball, 1992; Mason, 1981:137; Milanich, 1994; McNett, 1985; Purdy, 1981; Smith and Toth, 1990). Plainview points were made on large blade-like flakes at the Plainview site, Ryan's site, Bonfire Shelter, and Wilson Leonard in Texas according to Johnson (1989:44; cf. Warnica and Williamson, 1968). This reduction method resembles techniques described by Daniel et al. (1986) and Daniel and Wisenbaker (1987) for Suwannee projectile point production at the Harney Flats Site in west central Florida. Irwin and Wormington (1970) document that tools made on blades decrease with time in the Plains. Certainly this element of the assemblage could stand more stylistic and chronological research.

Cylindrical foreshafts fashioned from bone and ivory have been documented in Texas, Florida, and Montana (Haynes, 1982; Stanford, 1991). The fact that beveled ivory foreshafts are major components of the Kostenki cultures of Eastern and Central Europe, is a major factor in the possibility of ancestral relationship with Clovis assemblages (Haynes, 1982; Soffer and Praslov, 1993). There is one shaft wrench known from a southern Arizona Clovis site (Murray Springs, Haynes and Hemmings, 1968) and a single billet (short ivory peg) is known from Blackwater Draw. This item is similar to examples from Predmosti', a Gravettian (Kostenki related) Upper Paleolithic site in Czechoslovakia (Saunders et al., 1991:361). These distinctive ivory items are rare. The vast majority have been found in inundated contexts in the Aucilla River in Northwest Florida (Dunbar et al., 1989). This fact is reviewed again in Chapter Six, concerning Florida's Paleoindian record.

Several caches have been found which contain fluted points, biface preforms, and ivory or bone foreshafts placed together as if an offering or ceremony (Figure 3.03; Stanford, 1991). In some cases the items are covered in red ocher. These caches are spectacular components of the fluted point material culture, exhibiting large fluted points and biface preforms (Lahren and Bonnichsen, 1974; Mehringer, 1989; Stanford, 1991; Titimus and Woods, 1991). Figure 3.03 shows the distribution of these kinds of fluted point sites. Caches probably represent ceremonial deposits. Some have evidence for burials, although Anzick, in Montana, is the only one with preservation of skeletal remains. Found more often in northern latitudes, there are two Dalton related caches (Sloan and Hawkins). The chronological position of these distinctive occurrences is not well known, this will be discussed below, in the section on dating.

Artifacts which express artistic concern are also known from fluted point related sites. An ivory foreshaft from the Aucilla River, in Northwestern Florida, has an engraved zig-zag pattern (Haynes, 1982:390), there are engraved limestones associated with Clovis points from Gault in Texas (Collins et al., 1991), and an engraved bone was found at the Richey-Roberts (Wenatchee) cache (Mehringer, 1989). Sellards reported markings on a bone from the Blackwater Draw (1952:32). Perforated talc pendants with abstract incised lines were found at Reagan (Wormington, 1964). Bone gaming discs are known from the Lindenmeier Folsom site and engraved bones are known from the Wilson-Leonard Folsom site (Collins et al., 1991). Miniature and crystal facsimile points are also familiar in fluted point related assemblages. Ground Bola stones, with dimpled ends, are known from Florida and from southern South America. Both of these occurrences may be in contexts with Paleoindian materials, but they are also probable as Late Paleoindian or Early Archaic in age (Dillehay, 1984; Dunbar et al., 1989; Tesar, 1994a).

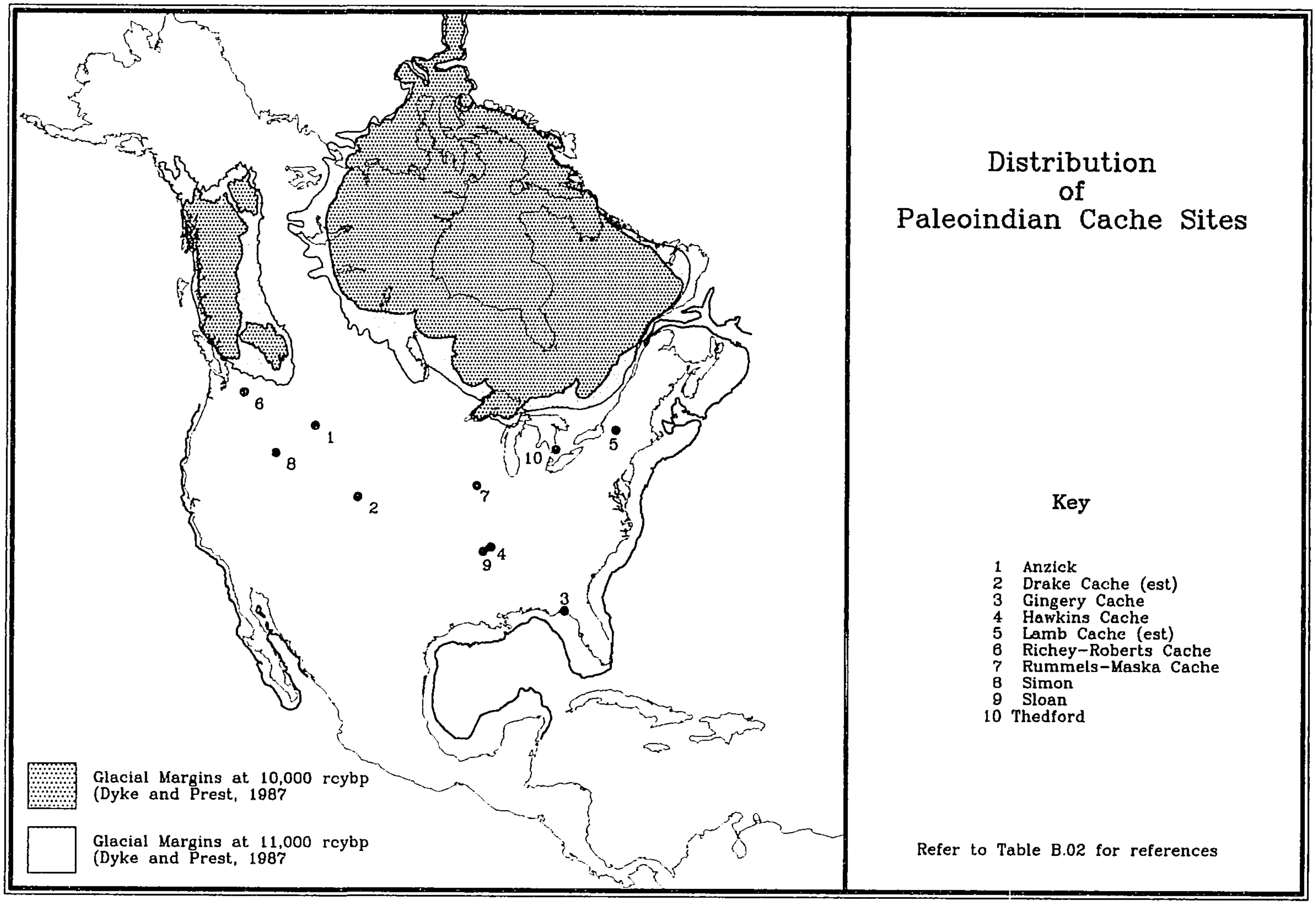


Figure 3.03 Distribution of Paleoindian cache sites

Distribution of Fluted Point Paleoindian Sites

The data base and mapping routine used for this dissertation research was developed by inventory and computer aided mapping from almost 200 references which included compendiums and primary references. The study was focused on archaeological sites and localities known to date, or proposed to date from first 2000 ^{14}C years of Paleoindian colonization (i.e. between about 12,000 and 10,000 rcybp), in North and Central America. The resultant sample is an opportunistic assessment from a wide assortment of published data from all regions of North America. The data base and references are presented in Appendix B, Table B.01 and B.02. Site locations were digitized directly from the references to a computer drafted map of North America. Coordinates for these sites could then be retrieved and recorded in the spreadsheet data base. The data base included site name, codes regarding the estimated ^{14}C chronology (if known), projectile point type or association, evidence for continued occupation at the site, presence or absence of skeletal remains, presence or absence of blades, comments and references. Figures 3.02 through 3.08; 3.12 through 3.14; and Figure A.01 are the initial mapping results of this survey.

This research methodology was attempted to discipline the presentation of the patterns of different kinds of fluted point sites and to test for spacial congruity with the isolated fluted point distributions illustrated in Figure 3.01. Another goal was to characterize the distributions of various kinds of fluted point sites, and other kinds of early sites such as convex based stemmed point, Nenana, or Microblade sites. Finally, the attempt was made to begin to document the locations of early Holocene aged archeological sites which exhibit evidence for ancestry/progeny relationships with the makers of both concave based fluted point and convex based stemmed point assemblages. The data base has the capability to grow in size and scope. Sampling error, as with the isolated fluted point frequencies shown in Figure 3.01, is possible, but the attempt was made to be thorough and the data are used as if they represent a statistical estimate of the actual pattern.

The sample includes a distinction between sites and localities. Sites represent published locations of discoveries with either high frequencies of artifacts, stratigraphic excavations, multiple references in the publications or various combinations of the three. Localities are generally places of low artifact frequency, or surface locations, or little published data, or combinations of the three. A total of N=795 late Pleistocene and early Holocene aged sites were recorded during the inventory. These ranged in age from terminal Pleistocene to as young as 7,000 years old. In addition, 1268 fluted point related localities were plotted. Of these localities, 255 were added to the spreadsheet data base because they had more associated data published. Examples of localities published include those from the Northeast (e.g. Jackson and McKillop, 1991; Lantz, 1984); the Southeast (Dunbar and Waller, 1992); the Great Basin (Davis and Shutler, 1969; Willig et al., 1988); the High Plains (Davis, 1988; Kehoe, 1966;

Titimus and Woods, 1988), the Northwest (Rice, 1985); Northeastern Alaska (Clark, 1984), the Southwest (Huckell, 1982; Judge, 1973), and Western Mexico (Ortiz, 1974). These localities tend to be clustered in the East, and dispersed in the West.

The data base includes 22 sites proposed as "pre-Clovis". These all remain equivocal and have not been plotted. Fourteen sites were faunal localities, with varying degrees of evidence for human interference. There were 50 sites which exhibited skeletal remain, either as the sole discovery or within other site contexts. Twenty two of these were estimated to represent the 11,200 to 10,000 rcybp frame, 11 fell in the next thousand year frame from 10,000 to 9,000 rcybp. Thirteen of the skeletal samples ranged from 9,000 to 7,000 rcybp and four were indeterminate. Eight sites were also indeterminate of material culture style. There is a disturbing, but distinct drop in site frequencies after 10,000 rcybp, which is either an artifact of sampling error, due to site reporting in other venues than Paleoindian specific literature. It is possible that populations were declining at this early time period, but only additional data gathering and analyses can address this conundrum.

The major focus of this dissertation research was on those sites within the time frame 11,200 (or before) to 10,000 rcybp and N=406 sites falling in this category were recorded. Of these sites, 312 (77 %) were fluted point or fluted point related sites. Three sites were classified as Nenana or Beringian, 24 (6%) were recorded as convex based stemmed point sites and seven were designated as Microblade sites.

Thirty eight sites estimated to represent the 10,000 rcybp boundary were recorded in this 11,200 to 10,000 rcybp frame for the purpose of displaying progeny related occurrences.

Figure 3.04 shows the distribution of the fluted point related sites and localities, without regard to type. The dense clusters of fluted points documented along the eastern seaboard in Figure 3.01 are not as extensive as the isolated point distributions, but there are congruities. Two main areas of sites seen in Figure 3.04 in the Northeast, the Southeast, occur in areas of isolated fluted point density (Figure 3.01). The sites form one cluster over the Northeast, and another occurs in the Southeast and Central states. Sites are missing across the drainage of the Mississippi between Texas the Southeastern sites, possibly an artifact of late Pleistocene - early Holocene channel fill covering sites from view to be discussed in Chapter 4.

A scatter of sites expands out across a broad expanse of the Plains, Rocky Mountains, and into the Great Basin from a dense array of sites in Texas. This dense array of sites is reflected in the isolated fluted point inventories shown in Figure 3.01, but not to the same degree. Sites are most dispersed over the Great Basin and Northwest. Two fluted point sites occur in the ice free corridor in this time frame and a cluster of sites is located in Northern Alaska.

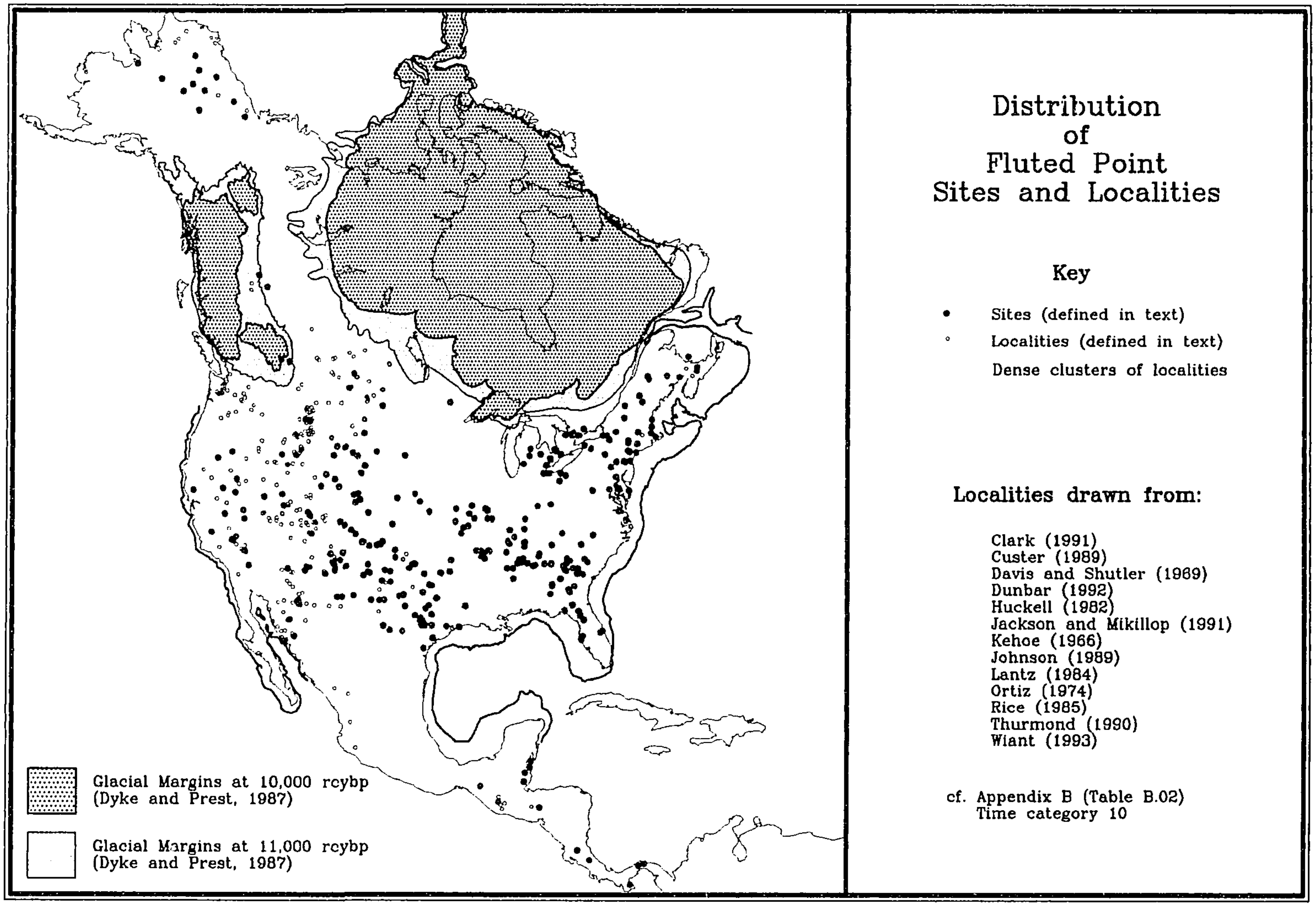
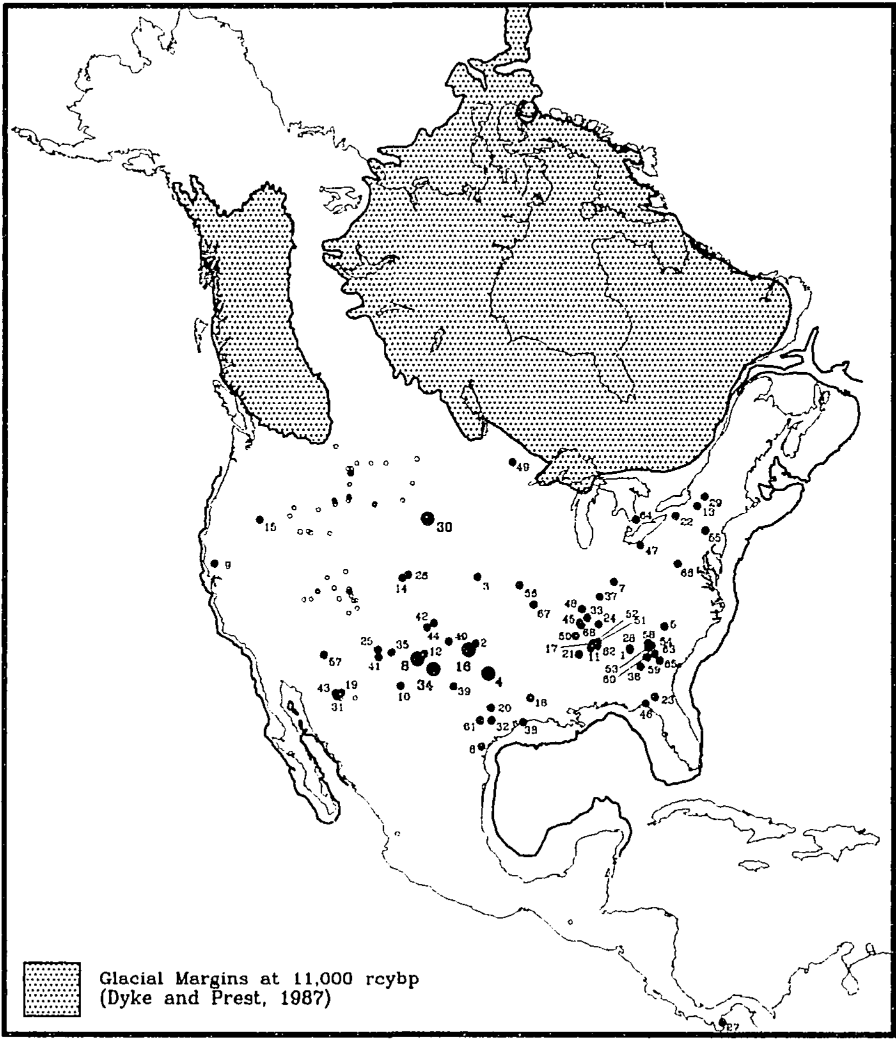


Figure 3.04 Distribution of fluted point sites and localities

Even more distinct geographical patterns come clear when the kinds of projectile points are taken into consideration. The distribution of sites listed as Classic Clovis, are shown in Figure 3.05 to be more frequent in the southern portions of both North America. Some Classic Clovis sites trail up into the Plains as localities, but some of these more northerly apparitions may actually be better classified as "Other" fluted points, such as the stubby variety or the western v-based variety described above. Until further classification and sorting they remain listed as Classic Clovis.

Folsom/Goshen occupation is restricted to the central portions of the continent in the High Plains and Texas and shown in Figure 3.06. Figure 3.07 exhibits Dalton\Suwanne\Simpson site distributions in the Southeast, along with the Debert/Vail like varieties found in the Great Lakes and Northeast. Folsom and Dalton distributions overlap in the eastern portions of the southern Plains (Johnson, 1989; Largent et al., 1990). "Other" fluted points, those points of questionable class or unnamed diversity, and fishtail fluted points are presented in Figure 3.08. These include the stubby, narrow vanities as described above for the Northwest and Great Basin, and the Alaskan vanities when such could be determined.



Distribution of Classic Clovis Sites and Localities

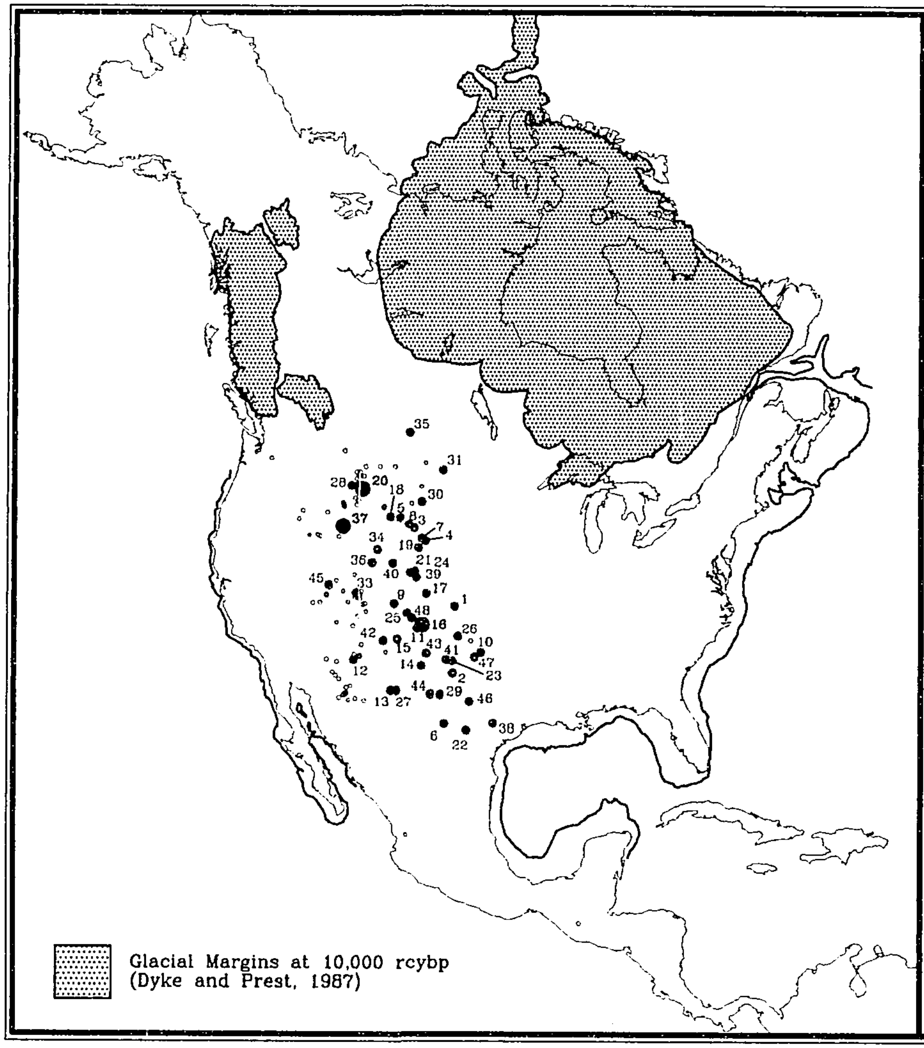
1 Allatoona Res.
2 Anadarko
3 Angus
● **4 Aubrey**
5 Baucom
6 Bee County
7 Big Bone Lick
● **8 Blackwater Draw Loc #1**
9 Borax/Clear Lake
10 Burnett Cave
11 Cedar Creek Res.
12 Clovis–Portales Blowouts
13 Corditaipe (est)
14 Dent
15 Dietz (Alkalai Lake)
● **16 Domebo**
17 Dust Cave
18 Eagle Hill II/Ft. Polk
19 Escapule
20 Gualt
21 Hester
22 Hiscock
23 Ichetucknee Spring
24 Johnson Hawkins
25 Judge Site (13 JB 5)
26 Klein II
27 La Mula West
28 Laffingall
29 Lamb Cache (est)
● **30 Lange/Ferguson**
31 Lehner Ranch
32 Little Pin Oak Creek
33 Little River Sites
● **34 Lubbock Lake**
35 Lucy
36 Macon Plateau
37 Magnet
38 McFaddin Beach
39 McLean
40 Miami
41 Mockingbird Gap
42 Muncy
43 Murray Springs
44 Nall
45 Nuckolls
46 Aucilla River
47 Paleo Crossing
48 Parrish Village
49 Pelland Blade Cache
50 Pierce
51 Pine Tree
52 Quad
53 Rucker's Btm. (9eb91)
54 Russell Res.
55 Shawnee–Minisink
56 Shriver
57 Silktassel
58 Simpson's Field
59 Site 9 GE 309
60 Site 9 GE 534
61 Spring Lake
62 Stone Pipe
63 Taylor Hill
64 Thedford
65 Theriault
66 Thunderbird
67 Walter Site
68 Wells Creek

Key

● **Early Clovis Sites**
• Clovis Sites (difined in text)
∘ Clovis Locality (defined in text)

Refer to Table B.02 for references

Figure 3.05 Distribution of Classic Clovis sites and localities



Distribution of Folsom and Goshen Sites and Localities

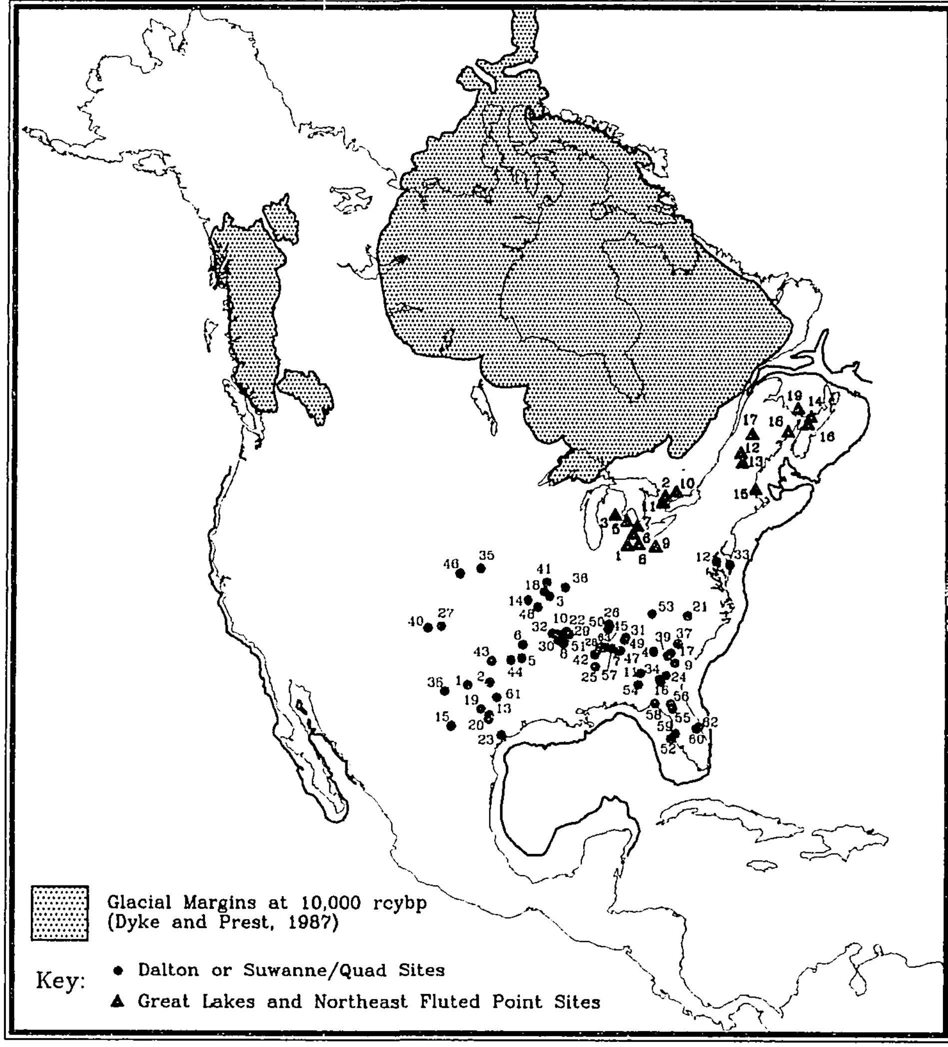
1 12 Mile Creek
2 Adair Steadman
3 Adobe
4 Agate Basin
5 Bentzen-Kaufman Cave
6 Bonfire R.S.
7 Brewster
8 Carter-Kerr McGee
9 Cattle Guard
10 Cedar Creek
11 Cimmarron
12 Concho
13 Dona Ana
14 Elida
15 Estancia Valley (Basin)
● **16 Folsom**
17 Fowler-Parrish
18 Hanson
19 Hell Gap
● **20 Indian Creek**
21 Johnson Site (CO)
22 Kincaid R.S.
23 Lake Theo
24 Lindenmeier
25 Linger
26 Lipscomb
27 Lone Butte Site
28 MacHaffie
29 Midland
30 Mill Iron
31 Moe
32 Not used
33 Montgomery (UT)
34 Morgan
35 Mortlach
36 Mud Springs
● **37 Owl Cave (Wasden)**
38 Pavo Real
39 Powars Site
40 Rattlesnake Pass
41 Rex Rodgers
42 Rio Rancho
43 San Jon
44 Shifting Sands
45 Site (42Md300)
46 Site 41 RN 129
47 Winters/Beckner
48 Zapata

Key

● **Early Folsom Sites**
• Folsom and Goshen sites
∘ Folsom localities

Refer to Table B.02 for references

Figure 3.06 Distribution of Flosom and Goshen sites and localities



Distribution of Dalton and Suwanne/Quad

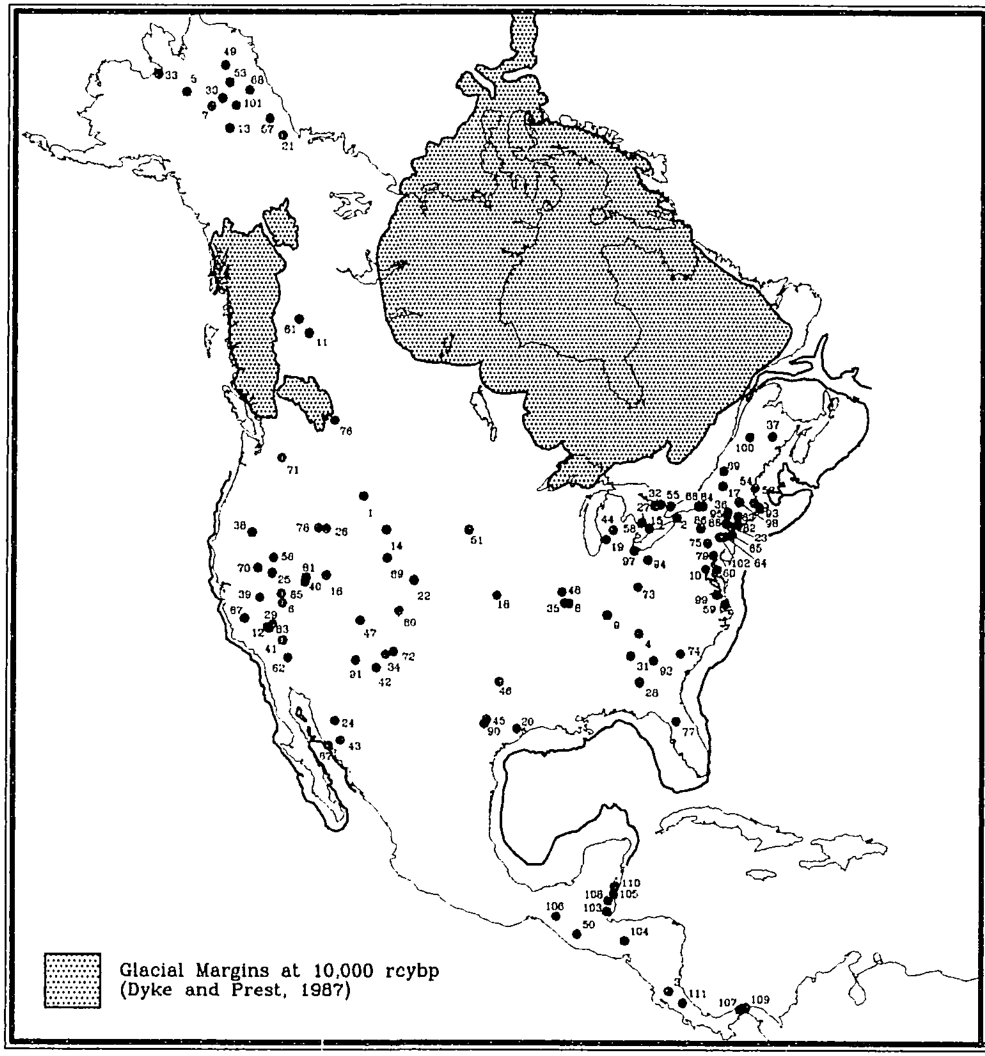
1 Abilene
2 Acton
3 Arnold Cave
4 Barnett Shoals (90c25)
5 Bell
6 Billy Ross
7 Boydston Creek
8 Brand
9 Brier Crk. Lcal.
10 Cache River Basin
11 Carmouche
12 Crane Point (est)
13 Crumley
14 Dalton Site
15 Devil's Mouth R.S.
16 Feronia
17 G.S. Lewis East
18 Graham Cave
19 Granite Beach
20 Gregg Ranch
21 Haw River
22 Hawkins Cache
23 J-2 Ranch
24 Joe Bell (9 mg 28)
25 Joe Powell
26 Johnson Site (TN)
27 Johnson-Cline
28 Klein Site
29 L'Anguille River Basin
30 Lace Place
31 LeCroy
32 Leopold
33 Linn Woods
34 Lowe
35 Meserve
36 Modoc R.S.
37 Nipper Creek
38 Petree
39 Pig Pen
40 Pigeon Cliffs
41 Pigeon Roost
42 Poplar
43 Pumpkin Creek
44 Quince Site
45 Red Hill Site
46 Red Smoke Site
47 Rock House Shelter
48 Rogers R.S.
49 Russell Cave
50 Site 40 WM 32
51 Sloan
52 Tampa Bay
53 Twelkemeier Site
54 W.F. George Lake
55 Bolen Bluff
56 Darby & Hornsby Springs
57 Flint Creek R.S.
58 Gingery Cache
59 Harney Flats
60 Helen Blazes
61 Horn R.S.
62 Lake Helen Blazes
63 Stanfield-Worley R.S.

Great Lake and Northeast Fluted Point Sites

1 Baker II
2 Banting
3 Barnes
4 DeWitt
5 Gainey
6 Grogitsky Site
7 Holcombe Beach
8 Mill Branch Site
9 Nobles Pond
10 Sandy Ridge
11 Udora
12 Vail
13 Adkins Site
14 Belmont I&II
15 Bull Brook(I&II)
16 Debert
17 Munsungun Lake
18 Quaco Head
19 Tyron

Refer to Table B.02 for references

Figure 3.07 Distribution of Dalton, Suwanne/Quad and Great Lakes/Northeast fluted point sites



Distribution of "Other" Fluted Point Sites

1	Anzick
2	Arc
3	Arenal
4	Bacon Farm
5	Batza Tena
6	Beatty-Golfield
7	Bonanza Creek
8	Bostrom Site
9	Carlson Annis Site
10	Catoctin
11	Charley Lake
12	China Lake
13	Circle Area
14	Colby
15	Crowfield
16	Danger Cave
17	Davis
18	Diskau
19	Doblaar
20	Doering Site
21	Dog Creek
22	Drake Cache (est)
23	Dutchess Q.C.
24	El Bajio
25	Fallon
26	Fenn Cache (est)
27	Fisher
28	Fort Benning
29	Fort Irwin
30	Girl's Hill
31	Horseleg Mtn.
32	Hussey
33	Iyatayet
34	Judge (8 XK 8)
35	Kimmswick
36	King's Road
37	Kingsclear
38	Klamath Lake Area
39	Komodo
40	Lake Hubbs
41	Lake Mohave
42	Lake San Augustine
43	Las Penitas
44	Leavitt
45	Levi R.S.
46	Lewisville
47	Lime Ridge
48	Lincoln Hills/Ready
49	Lisburne
50	Los Tapiales
51	Medicine Crow
52	Michaud
53	Natvakruak
54	Neponset
55	Newcastle
56	Old Humboldt (est)
57	Old John Lake (ARC-1)
58	Parkhill
59	Pasquotank
60	Paw Paw Cove
61	Pink Mountain
62	Pinto Basin
63	Piping Rock
64	Plenge
65	Port Mobile
66	Potts
67	Punta Blanca (Guaymas)
68	Putu
69	Reagen/John's Bridge
70	Reno
71	Richey-Roberts Cache
72	Sandia Cave
73	Sandy Springs
74	Savanah River Site
75	Shoop
76	Sibbald Creek
77	Silver Springs
78	Simon
79	Site 38 LA 336
80	Stoneham
81	Sunshine Locality
82	Templeton (6LF21)
83	Tiefort Basin
84	Timlin
85	Tonopah Lake (Mud Lk.)
86	Trojan
87	Tulare Lake
88	Twin Fields
89	U. P. Mammoth Site
90	Vera Daniels Site
91	Vernon
92	Wallace Res.
93	Wapanuket
94	Welling/Nellie Heights
95	West Athens Hill
97	West Union Ridge (est)
98	Whipple
99	Williamson
100	Windy City
101	Wiseman (WIS-025)
102	Zierdt
103	Dry Creek (site 168)
104	Esperanza (Lb20)
105	Ladiesville
106	Los Grifos Cave
107	Madden Lake
108	Melinda (Site 100)
109	Panama Canal Chnl site
110	Sand Hill (lowest)
111	Turrialba

Refer to Table B.02 for references

Figure 3.08 Distribution of "Other" fluted point sites

Distribution of Radiocarbon Dated Sites

A critical element in any attempt to perceive the trajectory and pattern of colonization by people making fluted points is an accurate image of the buildup of sites through time. This control is also necessary to address the relationships between other chipped stone assemblages, such as convex based stemmed point or microblade to be discussed below and to associate specific environmental conditions which may be associated with human population movements to be discussed in Chapter Four.

The most accurate means by which this is accomplished is, of course, radiocarbon (^{14}C) dating. Radiocarbon chronologies and summaries for Paleoindian sites are largely the result of work initiated by Vance Haynes. Beginning with dates from Lindenmeier (Haynes and Agogino, 1960), Haynes has obtained and documented numerous dates for several important sites. He periodically publishes compendiums of ^{14}C dates relevant to the dating of fluted point sites and human occupation of the North American continent (1964; 1967a; 1970; 1980b; 1982; 1984; 1987b; 1992; 1993; Haynes et al., 1992)[4].

A procedure for averaging radiocarbon dates was developed by Long and Rippeteau (1974), which narrows the range of possible error for several of these sites (N=22) to as little as 40 or 50 years, in some cases (cf. Haynes, 1990; 1992; Haynes

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[4] Haynes has also contributed several important technical principles with which dating accuracy can be improved, and - perhaps more importantly - developed a philosophical attitude with which to approach the issue of dating early sites (Haynes and Agogino, 1986; Haynes, 1966; 1980).

et al., 1984). The radiocarbon control in Haynes' recent work employs this technique to average ^{14}C samples at sites exhibiting equivalent stratigraphic occurrence (Haynes, 1993:220). Sites thus dated might be referred to as securely dated, that is more secure than those sites with single radiocarbon determinations.

However, radiocarbon dates are progressively younger than true calendar ages when compared with known age tree rings and, most recently, to U-Th coral dates which overlap both the radiocarbon and treering series (Bard et al., 1993; Becker, 1993; Stuiver and Reimer, 1993). Researchers interpret this difference as a proxy for increased high altitude production of ^{14}C, which resulted in increased atmospheric CO_2 content at the end of the Pleistocene.

Because of this fact, I performed calibrations at 100 radiocarbon year intervals to test the magnitude of fluctuation between radiocarbon dates in the 12,000 to 10,000 rcybp frame. These differences might influence the perception of how much "real" time was involved within and between radiocarbon dated for initial colonization and other subsequent developments. Figure 3.09 demonstrates that between 12,000 and approximately 10,500 rcybp the difference between ^{14}C and U-Th dates averages 1,900 years ($\sigma = 13$ years). However, after 10,500 rcybp the difference between radiocarbon and combined treering/U-Th dates narrows and fluctuates to 10,000 rcybp and beyond ($\bar{x} = 1{,}289$, $\sigma = 322$ years).

Simply put, the sum of 1500 radiocarbon years, from 12,000 to 10,500 rcybp, currently represents about 1500 years of calibrated time. In contrast, the 500 radiocarbon years from 10,500 to 10,000 rcybp represents about 1240 years of calibrated time, or about 740 years more than expected ($\bar{x}$ 148 years of calibrated time per 100 ^{14}C year interval). The radiocarbon results in the 10,500 to 10,100 rcybp are compressed and sites within this range need to be compared on a case by case, calibrated basis. It is possible that these relationships will change with further tree ring calibration, but this represents the most current understanding of this problem. Regardless, the focus is on sites from 12,000 to 10,500 rcybp, and these can be compared without resorting to the calibration curve.

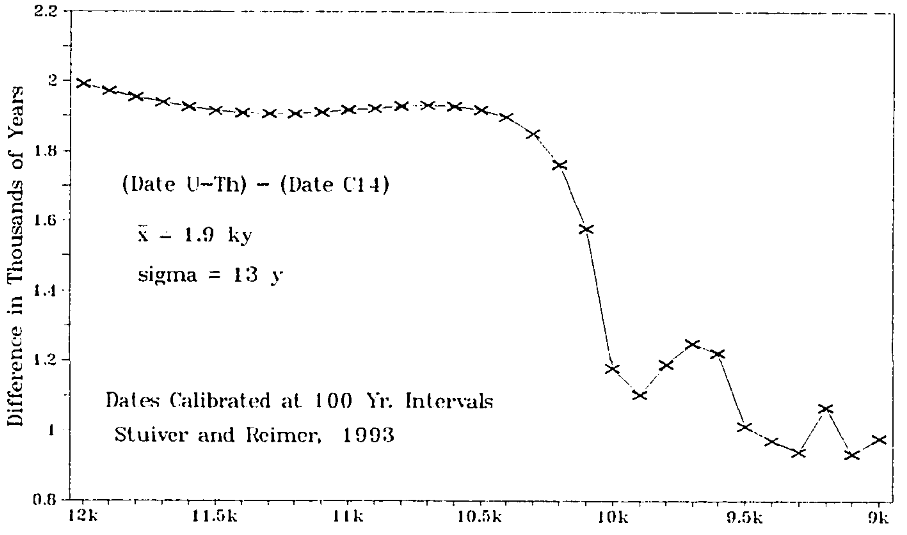

Figure 3.09 Differences between calibrated and uncalibrated radiocarbon dates

Table 3.03 presents the uncalibrated radiocarbon control for Paleoindian sites in both North and South America, including concave based fluted point and convex based stemmed point affiliated sites. These examples were accumulated during the site inventory study as part of the data gathering process. I did not tabulate several chronologically equivocal, isolated, or possibly "failed colonizations" pre-dating the 12,000 year ceiling, such as Bluefish Caves in Alaska, Meadowcroft Rock Shelter in Pennsylvania, or Pedra Fruada in Brazil (cf. Adovasio, 1993; Meltzer et al., 1994).

There are N=72 sites tabulated, N=45 of these date between 12,000 and 10,500 rcybp. Of these 45 sites, N=26 are securely dated, that is they have two or more ^{14}C dates averaged. Twenty five sites are listed after 10,500 rcybp and 14 of these are secure (>one date). Figure 3.10 spreads the dates presented in Table 3.03 in a chronological array, stretched across time (horizontally) so as to enhance clusters. Figure 3.11 shows the increase of sites through time in a cumulative frequency graph. Figure 3.12 shows the geographical locations of the securely dated North American sites and the lack of representatives in the Great Basin and Northwest and the Southeast regions.

Table 3.03 Radiocarbon dates for sites between 12,000 and 10,000 rcybp

Table 3.03 Radiocarbon dates for sites between 12,000 and 10,000 rcybp

Site	Date	N	Type	Reference
Monte Verde, Chile	12,040+/- 95	3	stemmed?	Dillehay, 1988 (mf avg on 3 probable worked items)
Taima-Taima, Venezuela	11,860+/- 130	1	stemmed (El Jobo)	Lynch, 1990
Tibito, Columbia	11,740+/- 110	1	indeterm	Lynch, 1990:17
Moose Creek, Alaska	11,730+/- 250	1	Nenana	Haynes, 1992:360
Aubrey, Texas	11,565+/- 70	2	Clovis	Ferring, 1994; 1995
Tagua-Tagua, Chile	11,380+/- 320	1	indeterm.	Lynch, 1990
UP Mammoth, Wyoming	11,280+/- 350	1	Clovis (?)	Haynes, 1992:360
Walker Road, Alaska	11,230+/- 90	3	Nenana	Haynes, 1992:360; Powers and Hoffecker, 1989; Bigelow et al., 1990:163
El Abra, Columbia	11,210+/- 90	1	fluted? Abriense	Lynch, 1990
Connely Cave No 4B, Oregon	11,200+/- 200	1	stemmed	Willig and Aikens, 1988:9
Blackwater Draw, New Mexico	11,170+/- 100	3	Clovis	Haynes, 1992:361
Lange/Ferguson, South Dakota	11,140+/- 140	1	Clovis	Haynes, 1992:360; Haynes,1993:221; cf. Hannus, 1990
Dry Creek, Alaska	11,120+/- 85	1	Nenana?	Haynes, 1992:360 Component I
Lubbock Lake, Texas	11,100+/- 60	2	Clovis	Johnson, 1991:226, cf. Haynes, nd
McFaddin Beach, Texas	11,100+/- 750	1	Clovis	Long, 1977 (bone date)
Healy Lake, Alaska	11,090+/- 170	1	Nenana	Clark, 1991:40
Fishbone Cave, Nevada	11,075+/- 190	2	possible stemmed	Orr, 1956; 1974

Table 3.03 Radiocarbon dates for sites between 12,000 and 10,000 rcybp

Domebo, Oklahoma	11,040 +/- 250	3	Clovis	Haynes, 1993:221; cf. Haynes, 1993:361
Colby, Wyoming	11,032+/- 120	2	fluted	Haynes, 1992:360
Post 11,000 rcybp				
Lehner Ranch, Arizona	10,930+/- 40	12	Clovis	Haynes, 1992:361
Indian Creek, Montana	10,930+/- 100	2	Clovis? Folsom?	Haynes et al.1992
Querero, Chile	10,925+/- 85	1	indeterm	Lynch, 1990:26
Owl Cave, Idaho	10,920+/- 150	1	Folsom	Miller and Dort, 1978
Tequendama, Columbia	10,920+/- 260	1	fluted? Abriense	Lynch, 1990
Murray Springs, Arizona	10,900+/- 50	8	Clovis	Haynes, 1992:361
Folsom, New Mexico	10,890+/- 50	6	Folsom	Haynes et al.1992
Milliron, Wyoming	10,840+/- 60	2	Folsom	Frison, 1990; Haynes, 1992:361
Fell's Cave, Chile	10,840+/- 100	3	Fishtail	Politis, 1991:290; Turner and Bird, 1981; mf avg of 3
Hell Gap, Wyoming	10,820+/- 170	3	Folsom/ Goshen	Haynes et al.1992
Dent, Colorado	10,810+/- 40	6	Clovis	Haynes, 1992:360; Haynes, 1993 dates = 10,690
Cerro La China (Site 1), Argentina	10,760+/- 94	2	Fishtail	Politis, 1991:290
Handprint Cave, Nevada	10,740+/- 70	1	Stemmed	Bryan, 1988:55; Gruhn and Bryan, 1988
Los Tapiales, Guatemala	10,710+/- 170	1	Fishtail	Ranere & Cooke, 1991:240
Agate Basin, Wyoming	10,690+/- 70	3	Folsom	Haynes et al.1992
Dry Creek, Alaska	10,690+/- 250	1	Microblade	Clark, 1991:39-40
Anzick, Montana	10,680+/- 50	5	fluted	Haynes, 1992:360; Stafford et al., 1991

Table 3.03 Radiocarbon dates for sites between 12,000 and 10,000 rcybp

Marmes R.S., Washington	10,680+/-90	3	stemmed point	Willig and Aikens, 1988:14
Shawnee-Minisink, Pennsylvania	10,670+/-270	2	Clovis	McNett, 1985; Haynes, 1993:223
Lindenmeier, Colorado	10,660+/-60	3	Folsom	Haynes et al.1992
Cerro La China (Site 2), Argentina	10,610+/-180	1	Fishtail	Dillehay et al., 1992:169
Smith Creek Cave, Nevada	10,600+/-80	4	stemmed	Willig and Aikens, 1988:14; cf. Thompson, 1985:116; Bryan, 1977; MF Average
Post 10,500 rcybp				
Debert, Nova Scotia	10,590+/-50	13	fluted	Haynes et al., 1984:189
Gallagher Flint Sta. Alaska	10,540+/- 150	1	Microblade	Haynes, 1982:395
Guitarrero, Peru	10,535+/- 290	1	stemmed Ayamptin	Whitely and Dorn, 1993
Charley Lake, British Columbia	10,530+/-80	3	fluted	Fladmark et al., 1988:375
Vail, Maine	10,520+/-70	5	fluted	Haynes et al., 1984:189
Cubilan, Ecuador	10,500+/- 130	1	indeterm.	Lynch, 1990
Hatwai, Idaho	10,465+/- 140	2	stemmed	Willig and Aikens, 1988:14
Cueva del Medio, Chile	10,430+/-60	2	Fishtail	Politis, 1991:290
Carter Kerr-McGee, Wyoming	10,400+/-60	1	Folsom	Haynes et al.1992
Pedra Fruada, Brazil	10,400+/- 180	1	"Serra Telhada"	Guidon and Delibrias, 1986
Dust Cave, Alabama	10,390+/- 65	3	Bolen/Big Sandy	Driskell, 1995
Blackwater Draw, New Mexico	10,380+/- 140	4	Folsom	Haynes et al.1992
Rogers R.S., Missouri	10,365+/- 300	2	Dalton	Goodyear, 1982
Danger Cave, Utah	10,355+/- 125	4	fluted	Jennings, 1957; Haynes, 1967; Homer, 1986

Table 3.03 Radiocarbon dates for sites between 12,000 and 10,000 rcybp

Tres Arroyos, Argentina	10,350+/- 70	2	Fishtail?	Lynch, 1990
Warm Mineral Springs, Florida	10,319	1	Greenbriar	Clausen et al., 1975; Cockrell and Murphy, 1978:6
Lake Mohave, California	10,270+/- 160	1	stemmed point	Ore and Warren, 1971; Carlson, 1983:76
Hanson, Wyoming	10,260+/- 90	4	Folsom	Haynes et al. 1992
Daisy Cave California	10,260+/- 90	3	Paleocoastal	Erlandson and Moss, 1994 San Miguel Island
Michaud, Maine	10,260+/- 620	1	fluted	Speiss and Wilson, 1987
Fort Rock Cave, Oregon	10,200 +/- 230	1	stemmed	Bedwell, 1973; Carlson, 1983:79; Waters, 1985; Willig and Aikens, 1988:10
Templeton (6LF21), Connecticut	10,190+/- 300	1	fluted	Moeller, 1980
Healy Lake, Alaska	10,150+/- 250	1	Microblade	Bonnichsen et al., 1987:409
Kincaid R.S.	10,150+/-85	3	Folsom	Largent et al., 1991, cf. Haynes, 1967
Redfish R.S., Idaho	10,100 /- 300	1	stemmed	Carlson, 1983:76
Midland, Texas	10,100+/- 800	1	burial	Wormington, 1964; Mammoth Trumpet 8(1):7 (U-Th date of 11,600 +/- 800 calibrated to radiocarbon equivalent.
Page Ladson, Florida	10,090+/- 50	3	Bolen/Big Sandy	Dunbar et al., 1989; Carter, 1993
Bonfire Shelter, Texas	10,080+/- 100	3	Folsom	Haynes et al., 1984:189
Witt Site (Borax Lake), California	10,045+/- 70	1	burial	Wallace and Riddell, 1988:92 (U-Th date of 11,380 +/- 70 calibrated to radiocarbon equivalent)
Arlington Canyon, California	10,040+/- 190	2	burial	Orr, 1962; Erlandson and Moss, 1994 Catalina Island
Mesa, Alaska	10,007+/- 40	3	"Plano"	Kunz and Reanier, 1994
Rattlesnake Pass, Texas	9,950+/- 150	1	Folsom	Davis et al., 1991:19

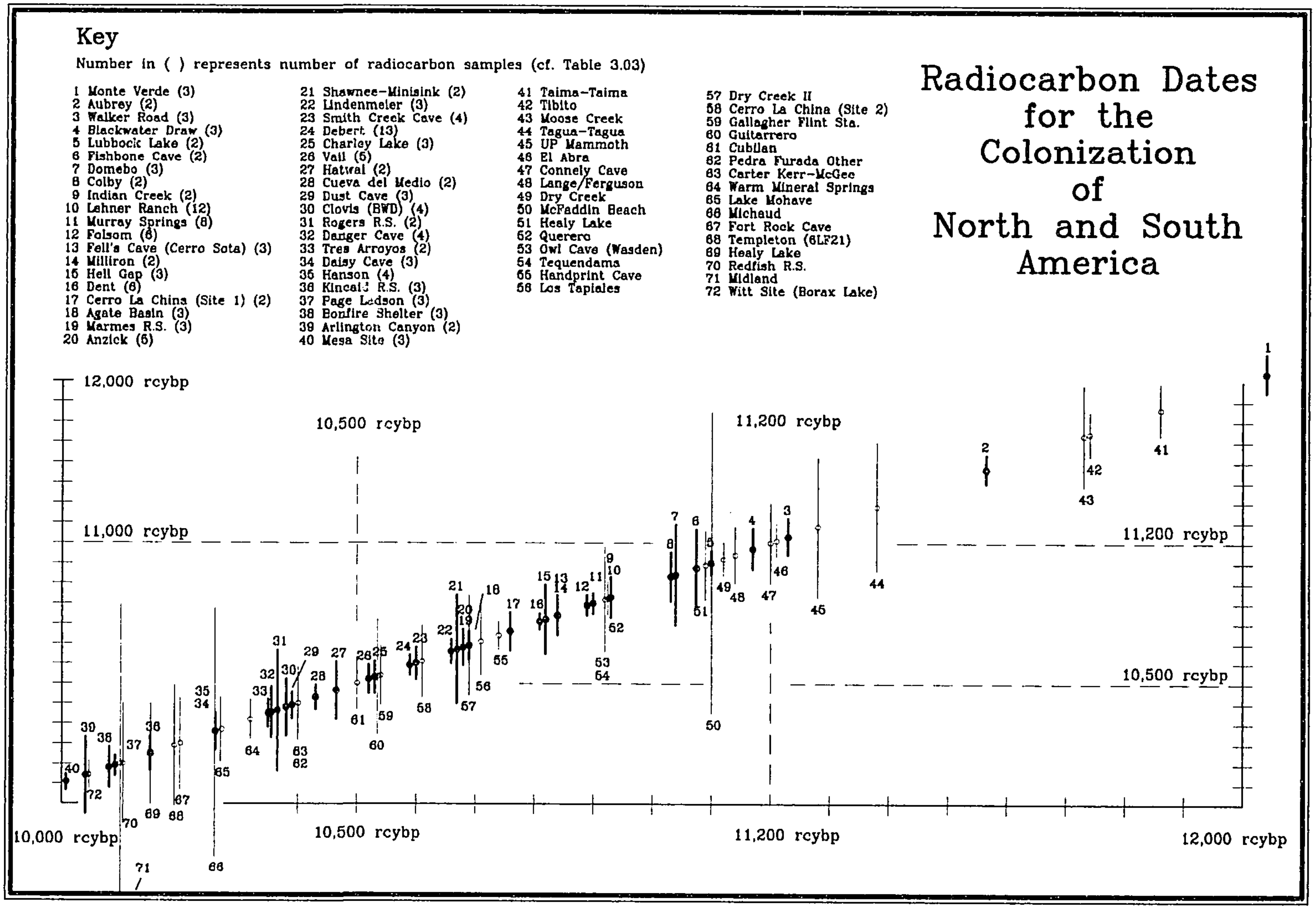

Figure 3.10 Radiocarbon dates for the colonization of North and South America

Using this data and these graphics at face value, it is apparent that securely dated human presence in the Western Hemisphere is rare (or equivocal) before 11,200 rcybp years ago (N=3) and that it increases significantly between 11,200 and 10,500 rcybp (N=23). The three securely dated Paleoindian sites that pre-date 11,200 rcybp occur in Monte Verde, Chile; Aubrey, Texas and Walker Road, Alaska, in that order. Figure 3.11 shows a steeper rate of growth of securely dated sites after 11,200 rcybp, and, using these data as a proxy for population growth, signals a possible increase in the numbers of people coming into the New World after this time.

Distinction for being the earliest securely dated <u>fluted point</u> site falls on Aubrey, in Texas. Aubrey is a Classic Clovis fluted point site at 11,565 +/- 70 rcybp, but this date exists well outside of the majority of fluted point dates. The remainder of early examples accumulate after 11,200 rcybp, namely Blackwater Draw, New Mexico, at 11,170 +/- 100 and Lubbock Lake, Texas, at 11,100 +/- 60. Domebo, in Oklahoma and Colby, Wyoming occur soon thereafter at 11,040 +/- 250 and 11,032 +/-120, respectively. If it weren't for Aubrey, two additional sites with single (not as secure) radiocarbon dates, in the 11,200 to 11,100 time frame the High Plains would compete for contemporaniety early Clovis occurrences in the Southern Plains, that is Union Pacific Mammoth Site, in Wyoming, and Lange-Ferguson, in South Dakota.

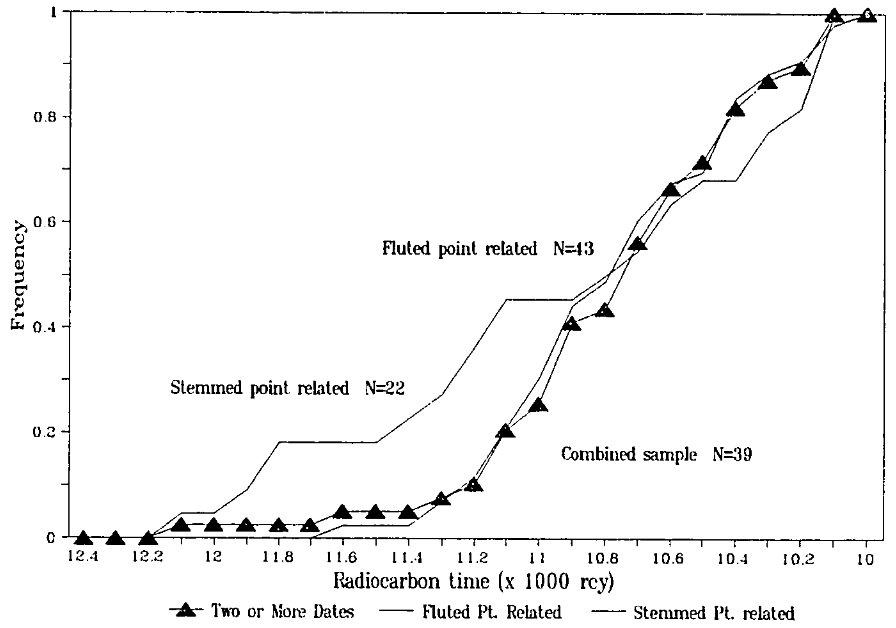

Figure 3.11 Cumulative frequency of dated Paleoindian sites

The earliest Folsom and Goshen sites appear to overlap some Classic Clovis sites. In fact, the securely dated Folsom affiliated sites Folsom, Milliron, and Hell Gap are statistically contemporaneous with the Classic Clovis related Lehner Ranch, Murray Springs, and Dent sites[5]. In the 300 radiocarbon years between 10,800 and 10,500 rcybp, fluted point sites occur in several distinct areas in northeastern North America, Central and southern South America (Table 3.03, Figure 3.10). Convex based stemmed point related sites occur in the Northwest and Great Basin and in

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[5] Stratigraphically, Clovis occurs below Folsom only at Blackwater Draw. Frison has changed his designation of the fluted point below Folsom at Carter-Kerr McGee from Clovis to Goshen (Frison, 1991:146). In general, Classic Clovis sites are earlier than Folsom, but exceptions include radiocarbon later dates for Dent and Shawnee-Minisink (Table 3.03).

Northwestern South America toward the end of this period (i.e. 10,800 to 10,500 rcybp), including Marmes Rock Shelter, Washington; Smith Creek Cave, Nevada; and Guiterrero Cave, Peru. Monte Verde might represent the earliest of these sites, and several other early examples, with equivocal dates, are known in South America (Table 3.03; cf. Lynch, 1990).

Radiocarbon dating of fluted points in the ice free corridor rests on a single site: Charley Lake Caves at 10,530 +/- 80 (Fladmark et al., 1988). No reliable radiocarbon dates are available for concave based fluted points in Alaska (Clark, 1984; 1991; Haynes, 1982). Recent re-dating of charcoal from Putu discounted an earlier reported radiocarbon date on charcoal of 11,470 +/- 500 (SI-2382) in a hearth (Feature 9) and reported that two new age estimates for this feature were 8,810 +/- 60 and 8,450 +/- 130 rcybp (Reanier et al., 1994). At Healy Lake basally thinned concave based points found within the lowermost, Chindadn component are bracketed between dates of approximately 9,000 to 11,000 rcybp range. At Dry Creek a miniature fluted point was found with the Component II (microblade) assemblage and it would therefore be associated with a ^{14}C date of 10,690 +/- 250 (Clark, 1991:39-40). Clark has also reported that obsidian hydration dating of fluted points at Batza Tena in Alaska evinced two populations, with an equivocal estimate between 9,000 to 13,000 years ago for the older of the two (Clark, 1991:40).

Many of the examples of Alaskan isolated fluted points show up in context with later lithic traditions (e.g. Paleoarctic, Northern Archaic, and Arctic Small Tool), and suggestions have been made that the technique of fluting observed in Alaska may be a late re-invention (analog) or copy (reticulation). Goebel et al., (1991:74) state: "(i)t is our opinion that the Alaskan fluted points thus far found are not directly related to the development of Clovis fluted points and are instead late arrivals from the northern Great Plains."

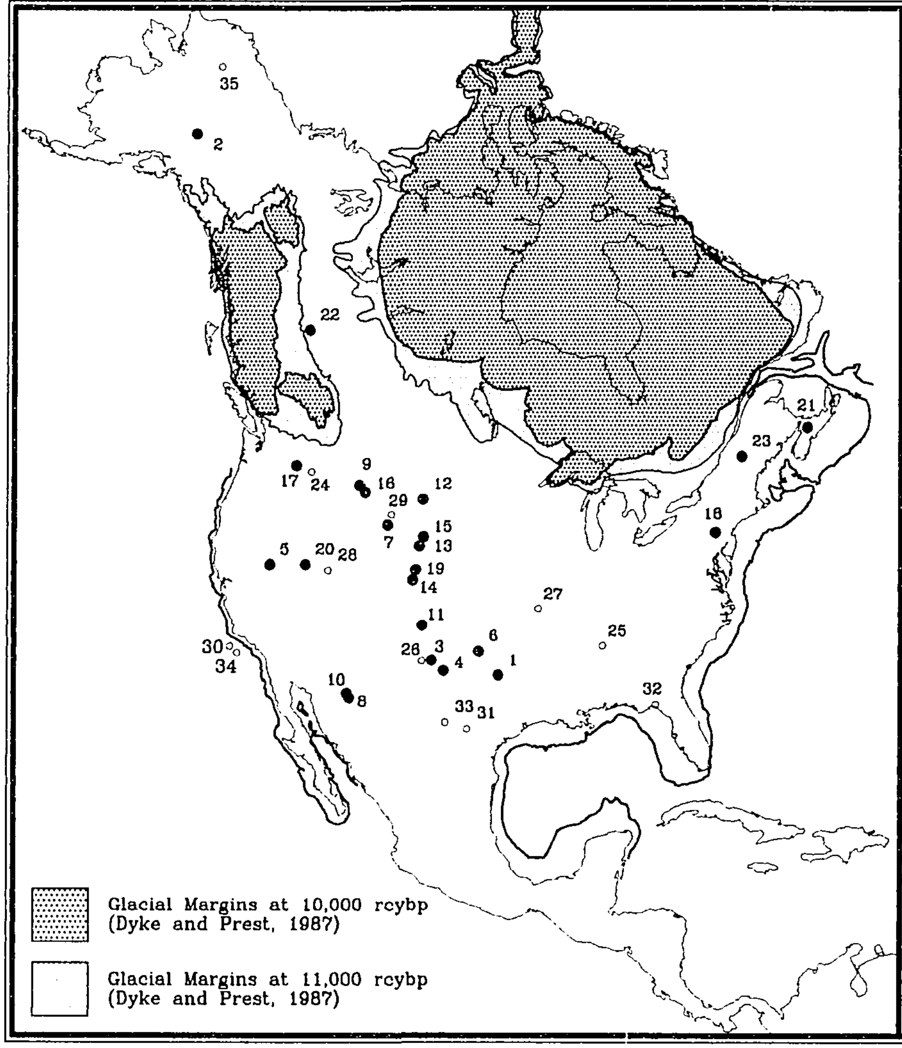
Radiocarbon dates on fluted points in the West are both rare and equivocal. The earliest date offered is Mehringer's observation that the Clovis points at Richey-Roberts lay directly on Glacier Peak volcanic ash (Layer G), which has been dated to 11,250 rcybp (Mehringer, 1990:502; no error range given). The ash layer is capped by a clayey silt and sand layer with abundant charcoal that returns an averaged radiocarbon date of 8720 +/-70 (ibid:497) higher up the stratigraphic column. Davis (1984) reported a date of 11,125 +/- 130 (Beta-4951) for the same Glacier Peak (layer G) ash at Indian Creek in Montana.

Other similar caches possible chronological settings don't agree with this proposition. Anzick is the only cache with secure (>one date) ^{14}C control because of human bone protein dates which average 10,680 +/- 50 rcybp (Stafford et al., 1991; Table 3.03). The collection of fluted points and assemblage from Richey-Roberts resembles the Anzick collections in appearance and assemblage. Sloan, a cache and burial site in Arkansas, was represented by several clusters of finely made Dalton points (Morse, 1975). According to Goodyear's 1982 estimate on Dalton chronology, this cache may date to the time frame of 10,500 - 9,900 rcybp. Finally, the Lamb Cache, located in the Far Northeast, occurs where the dates on fluted point radiocarbon dates cluster after about 10,600 rcybp, even though it remains undated (Gramly, 1988; Haynes et al., 1984). From this limited sample, the range of 10,700 to 10,500 rcybp seems a defendable estimate for ceremonial caching behavior. However, the Richey-Roberts bifaces were reported to be in such close proximity to the ash, that the 11,000 rcy frame may also be appropriate.

Other radiocarbon dates in the West are also equivocal. At Danger Cave, in Utah, several ^{14}C dates were run on samples from the lowest cultural level in which a stubby fluted point was found ("Zone I") (Haynes, 1967a:270; Wormington, 1964:194). These eight samples resulted in a wide range of dates, from 10,600 +/- 200 (TX-85) to 8,970 +/- 150 (TX-86). Average for four samples represented in the 10,000 rcy range results in a date of 10,355 +/- 125 but the stratigraphic associations of these samples and the projectile point are equivocal. A fluted point excavated from Connley Cave, Oregon, was found <u>above</u> a ^{14}C date of 9,540 +/- 260 (Gak-1744) (Haynes, 1987:86; Willig and Aikens, 1988:13). At the Henwood site in the Mojave Desert, a ^{14}C date on fluted points associated with a Lake Mohave assemblage gave the result of 8,470 +/- 370 (AA-648) (Warren and Phagan, 1988:123).

Another effective means of estimating chronology is the use of ^{14}C calibrated obsidian hydration rates. At Borax Lake, in California, Meighan and Haynes (1968) originally estimated dates between 12,000 - 10,000 on the basis of un-calibrated obsidian hydration rates for their fluted points. A more recent estimate for the average hydration rind of 8.7 microns for these fluted points, coupled with an average rate of 1 micron per 1000 year, might actually represent 8,700 ybp, in range with the two radiocarbon examples above (Moratto, 1984:83). At the Komodo site, in California's Mohave desert, calibrated hydration estimates $\bar{x}$ 9.6 of microns result in an estimate of 8,061 years ago, also in relative agreement with the radiocarbon estimates (Basgall, 1988:113; cf. Fredrickson and White, 1988:78).

There are wo securely dated fluted point sites in the Far Northeast (Debert in Nova Scotia and Vail in Maine). These two fall in the range between 10,600 to 10,500 rcybp. Secure dates for fluted points farther south at Shawnee-Minisink are slightly earlier, at 10,670 rcybp, but the margins of error are wide (270 rcy) (McNett, 1985). Fluting ends around 10,000 rcy, represented by eastern examples and late Folsom representatives. Radiocarbon dates for fluting in the East are 10,190 +/- 300 (W-3931) at Templeton (6LF21) in Connecticut (Moeller, 1980); and 10,200 +/- 620 at Michaud, Maine (Speiss and Brush, 1987). Several late Folsom sites in the Plains also represent this ^{14}C time frame (for instance, Lubbock Lake, Kincaid Rock Shelter, and Rattlesnake Pass (Table 3.03).



Distribution of Securely Dated Paleoindian Sites in North America

1	Aubrey Clovis	11,565 +/- 70 (2)
2	Walker Road Nenana	11,230 +/- 90 (3)
3	Blackwater Draw Clovis	11,170 +/- 100 (3)
4	Lubbock Lake Clovis	11,100 +/- 60 (2)
5	Fishbone Cave Stemmed (?)	11,075 +/- 190 (2)
6	Domebo Clovis	11,040 +/- 250 (3)
7	Colby Fluted	11,032 +/- 120 (2)
8	Lehner Ranch Clovis	10,930 +/- 40 (12)
9	Indian Creek Folsom	10,930 +/- 100 (2)
10	Murray Springs Clovis	10,900 +/- 50 (8)
11	Folsom Folsom	10,890 +/- 50 (6)
12	Milliron Folsom	10,840 +/- 60 (2)
13	Hell Gap Folsom	10,820 +/- 170 (3)
14	Dent Clovis	10,810 +/- 40 (6)
15	Agate Basin Folsom	10,690 +/- 70 (3)
16	Anzick Clovis	10,680 +/- 50 (5)
17	Marmes R.S. Stemmed	10,680 +/- 90 (3)
18	Shawnee-Minisink Clovis	10,670 +/- 270 (2)
19	Lindenmeier Folsom	10,660 +/- 60 (3)
20	Smith Creek Cave Stemmed	10,600 +/- 80 4)
21	Debert Fluted	10,590 +/- 50 (13)
22	Charley Lake Fluted	10,530 +/- 80 (3)
23	Vail Fluted	10,520 +/- 70 (5)
24	Hatwai Stemmed	10,465 +/- 142 (2)
25	Dust Cave Notched	10,390 +/- 65 (3)
26	Clovis (BWD) Folsom	10,380 +/- 140 (4)
27	Rogers R.S. Dalton	10,365 +/- 300 (2)
28	Danger Cave Fluted	10,355 +/- 125 (4)
29	Hanson Folsom	10,260 +/- 90 (4)
30	Daisy Cave Paleocoastal	10,260 +/- 90 (3)
31	Kincaid R.S. Folsom	10,150 +/- 85 (3)
32	Page/Ladson (Bolen notched)	10,090 +/- 50 (3)
33	Bonfire Shelter Folsom	10,080 +/- 100 (3)
34	Arlington Canyon Paleocoastal	10,040 +/- 190 (2)
35	Mesa Site Plano	10,007 +/- 40 (3)

Key

- ● Sites dating before 10,500 rcybp
- ○ Sites dating after 10,500 rcybp

Refer to Tables 3.03 and B.02 for references

Figure 3.12 Distribution of securely dated Paleoindian sites of North America

In the Southeast region, Classic Clovis points are undated, as are the occasionally fluted lanceolate, but concave base varieties such as Suwannee/Quad and Simpson. However, there is ample stratigraphic evidence demonstrating their antiquity. For example Suwannee/Quad points were found with Clovis at the Silver Springs in Florida (Hemmings, 1975). Suwannee/Quad points were found below Dalton at Hester, in Missouri (McGahey, 1992) and Stanford reports that Suwannee/Simpson like points were found stratigraphically below Folsom varieties at the Horn Rock Shelter in Texas (1991:9). Stanford (1991:9) has suggested that the Suwannee/Quad and Simpson forms actually predate Clovis, but there is not enough evidence to determine their true, stratigraphic and chronological relationships. Chapter Six presents more data regarding the occurrences of these varieties in Florida.

Figure 3.12 shows the geographical locations of the securely dated North American sites, demonstrating that the Central and Northeastern portions of the continent have good radiocarbon control. On the other hand, it is also true that reliable radiocarbon control is lacking from both the Northwestern and Southeastern regions -- two very important regions to test for the trajectory of colonization by people making fluted points.

Looking for Clovis Ancestors: Northeast Asia and Central Europe

The previous discussions have outlined evidence suggesting that the spatial and temporal patterns of colonization by people making fluted points does not conform to the Wave of Advance model of migration across Beringia and later down into the continent. Another significant aspect of the issue of the peopling of the New World, often glossed over by researchers in archaeology and from other disciplines, is the current lack of unambiguous precursors to the Clovis Culture in Asia and eastern Europe.

There are two basic archaeological cultures known in Siberia: Malta/Afontova (or what might also be called Kostenki) and Diuktai (blade and microblade) (Dolitsky, 1985; Grigor'ev, 1993; Haynes, 1982; 1987; Klein, 1971; Mochanov, 1978; Yi and Clark, 1985). Logically, movement across Beringia into the New World should be traceable from one or both of these groups.

Kostenki is a widespread group of Gravettian Upper Paleolithic sites known from several smaller regional cultures such as Willendorf, Pavlov, Kostenki and Avdeevo (Kozlowski, 1986; Grigor'ev, 1993). These assemblages share technological and stylistic attributes of chipped stone and bone industries, art and ornamentation, and residential structures built with the proboscidean remains. They are characterized as specialized mammoth hunters.

The distributions of these assemblages are considered by local researchers as the results of social groups linked by biological and linguistic ties (Soffer and Praslov, 1993:6-8). These groups become archaeologically visible between 30,000 and 25,000 rcybp in Central Europe and spatial and radiocarbon analysis of Kostenki sites reveals a pattern of expansion from west to east. That is, sites become increasingly younger and more scarce to the east, toward, but not actually near, the western Hemisphere (Haynes, 1987; Soffer, 1993:43; Svezhentsev, 1993). One of the farthest north and eastward of these sites is in fact an outlier of this cluster. This site is Berelekh, near the Indigirka River delta in Northeastern Siberia. The majority of Kostenki sites occur in the Russian Plain, near the Dnepr and Don Rivers.

Diuktai, on the other hand, is a microblade techno-complex or tradition with representatives across much of eastern and southeastern Asia (including Japan). These microblades occur unequivocally after ca 18,000 rcybp in Northern China and possibly diffuse across related cultures already on the landscape (Gai Pei, 1985:236-238). There is a good possibility that the incorporation of microblades represents copying (reticulation) of technological advances of chipped stone industry, by diffusion, by a wide set of Asiatic Upper Paleolithic cultures.

Diuktai assemblages from Northeast Asia have been suggested as the source from which Denali and Paleoarctic complexes are to have originated (Carlson, 1983; Dumond, 1983; Dumond and Harp, 1983; Nelson, 1937; Turner, 1986, Yi and Clark, 1985).

The assemblages are characterized as having:

- Convex based bifacial points
- Discoidal and wedge shaped cores
- Burins on notched flakes
- Burin spall implements
- Microblade scrapers
- Blade and microblade tools
- Thick bifaces with ovoid, straight bases
- Pebble choppers
- Dihedral burins
- Crescentic flakes
- Frequent use of obsidian
- Blades with notched bases

These assemblages also are considered as evidence for the expansion of the speakers of proto Na-Dene and who shared distinct biological characteristics as discussed in Chapter Two, and Appendix A (Carlson, 1983, 1991; Clark, 1991; Greenberg et al., 1986; Haynes, 1982:395; Turner, 1986). The site inventory presented above located eight early (12,000 to 10,500 rcybp) aged sites exhibiting microblades, of which Dry Creek is the earliest unequivocal occurrence (Figure 3.13)[6]. In the inventory sample, three of these sites have radiocarbon control and two exhibit continuity through to the early Holocene (Dry Creek, Gallagher Flint Station and Healy; Table 3.03; Appendix B, Table B.02).

There are several clusters of microblade sites in specific areas of Northeast Asia from which groups may have originated and which might be reconstructed archaeologically and biologically (cf. Dikov, 1978). Microblades represent a clear time transgressive migration or diffusion pattern between Northeast Asia and the New

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[6] Bluefish Cave has been proposed an early example of microblades at around 14,000, but the ^{14}C dates do not necessarily date the occupation (Morlan and Cinq-Mars, 1982).

World, and possibly the most distant association of archaeologic-biologic-linguistic data in the New World. West (1981; 1983), derived both Clovis (e.g. fluted point) and Denali (e.g. microblade) traditions out of the Diuktai of Northeast Asia. This possibility was also offered by Mochanov (1980). However, Diuktai projectile points and bifaces more closely resemble convex based stemmed points as seen in the Far West of North America. The position that Clovis is derived from these technologies is not supported by the spatial arrays, the chronologies, nor by technological or stylistic similarities.

Haynes (1982) discussed these two Siberian archaeological culture-complexes and pointed out that (Malta /Afontova) was a mammoth hunting, blade and biface oriented chipped stone assemblage with ivory foreshafts and use of red ocher and therefore was most potential for Clovis ancestry. In 1987 he increased the list of similarities between Clovis and European (Kostenki) assemblages to 9, including:

Blades
Burins
Knapped bone
Red ocher
Circumferentially chopped tusks
End scrapers
Shaft wrenches
Unifacial flake tools
Cylindrical bone points

However, these similarities lack proximity to earlier Clovis sites, as well as familiar or recognizable morphological similarities to Clovis projectile point morphology. That is, thin lanceolate biface projectile points made on biface preforms, with concave bases and possibly with fluting. The majority of sites from which a density dependent Wave of Advance migration might flow are in Central Russia. There are no sites in closer proximity to Northeastern Siberia trailing into Beringia, and Alaska except for the outlier, Berelekh. These artifact similarities may be due to ancestry, but also it is possible that they are due to independent invention or adaptation to similar subsistence or economic environments (analogy).

The most familiar, pre-microblade and microblade chipped stone assemblages shared in both Northeast Asia and the New World are assemblages exhibiting convex based stemmed points, blade and biface technologies, and use of burins. Examples of such occurrences include the early levels of Ushki Lake in Kamchatka; Osipovka on the Amur River and sites in Hokkaido, Japan. Similarities shared by these assemblages include point morphology and chipped stone reduction technologies (Bryan, 1980; Carlson, 1983:82; Chard, 1974:61; Dikov, 1968; 1983; 1988; Rouse, 1976:609; West, 1983:372).

Convex Based Stemmed Point Traditions

In 1958, Willey and Phillips (1958:90) lumped various potentially early stemmed point and ground stone assemblages into their Archaic stage in the Northwest and Great Basin there was a lack of ^{14}C control suggesting late Pleistocene/early Holocene chronologies. There was evidence for subsistence economies based on procurement of diverse animals and plant resources, markers of the Archaic as they defined it. In 1966, and with accumulating radiocarbon controls, Willey designated several "Old

Cordilleran" sites as Paleoindian (using the term Paleoindian chronologically). Rouse has called the pattern "Lermoid", after projectile point styles found in Mexico. These assemblages have recurrent characteristics and early radiocarbon controls which have been synthesized by various researchers including: Bonnichsen et al. (1987); Bryan (1980); Carlson (1983); Irwin-Williams (1979); Rouse (1976); Wallace, (1978); Willey (1971). A recent and useful publication concerning this tradition and problems in determining its ancestry, is Willig et al. (1988).

Convex based stemmed points, using the term as loosely as one would concave based fluted points, tend to be located in Western North America. This distribution appears to continue into South America, with distribution more to the north and west as well (Figure 3.13). As already stated, 24 convex based stemmed point related sites were recorded as belonging in the 11,200 to 10,000 rcybp range. Two other sites, Arlington Canyon and Daisy Cave in California, are representatives of the Paleocoastal Tradition, which may also be a convex based stemmed point progeny group (Morratto, 1984). Their distribution is shown in Figure 3.13. Many of the fluted point localities mapped in Figure 3.08 in the Northwest and Great Basin are also stemmed point localities, but this has not been sorted out or illustrated as yet. Seventy other stemmed point sites were recorded after 10,000, with the youngest extending to the 7,000 year old limit. Eighteen convex based stemmed point sites had indeterminate chronology.

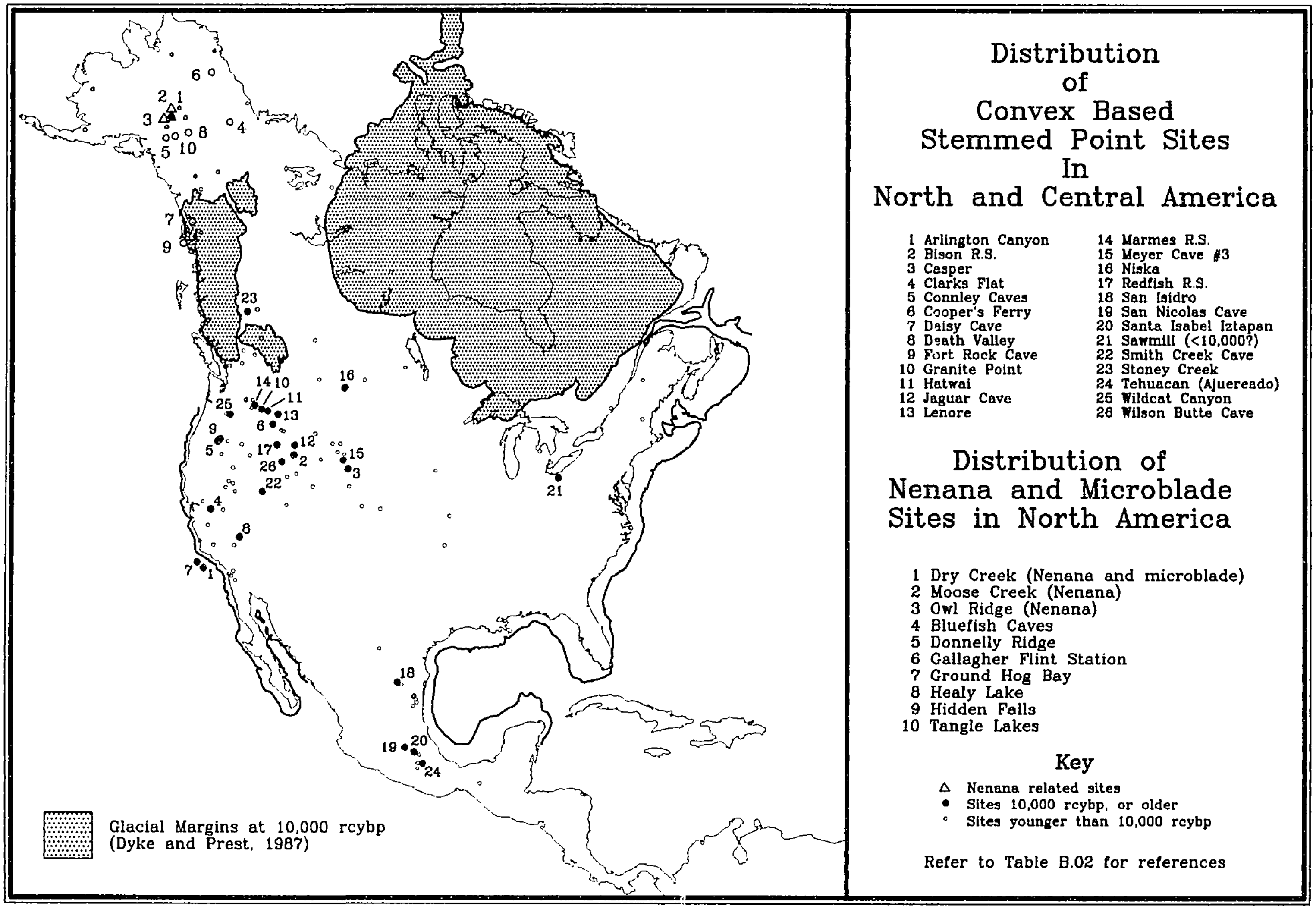


Figure 3.13 Distribution of stemmed point, microblade and Nenana sites

Stemmed points describe convex based lanceolate projectile points that are thick and round ended or pointed. They seem destined for socketing rather that split shaft attachment (Bryan, 1980). The term "stemmed" is not meant to include those shouldered projectile points which may have concave, thinned bases which would be hard to distinguish from fluted points if found broken below the shoulder. Examples of these can be seen in the assemblages from Fells Cave, and other fishtailed point sites in South America (Ardilla Calderon, 1991; Politis, 1991) or, perhaps, Arredondo in Florida (Bullen, 1975). Chapter Six will explain the chronological position of Arredondo points in Florida.

Various terms for stemmed traditions and complexes include Western Lithic Co-Tradition, Western Pluvial Lakes Tradition (WPTL), San Dieguito, Lake Mohave and others (Bedwell, 1973; Bryan, 1980; Moratto, 1984; Willig and Aikens, 1988:4). Projectile points include Windust, Lind Coulee, Lake Mohave, Cascade, Haskett and others. The Plano points known as Hell Gap, Agate Basin and possibly Eden would be included as representatives of convex based stemmed points (cf. Willig and Aikens, 1988:4). Other Plano varieties like Scottsbluff would be more ambiguous. The use of the term convex based stemmed points subsumes the noise of diversity just as the term concave based fluted point does (cf. Carlson, 1983).

As fluted variants occur in Central and South America, so too Lerma, El Jobo, Lauricocha (I, II, III) and Ayamptin styles in the southern portions of the hemisphere resemble stemmed points (Dillehay et al., 1992; Lynch, 1990; Mayer-Oakes, 1986; Rick, 1980; Willey, 1971). Pacamachay in Peru is a good example of these kinds of projectile points and the associated chipped stone assemblage (Rick, 1980).

The projectile points are long stemmed, often slightly shouldered bifaces, with blades frequently shortened by severe resharpening. The tips are often intentionally burinated. The points are thick in cross section, like the diamond shaped profiles of Agate Basin or Cody Complex projectile points. These bifacial artifacts were probably glued into a socketed fitting, rather than tied in a split shaft (Bryan, 1980:78; Musil, 1988; Willey, 1966:52). While these projectile points are distinct markers, they are infrequent in any particular site assemblage. The frequency of fluted and fluted related (concave base) projectile points within their specific site assemblages is generally greater (Goebel et al., 1991).

Other items of the assemblage include ovoid and keeled scrapers, ovoid knives, and end scrapers (some with lateral spurs, not unlike some fluted point assemblages). Bryan (1977) reported flake microtools and bola stones (Bryan, 1980; Carlson, 1983:76; and Wallace (1978); Warren and Phagan (1988); cf. Douglas et al. (1988:132). Burins are more frequent in stemmed point assemblages than in fluted point assemblages.

Points illustrated from Monte Verde (Dillehay et al., 1992) are stemmed varieties by this description, and they might therefore represent the earliest manifestation of these points in the New World. However, stemmed point chronologies in North America appear to be later than Classic Clovis fluted points both by ^{14}C data (Table 3.03) and geoarchaeological evidence (Davis, 1978; Willig, 1989). The earliest of these assemblages are approximately contemporaneous with fluted point related materials of the 10,600 rcybp time frame and later. The earliest securely dated (>one date) convex based stemmed point site is Marmes Rock Shelter at 10,680 +/- 80. Examples of other, securely dated convex based stemmed point sites include Smith Creek Cave in Nevada, at 10,600 +/- 80 and Hatwai in Idaho at 10,465 +/- 140 (Table 3.03).

Several discussion in the Willig et al. (1988) volume are dedicated to the dilemma of determining the origins of the stemmed point morphological diversity and assemblage differences from those of fluted points. Willig and Aikens (1988) discussed the problems of determining the relationship between fluted points and stemmed points by considering adaptational, chronological and cultural explanations. They reached no conclusion because problems accrued with each explanation. Both Willig (1988; 1991) and Moratto (1984:103) propose that fluted and stemmed points represent a cultural, traditional continuum from fluted points to stemmed points, based, in the main, on the temporal and geographical overlap of the two traditions.

On the other hand, Basgall (1988); Bonnichsen et al. (1987); Bryan (1980); Rouse (1976); and Warren and Phagan (1988) have concluded that stemmed and fluted points represent distinctly different social/cultural groups. Fluted point lithic tool assemblages are essentially lacking in burins, crescents, and convex based points especially when the Eastern North American assemblages are taken into consideration, but this is not true in all cases farther west. For instance, burins have already been listed above for the collections from Aubrey in Texas, and Murray Springs in Arizona and crescents are known from the Simon Cache in Idaho and from Borax Lake in California (Tadlock, 1966; Stanford, 1991). Regardless, their frequencies are very low in the fluted point occurrences, but they are more frequent in the stemmed point assemblages.

Fagan (1988) noted different platform preparation techniques between the two assemblages at the Dietz site in Oregon, and Pendelton (1979) recorded distinct differences in both raw material use and reduction sequences in stemmed assemblages from Nevada. Often there is a greater degree of refinement in the production of fluted points than stemmed, but not in all cases. While Frison has noted a resemblance between Folsom preforms and the penultimate production stages of Agate Basin points (1991:148), Bradley (1993) considers the reduction strategies of Folsom and Agate Basin stemmed points to reflect different cultural groups.

At Fort Irwin in California, 75% of the fluted points were made from cryptocrystalline raw materials, but only 25% of the stemmed points were (Basgall and Hall, 1991:61-63). These researchers observed that fluted points tend to be found as isolates, whereas stemmed points occur clustered within the confines of sites.

They state (1991:63):

> "Although not conclusive, variation in the overall disposition of fluted and stemmed points in the Mojave Desert is striking enough to suggest associations with different cultural systems..."

In excavated contexts in the High Plains, fluted point and stemmed point assemblages do not occur together on the same living surface. In fact, recent re-analysis of the Hell Gap stratigraphic sequence reveals that Folsom and Agate Basin levels might alternate, suggesting the return of different cultural groups at different times (Frison and Sellet, 1994). Willig (1988; 1989) demonstrated clear spatial separations between fluted and stemmed assemblages around relict Pluvial lake margins with the fluted point materials commonly located around lower (older) lake level strands.

On the other hand, the occurrences of concave base points in association with stemmed points in early and middle Holocene contexts (e.g. at Fort Rock, or Black Rock Cave, Figure 3.13) contribute to ambiguity classifying these assemblages in cursory review and based solely on projectile point morphology. In Ecuador, a mix of stemmed and fluted characteristics occured at the El Inga Site (Mayer-Oakes, 1986). Bola stones, listed as attributes of stemmed assemblages by Bryan (1980), occur in isolated and stratigraphic contexts in Florida, as well as in both stemmed and fluted sites in South America (Dillehay, 1984; Dunbar et al., 1989; Tesar, 1994a; Turner and Bird, 1981).

Certainly the stemmed point tradition is technologically and geographically distinct and recognizable. Also, the differences in the natural environments of the east and west would have influenced the development of lithic technologies, and choices of raw material. Thus, environment may have explanatory power regarding differences among contemporaneous groups. However, evidence for convex based stemmed point occupation extends across diverse environmental zones in northern North American, during the early Holocene, as does evidence of concave based fluted point occupation.

Often designated as Plano in the Plains, Central and Eastern states, convex based stemmed points, and their associated assemblages, arrive in the East later in the sequence, after 10,000 rcybp as one would expect with growing populations of linguistically and biologically related people (Doyle et al., 1985; Mason, 1981; Stothers and Abel, 1991; Figure 3.13 "sites younger than 10,000 rcybp"). It is also useful, perhaps, that similarities of projectile point morphology continue for more time with stemmed points than with fluted points, implying less innovation amongst the people who made stemmed points than those making fluted points. Examples include the similarity of biface projectile points of the Kayuk Complex of Alaska and Agate Basin points (Campbell, 1959), or Nebo Hill in Missouri (Reid, 1983; O'Brien and Warren, 1983)).

Differences between these assemblages perceived from the framework of adaptation and process (analogy) become differences between specialized exploiters of

Pleistocene megafauna (exemplified by fluted points) and exploiters of wide ranging resources from diverse lacustrine and arid desert ecosystems (represented by stemmed point assemblages). Hafting strategies are not perceived so much as cultural markers but as technological responses - i.e. analogies.

Were the people who made convex based stemmed points, and their associated tools, directly related to (i.e. progeny of) people who made fluted points, or they were related to other biological / linguistic groups? While this question may not seem germane to models of adaptations to changing environments, it is important to interpreting the process by which the New World was peopled - and how its populations became so diverse. A test of the relatedness of the people that comprised these groups could be made with skeletal samples if representatives of the two assemblages could be identified (Appendix A). In lieu of such ideal data, additional assemblage comparisons, sampling and principled test implications are vital to the resolution of this problem.

The accumulation of additional archaeological evidence for precursors in Siberia and Northeast Asia will also contribute to the resolution of this problem. Evidence was presented above, for instance, that convex based stemmed points and their associated assemblages are most similar to pre-microblade and microblade bearing archaeological remains in Northeast Asia (Bryan, 1991:24; Dikov, 1988). This means that if these assemblages could be traced into North and South America - earlier to later - from

Northeastern Asia or Siberia, then stemmed points in the Northwest and Great Basin are probably not Clovis progeny. Of course, we are still left no identified homeland for Clovis.

The Nenana Complex of Alaska

The Nenana Complex, a terminal Pleistocene Upper Paleolithic chipped stone assemblage in Alaska, is considered here as a possible early or pre-microblade expression of ultimate Asian convex based stemmed point blade tradition relationship . Nenana is represented by three archaeological sites in Alaska in the database inventory: Dry Creek (Component I, 11,120 +/- 85), Moose Creek site (Component I), Walker Road (Component I, 11,230 +/- 90) and Healy Lake (Level 8, Chindadn occupation dated at 11,090 +/- 170 (Gx-1341), Clark, 1984:69; Figure 3.13). These sites exhibit similar chipped stone industries, recurrent stratigraphic situations, abundant artifacts, and multiple ^{14}C dates in general agreement (Goebel et al., 1991; Powers and Hoffecker, 1989; Haynes, 1987a).

Materials found in these sites have been likened to materials in the lower (i.e. pre-microblade) levels in Ushki Lake in Kamchatka (Powers and Hoffecker, 1989:283; Dikov, 1978). Goebel et al., 1991:74 have suggested that the lower levels at Ushki and Berelekh share attributes with the Nenana Complex. Nenana Complex projectile points are convex based, tear drop shaped and known as Chindadn points. As with sites representing the stemmed point traditions, bifacial projectile points are in low frequency within individual Nenana assemblages. Artifacts which characterize the Nenana collections include: blades and blade cores, tools on blades, unifacial end and side scrapers, perforators, wedges, large planes made from cobbles, and bifaces (Goebel et al., 1991:49). Burins are also regular parts of the assemblage.

Goebel et al. (1991:50) have used a modification of Bordes typological system which compares frequencies of tool classes in cumulative percentage graphs. These researchers compared only four selected assemblage examples of Microblade (Dry Creek), Nenana (Walker Road), and Clovis (Murray Springs and Blackwater Draw) . Their modification of the Bordes system compared the percentages of tool classes with a computer clustering algorithm. While the Nenana assemblage was more similar to Clovis than to the Microblade sample, only four sites representing three assemblages were involved and the attributes used for the mathematical algorithm may be expressing similarities of functional, not ancestral, categories (cf. Jelinek; 1992)

Differences between the fluted point and Nenana examples in their cumulative percentage graph were most apparent in the category for "bilaterally retouched blades" The fluted point assemblages exhibited higher percentages, e.g. 28% at Blackwater Draw, 9.4% at Murray Springs, 5.4% at Walker Road, and 0% at Dry Creek I). The frequency of projectile points was also different: 13 % Blackwater Draw, 21% at Murray Springs and 1.6% Walker Road, 5.4% at Dry Creek I.

There was no attempt to address morphological differences of the chipped stone tools, the projectile points or the reduction strategies involved in manufacture. Nevertheless, these are the kinds of comparisons that need to be principled, attempted and expanded. The meaning of the attributes being compared need to be addressed to bring into focus if those characteristics have the highest potentials for reflecting ancestral relationships (homology), and to sort out attributes that may be reflecting independent invention (analogy) or diffusion (reticulation) (Tompkins, 1994; cf. Appendix A).

No skeletal remains have been associated with this archaeological culture with which to test biological relationships. An alternative hypothesis could be made that Nenana, with its tear drop shaped projectile points, represents ancestors or relatives of people who made convex based stemmed points (cf. Willig and Aikens, 1988:21; Mayer-Oakes, 1986).

Currently the geographic distribution of the sites is small and essentially contemporaneous with the earliest manifestations of Clovis farther south in the North American continent (i.e. Aubrey, Blackwater Draw, Lubbock Lake, Domebo, Colby and Lange/Ferguson). However, if sites of earlier date begin to accumulate in the site inventories and if there are analyses of stylistic and chipped stone reduction strategies that resemble other fluted point occurrences, then Nenana may indeed represent a potential assemblage for fluted precursors. The fluted point site arrays will still be difficult to explain away.

Fluted Point Progeny: Late Paleoindian and Early Archaic Occurrences

If people become visible archaeologically between 11,200 and 10,500 rcybp, what is the pattern of their developments afterward? Attention to the transformation of Paleoindian groups into subsequent Early Archaic ones can illuminate which groups settled in which places in the continent. The principle that compels this attention is that areas with higher densities and diversities of evolving artifact assemblages represent areas of thriving progeny cultures, with linguistic and biological relationship to the original colonists, probably near the initial entry point(s). This concept is analogous to the "age-area" hypothesis described by Willey and Phillips (1958).

Between 10,500 and 9,000 rcybp, several stylistic traditions become visible in North, Central and South America. Some of these traditions have apparent, albeit evolved, similarities with the concave based fluted point tradition, some which are more similar to the convex based stemmed point tradition, and some which appear to be mixtures of the two. These traditions develop in distinct areas of the continents, areas which also register relatively greater Paleoindian site abundance. The database inventory recorded 157 sites in the 12,000 to 10,000 rcybp time frame that exhibited evidence of continued, or later occupations. In addition, 128 sites were recorded in the next, 10,000 to 9,000 rcybp time frame. The arrays of these two classes of sites are shown in Figure 3.14. The following discussions offer particular sites for examples. References and data recorded for these sites is presented in Appendix B, Table B.02.

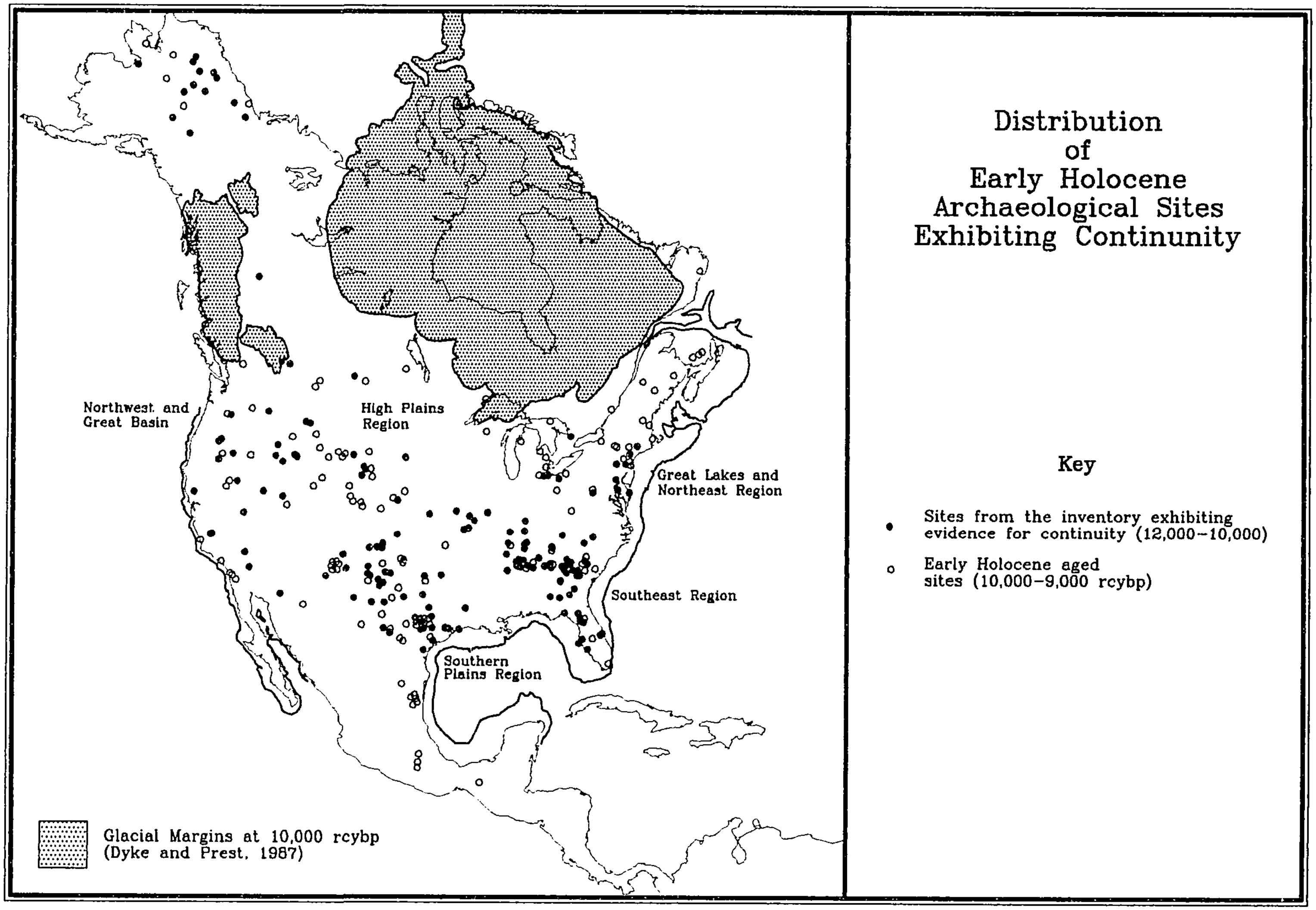


Figure 3.14 Distristribution of Early Holocene archaeological sites exhibiting continuity

Archaeological traditions in Alaska have clear stylistic and technological continuity from the earliest microblade traditions at the end of the Pleistocene, through to the middle Holocene. Evidence for these transitions is found at such sites as Healy Lake, Onion Portage, and Trail Creek in Alaska (Table B.02). Another site, Namu, represents an outlier in British Columbia with evidence for procurement of marine resources in the early Holocene, and implying boat technology. An expansion of the range of Agate Basin convex based stemmed point assemblages occurs in high Northern latitudes and in the early Holocene (Bryan, 1980). Engigstciak in Yukon Territory, for instance, dates in the 9,000 rcybp frame. These similarities exhibit aspects of both homology, analogy, and reticulation according to local researchers (Dumond, 1987; also discussed in Benedict and Olsen, 1978). There is no evidence for fluted point continuity into the Holocene in Alaska.

The transitions from fluted points into the subsequent traditions in the Northwest, the Great Basin, and along the California Coast are equivocal, as described above. Recent publications belie arguments amongst the local researchers who compare and contrast the assemblage characteristics and stylistic attributes of stemmed points and fluted points, without clear resolution (Willig et al., 1988). However, most Holocene examples of human occupation in the Northwest and Great Basin resemble stemmed point traditions, rather than fluted point ones (Moratto, 1984; Moriarity, 1966).

Examples of convex based stemmed point transitional sites in these western regions include Windust Cave in Washington, Connely Caves and Fort Rock Cave in Oregon, Hatwai in Idaho, Smith Creek Cave in Nevada, and C.W. Harris in California. Windust, Cascade, Lind Coulee, and Old Cordilleran archaeological cultures. In fact, convex based stemmed point assemblages have many more representatives in the 10,000 to 8,000 rcybp range, than earlier. Sites like Daisy Cave in the 10,000 rcybp frame represent another example of movement by water across to the Catalina Islands in Southern California, and earlier than the evidence from Namu at 9,000, presented above. Regardless, these same sites often contain concave based, fluted point similar, lanceolate points within the arrays of chipped and ground stone artifacts. I would suggest these are examples analogous to, or borrowed from the fluted point tradition, representing hafting options and not evidence for ancestry. Sites exhibiting these items include Fort Rock Cave and Connely Caves in Oregon, and Ventana Cave in Arizona.

In the High Plains, where evidence for fluted point occurrences is robust in the form of Folsom and Goshen/Plainview projectile point varieties, Agate Basin and Hell Gap convex based stemmed point sites accrue after about 10,400. The Agate Basin and Hell Gap stemmed point traditions are particularly robust after 10,000 rcybp. Sites that exemplify this observation include: Finley in Wyoming, Frazier, Jones-Miller and Sister's Hill in Colorado. How the Cody Complex, Eden and Scottsbluff materials are related to the Agate Basin or Folsom traditions is morphologically unclear. Likewise, there is confusion wrought with several concave based points in the area including

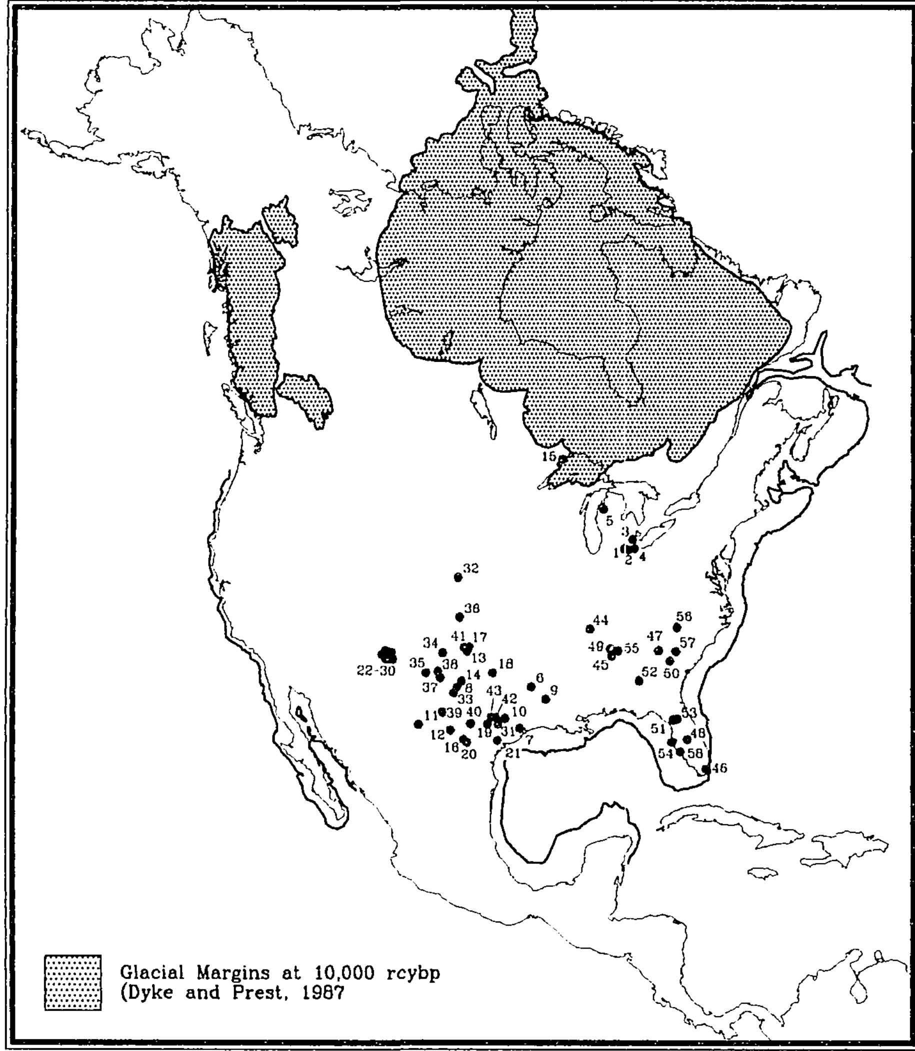
Lusk, Angostura, and Pryor Stemmed. Bryan (1980) has suggested that Lusk points fill the fluted point gap, and thus represent continuity, but the link is weak. Sites like Medicine Lodge Creek and MacHaffie are stratified sites which exhibit much of this complex stylistic variation, even including examples of concave based point of Dalton appearance (Frison, 1983). There could be a large area of sharing or contact, or both, across the Plains, the central states and eastward into the Southeast as shown by the intersection of clusters of sites in Figure 3.14. These sites can be reviewed for more clarity in Davis et al. (1991); Forbis and Sperry (1952); Frison (1983).

The Southwest is relatively void of people in the early Holocene (Berry and Berry, 1986; Irwin-Williams and Haynes, 1970; Young et al., 1987). This is particularly germane given the robust, if temporally restricted, evidence for the people who made fluted points in Southern Arizona at sites such as Murray Springs and Lehner Ranch. Of the few recorded early Holocene aged sites in the Southwest, Ventana Cave is a convex based stemmed point (San Dieguito) example, and Whitewater Draw is probably another. There is no evidence for progeny settlement of fluted point traditions in the Southwest.

The southern Plains represent another area with mixed assemblages of both traditions. On the Llano Estacado, Agate Basin and Hell Gap varieties occur above Folsom and Plainview in stratigraphic section. To the east, nearer the Plains/Woodland border, concave based and incipient notched Dalton and San Patrice projectile points are known across eastern Texas into Louisiana (Johnson, 1989). The San Patrice points are similar to the Greenbiar-Hardaway series of the Southeast and the Hi-Lo varieties of the Great Lakes region (Coe, 1964; Stothers and Abel, 1991; Figure 3.15). Whether these broader similarities are due to homology, analogy or reticulation remains a question for additional research.

Evidence in the Great Lakes for progeny fluted point traditions is robust. The Gainey, Parkhill, Barnes probably represent developments over the first 1,000 rcy of occupation (Storck, 1988; 1991). Likewise, in the Far Northeast Late Paleoindian projectile points retain the deeply indented base of the previous fluted points, but become shorter and more basally thinned than fluted (Keenlyside, 1991). Assemblages retain focus on bifacial technologies and unifacial tools. Many of the latter exhibit evidence for hafting.

Incipient notched, concave based Hi-Lo Projectile points varieties of the Great Lakes region (Stothers and Abel, 1991; Figure 3.15) are similar in morphology to the Greenbiar-Hardaway series of the Southeast and the previously mentioned San Patrice varieties across southern Texas and Louisiana (Johnson, 1989). Arguments in the literature pertaining to early Holocene occupation of the Northeast revolve around the possibilities of population decline, or even possible abandonment of the region in later, but still early Holocene time.



Distribution of Early Holocene Concave Based and Notched Point Sites

1 Barden #2 (4.1)
2 Dodge (4.1)
3 Eleven Hi-Lo Sites (4.1)
4 Green Creek (4.1)
5 Hi-Lo (4.1)
6 John Pearce (4.2)
7 Owen Site (4.2)
8 Steadman (4.2)
9 Whately (4.2)
10 Winnie's Mound (4.2)
11 Alpine Creek (4.3)
12 Baker Cave (4.3)
13 Beaver Dam A (4.3)
14 Beidleman Ranch (4.3)
15 Brohm etc. (4.3)
16 Chaparrosa Ranch (4.3)
17 Currant Creek (4.3)
18 Field Ranch (4.3)
19 Greenhaw (4.3)
20 Holdsworth (4.3)
21 Johnston (TX) (4.3)
22 Judge (12 WG 5) (4.3)
23 Judge (13 BR 3) (4.3)
24 Judge (13 BX 9) (4.3)
25 Judge (13 FJ 8) (4.3)
26 Judge (13 LG 9) (4.3)
27 Judge (14 CS 5) (4.3)
28 Judge (19 JL 5) (4.3)
29 Judge (9 SJ 5) (4.3)
30 Judge (9 VD 9) (4.3)
31 Lake Thunderbird (4.3)
32 Lime Creek Site (4.3)
33 Lone Wolf Creek (4.3)
34 Madsen Lake (4.3)
35 Milnesand (4.3)
36 Olsen-Chubbock (4.3)
37 Plainview (4.3)
38 Ryan's Site (4.3)
39 Site (41 CX 12) (4.3)
40 Strohacker (4.3)
41 Thurmond Rnch etc.(4.3)
42 Tombstone Bluff (4.3)
43 Wilson-Leonard (4.3)
44 Big Sandy Site (4.4)
45 Cave Springs (4.4)
46 Cutler Ridge (4.4)
47 Gregg Shoals (4.4)
48 Nalcrest (4.4)
49 New Garden Site (4.4)
50 Phinizy Swamp (4.4)
51 Senator Edwards (4.4)
52 Standing Boy (4.4)
53 Trilisa Pond (4.4)
54 Turtlecrawl Point (4.4)
55 Walls I R.S. (4.4)
56 Hardaway (4.6)
57 Taylor (4.6)
58 Wm Mineral Sprngs (4.6)

Key

Number in ( ) refers to point types explained in Appendix B, sites and references given in Table B.02

Figure 3.15 Distribution of Early Holocene concave based and notched point sites

Late early Holocene assemblages begin accumulating after this, and these are dominated by Kirk stylistic attributes and associated chipped stone assemblages (Funk, 1978; Funk and Wellman, 1984; Doyle et al., 1985; Mason, 1981). Kirks are demonstrated to be in the line of continuity with fluted point assemblages farther south (Chapman, 1985; Mason, 1981; Oliver, 1985), but the reasons for these particular similarities remain to be worked out. Again, the dilemma is sorting out analogy (independent invention), reticulation (diffusion) or homology (possible migration).

In the Southeast, the Dalton, Simpson, Suwannee/Quad projectile point types, and their associated chipped stone assemblages, probably reside in time between 10,500 and 10,000 rcybp, or a little later (Goodyear, 1982). Fluted points in the Southeast often have waisted, flaring bases, and these characteristics continue, and are enhanced on projectile points across the Paleoindian to Archaic transition in the Southeast (Anderson et al., 1992; Broyles, 1971; Coe, 1964). Single component Paleoindian sites are rare in the Southeast and while this is not so good for dating southeastern fluted points (Goodyear, 1991), it does bolster the argument for continued occupation and parent/progeny relations.

In the Southeast the apparently gradual transition from Paleoindian lanceolate forms to the smaller notched projectile point varieties may possibly reflect technological developments associated with the atlatl (Cockrell and Murphy, 1978; Webb, 1957). Specifically, incipient notched varieties like Greenbriar and Hardaway are followed stratigraphically by Bolen-Big Sandy-Taylor, fully side and corner notched projectile points. These measures may have been taken to strengthen the attachment of the point to the shaft, but this is speculation.

These innovations are taking place early in this Southeastern region, with the fully notched Bolen/Big Sandy varieties falling between 10,300 and 10,000 rcybp as radiocarbon dated in Alabama and Florida (Dunbar et al., 1988; 1989; Driskell, 1992). The Greenbiar-Hardaway series of the Southeast has already been mentioned as having similarities with San Patrice (Johnson, 1989) and the Hi-Lo varieties of the Great Lakes region (Stothers and Abel, 1991; Figure 3.15). The chronologies of these points in the latter two areas are currently equivocal. Chapter Six will discuss these developments from a Florida perspective.

There are numerous deeply stratified sites in the east which evince various segments of traditional continuity stratigraphically. Stanfield Worley, Thunderbird, St. Albans, Ruckers Bottom, and the Haw River Sites are good examples. Other good examples of evidence for continuity in the Southeast include: Wallace Reservoir, the Taylor site in South Carolina, and Dust Cave in Alabama (Table B.02).

Artifacts found within the assemblages are also used as evidence for technological continuity from fluted point traditions. These include various types of morphologically distinct unifacial scrapers, emphasis on biface reduction strategies, and wedges (Kimball, 1992; McNett, 1985; Purdy, 1981; Smith, 1986:14). But the chipped stone tools associated with these artifacts also exhibit evolution and change from earlier, Paleoindian items. This is true for notching of projectile points, and also in various chipped stone tools apparently used for working wood. The Dalton and Aucilla adzes are rather large chipped stone items of regular morphology which must have been used in the fabrication and construction of sizable wooden items, possibly camp or processing facilities, or boats (Morse and Goodyear, 1973; Gerrell et al., 1991).

Anderson and Hanson have proposed that site clusters represent clan groups tethered to particular river systems. Sufficient numbers of Early Archaic sites exist in the east to have been sorted to several functional categories, including residential base camps which may be evidence for early, if incipient, sedentism (Anderson and Hanson, 1988; Chapman, 1985). The accumulating evidence for the alteration of wood, implies some sort of building activities which have not been modeled by most researchers. The impression is of building and settling in.

Discussion

Artifacts belonging to the fluted point tradition represent the remains of biologically and linguistically related social and cultural groups. While this statement is meant as an hypothesis, it is buttressed by several facts. First, by the morphological similarities of fluted points and their reduction strategies from raw materials, next by the similarities of other tools and reduction strategies in the assemblages, by clusters of fluted artifacts and archaeological sites in both space and time and by the apparent continuity of progeny traditions and assemblages in some places, but not others.

Cultural, biological and linguistic cohesion is a logical and parsimonious explanation for the observed evidence. The same argument is thus implied for both stemmed and microblade archaeological cultures in their respective areas. If fluted points represent the earliest recognizable, recurrent, and well dated archaeological tradition or culture of North, Central and South America, then stemmed point, Nenana, and Denali represent others. If the fluted point tradition represents a linguistically and biologically related culture, then these traditions represent others. These are presented as rhetorical statements, to encourage more research to determine whether the people who made these other assemblages were the ancestors of the people who made fluted points, some of their progeny, or people of separate ancestries.

However, given this hypothesis, how can an archaeological culture like Clovis be so immediately recognizable, mature, practiced and widespread when it first appears, have several clear and evolving traditions which come from it into the Holocene, and yet be so invisible anywhere earlier ? Several researchers present different scenarios to explain this evidence. Most conclude that fluting itself must have originated in the New World (Table 3.04).

Table 3.04 Models of fluted point origins

Muller-Beck (1966, 1967) (in Goebel et al., 1991:73) suggested a link between the Eurasian Mousterian tradition to Clovis based on similarities of reduction techniques and on the presence of Mousterian elements in Northeast Asia-Siberia. This would suggest the presence of middle Wisconsinan aged sites in the New World, which are equivocal or non-existent.
West (1983) attempted a model of Clovis developing out of microblade precursors in Northeast Asia, but this is not supported by the chronological position of Clovis first, microblade assemblages later in the New World. Reduction techniques, and stylistic attributes are distinct, well.
Goebel et al. 1991 have Beringian Point Industry (Nenana), which includes Ushki I (& VII?) giving rise to Nenana and then to Clovis. However, Clovis is contemporaneous or earlier than these occurrences and some similarities of the Beringian Point Industry with convex based stemmed points in the continent also argues against this model.
Clovis technology developed from a bone tool technology which is difficult to perceive because of a lack of preservation. Originally based on equivocally early worked extinct bone material in Old Crow Basin, Yukon. Bonnichsen et al., 1987; Irwin et al., 1986.
Davis (1978) postulated the origins of fluted point making in the Great Basin, rising out of a convex based stemmed point precursor, but the dating of both fluted and stemmed point assemblages does not bear this out. Currently, convex based stemmed point occurrences are later than concave based fluted point ones in North America.
Haynes (1955; nd) suggested the possible development of Clovis out of a Plainview precursor. Parallels Frison's (1990; 1991) Goshen precursor model for the High Plains, which is not unequivocally substantiated by stratigraphic or chronological control. Plainview and Goshen considered as the same type by Haynes.
Kelly and Todd (1988) proposed that high technology foragers, resource focused, high mobility groups accessed specific resource niches, somewhat similar to leap-frogging concept described by Anthony (1990). Model based on H&G analogy, and assumes ice free corridor route, without thorough reference to archaeological chronology, site distribution patterns or cultural relations.
Anderson's (1990; 1991; 1992) resource centered model, models populations moving down rivers, from the corridor, to confluences, with rapid colonization and formation of isolated sub-traditions in response to spatial constriction due to growing populations and resource depletion. Postulates development of fluting in the central states, where their distribution is dense. No chronological control in these areas to determine trajectory yet.
Southeastern U.S. origins (Stanford, 1991; Bryan, 1991; Mason, 1962; Williams and Stoltman, 1965); Suwannee/Quad and Simpson possibly earlier than Clovis according to Stanford, 1991. No chronology available to test for early sites, no pre-Clovis homeland identified.
Dincauze, 1993 proposes that the larger sites of the east reflect staging sites for fluted point colonization, implies early colonization in the East.
See also Bonnichsen, 1991

However, the fact that there is a substantial *terra incognita* out on the continental shelves, and the deduction that colonizing populations must have come in from some coastline or inundated area (including Beringia),x allows for the possibility that some answers to these questions can be found underwater. It is a short intuitive step to propose that areas near clustered fluted point occurrences in the Gulf of Mexico, western Florida, and various locations along the East Coast of the United States were exploited by people who made fluted points and by their progeny.

Several facts and possibilities presented in this chapter can be combined to build a model of fluted point peoples colonizing the continent from the continental shelves of the East Coast of North America and the Gulf of Mexico. These include:

(1) The high frequency of fluted points found in Eastern North America, including fluted point clusters relatively near major drainageways of the modern coastline.

(2) The occurrence of more Classic Clovis fluted point sites in the Southern and Northeastern portions of North America, rather than in the High Plains or the Northwest where they are predicted by the Beringian - WOA model.

(3) The fact that the earliest fluted point sites have been found in the Southern Plains including Aubrey, Blackwater Draw, Lubbock Lake, Domebo and possibly McFaddin Beach. I propose that this represents evidence for the pattern and direction of colonization - from south to north.

(4) The presence of other possible early artifacts in the southern portions of North America such as true prismatic blades and more ivory foreshafts.

(5) The great diversity of fluted point and fluted point related projectile point styles in the East and Southeast.

(6) The robust record of continuity of traditional cultures into the Early Archaic as seen in Northeast and Southeast North America, indicating that people with biological and linguistic (ancestral) relationships to the people who made fluted points remained in this area, after their ancestors had come there.

It is possible, therefore that people sharing the fluted point tradition were existing out on the continental shelves before they become archaeologically visible inland. Given the dispersed locations of fluted point clusters, it may have been that these people came in to the continent from multiple staging areas, with movements proceeding up the major drainage channels in the Gulf of Mexico and the East Coast.

A complimentary model of human population movements by people who made convex based stemmed points and those exhibiting microblade technologies, originating in Northeastern Asia and moving through Alaska or along the Northwest coast, remain viable. However, the proposal that these groups are separate, avoids identifying the ultimate biological or geographical source for the people who made fluted points - other than the continental shelves. Bowdler (1990) explained a similar, counter-intuitive, distribution of archaeological sites being earlier in southeastern Australia, with a proposal that people were moving along the continental shelves first. I will return to this issue in the conclusion in Chapter Nine.

I propose that early fluted point sites, or perhaps better put, the sites of the ancestors of fluted point makers, will be found at the margins of the continental shelves where sea levels stood 11,500 to 11,000 years ago and that these sites will be more likely to occur offshore of the loci of higher density clusters of fluted points and fluted point sites, as shown in Figures 3.01 and 3.04, and near inundated river channels. This hypothesis might also include continental shelves near the clusters of isolated fluted points in Sonora, Mexico; Borax / Clear Lake in California, and Southeastern South America (Politis, 1991:289).

One test of this model is to determine the trajectory (chronology) of the colonization of Southeastern North America. If this model has merit, then Southeastern sites should be as early, or possibly earlier, than the Southern Plains examples of Aubrey, Blackwater Draw, Lubbock Lake, and Domebo. However, and as emphasized already, radiocarbon control for early Paleoindian presence in the Southeast is lacking (Anderson, 1990; 1991; Goodyear, 1991; Mayer-Oaks, 1984; Mason, 1962; Smith, 1986; Williams and Stoltman, 1965; Figure 3.12).

The evidence at hand is that a major pulse of Clovis colonization occurred over a 400 rcy time frame, that is from about 11,200 to 10,800 rcybp. Chapter Four will address the environmental conditions prevalent at the end of the Pleistocene, looking for correlations which might help to explain the apparent pulse of population increase by people who made fluted points as shown in Figure 3.11. Was this movement motivated by a "push", or a "pull", or some combination of both? Can we begin to explain this human migratory behavior by correlating site locations with rapidly changing environmental conditions such as sea level fluctuation, animal extinctions and/or the Younger Dryas climatic reversal? Chapter Four also discusses the degree and magnitude of post-glacial sea level rise, and appropriate locations for archaeological site discovery underwater on the continental shelves.

Chapter Four

THE END OF THE PLEISTOCENE

Environmental Conditions During Colonization

This chapter outlines the progression of the environment over the transition from Pleistocene (glacial) to Holocene (postglacial) conditions, particularly from 12,000 to 10,000 rcybp. This progression of conditions included glacial melting and associated meltwater discharges, sea level rise, shifting boundaries of plant and animal communities, the extinction of roughly 30 genera of large mammals and, of course, the unequivocal appearance of human populations archaeologically. Is it possible that one or more of these occurrences significantly impacted human populations, causing their movement inland?

In addition, some of these geological processes have obscured our perception of early human settlement patterns and adaptations by altering or concealing many relevant sedimentary records. For instance, migrating ice margins would have gouged any archaeological sites in their paths, increased stream flow from glacial meltwater would have eroded or buried past channel margin surfaces potential for archaeological scrutiny and rising sea levels have concealed the prehistoric record offshore.

Knowing these processes, and their chronologies, may contribute to the discovery of causal congruities between geologic and cultural processes. These congruities might reveal negative "push", or positive "pull" factors, or both, motivating the movements of people at the end of the Pleistocene (Anthony, 1990:898). The purpose, from the perspective of Chapter Two and given the distributional and chronological data discussed in Chapter Three, is to determine *how* and *why* people may have changed locations. Knowing the generalities of the geologic regimes may also help to anticipate areas potential for the discovery of early Paleoindian sites offshore.

Environmental conditions, like sea level rise, the availability of water resources and fluctuating floral and faunal communities, surely influenced Paleoindian movements, settlement patterns and procurement strategies. However, brisk rates of data accumulation in both archaeology and geology, have resulted in an understandable lag in correlation between these two disciplines. Recent archaeological address of the potential usefulness of explaining Paleoindian adaptations with up to date knowledge of recently known terminal Pleistocene environmental conditions was proposed by Bonnichsen et al. (1987), but no specific process or correlation was illuminated. Few others have attempted broad hypotheses built on site distributions and environmental chronologies with the exception of appealing to the axiom of Paleoindian changes in diet after the demise of the megafauna.

The Pleistocene epoch includes 11 glacial-eustatic sequences or couplets spaced relatively evenly over 1.8 million years of time. These oscillations are predicted by the changing parameters of Earth's orbit around the sun (i.e. obliquity, eccentricity, and precession), with glacial cycles nested in periodicities of roughly 23,000, 41,000 and

93,000 years. The mathematical model for orbital forcing was worked out by Milankovitch in the 1930s. Once considered an idea on the "lunatic fringe", these orbital parameters have since been demonstrated to be the major mechanism responsible for glacial cycles, and various associated environmental changes such as fluctuations in atmospheric CO_2 content, faunal extinctions, and redistributions of plant and animal populations (Imbrie and Imbrie, 1980; Chappell and Shackleton, 1986).

Glacial conditions are generally considered to be more equable than interglacials, by exhibiting mild winters and cooler summers. Glaciers build up more because of a lack of summer melt, than because of severe winter buildup. This equability allowed for floral and faunal mixed communities of warm and cold loving species continent wide, and unlike any known more recently. The orbital forcing theory states that glacial melting is the result of increasingly acute seasonality with progress into deglacial alignment (i.e. warmer summers and cooler winters). While glacial expansion is relatively slow in the deep sea records, glacial melting is always more rapid. Thus, a saw toothed pattern of glacial-interglacial conditions results, and as revealed by $^{18}O_2/^{16}O_2$ couplets in deep sea sediments (Kazanskivy, 1985).

The last Pleistocene glaciation cycle is known as the Wisconsinan. It commenced approximately 70,000 years ago with a gradual cooling trend and associated lowering of sea levels to the time of maximum glacial expansion at about 18,000 rcybp (Frye et al., 1978; Shackleton and Opdyke, 1973). There were two major bodies of ice in North

America, the Laurentide and the Cordilleran. The distribution of sequentially smaller ice boundaries (isochrons), representing the pattern and process of deglaciation have been summarized and mapped by Dyke and Prest (1987). Two of these margin reconstructions were used in the figures in Chapter Three (i.e. at 11,000 rcybp and 10,000 rcybp). In Alaska, glaciation was not widespread (Guthrie, 1985). It mainly covered the higher elevations of the Alaskan (south) and Brooks (north) mountain ranges.

During deglaciation, numerous proglacial lakes were located near, and the result of, the melting margins of the glaciers (e.g. Figure 3.07). Some of these were very large bodies of water. Further south, in the Great Basin, pluvial lakes were also significant features on the landscape and were undergoing changing lake base levels (Smith and Street-Perrott, 1983; Willig, 1988; 1989). In the Northwest, periodic and catastrophic releases of water from ice dammed lakes made severe impacts on the landscape (Baker, 1983). Combined, the glaciers, the lakes, the meltwater and the lowered sea levels significantly altered the character and appearance of the continent in a progression of changing conditions.

Deglaciation began as summer insolation maximums and winter insolation minimums began diverging between 14,000 and 13,000 years ago. Based on the orbital forcing models, the differentiation of seasons should have peaked about 11,000 years ago. Summers would have been warmer than today, and winters cooler (Patterson and

Hammer, 1987). Evidence from deep sea cores, and ice margin data confirm that the first robust pulse of melting began about 14,000 rcybp and was particularly rapid between 13,000 and 12,000 rcybp, relatively in concert with the Milankovitch model presented above.

However, melting slowed between 11,000 and 10,000 rcybp, a return to glacial conditions ensued. Ice margins expanded and sea level rise was reduced or reversed (Broecker et al., 1988; Curray, 1960; 1965; Fairbridge, 1961; Ruddiman and Duplessy, 1985; Ruddiman, 1987). A second robust pulse of melting and sea level rise then resumed from 10,000 rcybp to about 8,000 rcybp.

This "two step deglaciation" model of two melt water pulses (MWP I and II) is considered accurate because several lines of evidence point to it (Ruddiman and Duplessy, 1985). For instance, $^{18}O_2/^{16}O_2$ ratios obtained from Greenland ice cores, and used as proxies for temperature fluctuation, record the height of the warming trend at ca 13,000 rcybp and then a rapid return to cool conditions between 11,000 rcybp and ca 10,000 rcybp (Dansgaard et al., 1989; Paterson and Hammer, 1987).

This "whiplash" in the process of deglaciation was not predicted by orbital modeling and is known as the Younger Dryas (YD) interval. The YD is characterized by colder temperatures, lower precipitation, increased winds and storms, higher CO_2 levels, lower $^{14}C/^{12}C$ ratios and other atmospheric fluctuations (Bigelow et al., 1990; Carver and Brook, 1989; Mayewski et al., 1993; Paterson and Hammer, 1987:102;

Peteet et al., 1990).

Different kinds of evidence place the beginning of the YD between 11,100 and 11,000 rcybp and its end somewhere between 10,400 and 10,000 rcybp[1]. In calibrated years this is approximately 13,000 to ca 11,300 years ago (Stuiver and Reimer, 1993). The fluctuation of differences between ^{14}C and calibrated dates after 10,500 rcybp, shown in Figure 3.09, reflects variable production of ^{14}C at the end of the YD, and this implies significant changes in atmospheric conditions. Mayewski et al.(1993:195) have reported that both the beginning and the end of the YD were abrupt and on the order of 10-20 years from data gathering in Greenland ice cores (cf. Dansgaard et al., 1989). This kind of abruptness implies that social groups would have been aware of environmental changes during their lives and across generations.

The cause of the YD is unknown. One postulation is that Laurentide meltwater originally channeled to the Mississippi was diverted to the St. Lawrence River with the retreat of ice lobes. This melting may have released substantial flow from glacial Lake Aggasiz, which would have pirated the flow from the Mississippi to the St. Lawrence. This initiated a set of feedback mechanisms beginning with water channeled eastward

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[1] By counting annual layers in Greenland ice cores, Edwards et al. (1993:967) have bracketed the YD between 12,940 +/- 260 and 11,640+/- 250 calendar years (^{14}C equivalent = 11,100-11,000 rcybp and 10,100-10,000 rcybp). Another calibration of varve chronologies with ^{14}C dates reveals the abrupt end of the Younger Dryas at 11,280 (varve years) which also results in an estimated ^{14}C equivalent date of between 10,100 and 10,000 rcybp (Lotter, 1991; Stuiver and Reimer, 1993). On the other hand, counting of laminations in ice cores led Paterson and Hammer (1987) to place the end of the Younger Dryas termination at 10,750+/-150 (lamination years) which results in a ^{14}C equivalent of 9,600-9,500 rcybp. This estimation is farther off the mark and suggests missing couplets (cf. Stromberg, 1985 reference in Patterson and Hammer, 1987).

into the North Atlantic instead of south into the Gulf of Mexico. There it would have affected the North Atlantic Deep Water (NADW) currents, inhibited the transfer of warm water to the northern latitudes, and returned the planet climatic conditions to glaciation (Broecker et al., 1988).

Problems with this model revolve around the timing of the sequence of events. Which of these processes, cessation of meltwater or return to cold conditions, occured first? Temporal control is not of sufficient resolution to resolve this issue. Other, related models, still having to do with meltwater influx, ocean currents, and the dynamics of CO_2 fluctuations have been proposed (Shackleton, 1989; Edwards et al., 1993; Zahn, 1992). Possibilities of global magnetic fluctuations (with subsequent changes in increased atmospheric production of ^{14}C), as well as extraterrestrial phenomena, such as the effects of a possible supernova at this time have also been proposed (Brakenridge, nd; Edwards et al., 1993).

Other evidence also points to generally unstable geologic environments during this Younger Dryas, terminal Pleistocene time period. Crustal re-adjustments from the reduction of heavy glacial ice and concomitant increased weight of sea water accumulating over the continental shelves offer possibilities of crossing thresholds for faulting, uplift, subsidence, sliding, earthquakes and volcanic eruptions. This is especially true near the Laurentide and Cordilleran ice sheets, along the Northeast and Northwest coasts. The West Coast of North America was particularly vulnerable given the tectonic character of this margin. Evidence for just such kinds of readjustments exist in the form of cave roof spalling and volcanic ash records. For instance, the stratigraphic position of the Glacier Peak Ash (G) falls at the beginning of the YD. Other examples of evidence for this concept are shown in Table 4.01.

The simultaneity of these changing conditions with the archaeological appearance of people and the extinction of megafauna in the New World is clear. This correlation begs the question of what effects these processes may have had on human populations at the time (Bonnichsen et al., 1987; Haynes, 1992; 1993; Mead and Meltzer, 1985).

Condition of the Ice Free Corridor and the Northwestern Coastal Routes

Modeling the process of human colonization of the New World must take into account the pathways which were used and their condition. The ice free corridor is that space between the Cordilleran and Laurentide ice sheets found in Alberta, Canada through which migrating animals and people are to have come from Northeast Asia during Wisconsin glacial times (Burns, 1990; Fladmark, 1983; Hopkins, 1982:15).

The ice free corridor was recognized in the early part of the 20th century as the limits of glacial margins became understood (Antevs, 1935; Johnston, 1933) and Haynes reminded the modern archaeological community of this fact in the 1960s (Haynes, 1964; 1967). The axiom that evidence for people coming through the ice free corridor should first appear in the High Plains, discussed in Chapters Two and Three, is both logical and parsimonious.

Table 4.01 Ancillary conditions of the late Pleistocene and early Holocene

Condition	Evidence
Wind	The YD is characterized by evidence for increased wind activity in Alaska and South Carolina. This is confirmed by increased dust in YD levels i ice cores in Greenland (Carter, 1981; Carver and Brook, 1989; Hopkins, 1982:15; Paterson and Hammer, 1987:102; Peteet et al., 1990). The transition to YD conditions takes place abruptly, implying rapid changes in atmospheric circulation (Paterson and Hammer, 1987:102)
Volcanic Activity	Several volcanic eruptions are recorded in Northwest North America at the end of the Pleistocene. For instance, Mount St. Helens "S" ash is interbedded with flood deposits of the channeled scablands and ca 13,000 rcybp, and "J" has been dated at 11,700 +/- 400. Catto and Mandryk (1990:82) report a Glacier Peak ash dated about 12,750 +/- 350 (W-1644) in Montana. Glacier Peak blew sometime after 12,000 rcybp and again sometime between 11,200 +/- 100 or 11,300 +/- 230 (layer "G") (Mehringer et al., 1984; Mehringer et al., 1977; Mehringer, 1990). The Indian Creek site in Montana dates this Glacier Peak "G" ash at 11,125 +/- 130 (Beta-4951) (Davis, 1984:9; Davis and Greiser, 1992).
Rock Fall and Other Evidence for Seismic Events	At the Meadowcroft Rock Shelter a "major roof spalling episode" overlies a date of 11,300 +/- 700 (SI-2491) (Adovasio et al., 1990:350), at Owl Cave one occurred just after 10,920 +/- 150 (Miller and Dort, 1978:129). Rogers Rock Shelter exhibits roof fall sometime between 10,000 and 11,000 (Haynes, 1985:30). Some of these may reflect cryogenic spalling events related to the cold of the YD, and not temblors. Meadowcroft records another roof spalling event at 13,270 +/- 340, but radiocarbon contamination problems are known for these levels, so it may be a more recent event. At Kaufman-Bensen Cave a Goshen point was found below boulder rock fall (Frison, 1991:147), and at Fell's Cave dates below fallen boulders around 10,800 +/- 100 (Turner and Bird, 1981, Average of 3). Rock fall was recorded at the Marmes Rock Shelter (Fryxell et al., 1968). There is evidence for terminal Pleistocene faulting on Santa Cruz island (Pinter and Sorlien, 1991).
Pluvial Lakes Northwest	Pluvial lakes were drying up between ca 12,600 and 10,600. Aridity is inferred between 10,600 and 7,500 rcybp in general but individual histories are different (Smith and Street-Perrott, 1983; Willig, 1991:106).
Ground Water	Ground water fluctuations are possible at Murray Springs, Blackwater Draw, Warm Mineral Springs, and Page/Ladson (Dunbar et al., 1989; Haynes, 1990; Porter, 1988). These fluctuations may not be associated with increased precipitation.

Due to the relationships between expanded or contracted glacial margins and corridor closure or opening, the ice free corridor acts as an oscillating valve, allowing the movement of people through it when glacial margins were reduced by melting. However, like a natural Guillotine, the accumulation of ice lowers sea level for walking entry across Beringia, at the same time the "ice-free corridor" closes to pedestrian travel. With melting glacial margins, the corridor opens for pedestrian access, but sea levels would rise simultaneously, restricting pedestrian movement across Beringia by Upper Paleolithic grade populations without boat technology.

For instance, during Mid-Wisconsin time (ca 60,000 to 30,000 bp) sea levels would have restricted human movement except by water, or across the ice during early or late winter (Fladmark, 1983; Hopkins, 1982). Because the glaciers were reduced, however, the corridor would have been open for travel (Catto and Mandryk, 1990; Fladmark, 1983:18). Between 30,000 and 14,000 years ago the climate became colder and sea levels dropped considerably, allowing people and animals to cross the exposed Beringian land mass. However, at this time the corridor would have been closed or constricted. Of course, people could have colonized and inhabited Alaska during any opportune times, pausing in the area until the corridor opened to come down into the continent, or they may have had boat technology to cross over. However, these are all possibilist models, with no unequivocal evidence for such early human presence as discussed in Chapter Three.

Furthermore, recent surveys and research in the ice free corridor have raised the probability that the corridor was never completely closed by ice during Wisconsinan time (Catto and Mandryk, 1990; Fladmark, 1983; Hopkins, 1982; Roberts, 1984). These same surveys have demonstrated that the corridor apparently was a bleak tundra environment, probably ravaged by wind, littered with proglacial lakes and mucky deposits. There would have to have been a substantial environmental or density dependent push for humans to move through it (Fladmark, 1979).

In support of this hypothesis, human occupation in the ice free corridor is relatively late (Chapter Three, Figure 3.12). For example, Fladmark et al.(1988) date the Charley Lake Cave site around 10,500 rcybp and Roberts' (1984) inventory of ice free corridor Paleoindian projectile point frequencies reveals mostly early Holocene projectile point varieties such as Agate Basin, Hell Gap and Alberta. Therefore, it may be irrelevant whether the corridor was open or not with regard to its potential for human habitation, or with regard to its potential to act as a pull for human movement through it.

Fladmark (1978; 1979) has proposed an alternative to the inland corridor route which would circumvent ice free corridor passage with coastal travel and adaptations along the Northwest Coast. He suggested movement and subsistence procurement taking place along the paleocoastline could have been accomplished in small boats. This colonization would have benefitted from the ecological abundance of a Northwest coast fauna living in waters flushed by the (warm) Japanese current. An early Holocene aged site with evidence for the collection of marine resources in support of this model, is Namu in British Columbia (Chapter Three, Table B.02).

The two sites off the Southern California Coast, Arlington Canyon and Daisy cave, also represent good circumstantial evidence for sea going vessels as early as 10,000 rcybp (Erlandson and Moss, 1994; Glassow et al., 1988). Of course, given the data presented in Chapter Three, these archaeological sites are representatives of microblade and stemmed point traditions known from Alaska and the Northwest coast in contexts dating after fluted points are firmly entrenched within the continent around 10,800 rcybp (Carlson, 1983, Yi and Clark, 1985, Fladmark, 1979; cf. Chapter Three, Figure 3.13).

Thus, Fladmark's model is consistent with the pattern and process of convex based stemmed point and microblade site accumulations in the continent (Figure 3.13). However, I question whether Fladmark's Northwest coast migration model explains all of the peopling of the New World, particularly fluted point origins. Regardless, he has legitimized several important concepts (cf. Rogers, 1986; Rogers et al., 1992; and Gruhn, 1988). First, he has taken the intellectual concentration away from a strictly terrestrial migration route. Second, he offers the possibility of adaptation to coastal environments by upper Paleolithic peoples who are generally conceived to be focused on terrestrial resources either as land based specialized hunters or more generalized hunters and gatherers (cf. Bowdler, 1990; Meltzer and Smith, 1986; Perlman, 1980; Renouf, 1988; Widmer, 1988:33-34). Finally, he broached the issues of early boat technology and archaeological sites being inundated by rising post glacial seas.

In general, the geomorphology of the Northwest coastal area is complex. The continental margins were depressed by alluvial sedimentation from catastrophic flooding by ice dammed glacial lakes, uplifted by isostatic readjustments from glacial cover and shifted by tectonic actions due to the proximity of subduction zones all along this continental margin (Baker, 1983; Fairbridge, 1992). This coastal model is not being tested by direct continental shelf underwater research, although Easton (1993) and his colleagues have done underwater work on a middle Holocene aged inundated Archaic site in a near shore setting in Montague Harbor in British Columbia, presented again in Chapter Five.

Regularities of Early Paleoindian Stratigraphic Occurrences

The beginning of the Younger Dryas, at approximately 11,000 rcybp (+/- 100), is marked in the alluvium of several stratigraphic sections over North America (Haynes, 1968; 1984, 1991; Schumm and Brakenridge, 1987:234). This stratigraphic regularity is abrupt, agreeing with other evidence for an apparent pulse of change in several conditions. These regularities also represent possible sources of correlation with stratigraphic sections known from the Southeast, an area void of radiocarbon control for Paleoindian presence. Haynes (1968; 1984) has accumulated examples of this terminal Pleistocene stratigraphic regularity from 13 localities, including sites in the Southwest, the Midwest, the East Coast, and the Northwest. Others examples were also tabulated during the site inventory (Table 4.02).

In short, sediments filling overfit channels (Unit α) are older than 12,000 to

13,000 rcybp, and exhibit coarse textured sediments and increased ratios of arboreal pollen confirming wetter, i.e. full glacial, conditions. These are then cut by channel incision. Subsequent deposition of sediments, within these eroded sediments, begins with Unit β_1 and aggrades from 13,000 to 12,000 rcybp. Haynes reports that these late Pleistocene sediments reflect increased fluvial discharge at the very end of the Wisconsinan, which is coincident with the first meltwater pulse (MWP I) of deglaciation.

These β_1 sediments are truncated by a surface or unconformity reflecting dryer or drought conditions and with radiocarbon dates ranging from 11,200 to 10,900, depending on the site. This contact generally represents the stratigraphic location of the last of the Pleistocene fauna, as well as concave based fluted points, chipped stone tools and chipping debris (e.g. Clovis at Murray Springs, Lehner Ranch, and Blackwater Draw).

Table 4.02 Sites exhibiting stratigraphic evidence for the Pleistocene - Holocene boundary

Site	Descriptions and Dating
Haynes Samples (1984)	
Blackwater Draw #1, Texas	Clovis at contact 11,170 (average of 3), diatomaceous poind sediments overlying at 10,170 +/- 250; 10,490 +/- 200, black mat equivalent. Folsom in 10,490 equivalent.
Lubbock Lake, Texas	Stratum I at 11,100 +/- 80; 11,100+/-100, location of contact, equivalent to Blackwater Draw Clovis stratigraphic position. Local Bed 1 of Stratum 2a (diatomite) at 10,530 +/- 90; 10,540 +/- 100, equivalent to black mat. Local Bed 2 (peat) at 10,360 +/- 80; 10, 195 +/- 165 (Johnson and Holliday, 1985)
Domebo, Oklahoma	Artifacts found in gray organic sediments, under saturated anaerobic conditions that preserved bones and wood. Radiocarbon average is 11,040 +/- 250 on bone, 11, 340 +/- 370 on wood. (Haynes, 1992:360).
Murray Springs, Arizona	Coro Marl uncomformably overlain by Graveyard Gulch Member (medium to coarse sand) with charcoal dates ranging from 13,000 to 10,900. Implies the erosional surface formed after 13,000. 10,900 +/- 50 average for eight dates on Clovis artifacts on the contact. Black mat (Clanton Ranch Member) follows, with dates ranging between 10,800 and 9,700.
Lehner Ranch, Arizona	Average of 12 dates on Clovis surface: 10,930 +/- 40. Stratigraphic setting identical to Murray Springs, overlying black mat (Clanton Ranch Member equivalent) is undated.
Tule Springs, Nevada	Channel incision (E1) 11,500 years ago, appearance of numerous springs, 11,000 years ago, along Eglington scarp and the Gilcrease fault. Coincident with E2 aggradation and indicating disruption of the local base levels apparently by tilting the Gilcrease flat to the Southwest (Haynes, 1967b:79)
Pomme de Terre, Missouri	"(A)fter 13,000 the river cut and eroded its banks for a period of about 2,000 years ... (at the) same time the Port Huron glacial advance followed by (the) Two Creeks retreat occurred in the Great Lakes area to the North" (Haynes, 1985:27). "(T)he brief episode of degradation between Boney Spring alluvium and Roger alluvium marks Pleistocene extinction in the Ozarks (Haynes, 1984:349). In addition there is a rapid appearance of the oak and hickory dominated forest, between 10,000 to 11,000 years ago, which was probably related, in part, to a deduction in the water table which is also indicated by oxidized sediments (Haynes, 1985:29)
Rogers Rock Shelter, Missouri	Shelter deposits began accumulation after 11,000 rcybp
Kimmswick,	Thin clayey silts containing Clovis artifacts and mastodon. No radiocarbon control yet.

Shawnee-Minisink, Pennsylvania	"Eastern most Clovis site" on a late Wisconsin terrace buried by early Holocene alluvium, with dates 10,590 +/- 300 and 10,750 +/- 600.
Marmes Rock Shelter, Washington	11,000 rcybp "corresponds with the baal contact of the first postglacial episode of stream aggradation ... that appears to have occurred throughout North America south of the Wisconsin ice border (Haynes, 1984:350).
Additional Sites	
Charley Lake Caves, Alberta	Fladmark et al.(1988:376) write, "early postglacial period tills and glacio-lacustrine sediments were washed into the gully from deposits on the hillside above the cave, producing the strongly nonlocal lithology of Zone Ia. This process certainly had begun by 10,500 years ago, and possibly as early as 11,000"
Mustang Springs, Texas	A Blackmat equivalent is described, Stratum 3a, with radiocarbon at 10,130 +/- 30 (Meltzer and Collins, 1987)
Carter-Kerr McGee, Wyoming	"During Clovis and Folsom times a distinctive gley soil was formed at the Carter-Kerr McGee site ... the Agate Basin Site ... and the Sheaman Clovis Site ..." (Frison, 1984:305). Folsom occupation in the gley at 10,400 +/- 600.
MacHaffie Site, Montana	Wormington (1964:41) reported that the Folsom component of the MacHaffie Site in Montana "was found in a fine grained, smooth textured, black soil that overlay sterile sands..."
Aver Island, Louisiana	Borehole #1, 16 to 18 feet below the surface "an organic horizon...immediately above" a salt dome bed. Two radiocarbon dates on this organic horizon returned 12,000 +/- 100 and 10,900 +/- 300. Minimum age within the range of other earliest Holocene organic "mats"

Sedimentation resumes again, with finer grained, often fluvial or pond sediments, and this Haynes has designated Unit β_2. These Holocene sediments in Haynes samples suggest pond or wet meadow environments and are often referred to as black mats or black mat equivalents. This Holocene Unit (β_2) lays unconformably on the Pleistocene deposits, Unit β_1, suggesting that after an arid period, water tables rose after about 10,800 rcybp[2]. Often this β_2 sedimentation is represented by two or more zones.

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[2] The stratigraphic sequence at Monte Verde exactly parallels this sequence in all but the radiocarbon record. It may be that future research will resolve this discrepancy. In addition, it is interesting that the

Radiocarbon control for the lower portions of these sediments range from 10,900 to 10,000, depending on the site. Sedimentation of the upper portions of this unit correspond to the second meltwater pulse (MWP II), and date from 10,000 to 8,000, depending on the site.

Haynes has interpreted the β_1 / β_2 unconformity as evidence for a period of severely arid conditions he calls the "Clovis drought", an idea first proposed by Antevs (Haynes, 1990; 1991; 1984). At least two pollen records support this contention (i.e. at Lehner Ranch and at Domebo). Evidence that Pluvial lake levels fell in the Great Basin may also agree, but the strandlines are not precisely dated (Benson and Thompson, 1987). Lake Lahonton is possibly the best dated Pluvial lake, with a low stand, known as Gilbert, bracketed between radiocarbon dates of 11,000 rcybp and 10,300 (ibid:247). Willig (1991:105) has observed that large concentrations of fluted points known from the Far West are located around the lowest strandlines of the paleo-lake beds (i.e. China Lake, Tulare Lake, Alkali Lake (Dietz Site), Borax and Clear Lakes, Tonopah and Mud Lakes, and the Sunshine Locality (see Figure 3.08).

This sequence correlates with other data for the YD climatic fluctuation, and suggests that warming and increased fluvial discharge pertained before the YD; a dry, cold erosional hiatus reflects conditions during the YD; and warming, precipitation,

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rising water tables are not necessarily due to increased precipitation, as the mammoth footprints at Murray Springs attest.

increased sedimentation and the formation of wet meadow deposits occured after (cf. Baker, 1983:120). ^{10}Beryllium concentrations in ice cores - used as proxies for precipitation - also agree with this pattern (Paterson and Hammer, 1987:94).

The Mississippi River was the major drainage channel for meltwater from the Laurentide ice mass during both pulses of deglaciation (sometime between 13,000 and 11,000 rcybp and then again from 10,000 to 8,000 rcybp). Like other major drainages, the Mississippi was wide and entrenched (incised) at the full glacial due to lower sea levels (base levels) (Autin et al., 1991; Baker, 1983; Schumm and Brakenridge, 1987). During the first meltwater pulse, the Mississippi is characterized as a braided stream channel, with fast moving water and coarse grained sediment accumulation.

The flow of the Mississippi slowed substantially, possibly by the diversion of meltwater to the St. Lawrence River, after 11,200 rcybp, or as a response to glacial accumulation, as described above (Leventer et al., 1982; Baker, 1983:117; Broecker et al., 1988). Deep sea records record an abrupt cessation of sediments around 11,000 (Leventer et al., 1982; Curray, 1960:262). It may also be true that sea level rise was slowed or reversed during this time, allowing time for either pedogenesis on the (MWP I) aged alluvial terraces and, perhaps, channel incision from lowering base levels.

This hiatus would have been an opportune time for Paleoindian exploitation and possibly even occupation or settlement of these wide alluvial areas. However, the return to glacial melting and renewed meltwater drainage down the Mississippi will have initially eroded and then buried examples of these archaeological sites (Waters, 1992). Regrettably the late Pleistocene - early Holocene stratigraphy of the Mississippi is generally unknown (cf. Autin et al., 1991). Some meager fragments of these surfaces do remain which reflect evidence for Paleoindian activities in the form of isolated fluted points and related artifacts (for instance McGahey, 1992). Therefore, the low artifact and archaeological site density areas around the Mississippi illustrated in Figures 3.01, 3.05, and 3.07 may be artifacts of geological invisibility rather than lack of Paleoindian settlement or exploitation, or sufficient research attention in those areas.

While the late Pleistocene and early Holocene occupation of Southeastern North America is confirmed by stratigraphic data, only the early Holocene contexts are radiocarbon dated (Chapter Six). Sediment sealed Pleistocene / Holocene boundary situations, with similarities to sections in the Plains and Southwest, are reported from the Southeast, but these are also not well dated. Goodyear (1991) has summarized the geoarchaeological regularities of early Southeastern archaeological exposures in the Southern Appalachians and Coastal Plains. These are listed in Table 4.03

Table 4.03 Stratigraphic details of sites in the Southeast

Table 4.03 Stratigraphic details of sites in the Southeast		
Site or Project	Date or Point Type	Stratigraphic Description
Goodyear (1991)		
Tellico Reservoir Project	Radiocarbon dates accumulate after 9,500 rcybp	Holocene strata represented by more than 3 meters of deposits. (cf. Bacon Farm, Icehouse Bottom, Rose Island)
Tennessee River Valley		Severe erosion at the end of the Pleistocene sequence
Duck River, Tennessee	Radiocarbon dates accumulate after 9,000 rcybp	Severe erosion at the end of the Pleistocene sequence
Middle Tennessee River Valley (Quad, Pine Tree and Stones Pipe)	Clovis, Suwannee/ Quad	Paleoindian materials eroded from 2nd and 3rd levees, artifacts resting on sterile (Pleistocene) clay
Haw River Project, North Carolina	Dalton (10,500 to 9,900 est.)	Erosion recorded between Holocene (T1) sediments and brownish yellow clayey silt (Pleistocene) below. Holocene sedimentation beginning with sandy deposits and Dalton diagnostics.
Baucom Site, North Carolina	Dalton, Hardaway	A date of 8,170 +/- 110 (AA-351) came from the Hardaway side notched level.
Richard B. Russell Reservoir, (Gregg Shoals), Georgia	Kirk corner notched (9,000 to 8,000 rcybp est.)	Red sands overlay Pleistocene gravels. Grey clay with high organic content resulted in radiocarbon control of approximately 10,200
Ruckers Bottom,	Palmer side and corner notched (10,000 to 9,500 rcybp est.)	
Raes Creek	Kirk	Orange colored sterile, dense sandy clay zone lies under the Kirk horizons and represents Pleistocene. A date of 9,060 +/- 110 was obtained for the Kirk horizon.
Oconee River (9 GE 309	Clovis, Dalton, and notched points	Compact sterile red sand at the base of sedimentary section represents eroded Pleistocene terrace
Savannah River Site (Pen Point)		Three Terraces described.

Table 4.03 Stratigraphic details of sites in the Southeast

Smith's Lake Creek	Suwannee/Quad, Simpson, Dalton, other fluted points	Basal (Pleistocene) sediments represented by a red alluvial clay exhibiting pedogenesis
38 A 1135		Best stratigraphic integrity of a terrestrial Paleoindian site in the Southeast.
Theriault, Georgia	Clovis, Dalton, Hardaway	Medium textured sand overlays an orange sterile clay. Artifacts occur in the sand.
Muckafoonee Site, Georgia		Medium brown sand, light and reddish brown clayey sand and reddish brown clayey sand over white sand (?review)
Hester, Mississippi	Dalton, Big Sandy/Bolen	Pleistocene red brown hare sand
Additional Sites from the Southeast		
Warm Mineral Springs, Florida	Greenbriar	Initial deposition is a grey-green clay with large spall rockfall, without radiocarbon chronology. Deposition of "leaf bed alternating with calcitic mud, tufa, and wall skree. Some radiocarbon dates are inverted, but range from 10,630 +/- 210 toward the bottom to 8,920 +/- 190 rcybp at the top. See Table 6.7
Little Salt Spring, Florida	No early projectile points	Inundated ledge equivalent to Warm Mineral Springs, lower marl bed capped by peat. Radiocarbon of tortoise (*Geochelone crassiscutata*) found on -26 m ledge (13,450 +/- 190) with possible implement (stake) in it at 12,030 +/- 200.
Silver Springs , Florida	Clovis, Swannee, Bolen	Marl capped by peat with extinct fauna in the marl,but not the peat (Hemmings, 1975 , cf. Guest Mammoth Kill site)

Goodyear states that in the Southeast, Pleistocene sediments are often found in deeply stratified exposures and represented by oxidized (i.e. reddish) sandy or silty clays. These deposits are either eroded, or they exhibit soil development or induration suggesting prolonged exposure. Artifacts never occur in these lower sediments. Subsequent sedimentation reveals coarser textured (sandy) deposits which generally overlay the Pleistocene clays unconformably. Examples of possible early items have been found in the lower levels of these sediments (e.g. at Harney Flats, Silver Springs;

Theriault; and Hester) (Daniel and Wisenbaker, 1987; Goodyear, 1991; Neil, 1964).

One Southeastern archaeological site with a robust stratigraphic record of the late Pleistocene and Holocene sediments, is the Page/Ladson site in Northwestern Florida. This site is a fresh water inundated Paleoindian and Early Archaic site that has the potential to resolve the Southeastern Paleoindian dating gap (Dunbar et al., 1988; 1989; Milanich, 1994; Purdy, 1991). The stratigraphic record there includes well preserved late Pleistocene, early and middle Holocene aged sediments, excellent preservation of organics and bone, and Paleoindian and Early Archaic diagnostics.

The Pleistocene is marked at Page/Ladson by sandy spring deposits with abundant remains of extinct fauna and probable Proboscidean digesta (***Zone D***). Early diagnostic artifacts (e.g. Clovis, Suwannee, and Simpson projectile points) were found in disturbed contexts in the Page/Ladson sinkhole by sport divers, who originally brought the site to the attention of archaeologists in the 1960s. It is believed that these early diagnostic artifacts originally lay on, or in, the ***Zone D***, Strawmat. This ***Zone D*** "Strawmat" has returned eight radiocarbon dates which range from 13,130 +/- 200 to 11,770 +/- 90 rcybp and average about 12,300 rcybp. This stratigraphic unit is then unconformably overlain by fresh water calcitic mud deposits which do not contain remains of extinct fauna (***Zone C***). The deposition of ***Zone C*** fresh water calcitic mud deposits began sometime before 10,600 +/- 70 rcybp[3].

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[3] ***Zone D*** radiocarbon dates used in the averaging include: 13,130 +/- 200; 12,570 +/- 200; 12,370 +/- 90; 12,330+/-110; 12,240+/-90; 11,790+/-90; 11,770+/-90 (Dunbar et al., 1988:449).

These ***Zone C*** calcitic muds are interrupted further up the stratigraphic column by incipient pedogenesis (i.e. an organic "A" horizon) which has Bolen/Big Sandy/Taylor artifacts laying directly on it. These artifacts are securely dated at 10,090 +/- 50 rcybp (avg of 3). These calcitic muds had to have been subaerially exposed for some time for the accumulation of the organic horizon, perhaps 500 or more years. Calcitic mud deposition resumes after this time, for an unknown amount of time, until the initiation of peat and sand deposits indicative of modern conditions.

I suggest that the ***Zone D*** (Strawmat) - ***Zone C*** (calcitic mud) contact is a Southeastern equivalent of the α/β contact Haynes has proposed in sites farther west, and hypothesize that the initiation of the freshwater clays should, therefore, be sometime around 11,000 +/- 100 rcybp. Erosion of the ***Zone D*** deposits might be implied by this scenario, allowing for the gap between the pre-11,500 ^{14}C dates in the Strawmat and the 10,600 year date in the calcitic muds. However, radiocarbon analysis specifically targeting the initiation of the calcitic mud deposits (e.g. lower ***Zone C***) has not been attempted. Page/Ladson will be discussed again in Chapter Six both for its stratigraphic record and for its potential as a terrestrial analog for offshore site discovery.

Radiocarbon control from ***Zone C*** deposits below the Bolen surface, soil horizon rests on a date of 10,600 +/- 70 taken from a large tree trunk located in these deposits. As part of the research of this dissertation, another date was run from the ***D/C*** interface and the result was 12,370 +/- 90 (AA-11048) (cf. Table 7.18). It is clear in retrospect that a date from the bottom-most sediments of ***Zone C*** may have been more infomative. Bolen artifacts and wood were found on the soil horizon, resulting in three ^{14}C dates: 10,000+/-120; 10,000 +/- 60; 10,280+/-110 on wood (Dunbar et al., 1988:449; Carter, 1993)

Fluctuations in the Rise of Sea levels

Given that the continental shelves were exposed during the Wisconsinan, what is the evidence for how they were transgressed at the end? Past sea levels have been reconstructed from various data including: inundated terrestrial geomorphology (inundated strand lines or beach terraces, deltas, and barrier islands), inundated marsh peats or stratigraphic occurrence of brackish water molluscs (Edwards and Merrill, 1977; Fletcher, 1988). A geoarchaeological method of determining sea level fluctuations concerns tracing the retreat of human settlement patterns, inferred as a response to late Holocene sea level rise (Brooks et al., 1986; Donoghue and White, 1994; Holmes and Trickery, 1974). Data relating to conditions of the glaciers can also act as proxies for sea levels. These data include estimations of $^{18}O_2/^{16}O_2$ variation or reconstruction of total ice volumes across time (Clark and Lingle, 1978; Shackleton and Opdyke, 1973; cf. Van de Plassche, 1986).

The planet is, however, pliable and local scale sea level histories may be influenced by crustal readjustments that make global or continental scale correlations of eustatic phenomena difficult (Fairbridge, 1990). Various mechanisms and thresholds pertain to this issue, including isostatic rebounding from the loss of weight of melting glaciers, subsidence by the transferred weight of transgressing ocean waters and accumulating deltaic deposits from combined meltwater and precipitation drainage. Furthermore, each of these processes is controlled by local geology.

Faulting, uplift and subsidence in areas of tectonically active zones can alter the elevations and characters of sea level indicators. Because of these facts, some researchers suggest that true "eustasy" is not perceivable. Regardless, there are aspects of sea level rise that can be correlated with the colonization of the continent, regardless of particular elevations. Figure 4.01 exhibits selected sea level curves, in particular the most recent estimates for the Gulf of Mexico (Frazier, 1974).

The full extent of glacial sea level lowering is estimated at about 100 meters at 18,000 rcybp, but estimates range anywhere from 130 meters to 80 meters, depending on the researcher and data base (cf. Bloom, 1983; Fairbanks, 1989)[4]. Two of the first sea level curves were punctuated or "stepped" curves made by Curray (1960) and another by Fairbridge (1961). Milliman and Emery (1968) postulated a sinusoidal or "smooth" curve. These two kinds of sea level curves -- stepped and smooth -- characterize a "punctuated versus gradualist" debate within the discipline of sea level research (for instance Morner, 1971 and Bloom, 1983 respectively, cf. Figure 4.01). The two step meltdown process, along with geomorphological evidence for stillstands, suggests that the stepped curves are probably more appropriate.

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[4] Figures 3.02-3.14 describe the extent of sea level lowering based on the continental shelf margin or "break" which averages approximately 130 m.

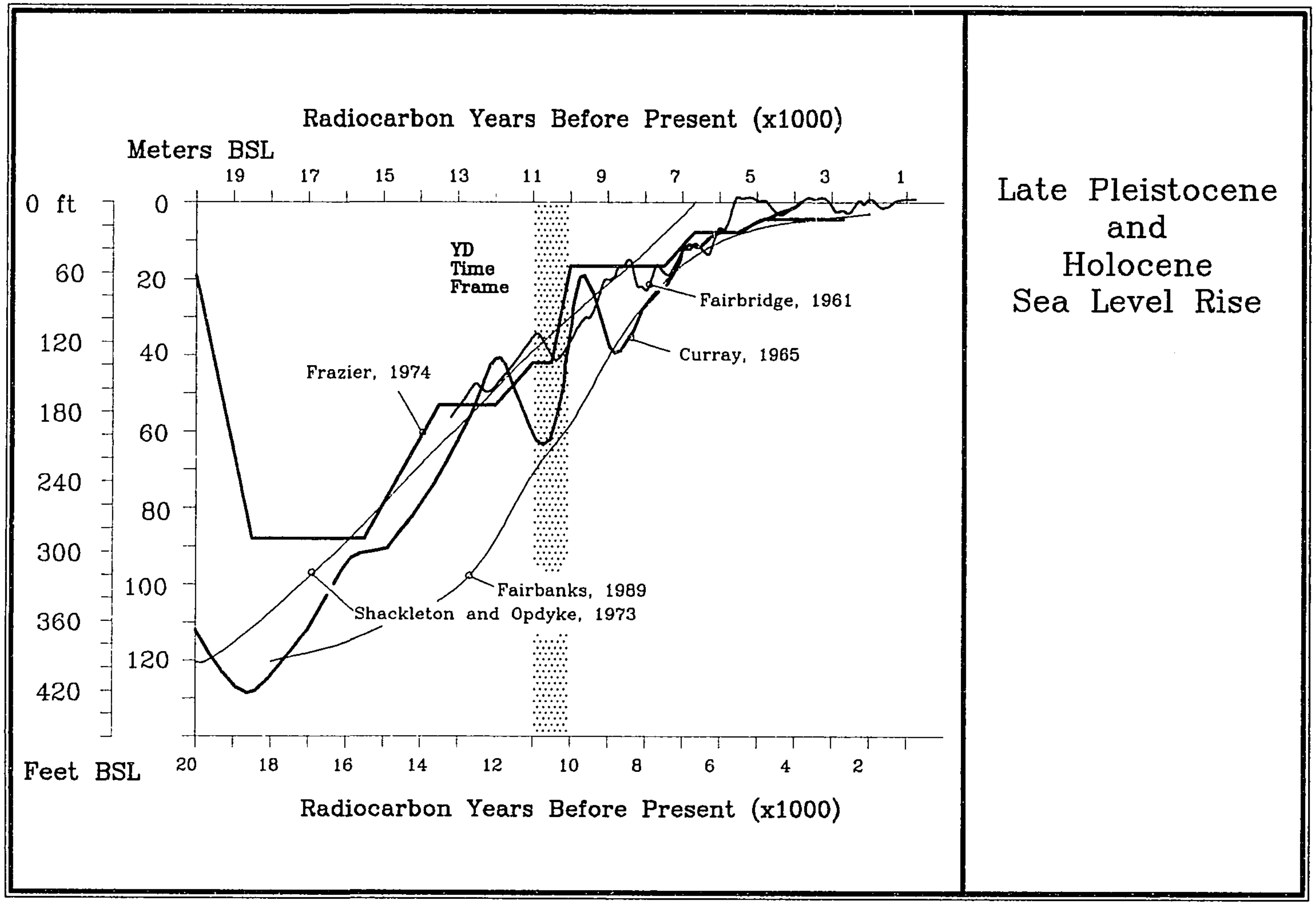

Figure 4.01 Late Pleistocene and Holocene sea level rise

The model of a "two step" meltdown process implies that sea levels would exhibit at least two stillstands inundated offshore: a deeper, full glacial, pre- Meltwater Pulse I, coastline farther out to sea and a shallower beach line nearer to the modern coastline representing the YD 11,000 to 10,000 year hiatus or regression (cf. Edwards and Merrill, 1977). This secondary stillstand might exhibit weaker geomorphic structures than the full glacial stillstand, since it probably existed for 1,000 rcy or less. There should be some evidence for sea level regression due to the colder conditions of the YD, if such occurred.

In 1960, Curray inferred such a regression with 3 meters of lowering estimated around 11,000 rcybp, with data from the Gulf of Mexico. He proposed a MWP I rise of almost 39 meters sometime between 16,000 and 11,000 rcybp. The regression is illustrated at about 21 meters during Younger Dryas time frame. Another approximate 20 meters of sea level rise occurred, by his estimate, between 10,000 and 9,000 rcybp. Around 8,000 rcybp slower rates of transgression, and possibly another regression, occur. Morner (1971:172) infers a similar sequence of fluctuation with data from Sweden. Both of these researchers considered glacial margin data in their estimations. The sea level curves from the Gulf of Mexico are discussed again in Chapter Six, and in the Concluding Chapter Nine.

In the Gulf of Mexico region, Aten (1983) and Autin et al.(1991) have described widespread floodplain surfaces along the lower reaches of Texas rivers, known as the

Deweyville Terraces. These terraces result from extremely large wavelength meander scars and channels cut into the Prairie/Beaumont Terrace (mid-Wisconsinan age) deposits. These Deweyville Terraces extend offshore, out on to the continental shelf under the Gulf of Mexico, with Paleochannels known offshore. The surfaces of the Deweyville terraces are characterized by meander channel scars three to six times larger than those of the modern Sabine River (Autin et al., 1991; Pearson et al., 1986:9).

The in-filling of the first of these terraces is inferred coincident with the first pulse of deglaciation and sea level rise (between 13,000 to 11,000 rcybp), while an inset channel is proposed to have been cut to a depth of 12 meters during a lowering of sea level between 11,000 and 10,000 years ago. Sedimentation of this second system of meander scars reflects the second "pulse" of the rising sea levels and associated alluvial fan sediments. Minimum dates from peats capping these deposits offshore, which record deposition after the regression interval, are reported by Nelson and Bray (1970) at 10,207 +/- 374 and by Pearson et al.(1986) at 10,145 +/- 285.

The subaerial pedogenesis of the Bolen age surface at the Page/Ladson site, described above, interrupts sedimentation of freshwater calcitic mud deposits and may be evidence for a regression of sea level also, possibly between 10,500 and 10,000 rcybp. These seem like good evidence for YD sea level regression. However, both Donoghue (1990) and Frazier (1974) infer a stillstand of sea level rise in the Gulf of

Mexico during this Younger Dryas time period, not a regression. Likewise, Fairbanks (1989) illustrates a gradualist sea level curve from Barbados, with a hesitation at the YD, but no regression (Figure 4.01). Interestingly, cores in his Figure 1 are labeled with "subaerial exposures" and sandy deposits between 10,900 and 10,300 rcybp at depths of 50 to 60 meters, but he doesn't refer to them in the text.

Looking at sea level records farther North along the Atlantic seaboard, in Maine, Oldale (1985; 1986) has postulated that 13,000 years ago, as glacial ice unloaded, rebound was more rapid than sea level rise. This caused apparent shoreline regression in this region until about 10,500 rcybp. At that time, the isostasy slowed and the shoreline began an apparent transgressive phase. Oldale pointed out that this geologic transition coincides with Paleoindian colonization and occupation of this area. It may be that Paleoindians were exploiting the continental shelf for more time than in other areas due to a lag of changing coastal conditions. Matthews et al.(1970) have proposed a similar scenario for the Northwest Coast.

After 10,000 rcybp glacial melting and sea level rise recommenced rapidly for the about 2,000 years. After 8,000 rcybp, glacial melting and sea level rise slowed until about 5,000 rcybp at which time conditions attained today's levels. Convincing evidence for apparent eustatic rise of sea levels above today's level, after 5,000 rcybp, has been presented by several researchers (for instance, Colquhoun and Brooks, 1986; Fairbridge, 1992; Stapor et al., 1988; Tanner; 1992).

The simultaneity of possible sea level regression with the apparent pulse of colonization by humans into North America after 11,200 rcybp, as presented in Chapter Three, opens the potential for cause and effect correlations with environmental conditions, as well as the geoarchaeological potential for site presence on the continental shelves as an explanation for their relative absence before that time. This is particularly true on the Eastern Seaboard and in the Gulf of Mexico, and with regard to fluted point related settlement patterns.

Discussion

The evidence presented in Chapter Three and in this Chapter does not support the ice free corridor model of initial colonization of the continent by people who made fluted points. The corridor was probably not favorable to human occupation or exploitation at the time that evidence for human colonization accrues in the New World (say 12,000 to 10,500 rcybp). The pulse of colonization between 11,200 and 10,500 also does not appear to originate from the corridor. The possibility of a migration route along the west coast by some form of boat travel does seem to be supported by the distribution of microblade and stemmed point related sites (cf. Figure 3.13, Chapter Three). Even the South American sites, like Monte Verde, Pacamachay and Ayampta, could be considered as part of this evidence.

However, explaining the distribution of fluted point related sites coming from these western margins is equivocal and the position taken here is that <u>initial</u> intrusions by people who made fluted points along the West Coast is unlikely. Future dating or site distributional data may prove this wrong.

On the other hand, the evidence presented in this dissertation raises the possibility, if not the probability, that evidence for the initial movements of populations related to the fluted point tradition may exist on the continental shelves of the Gulf of Mexico and the East Coast of the United States. This evidence suggests that these people frequented the major drainage channels of the region and the terminations of these channels, at that time, were out on those continental shelves. Given the proposed archaeological structure of fluted point Paleoindian settlement patterns presented in Chapter Three and geological factors of the terminal Pleistocene and early Holocene conditions presented above, can a new model be proposed to explain the initial peopling of the New World by the people who made these points?

Were Paleoindians occupying or exploiting, or both, the coastal margins of their time? This question recalls an older one (Binford, 1968; Hayden, 1981; Perlman, 1980; Smith, 1986). Namely, "did fluctuating sea levels <u>push</u> people who were already adapted to coastal niches inland, into the continents causing population pressure and increased social complexity?" or "were they <u>pulled</u> out to abundant coastal resources in the mid-Holocene influenced by the stress of increasing inland population pressures?"

Fladmark (1979) and Perlman (1980) predict early coastal adaptations, Widmer (1989) goes so far as to postulate early sedentism and technological complexity in coastal areas that are now inundated out on the continental shelf of Southwestern Florida. When people began to inhabit these environments is unknown because little underwater archaeological research has taken place to find the sites. I assume, based on the distributional data presented in Chapter Three, that people who made fluted points were out on the continental shelves, at least along the East Coast and Gulf of Mexico, and possibly along the West Coast and other areas as well. I also assume that the apparent pulse of fluted point archaeological sites proposed in Chapter Three is due to rapidly increasing population densities over the ^{14}C time frame of 11,200 to 10,700 rcybp.

From discussions of the chronology of fluted point related colonization presented in Chapter Three and of the chronology of deglaciation presented in this Chapter, it is clear that the major "pulse" of colonization took place essentially coincident with the Younger Dryas climatic reversal. Thus, people were accumulating in the continent during a period of increasingly colder, dryer, even drought, conditions, and with substantial faunal deaths occurring. Even the ice free corridor was not conducive to migration. It is possible then, that people were pushed or driven from deteriorating conditions in their former settlement areas. The question must be asked why would people have come into the continent under these adverse conditions?

One result of this dissertation background research was the concept that any fluctuation of sea level means there must readjustments to the coastal ecological system.

For instance, Edwards and Merrill (1977) have pointed out that sea level transgression increases the extent of estuary environments, particularly on low gradient shelves. Chappell and Thom (1977:287) predict a richer estuarine biota with transgressions. This kind of development should have been beneficial to humans from the standpoint of the extension of productive subsistence procurement niches. While sea levels may have been forcing people slowly inland, they probably would have stayed in relative proximity to the migrating coasts.

If people were on the continental shelves of North America (east or west), they may have been pushed inland after 13,000 years ago, by the first melting episodes of deglaciation, but probably in a progressive sequence. This first meltwater pulse would have resulted in readjustments approximately half way up the continental shelf slope, with coastal resources remaining intact, if not robust. Archaeological sites from this time frame would remain quite a distance out to sea, in relatively deep water. This is especially true of the wide expanses of the Gulf of Mexico and the East Coast, perhaps not as true in the west where uplift is a factor. It is also possible that these people frequented continental shelf areas, more than inland locations, because of richer habitats, until after 11,200 rcybp. This would explain their scarcity previous to this time (Butzer, 1988; 1991).

Another response of coastal ecosystems to sea level fluctuation, and one that may have more possibilities of explanation for the pulse of colonizing behavior, is less well understood, but mentioned in the literature. That is, regressing sea levels are more deleterious to coastal ecology than transgressing seas. Chappell and Thom (1977:287) have discussed models of hypersaline conditions and desiccation with regression from evidence in Micronesia. The fresh water table of the immediate land mass might be lowered, handicapping terrestrial ecozones. The former brackish water zone would become dry and hypersaline, needing sufficient time to flush the salts out with much precipitation. Finally, the contracted marine portion of the ecozone would have to rebound, possibly with depleted shallow water antecedents, since many of these would have been abandoned by the regressing seas.

If sea levels did recede sometime between 11,200 and 10,800 rcybp, in response to YD cooling or pirated stream flow to the St. Lawrence, then areas of the continental shelf that were previously inundated would be void of marine biotic communities and possibly the nearby terrestrial biotic communities would also be stressed because of the lag in environmental rebound. Even if the magnitude of lowering was not great, if the change was abrupt, on a geologic scale, then the effects could have been significant. Especially if the social groups involved had become specialized on the previously abundant coastal resources.

Combined, the effects of these environmental degradations could have been more debilitating to human populations than during intervals of transgressing seas. Coastal ecozones probably rebounded continuously, with gradually rising levels, and possibly with rich and abundant estuary areas in specific settings. This would pertain to the first meltwater pulse before 11,200 rcybp and to the second one after 10,000 rcybp. This model parallels Anderson's (1990) model of fluted point colonization, dispersion, and diversification near the major drainage systems of the East, with the exception of the ultimate direction of the population movements. Anderson assumes that the ancestors of the people making fluted points, initially came downstream, through the corridor (Chapter Two). I would just bring them up the channel systems, still interacting in major staging areas at the confluences of the major systems.

However, this assumes or speculates that people were accessing coastal resources at the continental margins during these times. This is untested and undocumented until 10,000 rcybp, and with early Holocene aged cultures in the West: the Coastal Microblade Tradition of British Columbia and the Paleocoastal Tradition of California (Erlandson and Moss, 1994; Moratto, 1984). Since these social groups have been presented as not immediately related to people who made fluted points, it remains to be seen whether this kind of adaptation is possible for fluted point traditional groups.

How much and how fast was sea level lowered, if at all, and what effect did it have on human populations? Just as Chapter Three concluded that underwater research was needed to search for early sites looking for the identity and pattern of early populations, so too this chapter ends with another reason to inventory archaeological sites on the continental shelves: testing for the environmental causes for colonization.

I propose that all of these (settlement pattern and cause) models hinge on finding age and culture appropriate sites underwater on the continental shelves. Therefore, areas with the highest potentials for early archaeological sites need to be identified. Then those areas which might have better preserved these sites during the inundation process need to be determined, and of these areas, those with potentials for accessibility by boats, divers and excavation equipment need to be targeted.

As it turns out, there are substantial areas of continental shelf with potentials for early site frequencies, potentials for site preservation and means of access by marine research techniques available. Some marine inundated sites have already been found, but not many. In Chapter Six, the nascent sub-discipline of continental shelf, marine inundated prehistoric archaeology is reviewed. Examples of these kinds of archaeological sites are presented and various principles and techniques are discussed which deal with this special problem. One particular area, Northwestern Florida, proves to be a good testing ground for the presence of early fluted point archaeological sites and for the further development of the principles for doing continental shelf archaeology.

Chapter Five

CONTINENTAL SHELF PREHISTORIC ARCHAEOLOGY

The Emergence of a Discipline

Continental shelf, marine inundated archaeology is archaeology underwater, but underwater archaeology only became a viable research option with developments in SCUBA diving in the 1950s. Initially lured by treasure hunting, divers soon came to realize the research value of shipwreck sites (Diole, 1952). Disciplined underwater archaeology gained its rightful place in archaeology in the 1960s with the underwater excavations of several Bronze aged shipwrecks in the Mediterranean (Bass, 1966; Gould, 1983; Green, 1990; Throckmorton, 1970).

The demonstration that controlled underwater excavations could be accomplished, even in deep water, and that the study of shipwreck assemblages and ship building techniques are valuable research topics, is due, in large part, to research projects and publications by George Bass of Texas A&M University. The excavations of two, deep, early Bronze Aged shipwrecks, the Yassi Ada and Cape Gelidonya, exemplify this great contribution (Bass, 1966; 1967; Bass and Doornick, 1982; Blackman, 1973; Muckelroy, 1978; 1980; cf. Throckmorton, 1970). More recently, underwater archaeological research has also contributed to the understanding of the evolution of maritime technologies and adaptations in a general anthropological sense (for instance Muckelroy, 1978; 1980).

Shipwrecks are not the only remains of human activity to be located underwater, however. Terrestrial occupation sites can be inundated by marine transgression or subsiding coastline and by rising freshwater baselevels. Controlled archaeological surveys and excavation of marine inundated, historical aged settlements such as Port Royal Harbor in Jamaica, or the Classical aged harbor site of Caesarea in Israel, are excellent examples (Blackman, 1982; Flemming, 1971; Frost, 1972; Hamilton, 1984; Raban, 1992; Taylor, 1965). Flemming, presents more of these kinds of sites in inventories of submerged occupation sites compiled in 1983 and 1994 (Flemming, 1983; 1994). Archaeological sites flooded by late Holocene rising sea levels, or by local land subsidence, not only record information about past settlement patterns and maritime technologies, but they also contribute to an understanding of the timing and effects of recent sea level rise and land subsidence from a geoarchaeological perspective (e.g. Galili et al., 1986; Kraft, 1986; Kraft et al., 1983).

However, most underwater archaeological research focused on marine inundated occupation sites has occurred with Historic or Classical aged examples. Thus, the underwater archaeology of prehistoric aged marine inundated occupation sites is less developed than either historic aged shipwreck or historic aged marine inundated terrestrial sites archaeology. This statement is based the relatively low frequency of publications which cover this subject in the marine archaeological lexicon and the lack of any university program specialized in this domain. This isn't to say that no research has pertained to this subject, only that it is much less developed.

Prehistoric sites inundated by freshwater are perhaps the most well known examples of any kind of inundated prehistoric occupation sites, because they have a relatively long history of archaeological research. Sites of this genre include dwellings in lakeside settings in central Europe and of Neolithic and early Bronze age (Ruoff, 1980). In the New World, Mayan ceremonial deposits have been brought up by divers in various lakes and cenotes of Mexico and the Yucatan (Borhegyi, 1959; Bush-Romero, 1975). Archaeological sites inundated as a result of the construction of modern manmade lakes would also fall in this category (Lenihan et al., 1981; Shiner, 1981). Perhaps most germane to this research project are the frequent discoveries of Paleoindian and Archaic aged materials in the karstic rivers and lakes of the Southeast and Florida (Goodyear et al., 1986; Cockrell, 1980; Dunbar and Waller, 1983; Milanich, 1994; Olsen, 1958). Table 5.01 presents some examples and descriptions of these kinds of sites and references.

However, prehistoric aged archaeological sites inundated by rising postglacial seas located out on the continental shelves have received considerably less research attention when compared to research done in these other settings. References calling for focused research on prehistoric sites altered and/or inundated by marine processes began showing up in the 1960s and 1970s (Emery and Edwards, 1966; Goggin, 1960), but specific research and documentation of sites and site inventories has mostly accumulated since the 1980s (e.g. Bailey and Parkington, 1988; Gifford, 1983; 1990; Gifford et al., 1985; Johnson and Stright, 1992; Masters and Flemming, 1983; Ruppe', 1980; 1988). This subdiscipline, which might be called continental shelf prehistoric archaeology or marine inundated prehistoric archaeology, is certainly nascent.

The first treatise on continental shelf archaeology that was published in a forum targeting the archaeological community, was in 1966 and by marine researchers J.O. Emery and M. Edwards of Woods Hole Oceanographic Institute (Stright, 1990:439). Actually more of an encouragement and proposal for archaeological research offshore, Emery and Edwards focused on four aspects of marine inundated prehistoric archaeological research: local sea level history, site preservation potentials, relevant cultural time periods, and the range of different kinds of sites which might be found (e.g. lithic production loci, occupation sites and shell middens). This proposal to find underwater situations analogous to known terrestrial settings which exhibit sites, essentially laid out one of the most useful principles for the discipline to use today.

This publication did not result in any immediate archaeological research (cf. Bullen, 1969; Salwen, 1967). A little over ten years later they published a more specific reconstruction of relict topography based on bathymetry and they used terrestrial analogues from known sites near Delaware Bay to predict the locations or settings for sites inundated offshore. This publication still dealt with proposed, not actual, archaeological site locations (Edwards and Emery, 1977).

Table 5.01 Fresh water inundated prehistoric archaeological sites

Settings	Sites	Comments	References
		European	
Lake Settings	Holderness, Lake Zurich, Neuchatel	Discovered in 1850, during a time of lower lake levels, these "Pile Dwellings" or "Palafittes" were originally thought to have been built on stilts over the water. It is now known that these villages are Neolithic and Bronze age structures built on the lake shores at times of low lake levels, possibly during the European equivalent to the Altithermal.	Ruoff, 1980 Munro, 1882
Crannogs	Milton Loch	Manmade islands in Scotland, made in water for protection, some are coastal, some in Lakes. 5th century BC time to 1745 AD	Morrison, 1980; Dixon, 1991
		North American	
Lake Settings: North America	Nalcrest Site, Lake Weohyakapka, Saxon-Holland site	Florida: Archaic aged sites Saxon-Holland site aka Blue Cypress Lake)	Bullen and Beilman, 1973 in Milanich 1994; Milanich and Fairbanks, 1980
Sinkholes / Cenotes	Warm Mineral Springs, Little Salt Springs Wakulla Springs, Florida	Various kinds of sites: sacrificial wells, to Paleoindian/ Early Archaic remains. Chichen Itza, Mexico and Montezuma's Well, Arizona are also examples	Bush-Romero, 1972; Gifford and Koski, 1994;Cockrell, 1980; Olsen, 1958
Karst River Situations	Guest "Mammoth Kill" Site; Page/Ladson Site	Florida Rivers: Aucilla, St. Marks, Wakulla Springs, Chipola, Econfina, Fenholoway, Suwannee, Santa Fe, Ichetucknee. Also sites in South Carolina	Hoffman, 1983; Rayl, 1974; Dunbar et al, 1989; Goodyear et al., 1990
Artificial inundation	Spring Lake, Texas	see also: Lenihan et al. (1981)	Shiner, 1981
Wet Lands, former Swamps	Windover Site, Hoko River - Washington (cf. Ozette)	Florida The Boylston Street fish weir below sea level and in relict estuary contexts, but currently under the city of Boston	Doran and Dickell, 1988; Johnson et al. 1942

Another thoughtful and extensive consideration of drowned land forms along the east coast was published by Edwards and Merrill (1977). Merrill was also associated with the Woods Hole Oceanographic Institute. They considered changing sea levels and shelf geomorphology, as well as climatic and fossil evidence (terrestrial and marine) from data discovered on the continental shelves along the East Coast of North America. They used this data to predict the kinds of settings for, and the general locations of places for the discovery of Paleoindian and Early Archaic remains.

They presented the limits of past ice margins, as well as the possible patterns of inundated river systems (known as paleodrainages or paleochannels) and they compiled evidence to demonstrate the clustered presence of extinct mammals remains around the paleodrainages of the Hudson, Delaware, and St. James rivers out on the continental shelf. Discoveries of these remains include mostly mastodon dentition (n=23), but also walrus (n=18), mammoth and sloth (n= 5 and n=1, respectively)[1]. They mapped the locations of inundated delta fans for 16 major river channels on the continental shelf of the east coast. Three of these coincide with dense areas of fluted point remains shown in Figure 3.01 (the Hudson, Delaware and St. James). No specific inundated archaeological sites were identified at that time, but subsequent research has demonstrated the presence of several inundated examples to be discussed below.

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[1] Fossils of extinct mammals were also collected from controlled excavations undertaken at the Fiche Site (8 Je 739) in the Apalachee Bay of Florida, and reported in Chapter 7 of this dissertation.

As an underwater archaeologist and major contributor to European marine archaeology, Nick Flemming is probably the major published proponent of marine inundated, continental shelf prehistoric archaeology in the world (Flemming 1983; 1985; 1994). Flemming has accumulated case histories on over 500 what he calls "submerged human occupation sites". These include both prehistoric, historic and classical aged marine submerged ruins, such as harbors and inundated urban areas and Neolithic, Mesolithic, and Paleolithic aged sites (1983; 1994).

The late Reynold Ruppe, of Arizona State University was another advocate of the potentials of prehistoric inundated archaeology and a vocal practitioner and proponent of continental shelf prehistoric archaeology (1978; 1980; 1983; 1984; 1988). Ruppe was shown the Venice Beach Site (8 So 26), marine inundated ceramic aged shell midden in a nearshore setting on the west coast of Florida, by William. Royal, an avocational archaeologist known for his discoveries at the Warm Mineral Springs site (Koski, 1989; Royal and Clark, 1960). Ruppe considered in detail how to find older sites further offshore, proposing their occurrence near paleochannels off the west coast of Florida. He attempted, but did not succeed in finding any sites further offshore than the Venice Beach Site, mainly because of waiting on weather to go offshore (Ruppe, 1980; 1988).

John Gifford, currently at the Rosentheil School for Marine Research in Miami, is an underwater geoarchaeologist experienced with marine inundated sites in the

Mediterranean and freshwater inundated sites in Florida. Gifford has, like Flemming above, contributed to recording to the inventory of marine inundated resources (Gifford et al., 1985). Gifford is currently working underwater at the Little Salt Spring site near St. Petersburg in Florida, approaching the task with a focus on technological and geoarchaeological aspects (Gifford, 1983; 1990; Gifford and Koski, 1994).

Last, but certainly not least, Melanie Stright (1986a; 1986b; 1990) is a significant documenter of submerged sites in North America and an advocate for their management as cultural resources. As a member of the Federal government's Minerals Management Service team, she helped to develop requirements for Outer Continental Shelf (OCS) cultural resource management of historic shipwrecks and prehistoric aged sites during minerals and oil prospecting, resource extraction and other development projects. Melanie was also instrumental in gaining Federal support for baseline research undertaken in the paleochannel of the Sabine River of Texas and Louisiana (CEI, 1977; Gagliano et al., 1982; Pearson et al., 1986). I will return to this important project in more detail below.

Table 5.02 reviews five examples of these kinds of sites from Europe and 15 from North America. The purpose of this Table is to describe site settings, recovery methodology, and artifact inventories. References are also presented. Figure 5.01 shows the North American occurrences, including the sites from the Apalachee Bay found by this research.

Table 5.02 Selected examples of marine inundated prehistoric sites

Table 5.02 Selected examples of marine inundated prehistoric sites

Site	Description	Techniques	Inventory	References
European				
Tybrind Vig, Denmark	Mid-Holocene Ertebolle coastal habitation in a relict estuary setting. Several inundated settlements around the coastline of Denmark are known. Sites are embedded in gyttja, which preserves the artifacts. Radiocarbon dates 5.8 - 5K. Older sites are suggested by artifacts and other items dredged up from the sea floor further out and deeper.	Excavation of m^2 units, air lifts. Close to the coastline (50-1200 ft, 5-18 feet of water). Excavations take place from floating platform. Materials excavated from "gyttja" Contexts not disturbed by inundation.	Paddles (ornamented), canoes, bows arrows, leister prongs, handles, bone and antler tools, axes, knives, needles points, hooks. Human bones, animals (red deer, boar, roe deer with butcher marks. Fishing equipment common. BURIAL of woman excavated.	Andersen, 1980; 1983; 1985; Skaarup, 1983
Fermanville North Shore of France	Mousterian layer of tools of Acheulian tradition on the banks of a relict creek bed and peat at a depth of 18 m (59') BSL. Ca.40kya.	10 km offshore, submerged river valley bordered by lagoonal deposits eroded by stone currents, artifacts exposed in the face of a cut	Rich tool assemblage (N=2554 in Flemming, 1983)	Flemming, 1994; Scuvee and Verague, 1988
Haifa to Atlit, Israel	Several Neolithic to Chalcolithic sites located up to 100 m offshore, Kfar Samir, K. Galim North, Megadim, Newe Yam, Nahal Oren, Tel Hreiss 1. 6800 rcybp. Progression of sites - earliest further out, to bronze closest.	Exposed by commercial removal of sand. sampling done (1985). Sea level rise. Pollen	Architectural features including hearths, also lithics, ground stone, and ceramics. Newe Yam = houses silos storage pits	Galili and Weinstein-Evron, 1985; Galili, 1987

Table 5.02 Selected examples of marine inundated prehistoric sites

Site	Description	Techniques	Inventory	References
Franchthi Cave	Coastline cave occupation onshore	cultural materials found in sediment cores offshore setting	Upper Paleolithic, Mesolithic	Gifford, 1983
Cosquer Cave, Cape Morgiou	Cave with wall paintings	Cave entrance is at 40 m (131') from the Mediterranean	Radiocarbon @ 15,000	Clottes et al, 1992
North America				
Connecticut, Long Island	Several discoveries of nearshore Archaic sites			Bourn, 1972; Stright, 1990
Chesapeake Bay	Oyster fisherman, interviews and correlations.		Early and mid-Archaic aged materials Also discoveries of fluted points	Blanton and Margolin, 1994
Edisto Island, S. Carolina	Proboscidean rib w/ apparent cut marks			Goodyear et al, 1990:8
Venice Beach (8 So 26), Florida	Venice Beach is located between 2.23 m BSL and 1.52 m ASL. It consists mainly of an oyster shell midden located both on and off shore.	Ruppe attempted a fathometer study of the offshore area in attempt to reconstruct the paleo-drainage system (Koski, 1989; Ruppe, 1980:33).	Ceramics, fish bone, acorns, seeds, wood, shell (*Crassostrea* dominant) Radiocarbon dates of 2940 +/- 80 from within the midden; 1981 +/- 85 and 1700 +/- 85 rcybp for post holes (possible fish weir) on the midden Steven Koski (1989) has reported Weeden Island ceramics, food refuse and remains of a possible fish weir on the inundated shell midden.	Koski, 1989; Ruppe, 1980
The Douglas Beach Site, (8 Sl 17), Florida	Accidental discovery in sediments below a shipwreck. Artifacts and other remains found in disturbed contexts below the marine sands	Excavations and collections and cores. Sediments "blown off" with "mailbox" rig	Water worn ceramics of 500 BC age, Newnan age diagnostic, other lithics, human bone and wood posts dating 4630 +/- 100 rcybp	Murphy, 1990

Table 5.02 Selected examples of marine inundated prehistoric sites

Site	Description	Techniques	Inventory	References
Tampa Bay, Florida	Commercial dredging of oyster shell beds beneath Tampa Bay revealed abundant artifacts Several specific locations have been identified.	No diver confirmation of context. Materials dredged up for commercial purposes (no monitoring)	Artifacts diagnostic of Paleoindian and Early Archaic presence, and Mid-Archaic through Late Archaic items	Goodyear et al, 1983; Goodyear and Warren, 1972; Warren, 1964
Apollo Beach, Florida	Materials dredged up for commercial purposes (no monitoring)	No diver confirmation of context.	Mid-Archaic (Culbreath) points. Fiber tempered ceramics, sand tempered ceramics	Warren, 1968a
Turtlecrawl Point, Florida	No diver confirmation of context. Materials Dredged while making artificial peninsula		Greenbriar and Bolen diagnostics. Unifacial tools, Dalton adze, Debitage (core reduction and tool manufacture). Also middle archaic Morrow Mountain and Newnan points found	Goodyear et al, 1980 Stright, 1990
Terra Ceia Bay, Florida	Materials dredged to be used for beach construction, artifacts eroded from the dredge spoil		Dalton and Greenbriar diagnostics, turtle back scraper lithic tools, and ceramics found. Also extinct faunal remains.	Warren and Bullen, 1965; Stright, 1990
Caladesi Causeway, Florida	Materials dredged		Suwannee and possible Bolen points	Warren, 1968b; Stright, 1990
Ray Hole Spring, Apalachee Bay, Florida	Offshore freshwater spring. Discoveries made on the margins of an inundated sinkhole, amongst cracks and/or holes in the limestone where items have been protected from current and wave action.	Hand fanning, and shallow excavations by induction dredges. Subbottom profiling done nearby Discussed in text	Cultural inventory consists of a few items of chert debitage	Anuskiewicz, 1988 Anuskiewics et al., 1994

Table 5.02 Selected examples of marine inundated prehistoric sites

Site	Description	Techniques	Inventory	References
Sabine Pass Block 6, Texas/LA	Seismic survey and coring accomplished in the western Gulf of Mexico	Discussed in text	Burned bone and shell from probable buried midden. Radiocarbon control of about 8,000 rcybp	Pearson et al, 1986; Stright, 1986a; 1986b
McFaddin Beach, Texas	Materials located along the beach by local collectors. Items coming from on or offshore associated with Late Pleistocene Trinity River deltaic formations.	Substantial numbers of artifacts and extinct faunal remains.	Abundant diagnostic items including Clovis, Greenbriar, and other Early and Mid Archaic aged diagnostics. Radiocarbon date on Probcscidean 11,100 +/- 750	Long, 1977
Santa Barbara Channel Island Clusters California,	These are locations of mainly ground stone artifacts found offshore from San Diego. Thirty four loci in the Santa Barbara Channel area.		Mainly mortars and pestles of the La Jolla (Paleocoastal) material culture of early to middle Holocene age. This culture group is also known on the Channel Islands, indicating boat travel by 10 rcybp	Masters, 1983; Moratto, 1984; Erlandson and Moss, 1994
Montague Harbor, British Columbia	Montague Harbor is an inundated prehistoric shell midden that is a continuation of an offshore site. Onshore shell middens, offshore shell accumulation over the archeological site. It is unclear whether inundated artifacts are part of the shell midden or previous contexts.	Excavations conducted at intertidal and offshore locations. Airlift excavations of 1x1 and 3x2 to depths between 1 m and 4 m. Coring done for stratigraphic sequence. Excavations take place 90 m offshore.	Artifacts include lithics (mostly debitage) and wood harpoon. Context apparently disturbed by inundation.	Easton, 1993 Flemming, 1983

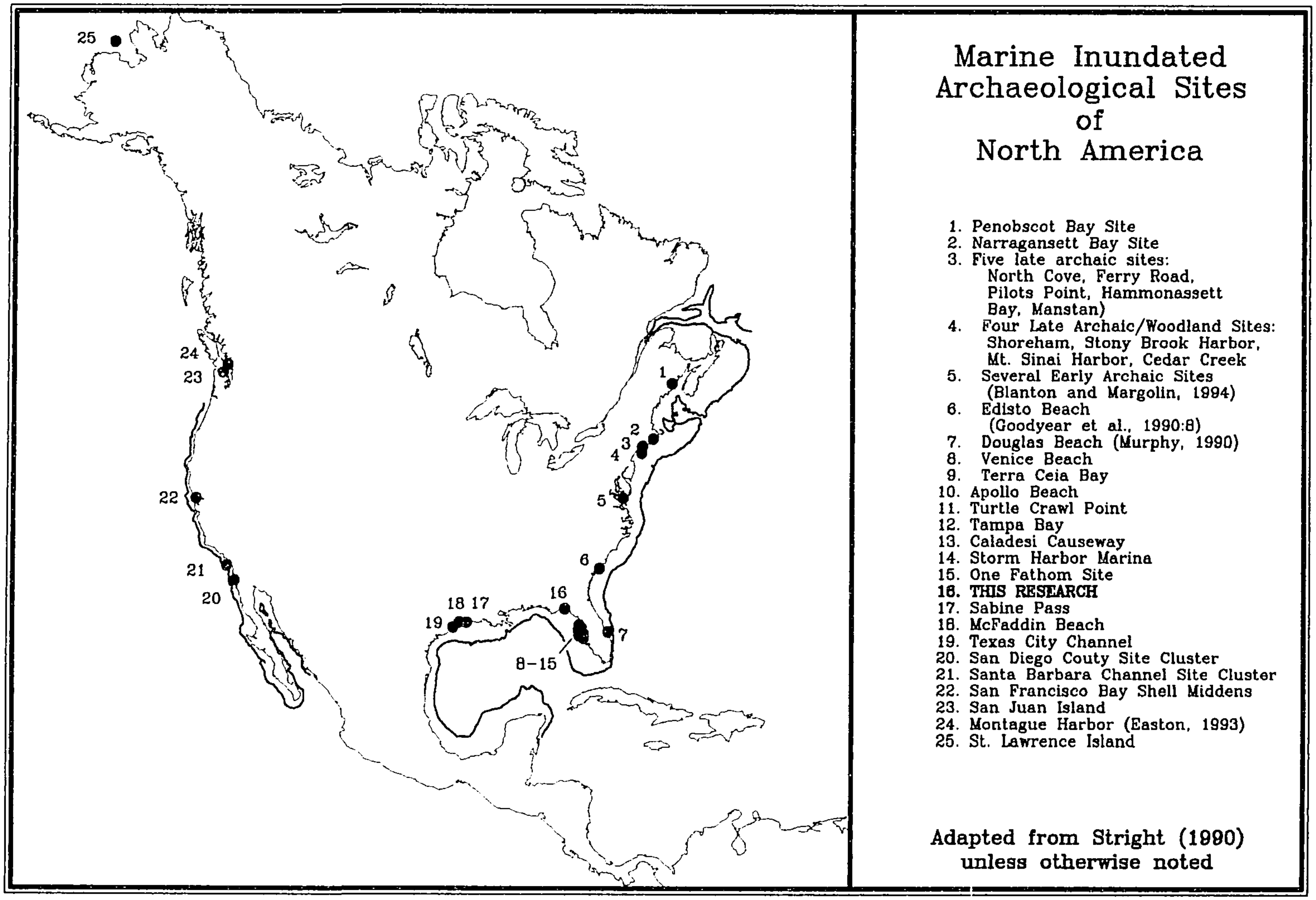

Figure 5.01 Marine inundated archaeological sites of North America

These inventories reveal that known continental shelf marine inundated sites often occur in intertidal and near coastal settings with depths ranging between surf line and about 10 meters (33 feet). These sites are usually within a few hundred meters of shore and usually in geomorphological situations that tended to protect the artifacts during inundation. Protection occurs either by sedimentation or because the items were located in a rock cavity of some sort.

Most discoveries of marine inundated sites are chance discoveries made by fishermen, oystermen, and sport divers (Flemming, 1994). Ceramic and chipped stone assemblages have been discovered by searching offshore of coastal land sites, such as at Francthi Cave in Greece, or Montague Harbor in British Columbia (Table 5.02). Fermanville was found during the course of a marine geology research project. Flemming says that marine inundated sites are often are discovered because recent storm surge erosion has exposed the artifactual items.

By far the majority of known marine inundated sites in the world are Neolithic and Classical aged sites come from the Mediterranean. Sites are particularly abundant around Italy because of extensive Roman aged maritime activities These sites include harbors and other facilities inundated because of subsequent land subsidence and sea level rise. The east coast of Italy also exhibits several discoveries of Upper Paleolithic remains (cf. Bietti, 1990). Mesolithic and Neolithic remains are frequent underwater in Israel (Galili, 1987).

The United Kingdom, France and Denmark have a number of inundated Mesolithic and Paleolithic aged sites, Japan has more than 30 locations of Paleolithic and later (Jomon and Yayoi) sites in marine inundated situations (Araki and Ishihara, 1989; Osaki, 1978). India and Australia are also beginning to be represented (Flemming, 1994). Areas where marine inundated sites are expected, but which have no representatives yet, include the Sunda and Sahul shelves (Southeast Asia and Australia) and Beringia.

Currently, the oldest (and deepest) inundated site in the world is Fermanville, France. At Fermanville, diagnostic Mousterian implements were spread over a buried occupation surface in a stratigraphic exposure located at depths of 18 meters (59 feet) in the English Channel near Cherbourg. Other Mousterian artifacts have been reported off the coast of Corfu, Greece (Flemming, 1994:8). In addition to the Italian Upper Paleolithic examples cited above, materials of this age are known from sites along the Israeli coast (Galili, 1985; Galili and Weinstein, 1985; Galili et al., 1986), from some inundated caves, particularly the recently discovered cave paintings in Southern France at Cosquer Cave (Waechter, 1964; Clottes et al., 1992) and from Japan.

Stright has recorded 97 inundated archaeological sites in North America, not including fresh water occurrences or the sites being described and analyzed in this dissertation. The emerging pattern is that sites are most frequent in the Northeast, off the west coast of Florida, and off the Texas Gulf Coast. Several localities are known off the coast of southern California, and a few are known from the Northwest (cf. Table 5.02; Figure 5.01). Of these, the west coast of Florida is, by far, the most prolific, particularly around Tampa Bay.

North American sites with artifacts diagnostic of Paleoindian and/or early Archaic occupations, and which are described more in Table 5.02, include: the Narragansett Bay Site in Massachusetts, sites in the Chesapeake Bay, Terra Ceia Bay, Turtlecrawl Point, and Tampa Bay in Florida, the Sabine Pass Shell Midden and McFaddin Beach in Texas, and the artifact discoveries of San Diego and the Santa Barbara Channel which are considered as Paleocoastal Tradition materials. Human remains have been found in inundated situations at the Douglas Beach Site (Murphy, 1990), Pilot Point Yacht Basin Site (Bourn, 1972; Stright, 1990), and in and around Tampa Bay (Warren, 1968 a and b; 1972a and b).

Middle Holocene European Meso- or Neolithic and North American Archaic aged remains are the most frequently discovered marine inundated sites. This is due, in part, to the fact that these occupations occurred near coastlines which are only a short distance from today's coastline, and thus are more readily discoverable. Shallow, middle Holocene aged remains are frequent in Denmark and the Baltic Sea (Flemming, 1994). Similar time period, North American Archaic aged remains are known from both East and West Coast North America. These are presented in Table 5.02.

Some of these North American sites were discovered by commercial dredging operations without any assessment or recording by cultural resource management professionals before or after disturbances took place, particularly in Florida. These dredging operations include mining for shell resources to use as raw materials for paving, dredging of navigational channels, and procurement of shell and sandy sediments for terrestrial fill and beach rejuvenation.

As this dissertation is written there are examples that could be made to show a lack of compliance with both state and Federal regulations when it comes to cultural resources management projects in coastal states (Anderson, Blanton, Dunbar, Stright, Tesar, personal communications). This is due in part to a lack of experience with, and formal management plans for these kinds sites and to fears of high costs of research. It is also due to a general inability to predict where sites are likely on local levels, and to the absence of appropriate consultants to call on for this type of work.

Specific archaeological projects with research focused on developing the skills necessary to locate and sample continental shelf, marine inundated archaeological sites are rare (Flemming, 1994:13). Examples I am aware of include work in the Francthi Cave area of Greece (Gifford, 1983; 1990; Van Andel and Llanos, 1984); a small project locating paleodrainage patterns on the Sahul shelf (Flemming, 1986); the Sabine River area of Texas/Louisiana (Pearson et al., 1986); and this dissertation research.

The research undertaken offshore of the Sabine River of Texas/Louisiana is a particularly useful example of how to find marine inundated prehistoric sites. This project was specifically designed to develop and test models of site discovery and to assess site preservation characteristics. This was accomplished by the personnel of Coastal Environments Inc. under contract with the Minerals Management Service of New Orleans, Louisiana (CEI, 1977; Gagliano et al., 1982; Pearson et al., 1986).

Starting off with a systematic analysis of the character and condition of nearby onshore archaeological site settings and geomorphology in Louisiana, Gagliano (1982) developed terrestrial analogues of sites and site settings to compare with subbottom profiles and core samples offshore. He listed several geomorphic settings which might tend to preserve sites which could be identified from remote sensing and core data.

Next, and using previously published paleodrainage reconstructions of the Eastern Gulf of Mexico, Gagliano and his team chose three specific areas to run small interval subbottom profiler and to place systematic vibra-cores. Their focus was on the discovery of buried terrace and estuary settings. These researchers analyzed massive amounts of remote sensing data, placed numerous short interval, ship borne vibra-cores into the sediments, and used sedimentological and radiocarbon analyses to determine the sedimentary history of the Sabine River paleodrainage system offshore, to search for the presence of archaeological sites, and to reconstruct the stages and impacts of subsequent inundation (Gagliano et al., 1982; Pearson et al., 1986; Stright, 1986b).

Two probable archaeological sites were identified on inundated and sedimented terrace surfaces near tributary channel margins now located under more than 4.5 meters

(15 feet) of sediment, 12 meters (40 feet) under the water, and almost 13 kilometers (8 statute miles) offshore. Dating around 8,000 rcybp, the remains were observed in several cores and consisted of two large areas affected by human behavior. One exhibited significant amounts of organics, phosphates, fine lithic debris and burned bone and the other was a mound of shell considered by its morphology to be a midden. These publications are a major contribution to this nascent discipline and a major influence in the development of the three fold approach for offshore discovery used in the Apalachee Bay presented below (CEI, 1977; Gagliano et al., 1982).

Another project focused on the discovery of inundated prehistoric sites is the Aucilla River Prehistory Project (ARPP). This project has developed specialized methods for underwater excavations with diver controlled induction dredges to excavate into Pleistocene and Holocene aged sediments in the freshwater inundated river sinkhole of the Page/Ladson site (8 Je 591; Dunbar et al., 1988; Milanich, 1994; Purdy, 1991; Table 5.01). Discussed in Chapter Four with respect to its place in the stratigraphic record of the Southeast, and below concerning the development of terrestrial analogues for this dissertation research, the Page/Ladson site exhibits a preserved sediment bank in the Aucilla River's "Half Mile Rise" section or reach.

Artifacts diagnostic of Paleoindian and Early Archaic time frame are abundant at the bottom of the sinkhole at Page/Ladson, and the sediment profile has been exposed by excavations and vibra-coring. Late Paleoindian or Early Archaic notched projectile points and adzes were found on a sedimented and inundated surface within these sediments in the sinkhole. The offshore research reported in this dissertation is a direct offshoot of the ARPP, having had the benefit of field excursions and consultations with instigators Jim Dunbar, of the Florida Department of State, and Dr. David Webb, Florida Museum of Natural History, as well as working directly offshore of the Aucilla river itself.

Combined, these two projects represent major contributions to the concepts and techniques needed to predict, discover and excavate marine inundated archaeological sites in diverse offshore settings. The underwater research presented in this dissertation combined the principle of searching for terrestrial analogues with the methods of remote sensing and coring (from the Sabine River project) and diver controlled induction dredging equipment exhausted to floating screens (from the Aucilla River Prehistory Project), to create a tripartite technological approach to discover and sample archaeological sites offshore.

The Principles of Continental Shelf Prehistoric Archaeology

One factor motivating this doctoral research is the conviction that the discovery of archaeological sites on the continental shelves will contribute to an increased understanding of the past. The intentional discovery, analysis, and interpretation of inundated prehistoric archaeological sites can address specific anthropological needs such as the reconstruction of late Pleistocene settlement patterns, population demography, and it can determine the beginnings of coastal and marine resource exploitation for numerous areas of the world. Furthermore, it can contribute to the confirmation and characterization of population movements across land bridges in such places as the Sunda and Sahul Shelves and across Beringia to the New World (Allen et al., 1977; Fladmark, 1979; Masters and Flemming, 1983).

The principles of continental shelf prehistoric archaeology are in development, but there are certain aspects from various projects which are beginning to stand out as shared attributes. In the grand scheme of things, sites are small things to find and relocate out on the continental shelf. What you see from the boat is monotonous and massive. When you descend the depths visibility can be minimal, and sediments, bottom relief and marine growths often conceal the past terrestrial characteristics.

In several of the foregoing examples marine inundated sites were discovered by accident, or during other kinds of economic or scientific activities. Several known inundated sites are simply continuations of onshore terrestrial sites, such as Franchthi Cave and Montague Harbor. Sites that have been located farther offshore and discovered by direct attempts to utilize terrestrial analogues, marine technologies, and actual diver forays are considerably less abundant.

However, it is clear that specialized research projects can systematically reconstruct and understand this missing aspect of prehistory. Questions which can begin the process of narrowing the large areas of water potential for survey include: are there certain areas or regions where archaeological sites might be more abundant than others? Are there certain areas or regions where there are more potentials for site preservation than others? Are there certain areas or regions that are more amenable to searching for early archaeological sites than others?

The simple observation of the extent of continental shelf areas can begin the process of narrowing the search areas to inspect. For instance, the continental shelf is narrow along the west coast of North America, but extensive in Beringia, the Gulf of Mexico and in some places along the East Coast of the United States. In South America, the western continental shelf is narrow, like the western North American one, but there is a large area of continental shelf off of the Southeastern coast. The Sunda and Sahul shelves of Southeast Asia and Australia are the most extensive of any in the world. Other areas of continental shelf potential for the remains of people who may have existed when sea levels were lower include the Iberian Peninsula, Northern Europe and the British Isles, the Persian Gulf and along the west coast of India.

Fairbridge (1992) has classified the continental shelves of North America in relation to the characteristics of depositional and tectonic histories with respect to discovering reliable evidence for sea level rise. These also relate to finding archaeological sites (Table 5.03). The modern western U.S. coastline exhibits high wave energy coastlines and subaerial fragments of Pleistocene shorelines raised by tectonic uplift (Fairbridge, 1992; Leonard and Wehmiller, 1992; Rollins et al., 1986).

Even though this western continental shelf is narrow and fraught with interpretive handicaps, several artifacts and sites have been found underwater in the Santa Barbara Channel (Glassgow et al., 1988; Masters, 1983; cf. Table 5.02 and Figure 5.01). The Northwest Coast, while still included in this region of tectonic activity, exhibits gentler coastal environments and more possibilities for site access (Easton, 1993). In conclusion, Fairbridge points out that the two most stable areas in North America for sea level research -- and hence for archaeology -- are the Bering Straits and Florida's western continental shelf.

Table 5.03 Continental shelf geological regimes from Fairbridge, 1992

Platform Character	Examples
Good for archaeological discoveries	
Semi-stable Platforms	Bering Straits and Florida
Sedimentary coasts	North Alaska, the Texas coast, the Carolinas and Chesapeake
More difficult for archaeological discoveries	
Deltaic Complexes	San Francisco Bay, Colorado River, Mississippi, Carolinas
Post-glacial isostatic uplift and forebulge transition areas	Southern Alaska, and Nova Scotia
Subsiding forebulge and sedimentary sequences	Northwest Coast, New York/Massachusetts

From an archaeological perspective, the best areas to search for marine inundated prehistoric aged sites are those areas with abundant evidence for late Pleistocene through middle Holocene age archaeological sites onshore, the time frame of deglaciation and sealevel rise. From the site distribution maps of Chapter Three, some good examples of these kinds of locations include Beringia, western Florida, and the Texas Gulf Coast (Fairbridge, 1992; Stright, 1990). Secondary possibilities are the Gulf of California, and the San Francisco Bay[2].

The types of sites that may have been flooded by rising post glacial seas include coastal production localities and shell middens, lithic procurement and reduction sites, special activity sites like kill sites, and various kinds of habitation sites including open, or rock shelters. Early ceramic period sites are possible in the Southeast and in South America, where ceramic production was occurring while sea levels were slightly lower than those of today. It should be kept in mind that archaeological sites discovered underwater on the continental shelves are not necessarily inundated coastal habitations. Given the width and slope of a particular continental shelf in question, sites can have been fully terrestrial at the time of occupation. Of course, these same sites may have developed into coastal settings as sea levels rose.

A major factor that inhibits the motivation to begin to search for archaeological sites inundated on the continental shelves is the probability of site destruction by rising sea levels and ocean currents. Wilburn Cockrell noted that common sense informs that an advancing surf line will "destroy" an archaeological site (1980:140) and he points out that similar, but incorrect, assumptions of disturbance by ocean movements

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[2] Note that not all potential prehistoric inundated sites need be marine inundated. For instance, Lake Michigan is a potential area to search for inundated prehistoric sites because of lowered lake levels at times during the deglaciation oscillations (Dyke and Prest, 1987; Chapter Four).

justified early shipwreck salvage and looting without archaeological scrutiny in Florida.

Archaeological contexts were often considered to have been irretrievably altered by "disaster and degeneration", i.e. jumbled and dispersed by wave action (Murphy, 1990:3). However, developments in shipwreck archaeology have shown that this notion is incorrect. The equivalent speculation that marine inundated prehistoric archaeological sites are irretrievably destroyed by rising seas is also not supported by the accumulating evidence (Flemming, 1983; Murphy, 1990; and this study). Inundation certainly affects, alters and dismembers sites, but it is the archaeologist's profession to reconstruct the past through these filters (Flemming, 1983:138).

Knowledge of certain geologic conditions which are likely to provide protection for archaeological sites can facilitate both discovery and sampling. Flemming (1983:138) has observed that sites can survive where the topographic and geomorphological conditions protect the remains from surf action, or where the wind and wave conditions are such that surf action is negligible. He presented examples of sheltered settings (ibid):

Bay lagoon or estuary
Accumulating beach
Lee of coastal island or archipelago
Sheltered alluvial coast
Sea cave
Karstic cave or sinkhole

Other examples include flood plains, river terraces, lakes, and ponds and since these are also likely areas for human habitation, they are likely for site preservation and discovery (CEI, 1977:13).

Estuaries are not only conducive for habitation and coastal exploitation, but they also represent particularly potential features for site preservation. As inundation proceeds up river channel drainage systems, creating flooded paleochannels, estuary conditions prograde in response. This progression is known as the "ria cycle". Examples of this kind of river channel inundation are illustrated by several publications (e.g. CEI, 1977; Kraft, 1986; Kraft et al., 1983; Edwards and Emery, 1977). Thus inundated estuaries could be prime targets for survey and testing.

The type of sediments which cover the sites also can create preservation potentials. Clay and silt are better than sands and gravel, for instance. This is for two reasons, first because finer deposits are laid down in low energy environments which were less disturbing during deposition. The other reason is that there are better chances for anaerobic conditions and taphonomic preservation once these fine grained beds are laid down. Finally, Flemming (1994:15) has observed that once sites have been submerged by 5 to 10 meters of water in lower energy environments they are generally protected from further significant change.

In summary, marine inundated site discovery can be enhanced by targeting areas with overlapping potentials for early site abundance and geomorphological situations which tend to preserve them. Karst areas are particularly noteworthy for these kinds of preservation characteristics. Flemming (1983:136) has emphasized that: "(o)ptimum preservation of artifacts occurs in submerged karstic caves, sink-holes, and estuarine lagoonal or peat deposits." This is one of several reasons that the Apalachee Bay was chosen for research: karst features continue from onshore settings with abundant early remains to inundated situations offshore in this area.

Once an area has been targeted for marine inundated prehistoric sites investigation, the research should be directed by three levels of desired interpretation and reconstruction. These relate to conditions before, during and after inundation and questions which cover these three conditions include:

> What is the character of the past land forms? What were the population densities, settlement patterns, and utilizations of these past land forms? Who were the past inhabitants in relation to groups known onshore of the same time frame?
>
> What was the sequence and amplitude of inundation and the concomitant alteration of the local environment? How did this influence human settlement patterns and how were existing archaeological sites altered (from both functional and geomorphological perspectives)?
>
> What is the modern character of the ocean surface and site composition. How has the marine environment evolved since inundation and what effect has this had on site integrity?

These are area specific questions which direct the attention of the archaeologist to the known regional cultural sequence and settlement patterns onshore, as well as on the changing geology, geomorphology and environment. Frankly, this is an exciting blend of culture history and geoarchaeological research activities.

Techniques for Underwater Site Discovery

The intentional discovery of inundated archaeological sites rests to a large extent on a clear understanding of past land use and settlement patterns onshore. This is perhaps the most important tool to finding inundated prehistoric archaeological sites offshore in any area. Inundated prehistoric archaeological sites do not usually leave signatures detectable by modern remote sensing techniques, but the locations of commonly associated terrestrial analogues can be identified or predicted by bathymetric, subbottom profiler side scan sonar analysis, or all three, as well as by diver survey and local sport and commercial diver information. Terms that have been used for this concept include "cultural signatures" (CEI, 1977:336), or "terrestrial analogues".

"Terrestrial analogues" are drowned geomorphic features formed under subaerial conditions and which are often associated with archaeological sites in onshore settings. Several examples are presented in Table 5.04. In general, the most potential discovery technique, or prospecting tool, is to search near any drowned fluvial feature which would have been used by prehistoric peoples. Kraft and John (1978:59) proposed using this technique to search for archaeological sites in Delaware Bay. They documented a shoreward progression of estuary deposits caused by sealevel inundation which they suggested would be reliable areas for human subsistence procurement activities and therefore likely places for sites.

This dissertation research used chert outcrop/quarry terrestrial analogues in offshore settings to find sites. Most chert outcrops occurring onshore of the research area (described in Chapter Seven) exhibit evidence of quarry activities, whether they are in terrestrial or freshwater inundated situations (Chapter Six also discusses this fact). Outcrops are visible offshore because the limestone dissolves more readily than chert inclusions do, which results in various outcrop formations and nodules. These chert outcrops represent dominant targets for survey out on the continental shelf. The procedure used -- towing divers with small boats looking for "sticky up" outcrops -- resulted in the discovery of more than 15 locations of human activity during three separate offshore forays.

Paleodrainage systems and other relict geomorphological features have been reconstructed in certain areas of the Gulf of Mexico and along the Eastern Seaboard of the United States, as discussed above (e.g. CEI, 1977; Gagliano et al., 1982; Edwards and Merrill, 1977). Published, and detailed reconstructions of river channel coursing and sedimentary sequences is perhaps best exemplified by Nelson and Bray 1970 and Pearson et al., 1986 for the Sabine River area. Locations of drowned estuaries, in the form of brackish water peats has been presented by Emery et al. (1988).

Since these fluvial and coastal margin features are also potential settlement and resource procurement loci for human beings, it follows that these are also potential areas to search for archaeology. Other possible targets include isolated sinkholes, analogous to Warm Mineral Springs or Little Salt Spring in Florida (Garrison, 1992; Serbousek, 1988), and relict karst drainage systems analogous to the Aucilla River (this dissertation).

Table 5.04 Site types, characteristics and analog potentials

adapted from Flemming, 1994 and Gagliano et al, 1982		
Type of Site	characteristics	analogues
Quarry sites	occupation/utilization of chert outcrops	sticky up rock
Estuary and bay margin sites	bay and estuary occupations	margin scarps may be preserved in bathymetry
Valley margin sites	occupation in close proximity to the valley wall scarp	edges of offshore paleodrainage troughs
Natural Levee Sites (major and minor)	occupation on high ground of levee, usually on cutbank side of meander loop cutoffs, junctions of tributaries	edges of offshore paleodrainage troughs
Chenier (beach) and accretion ridges	beach and accretion ridges in southwest LA and Southeast Texas	
Barrier island barrier spit complex	estuary habitats nearby	elevated topography
Point bar sites	activities around actively accreting meanders	
Lake margin sites	logistical forays at lake margins	strandlines
Coastal dune lake sites	possible resistance to erosion and resulting inverted topography	elevated topography
Shell middens	estuary, lake, bay margins	elevated topography
Conical earth mounds	later phenomena, but some within the range of lower sea levels (Middle & Late Archaic)	elevated topography
Crescentic and circular villages	terrace margins	elevated topography
Spring sites	occupation around water resource sinkholes in karst areas	offshore depressions
Salt dome margin		Louisiana specific

One simple way to identify relict or past fluvial features of inundated areas is by the study of the modern topography represented by bathymetric maps. The pattern of "low mean tide" depths can reveal the trend of past drainage systems and topographic irregularities that reflect drowned terrestrial features such as hills, rock (chert) outcrops, ledges or scarps and karst voids. An example of this type of analysis is presented in Chapter Seven, Figures 7.02 and 7.03.

Another procedure may be by the use of aerial photography, depending on ambient conditions and water depth. While this is a powerful tool for site discovery, mapping and spatial analysis in terrestrial settings, it has been relatively unsuccessful as a tool for site discovery and mapping for this dissertation research. This is because it was difficult to get the necessary marine conditions of smooth surface, clear water and appropriate sun angles to coincide with aircraft availability (Lysenga, 1981). Aerial photography only works when the conditions are just right, and if the water depths are not over about six meters (20 feet). There are no modern remote sensing techniques -- either active or passive -- that reliably penetrate the water surface.

Active remote sensing technologies that tow sensing devices under the water include magnetometry, side scan sonar and seismic reflection (or subbottom profiling). These techniques are used frequently for site discoveries in marine archaeology, that is for shipwreck or historic architectural remains (Green 1990; Muckelroy, 1978). These devices were invented and improved for use in marine exploration which was spurred by economically potential activities like petroleum and minerals exploration.

Magnetometers reveal polarity differences between objects, such as ferrous and/or large geological anomalies. This medium has been successfully utilized to locate sunken ships and massive architectural features exhibiting significant polarity anomalies. I am unaware of any prehistoric features that have been found by this technology. Likewise, the potential for side scan sonar to detect inundated prehistoric activity loci is limited. Side scan sonar equipment produces enhanced images of the sea floor bottom topography but it is limited to perceiving larger geological or architectural features with sufficient bottom relief, such as river channels or harbor facilities. Therefore, side scanning might be useful to discover paleochannel systems, or rock outcrops in the research area, but buried prehistoric sites or lower density artifact scatters would go undetected.

High resolution seismic profiling, or "subbottom profiling", on the other hand, can be utilized to discover drowned and buried drainage systems. Subbottom profilers have been shown to be effective and generally accurate tools for defining channel trends, sedimentary beds and other depositional features. Areas thus reconstructed can then be the focus of further archaeological investigations (e.g. Nelson and Bray, 1970; Pearson et al 1986; and Stright, 1986, Van Andel and Llanos, 1984; Van Andel et al., 1980). Since this device reveals information about the topography and the subbottom stratigraphic record, particularly with regard to fluvial features, and since fluvial features are the loci of most prehistoric activities, it follows that archaeological sites can be discovered nearby these features (Stright, 1986). Experience has shown that this is the most efficient tool to use with limited research dollars. I might add that subbottom profilers have also been used to discover buried shipwrecks and harbor features, making it an ideal tool for a wide range of cultural resource management purposes (Rosencrantz et al., 1972).

Since shipboard fathometers act as weak subbottom profilers, because they utilize weak seismic signals to determine depth, they can often reveal whether a bottom is "hard" (rock) and not a channel, or "soft" (sediments) and possibly a paleochannel. When used in conjunction with systematic transects, and data recording (time, depth, and navigational coordinates), acceptable inferences of "channel" trends can be made and plotted on maps. This is true for this specific area of "drowned karst" in the Apalachee Bay where this dissertation research took place and is not necessarily applicable to areas with deeper sediment cover, or inset channels in alluvial settings.

Once the configuration of the past drainage system is known, controlled short interval coring around areas where sites are predicted, but which may underlie sediment cover, can be an effective means of discovering preserved stratigraphy and possibly archaeological sites (Pearson et al., 1986). Coring, with either hammer pounded tubes or gas powered vibra-cores, is effective at ascertaining the stratigraphic details before excavation, as will be discussed in Chapter Seven. However, coring may only reveal the extent of sedimentary bodies and diver controlled induction dredging or industrial scale dredge excavations would then uncover potential areas to the appropriate levels.

Because sediments represent a common geomorphic factor along many Atlantic and Gulf of Mexico coasts, it follows that the development of methods to discover and access sites under such conditions will be vital to the success of the discipline in the future. Since this dissertation research had limited funds, an appropriate area without significant sedimentation was chosen, and this is the Apalachee Bay. In areas with little sediment cover or significant topographic differences, another potential way to discover sites is simply to tow divers or video cameras looking for evidence of exposed sites or site settings (terrestrial analogues). Such techniques have also been a benefit of working in the Apalachee Bay.

Techniques for Data Recovery Underwater

One aspect of modern marine archaeology, beyond the fact that is most focused on shipwrecks and historical aged sites, is that the disciplined approach to archaeology done underwater is essentially the same as archaeology done on land (Bass, 1966). Once sites are located, it is necessary to access them with divers equipped with various specialized, but readily available, tools and methodologies and all underwater activities have a need for locational control and mapping.

This research project attempted line of sight triangulation from one to two miles offshore in 1988. This attempt was a complete failure, if not simply comic relief, in retrospect. There are two purposes for navigational control. The first is simply to return to the sites for further scrutiny, and Loran-C navigational devices have been effective for this task in this research. The second is a need for mapping and illustration control. These maps may be somewhat inaccurate compared to terrestrial standards and yet portray the relationships to the interested reader or other researcher. Modern marine navigational control relies mostly on Loran-C land based radio beacon control, but as this dissertation is written, GPS satellite navigational control is becoming more accurate, available and popular than Loran-C. This research project utilized Loran-C navigation control.

The accuracy of Loran-C is variable with relation to the shape of the intersection of parabolic sound waves. In the research area studied for this dissertation, Loran-C navigational control is accurate to about +/- 60 ft on the east-west axis, and about 100 ft on the north-south one. No attempt was made to control for this fact in the mapping routines described in Chapter Seven. Rapidly developing GPS technology is significantly more accurate than Loran-C and could be deployed in any future projects.

Once an inundated archaeological site has been located, the most effective method of access is either by SCUBA or surface supplied air diving. The term SCUBA includes individual air tanks, which usually last about one hour, depending on the water depth. Surface supplied air diving occurs with floating or shipboard compressors which can operate for several hours at a time. This research has found that floating compressors are the most effective air supply in the shallow depths of the Apalachee Bay, even though we have not always had the benefit of their use.

These activities usually occur from boats or floating platforms. Of course, sites could be encircled and pumped dry to gain access, such as was accomplished at the Windover Site in Florida (Doran and Dickel, 1989). Tongs and dredges operated from the surface can also be effective given adequate provenience data of the collections (Blanton, 1994). Swimming from shore is also plausible, either for SCUBA, surface supplied air or snorkeling activities, depending on the distance and the water depth. Some data survey and data gathering was accomplished in the Apalachee Bay by snorkeling in 1986, but only in waters no deeper than about 1.8 meters (6 feet).

Once underwater, hand fanning sediments and bagging samples in plastic bags and containers represent the simplest sampling methods effective for this research. Of course, hand fanning is only useful when artifacts occur in surface or shallow sedimentary contexts. As discussed, various forms of coring are also effective at determining stratigraphic details before excavation. Finally, sediments can be moved underwater very effectively by either air lift or induction dredges.

Air lift dredges operate by sending compressed air to the diver end of a suction tube, creating a strong suction as the bubbles rise up the column. The spoil is exhausted at the surface of the water, but not much higher. The earliest example of controlled stratigraphic excavations of an underwater prehistoric site in North America, that I am aware of, is the air lift excavations at Warm Mineral and Little Salt Springs in Sarasota County, Southwestern Florida in the 1970s (Clausen et al., 1975:199; Clausen et al., 1979). These devices generally work best in water deeper than six meters (20 feet). Induction dredges, on the other hand, use a water pump to force water through a venturi device at the exhaust end of a suction tube. Induction dredges work in any depth of water, and have the added benefit of forcing the spoil up and out of the water whatever distance the exhaust tube takes.

Induction dredges have been used and refined to great benefit by the Aucilla River Prehistory Project research teams (Dunbar et al., 1988; Dunbar et al., 1991). Starting with equipment designed for gold dredging, the induction dredge system used by the ARPP now includes screens on floating platforms and a range of screen sizes to insert for different recovery sizes. Detailed stratigraphic control, small artifact retention and pedestal control are easily accomplished with this apparatus.

The Overlapping Potentials of the Apalachee Bay Research Area

Given the principles and concepts given above, the Apalachee Bay of Northwestern Florida is a prime location to prospect for inundated prehistoric sites. This is true for both archaeological and geological reasons. First, and as demonstrated in Chapter Three, this northwestern area of Florida exhibits a significant cluster of fluted point and fluted point related isolates and archaeological sites (Figure 3.01 and 3.04). This data leads to the hypothesis that Paleoindians colonized the area, either in high numbers or over a long period of time, possibly before, during or just after the Younger Dryas (YD) climatic event as described in Chapter Four. In any case, when sealevels were considerably lower.

Continued human presence during the time frame of the second meltwater pulse (MWP II, Chapter Four), from approximately 10,000 to 8,000 rcybp, is also implied by the abundance of Early Archaic artifacts in the area. This leads to another hypothesis, that cultural evolution occured over several biological generations in this area (Anderson et al., 1992; Dunbar and Waller, 1983; Dunbar, 1991). The lack of secure radiocarbon dates for any of the Paleoindian occupations in the Southeastern region generally, and Florida specifically, adds to the importance and potential of the research area.

A second potential of the area is that the local geology is characterized by a flat karst topography with numerous collapse and solution geologic features. Chapter Six will bring out some of these geological details. Sinkholes are dispersed across the onshore landscape as isolates (cenotes) and as linear sets (rivers). Furthermore, the Page/Ladson Site is a primary example of the fact that sedimentary profiles in these features can and do reflect the Pleistocene/Holocene transition. Scattered outcrops of resistant limestone and chert in various stages of decay also dot the landscape, and represent the locations of past quarry activities.

Examples of all of these terrestrially formed karst features continue out onto the continental shelf, which opens the way for site discovery by the use of terrestrial analogues. Since most Paleoindian and early Archaic archaeological materials are found in and around karst features on shore, these features are also likely to preserve records of cultural activity and stratigraphy offshore. The pocketed karst topography drowned on the continental shelf also acts as a protective vessel for some sites.

A third benefit of the regional geology is the fact that sediment cover on the continental shelf immediately offshore is minimal and consists mostly of sandy biogenic sediments (shell hash). The lack of significant sediment from the local river mouths is due to the drainage characteristics of the onshore karst. Ground water and surface runoff most commonly flow very slowly through exposed and underground connections of the onshore river channel segments and therefore it has little capacity to carry sediment. Furthermore, erosion of the local parent material is accomplished by chemical, rather than physical, erosion. More on karst development and sediment characteristics is presented in Chapter Six.

Finally, the low slope of the continental shelf, low wave energy conditions, and the somewhat protected nature of the Apalachee Bay, contribute to a relatively mild marine environment. These facts should have tempered the disturbance of sites by transgressing and surging seas -- depending on local conditions and the strength of particular storms. As will be supported in Chapter 6, the 11,000 rcybp coastline probably lies somewhere around depths of 40 meters (130 feet), currently located 130 kilometers (80 statute miles) out from the mouth of the Aucilla River. Therefore a significant area to search for relevant archaeological sites exists underwater which has great potential for exhibiting evidence for past human occupation.

Research Goals and Objectives of the Apalachee Bay Research

As will be described in Chapters Six and Seven, the major impetus of this offshore research has been the discovery and excavation of an inundated sinkhole exhibiting late Pleistocene and early Holocene aged sediments. However, the more general intent has been to inventory, describe, analyze and interpret whatever geomorphic features and inundated archaeological sites were encountered. The research has a formal design which sets a range of archaeological and geological goals.

Succinctly, these goals are to reconstruct the path of the paleodrainage system and other paleogeographic details of the offshore environment, to inventory the past human settlement patterns as they evolved before full inundation and to determine the chronology and impact of transgressing seas afterward. These long range goals and objectives were written before the 1989 archaeological/geological field session, described in Chapter Six, to focus and guide the offshore research. These goals and objectives are:

I. To reconstruct the cultural history, settlement patterns, and environmental adaptations of shelf inhabitants from initial settlement to inundation.

II. To reconstruct the process and pattern of the marine transgression of the continental shelf, and the response of the inhabitants to it.

III. To disseminate this information in such ways as to contribute to the rich local culture history, to act as an example of multidisciplinary inundated prehistoric archaeological research and to aid in the assessment of sea level rise, land use planning, and other environmental and cultural resource management concerns.

Various short term research topics were developed to address these larger issues:

1. Identify and inventory relict terrestrial features commonly associated with prehistoric archaeological sites (e.g. chert outcrops, and relict river channels, sinkholes, rock shelters, etc.). This should be accomplished by visual survey (aerial and diver survey), active remote sensing, and vibra-coring (Ruppe, 1988; Stright, 1986).

2. Identify and date sea level stillstands and other relevant data to build an inundation sequence for Northwestern Florida and to characterize the process of inundation: magnitude and sequence.

3. Excavate and evaluate archaeological sites to build an network of site conditions and human behavioral regularities (culture history and adaptation to the environment).

There has always been an aspect of this research, outside of the scientific objectives and academic research designs, and stemming from the first very low budget attempt to find sites, that discoveries needed to be made immediately and effectively in order to garner sufficient attention and additional funding to proceed farther out on the shelf and deeper into the sediments. Stemming from this perspective, our experience of looking for marine inundated archaeological sites has developed by addressing the following limitations:

1. Short, and often unpredictable time at sea

2. Mediocre visibility in murky water (often less than 6' of visibility)

3. An initially poor understanding of site formation processes involved in the transformation from terrestrial to inundated sites and the location of "deep, protecting sediments" which lead to the next problem:

4. A need for adequate remote sensing devices with which to predict sedimented karst features, and therefore site locations.

5. A perpetual struggle to obtain research vessels of adequate size.

Several of these issues were resolved during the course of this dissertation research, as will be described in the narrative presented in the second half of Chapter Six. However, the acquisition of adequate boats, in particular, seems to be a pressing and perpetual logistical need. This dissertation research has used boats ranging from little eight foot inflatables to the comparatively luxurious 50 foot marine research vessel (Florida State University Marine Labs *R. V. Seminole*). The most frequently used vessels were 18 foot to 20 foot outboard motor boats which commuted from the coast to sea each day.

A related issue of concern for marine bound archaeologists, is the high potential for aborted or altered research forays. The most common stumbling blocks revolve around boat and equipment failures, or both; and weather or ocean conditions, or both. Given all these constraints, actual time spent underwater in survey and excavation can be a small fraction of the actual time spent in the field. Because of these facts, it is important to plan for field sessions during seasons with consistent weather and it is important to plan for "down time".

While researchers should always attempt to go to sea with well maintenanced equipment and equipment backups, this is not always possible. Therefore, it has been useful to have alternative research activities planned for eventualities. For instance, diver survey and collections along transect lines in case of excavation equipment failures and coastal margin survey and collection or artifact, or sediment analysis, or other activities could be prepared for in case of weather or boat problems. This kind of research is logistically intensive, and can be very productive if everything is in place or if useful research alternatives are considered.

Chapter Six discusses the geological, environmental and archaeological background of the research area and presents a narrative history of this dissertation research in the Apalachee Bay. Chapters Seven and Eight describe and illustrate the geological and archaeological discoveries made and presents the results of various analyses undertaken to address several aspects of the research design topics. Chapter Nine will conclude the dissertation with interpretations of the data

Chapter Six

RESEARCH BACKGROUND

The broader coverage of the last five chapters now shifts to the specific area chosen for offshore study, Northwestern Florida. This chapter describes the geology, drainage and natural environment of the region. Past environmental and sedimentary changes characteristic of the region are discussed and the progression of the local late Pleistocene to middle Holocene culture history pertinent to the inundation sequence is reviewed. Terrestrial analogues for offshore site discovery are presented within this prehistoric background. A narrative history of the offshore research program follows to outline the nature and evolution of the project, and to reduce the amount of description necessary for the information presented in Chapters Seven and Eight.

Karst Geology of the Region

Figure 6.01 shows the modern outline of the Floridian peninsula and bathymetric contours of the continental shelf around it which describe past shorelines during times of lower sea levels. The boundaries of different karst regions and major geologic structures are also shown in this figure, as are the locations of sites discussed. The research area for this dissertation is also illustrated on this graphic.

The major upper sedimentary beds in peninsular Florida are Tertiary limestones accumulated from past higher sea levels and lower peninsular elevation. Quaternary aged limestones are represented in southern Florida. The sedimentary beds of relevance to the research area are presented in Table 6.01. The panhandle region is separated from the peninsula by a sediment filled trough which divides the North American craton from the peninsular platform (Schmidt, 1984). This feature is known as the Gulf Trough, and the Apalachicola River marks its trend. The Northwestern and Central portions of the peninsula exhibit Tertiary limestones at or near the surface. An elevated portion of these exposed limestones in the Northwest portion is known as the Ocala Uplift. Another large scale, low elevation ridge known as the Peninsular Arch divides the peninsula lengthwise (Figure 6.01). The southern portion of the peninsula is sandy and depressed in the South Florida Basin. Because of this low elevation, extensive wetlands and swamps have formed with associated Holocene aged peats and marls. These area expressed most dramatically in Lake Okeechobee and the Everglades.

Table 6.01 Major sedimentary beds of the research area

Formation	Epoch	Comments
Undifferentiated Sand and Clay	Pleistocene/Holocene	Lake Flirt Marl Equivalent (DuBar et al., 1991:603)
************** Unconformable Contact - Lacuna *************		
St. Marks Formation	Lower Miocene	Related to Hawthorne formations in the Tampa Bay area. White to very pale orange, finely crystalline, sandy, silty, clayey limestone to silicified or dolomitized limestone.
Suwannee	Oligocene Limestones	Oldest unit exposed in the study area. Ranges from pale orange, finely crystalline, Fossiliferous limestone to highly indurated dolomitized limestone.
Ocala Group	Upper Eocene	
Avon Park Formation	Middle Eocene	

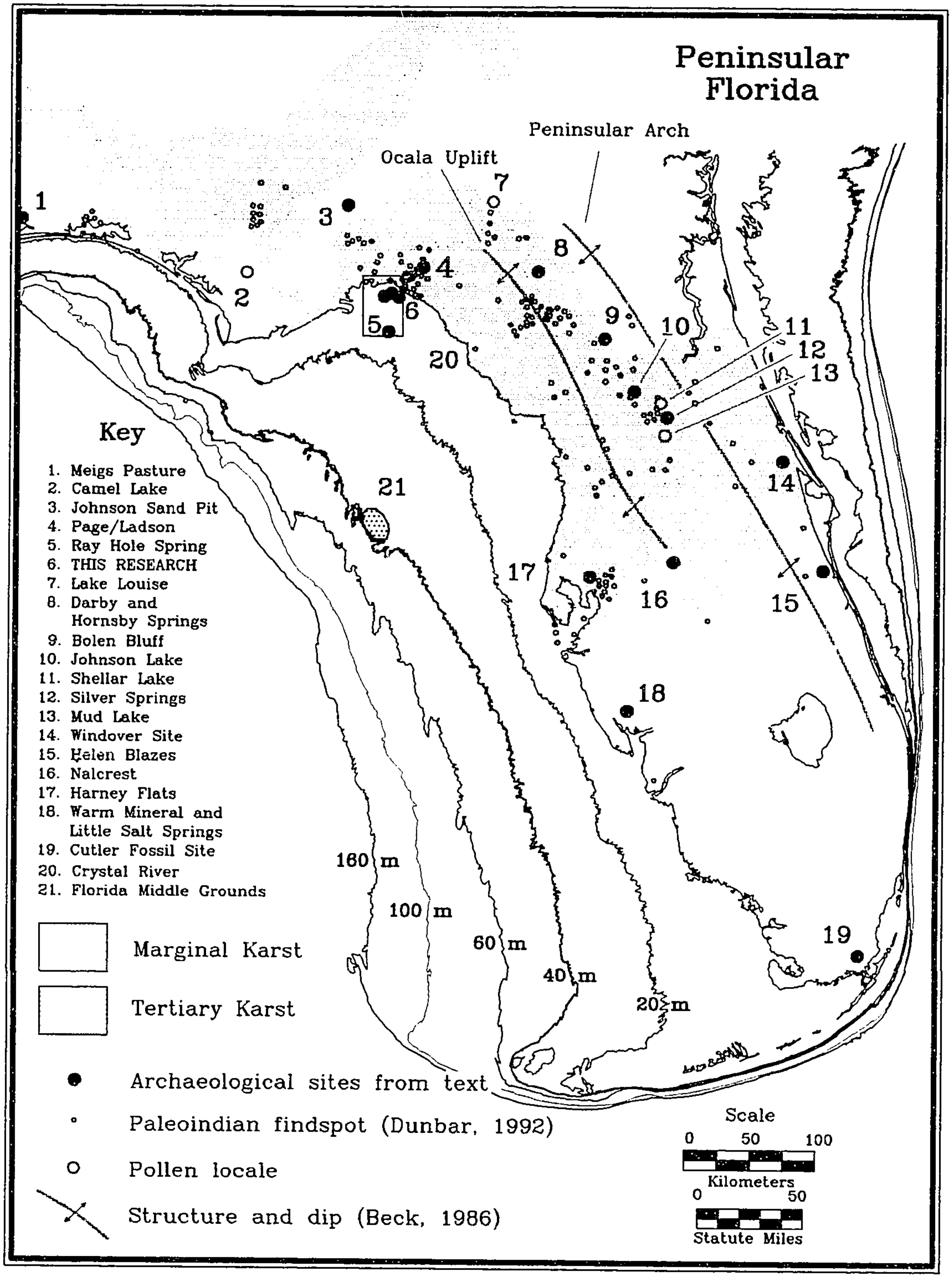

Figure 6.01 Peninsular Florida – bathymetry, geology and site locations

The karst formations in the Marginal Karst region of the Central portions of the state tend to be buried by sandy sediments, but the Tertiary Karst region, more to the Northwest, exhibits karst features of diverse size that are either exposed or shallow buried (Cooke, 1945; Schmidt and Scott, 1984). Dunbar and Waller (1983) and Dunbar (1992) have pointed out that more than seventy percent of the Paleoindian diagnostics known from the state come from these two regions, with the majority found in the Tertiary Karst region. Typically the sediments filling these features are described as "undifferentiated sands and clays" (Table 6.01; Rupert and Spencer, 1988). A more accurate description might be "undifferentiated peats, marls, and sands".

The Apalachee Bay lies between the Panhandle and the peninsula, at the corner of the coastline, in an area called the Big Bend. Onshore of the Apalachee Bay the bedrock topography is extremely flat and covered with shallow sandy sediments and associated soils, except where interrupted by exposed bedrock outcrops or pocketed by karst voids. This area is known as the Gulf Coastal Lowlands, and it is separated by dune fields into the Woodville Karst Plain (to the east) and the Appalachicola Lowlands (to the north) (Puri and Vernon, 1964; White, 1970). These dunes include the Lake Munson Hills, the Wakulla Sand Hills and Okefenokee Dunes, and represent dune formations of ten meter (33 foot) relief and Pleistocene age, form the boundary between these two flat areas. These dunes were blown up onto this onshore area from subaerial exposure of offshore sediments during periods of lower sea level (Hendry and Sproul, 1966). Farther inland, the regional topography exhibits relief on the order of 30 to 45 meters (100 to 150 feet) in the Tallahassee Red Hills, a relict and weathered Miocene or Pliocene aged delta of red clays and sands altered by erosion, subsidence and pedogenic processes. Karst features are formed by the chemical erosion of limestone in contact with acids found in soil, water, or atmosphere (Jennings, 1985; Sweeting, 1981).

The primary agent of this chemical erosion process is carbonic acid (H_2CO_3) which is formed at the fresh water - air interface and accumulates in the water (Jennings, 1985:20; Ritter, 1986:452; Milanovic, 1981:25). The rate of chemical erosion is dependent, in part, on the concentration of carbonic acid in the water, which is directly dependent on the partial pressure of CO_2 (pCO_2) in the global atmosphere[1]. The decay of organic matter in soils represent secondary sources of CO_2 and corrosive acids.

Each year about 13 million tons of dissolved solids are transported to the Atlantic and the Gulf of Mexico, mostly through the aquifer connected flow of fresh water springs in Florida (Dysart and Goolsby, 1977; Rosenau et al., 1977). The rate of limestone dissolution has been estimated at approximately one vertical foot of limestone in about 11,000 years, but solution rates vary depending on local conditions and

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[1] Because the concentration of atmospheric CO_2 is the dominant factor in the chemical attack on limestones, and because CO_2 levels have fluctuated in the past, karst erosion and sedimentation characteristics are potential, if untapped, proxies of past CO_2 concentrations (Broecker and Peng, 1986).

topography (Heath and Conover, 1981; Opdyke et al., 1984:227).

The most well known karst formations are sinkholes, cenotes or dolines. These depressions or voids are formed by surface solution, by internal collapse or by combinations of the two (Beck, 1986). The river channels in the research area are more like linear sets of sinkholes, and the surrounding areas can be pocketed topographically with isolated solution and collapse voids of diverse size. This pocketed nature is particularly acute at the coastal margins because the mixing of fresh and salt water at the coastal margins is particularly corrosive due to an "ionic strength effect" which temporarily increases the corrosive ability of mixed liquids above the combined potentials of the parent liquids. This ionic strength effect is particularly robust in the presence of NaCl, and mixing of fresh and sea water substantially increases solubility such that the shorelines are pocketed with eroded void features (Howenstein and Garrett, 1993; Hutton et al., 1984; Milanovic, 1981). I will return to this issue below and in Chapter Seven.

The Woodville Karst Plain is part of the larger area of positive bedrock relief known as the Ocala Uplift, presented above. Opdyke, et al. (1984) hypothesized that the Ocala Uplift is the result of isostatic rebound from substantial dissolution of limestone in late Pleistocene time, that the Ocala and Suwannee basement limestones uplifted as they became less dense from increased rates of chemical erosion. This dissolution and isostatic uplift could have occurred at the very end of the Pleistocene, a time of increased CO_2 partial pressure (Broecker and Peng, 1986), and the uplift may have an effect on the perception of eustatic sea level fluctuation in this region. If isostatic rebound was taking place in the early and middle Holocene, then apparent sea level rise would linger, allowing for subaerially exposed surfaces to become inundated later. I will discuss this possibility again, after presenting evidence for a local sea level chronology in the conclusion in Chapter Nine.

Karst Sedimentary Characteristics

While the dissolution and collapse characteristics of karst formations are well documented, less published attention is paid to the sediments that fill these features. Nevertheless, karst sediments are diverse and informative. The three main lithologic units observed consist of marls (calcitic muds), peats (decayed plant material), and sand to gravel textured sediments. These sediments reflect differing environments of deposition either precipitated by various biogenic and chemical processes, directly eroded from the limestone parent materials, or brought in by gravity, wind, or people.

In Southern Florida, marls (calcitic muds) have been shown to be the result of the precipitation of calcium carbonate by blue green algal periphyton (Gleason and Spackman, 1974:146; Purdy, 1991:10). Late Pleistocene aged examples of these sediments are known locally as Lake Flirt Marl. These researchers suggest that this process takes place with seasonal couplets of exposure and inundation in the parent basin[2]. Marl deposits may be due as much to differences of pH and temperature, as to water depth, but this is speculation. Its presence is certainly indicative of conditions different from those leading to the accumulation of peat.

Peat is a common and extremely diverse sedimentary unit, as well as an excellent source of paleoenvironmental data. Peats are formed from the wasted biomass of their surrounding plant communities in shallow water, acidic aquatic conditions. Peat beds are usually dominated by specific plant communities such as sawgrass, mangrove, prairie, or pond (waterlily). Perishable artifacts, like wood items, basketry and textiles, are often preserved in pristine conditions in peat, as are human remains (Aaby and Berglund, 1986; Purdy, 1991).

The other sedimentary units seen in the karst formations include sedimentary beds with a diversity of sand and gravel size particles, as well as other types of clasts (faunal bone and artifacts). These sands and gravels can have resulted from the physical and chemical weathering of the limestone, localized flow regimes within karst, or mixed karst/alluvial drainages. Windblown sands, colluvium and animal or human introduced items are also possibilities for the sources of these deposits. When capped by sediments implying more aquatic regimes (peats and marls), some of these units can be inferred as the result of past subaerial exposures.

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[2] The lack of sedimentary couplets in larger units of marls in the Page/Ladson site or with examples from the offshore research to be described in Chapter Seven suggest that the deposition also occurs in shallow, but continuously inundated situations. These geological processes are not well understood at this time.

For instance, at the Page/Ladson site in the Aucilla River, sandy sediments with abundant extinct faunal bone are interpreted as Pleistocene channel margin deposits down in the sinkhole (*Zone D*, Strawmat and Limesand units, Chapter Three and below). These sediments are followed in the stratigraphic column by beds of marl and a peat, which represent inundated Holocene conditions.

Freshwater Drainage

In addition to local rainfall runoff, the sinkholes, lakes and rivers of the Northwestern portion of Florida discharge the groundwater of the Floridian Aquifer through a complex set of inter-connections (Davies and LeGrand, 1972). The Floridian aquifer is the largest of several aquifers in the state and it drains the Gulf Coastal Plains from portions of Alabama, Georgia, and South Carolina. Its main exit to the Gulf is through the rivers of the Apalachee Bay described below and in Table 6.02, as well as others farther south along the coast. As an example of the significance of this flow, note that while Northwest Florida occupies only 30% of the state's total surface area, it provides 62% of the combined spring drainage flow (Opdyke et al., 1984:227).

Fresh water springs are common in the region and some must have represented reliable water resources for humans and other animals in times of regional drought , or lowered sea- or base levels, or both (Rosenau et al., 1977). These springs are also evidence that the karst caverns and sinkholes riddled through the local limestones are connected subterraneously.

The area immediately onshore of the research area exhibits particularly abundant spring flow. Perhaps the most well known of these springs is Wakulla Springs, an isolated karst sinkhole with an associated outflow channel, from which numerous extinct faunal remains have been recovered from underwater, at the bottom of the sinkhole feature. These remains include a full mastodon (*Mastodon americanus*) skeleton and more than six hundred bone points of probable Archaic age (Olsen, 1958; Rupert and Spencer, 1988). Recently, buried Paleoindian and Early Archaic artifacts have been reported from excavations around the margins of this sinkhole/spring (Florida Anthropological Society Newsletter, 1995). Wakulla Spring drains to the Apalachee Bay via the Wakulla River and then the St. Marks.

Marine inundated, but fresh water flowing springs are known from underwater on both of Florida's continental shelves, including the Ray Hole Spring located within the research area discussed in Chapter Seven (Garrison, 1992; Rosenau et al., 1977; Serbousek, 1988; Aneskuwitz, 1988).

It is important to understand that the base levels of aquifer water in these springs (and other karst features) fluctuate with sea level oscillations, both tidal and eustatic depending on local conditions (Clausen et al., 1975; Dunbar, 1981). Some lakes and other water bodies are perched above aquifers either by elevation or by sediment capping, and are, therefore, more dependent on local precipitation. These kinds of features often reveal interrupted stratigraphic records implying local desiccation

(Dunbar, 1981; Watts and Hansen, 1988; Watts and Stuiver, 1980:325). Dunbar (1981) attempted a reconstruction of aquifer base level fluctuations for central Florida based on various lines of evidence for a cultural resource management project near Tampa Bay. He suggested that, in general, perched systems exhibit sufficient water for sedimentation generally before and then again after 8,500 rcybp, but that stratigraphic lacunae occur between implying low water tables, or arid conditions.

Table 6.02 lists three alluvial and five karst rivers of the immediate research area, treated in a clockwise direction. The Apalachicola River is the major drainage of the area, although it drains just west of the Apalachee Bay. The Apalachicola carries significant sediment load, forming barrier islands and protected bays immediately offshore. The same is true for rivers farther east along the Panhandle, such as the Choctawhatchee and Escambia Rivers (Pensacola and Choctawhatchee Bays, respectively). The sand cover from these rivers extends for some distance south, out onto the continental shelf, but not into the Apalachee Bay (Locker et al., 1988).

The Ochlockonee and St. Marks rivers flow into the Apalachee Bay, and share characteristics of both karst and alluvial rivers in that they have sufficient capacity to carry sediment, but they cross karst terrain and contain reaches which exhibit karst solution and collapse features. The Ochlockonee drains karst streams connected to the aquifer from the Apalachicola Lowlands on its eastern flanks and surface runoff and removal of sandy sediments from the Lake Munson Hills dune fields to the west. This combined sediment load and flat topography results in a meandering stream in its lower reaches.

The sediments of the Ochlockonee exhibit inset stream terraces and cutbank stratigraphic exposures onshore and they are responsible for the formation of an inundated relict barrier island known as the Ochlockonee Shoal in the Apalachee Bay offshore. This geomorphic feature is discussed and illustrated in Chapter Seven and Figure 7.02.

Table 6.02 Rivers in and near the research area

RIVER	DESCRIPTION
ALLUVIAL	
Apalachicola	Alluvial river = 35% of the total freshwater flow on the west coast. Formed by the confluence of the Chattahoochee and Flint Rivers.
Ochlockonee	physiography change: east karst, west alluvial difference in exposed limestones? Three stream terraces above the flood plain. Source in south Georgia 115 miles, entrenched some places, it meanders
St. Marks	Mixed alluvial and karst river head in Tallahassee Hills channel karst intermittent to Natural Bridge, then courses through a well defined channel incised in bedrock
KARST	
Wakulla	Spring rise, then merge with St. Marks (McBride Slough = relict course of the Ochlockonee
Aucilla	Including spring fed tributaries Little Aucilla and Wacissa 2466 Km2 basin area. The Aucilla is a discontinuous, karst river system
Econfina	Like the Aucilla, tannin rich, smaller, and fewer discoveries of Paleoindian materials
Fenholoway	Damaged by pollution from local paper mill, sport divers avoid this river and artifacts and faunal remains are probably preserved in place, or in naturally disturbed situations
Steinhatchee	Tannin rich karst river with much exposed limestone karst morphology

The St. Marks River is more like a karst river than the Ochlockonee, but it does carry some sediment load. The St. Marks was the scene of small early Spanish, and later English sea ports. It is known for its underwater discoveries of both historic and prehistoric artifacts. Some Paleoindian and Early Archaic diagnostics are known from this river. The St. Marks is dredged occasionally for navigational access by larger vessels, but no cultural resource management assessment has been made for this disturbance.

The Aucilla marks the precise beginning of the Big Bend and it is the largest fully karstic drainage system of the Apalachee Bay. The Aucilla begins in southern Georgia and flows both above and below ground for much of its course to the sea. The Aucilla has represented an indigenous cultural boundary for at least 4,000 years of time (Tesar, 1980). The Aucilla is a tannin rich river with very low sediment load and low turbidity. The tannin reduces underwater visibility substantially in the summer, rainy season. The Aucilla is interrupted in several places where the flow of water goes underground and comes back out in another segment downstream. The last three segments of the Aucilla make up the research area of the Aucilla River Prehistory Project, to be described below.

The head or rise of the last of these segments begins at the Nutall Rise, and flows unimpeded eight kilometers (five statute miles) south to the Apalachee Bay, widening in breadth along the way. The next segment inland, known as the Little River, ends

250 meters north of the Nutall Rise and extends one kilometer (.7 statute mile) north to its origin at the Head of Little River. The siphon for a third discontinuous segment inland, known as the Halfmile Rise, lies one kilometer (.6 statute mile) north of the Head of Little River and continues approximately two kilometers (1.2 statute miles) north before going underground again, near a local picnic spot known as Cow Pasture. This is the area incorporated by the Aucilla River Prehistory Project. The Page/Ladson site is located in the Halfmile Rise segment, about 300 meters (.2 statute mile) north its the siphon. The site is located at the confluence of the Aucilla and a smaller, spring fed tributary known as the Wacissa.

These segments exhibit channels of highly irregular bottom morphology made up of systems of sinkholes and rock jumbles resulting from numerous dissolution and collapse events and fluctuations in water flow and level. Since karst processes are advanced in the presence of water, more decay occurs during times of high sea- and aquifer baselevels. Thus, the river system evolves toward surface connection between these discontinuous segments. Several examples of recent head collapse and connection between segments are known (Dunbar et al. 1989) and others have been inferred from the study of aerial photomaps.

Sediments within these features in all three segments, include recent organic debris, peats, marls, sands, gravels and fossils of extinct and extant fauna. Especially abundant on the underwater surfaces are aquatic species of turtle and alligator remains.

Chipped stone artifacts and debris of Paleoindian, Archaic and Ceramic aged artifacts, as well as modern jetsam have been found in several locations in this river. The Nutall Rise, for instance, has an abundant record of soda pop and other glass bottles dating back to the 1920s, that were thrown into the sink by local residents. Paleoindian, Early Archaic and Ceramic aged diagnostics have been found in Nutall Rise as well. Terrestrial and underwater discoveries of a rich temporal range of projectile points, chipped stone tools and debitage along with ceramics and historic aged items are common from Cow Pasture to the mouth of the Nutall Rise segment of the river.

Karst rivers, of smaller scale but similar character to the Aucilla, continue farther down the Big Bend coast, including the Econfina, the Fenholoway, the Steinhatchee, and Withlacoochee. Farther south along the coast, the Suwannee River is another mixed karstic and alluvial drainage river (McPherson and Hammett, 1991) and one that rivals the Aucilla for shear numbers of early diagnostic artifacts, in particular the Suwannee varieties. The exposed Tertiary karst region ends at Tampa Bay, and the Paleoindian and Early Archaic diagnostic frequencies also drop off, as will be discussed below. These river systems surely continued out onto the continental shelf ,with lower sea levels in the past, and therefore must have paleodrainage patterns out on there. Chapter Seven will reconstruct a segment of this pattern in the Apalachee Bay.

Local Natural Habitats

The research area lies between 30° and 25° latitudes, at approximately the 84° Longitude. Rain is most frequent in the summer, and winters are relatively dry. The rainfall averages between 56 and 58 inches per year, half of which falls from June to September (Watts, 1983:305). The abundance of rainfall and aquifer drainage in the area results not only in the dissolution of the limestone bedrock, but also in a great diversity of flora and fauna. The forested habitat that covers the onshore area is a species rich, mixed hardwood forest with pine (*Pinus*), *Quercus* (oak), and *Carya* (hickory)[3]. Areas closer to the river segments or near isolated water filled sinkholes exhibit *Taxodium* (cypress) and *Nyssa* (Tupelo or Black gum) (Clewell, 1980; 1991). Vegetation grows in sandy soils, amongst the cracks, crevices and sediment choked paleokarst features of the Woodville Karst Plain.

A zone of flat marsh lands with dominant cord grasses, including *Juncus* sp. and *Spartina* sp. parallels the coast along a band two kilometers (1.2 statute miles) wide. This Coastal Marsh Belt is a bedrock controlled ecozone, generally flooded at high tide and during storms (Puri and Vernon, 1964; Rupert and Spencer, 1988). Rupert and Spencer (1988:11) have stated that:

> "Formation of open coastal marshes is attributable to the zero-energy nature of the Big Bend coast. Sand movement is minimal, and beaches are virtually absent due to a lack of wave activity [and sediment supply - mf]..."

---

[3] Much of the Woodville Karst has been logged for pine. The Aucilla was logged at the turn of the century, but not in recent time.

The brackish groundwater is shallow or exposed in and amongst the karst voids The gradient is low and there are sandy dendritic tidal channels. Solution features include pits, depressions, borings, etchings, pinnacles, and sinkholes. Marsh grasses thrive and there is little decay of deceased flora, thus marsh peats accumulate. Small island refugia of greenery, represented by oak and bay trees, well out into the marsh grass belt, survive where karst void features are still connected to the aquifer.

Environmental Change

The abundant remains of extinct fauna, and changing sediments exhibited in inundated settings in these river segments, imply that the environment has changed in the past. Certainly sea levels were lower and extensive areas of the continental shelf were exposed in the past. But what effects did transgression have on the local environment and what are the possible configurations of past terrestrial features and sedimentary columns which might be inundated offshore, or which might relate to reconstructing this history?

This section of the dissertation reviews Florida's stratigraphic record of late Pleistocene and Holocene stratigraphic records relating to conditions from before inundation of the continental shelf, say 12,000 rcybp, to the attainment of today's sea levels, sometime between 5,000 and 4,000 rcybp. These records are pertinent to understanding past environmental change, and necessary to develop possible analogues for site and stratigraphic discoveries offshore.

Pleistocene and Holocene pollen records with published stratigraphic records relevant to this northern Florida research area come from four localities: Camel Lake, Shellar Lake, Lake Louise, and Mud Lake near Gainesville (Figure 6.01). For the purpose of brevity, tables have been prepared which summarize salient aspects of these records (Tables 6.03 through Table 6.06; Watts, 1969; 1971; 1983; Watts and Stuiver, 1980; Watts et al., 1992). These salient aspects include sand, peat and marl lithologies and comparison of unconformities representing lacunae, fluctuations between *Pinus* and *Quercus* pollen frequencies, and organization of the radiocarbon control (see Purdy, 1991:10-13 passim for similar discussion).

From several of these records, Watts (1983:302) has suggested that the full glacial was probably dominated by *Pinus*, but with *Ambrosia* (ragweed) and grass pollens common. The interpretation is of an open pine forest, with xerophytic plants, occurring on well drained (sandy) soils. This full glacial climate, without modern analog, has been characterized by Watts as a dry and windy and time, with mobile dunes and deflation of silts (Watts 1983:304).

Toward the end of the Pleistocene, more or less during the first meltwater pulse (MWP I), *Quercus* and *Carya* become more frequent, and *Pinus* declines. At Camel Lake (Table 6.03) a unit of Peat/Silt/Sand couplets records aggradation between 14,000 and about 11,000 rcybp. The terminal Pleistocene record at Sheelar Lake near Gainesville also shows a trend from late Pleistocene, *Quercus* dominance to *Pinus* roughly in concert with the Younger Dryas (YD) time frame (between 11,200 to 10,000 rcybp) (Table 6.04)[4].

Table 6.03 Stratigraphic sequence at Camel Lake

<table>
<tr><td colspan="4">The lake margins are at 20 meters ASL, depth 4.4 meters, penetration 13.5 meters
from Watts et al., 1992</td></tr>
<tr><th>Depth</th><th>Sediment</th><th>Comments</th><th>Dates</th></tr>
<tr><td>0-4.76 m</td><td>Black Lake Mud (gytja)</td><td>Modern flora: Domination by Pine and Taxodium.</td><td>7,760=/-100 (Beta-37484)</td></tr>
<tr><td colspan="4">******* Unconformable Contact - Lacuna *******</td></tr>
<tr><td>4.76-5.80</td><td>Orange Peat</td><td>Oak dominant, with Carya common, Pine low. Other broad leafed species common also.
Peat inferred as shallow water</td><td>10,020+/-110 (Beta-37849)
10,980+/-100 (Beta- 37850)</td></tr>
<tr><td colspan="4">******* Unconformable Contact - Lacuna *******</td></tr>
<tr><td>5.80-7.38</td><td>Peat/Silt/Sand</td><td>Pine dominant at base but declining, spike of spruce by the upper levels - contrasts idea of warming trend</td><td>12,610+/-135 (Beta -23162)
14,330+/-480 (Beta-23163)</td></tr>
<tr><td colspan="4">******* Sand deposition *******</td></tr>
<tr><td>7.38-9.12</td><td>Silt, silty peat, sand stringers</td><td>Increasing pine, with fluctuating oak</td><td>29,350+/-600 (Beta-23164)</td></tr>
<tr><td>9.12-9.56</td><td colspan="3">Sand</td></tr>
<tr><td>9.56-10.72</td><td>Silt, Silty Peat</td><td></td><td>31,610+/-480 (Beta-23164)</td></tr>
<tr><td>10.72-11.50</td><td colspan="3">Sand</td></tr>
<tr><td>11.50-13.5</td><td>Sand and organic silt</td><td></td><td>>33,000 (Wis-1934)</td></tr>
</table>

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[4] This dry to wet fluctuation is a reversal of other paleoenvironmental records discussed in Chapter Four, which exhibit wet to dry sequences, but does mark the approximate YD time frame.

Quercus pollens remain dominant over *Pinus* at Camel Lake throughout this time, but the sediments change to orange peat suggesting a change in the depositional regime, and implying shallow but elevated water tables. Radiocarbon control places the initiation of this orange peat around 10,980+/-100, the earliest date for Holocene aggradation in the lower Southeastern region, to my knowledge (cf Table 4.03).

Table 6.04 Stratigraphic sequence at Shellar Lake

<table>
<tr><td colspan="4">No deviations given for these dates (Watts and Stuiver, 1980, Watts, 1983)</td></tr>
<tr><th>Zone</th><th>Description</th><th>Comments</th><th>Dates</th></tr>
<tr><td>Sh-6</td><td>No description</td><td>Modern conditions</td><td></td></tr>
<tr><td>Sh-5</td><td>No description</td><td>Pine dominates at the upper portions with Oak in decline again. Taxodium increasing from Sh-4/5 boundary to today's conditions.
Oak returns to dominance at the base, Carya significant</td><td>7200</td></tr>
<tr><td>Sh-4</td><td colspan="3">**************** Unconformable Contact - Lacuna ****************</td></tr>
<tr><td>Sh-3</td><td>Organic mud</td><td>Pine on the rises again between 13,540 and 11,230, concomitant rise in upland herbs. Increasing frequency of charcoal fragments imply fires.
Oak dominance, along with hickory, between 14,600 and 13,540.</td><td>11,230
13,540</td></tr>
<tr><td>Sh-2</td><td>Organic Mud</td><td>Initial values of pine low, oak and hickory more dominant.</td><td>14,600</td></tr>
<tr><td colspan="4">******************* Unconformable Contact - Lacuna ********************</td></tr>
<tr><td>Sh-1</td><td>Silt</td><td>Pine dominance but Oak and hickory well represented, herbs and grasses. Jointweed (Polygonella sp.).</td><td>18,500
23,880</td></tr>
</table>

Quercus comes back to dominance again regionally, along with other broad leafed arboreal species, between 10,000 rcybp and approximately 7,000 rcybp, implying desiccation of the climate. Watts and Stuiver (1980:326) have proposed a dry, warm

Hypsithermal from this data at Camel, Mud and Shellar Lakes, as well as at Lake Louise (Tables 6.03, 6.04, 6.05 and 6.06).

Table 6.05 Stratigraphic sequence at Mud Lake

Elevation: 50 m ASL, 14.4 m of sediment in lake, depth of penetration: 9.5 m and 13.6 m from Watts, 1969			
Zone	**Description**	**Comments**	**Dates**
Zone 1	Gray algal muck (gytja) (0-2 m)	Pinus - Taxodium level	2,280+/-200 5,070+/-150 (base)
Zone 2	Humus rich fine muck (2- 3.6 m) diatoms Grading to silt (3.6-4.2 m) diatoms Silty shell muck (4.2-4.9 m) diatoms	Quercus Zone High oak percentages, shrubs and aquatics	8,160+/-200 (I-1558) at base
Unconformable Contact - Lacuna			
Zone 3 (4.65-6.20 m)	Detrital muck - Sawgrass Peat	Quercus Resembles Zone 2 (Possible Sangamon age)	>35k (L 817B) 34,500 +/- () (I-1478)
Zone 4		Pinus Dominant, with very little pollen of other trees or of grassy swamp (6.2-7.7 m)	
Zone 5	Shelly silt grades to detrital muck	Abundant oak, hickory and sweet gum. Elements of mesic hardwood forests (i.e. sugar maple, beech, basswood and hornbeam) (7.7-11.2 m)	
Zone 6	Dark brown medium grained detritus muck	Pine with traces of spruce. Elements of mesic hardwood forests (i.e. sugar maple, beech, basswood and hornbeam)	

Pollen records usually exhibit a final change of conditions in the middle Holocene in the form of a decrease of *Quercus* and *Carya* pollens and a substantial increase in the frequency of *Pinus* sometime soon after 7,000 rcybp. Along with this change in upland arboreal floras come increased frequencies of swamp or wetlands flora, in particular

Taxodium (cypress). This suggests that freshwater base levels reached today's levels, facilitating the growth of more of these water loving species.

Table 6.06 Stratigraphic sequence at Lake Louise

49 m ASL, karst lake feature, lake depth: 5.8 m, 2 core D (Watts, 1971)			
Depth	**Sediment**	**Comments**	**Dates**
5.80-5.88	Grey Gyttja	Increased frequency of *Taxodium*	
5.88-11.60	Blackish brown algal gyttja Sand frequency increasing below 10.20	Oak decreasing, Pine rising marked at 10.30. Oak dominant at base, Pine frequency down	6,710 +/- 140 (Y-2646) 8,510 +/-100 (Y-1770) at base
11.60	********* Silty rubble - Penetration stopped		

Stratigraphic Records

Like Dunbar (1981), Watts and Hansen (1988) observed depositional interruptions in the stratigraphic columns of several pollen cores around 8,500 rcybp in concert with evidence for dryer conditions in the form of increased *Quercus* and decreased *Pinus* pollen percentages at Camel Lake (Table 6.03), Shellar Lake (Table 6.04); Mud Lake (Table 6.05) and at Lake Louise (Table 6.06). These sample sites are located in the Peninsular Arch portion of the state (Figure 6.01), which is elevated from the aquifer surface.

They present this regularity as evidence that early Holocene aquifer levels did not rise high enough to flow in lakes with depths less than 18 meters (59 feet). They suggested that if coring is intended to encounter Pleistocene and early Holocene sediments, the karst lake or other feature should exhibit depths greater than 18 meters.

However, this stratigraphic break also occurs in other radiocarbon or artifact controlled stratigraphic records which are lower in elevation or deeper than 18 meters, or both. Sites in this category include: Warm Mineral Springs (Table 6.07), Harney Flats (Table 6.09), Windover Site (Table 6.10), and possibly at the Page/Ladson Site nearest to the dissertation research area (Table 6.11).

At the fresh water inundated Warm Mineral Springs site (Clausen et al., 1975; Cockrell and Murphy, 1978), alternating beds of leaves (peat) and calcitic muds (marls) mark the beginning of deposition in the solution notch at a depth of 13 meters (42 feet) (Table 6.07). The earliest radiocarbon date, possibly indicating the onset of aggradation is 10,630 +/- 210. Three subsequent dates cluster in the 10,000 rcybp time frame and a suite of dates range throughout the 9,000 to 8,900 rcybp time frame (Table 6.07). These alternating peat and marl couplets indicate that baselevels fluctuated about this level.

The development of tufa on top of these alternating deposits suggests subaerial exposure and subsequent precipitation of $CaCO_3$, possibly as a result of lower water tables, between 8,920 and 8,600 rcybp. Calcitic mud and aquatic sedimentation recommenced after 8,600 (Table 6.07; Clausen et al., 1975, Cockrell and Murphy, 1978). This hiatus correlates with other stratigraphic markers for possible lowered freshwater or simply dryer conditions, or both, observed in the pollen stratigraphies presented above and at other sites presented below. A gytja peat, representing modern conditions, at the top of the sequence is undated. A similar stratigraphic sequence has been reported from Little Salt Spring, nearby (Table 6.08).

Table 6.07 The stratigraphic sequence at Warm Mineral Springs

<table>
<tr><td colspan="4">13 m ledge, Cockrell and Murphy, 1978; Clausen et al., 1975</td></tr>
<tr><th>Zone</th><th>Description</th><th>Comments</th><th>Radiocarbon Dates</th></tr>
<tr><td>1</td><td>Algal gytja</td><td>Subaqueous</td><td>no dates</td></tr>
<tr><td>2</td><td>Calcitic Mud</td><td>Subaqueous Two minor Spalling Events</td><td>8,520 +/-400 (W-1243)
8,600 +/-400 (W-1241)</td></tr>
<tr><td colspan="4">Deposition of Tufa
**** Possible subaerial formation or lacuna ****</td></tr>
<tr><td>3</td><td>Leaf Bed - Calcitic Mud</td><td>Leaf beds alternating with calcitic mud stringers, tufa and wall skree fragments.
This is the unit from which the skeletal remains and artifacts have been found</td><td>8,920 +_ 190 (wood) , top (GAK-3992)
9,220 +_ 180 (wood) , lowest (GAK-3991)
9,350 +_ 190 (wood) , middle (GAK-3993)
9,370 +_ 400 (charcoal) , Top(W-1245)
9,420 +_ 150 (charcoal ?) Level 1(GAK-3995)
9,500 +_ 400 (charcoal) , Middle(W-1212)
9,870 +_ 370 (charcoal) , Bottom(W-1153)
9,880 +_ 230 (wood) Level 5 (GAK-3999)
10,000 +_ 200 (wood char.) Zone 3 (LJ 120)
10,020 +_ 180 (wood) Level 2 (GAK-3996)
10,260 +_ 190 (wood) Level 4 (GAK-3998)
10,630 +_ 210 (wood) Level 3 (GAK-3997)</td></tr>
<tr><td>4</td><td>Grey-Green Clay</td><td>Clay below leaf bed with large spall rockfall,</td><td>no dates given</td></tr>
<tr><td colspan="4">******* Bedrock *******</td></tr>
</table>

At the Harney Flats site, a terrestrial lithic production site near Tampa Bay, deposition of pale brown sands lie unconformably on Miocene aged Hawthorne clay (Daniel and Wisenbaker, 1987; Goodyear, 1991; Table 6.09; Figure 6.01). No radiocarbon control is available from the site, but Paleoindian and Early Archaic artifacts were found in proper stratigraphic order. The pale brown sand exhibits almost 70 centimeters (2.5 feet) of sterile sand before the artifacts occur. If this contact was the YD marker at 11,000 rcybp, then occupation occurred sometime afterward.

Table 6.08 Stratigraphic sequence at Little Salt Springs

From Gifford and Koski, 1994			
Description	**Zone**	**Comments**	**Dates**
Modern			
Gytja			
Peat			
Marl			8,090+/-60
******* Unconformable Contact - Lacuna *******			
	Unit F	fossil marine shells, wood fragments, and most artifacts	8,570 (avg of 2) Artifacts dates from 1979: 9,920 +/- 160 (Tx-2461) 9,645 +/- 160 (I -6460) (stake) 9,500 +/- 120 (Tx-2460) (stake) 10,190 +/- 1450 (Tx-2595) (Hearth) 9,080 +/- 250 (Tx-2594) (Mortar) Date below burial in basin: 10,980 +/- 210 (I-6459)
Sand	Unit G		
Organic Mud	Unit H		From 1979: Calcitic Mud (?) 9,920 +/- 160 (Tx-2461)
******* Sand Unit I *******			

The lowermost items include strictly Suwannee (Paleoindian) artifacts (points, preforms, tools, and debitage) and then Bolen (early Early Archaic) artifacts gain dominance farther up the column. The most recent artifacts in this unit are Kirk (late Early Archaic) items. This Kirk artifact accumulation, while sparse, continued up into, but not beyond a dark hardpan soil. As will be discussed in the section on culture history below, these Kirk artifacts span a time of roughly 9,500 to 8,500 rcybp (Oliver, 1985:202). Above the pedogenic zone and lacuna, artifacts of Newnan style (approximately 6,000 rcybp) occur in the next stratigraphic unit, a white sand.

Therefore, it is possible that the hardpan induration at Harney Flats marks pedogenesis, possibly related to aridity or lowered water tables (Dunbar, 1981:98), or both, and that it agrees with the other lacunae or pedogenic horizons presented above and below for an 8,500 rcybp marker.

Table 6.09 Stratigraphic sequence at Harney Flats

excerpted from Goodyear, 1991:55 (no radiocarbon control based on stylistic criteria)			
Zone	**Description**	**Comments**	**Dates**
Zone 1 (0-.15 m)	Humus rich gray sand	Sterile	
Zone 2 (.15-.75 m)	White sand	Woodland ceramics in upper portions, begin Newnan at .60, in and above the hardpan	7,000 to 6,000 rcybp equivalent
Zone 3 (.75-.85)	**** Dark brown hardpan soil - possible lacuna ****		
Zone 4 (.85-1.05)	Yellow brown sand	Possible Kirk horizon	9,500 to 8,000 rcybp
Zone 5 (1.05-2.00)	Pale brown sand	Suwannee-Bolen mix (mostly in upper 30 cm, below 1.3 artifacts dropped off significantly)	10,000 to 11,000 rcybp equivalent
******* Unconformable Contact - Lacuna *******			
Zone 6 (several meters below surface)	Bluish green clayish sand	Sterile	Pleistocene

The radiocarbon controlled section of stratigraphy at the Windover Site, near Cape Canaveral in east central Florida (Table 6.10; Figure 6.01), begins with a tan to black colored waterlily (Holocene) peat which lies unconformably on a light colored (gray) sand (Pleistocene). Radiocarbon dates of 10,750 and 10,160 rcybp have resulted from samples in the lower levels of the waterlily peat, confirming this placement (Table 6.10; Doran and Dickel, 1989; Doran et al., 1986; 1990; Purdy, 1991). The waterlily peat terminates in a rubber peat with radiocarbon dates between 9,000 and 8,000 rcybp.

Table 6.10 Stratigraphic sequence at the Windover Site

Doran and Dickel, 1989; Doran et al., 1986; 1990; Purdy, 1991			
Unit	**Description**	**Comments**	**Dates**
Black Peat	Decomposed saw grass		4,790+/-100 (Beta 10763) 6,070 +/- 90(Beta 13910)
Red-Brown Peat	Upper and lower units: BURIALS in lower 50 cm of unit, directly on Rubber Peat below 2.6 m(?) below pond bottom	Fresh water molluscs, (*Heliosoma trivoluis*), turtle, fish	upper peat unit: 5,800+/-80 (Beta 10764) 7,290 +/- 120 (Beta 20450) Bottle Gourd grave goods 7,360+/-70 (Beta 11381) (peat in cranium) 7403 avg 3 wood artifact dates (mf) 7496 avg 5 bone collagen dates (mf)
******* Possible pedogenesis? *******			
Rubber Peat	*Chenopods* increase *Quercus* decline	*Planorbella sp.* Freshwater shells	7,950+/-140 (Beta 10855) 8,990 +/- 90 (Beta 13908) 9,530 +/- 110(Beta 14649)
Tan-Black Waterlily Peat	*Quercus* dominant		(basal portions of peat) 10,160+/-120 (Beta 11382) 10,750+/-190 (Beta-13907)
******* Unconformable contact - Lacuna (?) *******			
Gray (white) Pleistocene sand Pollens: *Pinus* dominant, *Quercus* and *Carya* significant			

The researchers state that the formation process which resulted in this rubber peat is not clear (Doran and Dickel, 1988:283; Purdy, 1991:208). *Pinus* pollens decline and *Quercus* increase in this zone, implying that conditions are drying and they state that the plant parts of the peat are degraded (Purdy, 1991:15-17). The use of the term "rubber" implies induration to me, which may be the result of exposure and pedogenesis, and which compares roughly with the other stratigraphies reviewed here.

All of the burials of the Windover site (MNI=168) lay on this possible pedogenic boundary, and in the red peat above. Radiocarbon dates for the peat and the burials range between about 7,500 and 7,000 rcybp.

The red brown peat is proposed to have formed in shallow, but continuously inundated, conditions. The burials were dug into and placed on the accumulating red peat and it continued to form around and above them. The grave goods exhibited impressive numbers of carved bone items, some with designs, and fabric and other perishable items. However, diagnostic chipped stone artifacts were rare. These diagnostics artifacts include one possible Kirk (late Early Archaic) and two generic Florida Archaic Stemmed varieties (Middle Archaic). These projectile point varieties will be discussed in the section below regarding culture history.

The last stratigraphic section to be discussed is also one of the best preserved stratigraphic records of the Pleistocene / Holocene transition in Florida, and perhaps in the whole of the Southeast -- Page/Ladson (Dunbar et al., 1988; 1989; Purdy, 1991; Milanich, 1994; Table 6.11; Figure 6.01). Page/Ladson is a ten meter (33 foot) deep sinkhole in the Half Mile Rise section of the Aucilla River, which contains a massive sediment bank on its west side and a scoured limestone bank on its eastern side. This river sinkhole has exhibited numerous early projectile point diagnostics, lithic tools and debitage in both disturbed and *in situ* contexts and several excavation units have been dug. Test Pit C, a deep exposure in the sediment bank on the western side of the sinkhole, exhibits the longest, and best preserved sequence. Page/Ladson represents an analog for expected Pleistocene/Holocene stratigraphy and early archaeological deposits on the continental shelf offshore.

Table 6.11 Stratigraphic sequence at the Page/Ladson Site: Test Pit C

Carter, 1993; Dunbar et al., 1988:449; 1989; Purdy, 1991			
Description	**Designation**	**Comments**	**Dates**
Peat with sand stringers	Zones A & B	Dates from Test B	3,440 +/- 70 (Beta 11559) 4,070 +/- 60 (Beta 11558)
Red Peat		(Observed in Test C and test B)	No dates: Possible 8,000 to 9,000 rcybp equivalent
******* Unconformable Contact - Possible Lacuna *******			
Gray Clay "marl" in Test C	Zone C Dates = Test B	Gray clay with fine sand. Peat equivalent in Test B	9,450 +/- 100 (Beta 15089) 9,730 +/- 120 (Beta 11905)
******* Unconformable Contact - Possible Lacuna *******			
Subaerially formed A horizon	"Dirt"	Pedogenic "A" horizon, artifacts on surface include Bolen points, adzes, and some flakes.	10,000+/-120 10,280+/-110 10,000+/-60 Avg =10,090+/-50
Gray "marl"	Zone C	Gray clay with fine sand, large tree stump dated	10,600 +/- 70
******* Unconformable Contact - Possible Lacuna *******			
"Straw Mat" or "Limesand"	Zone D		13,130 +/- 200 (I-13,591) (Test A) 12,570 +/- 200 (I-13,590) (Test A) 12,370 +/- 90 12,330 +/- 110 (Beta-15088) (Test B) 12,240+/-90; 11,790+/-90; 11,770+/-90

As described in Chapter Four of this dissertation, strata laid down at Page/Ladson during Late Pleistocene times in Test Pit C were designated ***Zone D*** and which is known locally as Strawmat and Limesand. Bones and digesta of extinct fauna are found in this stratigraphic unit and radiocarbon dates cluster in the 12,300 rcybp range, notwithstanding one apatite radiocarbon date of 10,520+/-90 on a mammoth femur found upright in the ***Zone D*** deposits of Test Pit A (Table 6.11). An unconformable contact marks the transition from sandy ***Zone D*** deposits to ***Zone C_1***, a two meter thick unit of shallow water deposited gray clay (marl), with a single radiocarbon date of 10,600 +/- 70 on stump wood (Table 6.11).

As part of the dissertation research, and in an attempt to close the radiocarbon gap between dates in ***Zone D*** and those in ***Zone C_1*** , a date was run on a seed from the very uppermost *Zone* ***D*** deposits. This sample resulted in a date of 12,370 +/- 90 (AA-11048), in line with the other radiocarbon determinations (cf Table 7.13). In retrospect, and given that there is a possible lacuna of more than 1,000 years, a date from the bottom-most sediments of ***Zone C_1*** may have been more informative. Regardless, the sequence, as it stands now, can be viewed as reflecting dryer (lower water table) conditions during or at the end of the first meltwater pulse (MWP I) (Strawmat/Limesand ***Zone D***), and slightly higher water tables or wetter conditions during the Younger Dryas (Gray Clay ***Zone C_1***).

A major stratigraphic break occurs in the ***Zone C_1*** Lower Gray Clays, separating what might be called ***Zone C_1*** from ***Zone C_2***, which reflects subaerial exposure, sediment induration and pedogenesis. Diagnostic Bolen chipped stone artifacts lie on this pedogenic surface in association with stakes driven into the sediments and other pieces of wood in apparent primary context. This evidence implies lower aquifer levels sometime between 10,600 and 10,100 rcybp, based on an average of three radiocarbon dates associated with artifacts (Table 6.11).

Another meter of gray clay deposition resumes sometime after the Bolen occupation (***Zone*** C_2), covering and preserving the archaeological activity surface with clay and indicating that water tables rose again, but at higher elevation in the sinkhole than before. Above the Upper Gray Clay peat and sand stringers, couplets, continue to the top of the section. These stringers begin with a degraded red peat. These alternating sand and leaf couplets indicate essentially modern sedimentary conditions.

Radiocarbon control from these upper clays might be inferred from dates in possible equivalent units in Test Pit B and suggesting dates between 10,000 and 9,000 rcybp (Dunbar et al., 1989:479). The sand and leaf bed deposition begins after 4,000 rcybp and represents today's conditions. The degraded red peat stringer at the bottom of that sequence might be evidence for a lowering, or change in aquifer levels in the 9,000 to 7,000 year range, but without associated radiocarbon dates, this interpretation is ambiguous, but at least not contradictory with additional evidence for arid (lower water table) Hypsithermal conditions.

Coast and Continental Shelf Geomorphology

The geomorphology of the continental shelf offshore is the combined result of past subaerial exposure, transgression by rising sea levels and prolonged inundation. Several studies by marine geologists, using subbottom profilers, vibra-coring and sediment grab samples, have described the surface sediments, portions of the paleodrainage system and the progression of barrier islands associated with the inundation of the Apalachicola and other alluvial rivers farther west along the panhandle (e.g. C.E.I., 1977; Donoghue, 1990, Doyle and Holmes, 1985; Doyle and Sparks, 1980; Locker et al., 1988; Schnable and Goodell, 1968).

Donoghue (1990), published subbottom profiler data from the Apalachicola Bay which showed that the alluvial paleochannel, now under sediment in the bay, was terraced and overfit. He suggested that this reflected increased flow in the late Pleistocene, possibly associated with the first pulse of glacial melting. Combined, these studies reveal mainly that a significant amount of sediment covers the continental shelf offshore of the Panhandle region west of the research area, but that sediment in the Big Bend drowned karst region is restricted.

The geomorphology and stratigraphy of karst solution features along the coastal marsh belt have been published by Hutton et al. (1984) and Hoenstine and Garrett (1993). Near the mouth of the Crystal River on the west coast of Florida, just north of Tampa Bay, Hutton et al. (1984) described a low energy, low gradient, marsh dominated coastline (Figure 6.01). They probed sediments with steel bars to record depth to bedrock data along several transects and they hammered in some cores in deeper probes. The result was the reconstruction of an irregular bedrock surface with diverse and numerous voids. In general, the eroded limestone voids were filled with sand or remnants of eroded marsh (peat), or both. A calcitic mud (marl) they called a "weathering residuum" was identified in some cores, below the sand and peat. No radiocarbon analysis was presented in the report.

Hoenstine and Garrett (1993), members of the Florida Geological Survey in Tallahassee, conducted a baseline study of several rivers of the Big Bend coastal region, using auger probes and vibra-cores to describe the modern coastal bedrock geology and sedimentation. Their results paralleled those of Hutton et al. (1984) in finding a highly irregular bedrock morphology, sand and marsh peat sediments, and calcitic mud in deeper voids. They stated (1993:10):

> "the oldest Holocene sediments often include reworked carbonate rubble and mud with wood fragments. Where preserved, this residuum generally grades into a few centimeters of clay rich clastics. The clay rich clastics may be overlain by a 3 feet or more of burrowed sand and/or relict oyster bioherms. This sandy sequence is overlain by peat or peat rich sands in cores nearest the marshes"

Three radiocarbon dates from these deposits, reflecting depths of 30 to 60 centimeters (1-2 feet) BSL, ranged between 4,000 and 5,000 rcybp[5]. One sample taken from the lower "clay rich clastics" in a near shore setting near the mouth of the Aucilla, is virtually contemporaneous with samples from similar stratigraphic positions gathered during the course of this research and described in Chapter Seven (i.e. 6,920 +/- 195 [no lab number given]). These sand, peat and marl sequences are important analogues for assessing sedimentary sequences inundated on the continental shelf

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[5] These are 3,885 +/- 145; 4,475 +/- 130; 4,810 +/- 169 [no lab numbers were given]

offshore, and which might reflect past coastal and near coastal conditions.

Sea Level Rise

There are few published reconstructions of past sea levels in this specific northwestern continental shelf region. However, the chronology of sea level rise across the Floridian continental shelf can also be extrapolated from western Gulf of Mexico sea level curves, with the caveat that these areas exhibit alluvial sedimentary regimes and that absolute elevations may be different (Curray, 1965; Frazier 1974; Nelson and Bray, 1970). A summary graphic of the sea level curves from the western Gulf of Mexico, and various local data points is presented in Figure 6.02. A short section of local sea level curve built by various lines of evidence to be presented in Chapter Seven and discussed in Chapter Nine of this dissertation are also included.

Figure 6.02 shows that maximum lowering at 11,000 rcybp is either around the 60 meter (200 foot) isobath or near the 40 meter (130 foot) isobath. It also shows that between 9,000 and 7,000 rcybp three researchers record regression or strand development. Curray (1960) inferred a substantial, 20 meter (65 foot) regression between approximately 9,500 and 7,500 rcybp. With more specific radiocarbon data points, Nelson and Bray (1970) reconstructed a regression of almost four meters (13 feet) which, by their estimate, occurred from approximately 9,000 to 6,000 rcybp. Frazier inferred a stillstand at 16.5 meters (54 feet) between 9,500 and 7,500 rcybp (Frazier, 1974:23). These three estimations are in rough chronological agreement with onshore pollen evidence for aridity and stratigraphic markers for lacunae and pedogenesis listed above. The possibility of a causal relationship between these data sets could be addressed in future research. However, no data exist from the Big Bend area with which to test this possibility at this time.

Using data gathered from various known cores in both on- and offshore settings, Schnable and Goodell (1968) recorded stratigraphic evidence for brackish water conditions at a depth of 22 meters (72 feet) BSL in the Apalachicola Bay. Radiocarbon analysis was performed on a brackish water *Rangia cuneata* shell which returned a date of 9,950 +/- 180 (no lab number available). This data point is shown in Figure 6.02.

Ballard and Uchupi (1970) used bathymetric evidence to identify possible barrier spits and other relict geomorphology on the western continental shelf of Florida. They identified one set of relict features at depths of 160 meters (525 feet), well beyond any Wisconsinan sea level lowering estimates (Bloom, 1983; cf Chapter Four). They also recorded a robust development of barrier spits and other coastal morphologies at common depths of 60 meters (197 feet). Less robust but inferred evidence for stillstands or strands at contour depths of 40 meters (131 feet), 32 meters (105 feet), and 20 meters (65 feet). They had no radiocarbon control, but speculated that the 60 meter contour could be a stillstand of 10,000 rcybp age. Their bathymetric zones are shown in gray in Figure 6.02.

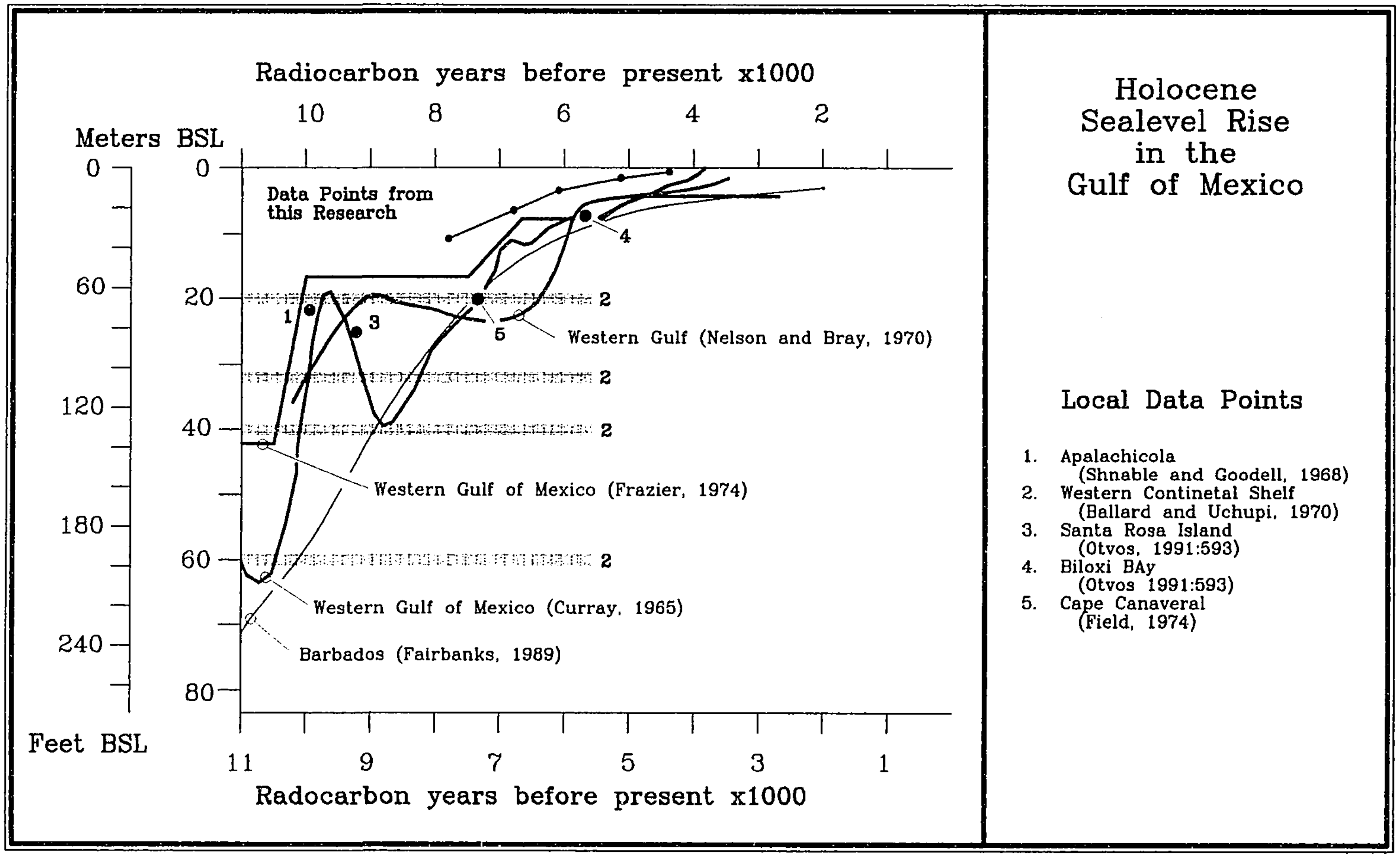

Figure 6.02 Holocene sea level rise in the Gulf of Mexico

A relict reef formation, with area of approximately 800 square kilometers (308 square miles), is known as the Florida Middle Grounds and is located near the 40 meter (131 foot) contour, 130 kilometers (81 statute miles) offshore (Figure 6.01). This feature exhibits ten vertical meters (33 feet) of relief, and represent shallow water, nearshore coral reef development. This agrees with the data presented by Ballard and Uchupi (above) for a strand at 40 meters. However, no radiometric controls have been published regarding its age (Back, 1972; CEI, 1977; Jordan, 1952). This isobath is also marked on Figure 6.02.

Some large sinkholes are known out on the continental shelf of western Florida. These karst features can only have formed during times of subaerial exposure with lowered sea levels. However, some occur at levels well beyond most Wisconsinan eustatic sea level lowering estimates (Bergantino, 1971; CEI, 1977; Bloom, 1983; Garrison, 1992; Jordan, 1952; 1954; Serbousek, 1988).

Ray Hole Spring is a marine inundated sinkhole within the research area of this dissertation research. Ric Aneskuwitz of the Minerals Management Service in New Orleans, J.S. Dunbar of the Bureau of Archaeological Research, Florida Department of State in Tallahassee, and others, have been investigating this feature for several years. This sinkhole is an intermittently active freshwater spring located 30.6 km (19 statute miles) offshore in about ten meters (33 feet) of water (Aneskuwitz, 1988; Aneskuwitz et al., 1994; Figure 6.01). Induction dredge excavations have taken place there, and unequivocal lithic debitage has also been encountered. Additional information on this site can be found in Table 5.02.

The stratigraphic column there consists of a biogenic cover of marine shells and shell debris, and sand, known as shell hash. These sediments are also found in cracks and voids in the limestone bedrock surrounding the sinkhole. Chunks of limestone rock and occasional chert items overlay oyster shells in these voids. The oyster shells are indicative of shallow marine, and brackish water environments adjacent to a coast and these returned a radiocarbon date of 7,390 +/- 60 rcybp. *Quercus* wood was found in a crack in the limestone bedrock, with depth in the shell hash. The wood is considered to have been deposited when the surrounding area was a terrestrial or fresh water environment and it returned a date of 8,220 +/- 80 rcybp. This is not an *in situ* tree stump, and the shell may be reworked, but these two dates are used in this dissertation to interpolate inundation at this depth at about 7,805 rcybp. Obviously, this estimate has some potential for error.

Local Culture History

As with the discussions on paleoenvironments presented above, the portions of Florida's prehistoric cultural record pertinent to understanding the possibilities for human occupation of the continental shelf encompasses the time before inundation of the continental shelf, say 12,000 rcybp, to the establishment of modern sea levels, sometime between 5,000 and 4,000 rcybp. This frame includes Paleoindian, Early and

Middle Archaic cultural manifestations and their onshore occurrences can be used to develop analogues for finding preserved archaeological sites. In this discussion, projectile point types and other formal tools of the chipped stone assemblages (traditions) are used to define these groups. This is true in Floridian prehistory in general, until the advent of ceramics in archaeological deposits, at which time ceramic types take precedence (Bullen, 1975; Dunbar, 1991; Milanich, 1994; Purdy, 1981; Tesar, 1980; 1994). The introduction of ceramics in the Southeastern region, in Late Archaic time, is roughly coincident with the attainment of modern shorelines. The sites are shown in Figure 6.01.

Paleoindian Colonization

As laid out in Chapter Three, the timing of the initial colonization of the Southeast, in general, and Florida specifically, is not yet known with certainty. One example of evidence for 12,000 year old (i.e. "pre-Clovis") human presence in Florida is the giant land tortoise (*Geochelone crassiscutata*) found in association with a possible culturally modified stick or "spear" on the solution ledge at Little Salt Spring (Clausen et al., 1979; Purdy, 1991:146, Figure 6.01). The tortoise resulted in a radiocarbon date of 13,340 +/- 190 and the stick at 12,030 +/- 200. Another possible early association is a bola stone found at the Page/Ladson Site in the upper portions of the Strawmat/Limesand Pleistocene levels in Test Pit B and associated with a radiocarbon date 12,330 +/- 110 (Beta-15088) (Dunbar et al., 1991). However, the artifact at

Little Salt Spring is equivocal, and the stratigraphic associations are questionable at Page/Ladson.

Unequivocal, but also undated, evidence for the early colonization of the region is represented by the presence of Early Paleoindian Classic Clovis fluted and other, more abundant, flat or concave based Paleoindian lanceolates known locally as Suwannee and Simpson points (Chapter Three). Clovis points have been found stratigraphically associated with diagnostic Suwannee points in the lower levels of the Silver Springs site, demonstrating their potential for antiquity (Hemmings, 1975; Neill, 1958).

Sites with Paleoindian diagnostics generally exhibit assemblages mixed with Early Archaic (Bolen and Greenbriar) diagnostics, although often with the Suwannees statistically more abundant in lower levels. One such site is Harney Flats, near Tampa Bay. Suwannee projectile point reduction strategies have been reconstructed from the Harney Flats site near Tampa Bay (discussed above with regard to the stratigraphic record; Table 6.09; Daniel and Wisenbaker, 1987). Other sites with mixed Paleoindian and Early Archaic diagnostics include: the Johnson Sand Pit (Tesar, 1994), Hornsby Springs (Dolan and Allen, 1961), Lake Helen Blazes (Bullen, 1958); and the Paynes Prairie sites (Bullen, 1958:34). These sites are shown in Figure 6.01.

Paleoindian, and Early Archaic artifacts were originally discovered by sport divers in several northern Floridian rivers, such as the Santa Fe, the Ichetucknee, the Aucilla and Wacissa, the Steinhatchee, the Oklawaha, and the Withlacoochee (Milanich, 1994).

These divers brought these artifacts to the skeptical attention of professional archaeologists in the 1950s and early 1960s, and these researchers have conceded over the years as to the value and authenticity of these artifacts. Figure 6.01 shows Dunbar's plotting of individual site locations or find spots, and it is readily apparent that the majority of these items are found in the Tertiary and Marginal Karst regions of the northwestern portion of the state, discussed above. These sites area mostly found within, but also around the nearby areas of the margins of freshwater karst features (Dunbar and Waller, 1983; 1992; Dunbar, 1991; Milanich, 1994).

Dunbar (1991:210) has stated that the Suwannee variety represents 81% of his statewide inventory of known Paleoindian diagnostics, with Clovis fluted and Simpson fishtail projectile points following at 14% and 5% respectively. However, the distribution of these frequencies is not uniform across the landscape. Two of the three major rivers where discoveries are most frequent, the Santa Fe and Suwannee, exhibit only about 10% of Clovis fluted points each. The Aucilla, a third major location of Paleoindian discoveries, exhibits 39% of its collection as Clovis, the highest relative frequency of this type in any river in the region (Dunbar et al., 1989:475). Carved ivory foreshafts are also more frequent in the Aucilla than other rivers, or in any other place in the continent (David Webb, personal communication).

Since Clovis is considered to be earlier than Suwannee or Simpson, it follows that the Aucilla has more possibility to exhibit these earlier remains and may help to reconstruct the process and pattern of the fluted point colonization process as presented in Chapters Three and Four.

The model used to explain the presence of these materials within the river sinkholes is known as the Oasis Hypothesis. This model was first proposed by Neill in (1964) and was later refined by Waller (1970) and Dunbar and Waller (1983). It states that early artifacts and extinct faunal remains are concentrated in sinkhole depressions because animals were dispatched and butchered down in them during the late Pleistocene, when water baselevels were lower in concert with low sea levels. As described above, late Pleistocene climatic conditions were more arid and characterized by oak and grassland savannah uplands, with canyon like karst sinkhole features disbursed across the landscape.

This environment supported substantial numbers of late Pleistocene fauna and reliable fresh water resources would have been available to the fauna down in aquifer connected karst features with adequate pathways for entry (Agenbroad, 1984; Waller, 1970; Watts, 1983; Watts and Hansen, 1988; Webb, 1974). Perched karst features would have been dry. This situation would have lasted until the fauna were extinct or the features became flooded by rising sea levels, or both. This time frame is marked at the Page/Ladson site by the Strawmat/Limesand and Lower Gray Clay contact. Subsequent sinkhole filling took place with fresh water sediments as evinced at Page/Ladson. People are assumed to show up during this process, and we believe they were accessing the megafauna, now inundated chert resources and the water down in these features as well.

Research directed toward the discovery of *in situ* Paleoindian artifacts in karst sinkhole situations to test this Oasis Hypothesis in the Aucilla River was initiated by David S. Webb and James S. Dunbar in 1983 (Dunbar et al., 1988; 1991; Milanich, 1994:45-47). Initially brought to their attention by avocationals Dick Ohmes (now deceased), Ben Waller (now deceased) and Don Serbousek, of Ormond Beach, as well as other local collectors, the project has progressed to what is now known as the Aucilla River Prehistory Project.

This research project has accomplished several survey and excavation projects in various sinkholes of the modern drainage system of the Aucilla, in particular at the Page/Ladson site (Dunbar et al., 1988; 1989; Richardson, 1988; Willis, 1988). The current research attention and next generation of publications is focused on much finer details of the changing sediments of this site and of other sites in the three discontinuous segments described above, Nutall Rise, Little River, and Halfmile Rise.

While there have not yet been occurrences of early Paleoindian materials in secure and datable stratigraphic contexts with extinct fauna, instances exist which strongly imply their association. In particular, extinct faunal bones with cut marks, and ivory foreshafts have been found in the Aucilla and other river systems, implying associations of living animals and humans. Also, Paleoindian artifacts are found in stratigraphic situations at the beginning of Holocene aggradation in Florida, as in other settings in the continent. Bullen noted that sites producing Suwannee points or Suwannee-like fragments, occur at the base of substantial sand deposits "which rest on earlier clay or clay and sand deposits." (Bullen, 1958:29; cf Hemmings, 1975; Simpson, 1948; Neil, 1958). Given data presented in Chapter Three, it may also be that Classic Clovis points are restricted to the time frame of 11,200 (11,500?) to 10,800 (10,500) rcybp, implying that people who made Clovis points were in the area sometime in that range (cf Haynes, 1982:390; Mead and Meltzer, 1985; Webb et al., 1983).

Transition from Paleoindian to Archaic Economies

The boundary between Late Paleoindian and Early Archaic adaptations is arbitrary. Local convention has it that the notched Bolen points represent Late Paleoindian adaptations. A different view is taken here: Bolen notched points represent technological innovations probably related to shifts in resource procurement methodology and therefore represent examples of changes in adaptation - classic markers of the Archaic. Radiometric dates associated with Early Archaic diagnostic materials accrue after 10,300 rcybp. Sites which exemplify these assemblages include most of those mentioned above with the Paleoindian assemblages, but other freshwater inundated examples include Little Salt Spring, Warm Mineral Springs, and possibly the Nalcrest Site. Darby Springs, Johnson Lake, Johnson Sand Pit, Cutler Ridge and Helen Blazes represent terrestrial examples (Bullen, 1958; Bullen and Dolan, 1959;

Carr, 1986; Dolan and Allen, 1961; Tesar, 1994b).

Diagnostic projectile points which exemplify these cultural developments include the incipient notched, concave based, Greenbriar or Hardaway points and the fully notched varieties known as Bolen in Florida, and Big Sandy or Taylor projectile points elsewhere in the Southeast (Anderson and Hanson, 1988; Bullen, 1975; Cambron and Hulse, 1964; Oliver, 1985). Dalton projectile points, familiar in most areas of the Southeast, have been reported from marine inundated occurrences in Tampa Bay (Goodyear et al., 1983; Warren and Bullen, 1965), but they are rare in the northwest karst region nearest the research area.

A great variety of other chipped stone tools are included in these Early Archaic assemblages, such as several varieties of unifacial and bifacial cutting, scraping and chopping tools (Willis, 1988; Purdy, 1981). Possible early evidence for atlatls is also recorded at Warm Mineral Springs (Cockrell, 1980; Cockrell and Murphy, 1978; Webb, 1958). Evidence for wood working is evident regionally in the form of adzes, hafted scrapers, and scraper use wear analysis (Gerrell et al., 1991; Morse and Goodyear, 1973; Marshall, 1985). Combined, this tool diversity and woodworking evidence suggests that Late Paleoindian and Early Archaic people were settling in, and innovating new artifact types in response to both cultural and environmental progression.

Based on observations of several local collections, Greenbriar and Bolen Early Archaic aged artifacts are abundant in the Aucilla River. Two specific Early Archaic sites are known from within sinkhole features, i.e. Page/Ladson in the Halfmile rise section and the Little River Site at the Head of Little River (Dunbar et al., 1988; 1989; Willis, 1988). Anderson has built a workable model of band and macro-band level social groups acting in restricted mobility settlement and subsistence patterns which are tethered to individual drainage systems in eastern South Carolina for this same time frame and cultural group (Anderson, 1992; Anderson and Hanson, 1988).

Variations of this theme, with reference to karst drainage patterns and ecology, could easily be applied to Northern Florida and tested with Late Paleoindian and Early Archaic settlement patterns. Clan based social groups might have been tethered to particular discontinuous segments of the Aucilla drainage, with base camps at the rise or siphons of the segments, or both. Another possibility is that different kinds of economic activities might have clustered in particular geomorphic settings within a discontinuous system. Only further data accumulation and synthesis can investigate these possibilities.

Other projectile point types considered diagnostic of later, progeny related late Early Archaic, time periods include Arredondo (fluted), Hamilton, and Kirk varieties (Bullen, 1975). However, the relative frequency of these later Early Archaic diagnostics decline dramatically in private collections and archaeological sites in

Northwestern Florida (cf Tesar, 1994; Willis, 1988). Projectile points which occur later than Kirk varieties, in the 8,500 to 7,000 rcybp time frame, like bifurcate based projectile points known in more northerly latitudes of the Southeast, such as at the St. Albans site in West Virginia (Broyles, 1971), are rare to absent in this region of Florida. Anderson (1992:43) notes a similar pattern of reduced artifact frequency for these items on the coastal plains of Carolina and suggests environmental degradation and abandonment. The rough correlation of this possible cultural abandonment and degradation of environmental conditions discussed above, in the form of aridity (based on pollen evidence), lowered water tables (based on stratigraphic criteria) and regressing sea level (based on western Gulf of Mexico sea level data) makes a remarkable set of coincidences.

Several of these early Paleoindian and Early Archaic sites are examples of freshwater inundated sites found <u>within</u> karst features, others occur immediately around these karst features. Therefore, the potential for the remains of human activities to be located within or around karst features located offshore allows these geomorphological features to be analogues for offshore archaeological site discovery.

Early, Middle and Late Archaic Settlement Pattern Changes

Between 8,000 and 7,000 rcybp the abundance of evidence for human occupation moves from the western side of the state to the eastern side and the frequency and size of sites increase substantially (Milanich, 1994; Russo et al., 1992; Ste. Claire, 1990).

The artifact styles and settlement patterns also change, and combined these changes mark the Early to Middle Archaic transition. Notching declines in the projectile point artifact assemblages and a plethora of large bladed, and often convex based, stemmed point varieties dominate[6]. These types are subsumed under the covering term Florida Archaic Stemmed. One particularly abundant, well dated, carefully made and often basally thinned variety is known as Newnan. One such site is known from an offshore setting near Fort Pierce, on the west coast, south of Cape Canaveral, and demonstrating the near shore potentials of finding sites of this age (Murphy, 1990).

Middle Archaic aged settlements are mostly found all along the eastern coast, and in particular around the St. Johns River area. Other sites of Middle Archaic aged occupations are known at Little Salt Spring near Charlotte Harbor, sites around Tampa Bay, and a site in the Apalachee Bay discovered by this dissertation research, the Econfina Channel Site, to be described in Chapters Seven and Eight. Tesar (1994) lists other occurrences in the Big Bend area onshore.

Knowledge of human subsistence procurement activities, evidence for seasonality, and human diet reconstructed from osteological data exemplify both Middle and Late Archaic archaeological research done in Florida. This is due, in part, to substantial preservation of organic remains in peaty, anaerobic environments in the eastern portions of the state (Doran and Dickel, 1988; Milanich, 1994; Purdy, 1991; Russo et

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[6] The term "stemmed point" is not meant to infer patristic relation with other convex based stemmed points described in Chapter Three.

al., 1992; Ste. Claire, 1990). Fresh and salt water shell middens become frequent, along with large burial sites such as Windover, Little Salt Springs and several others (Ste. Clair, 1990). Several preserved canoes are known to date from this time period (Newsom and Purdy, 1990) and human osteological evidence for marine based subsistence practices has been presented by Purdy (1991:218).

Late Archaic adaptations, between 4,000 and 5,000 rcybp, signal the development of increasingly complex social groups in Florida. The introduction of ceramic "boiling balls", fiber tempered pottery (known locally as Norwood) and Gary projectile points, along the Panhandle and in this Big Bend region suggests the influence of Poverty Point related ideas or perhaps migrating people during and just after the final moments of the transgression (Milanich, 1994:95; Tesar, 1980; Granberry, 1991; cf Appendix A, Table A.13). The Meigs Pasture Site near the Choctawhatchee Bay is an example of this kind of site (Milanich, 1994; Figure 6.01). At this time sea levels are at or near today's level and the possibility of Late Archaic sites inundated on the continental shelf diminishes, but does not disappear. Examples of nearshore inundated sites with ceramics are known from both the east and west coasts and represent the last of possible inundated prehistoric archaeological sites to be expected in nearshore settings. These sites include Venice Beach (Koski, 1989) and Douglas Beach (Murphy, 1990). These sites are described above in Table 5.02.

Discussion

It is clear from the foregoing passages that a robust record of Paleoindian, Early and possibly Middle Archaic aged prehistoric sites occurs onshore in Northwestern Florida. It is logical to assume that more sites lie on the continental shelves of Northwestern Florida, inundated by Holocene sea level rise. Since Paleoindian and Early Archaic sites are often found around and within karst features in onshore settings, similar discoveries are likely in analogous situations offshore.

In this light, the reconstruction of the paleodrainage pattern on the continental shelf offshore, could significantly narrow the size of the area to search for karst cavities which might preserve archaeological remains. Paleoindian kill sites, or Late Paleoindian or Early Archaic activity areas could be found within karst features covered by sediments during the inundation process. Special activity areas, or base camps could be found around the margins of these same features, although not necessarily protected by sediments or karst voids. In particular, the discovery of an analog of the Page/Ladson site sedimented sinkhole.

Chapter Seven also presents data and analyses regarding the past drainage system and the geomorphology of three archaeological sites discovered in the course of this research. Chapter Eight presents data and analyses of the artifacts collected from the sites. First, however, I present a narrative account of the development of this dissertation research in chronological order. The purpose of this narrative is to outline the nature of the research and its evolution, and to reduce the amount of description necessary for the information presented in Chapters Seven and Eight.

A Narrative History of the Offshore Research

The purpose of this section is to describe the logistics and methodology of the field work, including characteristics of the research vessels, crew sizes, and difficulties encountered. Specific descriptions of the samples and results of analytic tests, as well as graphics showing the locations and character of these investigations are described in Chapters Seven and Eight.

Table 6.13 Summary of offshore field sessions

Session and activities	Days at Sea	Crew
1986 - survey, collections	3	7
1988 - collections, excavations, survey	5	varying around 5
1989 - collections, excavations, survey	5 (7 plan)	varying around 5
1991 Total - remote sensing, coring, collection	11 (20 plan)	5
1991 - seismic	3 (10 plan)	5
1991 - collections	4 no plan	varying around 5
1991 - coring	4 (10 plan)	5
1992 Total - survey, collections, excavations	16 (20 plan)	12
1992 - First EW session	6 (10 plan)	7 crew, 5 staff
1992 - Second EW session	10 (10 plan)	7 crew, 5 staff

This dissertation research has taken place over five field sessions, beginning in 1986 and finishing in 1992 (Table 6.13). The average number of days at sea was about eight, but the range was from three to 20. The average number of people helping with the field research was seven. The first three excursions were focused on diver reconnaissance to find and define sites by searching in likely areas looking for exposed bedrock and possible relict channels. These likely areas were discovered by conversations with locals about rock outcrops, by study of bathymetric contour configurations, and by simply towing divers around.

In all, 18 locations of artifact encounters were made offshore during the course of this research. Of these, three are significant accumulations of artifacts suggested past special activity or habitation sites. These are: the Econfina Channel Site (8 Ta 139); the Fitch Site (8 Je 739); and the J&J Hunt Site (8 Je 740).

Initial Offshore Foray - 1986

Survey for offshore archaeological sites in the Apalachee Bay began in 1986. The initial survey deployed three small boats and six divers over a three day period. Boats were launched each of the three days from the St. Marks, Aucilla, and Econfina Rivers respectively. The survey technique was to find areas of exposed rock and sample for chert and associated artifacts. Locating these exposed rocks by towing divers at slow speeds proved an effective means of finding chert outcrops and associated prehistoric quarries. This survey identified five locations of protruding chert, four of which exhibited evidence for quarry activities (Figure 8.01).

In addition, a relict (inundated) river channel was identified from fathometer and diver observations. Grab sample collections from this locality produced chipped stone artifacts, including some bifacially retouched items. The artifacts were abundant and found within a 15 to 20 centimeter (six to eight inch) brown colored shell hash matrix which overlay bedrock. A sample of cypress wood mixed within this artifact bearing marine/brackish water sediment was radiocarbon dated to 5,160 +- 100[7] (Faught, 1988; 1989). The site was designated as the Econfina Channel Site (8 Ta 139[8]).

The initial discovery of wood in sediments offshore was exciting because one early goal was the discovery of terrestrial sediments, and the wood was initially thought to be indicative of that kind of sediment. This vision has been tempered and we now know that wood is very frequent in Apalachee Bay sediments, and probably accumulates as water logged flotsam during the brackish or early marine stage in the evolution of the landmass with inundation (Chapter Seven).

Excavations at Econfina Channel - 1988

The initial success at finding archaeological sites offshore, questions about the deposition of the lithic materials, wood and shell hash matrix in which they were found, as well as the possibility of more site discoveries farther offshore, helped to generate some funds for a return to the site. First, however, it was necessary for me to learn how to operate the equipment necessary for excavations and coring offshore.

This was done in the summer of 1987 at the Page/Ladson excavations in the

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[7] Funding for this analysis (A-4696) was provided by the University of Arizona Radiocarbon Labs, under NSF grant BNS 8505083.

[8] The original number for this site was 8 TA 531, which was subsequently changed to 8 TA 139, the accession number is 88-013 Depart of Archaeological Research site files.

Aucilla River's Halfmile Rise segment. This particular field session first encountered the Bolen aged items on the pedogenic surface within the Gray Clay unit described above in the section on stratigraphic sequences.

The 1988 offshore project was as much a test for the equipment and logistics, as it was strictly an archaeological research endeavor. This was our first attempt at excavating an inundated prehistoric site out on the continental shelf, using the induction dredge equipment developed for use at the Page/Ladson site. Funding was provided by Dorothy Fitch of the Fitch Educational Fund, Texas Communities Foundation, Dallas. The research design of the 1988 field season was to collect cultural items from both systematic surface and excavated contexts at the Econfina Channel Site (8 Ta 139), establish the depth of the relict river deposits looking for analogues to the Page/Ladson Site and survey for more archaeological sites farther out in the Apalachee Bay.

A total of eight days were spent in the field, six of which were actually at sea (June 29 through July 6, 1988). There were between four and eight crew members at various times working from three small boats (boat sizes = 23', 20' and 18'). Boats were launched each day from the Econfina River. As it turned out, the precise location of the artifacts found in 1986 was not relocated 1988 due to poor navigational control in 1986. A Loran-C navigational device was obtained to record the locations of the 1988 research locality and sites discovered during survey.

The 1988 research activities included random observations along about one kilometer of the relict feature, attempting to locate possible concentrations of flaking debris, and to become familiar with the physiography of the relict channel. During this survey, a second locus of frequent artifacts was found farther down stream which then became the focus of more intensive investigations (Figure 7.20).

At this second locus - still considered the Econfina Channel Site (8 Ta 139), a site datum was set and two systematic hand fanning transects were taken from it across the channel and its southern margin to determine artifact densities. Four test pits were excavated in the center of the relict channel to test for sediment depth (Test Pits 1 through 4). Sediments from these excavations were not screened. Four other one meter square test excavations were placed on the southern channel margin and all sediments were run through 1/4 inch screens (Test Pits A through D).

The results of these excavations were numerous lithic artifacts, shell, and some faunal bone remains. In addition, the excavations of Test Pit D probed more than one and one half meters into marine sediments. Numerous lithics and *Crassostrea* shell were found the upper levels of the test pit. A zone of large, light colored rounded limestone (dolomite) rocks were found at lower limits of the excavation. Records of these excavations are recorded on video tape.

In addition to the five days of excavation at the Econfina Channel location, one day was spent looking for new sites farther out on the shelf, particularly around the six meter (20 foot) contour. This foray was accomplished with the excavation crew and a regional organization of nonprofessionals from the eastern part of the state known by the acronym M.A.D.A.. Two new sites were found during this activity, using the same technique of investigating rock outcrops developed in 1986, the Stallings Site and the Fitch Site.

The Stallings Site (Figure 8.01) was found in an area of approximately three meter (10 foot) depth, flat relief, some sea grass, white quartz sand, coral growth and outcropping limestone. Occasional lithic flakes and a single unifacial scraper were found at this location.

The Fitch Site (8 Je 739) was found farther to the west and south. Fitch is a large site which probably represents a lithic quarry of unknown age. Fitch is located in an area of rolling, rough textured topographic relief ten kilometers (about six statute miles) offshore, in 5.5 meters (18 feet) of low tide water. The initial collections from this site consisted of large flaked items, one resembling a discoidal core, which technologically recalled Paleoindian or Early Archaic sites. These items were reported to be abundant and to be on a hill-like rise of sea floor with much locally exposed bedrock. For these reasons Fitch was targeted for further investigation.

The Fitch and J&J Hunt Sites - 1989

The third field session of offshore research included more extensive controlled surface collections, induction dredge excavations, and additional site survey by diver tow (Faught, 1990b). Funding was provided a second time by Dorothy Fitch of the

Fitch Educational Fund, Texas Communities Foundation, Dallas. Research concentrated on the Fitch Site (8 Je 739) and the local area. Field activities took place over a six day period, from July 7 through July 12, 1989. Between five and eight people were involved at any one time. Navigational control was by Loran-C.

Research vessels included the R.V. Nectes of the Florida State Museum Marine Lab which remained anchored at the Fitch site for all six days of the field experience, and two smaller vessels of 18' and 20'. Increased attention to dive safety was paid in the 1989 activities through the auspices of the FSU Academic Dive Program.

Diver tow survey activities were accomplished with the 18' vessel which was also used also to ferry personnel to and from shore. Scuba tanks were refilled aboard the Nectes with a compressor lashed to the decks. The induction dredge was run from the back of the Nectes and, at times, from one of the smaller boats.

More than 200 meters of collection transects took place at ten meter intervals, with some five meter intervals also collected. These collections originated from two loci of apparent chert clustering, and generally higher bedrock (Figure 7.24). Some sediment samples were also taken from these transects as we began to recognize a need to describe and compare common sediments. Records of these activities are on video tape, maps and notes were made on mylar plastic drafting film. A permanent datum consisting of an aluminum pipe was driven into the bedrock at Locus 1.

Three one by one meter induction dredge test pits (TP) were dug at the Fitch Site.

Each test pit was put into the shell hash away from the outcropping rock. The induction dredge was exhausted to the sea floor, down current from the excavations, and instead of to a floating screen rig. A nylon net filter (with approximate 1/4 inch mesh) was attached to the exhaust end for coarse sediment sampling. Samples of sediment from these excavations were collected by 20 centimeter arbitrary and natural levels where appropriate, brought to the surface and studied for cultural and relevant natural items.

The surface collections at Fitch included hundreds of chert items, most of which were either heat or percussion fractured chert artifacts, and inferred as the remains of quarrying activities (even though cortex frequency was low). A few pieces of percussion flaked chert debris were found in the lower levels of TP 1 and 3.

Dolomite rocks were observed in Test Pits 2 and 3 immediately below the marine shell hash. These rocks were white to buff colored, rounded and somewhat soft and similar, if not identical, to those seen at the Econfina Channel Site in 1988. Sediments were observed below these rocks in Test Pit 2 (some of the fossils were found in these lower sediments). In addition, fossil remains of extinct animals were discovered below the dolomite during the excavation of Test Pit 2 (Table 7.04).

In combination with the collections and excavations going on at the Fitch Site, additional survey took place each day searching for new sites, and recording geologic details. Approximately 4.5 kilometers (9 statute miles) of linear distance was traversed and five new artifact encounters were added to the growing inventory (Figure 8.01), this includes the discovery of Area A at the J&J Hunt Site (8 Ta 740). This site was initially proposed to be a habitation site because of a diversity of tool types, low frequency of cortex on the lithic debris, bone and the presence of nearby oyster shells which were thought to be a midden (Faught, 1990b). This interpretation did not hold up well with further scrutiny, as will be discussed in the conclusion (Chapter Nine). One dive was spent at the locale collecting both random and some systematic samples along a single transect.

Given the apparent richness of artifacts (both number and variety), a decision was made to move the operations to this new location for the remainder of the field time. Closing chores and data recording took until the afternoon and as we were preparing to pull anchor, we were hit by a rapidly moving squall. The rain and wind of this storm was powerful enough to capsize one of the small support boats and all equipment aboard it. The boat didn't sink because it was made with a foam center and we were able to turn it back over with equipment on board the Nectes after the storm abated a bit. Divers then retrieved most of the diving equipment that had gone overboard.

This squall forced us inshore, but preparations were made to continue working at J&J Hunt using the small boats to ferry out of a temporary camp on the Aucilla River. Regardless, the storms and high seas continued until the end of the field session.

Remote Sensing and Coring Activities - 1991

During the course of these budding experiences, it became apparent that the goal of discovering deep sediments offshore would take more effort than random probing with the induction dredge. The 1991 research was designed as a two year, three fold plan to locate river sinkhole features, stratigraphy and possibly intact Paleoindian materials offshore (Faught, 1992). Funding was obtained from NSF for this activity (BNS 9100515) and the plan was to employ the proven technologies of seismic reflection remote sensing and vibra-coring, to identify and analyze drowned drainage systems (Pearson et al., 1986; Stright, 1986a; 1986b), and to combine these methods with induction dredge excavations as deployed at the Page/Ladson Site, to excavate appropriate analogues offshore (Dunbar et al., 1988; 1989).

The 1991 seismic reflection survey had two major objectives: (1) to define the course of the relict Aucilla river channel system out on to the continental shelf and (2) to inventory the configurations therein for possible vibra-coring and other survey activities. This field session was handicapped by significant difficulties and yet managed to accomplish the main aspects of its goals. These difficulties included both inclement weather and equipment failures. As with the previous years, the 1991 activities were recorded on video tape, as well as Mylar plastic maps and notes. Navigational control was by Loran-C.

After two previous unsuccessful attempts, we found that obtaining a subbottom profiler device and adequate operator can be a major stumbling block. The cost of either purchase or lease is prohibitive and its operation the purview of a specialist. The 1991 research was fortunate to have acquired all the components for a successful seismic reflection survey from John Chance and Associates of Lafayette, La. through the recommendation of Ric Aneskuwitz of the Minerals Management Service of New Orleans. Dr. Joe Donoghue of the Department of Geology, Florida State University, Tallahassee, came along as operator.

The original plan focused on traversing two large areas of the Apalachee Bay over two five day cruises (Figure 7.05). The seismic device was towed behind the *R. V. Seminole* (viz Nectes) with five crew members recording data and maintaining the equipment for three of the originally planned ten days (June 3-5, 1991), however. As an example of the character of this kind of research, the first vessel cruise was cut short due to unacceptable weather conditions (after June 3-5, 1991). The second session was aborted when Chance and Associates, Inc. requested the return of the subbottom device for immediate use on another (paying) project.

Even though these factors precluded the area being traversed completely, the main objectives were met, and the efficacy of the technique was demonstrated. These readouts were studied and navigational waypoints were plotted on the bathymetric map of the Apalachee Bay. Preliminary analyses revealed 22 locations possible for vibra-coring and further research - several of which were in a discontinuous river segment associated with the J&J Hunt Site.

Between the cruise for remote sensing and the scheduled vibra-coring cruises aboard the *R. V. Seminole*, divers went back offshore to inspect and mark certain locations identified by the seismic lines, especially those identified near the J&J Hunt Site (8 Je 740). Four crew members accomplished this task over a five day period from two small (20') vessels which were launched from the Aucilla River each day. These forays focused on ground truthing the profiler data, buoying locations for vibra-coring and making systematic sediment and artifact collection transects radiating out from the margins of the PaleoAucilla channel system.

Ground truthing and preparations for vibra-coring included determining the deepest portions of the drowned or relict channel morphology and its margins. The technique developed to accomplish this task included fathometer transects from the small boats crisscrossing the area looking for the deepest spots, whereupon marker jugs were dropped. More boat transects were also run perpendicular to the trend of the channel and the margin breaks inferred by fathometer readings and then buoyed. Loci L_1, L_2, and N_1 were marked in this manner (Figure 7.31). A 5.8 inch rebar datum was driven 1.3 meters (4.25 feet) into the sediments at the center of Locus L_1 and from which Loran-C coordinates were taken. This rebar remains in the center channel feature.

River margin breaks were difficult to perceive, especially by divers underwater.

The marginal slopes of about 1.5 meters over 100 meters was almost imperceptible underwater, and the channel margins tended to be approximately 200 meters across. After the channel centers and margins were identified and buoyed, collection transects were laid on the margins radiating out from the river feature with some perpendicular transects added to these main linear transects in areas of artifact encounters.

Three areas were searched in this manner: two before the vibra-coring cruise and another during the cruise to search in and around an in-place tree stump that was discovered (Area B, Area C and Locus L_2; Figure 7.31). Seven collection units exhibited artifacts in Area B, a single artifact -- a possible fluted biface -- was located at Area C. The stump, whose discovery is described below, was sampled for radiocarbon analysis in 1991, and again during the 1992 field session to confirm that it was an in place stump - which it was.

After the remote sensing and channel marking with buoys, vibra-coring was done to search for stratigraphic details, and hopefully to find bones or artifacts in the core tube. Originally -- as with the remote sensing activity -- two five day sessions were planned for vibra-coring.

The coring device consisted of a Stowe 384V commercial cement vibrator head bolted to 3 inch by 30 foot aluminum tubes. An eight hp engine operated from the rear deck of the *R. V. Seminole* powered the device. Provenience control included: Loran-C coordinates, depth of the water column and time, core penetration depth as well as actual recovery amount, and north orientation. All depths were adjusted low mean water depth from the apparent water depth in the field (Table 7.06).

While a large pool (22) of locations potential for vibra-coring had been compiled during the intervening time by studying the subbottom readouts, only two areas were chosen for research - one farther out to gather comparative stratigraphic data for sea level rise and one closer in to determine the chronology of sea level rise and to look for appropriate places for induction dredge excavations. The locations targeted for this were "T" -- approximately 19.5 kilometers (12 statute miles) offshore -- and portions of the discontinuous segment between L_1 and N_2 - between 6.5 and seven kilometers (four and 4.3 statute miles) offshore (Figure 7.11). Successful cores were clustered in two places: Loci L_1 and L_2 (Figure 7.33). We attempted a crisscross pattern of cores to probe the sedimented sinkholes both longitudinally and laterally, however the pattern was not completed before mechanical troubles developed with the research vessel.

Random hand fanning around the area of Core 91-6 (Figure 7.33) revealed many large oyster shells (*Crassostrea* sp.), abundant pieces of wood and a large tree stump. Lee Newsom, University of Southern Illinois, has identified the stump as oak. This discovery was made in depths of approximately four meters (13 feet) BSL. Artifacts were sought by additional collection transects, but without success.

The vibra-coring procedure developed as follows: once the locale was identified to core, we set the vessel by anchoring at three points to secure the vessel. Water depth/time and Loran-C geographic position were then recorded. Divers positioned and manhandled the core tubes in the water with a winch and crane on board the *Seminole*, and by twisting a "T" bar bolted to the 3 inch core tubes while standing on the bottom.

The vibrator head bracket was attached the core tube and a safety line was attached to the head to manipulate the device from the research vessel and to keep the heavy device from falling and injuring divers. The device was put into the water with divers at the ready. Large lead weights were tied on to the core "T" handles, with slack, to aid in penetration. Once the core tube was perpendicular and the weights were in place, we would start the engine, throttle up and begin the vibra-coring by twisting the core tube and slamming the weights by lifting the slack line and letting it go. I must admit, this is an intense and noisy experience underwater.

Once the core hit bedrock, loose rock or compacted sediments there would be a change in sound, the core simply would go no farther in the matrix, or the core tube would fatigue at the contact with the vibrator head, breaking the tube and ending the activity. Knowing when to quit the vibra-coring attempt was often difficult and the tube must be watched closely so as to perceive if it is continuing down (Smith, 1984; Hoyt and Demarest, 1981).

When the decision was made to stop, we would score the core tube with a diver knife or other appropriate device, marking the bottom and compass north on the core tube. The compacted sediment depth can be determined in the tube with a plumb bob before the core is pulled. The sediment and water filled tube was then plugged so that sediment would not escape when pulling.

Pulling the core out with the wench aboard the *R. V. Seminole* was very easy. Once aboard, the aluminum tube was shortened by cutting to the length of sediment column within it, then capped and taped at both ends, and labeled (i.e. North, depth, time, date, and core number). We have found that scoring the provenience number in the aluminum of the core tube is desirable as well in case of blurred marking inks.

During the first foray we set up for vibra-coring at nine locations, and removed seven acceptable cores. One attempt was abandoned due to high seas (at Locus T), and the other was abandoned due to insufficient compaction of the sandy sediments (Core # 7, Locus L_2). This first vibra-coring foray was cut to four days because of mechanical trouble with the *R. V. Seminole.* Cores were not cut in the field, and therefore we had no idea of the success or failure of the penetrations, except as to depth, which, in comparison with the sediment depths at the analog Page/Ladson site, seemed very short.

The second foray for vibra-coring represents one of the most frustrating experiences we have had while doing research in the Apalachee Bay. With the experience of the first vibra-coring cruise under our belts and several ideas for improvement, the crew made several alterations to the three point anchoring and vibra-coring procedures which resulted in significant changes in set up time and effectiveness. During the time between the two cruises, we rehearsed our procedures for vibra-core set up and recording and obtained a small inflatable boat to ferry anchors for rapid three point anchoring -- a job previously done by swimmers.

The activities began with the underwater visibility at an unusually clear 30 foot and calm sea conditions. The new procedure for anchoring and set up took less than one hour for the first core (a second attempt at Locus T), suggesting to us the possibility of many cores over the next few days.

However, the cable which drove the vibrator head snapped upon starting and nothing could be done to remedy the situation at sea. After returning to the FSU Marine Labs at Turkey Point, driving to Tallahassee for parts, and fixing this problem within 24 hours, the crew was then frustrated the remainder of the week by strong winds from the south which fetched up very rough seas. No further vibra-coring was accomplished.

A second visit was made to this location at the end of the field session in 1991 in order to sample the stump for ^{14}C analysis. At that time the feature was exposed by hand fanning to a depth of 40 centimeters, to test if was indeed *in situ*. The base of the stump was not found at that time as the feature continued vertically below our shallow excavation. The stump was demonstrated to be *in situ* by induction dredge excavation during the 1992 field session. The outer rings of the stump and two shell samples were

^{14}C dated as part of the analysis done for this dissertation (these dates are presented in Table 7.12).

Even though the 1991 seismic profiling and the vibra-coring activities were cut short from their original design, they both have been extremely effective in exposing the basic channel trends and stratigraphic regularities, giving samples for various analytic purposes, and allowing for planning for excavations, and revealing many areas for future survey and collection transects.

Sinkhole Excavation and J&J Hunt Site Collections - 1992

The excavation portion of the three part research design took place in June and July of 1992 with more crew and logistics than before. With funding and assistance from the National Science Foundation (BNS 9100515), EARTHWATCH (Clovis Underwater - 92), and the Texas Communities Foundation, we deployed as many as 12 people at a time offshore. The field session was planned over a 21 day period, during which there were (3) days of down time for weather, and several other lost hours due to equipment problems.

Access to the sites was initially intended to be from the *R. V. Seminole* through the Academic Dive Program at FSU. However, last minute and unexpected price increases for the use of this vessel precluded its use. Therefore, smaller vessels (21', 18' and 17') were obtained. Since, the small boats could not could not stay at sea over night and could not adequately service operations with 2 foot or higher seas, travel to and from the sites had to occur each day. The session usually ended with increasing afternoon wave action (a daily phenomena by about three or four PM), or with thunderstorms and winds.

Crews would load the boats in camp at the Nutall Rise on the Aucilla River, tow them by truck to a boat launch four miles down stream, and then proceed out to the site another four miles by means of compass bearing and marker buoys (after initial relocation by Loran-C)[9]. Travel time for this procedure was approximately 1.5 hours each way[10]. Given these constraints, the total daily time on site was anywhere from three to five hours each day, allowing two to three one-hour dives each day.

Excavation equipment included six and four inch dredges. The four inch dredge was to be operated from a floating inner tube and styrofoam screen rig. The six inch was operated from a pontoon platform with attached screen rig (Gopher). Three point anchoring was used to hold the dredges in place, but the fine grained sand bottom was not great for holding the 6 inch pontoon screen rig.

Since equipment failure was becoming known as a distinct potential in this research, and wanting to avoid delay as much as possible, several dredges were borrowed for the 1992 field session. Five four inch and one six inch dredge were

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[9] Several localities (L_1, Areas A & B, and several coastal markers) were recorded with a GPS device in 1992.

[10] Another forced aspect of the session that caused some difficulty was the rental of SCUBA tanks which were heavy and of small capacity implying that we had to lug more of them to sea which bogged down the small boats.

available at the first half of the field session. By the third week of the field session none of the four inch dredges were operable for various unavoidable reasons, but the six inch dredge performed well throughout the remainder of the session.

Still, the 6 inch screen rig managed to pulled anchor on two occasions. Once it pulled completely and was eventually located along the coast several miles to the south, near the mouth of the Econfina. Operations were set back two days during this event. The second time the dredge pulled only 100 meters from the site, but several hours were lost relocating the excavation unit and returning the screen to its proper location. This happened at the very end of the session, as Test Pit 1 was getting near levels thought at the time to be potential for artifact discovery.

Research focused on the excavation of a two by two by three meter deep Test Pit in the sinkhole of L_1 (Test Pit 1), the exposure of the base of the Stump at Locus L_2, and upon several collection transects from areas A and B of the J&J Hunt Site (8 Je 740). Additional exposures were planned to expose sediments in the sinkhole at L_1 and near Area A, but due to the aforementioned equipment failures, weather problems and transportation restraints, the exposures at TP 1 and the Stump at L_2 were the only ones accomplished.

Test Pit 1, L_1, is the deepest exposure we have made on any offshore excursion. This two by two by three meter *sondage* was placed so as to approximate the common areas of archaeological discoveries made by sports/collector divers in the area - the shallows on the downstream shallows of a sinkhole (Waller, 1983). The 6 inch induction dredge was deployed for this excavation. Crews consisted of two divers, one digging and one controlling the induction dredge intake tube from above. A third crew member would tend the screen and dredge pump and act as safety diver.

The initial exposure at Test Pit 1 was a one by one meter and which cut through the marine sediments to the brackish zone and increasing clay at about 1.6 m. Fragments of wood and *Crassostrea* shell increased with depth as well. The gray clay sediments were identical to those seen in the vibra-cores, and at the Page/Ladson site (Dunbar et al., 1989). This one by one size became too narrow to operate in, so it was enlarged to two by two meters before continuing a farther down. At the bottom (depth in the sediment column of 2.5 m) a zone of "dolomite" was located and as predicted by previous experiences at Fitch, Econfina and from the cores taken in 1991. An attempt was made on the last field day to go below the dolomite in a small exposure but this was unsuccessful. No new stratigraphic zones were located in Test Pit 1.

Elevations of the main stratigraphic divisions of TP 1, L_1 were recorded in the field, as well as by systematic video coverage, all of which resulted in Figure 7.37. It had been intended to make detailed drawings and make sediment samples directly from the exposure wall after completion of the excavations but complications precluded this plan. Attention to making the pit deeper was considered a higher priority in the field, rather than having more systematic collections of marine and brackish water sediments.

In retrospect, it may have been effective to collect samples with known accurate depths during the course of the excavations, reconstructing the relationships later.

The Stump at Locus L_2 was removed by 4 inch induction dredge excavations to test the hypothesis that it was a tree which had grown in place. This hypothesis was confirmed, the profile revealed that the oak tree had grown in the grey clay sediments to be discussed in Chapter 8. This also represents evidence for fresh water conditions and a secondary marker for the reconstruction of sea levels at 7,240 +/- 100 (A-6714).

Several collection transects were also made at Area A, within the area originally discovered and sampled in 1989 (Figure 7.33). A permanent datum was driven into sediments at Area A, and collection transects were taken from it. Numerous chipped stone artifacts were located by this method, as well as bone and sediment samples. A total of 27 controlled transect and other collections were collected at various intervals from two main transect lines (240° and 180°) Area A in 1992.

Area B was discovered in 1991 near the end of a 120 meter transect taken from the western margin marker of Locus L_1. The transect made in 1992 was laid somewhat farther to the west and included 13 systematic collection samples. Artifact density was low in this area, but curated sediment samples and artifact collections contribute to the overall understanding of the character of the relict river channel segment and its margins.

Summary

Given the resources available to this dissertation project, and the setbacks encountered, a surprisingly robust inventory of marine inundated archaeological sites and geomorphological data resulted. We have found that the "costs" of doing underwater archaeology include not only financial backing, but considerable staff and equipment coordination as well.

Doing prehistoric archaeology in a marine setting implies the potential for unacceptable sea and/or weather conditions as well as equipment failures. Because of these facts, attempts were made to obtain backup equipment and to develop alternative research designs for deployment with down time. That is, if equipment failures precluded certain excavation or coring projects, then other diver collections or survey projects were planned and available so as to not lose the offshore time. This concept contributed to the success of the offshore program presented here.

Waiting on weather is another potential problem. In the Apalachee Bay, the most predictable and acceptable conditions to go to sea range between June and July. The best access could be gained by the use of 50' to 75' research vessels which could weather 1.5 to two meter (five to six foot) seas (maximum for the Apalachee Bay) and which could stay out over three to five day periods. We had this kind of experience while working at the Fitch Site in 1989, and it was very effective.

Another aspect of the research is describing the geomorphology of sites in low visibility, often less than 1.5 to two meters (five to six feet). There is no way for individuals to view large areas at a time. During the data collection procedures the sites become "known" to the researchers by discussion and by sketch mapping. This sharing is vital. Additional reconstruction can then be done by review of the field notes, bathymetric and subbottom profiler reconstruction and sediment studies (Chapter Seven).

Our experience is that navigational control has two purposes. The first need is to be able to return to the site, and the second is to construct maps for describing the geomorphology and archaeology of the continental shelf. Mapping accuracy for Loran controlled data points is on the order of +/- 50 meters (about 160 feet). Mapping accuracy for transect data is on the order of +/- one meter (three feet). Setting datums and more controlled measurements are now needed to more accurately record spatial relationships.

There were several experiences which call for improved methods. One aspect of the excavations of Test Pit 1 at the J&J Hunt Site, that was not foreseen, was the daily necessity of cleaning out sediments "washed" in each night during the tidal cycle. At the beginning of each day it would take from .75 to one hour (one dive) just to clean the test pit of these sediments. It was concluded that a "fence" or "snowline" of some impermeable material built around the excavations, out some two to three meters so as to not impact the excavation walls would be ideal.

Also, because of wave and current actions the dredge tube was difficult for the divers to control and it became a significant perpetrator of wall collapse. Dredging operations consisted of one diver excavating, while another controlled the dredge tube to facilitate excavator control of the dredge head. However, when the operation was stalled for whatever reason, the migrating tube could cause damage. A heavy metal pyramid frame holding the dredge tube directly over head would be very effective in controlling this problem.

Finally, it is not uncommon that "situations" happen during offshore research where abandoning the site due to adverse conditions becomes absolutely necessary. Therefore, one should always keep in mind that return visits might be years away, and therefore research goals must be prioritized. For instance, little attention was paid to the stratigraphic column of Test Pit 1, L_1 during its excavation. Focus was consistently made on making the exposure deeper until virtually the last two days of field time. At that time, video footage and some wall sampling took place. Just as easily we could have been driven in without any records.

Chapter Seven describes in detail the data gathered during these excursions in the attempt to reconstruct the context of the archaeological discoveries. Chapter Eight presents the inventory and analysis of chipped stone artifacts. Chapter Nine will conclude the dissertation.

Chapter Seven

RESULTS OF ANALYSES: GEOMORPHOLOGY

This chapter describes observations and results of analyses undertaken to understand the geomorphology of the Apalachee Bay continental shelf research area (Figure 7.01). The first task is an attempt to reconstruct the topography and the configuration of past terrestrial land forms by utilizing bathymetric, aerial photographic, and subbottom profiler information. Next, surface and subsurface sediments are described from each of three archaeological sites studied for this purpose, and the character of artifact degradation at each site is presented. The purpose of these discussions is to identify terrestrial remnants, interpret the inundation sequence and characterize possible post-inundation site formation processes.

Definition of the Study area

The study area, shown in Figures 7.01 through 7.03, was originally drawn to encompass almost 1500 square kilometers (585 square statute miles), and including the archaeological site of Ray Hole Spring, described in Chapters Five and Six (Anuskiewicz, 1988; Anuskiewicz et al., 1994; Dunbar et al., 1992). The area is a drowned karst plain developed by a progression of terrestrial, freshwater, brackish and fully marine conditions. The general trend of the bottom is extremely flat, with local relief varying on the order of .30 to 1.5 meters (one to five feet) vertically over distances of more than 100 meters horizontally.

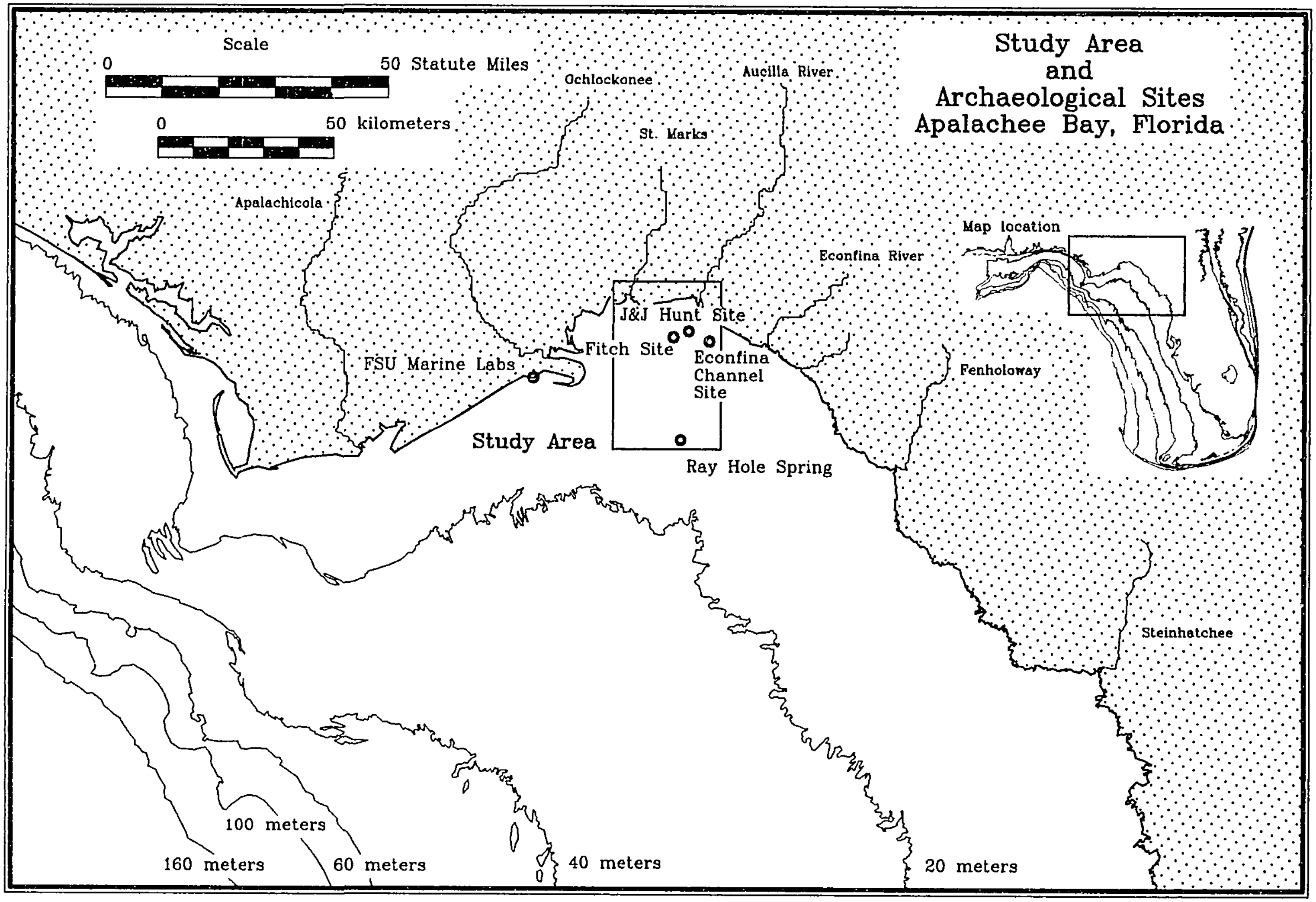

Figure 7.01 The Apalachee Bay and the study area

The research area can be described as having a thin cover of sand and marine shell hash sediments over bedrock limestone. Shell hash is a term used to describe sandy biogenic deposits composed of broken and whole marine mollusca in a medium to fine textured reworked quartz sand. This sediment is generally thinner than one meter (three feet) except in karst void features like relict sinkholes, karst pockets and channel segments. Test Pit 1, Locus L_1, J&J Hunt Site, to be described below, exhibited 1.6 meters (5.25 feet) of this sediment. The sediment loads of the Apalachicola and Ochlockonee Rivers are found to the west of the study area, and the sediment depths in these features certainly exceed 2 meters (6.5 feet).

Bathymetric Enhancement

Perhaps the simplest way to identify relict or past features of inundated areas is by the study of the topography represented by bathymetric maps. The pattern of these low mean tide depths can reveal the trend of past drainage systems such as concave river channel trends, as well as other topographic irregularities that may represent drowned terrestrial features as convex or protruding hills, rock outcrops (chert), ledges or scarps. Initial study of isobath interpolations printed on the NOAA bathymetric map of the Apalachee Bay study area revealed a few potential areas for survey, one of which resulted in the discovery of the J&J Hunt site in 1989 (8 Ta 740). However, a more controlled topographic analysis was attempted because there appeared to be additional details in the distribution of the depths than was interpolated on the published map.

Recent developments in computerized algorithms for contouring and generating mesh surfaces (SURFER) and computer aided drafting (AutoCAD) enabled the construction of both mesh and contoured images of the study area (Figures 7.02a, 7.02b and 7.03). These maps also served as the base for plotting the subbottom profiler record, and for the smaller scale iterations for the site maps illustrated. The procedure for making these maps included registration of the computer base map to local UTM Zone 35 coordinates and then digitizing the coastline and depth points with the x, and y values equal to UTM coordinates, and z values equal to depth in feet BSL. These coordinate and depth data were then transferred to the contouring program. The use of feet BSL instead of meters conforms to common navigational usage. Every effort was made to call out depths in meters where appropriate in the text.

Numerous iterations were run in an attempt to discover the most informative and visually accurate image, particularly during the mesh routines. The mesh image finally decided upon was an inverse distance algorithm with a weight of two, a grid pattern of 200 x 200 lines. The mesh images required a vertical exaggeration of 500 x for the area presented in Figures 7.02a and 7.02b and 50 x for the smaller scale mesh image of the discontinuous channel segment of the paleoAucilla near the J&J Hunt Site shown in Figure 7.31. The topography map (Figure 7.03) was generated from this same grid algorithm, but without any vertical enhancement. The contour information and mesh images were then transferred back into AutoCAD for further additions and printing.

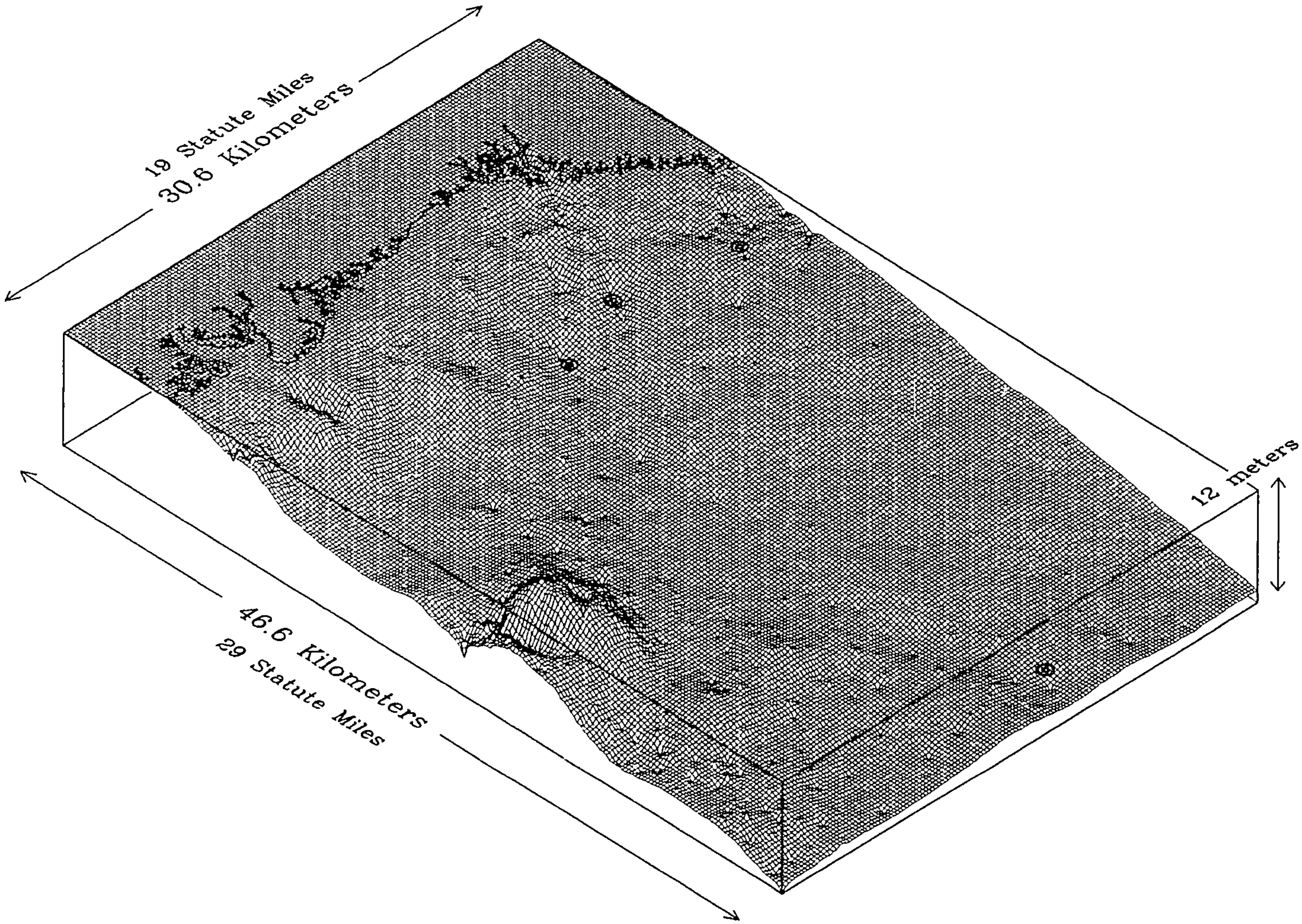

Figure 7.02a Mesh reconstruction of the study area (without labels)

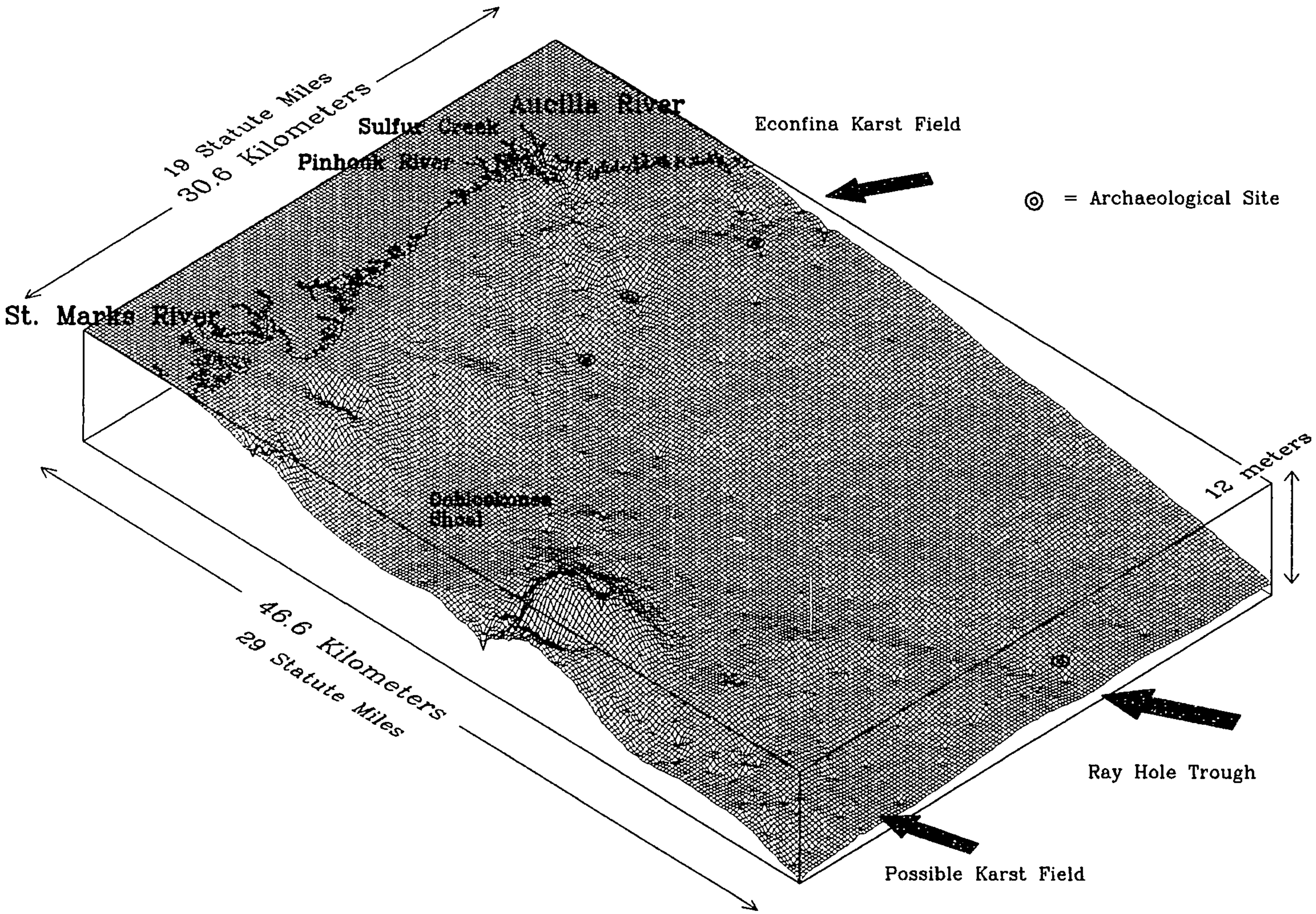

Figure 7.02b Mesh reconstruction of the study area (with labels)

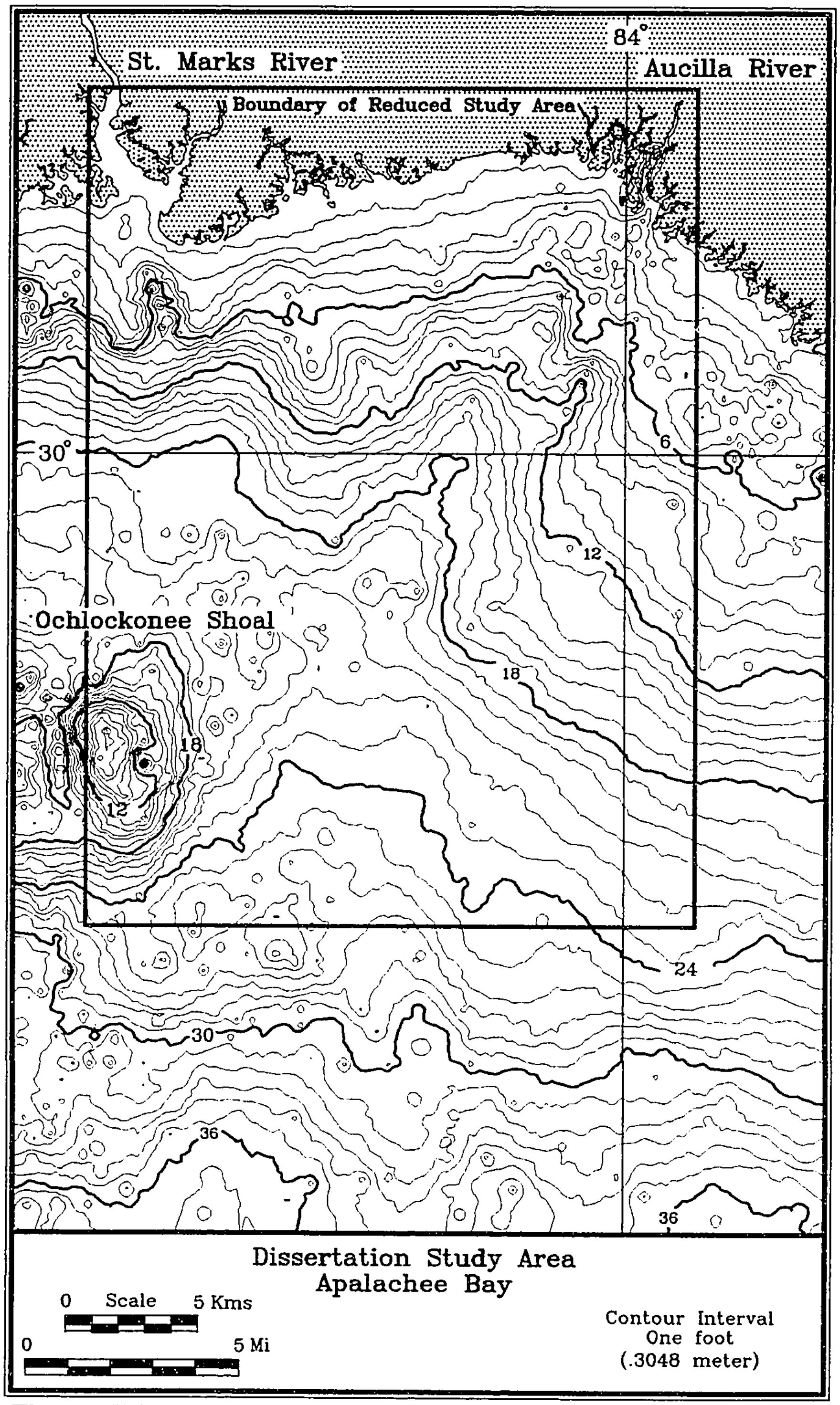

Figure 7.03 Topography of the study area

Review of the mesh images of Figures 7.02a and 7.02b, shows several prominent features of the shelf. The St. Marks and Aucilla drainages show possible channels offshore, as do some of the smaller drainages (i.e. Pinhook and Sulfur Creek). The St. Marks River Channel has been dredged and thus is enhanced. Numerous sinkholes offshore of the Econfina River show up well. This area is labeled as the Econfina Karst Field in Figure 7.02b. Also there is a slight drop off at the 1.8 meter (six foot) contour when enhanced by the 500 x exaggeration of vertical scale.

The Ochlockonee Shoal is a prominent feature of the mesh, and it probably overlies bedrock and other possible drainage features. This accumulation is probably a drowned barrier island formed by sediments from the Ochlockonee of early or middle Holocene age. No published descriptions or stratigraphic studies regarding this feature were encountered during background studies. The Ray Hole Trough, labeled on Figure 7.02b, is another prominent feature of the mesh reconstruction, and one that was not recognized until this enhancement. This feature appears to be a major depression or drainage way, or both, in the lower portions of the study area near Ray Hole Spring[1].

Finally, depressions in the southwest corner of the study area, in water depths of nine to 11 meters (30 to 36 feet), may be another possible karst sinkhole field, analogous to the Econfina Karst Field, and these features may have formed during an earlier stillstand. This feature has not been diver confirmed but may represent an area

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[1] A seismic trackline made by Donoghue recently near the Ray Hole Spring confirms that there is a channel feature in the Ray Hole Trough defined by this bathymetric analysis.

potential for archaeological discoveries analogous to the Econfina Channel site to be discussed.

Aerial Photo Analysis

Aerial photographs have been somewhat successful as a tool for the study of geomorphology during this dissertation research project. In particular, photogrammetric quality color aerial images taken to study the distribution of sea grass beds in the Big Bend area were made available to me by John Thompson of Continental Shelf Associates Inc., Jupiter, Florida. These images were taken on nine by nine inch color negatives, at scale of 1:40000 and several north -south flight lines crossed the study area (Continental Shelf Associates, Inc.,1985). These photos revealed acceptable visibility in some parts of the research area but not in others, due to tannic rich waters from the onshore rivers, surface turbidity by wind action, and some unacceptable sun angles. The research areas surrounding the Fitch Site and the J&J Hunt Site were obscured by these problems.

Nevertheless, progress was made using these aerial photographs to map and record geomorphology within the larger study area defined in Figure 7.01. For instance, possible relict channel segments were identified underwater, including one in which the channels were confirmed by the subbottom profiler tracklines (Figure 7.04 and Figure 7.11, Loci Q-R-S, and T). The interpretation of numerous karst void features near the Econfina Channel Site, from the bathymetric enhancement (Figure 7.02b) was confirmed by comparison with these aerial photos. Finally, lineaments of sequentially deeper, and presumably sequentially older, oyster beds (bioherms) were observed radiating from the mouth of the Aucilla River. These are also plotted on Figure 7.04. Using the stratigraphic record of daily growth, spawning and storm disturbance lacunae, this record, in concert with radiocarbon control, could help to reconstruct the inundation sequence, as well as storm frequencies and other environmental proxy data (Faught, 1980). It is also possible that these bioherms could be used to develop an absolute chronology of shellring growth for this area.

Two flights were taken over the study area as part of the dissertation research, one in 1988 and the other in 1992. Bottom visibility was generally good in 1988 and low altitude passes confirmed the presence of paleoriver channels, sinkholes and other inundated karst formations underwater. However adequate navigational controls were not available and the flight lines of the plane were more or less random. There was no way to relocate features on maps or to return to them by boat. These images do substantiate the presence of relict terrestrial karst features in the Apalachee Bay, however.

The second, low altitude flight pattern was attempted in 1992. This attempt was organized along systematic flight lines with buoy markers set at the J&J Hunt Site for navigational and observational controls. However, at that time visibility was minimal due to dark brown coloration from the mixing of tannic acid rich river flows.

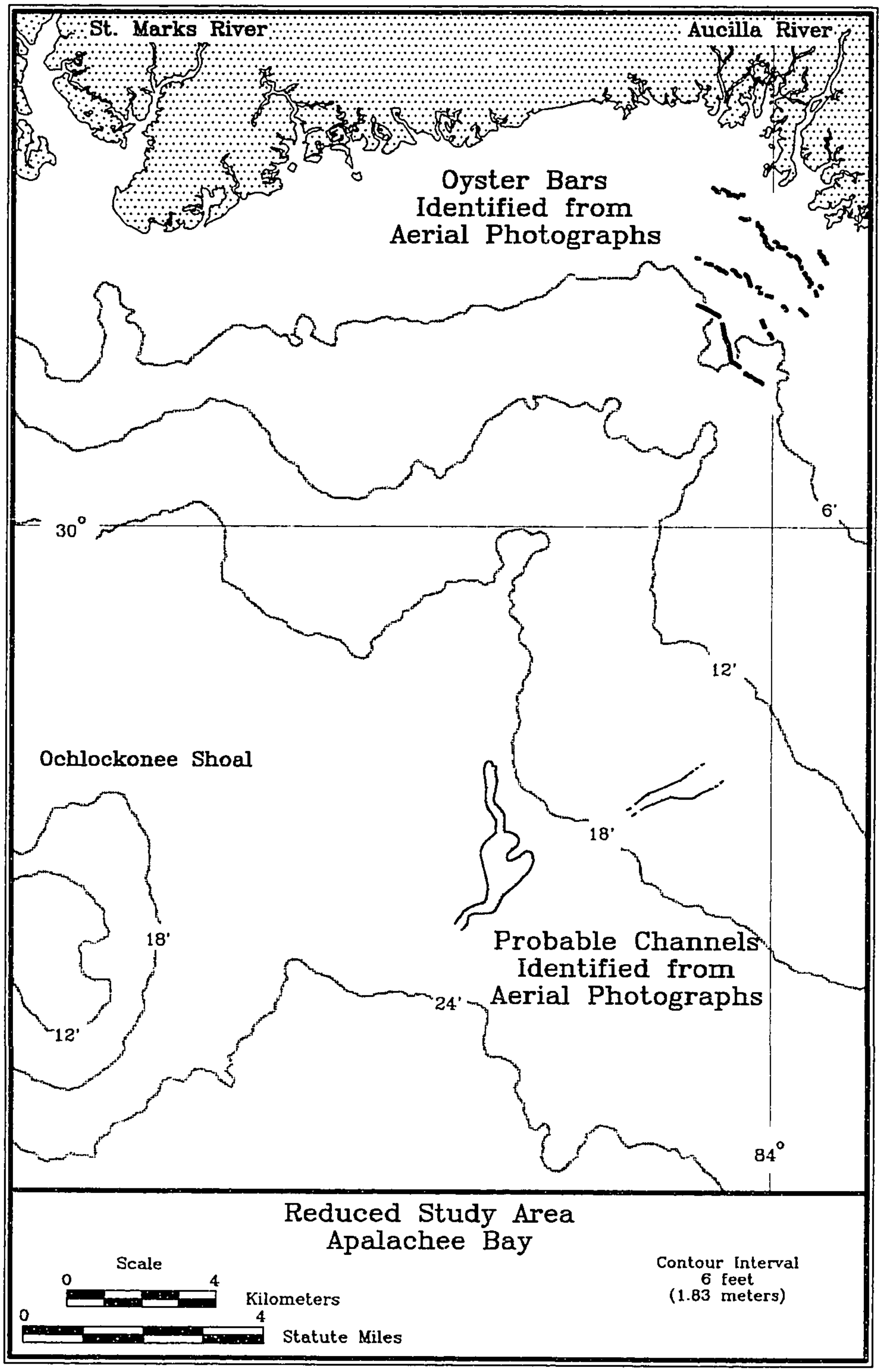

Figure 7.04 Features discovered by aerial photo analysis

There was no penetration of the water surface, even though water turbidity was at a minimum, the sun angles were correct and navigational controls in place (Lysenga, 1981). This tannic acid coloration is generally troublesome in this area in a zone five to eight kilometers (three to five statute miles) from the coastline - areas of particular interest at this stage of the research program. Generally clearer water is to be found farther offshore.

Remote Sensing - Seismic Reflection Survey

As discussed in Chapter Five, magnetometry, side scan sonar and seismic reflection (or subbottom profiling) are the most frequently deployed techniques for remote sensing "sites" (shipwrecks) in marine archaeology (Green 1990; Muckelroy, 1978). Of these three, subbottom profiling was determined to be the most useful tool for this doctoral research, because of limitations with the other two methods (discussed in Chapter Five), the successful use of the subbottom profilers by others in the past to reconstruct paleochannel systems (Pearson et al., 1986), and the availability of a specific device and appropriate personnel to operate it.

Subbottom profilers operate on the principle that echoing acoustic signals are altered when they encounter different densities of various mediums (i.e. between the water column and sea floor; bedding planes, faults, bedrock or sediment textures, etc.), and that these signal returns can be manipulated to create an image which resembles the morphological characteristics of the feature. The technique was developed in the 1930s by throwing dynamite from the stern of the *R. V. Atlantis* of the Woods Hole Oceanographic Institute, and timing the explosion returns. Needless to say, the equipment is much improved today. Specific items developed for subbottom profiling include a sound source ("pinger" or "boomer" depending on the frequency of the sound signal), a receiver (hydrophones), and a display or recording device (hardcopy read out or tape drive recorder).

Distinctive features (cut and fill channels, diapirs, fault lines, sinkholes, etc.) are recognized by their morphology as reconstructed on the readouts. Highly reflective (hard) surfaces or beds produce solid dark lines on the readouts. Depth on the readout is plotted as a function of the length of time for the return of the acoustic signal, but the speed of sound changes as it passes through different mediums. Sound speed through the water column to the sea floor bottom is uniform, but the estimation of absolute depths to underlying sediments can necessitate comparison with cores. Thus, depths printed on the hardcopy read outs are relative and dependent on substrate.

Undesirable sound signals can be produce distorted images. These include ship engine noises or noises made by the water while towing the device. Surface wave turbulence results in uneven records and a wider area of the subbottom is returned with increasing water depth. Echoing (reflection multiples) and point source reflections made by fish or other marine organisms, and seen as hyperbolas on the readouts, are also potential sources of error. Full attenuation of the signal can occur with gas or liquid filled geologic features.

The equipment used in the 1991 field session included a GEOPULSE 3.5 kHz boomer sounding device with an 2.4 meter (eight foot) long hydrophone array. A GEOPULSE 5210 A received the signal and an EPC 3200 electro-sensitive paper recorded the signals. Dr. Joseph Donoghue of FSU set and adjusted the pinging rate and receiver settings. The boomer sled, pontoons made from 12 inch PVC pipe, was pulled 50 feet from the stern of the *R. V. Seminole.* The targeted vessel speed was 3.5 knots and waypoints for the course were estimated before the cruise and absolute navigational position data was recorded every five minutes. All navigational data were taken from the *R. V. Seminole* instrument panel. This data included the time, Loran-C coordinates[2], latitude / longitude (estimated by the Loran-C device), vessel speed, vessel heading and water depth. Seismic activities were stopped when wave heights reached one meter (three foot), or larger, to avoid oscillations on the readouts from rolling changes in the boat's position above the bottom. The trackline record is contained on rolls of electro-sensitive paper, labeled as Lines 1 through 7, in the order in which they were taken. These are shown in Figures 7.05 and 7.22. When referred to in the following discussion, or in the figures, the positions of these points is recorded in the form of Line number.Waypoint. For instance 5.24 is waypoint 24 on Line 5.

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[2] Loran-C numbers are not given as data, they are available to interested, and qualified individuals, and are curated by the Bureau of Archaeological Research, Tallahassee with the final report.

The plan for remote sensing focused on two general areas: one with closely spaced vessel transects running across an area of expected channel presence near the J&J Hunt site (8 Je 740), and another intended to explore farther out to sea in unknown waters with coarser (two by two kilometer) transects (Figure 7.05). These transects reflected our estimation of the trajectory of the relict drainage system, at that time. As described in Chapter Six, two five day cruises were planned to cover the area.

Originally designed to include the site of Ray Hole Spring, this coverage of the larger area was abandoned after three days of pulling the remote sensing device in the pattern described in Figure 7.05. A detailed analysis of the readouts was undertaken as part of this dissertation research in order to maximize data recovery, to reconstruct a more accurate image of the past drainage system and regional geography, and to generate areas potential for archaeological survey. The base map constructed from the Apalachee Bay bathymetric map acted as the base for this effort. Loran coordinates taken from the five minute interval records were hand-plotted on an enlargement of the bathymetric map at a scale of 1:40000, and then digitized onto the computer data base map. Features identified from the 1:40000 aerial photos were also digitized to this topographic image (Figure 7.04).

A total of 111 kilometers (69 statute miles) of usable seismic transects were recorded out to a distance of approximately 27 kilometers (17 statute miles) from the modern mouth of the Aucilla River. Figures 7.04 and 7.05 represent about half of the

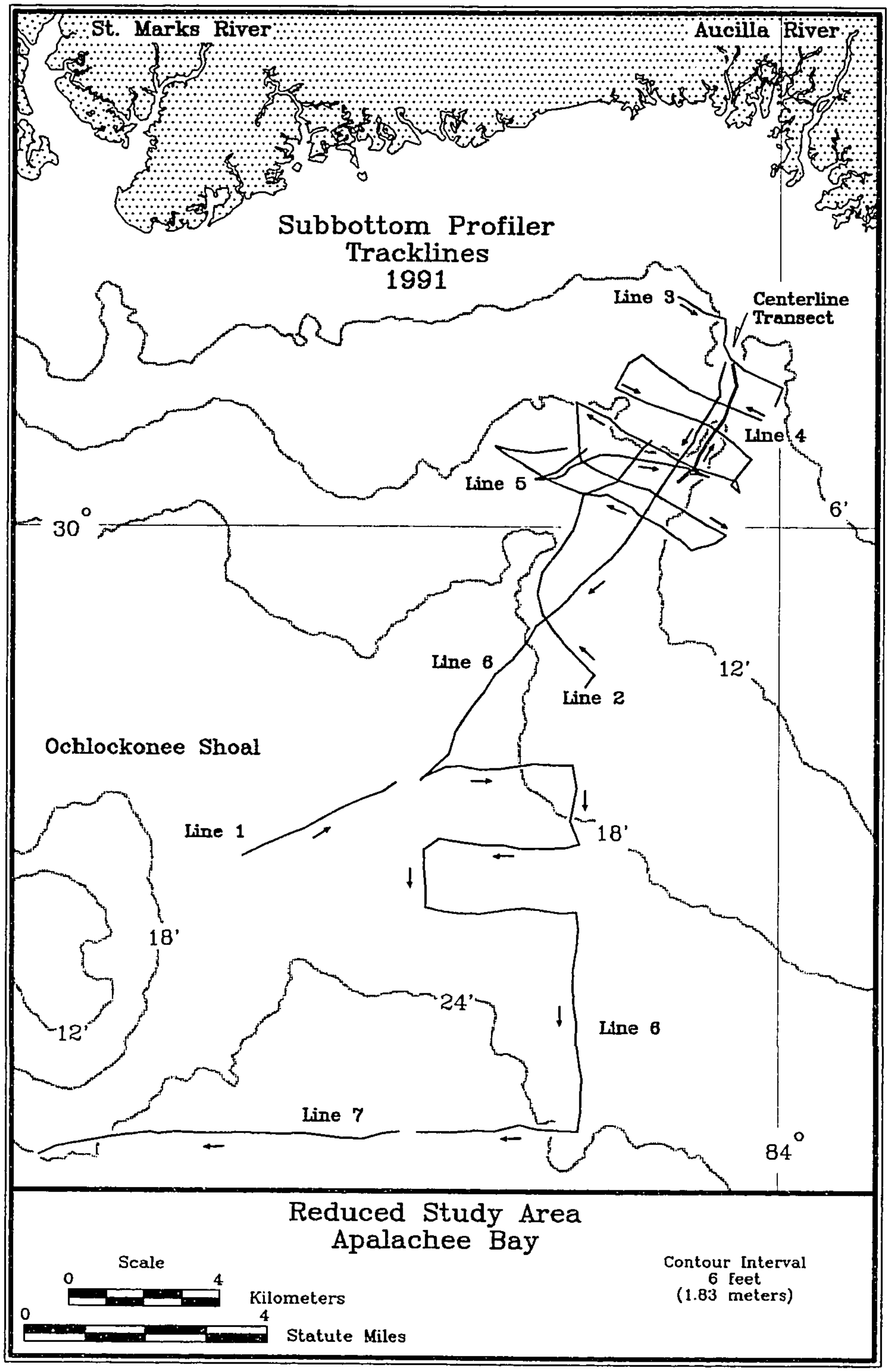

Figure 7.05 Subbottom profiler tracklines

original study area defined in Figures 7.02a, 7.02b, and 7.03 and shows these subbottom profiler transects. This enlargement was necessary to bring out features in better detail. Figures 7.11 and 7.12 are also mapped at this scale.

The subbottom profiler tracklines revealed a generally flat bottom interrupted by three kinds of seismic anomalies: channels, karst ripples or jumbles(Figure 7.11). Other topographic features which were mapped include isolated sinkholes, low relief depressions and low relief hills (Figure 7.12). Graphics showing the size distributions of these features is shown in Figures 7.17a and 7.17b. One possible cultural feature - a domed reflector that may represent a mound of shell or a shell midden of 64 meter (210 foot) length and 61 centimeter (two foot) relief - was also noted, but not field verified (Figures 7.06 and 7.12). Goodyear et al. (1980) commented on similar reflectors at Turtlecrawl Point, near Tampa Bay (cf. Stright, 1990:445).

These features were tabulated on the basis of similarities of form and texture on the hardcopy readouts. The features were then plotted on the computer map by setting the digitizer between way points and drawing between approximate feature beginning and ends, resulting in lines on the topographic map to the accurate scale. This turned out to be a highly effective method of recording and analyzing the data. In addition, several tracklines crossed each other, which allowed interpretations to be tested. In general, the interpretations held up under critical scrutiny. Pearson et al. (1986:76) discuss this cross checking technique.

Channels

Anomalies on the subbottom charts inferred as channels have distinct shapes and margins. These anomalies contrast areas of inferred karst development, discussed below, by having more distinct, and restricted, margins. Channels either have sediment fill or deeper sediments than depressions. Channels are represented by acute V or dished shapes, depending - apparently - on the angle at which the channel flow trend was encountered by the profiler trackline. The hypothesis is that when the crossing is perpendicular to the channel trend the shape is more V- or U-shaped (Figure 7.07, for instance), while if the crossing is parallel then the seismic morphology is more gradual or dish-shaped (e.g. Figures 7.08 through 7.10). The average size (width) of the channel anomalies was 115 meters (377 feet), with a standard deviation of 65 meters (213 feet). The statistics of size for these karst features is shown in Table 7.01 and the size distributions are shown in Figure 7.17a.

Twenty-two locations considered potential for coring were documented in the field in 1991 (designated Loci G through BB, including clusters $N_{1,2,3}$ and $L_{1,2}$ in the discontinuous segment of the paleoAucilla to be described below). These features are labeled directly on the electro-sensitive hard copies and recorded onto the navigational control data sheets. Subsequent, more detailed data analysis identified 12 additional channel features bringing the total to the 34 channel crossings shown in Figure 7.11.

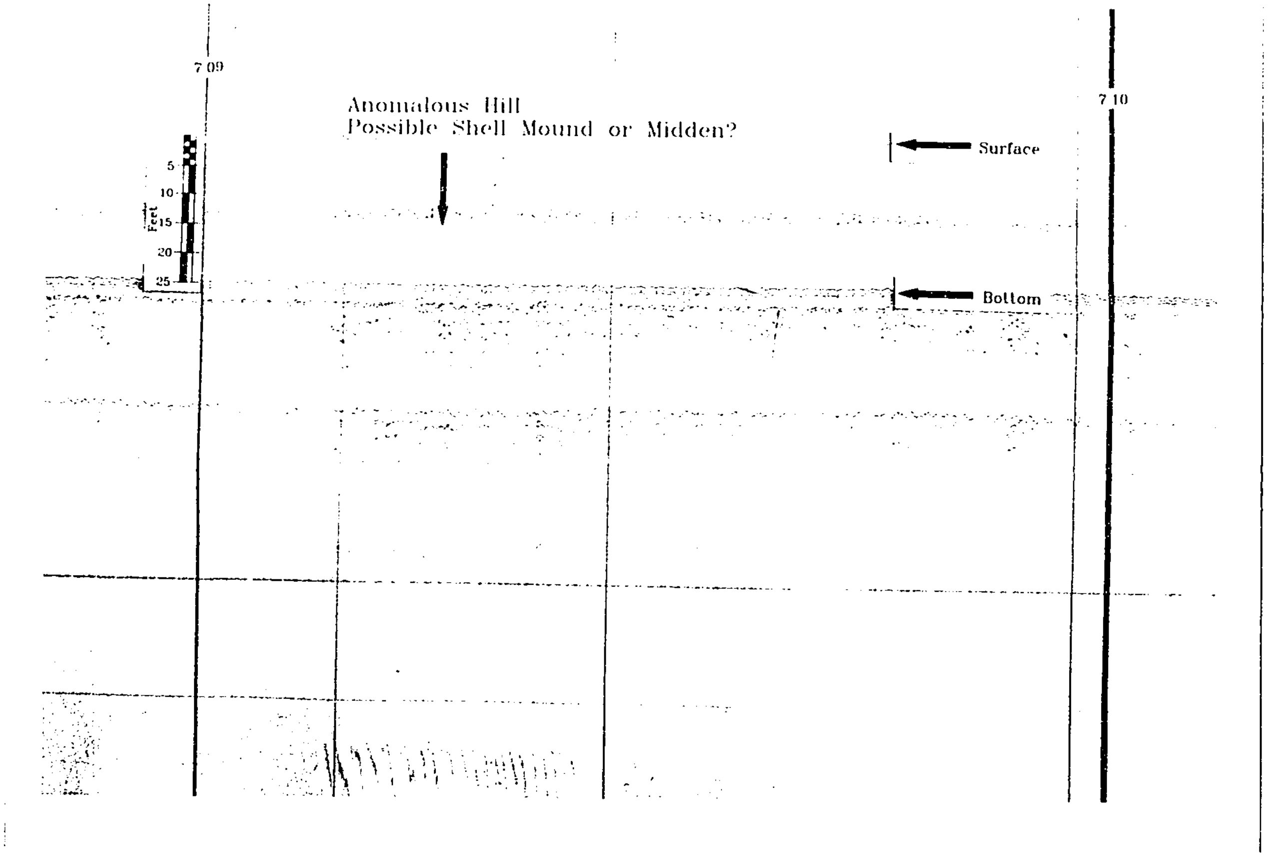

Figure 7.06 Subbottom profiler record of possible shell midden, waypoints 7.09 through 7.10

Table 7.01 Summary of anomalies defined by seismic profiling

Type	N	**Range**	Average Length	Standard Deviation
Channels	34	14.6 m (48 ft) to 1381.4 m (4532 ft)	115 m (376 ft)	65 m (212 ft)
Karst Features	106	23 m (75 ft) to 257 m (842 ft)	189 m (619 ft)	190 m (622 ft)
Sinkholes	27	14.6 m (48 ft) to 124.4 m (408 ft)	51 m (167 ft)	27 m (87 ft)
Depressions	23	37.5 m (123 ft) to 394 m (1294 ft)	179 m (587 ft)	102 m (333 ft)
Hills	33	10 m (33) to 568.5 m (1865)	87 m (286 ft)	102 m (335 ft)

Divers observed four of these locations after the preliminary studies of subbottom profiler record had been accomplished in 1991. These are Loci (L_1, L_2, N_2, and T_1). Two of these were probed with vibra-cores (Loci L_1 and L_2, to be discussed further below). These diver observations and vibra-cores substantiated the inference of paleochannels because the flat bottom morphology deepened in the channel area, grass or exposed bedrock defined the channel margins, or surface sediments were finer textured (muckier) within the channel trend than up on its margins, or various combinations of the three. Furthermore, deeper sediments were encountered when probed with the vibra-cores (at Loci L_1, L_2). The analysis of aerial photographs from the Sea Grass Study, presented in the text above and shown in Figure 7.05, confirmed that Loci Q, R, S and T_1 were probable channel features (see Figure 7.18 also)

One additional objective of the remote sensing activity was to test the hypothesis that river channels of this karst region are actually made up of sets of sinkholes in linear arrays. If that were true then it would be possible to identify specific sinkholes which might preserve *in situ* artifacts and faunal remains - the basis of the proposal submitted to NSF in 1990 for this dissertation research (Faught, 1990a).

Thus, after east-west transects had been run on the upper segment of the relict channel (Lines 3 and 4; Figure 7.05 and 7.22), waypoints for a "Centerline Transect" were calculated from Loran-C coordinates for the center points the features encountered by the transverse (east-west) tracklines[3]. This approximate centerline was then run as a trackline course (waypoints 5.19 - 5.30; Figures 7.05, 7.08 - 7.10, and 7.22).

The Centerline Transect resulted in the substantiation of the linear sinkhole array hypothesis and the delineation of a discontinuous channel segment analogous with those known onshore. It also resulted in the discovery of additional sinkholes not previously remotely sensed or diver observed. It can be seen from Figure 7.11 and 7.22 that seismic transects downstream of this segment did not encounter any channel features. Some features were encountered upstream -- that is closer to the coastline -- but they are of significantly lower relief in comparison with the channel features.

Other lines of evidence also support the hypothesis that this was at one time a discontinuous channel segment. For instance, the J&J Hunt Site (8 Je 740) is directly on the trend line of the relict river channel centerline but on higher ground (arrow

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[3] Channel crossings made during a previous cruise aboard the R.V. Bellows on Dec. 6, 1990 were included in this estimation. Two transects were run in the area at that time, but in relatively heavy (>4') seas, therefore most of the readings are not useful. This research was undertaken by Dr. Donoghue of FSU and Dr. Anuskiewicz of Minerals Management Service.

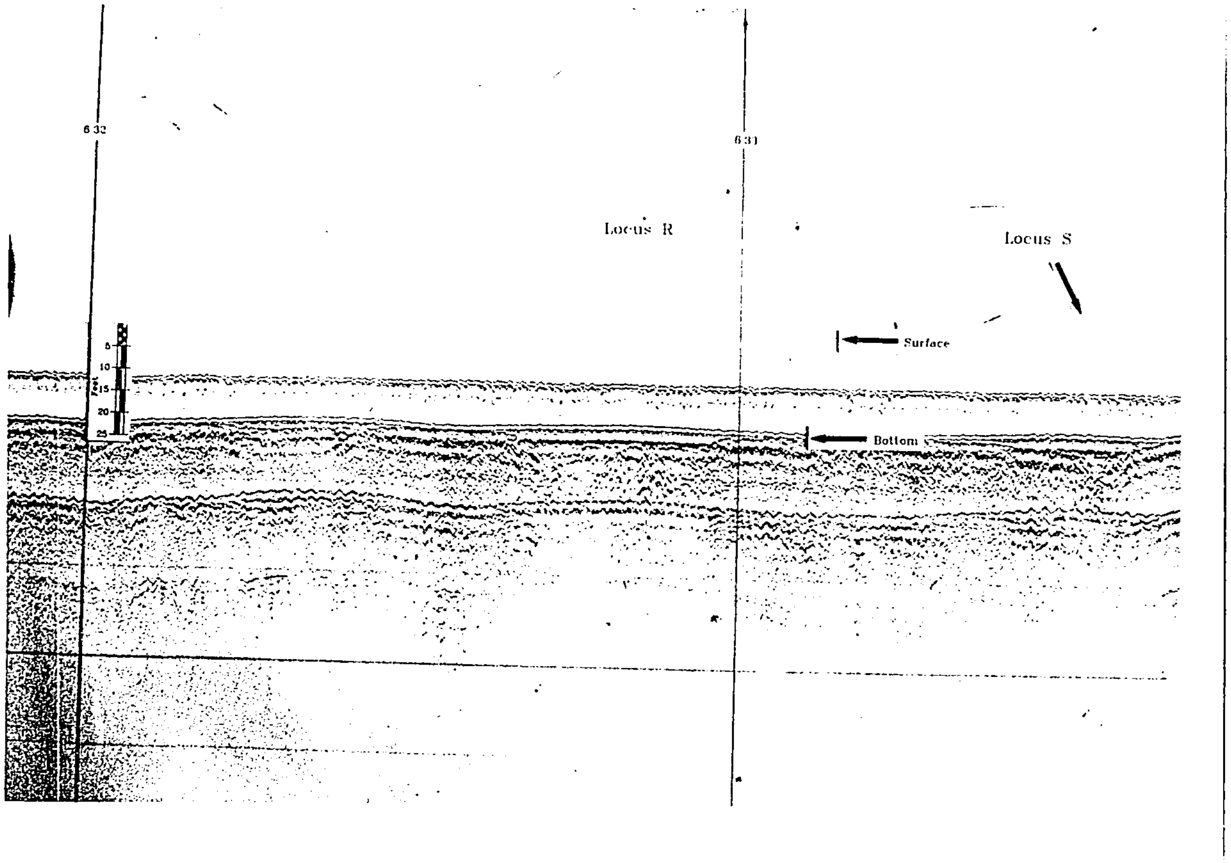

Figure 7.07 Perpendicular channel crossing, Loci R and S, waypoints 6.32 through 6.33

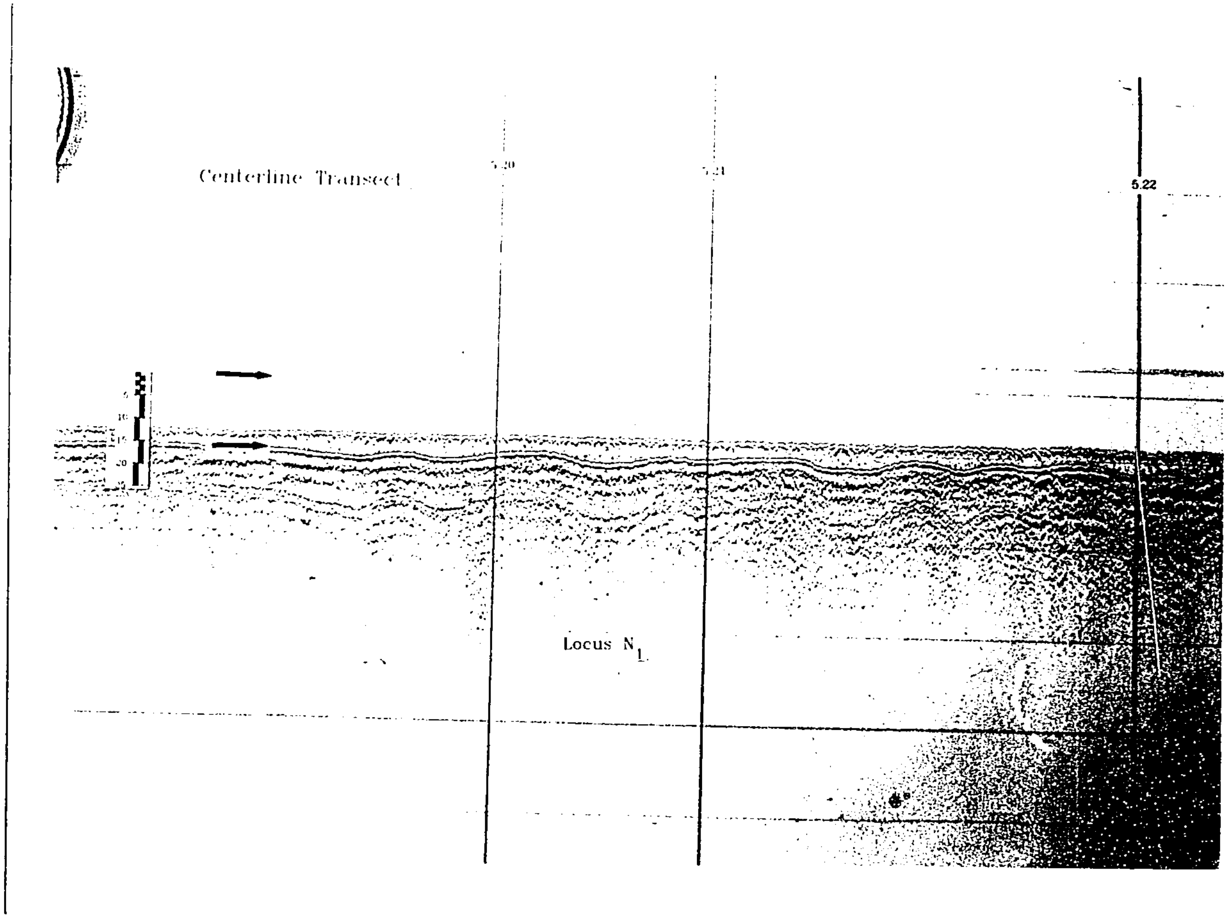

Figure 7.08 Centerline Transect, from south (left) to north (right), waypoints 5.20 through 5.22

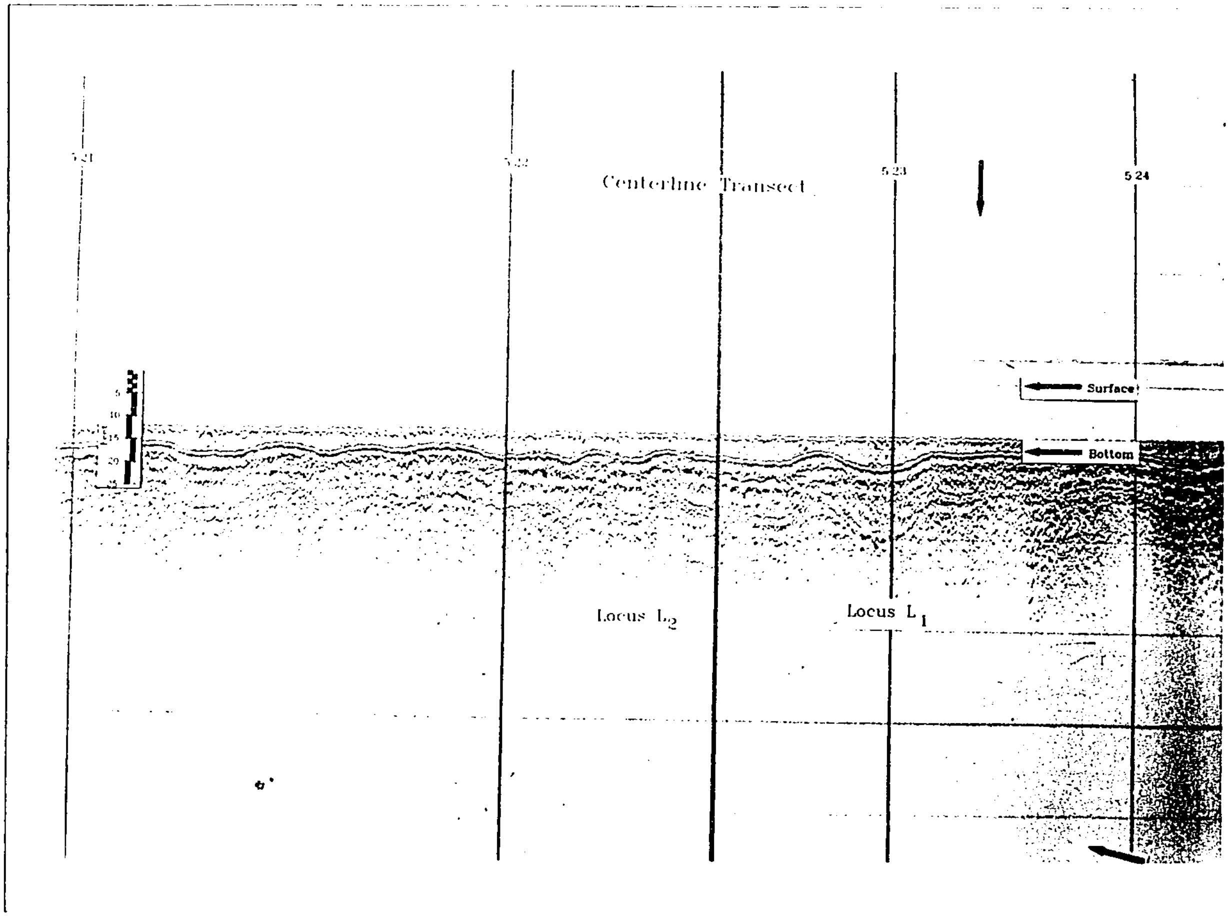

Figure 7.09 Centerline Transect from south (left) to north (right), waypoints 5.22 through 5.24

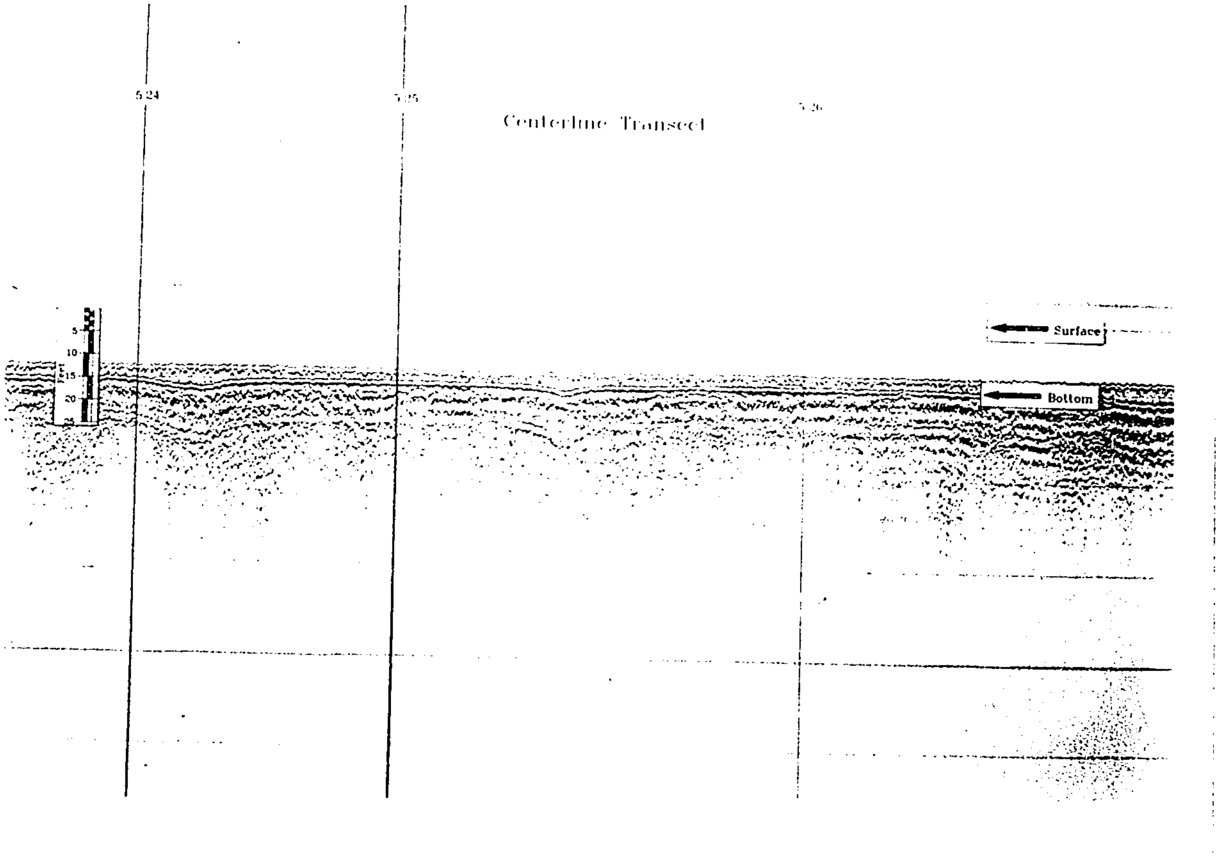

Figure 7.10 Centerline Transect, from south (left) to north (right), waypoints 5.24 through 5.26

between 5.23 and 5.24 on Figure 7.09). This site, to be discussed more below, is considered to be a former inland habitation site, and not a coastal occupation. This hypothesis uses the analogy of similar sites located in onshore settings around sinkholes.

Subbottom profiler Line 6 paralleled the Centerline Transect of Line 5, to the west, specifically to test the hypothesis. This transect exhibited significant karst point source returns, but it did not reveal any unambiguous channel morphologies. Review of Figure 7.22 and 7.30 shows the locations of the tracklines, Figure 7.13 shows the subbottom profiler record of waypoints 4.15 through 4.16 and Figure 7.14 shows waypoints 6.05 to 6.04. On the other hand, a possible channel or drainage feature is possible, farther west and north, and in association with the Fitch Site (designated as the Pinhook paleochannel, Figure 7.18).

On the basis of these observations, it is suggested that the portion of relict channel that we have identified in these upper reaches of the paleoAucilla represents a discontinuous channel segment, identical to portions of the modern Aucilla River, such as the Halfmile Rise section where the Page/Ladson site (8 Je 591) is located, or the Little River run (Willis, 1988); or the Nutall Rise (each described in Chapter Six). The approximate length of the segment is 1.25 kilometer (.93 statute mile), beginning approximately 6.5 kilometer (four miles) from the modern mouth of the Aucilla River and includes, in north to south order, Loci L_1, L_2, N_2, N_1, and N_4 (Figure 7.30).

The notion of discontinuity carries with it the implication that there would have been a rise of effluent aquifer water at the beginning of the segment (Locus L_1) and a siphon of descending (influent) water at the end. This segment would have pertained when sea levels were farther out on the continental shelf. With rising sea levels the channel segment would probably evolve toward connection, not unlike a ria cycle described for alluvial rivers in Chapter Five. Thus, the sinkhole at Locus L_1 is an ideal place to place test pits searching for the remains of Pleistocene animals and evidence for human activities (Faught, 1991).

Channel segments farther south in the research area, Loci Y or BB, appear to be more similar to alluvial/karst channels of the St. Marks or Ochlockonee Rivers onshore (Chapter Six). The St. Marks, Aucilla, and Econfina Rivers would be tributaries to this larger paleochannel. This could also signal a change in past environmental regimes and drainage characteristics at and below, that is farther out from, this eight meter (26 foot) isobath. The change from karst controlled to more alluvially controlled drainage ways could also signal a change in associated flora and fauna in the past. More diver confirmation and coring could resolve and enhance these observations. A reconstruction of the drainage system is presented in Figure 7.18. The area covered in this illustration includes the full sized (1500 square kilometer) research area as described in Figures 7.02a, 7.02b, and 7.03. This reconstruction was determined by the positions of the channels, by aerial photograph channels, and by bathymetry.

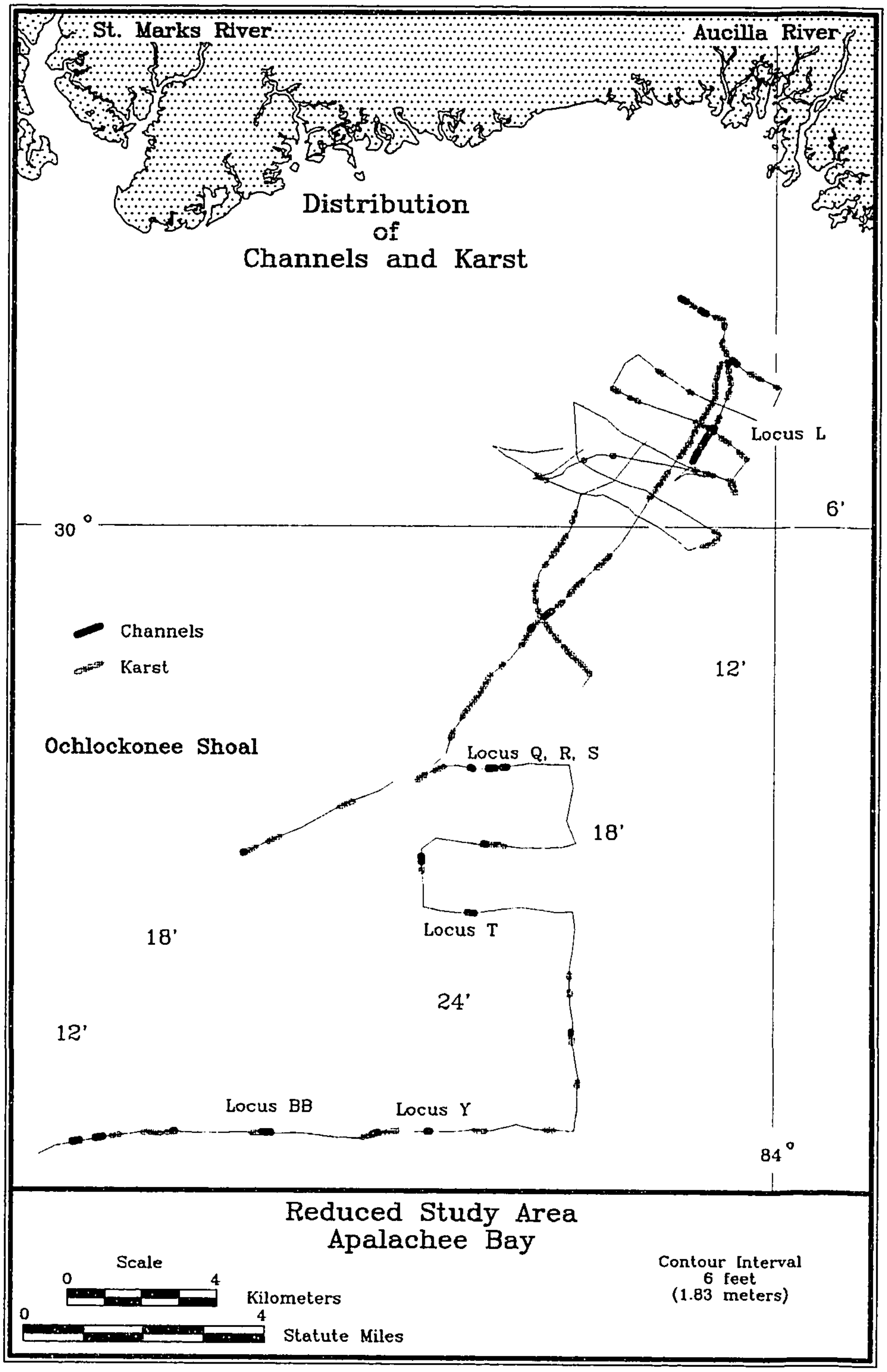

Figure 7.11 Distribution of channels and karst

Karst

In the initial stages of observations of the seven tracklines, several areas exhibited variegated textures which were less distinct than channels, but which were at the same time clearly anomalous from the surrounding topography and subbottom stratigraphy. It became apparent that these probably represent karst solution and collapse structures. Consultations with Dr. Donoghue and substantiation by other seismic research (Gilboy, 1986; Popenoe et al., 1984) confirm this interpretation.

The principle explaining this special texture is that remnant portions of limestone - isolated by the solution of the surrounding rock - return point source signals which are documented as parabolas. The texture of these signals appear as ripples and/or jumbles on the hardcopy. The distribution of these anomalies are presented in Figure 7.11, and examples can be found in Figures 7.13, 7.14 and 7.15.

Karst anomalies are the most frequent anomaly return in the survey area (N=106). They average 189 meters (619 feet) in width or length, and exhibit a standard deviation of 190 meters (623 feet). There is morphological variation within this category that was not considered, such as sediment fill characteristics, depth of the karstification to bedrock, and different parabola textures. The statistics of size for these karst features is shown in Table 7.01 and the size distributions are shown in Figure 7.17a.

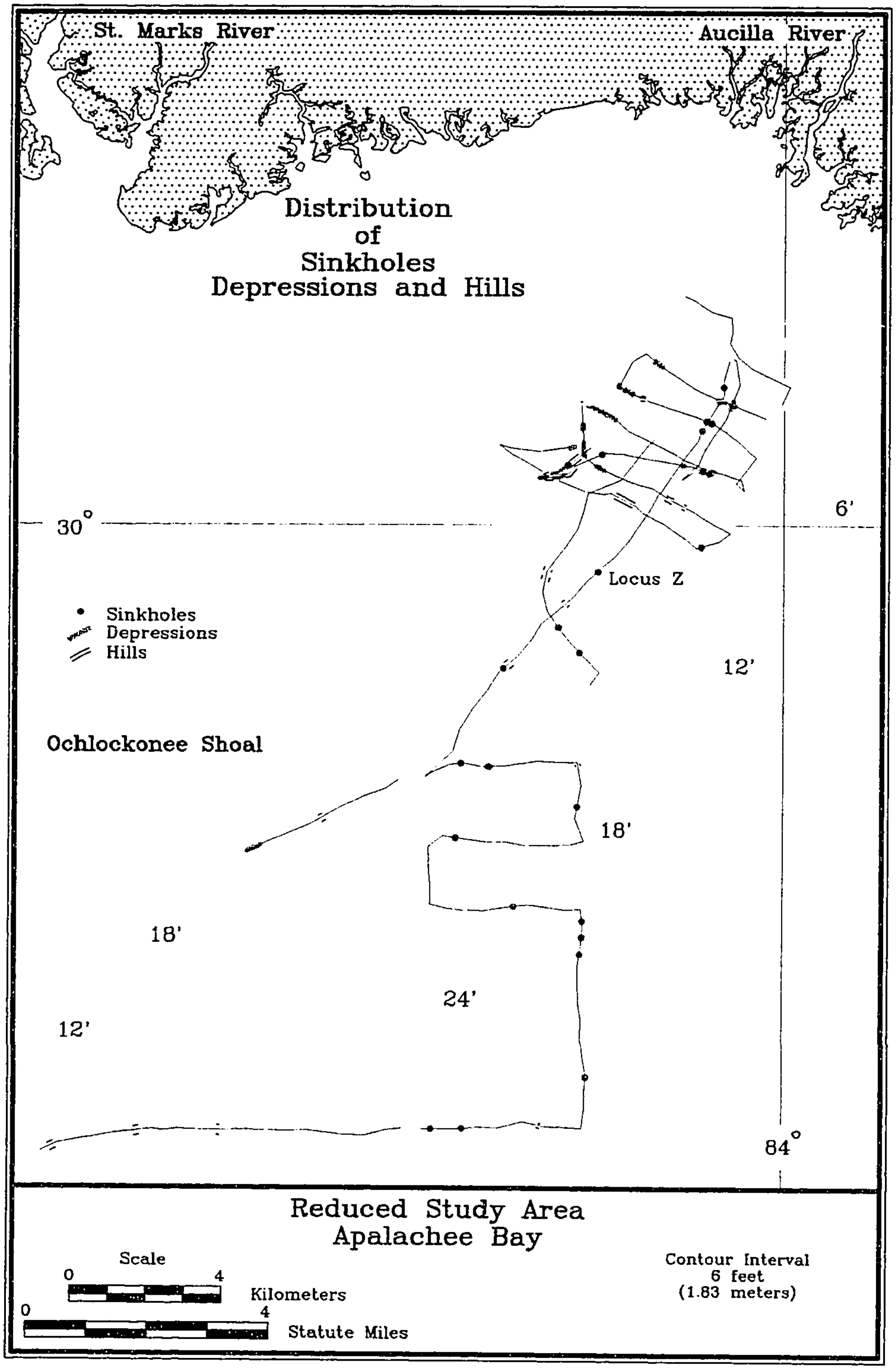

Figure 7.12 Distribution of sinkholes, depressions and hills

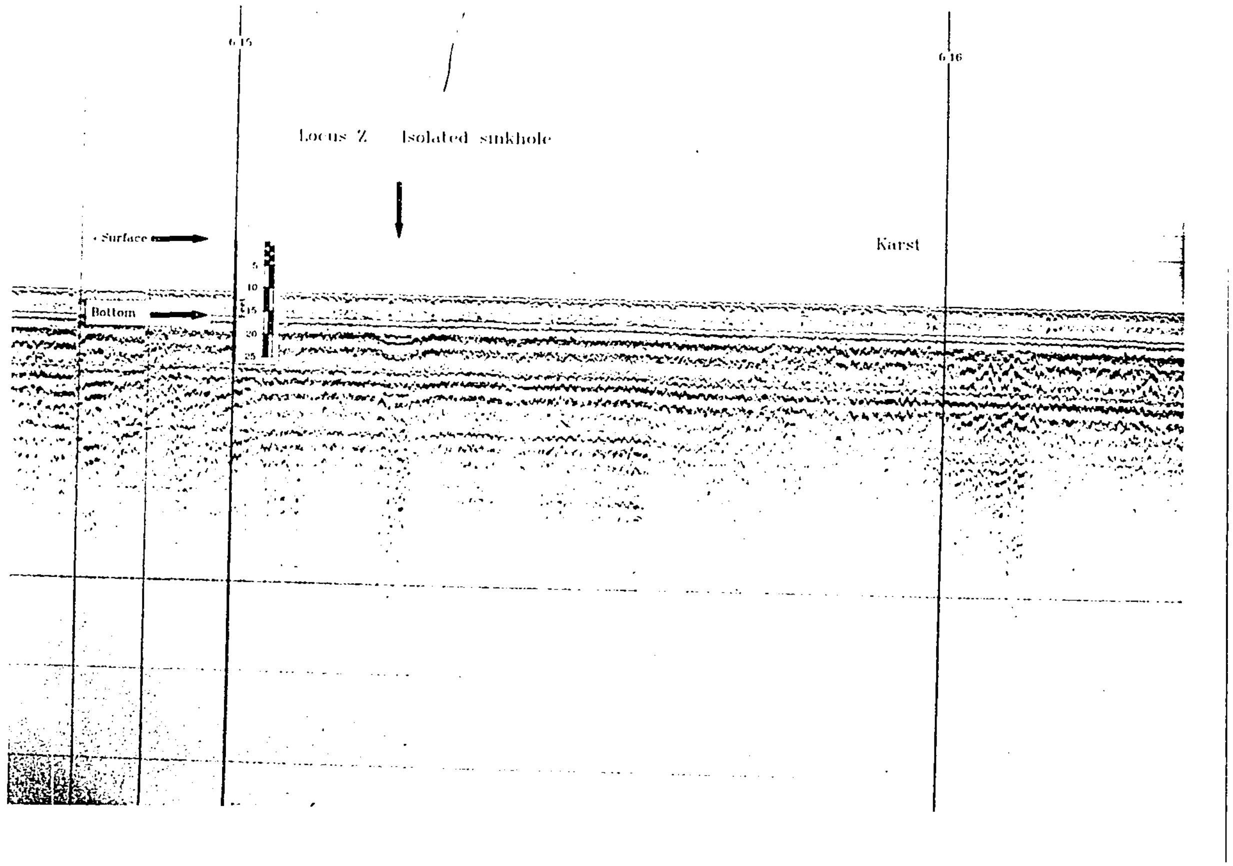

Figure 7.13 Example of an isolated sinkhole (Locus Z) and nearby karst, waypoints 6.15 through 6.16

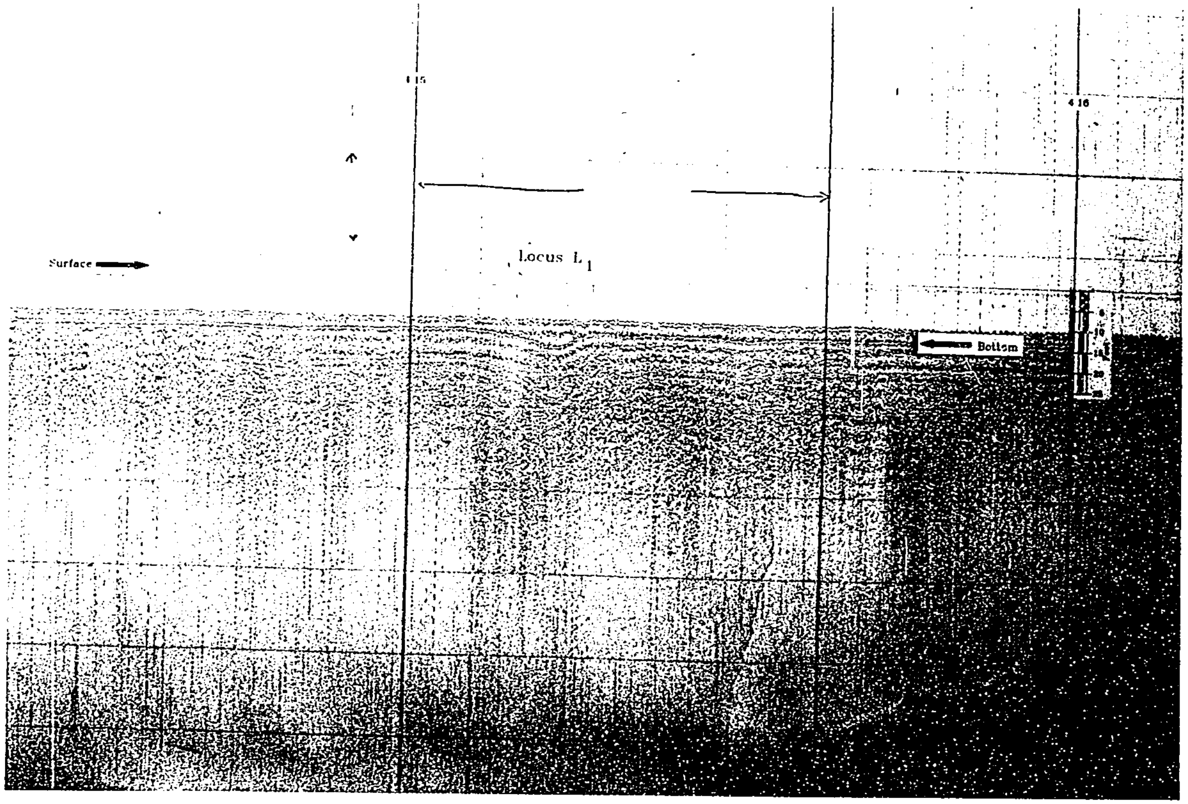

Figure 7.14 Trackline crossing of Locus L_1, from west (left) to east (right), waypoints 4.15 through 4.16

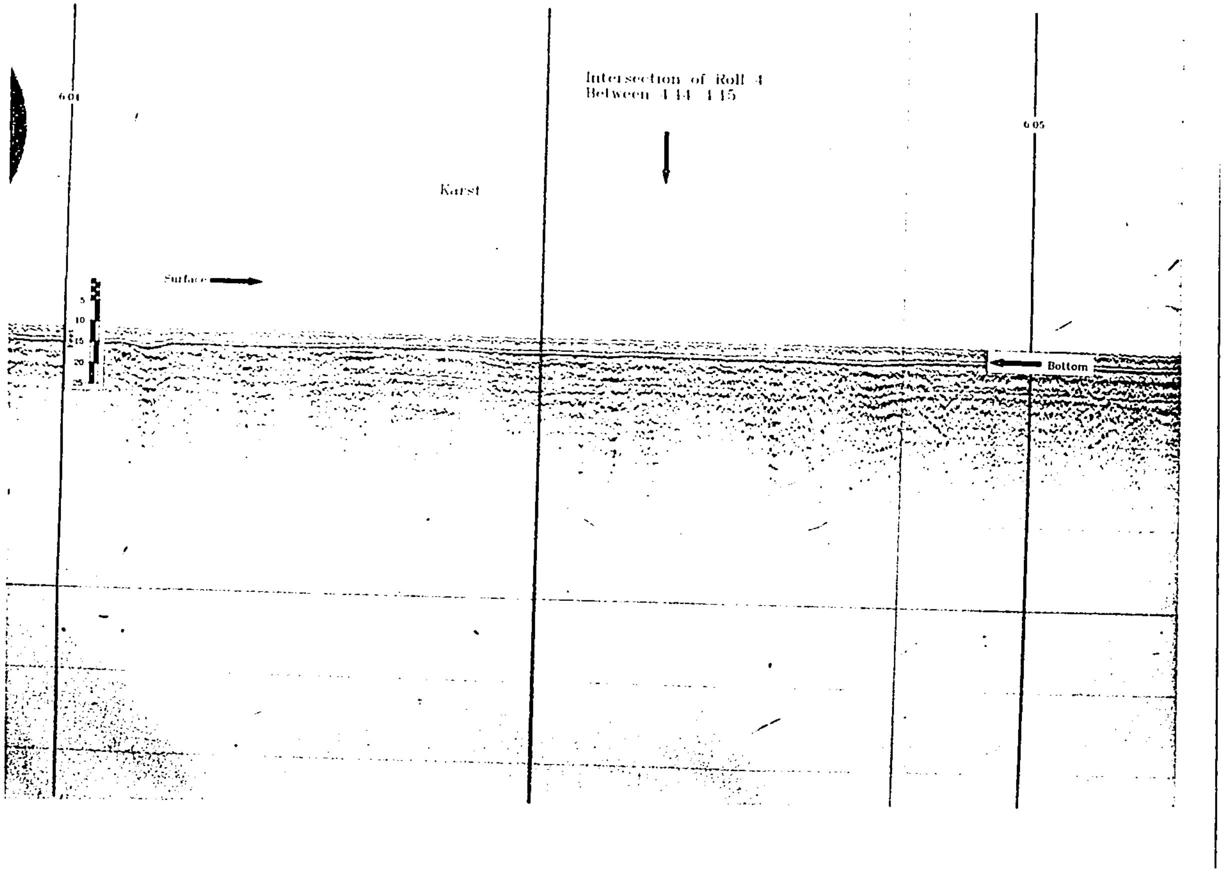

Figure 7.15 Karst anomaly, west of the Centerline Transect, north (left) to south (right), waypoints 6.04 through 6.05

Isolated Sinkholes

Isolated anomalies with distinct boundaries like V- or U-shaped channels, but which are smaller and not on apparent channel trend lines were classified as isolated sinkholes (Steeples et al., 1984). The distribution of these features is illustrated in Figure 7.12 and an example of a profiler signature of one of these features is represented in Figure 7.15. A Total of 27 anomalies were classified as isolated sinkholes. It may be that a small percentage of these are actually channel segments or that a few channels are sinkholes, additional hardcopy study, or field verification would be necessary to challenge these interpretations.

The average crossing width of these anomalies was 51 meters (167 feet) and the standard deviation was 27 meters (about 88 feet). This average, and the standard deviation, of the sinkhole sizes are listed in Table 7.01, to compare with similar data for the other anomalies, and the size frequency distributions are presented in Figure 7.17b.

Depressions

Twenty-three features looked somewhat like channels but had little or no sediment fill and low , 30 centimeter to one meter (one to three foot), relief. These depressions resemble the Centerline Transect channel crossings in that they are gently sloping, concave features (e.g. as if the trackline was parallel to the axis of flow) but there is often a lack of sediment fill. In some cases, the distinction between calling a feature a depression or designating it as a channel lay in the fact that the alignment of the trackline was apparently perpendicular to the general flow regime, where a V shaped channel was expected, but a gently sloping dish shaped feature pertained. This ambiguity could be resolved with additional study of the images, diver confirmation, coring, or all three.

The average crossing width of these features was 179 meters (587 feet), and a standard deviation of 102 meters (335 feet). The linear extent of these anomalies is shown in Figure 7.12 and averages are shown in Table 7.01 for comparison. The size distributions are shown in Figure 7.17b. Examples of depressions can be seen in Figures 7.24 through 7.26.

Hills

Simple changes in topography on the order of 30 centimeters to one meter (one to three feet) of positive relief were classified as hills and these are plotted in Figure 7.12. The possible shell midden shown in Figure 7.06 was placed in this category, along with 32 other features. These features averaged 87 meters (285 feet), the standard deviation was 102 meters (335 feet). Statistics for Hills are presented in Table 7.01 and size distrbutions shown in Figure 7.17b.

Discussion

The point source returns inferred as karst topography are both the largest and the most frequent signal returns from the subbottom profile record in the study area. It is most frequent, or advanced in two areas. The first is located between the 1.8 and 3.6 meter (six foot and 12 foot) contours around the paleoAucilla channel segment from Loci L_1 through N and the area of depressions and karst to the west (Figure 7.11 and Figure 7.18). A second, more extensive but less severe, karst field lies somewhat deeper, between the five meter (approximate 16 foot) and 6.5 meter (21 foot) isobaths. Areas deeper than this exhibit karst in smaller and less developed reflections. The distribution of crossing lengths, shown in Figure 7.17a and 7.17b, generally parallels the size distributions of the crossing lengths of channel features, only there are many more karst features represented. Karst anomalies tend to show up on either side of the channel features. This proximity to water filled channels conforms to idea of water controlled, chemically erosive karst development presented in Chapter Six.

Channels are the next most frequent returns. Most channel anomaly crossings are less than 160 meters (525 feet) in size. Channel anomalies are also more distinct in two main areas, one around the discontinuous segment L_1 through N, and the other in the region between Q-R-S to T. Vague encounters of channels without clear trends occur in Line 1 east of the Ochlockonee Shoal and in the last parts of Line 6 and all of Line 7 to the south.

The character of the seismic returns made south and east of the Ochlockonee shoal along the final portions of Line 6 and in all of Line 7, including Loci Y through BB, reflect possible alluvial drainage characteristics, or possibly mixed alluvial and karst systems. As an example, the margins of Locus Y (Figure 7.16) appear to be terraced, a characteristic of alluvial drainage systems. In this light, the Ray Hole trough (Figure 7.02b) probably represents a major order stream trunk. The upper reaches of this feature are probably the result of the confluence of the paleo St. Marks and Ochlockonee with the paleo Stony Bayou - Pinhook - Aucilla - Econfina drainage systems, as reconstructed in Figure 7.18. The estimated location of the actual confluence is at the eight meter (26 foot) isobath. This major confluence, which should probably be called the paleoOchlockonee, probably carried sediment before inundation progressed to the position of the Ochlockonee Shoal (Figures 7.02b and 7.03).

Of the three kinds of anomalies, sinkholes were the most restricted in size. Sinkholes cluster between about 60 and 80 meters in crossing length, and do not exhibit examples larger than about 130 meters. They are dispersed across the landscape.

Anomalies designated as depressions are particularly concentrated west of the paleoAucilla discontinuous segment and near the Fitch Site (8 Je 739; Figure 7.12). These may be the remains of a drainage system orders of magnitude older than the Holocene inundated portions of the paleoAucilla segment, or possibly a remnant of the paleoPinhook drainage or both. There appears to be a particularly dense area of topographic and geologic characters in this area which encompasses the Fitch Site and which consists of karst anomalies, depressions, and hills. There may be more frequent rock outcrops in this area, than others, as well.

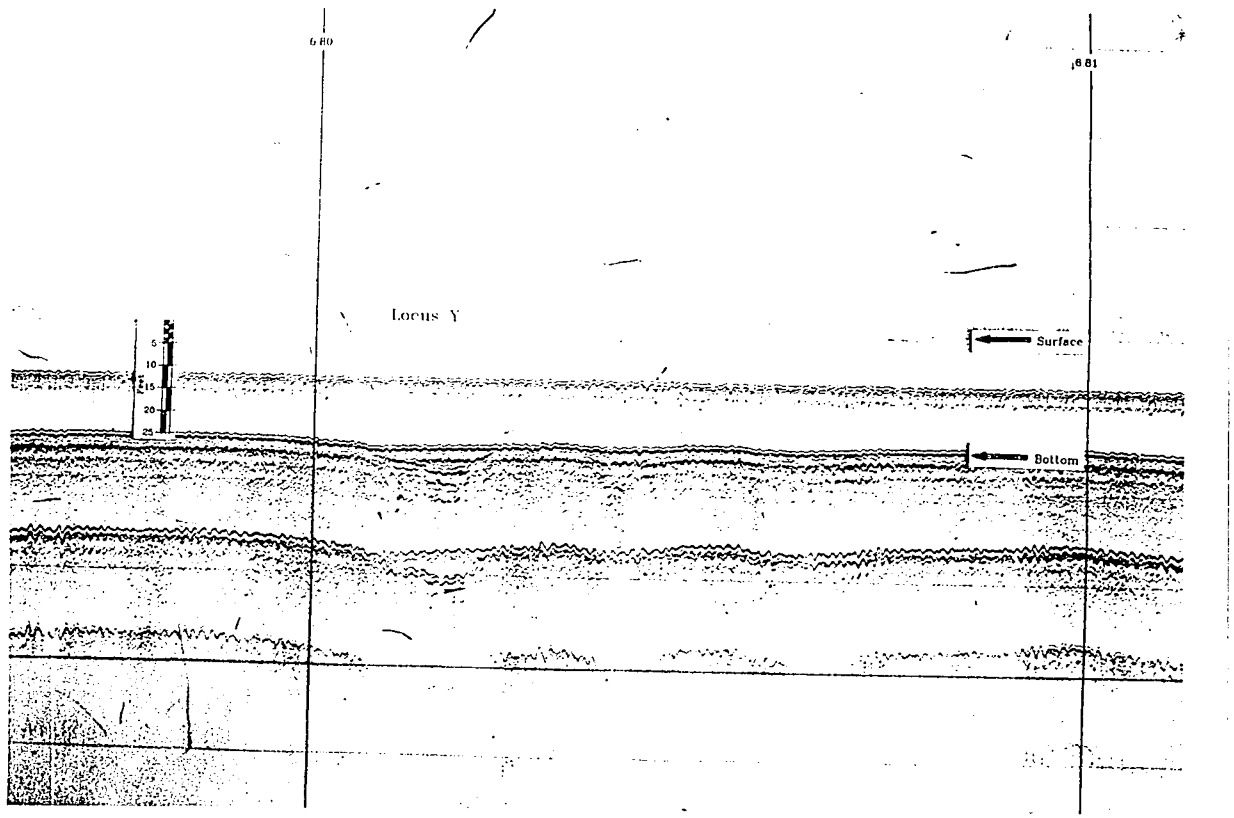

Figure 7.16 Locus Y, east (left) to west (right), waypoints 6.80 through 6.81

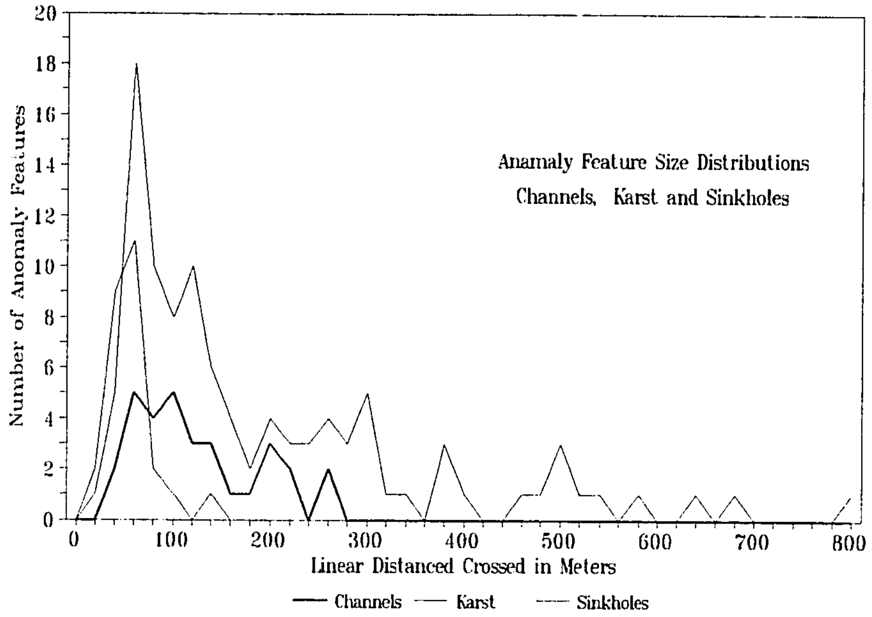

Figure 7.17a Anomaly feature size distributions: channels, karst and sinkholes

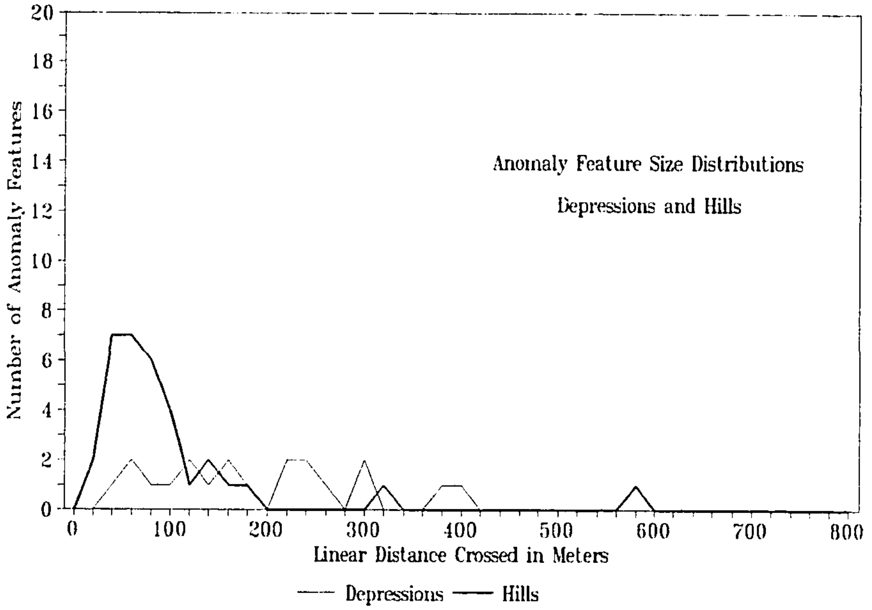

Figure 7.17b Anomaly feature size distributions: depressions and hills

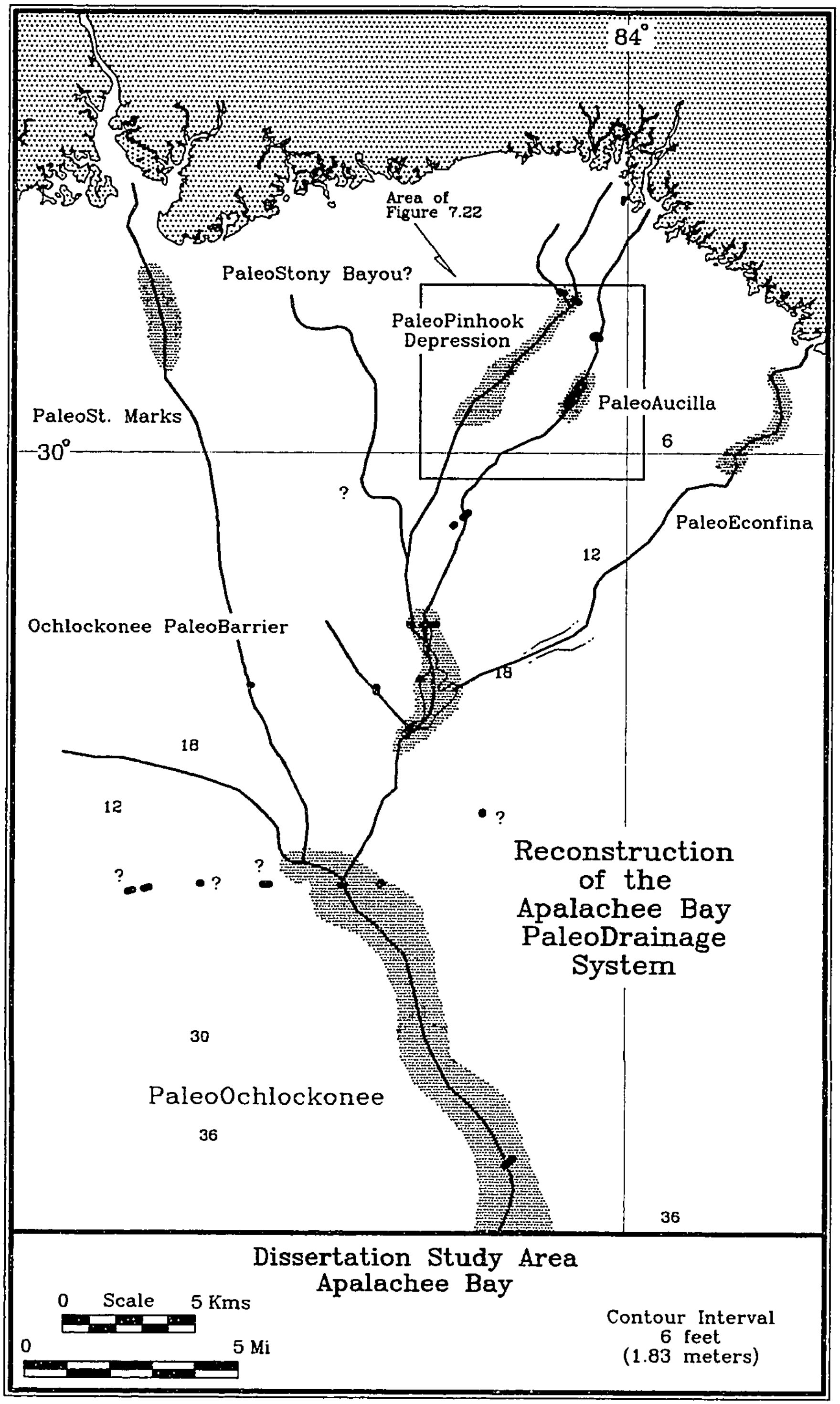

Figure 7.18 Reconstruction of the paleodrainage system

Hills (elevated, low relief areas) have the most diffuse distribution in the study area, although several coincide with depressions mentioned above and near the Fitch Site (8 Je 739; Figure 7.12). As mentioned previously, one hill anomaly located between waypoints 7.08 and 7.09 in Line 7 might be a shell mound. It is situated on the eastern margins of the paleoOchlockonee (Figure 7.12 and 7.06).

The first three excursions taken offshore as part of this research, that is in 1986, 1988, and 1989 (Chapter Six), relied on opportunistic discoveries of relict channel configurations and deep sinkholes (Dunbar, 1988; 1989b; 1992; Faught, 1988). It became clear from these attempts that this methodology was a handicap, and that remote sensing could resolve the problem. The subbottom profiler data has contributed to a more robust understanding of the offshore geomorphology in this study area. Now, even with the limited areas of exposure from the 1991 subbottom transects, additional survey and testing can focus on several channel margins, anomalous topographies and sediment profiles already in hand.

Offshore Geomorphology

Descriptions of sea floor surface sediment characteristics and sediment stratigraphies made by marine geologists are often based on large scale sampling intervals. However, to describe the geomorphology and characteristics of inundated archaeological sites, much finer sampling intervals and descriptions are necessary.

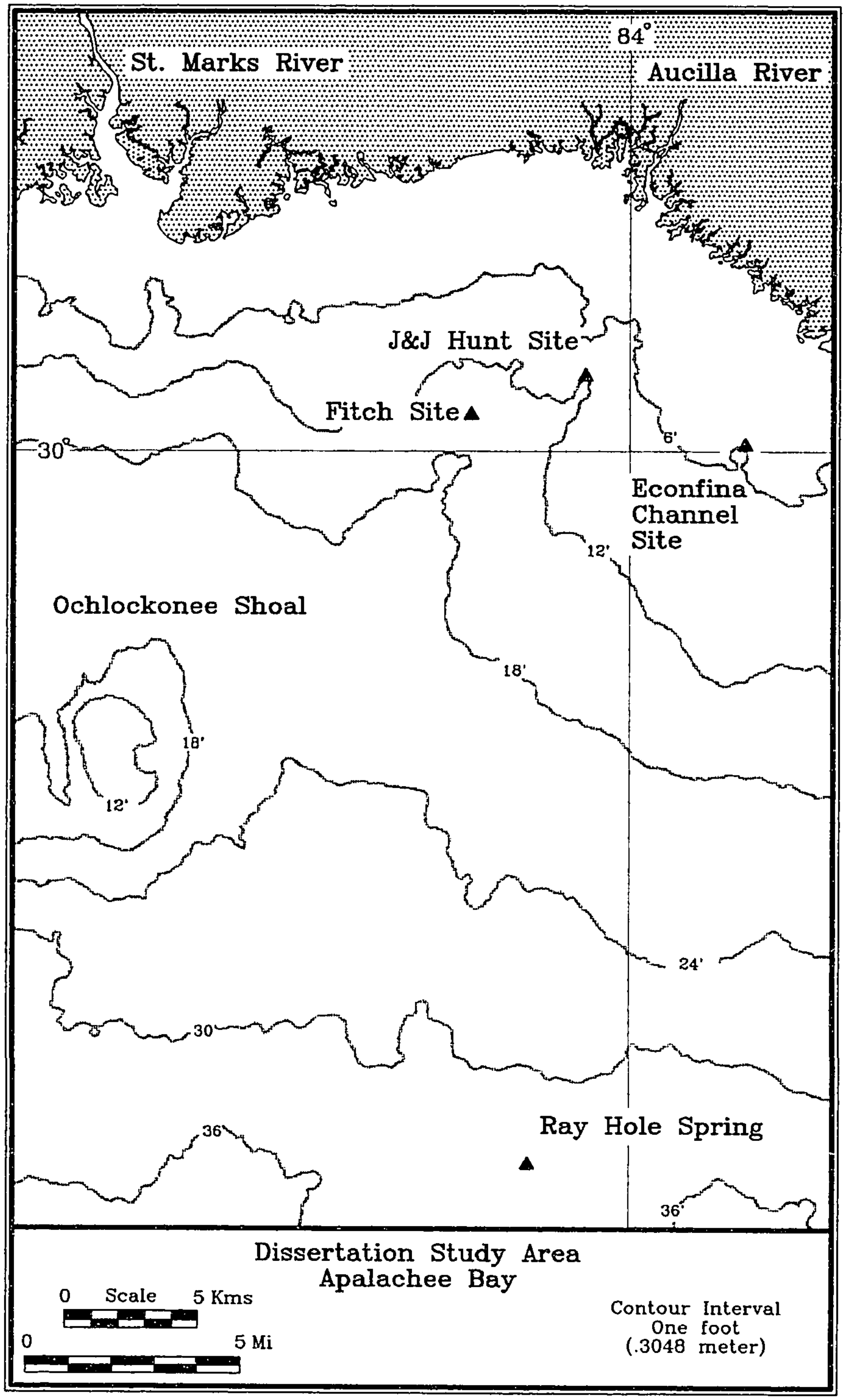

Figure 7.19 Location of sites discussed in text

Goals for this aspect of the research include revealing and describing the array of geological and archaeological materials discovered with regard to evidence for past terrestrial conditions, possible archaeological site activity areas, the chronology and magnitude of sea level rise, and the regularities of inundation and post-inundation site formation processes. Data gathering techniques included observations of the surface arrays, random and systematic grab collections of sediment and artifact samples, controlled vibra-coring and induction dredge excavations.

In the stratigraphic descriptions that follow, the term "units" is used to represent major lithologic divisions based on texture and/or constituents. Sediments subsumed under the term Units imply similar sedimentary depositional regimes (Waters, 1992). The term "zone" expresses color and texture variation within units and is used to refer to pedogenesis (especially based on a change in color). The data base, geomorphology and artifact conditions of each site are discussed in turn, beginning with the Econfina Channel Site, then Fitch, and finally the J&J Hunt Site.

Geomorphology of the Econfina Channel Site (8 Ta 139)

Work undertaken at the Econfina Channel Site in 1988 was the first disciplined foray to make surface collections and induction dredge excavations at a location known to exhibit cultural materials inundated in the Apalachee Bay (see the narrative section in Chapter Six). The data used for reconstructing the character of the surface sediments and stratigraphy at Econfina Channel Site consisted of observations and drawings recorded in the field during transect collections and test pit excavations, by grab samples of sediments from the excavations of Test Pits A through D, by review of 8 mm video footage made during the course of the 1988 field session and by study of the 1984 aerial photographs discussed above. Data gathering protocols, such as the development of the hand-fanned transect collection strategy were developed at this early stage, but sediment sampling had not yet become an important issue.

Figure 7.20 shows two views of the Econfina Channel site. On the right a large scale image shows the location of the site with reference to the 1.8 meter (6 foot) (SURFER gridded) contour, and a possible paleochannel configuration printed as the six foot (1.8 meter) isobath on the NOAA Apalachee Bay navigational map. On the left side of the figure a small scale detail of the site is reconstructed from the field notes, and video footage, and it shows the locations of collection transects and induction dredge test pits with reference to the margins of the Econfina paleochannel.

The 1988 research focused on a linear, east-westerly tending channel feature with a sandy bottom slightly deeper than the grassy margins on either side. Distinct color differences delineated the channel (white to light gray/brown) from the margins (dark tan to black colored limestone and brown shell hash) and from the sea grass beds (*Thalassia* sp.). Curiously, the daily tidal flow remained pronounced within the inundated channel bounds, as compared to the upland of sea grasses, even at a distance of 4.7 kilometers (three statue miles) and a depth of about 2 meters (six feet).

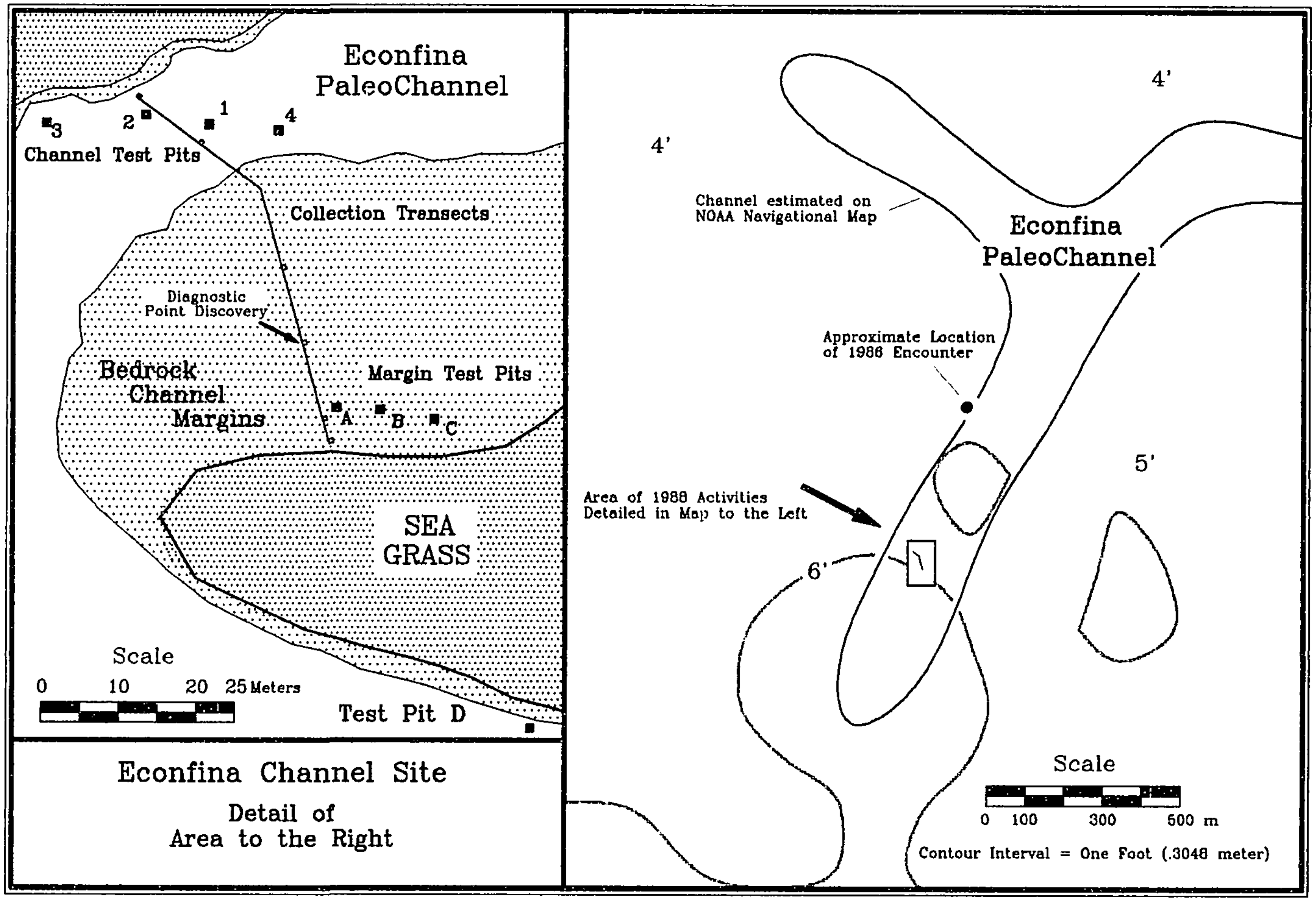

Figure 7.20 Topography and layout of the Econfina Channel Site

South of the channel bed, between the channel and the sea grass uplands, the margins consisted of a wide area of limestone outcrops and karst voids covered with a matrix of shell hash, frequent oyster shells and visible lithic debris. Several rock outcrops tested along these margins represented fine grained chert resources, and the amount of cortex observed on the lithic debris confirmed that raw materials were procured there. The artifact assemblage is discussed in Chapter Eight.

Two collection transects were laid out from a datum on the paleochannel margins and six 50 x 50 centimeter (.25 m^2) hand-fanned collection units were sampled at intervals of 10 meters. These are shown in Figure 7.20 (in the left frame). Eight one by one meter induction dredge exposures were also made at the Econfina Channel locality to search for deep sediments and *in situ* artifacts. Test Pits 1 through 4 probed the main channel sediments which exhibited shallow, light colored sand on bedrock.

Since each of these exposures bottomed out on hard, smooth limestone bedrock and field time was limited, Test Pits A, B, and C were dug into the sediments along the channel margins. All of these induction dredge test pits resulted in exposures of less than one meter and all bottomed on jagged and saprolitc limestone bedrock. Artifacts, were found mixed in the sediments from the surface to a depth of 40 centimeters in the sandy shell hash. Sections of the exposures of Test Pits A, B and D are illustrated in Figure 7.21.

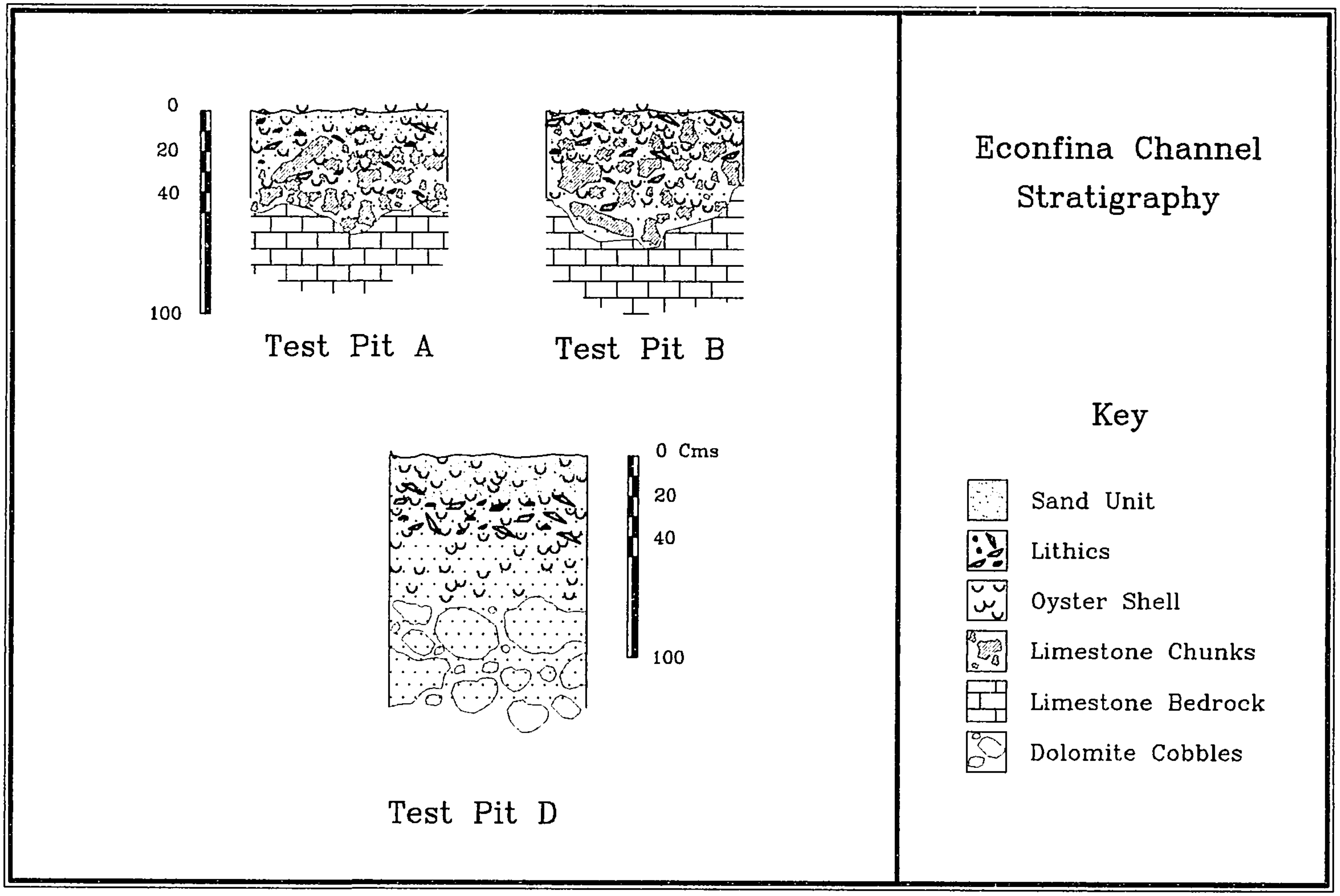

Figure 7.21 Stratigraphy of the Econfina Channel Site

These excavations and transect collections demonstrated that the channel margins exhibited karst voids filled with a shell hash unit of quartz sand with inclusions of whole and fragmentary marine shells, lithic artifacts, and fragments of jagged and degraded bedrock limestone, other calcareous concretions and dolomite. These voids, at scales of 50 centimeters to one meter (18 inches to three feet), represented small, inundated examples of a coastal margin karst bedrock geomorphology similar to that described by Hutton et al. (1984) and Hoenstine and Garrett (1993).

The deepest excavations at the Econfina Channel site were in Test Pit D, where more than 1.25 meters (approximately four feet) of sediment profile were exposed. This test unit was placed outside of the bedrock channel margins, into a smooth shell hash desert, representing another exposure within the relict channel. This was a final effort to locate deeper sediments in 1988. The stratigraphic units included sandy deposits with whole and fragmented oyster shells (*Crassostrea*), abundant, but very small lithic debris in the upper 40 centimeters of sediment. A few of the oyster shells were articulated examples.

Within the lowest portions of Test Pit D, above the dolomite clasts, both whole and fragmented oyster (*Crassostrea* sp.) shells were found, along with pieces of wood and a single fresh water bivalve shell (*Psidium* sp., Heard, 1979). At a depth of approximately 65 centimeters large rounded cobbles of dolomite were encountered in this test pit. These dolomite cobbles and surrounding sediments could be broken apart for continued excavation, but field time ran out before bedrock or lower sediments were reached.

Rock samples taken from Test Pit B reflected the three main types of rocks observed site wide: angular to subangular to occasionally rounded gray limestones (64% by weight), very rough textured, jagged pieces of calcareous concretions (25%), and, finally a very soft, rounded dolomite (11%). The concretions were designated "popcorn limestone" during the field session because of their rough texture. Some of these included limestone fossils but also other, possibly modern shell fragments implying recent cementation.

A significant number of items in the collections (both cultural and natural) appeared to have been chemically altered and degraded. Also, pieces of limestone could easily be broken off of the bedrock within the voids, and others were already detached in place. This corrosion, probably a factor of decreased pH due to the mixing of salt with fresh water, was more pronounced at Econfina Channel than at any other of the sites. The extent of this chemical degradation may also be reflected by the numerous voids which make up the Econfina Karst Field seen in Figure 7.02a and labeled in Figure 7.02b.

Oyster shells dominated the collections in all units and these shells had flat upper valves and cupped lower valves conforming to the definition of *Crassostrea rhizophorae* in Abbott (1974:456). This designation is also true of oysters observed and collected at the J&J Hunt Site to be discussed below. In Test Pits A, and C there was substantial differential abundance of flat valves over cupped ones to the degree of more than three to one (Table 7.02). This differential preservation may be due to cultural behavior. The relationship was reversed in the upper levels of Test Pit D and approximately one to one in the lower levels of Test Pit D.

Table 7.02 Ratios of flat to cupped valves and limited size data - Econfina Channel Site oysters

Prov. Unit.	Cupped Versus Flat (N)	Ratio	Largest Size (Flat)	Average Size Cupped / Flat
Test Pit A	95 / 338	3.56 / 1		3.62 cm / 2.54 cm
Test Pit B	228 / 382	1.67 / 1	5 cm	3.59 cm / .28 cm
Test Pit C	95 / 288	3.03 / 1	8 cm	8.63 cm / 3.76 cm
Test Pit D upper	88 / 47	.53 / 1	4.5 cm	4.65 cm / 3.79 cm
Test Pit D lower	75 / 90	1.2 / 1		4.74 cm / 2.04 cm

Other shell species noted at Econfina Channel included low frequencies of *Pecten* sp., *Arca* sp. and some gastropods within the shell hash matrix. Fish bones were observed in the sediment collections from Test Pits B and C, but species identifications were not undertaken. Fresh water shells were observed in the collections, including apple snail shells noted in Test Pit B and articulated *Psidium* sp. bivalves in the lower levels of Test Pit D.

The current mean low tide depth of 1.5 meters (five feet) BSL is not conducive to oyster habitation and the shell remains are therefore either relict natural items grown in place, on a substrate which contained the cultural chipped stone artifacts, or they are cultural food deposits associated with the lithic debris, or both. Given the differential distribution of the cupped versus flat valves, presented above, as well as example of articulated shells found in the upper portions of Test Pit D, combinations of both probably apply.

It is probable that the chipped stone cultural items were originally deposited on terrestrial sediments such as sand or clay, but that these sediments were subsequently eroded by rising sea levels, and replaced by the modern marine sand unit. This replacement resulted in the abandonment of shell, rock, chipped stone artifacts, and occasional larger pieces of water logged wood. The upper levels of Test Pit D, which exhibited articulated oysters in association with diffuse, but very small lithic debris also suggest an eroded context. Examples of this kind of site erosion, where smaller lithic artifacts are washed out and larger items stranded ashore at the water/land margins, are known from near the mouth of the modern Aucilla.

Condition of the Chipped Stone Artifacts at Econfina Channel

A total of 517 chipped stone artifacts were collected at the Econfina Channel Site. Their average weight was almost 31 grams, and the standard deviation of weight was 74.3 grams (cf. Table 8.02). The lithic materials from Econfina Channel were more chemically degraded than at either of the other two sites, but the artifacts were not abraded by physical movement. This chemical degradation appeared to work from inside-out in some examples and from outside-in with others. Similar characteristics will be described for the Fitch Site and J&J Hunt below, but the degree of degradation at Econfina was advanced over the other two sites by magnitudes.

Three categories of condition were noted and inventoried in the collected assemblage: white (significant corrosion, porous, no or little apparent patina), gray (no patina or corrosion), and black (a dark organic patina on light colored chert). Some of the black items exhibited edge corrosion. Of the total assemblage, 23% were white, 55% gray, and 22% black. Of the chipped stone tools (defined and illustrated in Chapter Eight), four were gray (all coming from excavated contexts), one was black without corrosion (from a transect collection unit), none were white. A single diagnostic projectile point, also found in transect collections, exhibited the black organic patina and some edge corrosion.

The most corroded chipped stone debris at the Econfina Channel Site came from Test Pit 4, from within the relict channel sediments, and therefore associated with more intense tidal flow in the channel proper. Some of these degraded cultural items were actually porous and light like pumice, but still retained details of their artifactual surface morphology, such as flake scars. These most porous categories found at Econfina are completely absent from the collections made at Fitch or the J&J Hunt site localities. It certainly seems that mixing corrosion of salt with fresh water is a factor in this condition.

Geomorphology of the Fitch Site (8 Je 739)

The Fitch site was discovered in 1988 by diver tow survey and it was revisited in 1989 for collections and excavation (see the narrative section in Chapter Six). The data used for describing and illustrating the geomorphology of the Fitch Site include observations and drawings recorded in the field notes during transect collections and test pit excavations, grab samples of sediments from the transect collections and test pit excavations, reconstruction of the subbottom profiler record of 1991 and review of 8 mm video images made during the course of the 1988 field session. The area around Fitch was obscured on the Sea Grass aerial photos. Sedimentary descriptions from induction dredge test pits are given in Table 7.03. Species identification of faunal bone found at the Fitch site were done by personnel at the Florida Museum of Natural History and the data are presented in Table 7.04.

Systematic hand-fanned transect collections were deployed at the Fitch Site and several grab samples of sediments were taken, including collections of three successive stratigraphic samples in Test Pit 3. These samples represent collections from nylon net filter bags attached to the dredge exhaust underwater and thus represent a collection of sediments greater than six millimeters (.25 inch).

Figures 7.22 and 7.23 can be used to understand the layout of the Fitch Site, and to refer to the photographic images of the subbottom profile tracklines (Figures 7.24 through 7.26). Figure 7.22 is a larger scale image showing portions of Lines 3, 4, 5, and 6 of the subbottom profiler tracklines which crossed over areas near both Fitch Site and J&J Hunt. It can be seen from this illustration that Fitch lies south and west of the J&J Hunt site and the paleoAucilla paleodrainage system, within the paleodrainageway of the Pinhook described above.

Figure 7.23 shows an enlargement of the Fitch Site, with the inset detailing the area blocked out in Figure 7.22 to illustrate the configurations of the site with regard to the 1991 subbottom profiler tracklines. The subbottom profiler record for this segment of Line 5, from point 5.02 to point 5.06, is shown in Figures 7.24 through 7.26. The larger portion of Figure 7.23 illustrates the two collection transects made at Fitch in 1989, and as they relate to the five meter (17 foot) contour and the to the Line 5 subbottom profiler record.

Review of the subbottom profile tracklines taken over Fitch (Figures 7.24 through 7.26) confirm depressions with shallow sediment fill, along with karst anomalies and possible outcrop rises or hills. In particular, between waypoint 5.02 to waypoint 5.04, a depression is described, with point source returns (karst), and within which the Fitch Site lays. This depression is confirmed by the approximate five meter (17 foot) bathymetric contour and may represent the paleoPinhook drainageway. No distinct channel feature was identified in this system, either by the subbottom profile record or by divers. Southeast of the sampling area more possible outcrops can be seen on the subbottom profiler images in Figure 7.26 between waypoints 5.04 and 5.06.

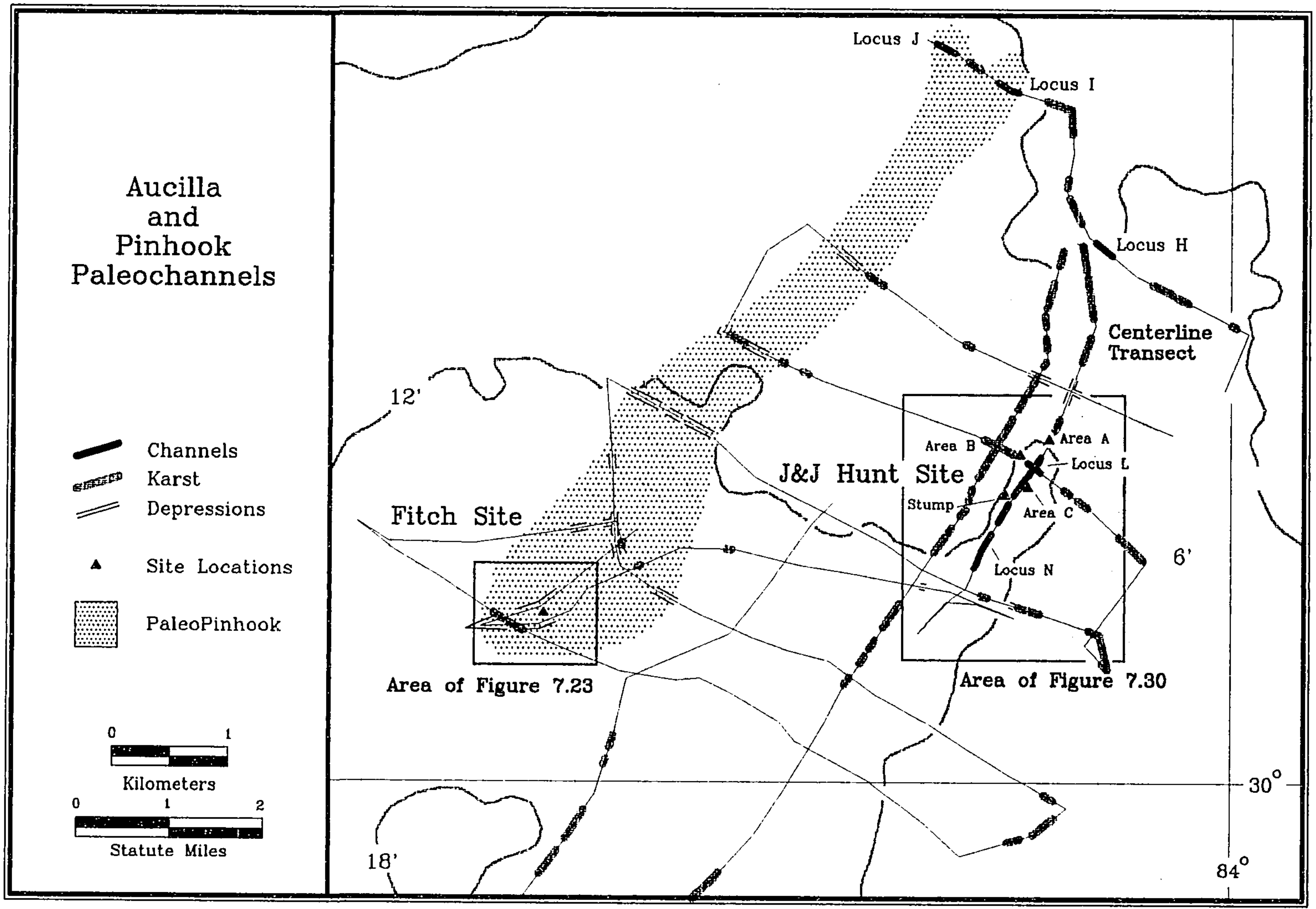

Figure 7.22 Detail of the areas surrounding the Fitch and J&J Hunt Sites

Diver observations at the site revealed areas of exposed bedrock with relief of 30 centimeters to one meter (one to three feet) interspersed with deserts of biogenic sandy shell hash at scales of 10 to 20 linear meters or more (Figure 7.23). Some of the higher outcrops were chert. Artifacts and pieces of chert were found spread over the surface of a large area, both on and off the bedrock exposures. The main natural rock clasts were chert and subangular to rounded pieces of limestone.

No "popcorn" limestone fragments were observed, as at Econfina Channel, and no surface expressions of dolomite clasts as at Econfina and J&J Hunt. No sea grass was observed within a 200 meter radius of the main site datum, neither could any specific area could be called a channel at Fitch. It may be that the entire topographically low area of exposed bedrock, interspersed with shell hash, may represent a large drainageway feature on large scale and that fresh water, but possibly shallow, channel sediments underlay the shell hash sediments, locally.

Two collection transects were setup, and 32 hand-fanned collection units of 50 by 50 centimeter (.25 m^2) size were sampled to depths of 20 centimeters if possible (Figure 7.23). Three induction dredge Test Pits were dug near the main datum (Test Pits 1, 2 and 3 on Figure 7.23). Test Pit 1 lay immediately north of a major outcropping where the Locus 1 datum was set up. This exposure exhibited pieces of chert in a jumbled mass (Figure 7.27). The stratigraphies of the other two induction

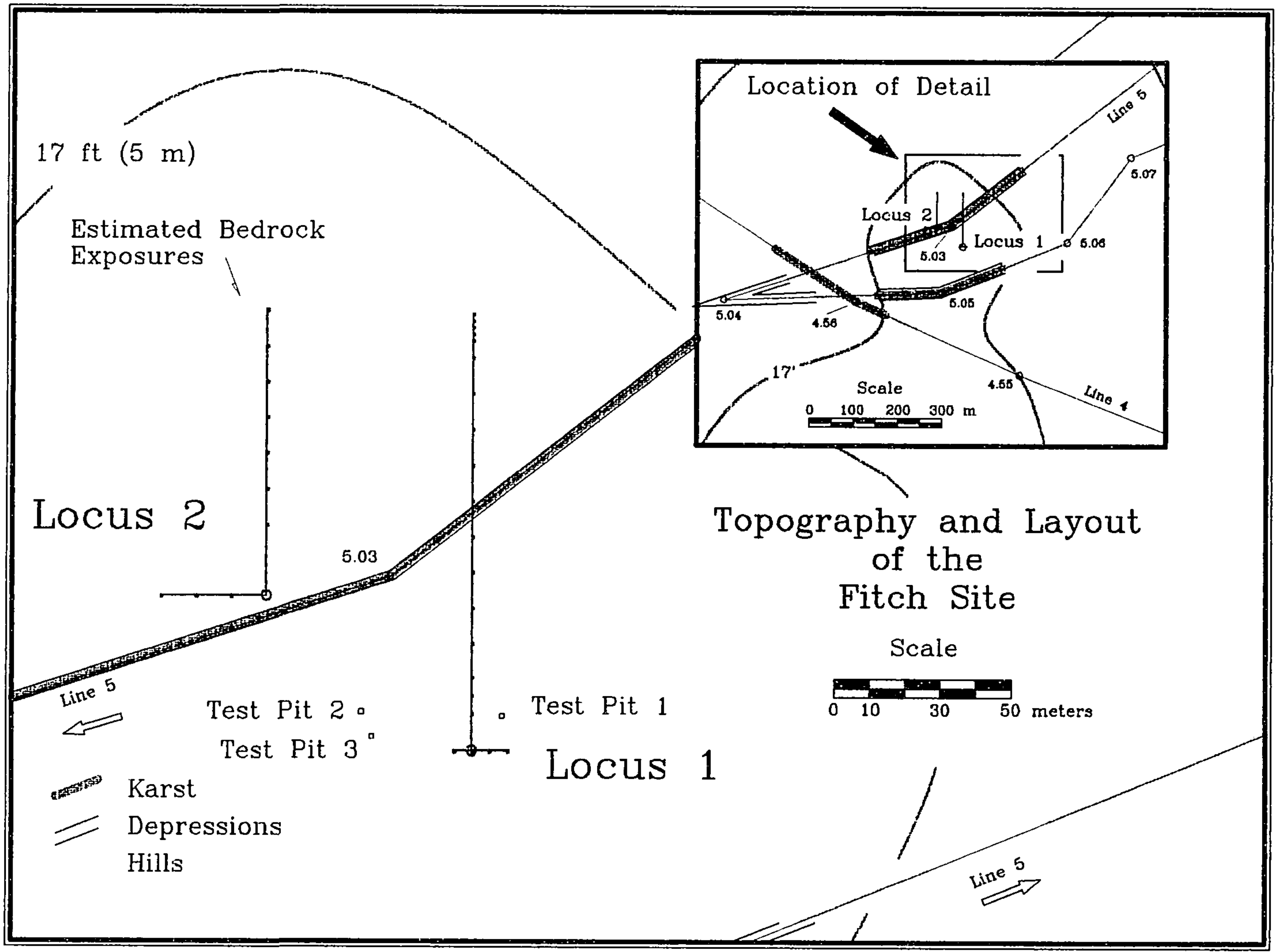

Figure 7.23 Topography and layout of the Fitch Site

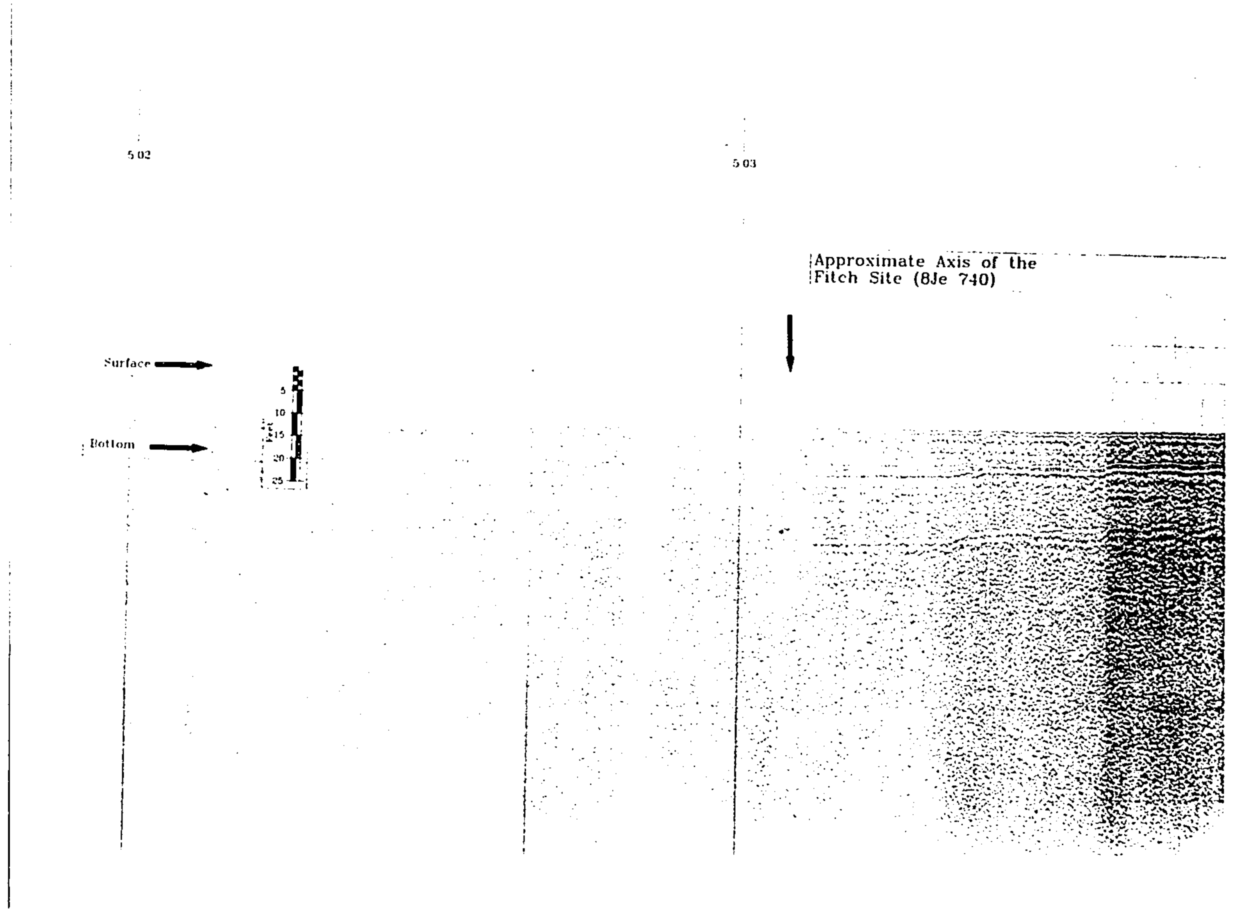

Figure 7.24 Fitch Site, depression and karst, northeast (left) to southwest (right), waypoints 5.02 through 5.03

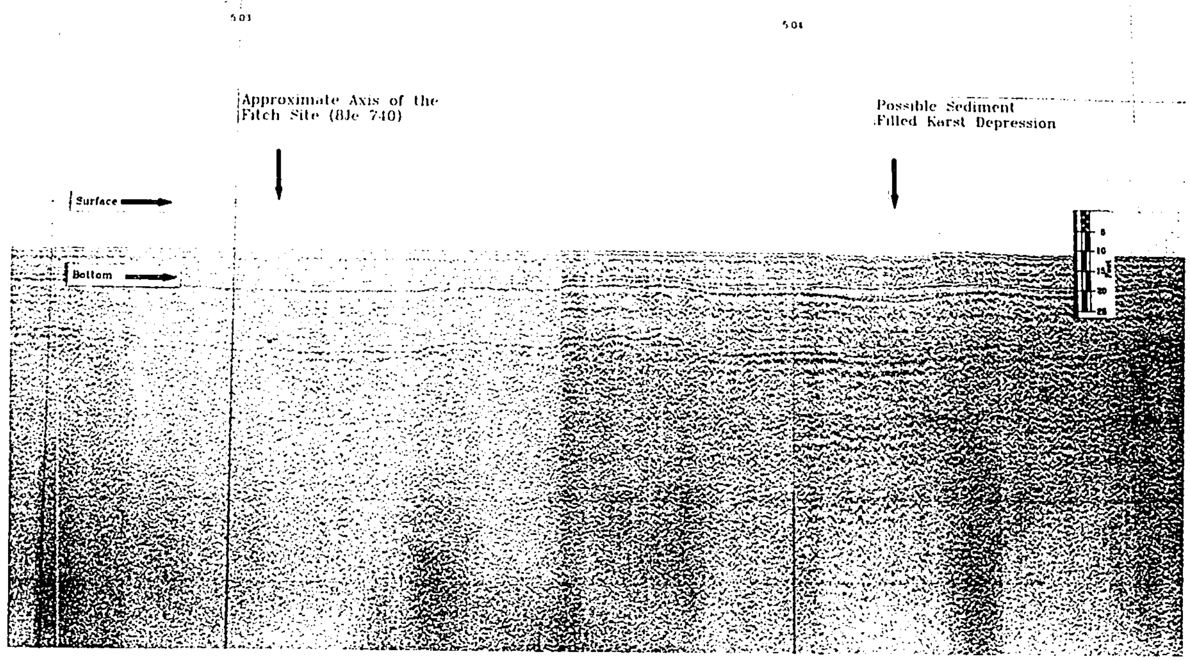

Figure 7.25 Fitch Site, depression, from northeast (left) to southwest (right), waypoints 5.03 through 5.04

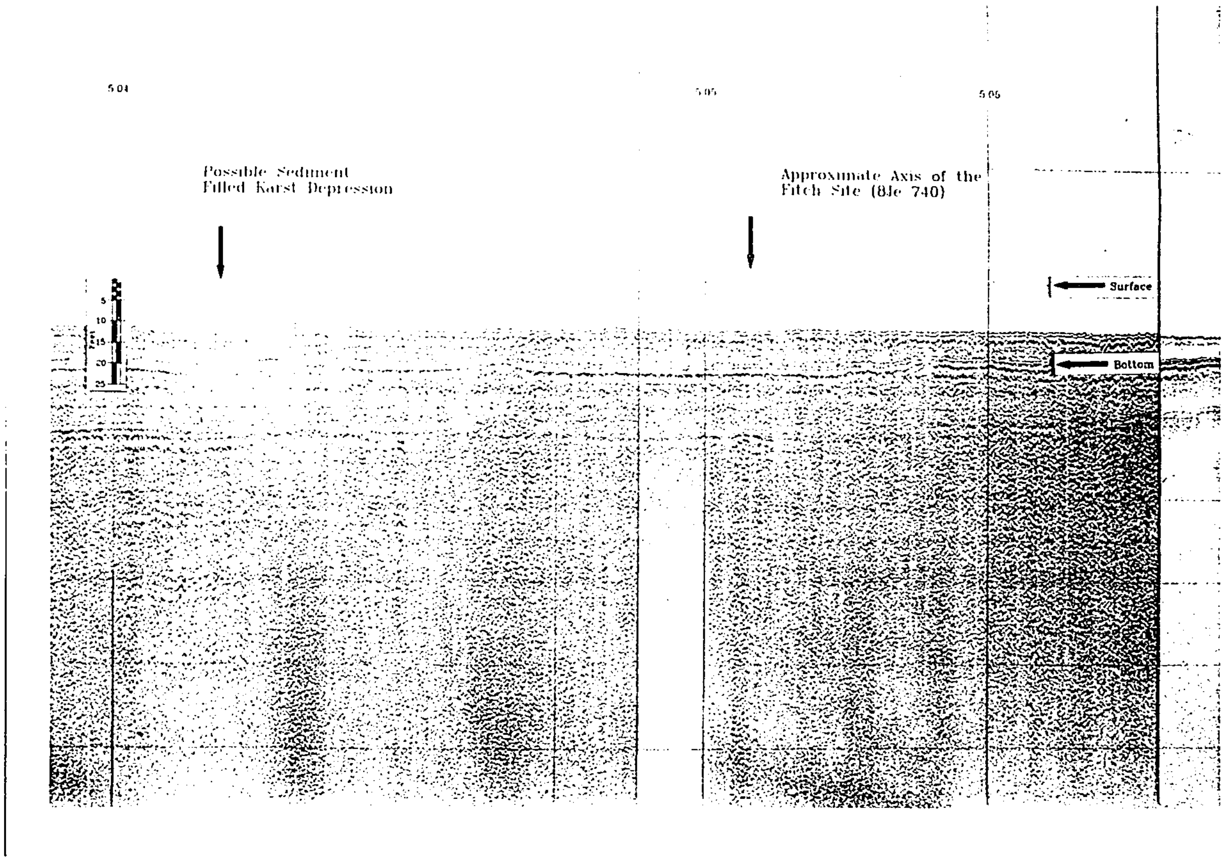

Figure 7.26 Fitch Site, depression and possible outcrops, from west (left) to east (right), waypoints 5.04 through 5.06

dredge test pits (TP 2 and 3) were located west of this rock outcrop and exhibited deeper and more diverse deposits which can be divided into five stratigraphic units shown in Figure 7.27 and described in Table 7.03. Some of these units are distinct from other unit designations at Econfina or the J&J Hunt site, and thus are referred to as "Fitch Stratigraphic Units" to avoid confusion. A list of the faunal elements discovered during the excavations and surface collections and their proveniences is listed in Table 7.04.

The majority of chert artifacts and chert items gathered during the transect collections were located in the sandy marine shell deposits of Fitch stratigraphic Unit 1 in situations virtually identical to Econfina Channel and J&J Hunt Site (to be described). These items may have moved onto and slightly into the more consolidated sediments of Fitch stratigraphic Unit 2, as seen in Test Pit 3, subsequent to the formation of Fitch stratigraphic Unit 2, implying movement after the deposition of the mollusca shells of Fitch stratigraphic Unit 3, upon which the chert items lay in Test Pits 2 and 3. Refer to Table 7.03 for nomenclature clarity.

Comparison of samples of the biogenic matrix (shell hash) from Test Pits 1 and 3 were sorted to size [greater than one centimeter (.5 inch) and less than one centimeter (.5 inch)] and then several classes of constituents were weighed for relative frequency. These are shown in Table 7.05. In general, these data are conflicting. In Test Pit 1, associated with a bedrock exposure, items grade from larger to smaller with depth. In

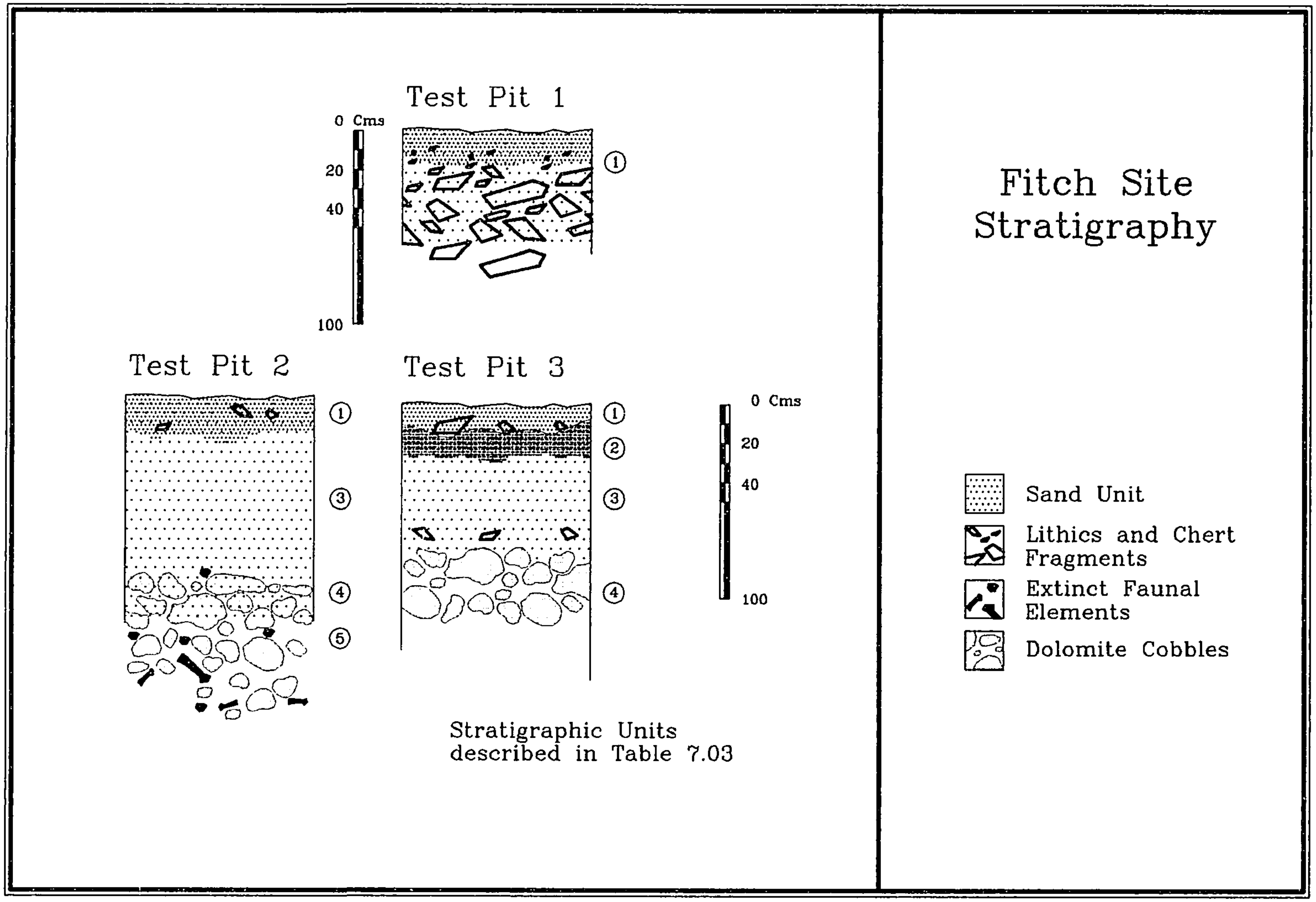

Figure 7.27 Stratigraphy of the Fitch Site

Table 7.03 Description of stratigraphic units at the Fitch Site

Stratigraphic Units Fitch Site (8 Je 739)
Fitch stratigraphic Unit 1 The uppermost sediment was a loose medium sand between 10-20 cms deep. On and in this unit lay the majority of the chert artifacts collected. The matrix consisted of sand and shell fragments with occasional whole individuals observed. Bedrock could be encountered immediately below this unit locally. It has high potential for seasonal or occasional (storm surge) migration (Doyle and Feldhausen, 1981).
Fitch stratigraphic Unit 2 Just under the loose sandy matrix of stratigraphic unit 1 was a darker (grey) compacted silty/sand unit of finer matrix with few shell fragments visible and significantly rarer numbers of chert items. The Unit 2 matrix was firm, implying that removal would take significant energy. Cherts within and below this unit are unstained. The hiatus between Units 1 and 2 was distinct and unconformable. Larger chert items were found in abundance with depth in TP 1 just north of the Locus 1 datum (Figure 7.23 and 7.27), possibly equivalent with this stratigraphic unit.
Fitch stratigraphic Unit 3 Below Unit 2 was a coarse textured mix of fragments of diverse species mollusca. Observed in between the bedrock exposures of Loci 1 and 2, this unit extended variously between 60 to 80 cm below stratigraphic Unit 2 and exhibited a massive structure. However, variation of the constituents with depth implies that there is some stratification within (Figure 7.28). The contact between stratigraphic Units 2 and 3 was distinct, although conformable. Analysis of samples of the matrix from Unit 3 reveals that small fragments of wood, faunal elements other than mollusca (often turtles), and chert fragments are more frequent with depth (Figure 7.28). In contrast, branching coral fragments are most frequent in the upper 2 levels. Larger pieces of wood, with various diameters between 3 to 7 cm, were found in the lower levels of this Unit in TP 3. Only 2 of many small chert fragments found with depth in unit 3 exhibited bulbs of percussion. The remainder was small trapezoidal chunks of chert.
Fitch stratigraphic Unit 4 Unit 3 lay directly upon a natural "pavement" of rounded boulders and cobbles of buff colored dolomite. The presence of rounded dolomite underlying either freshwater or marine deposits with either freshwater or terrestrial fauna within or below (i.e. Unit 5) parallels the sequence observed at Econfina Channel Site and J&J Hunt. The source of these stones is enigmatic. Multiple working hypotheses include degraded Eocene or Miocene Dolomite washed in or a diagenetic formation of the deposits as the result of chemical reactions during the inundation sequence.
Fitch stratigraphic Unit 5 Below the dolomite in Test Pit 2 was a "brighter" or lighter grey stratum of consolidated silty/clayey calcitic material with occasional trapezoidal chert chunks and disarticulated skeletal elements of extinct terrestrial fauna such as horse (*Equus* sp.) camel (*Paleolama* sp.), and sloth (*Eremotherium* sp.) (Table 7.04). In TP 2 this zone was friable and produced the majority of extinct fossils found, whereas in TP 3 the zone was more dense and difficult to remove.

Table 7.04 Faunal elements identified from excavations at the Fitch Site

Species	Element	N	Provenience	Comments
		Extinct Terrestrial Fauna		
Eremotherium (Extinct Sloth)	claw	1	Test Pit 2	
Eremotherium (Extinct Sloth)	tooth fragments	4	Test Pit 2	lower levels
?*Eremotherium* (Extinct Sloth)	skull fragments	3	Test Pit 2	lower levels
Sirenia? Dugongidae	rib fragment	1	Test Pit 2	lower levels
Equus	deciduous premolar fragments	31	Test Pit 2	lower levels
Paleolama mirifica	teeth rm1-m2 lm1-m2	2	Test Pit 2	(FS 38 "above the white rocks")
Mysticeti	auditory bulla fragment	1	Test Pit 2	(FS 38 "above the white rocks")
Procyonid? (Raccoon)	bone fragment	1	Test Pit 2	
		Aquatic Faunal Species		
Geochelone (Giant Tortoise)	scutes	7	Test Pit 2	
Geochelone (Giant Tortoise)	scute fragments	2		
Terrapene (Box Turtle)	neural scute	1	Test Pit 2	
Terrapene	nuchal scute	1	Test Pit 2	
Terrapene	peripheral scutes	3		
Terrapene	neural scute	1		
Terrapene	plastron fragment	1		
Terrapene	shell fragment	1	Test Pit 2	
Terrapene	peripherals plastron	5	Test Pit 2	
Kinosternidae (Mud Turtle)	2 peripherals, 1 costal	3	Test Pit 2	

Species	Element	N	Provenience	Comments
Tortoise	scutes	5	Test Pit 2	
Tortoise	scutes	15		
Chelydra (Marine Turtle)	peripheral scute	3		
Chelydridae (Marine Turtle)	peripheral	1	Test Pit 2	
Osteicthyes	Right articular	1	Test Pit 2	
Cheloniidae	scute	1	Test Pit 2	
Testudinides	femur (proximal half)	1	Test Pit 2	FS 38 ("above the white rock")
Testudinides	scute fragments	48	Test Pit 2	
Testudinides	limb bones	2	Test Pit 2	
Testudinides	Shell fragments	27	Test Pit 2	
Alligator	tooth	1	Test Pit 2	lower levels
Alligator	scute	1	Test Pit 2	lower levels
Trachemys	coastal shell frags	2	Test Pit 2	
Marine Faunal Species				
Carcharodon (extinct Great White Shark)	Tooth	1	Test Pit 2	Above the white rocks
Carchariunus sp. (Bull Shark)	Tooth	1	Test Pit 2	
Amia calva (Bow Fish-fresh water)	jaw	1	Test Pit 2	
Diodon (Parrot Fish)	mouth plate	2	Test Pit 2	

Test Pit 3, farther away from any bedrock exposures, it was the opposite - smaller clasts graded to larger sized ones with depth. Test Pits 1 and 3 both reveal relatively stable and similar frequencies of limestone pebbles throughout, but coral fragments increase with depth in Test Pit 1, and decrease with depth in Test Pit 3.

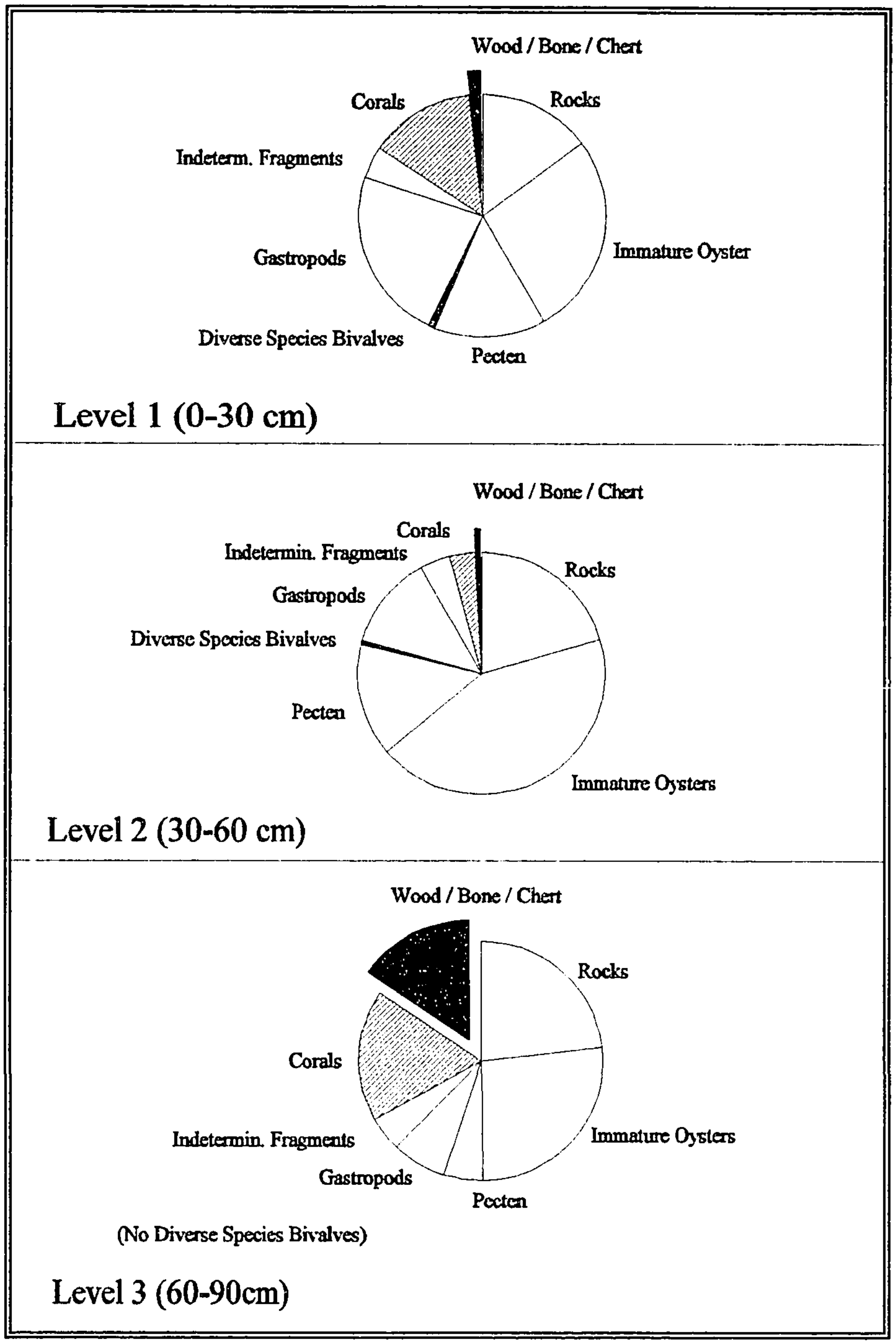

Figure 7.28 Species diversity and clast types from Test Pit 3, Fitch Site

Table 7.05 Particle size distributions and point counts for sediments from Test Pit 1, Fitch Site

Category	Level 1	Level 2	Level 3	Below Dolomite
Percent of particles greater than 1/2"	TP 1 64 % TP 3 31 %	TP 1 38 % TP 3 53 %	TP 1 32 % TP 3 53 %	NA TP 3 43 %
Frequency of limestone pebbles (%)	TP 1 12 % TP 3 16 %	TP 1 13 % TP 3 17 %	TP 1 11 % TP 3 20 %	NA TP 3 76 %
Frequency of coral fragments	TP 1 21 % TP 3 13 %	TP 1 45 % TP 3 16 %	TP 1 43 % TP 3 5 %	NA TP 3 3 %

The varieties of mollusc species and particle types in the sediments of Fitch stratigraphic Unit 3 in Test Pit 3 were more diverse than in any sediments observed at either Econfina Channel or J&J Hunt. Constituents of this shell hash included whole and fragmentary portions of various bivalve and gastropod species, branching coral (either *Hydrocoralline* sp. or *Astrocoenia* sp.), rounded and subrounded limestone pebbles and pea gravel, chert, faunal bone, and fragments of wood. Distributions of these items through the sediment column are shown in Figure 7.28. Higher frequencies of chert and bone were found in the lower levels of Test Pit 3, *Crassostrea* sp. was most frequent in Level 2 just above, but all oysters in all levels were immature individuals of two millimeter or smaller size. Branching coral fragments were more abundant in the upper levels.

Combined, the graded nature of the constituents of the sediment column of stratigraphic Unit 3 in Test Pit 3 are reflective of an inundation sequence. This sediment accumulated in a coarser or rockier, possibly more energetic marine environment than observed or implied at either Econfina Channel or J&J Hunt Site. How the wood and faunal fragments have been incorporated into the sediments, or what species the wood remains reflect, or their ^{14}C chronology remain questions for future research.

The presence of dolomite below marine sediments in Test Pits 2 and 3 at the Fitch Site parallels findings at Econfina (discussed above) and J&J Hunt (to be discussed below). Fitch stratigraphic Unit 5, observed in Test Pit 2 below the dolomite and from which extinct terrestrial fossils were pulled (Table 7.04; Figure 7.27), is the only exposure of sediments seen below the dolomite during the entire course of this research (Fitch stratigraphic Unit 4) . This lower stratigraphic unit (5) is inferred as a possible fresh water sediment containing elements of extinct fauna. The age of the unit is unknown.

The extinct terrestrial species found in this exposure, and shown in Table 7.04, cannot resolve this problem because the species involved have long Pleistocene histories. Furthermore, the possibility that these items were reworked into Holocene sediments cannot be addressed with the limited data on hand. A sample of fossil sloth claw was submitted for radiocarbon dating, but it was determined to be contaminated by chemicals which were used to prepare a cast of the fossil at the Florida Museum of Natural History

Condition of the Chipped Stone Artifacts at Fitch

As will be detailed in Chapter Eight below, the N=477 lithic items found at the Fitch Site were large on average, 118.6 grams, and diverse in size, exhibiting a standard deviation of almost 400 grams. The linear distribution of artifacts from the collections at Locus 1, and shown in Figure 7.29, indicates that items decrease in size with distance north from the main datum. This is roughly paralleled in the Locus 2 collections, when compared from the same general latitude. This apparent northward momentum of items moving from bedrock/lithic sources on to marine sediments could represent a singular, significant storm occurred at some time in the past, resulting in the movement of items in this pattern.

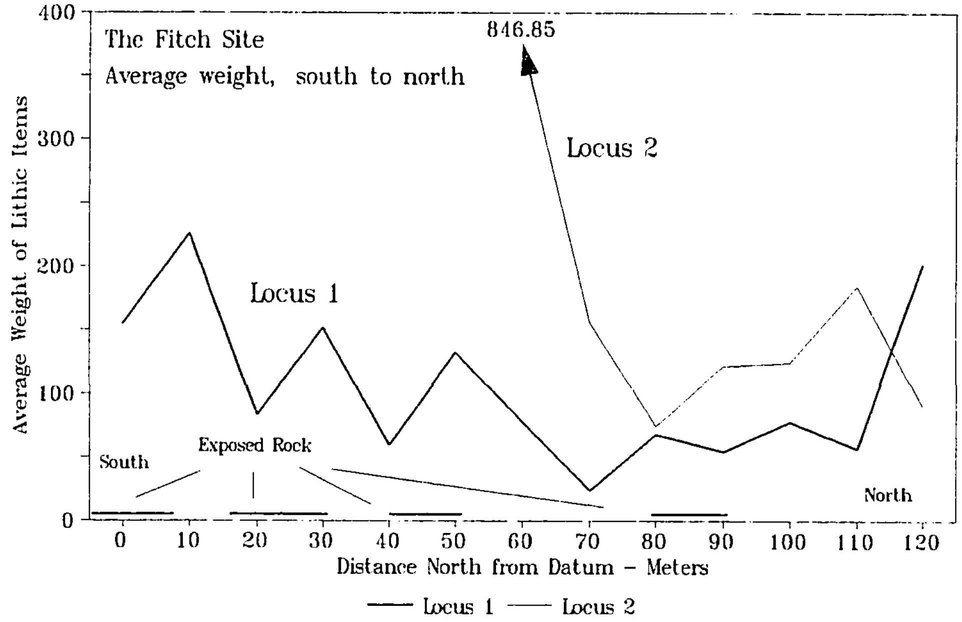

Figure 7.29 Artifact weight distribution with distance from datum at Fitch

While the chert items collected at the Fitch Site were slightly corroded and often covered with marine growth, they were not physically abraded by tumbling. The items were less degraded than those observed at Econfina Channel, even though the site has probably been inundated for a longer period of time. Therefore, Fitch does not appear to have remained in an area of fresh and salt water mixing as corrosive as at the Econfina Channel Site.

Most of the chert items exhibited barnacle and/or immature oyster growth which indicates some amount time for exposure to the open salt water environment. In contrast, chert found with depth in the sediment column was only slightly degraded, gray in color, and without sea growths. Most of the chert items collected from the Fitch Site were covered with a black and brown organic patina, some exhibited edge corrosion, a few (less than 1%) were pristine edged black, and likewise a few (less than 4%) were without patina (gray colored chert). No items were white and porous as at Econfina. The unstained examples, mostly small artifacts and trapezoidal pieces of chert, came from the lowest levels of stratigraphic Unit 3 in Test Pits 1 and 3.

A few of the chert items were broken and cut in order to view the original chert colors, the quality of the chert, and the degree of degradation. The chert observed so far is a medium grained material whose colors included pink and white, both with speckle inclusions. Thin section microscopy also revealed that the brown coloration is the result of a build up of organic materials on the exposed surface of the chert.

Geomorphology of the J&J Hunt Site (8 Je 740)

The J&J Hunt site was discovered in 1989, and revisited in 1991 and 1992. The data used to reconstruct the geomorphology of J&J Hunt include bathymetric data and subbottom profiler transects, numerous systematic transect collections, vibra-core stratigraphy, induction dredge excavations, field notes, drawings and video coverage. All aerial photographic coverage of the study area around J&J Hunt was obscured in the 1984 Sea Grass aerial photos and the 1992 field session fly over described above.

Figure 7.22 shows the location of the J&J Hunt Site at the head of the paleoAucilla, and its relation to the Fitch Site, the paleoPinhook and the 1991 subbottom profile tracklines and the outline of Figure 7.30 is also shown. Figure 7.30 shows an enlargement of the discontinuous segment of the paleochannel of the Aucilla with the subbottom profile lines and the location of the paleochannel, karst and sinkhole crossings. Specific study areas to be discussed are called out in Figure 7.30 (e.g. Areas A, B, and C and the Stump). Figure 7.31 is a 3-D mesh estimate of the configuration of the channel segment built from bathymetric and subbottom profile data. Figure 7.32 zooms in on the head of the channel segment to show the detailed locations and nomenclature for collection transects, the vibra-core locations and induction dredge excavations in relationship to the subbottom profiler tracklines.

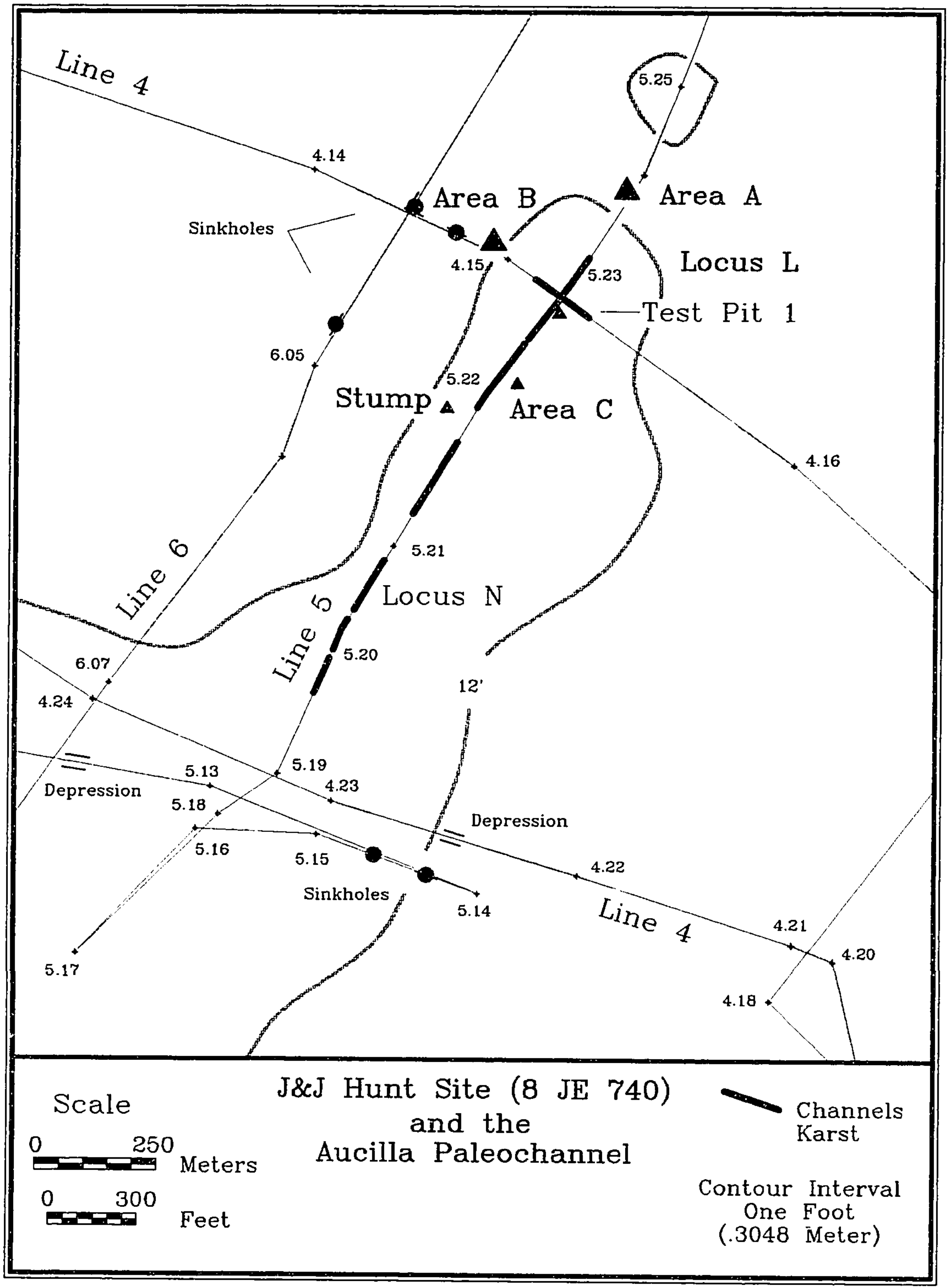

Figure 7.30 The J&J Hunt Site and the PaleoAucilla Channel

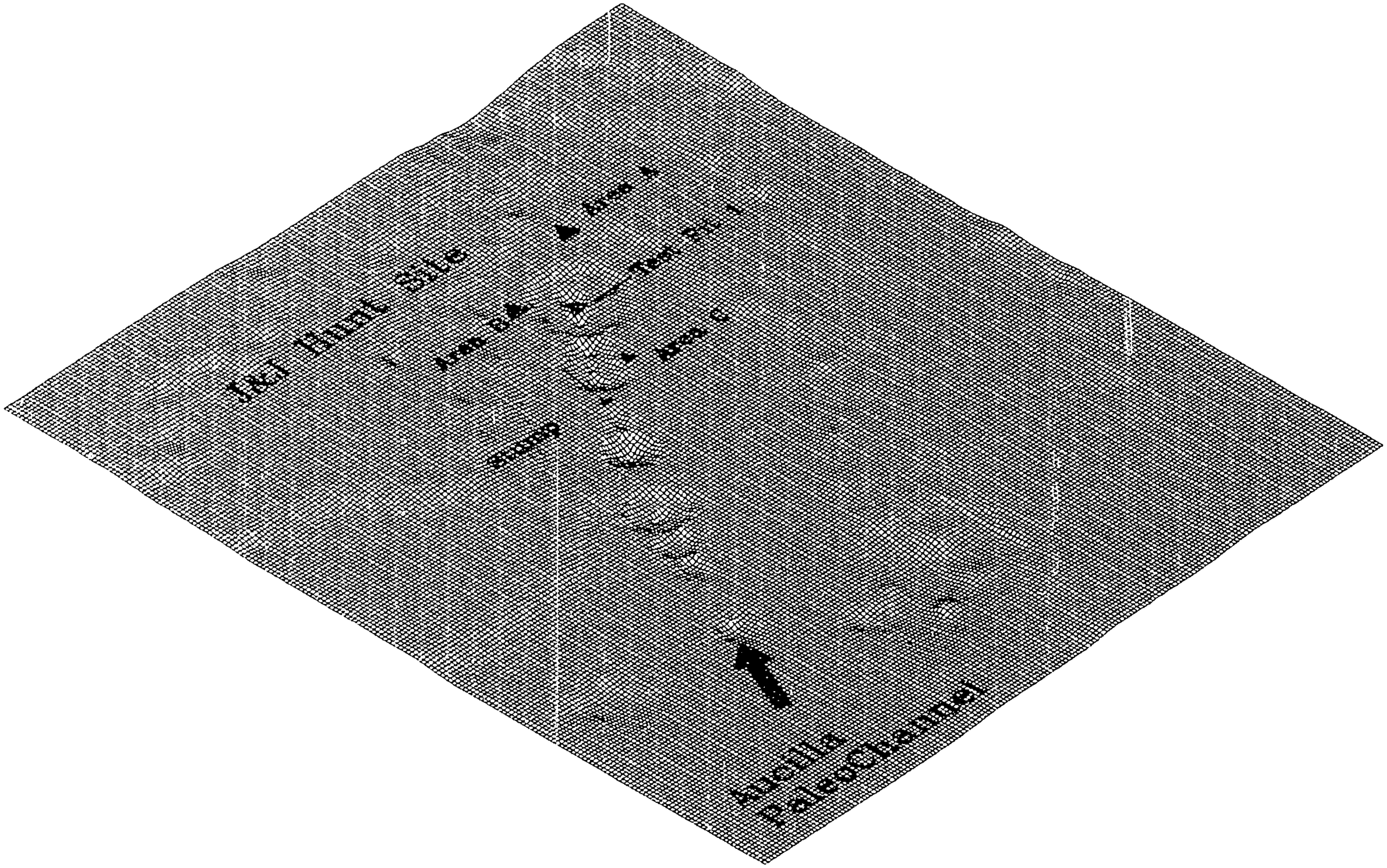

Figure 7.31 Mesh reconstruction of the paleoAucilla channel

The data collection strategies employed at J&J Hunt were more robust and systematic than previously attempted at either Fitch or Econfina Channel. In particular, diver controlled transect collection protocols were modified for maximum data gathering potential. To wit, systematic 50 x 50 centimeter (.25 m^2) sediment collection units were searched for artifacts and other items by hand-fanning. At the completion of the exposure, two liters of sediment were gathered, if possible. A study of particle size distributions of these samples was undertaken to characterize the surface sediment arrays, and the results are presented by pie diagrams (Figure 7.33).

Eight vibra cores were attempted and seven extracted from the channel, searching for deep sediment profiles and the stratigraphic column. The locations of these cores are plotted on the map of the head of the discontinuous segment illustrated in Figure 7.32, they are drawn in Figure 7.34 and described in Tables 7.06 and 7.07. Given the enhanced understanding of the subbottom record after computer mapping, an attempt was made to compare these core locations to the subbottom profile record, and this is illustrated in Figures 7.35. A profile reconstruction of L_1 based on the core data is shown in Figure 7.36. Two induction dredge Test Pits were dug: at the Stump and at Test Pit 1 (Locus L_1) (Figures 7.36 and 7.37). Pollen analysis (Table 7.10), radiocarbon analysis (Tables 7.11, 7.12, 7.18), , foraminifera analysis and thin section microscopy have been applied to sediments and items from these exposures.

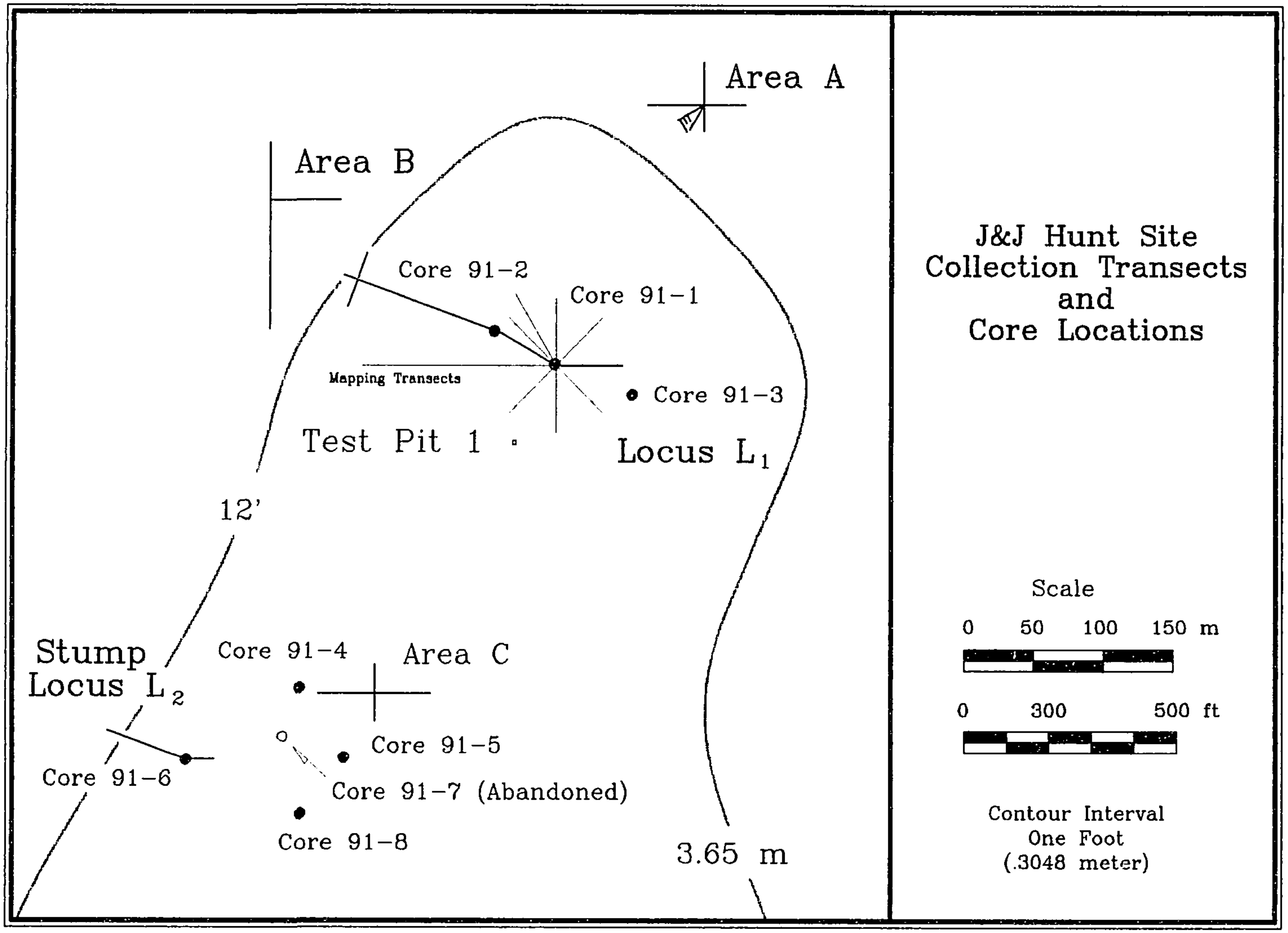

Figure 7.32 Detail of the J&J Hunt Site showing sample locations

The bathymetric and subbottom profiler data mesh reconstruction of the general area shown in Figure 7.31 reveals a depressed area of relict channel bottom surrounded by margins with approximately one meter (3 feet) relief. The vertical scale of this mesh image is exaggerated at 50 x to bring out this slight change. The outline of the 13 feet contour can be used to envision the possible channel configuration as inundation progressed, and possibly around 6,800 rcybp as discussed in Chapter Nine with regard to the chronology of sea level rise for this portion of the Apalachee Bay.

Diver controlled sampling transect collections detailed in Figure 7.32 included the crossing from Locus L_1 to Area B, several transects at Area A, a crossing pattern at Area C[4], and a transect across the area of the Stump at Locus L_2,. Artifacts were found at all four of these locations. Another discovery of artifacts was made at the southern end of this paleoAucilla discontinuous segment, but it has been included with discoveries known as "encounters" detailed in Chapter Eight. Artifacts were found in the highest concentrations in Areas A and B located around the rim of the sinkhole feature at the head of the segment (Locus L_1) at one and eleven o'clock respectively.

These two artifact bearing areas coincide with outcropping limestone bedrock interspersed with sediment filled karst voids on small (1 to 2 meter) scale and larger

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[4] These collections were made from what was thought in the field in 1991 to be Locus N, but subsequent plotting of several Loran-C readings from this collection reveal that it was more likely taken from areas east and somewhat north of Locus L_2. This discrepancy has been resolved by calling the transect "Area C" in keeping with a standard way of dealing with collections made around a paleochannel segment. Field notes retain the "N" nomenclature.

particle size surface sediment signatures to be discussed below. Bedrock relief is low at this site, between 30 and 60 centimeters (one and two feet) and no chert outcrops have been identified locally.

A total of 14 sediment samples were taken from the long transect west of L_1 at 20 meter intervals (two samples were noted as on bedrock). Five locations were sampled from the transect collections near the Stump at Locus L_2 (at the location of Core 91-6) and four additional samples of approximate 10 centimeter stratigraphic intervals were taken from sediments immediately near the Stump. Nine sediment samples were gathered from transects west and east of Area C.

The purpose of the particle size study was to identify variation of particle size frequency which reflect the changing surface characteristics of the area. The samples were run through 13, 6, 3, 2, and one millimeter screen sizes. The remaining sediments were agitated and allowed to settle, allowing the clay (mostly organic material) particles to settle out last. Upon drying, the clay sized material was easily separated from the sand sized fraction. Particle fractions were then weighed and recorded in a computer spreadsheet program. A total of 35 samples have been processed by these techniques. The results of this study are presented in the form of pie diagrams plotted at their place of collection on the map base (Figure 7.33).

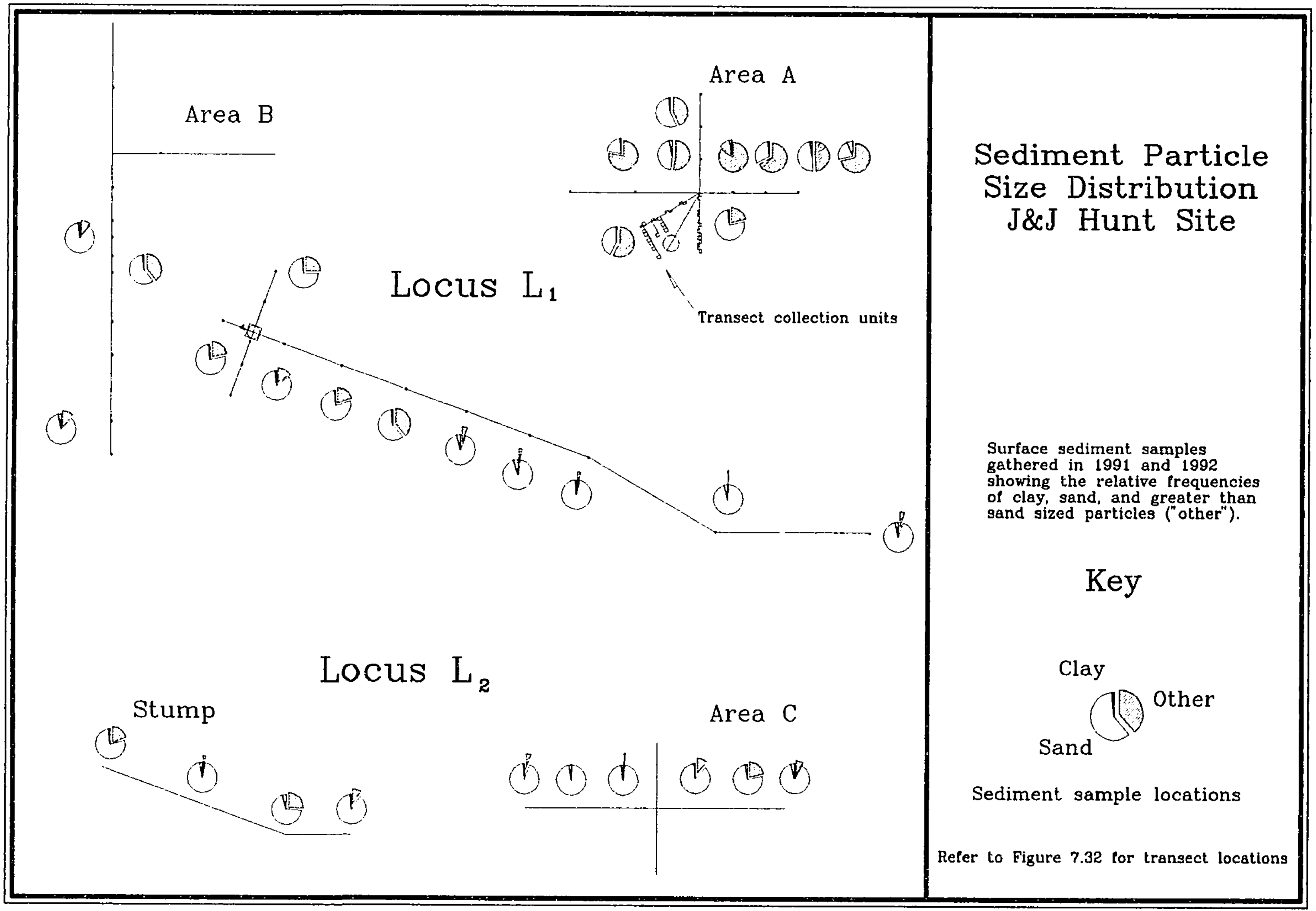

Figure 7.33 Sediment particle size distribution – J&J Hunt Site

The results of this particle size study show graphically that surface sediments are generally fine grained within the paleochannel trough, and increase in size with distance from up on the margins, particularly near the bedrock exposures at Areas A and B. The finest sediments include samples taken from L_1 and Area C, while the coarsest include the collections from Area A.

Data was gathered regarding the constituents of the coarse fractions of these samples to characterize sediment diversity and distributions, to summarize the condition of the quartz particles present, but the analysis and illustration of this data was delayed. In general, the coarse fraction was dominated by marine shell, with rounded and subangular fragments of limestone and rounded clasts of dolomite, chert artifacts and faunal bone locally. Faunal bone fragments were only located in association with the artifacts, they did not occur outside of artifact bearing sample units. The marine shell was mostly *Pecten* sp. with smaller percentages of *Crassostrea* sp.

Condition of the Chipped Stone Artifacts at J&J Hunt

A total of 513 artifacts were gathered from Area A, weighing an average of about 14 grams each ($\sigma = 40$ grams). Collections at Area B resulted in a collection of 165 chipped stone artifacts, averaging a little more than seven grams ($\sigma = 21$ grams). Three types of artifact condition were noted for the artifacts found around this discontinuous segment of the paleoAucilla River: black stained, black and brown stained with edge corrosion, and unstained.

Combined, chert artifacts patinated with black organic growth, but with no edge corrosion, dominated the collections at 59 % from Areas A and B. However, 68 % of the artifacts at Area A were patinated in this way, contrasting only 30% at Area B. A more equable representation was observed in items with black and brown organic patination and with corroded edges, 27 % of the combined artifacts from both Areas (25% at Area A and 32% at Area B). Unpatinated or lightly patinated chert artifacts followed in less abundance in the combined sample, seven percent of the artifacts, but less than one percent of Area A artifacts were clean, while 23 % of the Area B samples lacked patination. In short, the artifacts from Area A were substantially more patinated than the ones from Area B.

A fluted biface or projectile point base was found during collections at Area C (Figures 8.08 a and b), and this artifact was coated with black patina and it exhibited some edge corrosion. The Florida Archaic Stemmed projectile point found near the Stump with hand-fanning in 1992 was unstained (Figures 8.09 a and b).

These conditions can be explained by the spatial distribution of items in the relict topography. This is to say that the black, and black/brown patinated items with edge corrosion, were more abundant at Area A, while unpatinated or lightly patinated items were more prevalent in Area B. Since it is likely that the items at Area A were inundated by fresh water, as the river channel water levels rose in response to sea level rise, then these organic patinas might therefore be fresh water associated. Similar black organic patination is familiar to artifacts known from the Aucilla river inland, and items exhibiting this character represent the Early Archaic time period. Middle Archaic items found underwater in the Aucilla are rarely stained in this way. The Area B chipped stones, positioned on the upland margins of the river channel, would have remained stranded from fresh water inundation and possibly flooded during and after the brackish phase.

Results of Vibra-Coring

With the knowledge of the channel configuration better understood from the subbottom profiler data and transect sampling by divers, the next task of the tripartite research design was to probe the relict channel sediments with vibra-cores. The resulting core pattern at Locus L_1 was three cores abreast, and a criss-cross of cores was made at Locus L_2. The locations of these cores is shown in Figure 7.32, they are illustrated in Figure 7.34. Descriptions are given in Tables 7.06 and 7.07.

The cores were transported to the University of Arizona and put in cold storage at 3.3 degrees Celsius (38 degrees Fahrenheit). Later, they were cut in half with a circular hand saw along the E-W axis, preserving the northern orientation in the curated half, and trimming, describing and sampling in the other half. This half was also photographed with both color slide and color print films and drawn on the backs of the data recording sheets..

Systematic descriptions were made of the sediments in the cores which included the following data: Munsell color, sediment texture, verbal description of the matrix, notation of inclusions, orientation of particles if any, reaction to HCL, and other comments (following Swanson, 1981). This data is presented in Tables 7.06 and 7.07. Data regarding the depth of the core in the water column, length of penetration, length of recovery and compaction of the sediments in the cores are listed in Table 7.08.

Sediment compaction by the coring vibration averaged 41%, as shown in Table 7.08, most of which apparently pertained to the loose upper marine sands. The gray clay was already compacted as was the dolomite (for example Core 91-2). This was borne out in the core that encountered mostly dolomite where the compaction was only 19% and in the excavation of Test Pit 1, Locus L_1 described below where the thickness of the gray clay and position of the dolomite was similar to the cores, but the sand unit was much thicker, without compaction by vibration as in the cores.

In general, the sediments at Locus L_1 exhibited more stratification than those from Locus L_2 which, excepting Core 91-6, exhibited either marine sediments or dolomite or mixtures of the two. One core in the L_2 pattern (91-7) hit bedrock at depths so shallow that the sandy sediments fell out and it was abandoned (Figure 7.32). The topographic mesh in Figure 7.31 shows that this area is not associated with a bathymetrically visible sinkhole and that the channels sediments are correspondingly shallow.

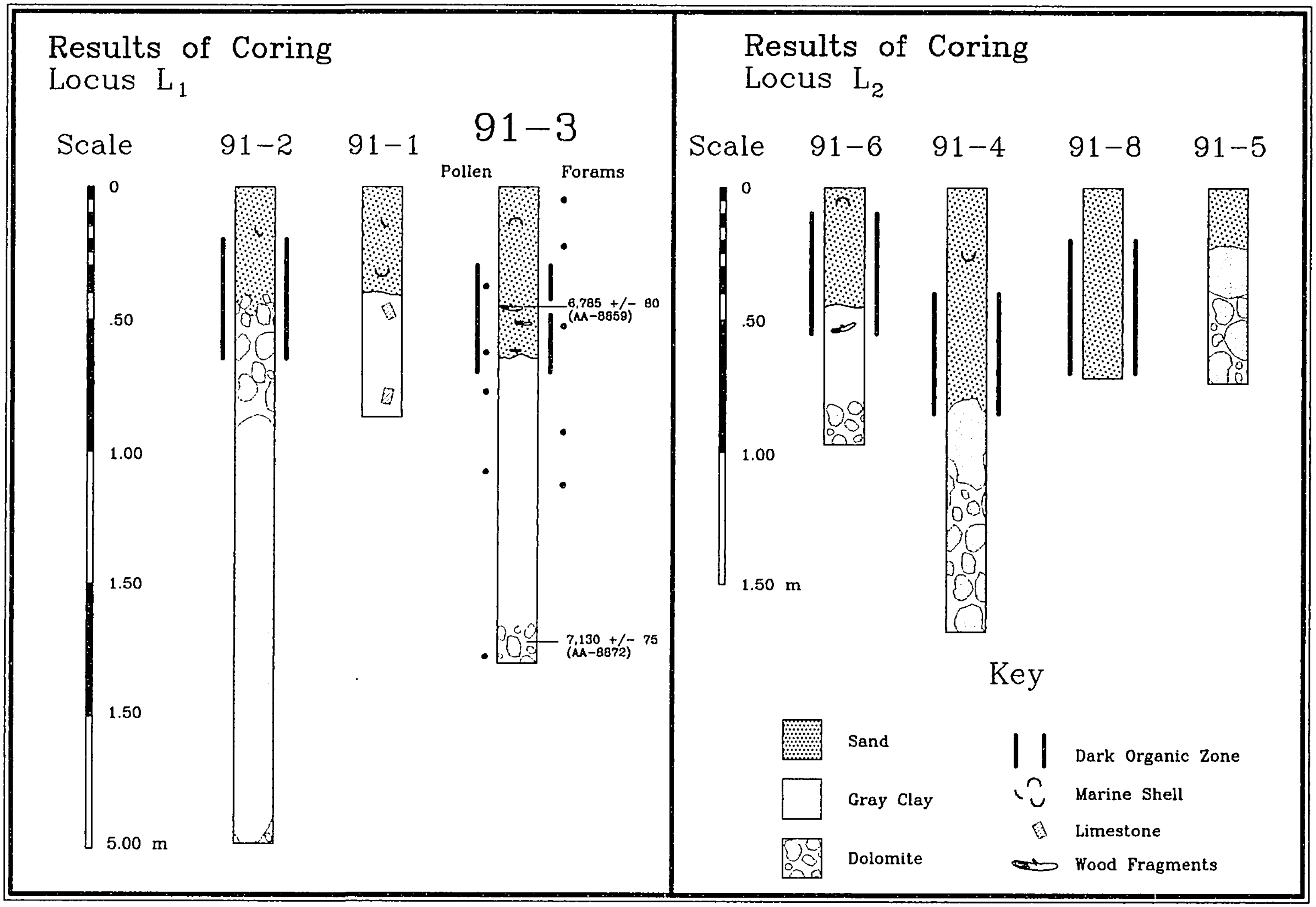

Figure 7.34 Core stratigraphy – J&J Hunt Site

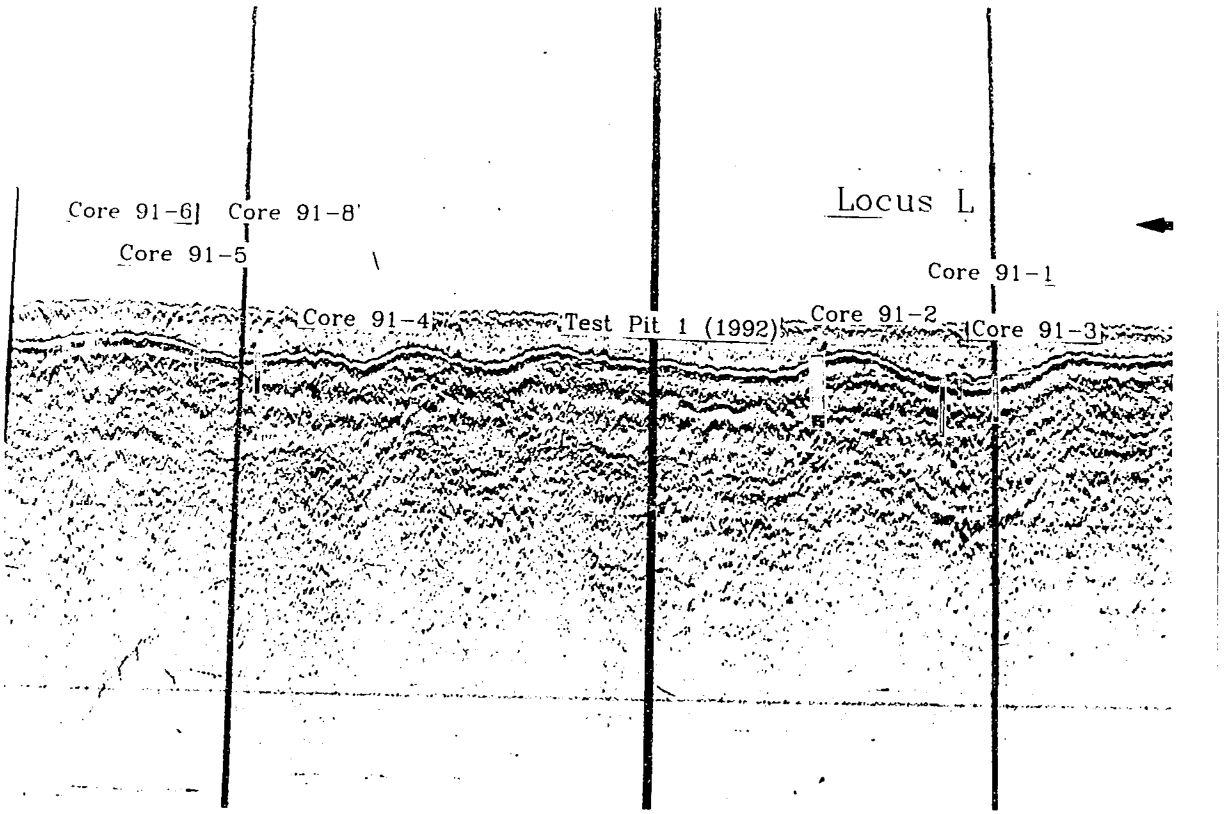

Figure 7.35 Cores overlaid on the profiler record, south (left) to north (right), waypoints 5.22 through 5.33

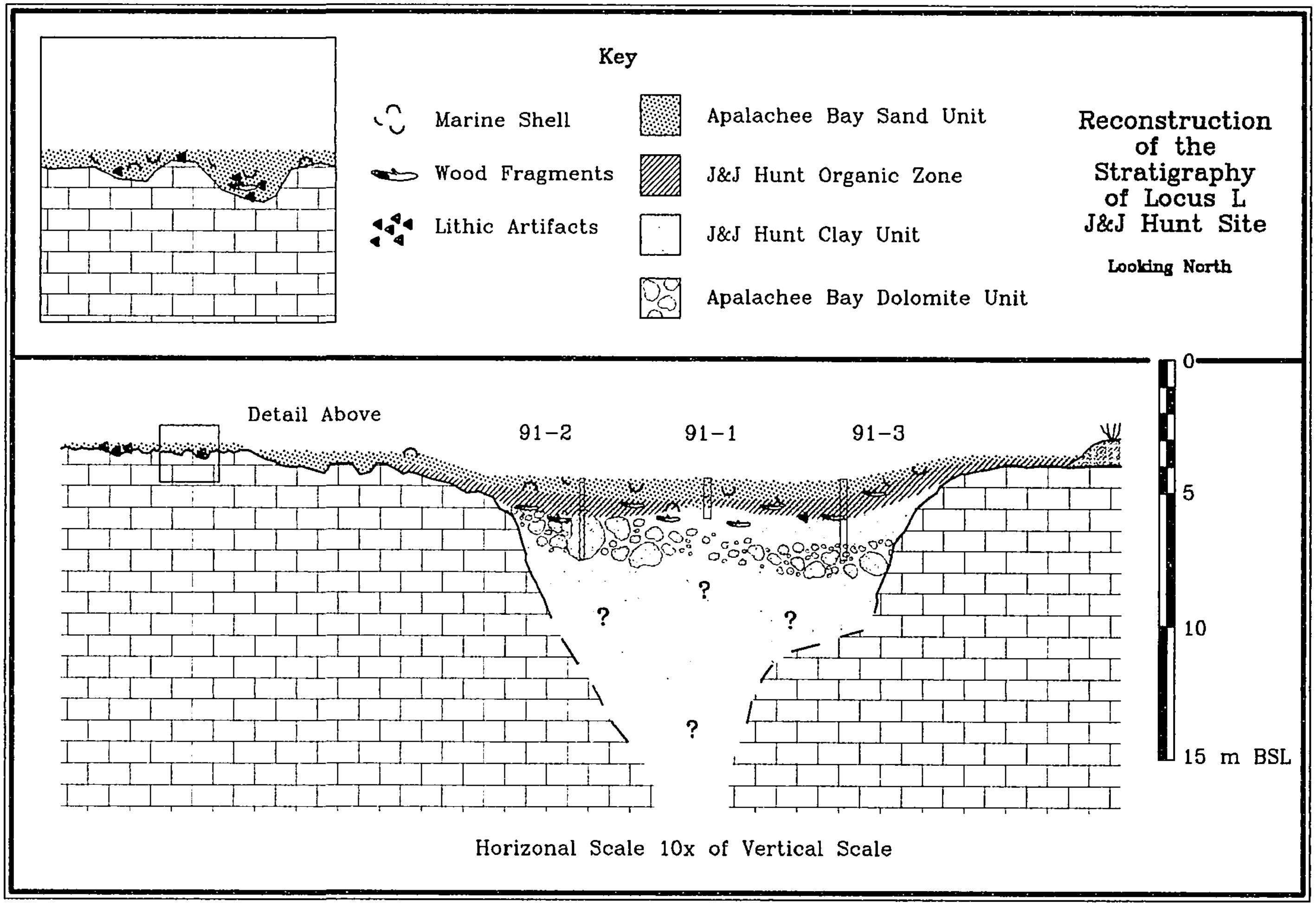

Figure 7.36 Reconstruction of the stratigraphy of Locus L1, J&J Hunt Site

Table 7.06 Stratigraphic descriptions of cores from Locus L_1

Core Descriptions
Locus L_1

Core 91-1 Length = .87 m

Core 91-1 exhibited two major stratigraphic units: an upper unit of brown medium textured quartz sand (2.5 Y 4/2 to 5 Y 4/1) to approx. 40 cm depth, an unconformable contact, and a lower unit of fine-sandy gray clay (2.5 Y 4/0 to 3/0). This clay was identical to samples in Cores 91-1 and 91-6. In the sandy unit a zone of larger broken shell particles and immature individuals was observed between 25 and 35 cm depth. There was evidence for tunneling bioturbation from the upper sand zone into the clay unit. Large pebble sized pieces of angular limestone were observed in the grey clay unit along with a general diffusion of fine plant fragments. The grey clay has 10 - 20% fine sand particles and is very sticky. Sand particles were quartz and angular to subangular in both zones.

Core 91-2 Length = 2.48 m

Core 91-2 was composed of two major stratigraphic units: a brown sand unit to a depth of 45 cm, and then a unit of apparent dolomitic rock in a brownish gray colored clay matrix to 90 cm depth (approximately 2.5 Y 7/2 for the rock, 2.5 Y 5/0 for the clay). Uninterrupted dolomite continued from 90 cm to the bottom of the core - as if the core penetrated a very soft boulder or perhaps bedrock. Smaller cobbles observed at the bottom of the core suggested a boulder instead, and this is the provisional interpretation.

Core 91-3 Length = 1.80 m

The stratigraphic sequence began in Core 91-3 with a unit of medium textured brown sand to a depth of 30 cm. Within this unit a zone of particularly abundant shell extended from 10 cm to 20 cm.

The next stratigraphic division was a substantially darker zone or horizon (2.5 Y 2.5/2) that represented a grading textural transition from sandy matrix above to fine-sand clay below (extending between 30 to 51 cm). This zone represents a horizon of increased organic matter including many fragments of wood, both "fresh" and black colored. Initial interpretations of this color concluded it originated from degraded, rather than burned fragments, but later pollen analysis documented a significantly increased frequency of charcoal fragments, so there may be greater charcoal representation.

The second stratigraphic unit, from 51 cm to 1.50 meter was a grey fine-sand clay identical to that seen in Cores 91-1 and 91-6. Variations in darkness (value) within the clay were noted. The third unit was dolomitic cobbles in a grayish brown clay as seen in Core 91-2. The clay unit and lower dolomitic unit were disturbed by the vibration of the device such that clay from the dolomite unit flared up into the grey clay unit.

This is by far the longest core with a full record for stratigraphic studies. Core 91-3 was dissected in 5 cm increments for pollen, foraminifera, ostracodes, particle size analysis, and shell species identification. These are reported in the text.

Table 7.07 Stratigraphic descriptions of cores from Locus L_2

Core Descriptions Locus L_2	
Core 91-4	Length = 1.68 m
Core 91-4 was composed of 2 major stratigraphic units, the brown sandy zone to a depth of 80 cm, and a dolomitic and brown grey clay zone underneath it to the bottom. The sand zone increases in shell content between 30 and 60 cm. Likewise darker colors predominate from 45 to approximately 53 cm in the sand zone. Clay content increases about this depth with dolomitic rock beginning at 80 cm. The clay matrix around dolomite rocks was rich in plant particles and immature shell individuals and appeared more mixed or disturbed than other units.	
Core 91-5	Length = .74 m
Core 91-5 consisted of two major stratigraphic units. It is very similar in content, if not length with Core 91-4. The first unit is brown sand to a depth of 22 cm, with the upper 10 cm lighter than the lower 12, likewise shell increases in a zone within the center of the sand unit, although not as predominantly as with the other cores.	
Core 91-6	Length = .97 m
Core 91-6 is a short core but one with much stratigraphic integrity. It is composed of identical units as core 91-3, i.e.: upper sand, dark sand matrix with wood particles grading to grey fine-sand sticky sandy clay with plant fragments, and finally dolomitic rocks at the bottom.	
Core 91-7	Aborted
Core 91-8	Length = .72 m
Core 91-8 exhibited a single unit of sand with marine shell inclusions. There is some increasing clay content with depth.	

In several of the cores a regular pattern of sedimentary change was observed. This can be summarized as marine sands grading to gray fine-sandy clays over a dark horizon-like boundary of organic debris and coloration. Dolomite pebble or cobble size clasts occur at the bottom of the cores. Cores 91-2, 91-4, 91-5, consisted mostly of marine sediments or dolomite or combinations of both. Cores 91-8 and 91-7, which was abandoned, only encountered marine sediments. Coring at the Core 91-1 location was abandoned while the core tube was still in the consolidated gray clays, more sediments may have been located below.

Table 7.08 Core depth, penetration and compaction data

Cores Shown in Figure 7.32 and 7.34				
Core #	Water Depth	Length of Penetration	Length of Recovery	Estimated % of Compaction
91-1	4.5 m (14' 9")	1.52 m (5')	.87	43 %
91-2	4.5 m (14' 9")	3.05 m (10')	2.48	19 % (not averaged)
91-3	4.5 m (14' 9")	3.05 m (10')	1.80	41 %
91-4	4.9 m (16')	2.54 m (8' 4")	1.68	34 %
91-5	Not Available	1.22 m (4')	.74	40 %
91-6	4.3 m (14.1")	1.83 m (6')	.97	47 %
91-8	Not Available	1.22 m (4')	.72	41 %
Average	4.5 m	2.06 m	1.32 meter	41 % (minus 91-2)

Table 7.09 summarizes the depths of these stratigraphic units in the core tubes. The depth to gray clay is most regular with an average of 48 centimeters ($\sigma = 8$ cm), likewise the depth to the organic zone ranges between .30 and .40 centimeters. The dolomite elevations are irregular ($\sigma = 46$ cm), but the average is σ 80 centimeters.

The provisional interpretation of these units is that the upper brown sand unit reflects modern, fully marine conditions, even though greatly compacted, that the dark brown organic zone, represents a sedimentary transition from sandy to clayey sediments reflecting brackish water, tidal marsh, river mouth or near coastal conditions. Consequently, the gray sandy clay might reflect freshwater conditions. The dolomite unit is problematic, as will be discussed below. It is either colluvium from Tertiary deposits exposed along the drainageway, or it is a recent, diagenetic formation.

Table 7.09 Summary of depths to sedimentary units in the vibra-cores

Core #	Depth to Organics	Depth to Clay	Depth to Dolomite
91-1	NA	.40	NA
91-2	NA	.40	0.4
91-3	0.3	0.5	1.7
91-4	0.4	0.55	0.8
91-5	NA	0.6	0.22
91-6	0.1	0.4	0.9
91-8	0.4	NA	NA
Average	0.28	0.48	0.8

Estimation of the location and scale of the cores on the subbottom profile record is shown in Figure 7.35. Reviewing this graphic shows some agreement between the dolomite in the cores with some point source jumbles in the profiler record, particularly in the location of Test Pit 1, L_1 shown in Figure 7.35. The potential that some point source returns on the seismic records might represent areas of dolomite concentration is not lost on the interpretation of karst returns made in Figure 7.11.

Small pieces of stick wood were taken from Core 91-3 for radiocarbon analysis (Table 7.12; Figure 7.34). One from the zone of dark organics to estimate the inundation sequence (6,785 +/- 80) and another from the lowest portions of fine-sandy gray clay to date what was then thought to be the initiation of fine-sandy gray clay (7,130 +/- 75).

Palynological analysis was performed on three samples from the gray clay unit and two from the brackish water zone in Core 91-3 to test for preservation and to identify the changes in the local floral environment during the inundation process. The analysis was done by Barbara Hansen, consulting palynologist from Stillwater, Minnesota. Hansen was chosen for this analysis because she is familiar with Floridian pollen assemblages, including having analyzed samples from the Page/Ladson Site, nearby (Watts and Hansen, 1988; Watts et al., 1992, Grimm et al., 1993). Sample locations in Core 91-3 are shown in Figure 7.34, sample locations and summary descriptions of pollen samples are given in Table 7.10.

This analysis shows that pollen content is low, but preservation is good. In general, *Pinus* (pine) pollen percentages were high in the bottom of the gray clay zone but decreased as conditions changed to the organic or brackish water zone or horizon. Alternatively, percentages of *Quercus* (oak) and *Taxodium* (cypress) increase in the organic or brackish water zone, with cypress becoming dominant by that zone. This is an appropriate sequence showing increased swamp/water loving species increasing with inundation, while upland species decline with overwhelming water and saline content. Absolute pollen frequency and fragments of charcoal are concentrated in the brackish zone, suggesting particle settlement before reaching the sea or sediment compaction.

Table 7.10 Stratigraphic locations of pollen samples - Core 91-3

See Figure 7.32 and 7.34 for core illustrations			
Depth in Core	Description	Pollen Assemblage	Associated Dates
35-40 cm	Upper brackish water zone	*Pinus* = 9%, *Quercus* = 4% *Taxodium* = 77%, Pollen concentration high at 85.7 particles per cubic liter^3 grains per cc, *Nyssa* present. Charcoal fragments high, implying increased fire, possibly cultural	average of three : 6805 rcybp (+/- 70)
60-65 cm	Lower brackish water zone	*Pinus* = 36%, *Quercus* = 4%, *Taxodium* = 30% Pollen concentration 5.97 particles per cubic liter^3 grains per cc, *Nyssa* present	
75-80 cm	Upper gray clays	*Pinus* = 40%, *Quercus* = 6%, *Taxodium* = 31% Pollen concentration 3.22 particles per cubic liter^3 grains per cc, *Nyssa* absent Hickory drops out, grasses increase, (possibility of marsh conditions beginning?)	
105-110 cm	Lower gray clays	*Pinus* = 36%, *Quercus* = 4%, *Taxodium* = 30% Pollen concentration 2.46 particles per cubic liter^3 grains per cc, *Nyssa* absent	
175-180 cm	From clay matrix around dolomite rock	*Pinus* = 68%, *Quercus* = 4%, Taxodium = 12%, pollen concentration = 1.61 particles per cubic liter^3 grains per cc	Average of four 7,014 rcybp (+/- 40)

In addition to the pollen analysis, five samples were analyzed by Manuel Palacios for ostracodes and foraminifera. Palacios is a doctoral candidate in the Department of Geology, University of Arizona and consultant specializing in this type of analysis. In summary, those samples from the marine unit and the brackish zone contained foraminifera reflecting marine and brackish conditions respectively, in agreement with the interpretations made on the basis of sedimentology. Some samples from the brackish water zone were listed as especially indicative of moderate to low wave energy conditions. Samples from the gray clay unit, on the other hand, were void of any ostracode or foraminiferal species. This was unfortunate and means that the interpretation of a fresh water environment for the deposition of the fine-sandy gray clay rests solely on the geomorphological data.

Excavation of the "Stump", Locus L_2

As described in Chapter Six, an oak tree stump was discovered at the location of Core 91-6. Systematic hand-fanning of sediments around the Stump at Locus L_2 in 1991, resulted in four sediment / shell / wood samples grabbed at 10 centimeter intervals. Subsequent radiocarbon dating of the outer 10 rings of the stump [7,240 +/- 100 (AA-6714)] and of shells gathered from around it (average of 6255 rcybp for 3) was accomplished and the results. These are presented in Table 7.11.

Table 7.11 Radiocarbon analysis results: Locus L_2 Stump excavations

Site	Provenience	Material	UA #	Date
8 Je 740	Stump - L_2 In place base of cypress tree	Oak wood	A-6714	7,240+/-100
8 Je 740	Shell from the uppermost levels around the Stump at Locus L_2	Shell - *Crassostrea* sp.	AA-10509 Organic fraction	5,260+/-75 est @ 6,000
8 Je 740	Shell from the uppermost levels around the Stump at Locus L_2	Shell - *Crassostrea* sp.	AA-10508 Carbonate fraction	6,135+/-80 est @ 6,000
8 Je 740	Shell from the lowermost levels around the stump - Locus L_2	Shell - *Crassostrea* sp.	Organic fraction	Not Dated est @ 7,000
8 Je 740	Shell from the lowermost levels around the stump - Locus L_2	Shell - *Crassostrea* sp.	AA-11045 Carbonate fraction	6,375+/-80 est @ 7,000

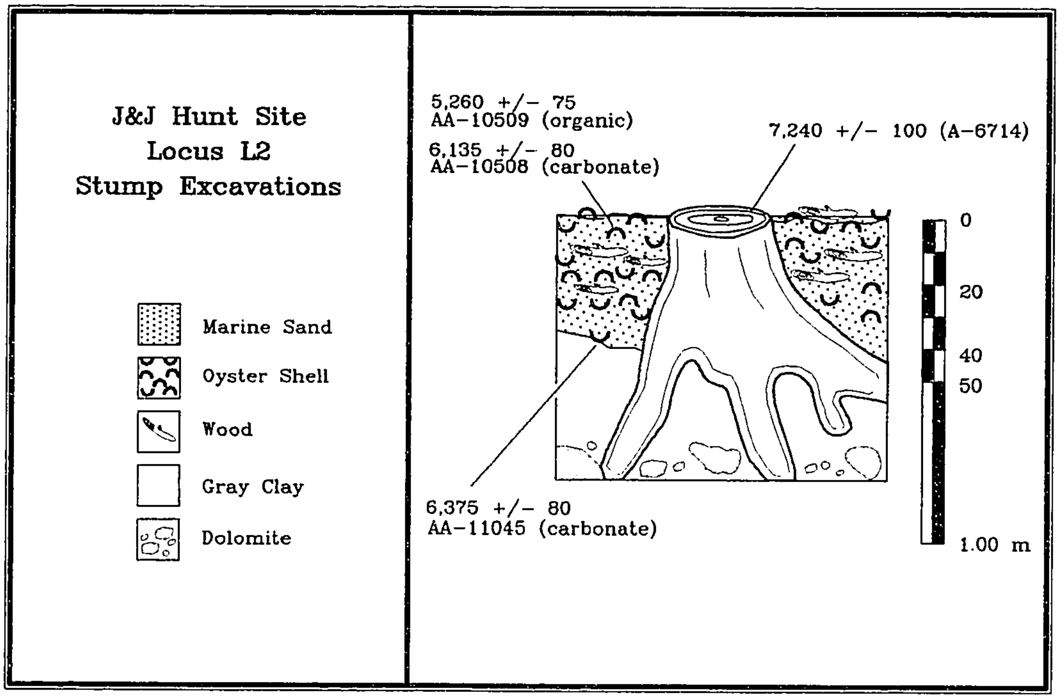

Figure 7.37 Stratigraphy of the Stump excavations – Locus L2

The stump was re-located in 1992 and a one by one meter induction dredge excavation unit exposed the stump roots and confirmed its growth within the fine-sandy gray clays (Figure 7.37). The stratigraphic sequence of oyster shell, which presumably grew on and around the stump during inundation, followed by fragments and pieces of wood in a dark organic zone, and then fine-sandy gray clays with basal dolomite rocks paralleled the sequence observed in the cores and excavations in the sinkhole at Locus L_1. This stump represents an excellent secondary marker of sea level rise for the continental shelf in this Apalachee Bay area (van de Plassche, 1986) and a large sample was curated for researchers interested in tree ring research for the Southeast U.S. A projectile point found on the surface near the Stump excavations, represents evidence for people in the area before inundation (cf. Figure 8.09a and 8.09b).

Excavation of Test Pit 1, Locus L_1

The major goal of the 1992 field season was the excavation of a test pit in the sinkhole at Locus L_1 to expose the sediments of an offshore inundated sinkhole and hopefully to burrow to Pleistocene levels. Illustrations showing this feature include Figures 7.30, 7.31, 7.32, 7.35 and 7.36. Radiocarbon control is presented in Table 7.12. Excavations took place with a six inch induction dredge operated from a 16 foot pontoon screening platform equipped with a .5 centimeter (1/4 inch) screen mesh. Excavations ended at a depth of three meters (almost 10 feet), within a zone of dolomite cobbles and pebbles.

Initial planning considered two or more excavation exposures, but equipment failures and weather restrictions confined the test to a single *sondage*, as described in Chapter Six. The test pit was put at the south (downstream) end of the sinkhole, toward the southwest margin. Sediment depth in the center of the sinkhole was thought to be too much to allow for sufficient exposure in a single season of digging. Placement was focused toward the downstream end of the sinkhole in order to get in the shallows where sport divers have had the most success in discovering artifacts (Waller, 1983).

Subsequent computer aided reconstruction of the paleochannel and estimation of the positions of the cores and excavation units exhibits the possibility that Test Pit 1 may have been placed <u>outside</u> of the L_1 sinkhole proper, and slightly into the next depression further downstream (Figure 7.32; Figure 7.35). This placement is still potential to find isolated artifacts and faunal remains, but a location farther north within the sinkhole at L_1 is probably a better location for the future.

The priority of Test Pit 1 was to expose as much sediment as possible. Personnel were available on the pontoon to observe the .5 centimeter (1/4 inch) screen in case the dredge encountered artifacts or faunal elements, but no systematic collections were made. The primary objective was to locate Pleistocene or Early Holocene aged sediments, if possible.

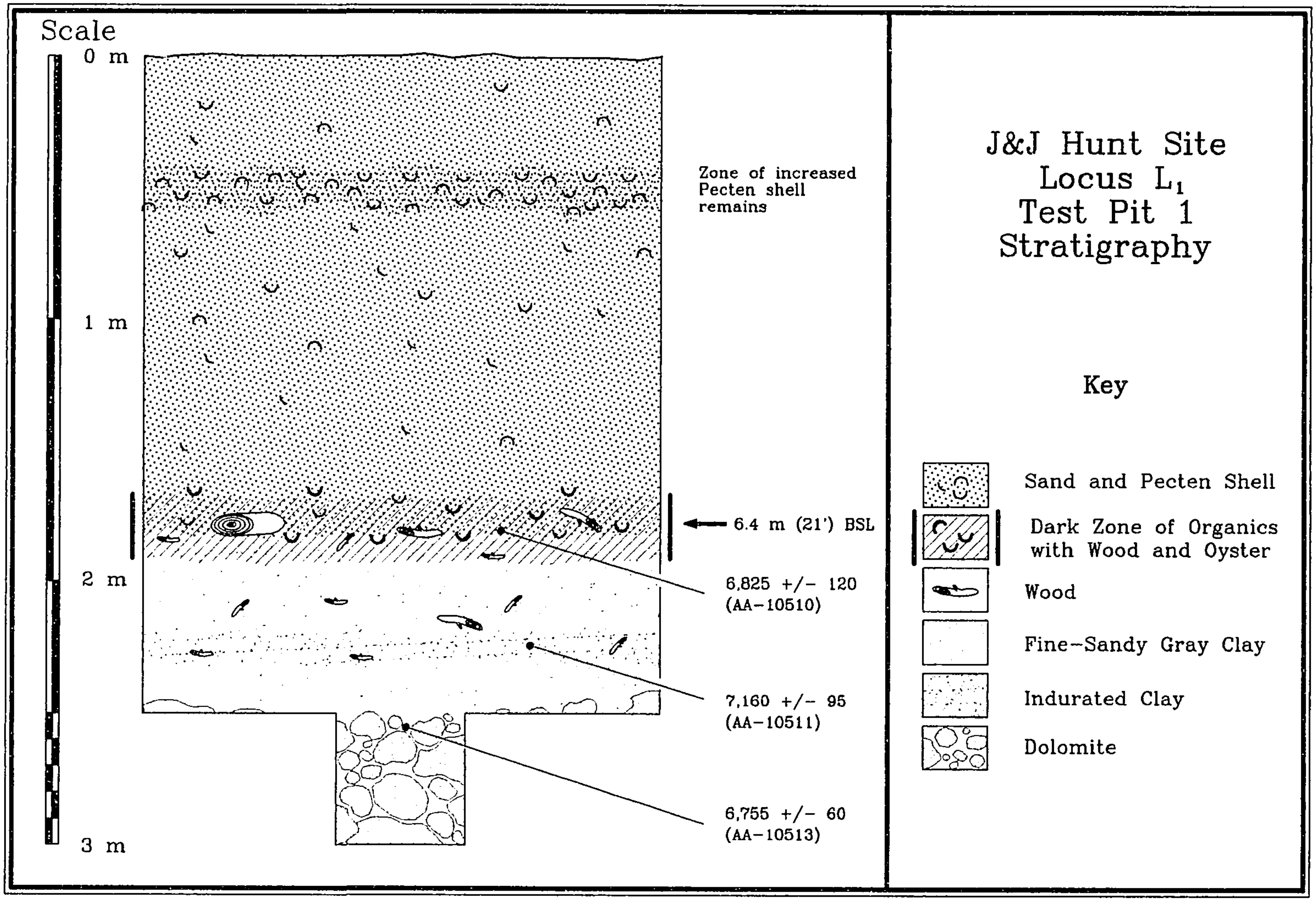

Figure 7.38 Stratigraphy of Test Pit 1, Locus L , J&J Hunt Site

Test Pit 1, L_1 revealed the same stratigraphic sequence seen in the cores, with the exception of a much thicker marine sand unit (Figure 7.38). These sediments were relatively consolidated and remained standing day after day, even with much abuse by divers, dredge tube and tidal flow, particularly the fine-sandy gray clays. Some slumping did occur, however, as discussed in Chapter Six and the test pit filled with tidal flow derived sediments each day.

The marine sands consisted of approximately 1.70 meters of sediments and exhibited mostly *Pecten* marine shell and reworked quartz sand. The exposure of this stratigraphic unit in Test Pit 1 revealed a three zones of stratification. First a zone of finer particles with few *Pecten* shells or shell fragments in the upper 10 to 12 cm, then a central zone of increased whole shell at depths of .8 to 1 meter, and finally a lower zone of increasing dark color, fewer mollusc individuals, and species grading to *Crassostrea*. Crotovina-like bioturbation tunnels were evident throughout.

Toward the base of this sand, at depths between approximately 1.70 and 1.90 meters in the sediment column, the color of the sediments darkened and fragments and pieces of wood and balls or chunks of gray clay became increasingly frequent in the dredge screen. This dark zone of organic sediment exhibited the highest frequencies of oyster shell (*Crassostrea* sp.) and Pecten declined. Two pieces of chert shatter were found in the screen during the excavation of this inferred brackish water zone, both covered with black organic patina and edge corrosion, and both representing circumstantial evidence for the presence of people in the area during inundation.

The lower contact between the dark colored brackish water clayey sand with wood and oyster above, and fine-sandy gray clays below was distinct, but conformable. The lower clays lacked immediately visible structure or evidence for marine or brackish representatives (i.e. *Crassostrea* or *Pecten*). The clay zone was more difficult to excavate than the marine sands due to extreme consolidation, especially between ca 2.20 and 2.30 meters in the sediment column where a particularly dense zone of the clay was encountered. Dolomite cobbles were encountered after about 60 centimeters (almost two feet), as with other exposures in the study area, and these were penetrated another 50 centimeters (1.6 feet) by induction dredge excavations and dismantling.

Radiocarbon analyses of wood samples from these excavated sediments, given in Table 7.12 and Figure 7.38, agree with those from the vibra-cores, but the lower most sample was inverted. Thin section microscopy analysis was performed on dolomite clasts from Test Pit 1 by Timothy Demko, PhD candidate at the Geology Department of the University of Arizona. This analysis revealed few rhomboids in the interstitular spaces of the clasts, and suggested its recent formation in either subaerial or, more probably, brackish water conditions (cf. Coudray and Montaggioni, 1986). Rhomboids form between particles in the molecular structure such that a recent dolomite has few, and ancient dolomite has many.

Table 7.12 Radiocarbon analysis results - Locus L_1 Sinkhole

Site	Provenience	Material	UA #	Date (rcybp)
Cores				
8 Je 740	Sample from core 91-3 in center of L_1 sinkhole - Brackish water zone	Wood depth .45 - .50	AA-8859	6,785 +/- 80 est @ 6,000
8 Je 740	Sample from core 91-3 in center of L_1 sinkhole - Lowest level of grey clay on dolomite rocks	Root (?) depth 1.58 - 1.63 zone	AA-8872	7,130 +/- 75 est @ 11k??
Excavation				
8 Je 740	TP 1 - L_1 - "Brackish" zone (hiatus between marine sands and fresh water clays)	Wood - ? sp.	AA-10510	6825 +/- 120 est @ 7,000
8 Je 740	TP 1 - L_1 Upper level of grey clays above "hard zone"	Wood - Oak (?)	not run	est @ ??8K
8 Je 740	TP 1 - L_1 "hard zone" central level of grey clay	Wood - Oak (?)	AA-10511	7,160 +/- 95 est @ ??10k
8 Je 740	TP 1 - L_1 - Lowest level of grey clay on dolomite rocks	Wood - small stick from 1/4" fraction	AA-11047	7,010 +/- 80 est @ ??11k
8 Je 740	TP 1 - L_1 - lowest level of grey clay on dolomite rocks	Wood - (Oak and Cypress)	AA-10513	6,755 +/- 60 est @ 11k??

Summary of the Sedimentary Units and Radiocarbon Control

Sediments within karst features inundated on the continental shelf reflect marine, brackish and fresh water environments. Summary descriptions of each of the characteristic sediments identified at the J&J Hunt Site, as well as at Fitch and Econfina Channel are presented in Tables 7.13 and 7.15 through 7.17. Radiocarbon averages for each stratigraphic unit are shown in Table 7.14, and various other radiocarbon dates in Table 7.18.

Where they pertain, the fine-sandy gray clays developed at least for a few hundred years prior to brackish conditions, until about 7,000 radiocarbon years ago at the J&J Hunt Site. How much previous to this time they formed is unknown. The lack of any foraminiferal remains in these deposits, as described in Chapter Seven, may reflect the generally rapid rate at which these sediments accumulated or the possibility of their isolation from sources of foraminifera until the brackish phase.

Table 7.13 **Description of the J&J Hunt fine-sandy gray clay**

J&J Hunt fine-sandy gray clay
A generally structureless sticky gray to dark gray clay to silt textured sediment with 10-20% angular to subangular fine quartz sand particles and plant fragments of various sizes were observed in the cores and excavation exposures at Locus L,. The boundary between the overlying sand and this clay unit is generally conformable over about 10 cm., and is marked by the zone of dark organics described in Table 7.15.
Similar deposits have been described by Hutton et al. (1984) near the moth of the Crystal River farther south along the coast, and by Gleason and Spackman (1974) in the mangrove swamps of Southwestern Florida. Hoenstine and Garrett (1993:10) described a similar deposit as a residuum of "carbonate rubble and mud with wood fragments".
Radiocarbon dates fro this zone include those on wood from the cores and text excavations: 7160 +/- 95; 7130 +/- 75; 7010 +/- 80 and 6755 +/- 60 (cf. Table 7.12). The arithmetic average for all of these dates in 7014 rcybp. The indication of this chronological window is that conditions enabling fine-sandy gray clay sedimentation pertained at least to 7,000 rcybp.
This unit represents a quiet, probably fresh water depositional regime The working hypothesis is that the unit is a fresh water deposited algal precipitation of $CACO_3$ but the species or chemical process of its formation has not yet been studied. No foraminifera were present. Pollen preservation records high pine frequencies (68%) at the base, correlating with other mid-Holocene pollen assemblages discussed in Chapter Six, i.e. Camel Lake and Lake Louise (Watts, 1971; Watts et al., 1992). Cypress is present throughout the column, but dominates in the brackish zone.

The fine-sandy gray clay of Locus L_1, offshore, exhibits gross visual and textural similarities with the Gray Clay Units (Unit C_1 and C_2) of the Page/Ladson Site, described in Chapter Six. Since the Page/Ladson gray clays have radiocarbon dates ranging from 10,600 to 10,090 (average of 3; Carter, 1993; Dunbar et al, 1988; 1989a), and because of the robust similarities of the two deposits, the offshore deposit was interpreted as possibly contemporaneous with the onshore example (Faught, 1992). By this thesis the on- and offshore samples would be chronostratigraphic units.

However, radiocarbon dates bracketing the organic zone (average 6805 rcybp) and from the lowest levels of the gray clay (average 7014) negate this hypothesis--at least in the levels of gray clay observed above the dolomite in Locus L_1.

Table 7.14 Summary of radiocarbon dates from the stratigraphic units

Date: Shell Unit	Dates: Brackish Horizon	Dates: Fine-sandy Grey Clay Unit
Oyster dates (Stump at L_2): 5,260 +/- 75 (shell organic) (same shell as below) 6,135 +/- 80 (shell carbonate) (same shell as above) 6,375 +/- 80 (shell carbonate) Wood: 5140 +/- 100 (Econfina) 6100 +/- 60 (Area A) Averages: J&J Hunt Site Carbonates 6255 rcybp (7173 Cal Bp) Organics (weighted) 5800 rcybp (5935 Cal Bp)	6,785 +/- 80 (wood from Core 91-3 6,825 +/- 120 (wood from TP 1, L_1) Average: 6805 rcybp	7,160 +/- 95 (TP 1, L_1, middle gray clays) 6,755 +/- 60 (TP 1, L_1, Bottom) 7,010 +/- 80 (TP 1, L_1 Bottom) 7,130 +/- 75 (Core 91-3, Bottom) Average: 7014 rcybp

These deposits are more probably allostratigraphic units, representing the interaction of limestone, microorganisms and water with outcomes dependent on pH or salinity, or temperature, or combinations of the three. Remember from Chapter 6 that studies of similar deposits in South Florida suggested shallow water, intermittently exposed karst void features with low pH caused increased algal activity and concomitant deposition of $CaCO_3$ precipitate (Gleason and Spackman, 1974).

Given these facts it may be that a common denominator in the development of these calcitic mud units is mixing corrosion taking place both at the coast and at the confluence of the Wacissa and Aucilla Rivers (Dunbar et al, 1988; 1989a), also discussed in Chapter Six. If this were true, one might expect to find decreasing clay formation with distance from the confluence of the Wacissa and Aucilla, and older, but identical, examples of the fine-sandy gray clay deposits in shallow karst features farther out on the continental shelf. The Stump, for instance, was dead by 7240 rcybp and yet it roots were found in the fine-sandy gray clays of that locale (Figures 7.32 and 7.37).

Determination of the algal constituents and chemical processes involved in the development of these clays could offer several avenues for the development of proxy data for past environmental changes. Excellent preservation of organic matter, pollen, and at least marine and brackish foraminifera have been demonstrated in this sediment by this research.

The zone of dark organics which marks the transition from fine-sandy gray clay to marine sands is hypothesized to represent a tidal marsh, brackish water phase of the inundation process. This was confirmed by foraminifera studies. Pollen analysis of this zone revealed dominant cypress and significant absolute frequency of pollen grains and charcoal fragments. Pine declines substantially in this zone.

The fine grained nature of the sediments, the accumulation of organic matter, and the quiet water species of foraminifera present in the brackish zone in L_1 imply a gentle inundation of this portion of this segment of the paleoAucilla River.

Table 7.15 Decsription of the J&J Hunt zone of dark organics

J&J Hunt zone of dark organics
Four of the cores (91-3, 91-4, 91-6, and 91-8) and the excavations at Test Pit 1, L_1 exhibited a darkening of the color of the deposits with depth which often included pieces of wood and/or other organics, especially in cores 91-3 and 91-6 and Test Pit 1, Locus L_1. This zone represents the transition from sand sediments of the Unit 1 above to the fine-sandy gray clay unit below. The average thickness of this unit in the cores was 30 cm, and 20 cm in Test Pit 1, L_1. In Test Pit 1, L_1 this zone was located between 1.70 and 1.90 meters into the sediments (center of zone = 21' BSL used for paleo-sea level estimate).
It is hypothesized that this darker unit represents the brackish phase of the inundation process and this was tested with foraminifera studies, which confirmed the presence of brackish water species. Pollen analysis of this zone revealed dominant cypress and significant absolute frequency of pollen grains and charcoal fragments. Pine declines substantially in this zone.
Radiocarbon dates from this zone include: 6825 +/- 120 (AA-10510) from Test Pit 1, L_1; 6785 +/- 80 (AA-8859) from core 91-3. Preservation of wood fragments and other organics represent useful markers of paleoenvironmental and paleo sea level data. However, this is presented as an hypothesis in need of further testing. No modern analog samples have been directly compared to these inundated samples.

The final sedimentary unit pertaining to this offshore research area is the overlying marine sand, shell hash which mantles the drowned karst plain of this portion of the Apalachee Bay (Table 7.17). The origins of this sediment are probably diverse, coming from the rivers, as windblown sediments and movement and deposition from offshore currents. These sands are mixed with terrestrial sediments from before inundation and accumulation of marine organic debris after. It is probable that the distributions of items found in this sediment at different locations informs the researcher of the past terrestrial nature of the spot. However, this evidence will be dispersed over wide areas.

Overall, the fine grained nature of these sediments also implies that the inundation was gentle, if that is possible. This statement is also supported by the mixed sizes of artifactual materials found in the transect collection units. This statement pertains to the Econfina Channel and J&J Hunt sites, but not necessarily the Fitch site.

Table 7.16 Description of the Apalachee Bay upper sand unit

Apalachee Bay upper sand unit
A brown colored sand was observed at all sites and in all cores and excavation units. This sediment is a brown to tan medium to fine grained quartz sand with varying frequencies of marine shell, fragments of wood, limestone and dolomite rocks, chert fragments, chipped stone artifacts and bone, locally, as inclusions. Crotovina-like bioturbation tunnels were evident locally.
The thickness of this unit varied from exposure to exposure. It averaged 40 cm in the cores (about 1 meter before compaction). Excavation of Test Pit 1, L$_1$ demonstrated a Unit 1 thickness of 1.8 m Radiocarbon dates from wood obtained while hand fanning sediments at Econfina Channel in 1986 and J&J Hunt in 1992 resulted in dates of 5140 +/- 100 (Econfina) and @ 6,100 +/- 60 (Area A) (Table 7.18). The elevation of the Econfina collection was approximately 5' BSL, where the J&J Hunt Area A sample was from the margins at a depth of 13' BSL.

The results of thin section microscopy presented above suggests that the dolomite is a recent formation, supporting the hypothesis of diagenesis rather than reworking. The lack of dolomite in the calcitic muds at the Page/Ladson site and the evidence that dolomite development may take place after the brackish phase imply that the chemical development of dolomitic clasts and clays is enhanced in the presence of NaCl. The next question to be asked is whether the dolomite can be penetrated and whether older calcitic mud sediments are protected below it. Assuming that dolomite formation takes place within the gray clays after inundation, then older clays could exist below the dolomite clasts and clays in karst features with sufficient depth.

Table 7.17 Description of the Apalachee Bay dolomite

Apalachee Bay dolomite
"Dolomite" is used here to describe a buff colored fine textured, soft rock which barely interacts with HCl. The rocks are rounded and range in size from pea gravel to boulders. The dolomite cobbles noted at J&J Hunt appear to be identical as those observed at the Fitch Site (Fitch stratigraphic Unit 4) and at the Econfina Channel Site (Test Pit D lower levels). In the cores the contact between the fine-sand gray clays and the matrix around the dolomitic clasts are conformable, i.e. the more buff colored clays of the dolomitic unit grade with the darker, grayer sticky clays above, and this takes place over approximately 5 to 10 cm boundaries. However, the inclusion of stones of cobble and larger size is abrupt in all sediments observed and the source of these cobbles, regarding parent material has been problematic. One multiple working hypothesis had the clasts eroding from a band of dolomite in the parent bedrock. Another alternative for the formation of these clasts sees them as the result of a diagenetic process or replacement associated with sea level rise. A single radiocarbon date from within the dolomite unit came from Core 91-3 (also listed above) at 7130 +/- 75 (AA-8872), but this date is on wood incorporated in the clay matrix and not indicative of the formation of the dolomite. Thin section microscopy revealed few interstitular rhomboids.

Table 7.18 Results of radiocarbon analysis - various

Site	Provenience	Material	UA #	Date
8 Je 139	Econfina Channel - from marine sand unit on paleo channel margins	Wood - Cypress collected in 1986	A-4696	5140+/-100
8 Je 740	Area A - found in the marine sand unit	Wood - Oak?	AA-10512	6,100+/-60 est @ 9k?
8 Je 591	Page/Ladson Site - below grey clay Strawmat (Unit *D*)	Wood	AA-11048	12,370+/-90 est @ 11k?
Aucilla River Coast	Modern Oyster shell (*Crassostrea* sp.)	Shell for calibration Same as below	AA-11046a	260+/-50 est @ 400 bp??
Aucilla River Coast	Modern Oyster shell (*Crassostrea* sp.)	Shell for calibration Same as above	AA-11046s	335+/-45 est @ 400 bp??

This chapter has described several offshore areas and stratigraphic exposures which have resulted in a more clear image of the geomorphology of paleodrainage systems offshore, the stratigraphic sequence for the fill of inundated karst void features and various aspects of archaeological site formation processes and characteristics. While the discovery of Pleistocene and early Holocene sediments has not been made yet, the information presented here can be used to find and compare other preserved sedimentary columns offshore. Chapter Eight presents the analyses of the chipped stone and other artifact distributions and industrial attributes to determine more details of site formation processes, past cultural behaviors and chronology.

Chapter Eight

RESULTS OF ANALYSES: CHIPPED STONE

The discovery of marine inundated prehistoric archaeological sites was the intent, focus and justification for all of the offshore forays made during the course of this research. This Chapter presents the context and character of the chipped stone artifacts found at the three locations discussed in Chapter Seven: Fitch, J&J Hunt and Econfina Channel. At these locations evidence for Paleoindian, Early and Middle Archaic cultures was found. The locations of other artifact discoveries are also illustrated.

Offshore artifact discoveries fell into two basic categories: encounters and clusters. Encounters represent locations where divers found artifacts by hand fanning around rock outcrops, or other anomalous features, during diver tow surveys. Fifteen such encounters were made during surveys conducted in 1988, 1989 and 1991. Formally, these encounters consisted of ten or fewer items. All were found near rock outcrops and their distribution is represented by small dots in Figure 8.01. None of these sites was returned to for more detailed geomorphological study and no analytic effort was expended on the samples.

Clusters, on the other hand, represent find spots of more than 10 chipped stone artifacts in clustered distributions, usually including tools or diagnostic items or both. Clusters include the Econfina Channel, Fitch and J&J Hunt sites. Figure 8.01 depicts these sites as triangles. These sites have had the benefit of more intensive sampling and

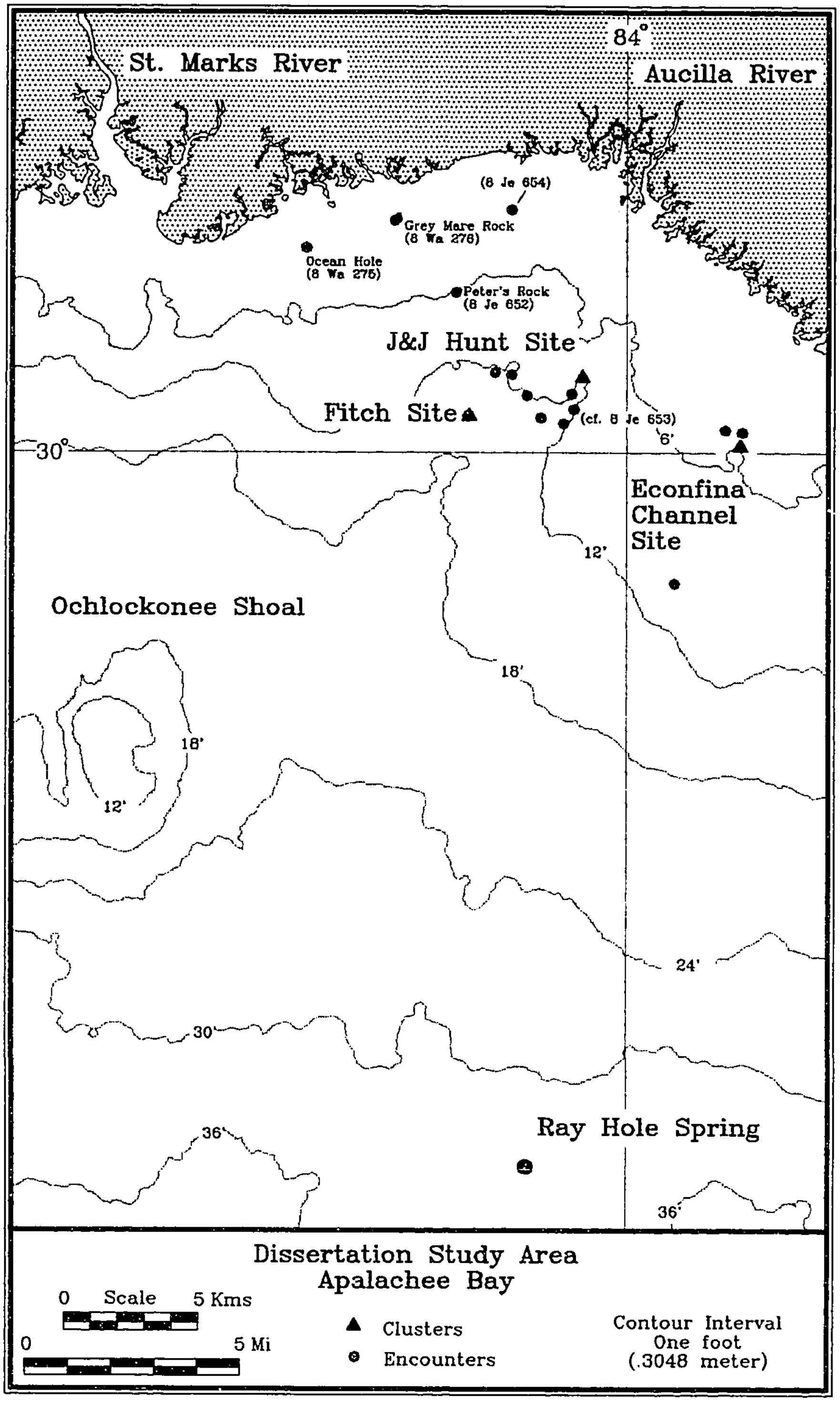

Figure 8.01 Location of artifact encounters and clusters

study including 101 hand fanned collection units and 13 induction dredge test pit exposures resulting in a total of N=1674 chipped stone artifacts. These items are interpreted as members of terrestrial sites inundated by rising sea levels.

However, the stratigraphic contexts of the artifacts were usually on and in marine sediments, implying post-inundation contexts. Therefore, the possibility that these clusters represent artifacts dropped from boats, as suggested by Masters (1983) for groundstone artifacts found offshore in California, needs to be rebutted. First, the three sites exhibited arrays of artifacts not unlike a vertically displaced plowzone, with little apparent horizonal movement of items, the Fitch sample notwithstanding and as discussed in Chapter Seven. There were robust numbers and diverse types of chipped stone debris and they were found near limestone and chert outcrops suggesting terrestrial derivations. The proximity of these clusters to inundated paleochannel features also supports the idea that these were locations of past human activities in terrestrial settings, inundated later by rising post-glacial seas. Finally, several diagnostic artifacts represent time periods when sea levels were lower, or farther out on the continental shelf, and they must, therefore, have been originally deposited on land.

The intent of the analyses performed on these artifacts was to investigate the potentials of artifact assemblages altered by inundation in an offshore environment and to determine the reduction strategies and possible tool outcomes represented by the chipped stone assemblages at each of the sites. These analyses are based on the conviction that debris from different lithic reduction activities will have characteristic signatures, following Flenniken (1985:267). I have compiled some of these characteristics and present them in Table 8.01.

Table 8.01 Chipped stone reduction types and characteristics

Reduction Types and Characteristics
Primary reduction
Quarry activities often result in higher frequencies of cortex, larger items, more complete flakes and shatter (Sullivan and Rozen, 1985). Weight frequency distributions should be variable (Patterson, 1990).
Secondary reduction
Secondary reduction characteristics include more broken flakes and flake fragments, more restricted angles of the flakes, smaller flakes and less cortex (Sullivan and Rozen, 1985). Biface production: expect high frequency of light edge treatment or modification in the form of grinding on the biface just before the blow, not to be confused with use wear, some of which would exhibit a more polished appearance. There might be a mix of acute and flat platform angles, depending on the preform blank for (i.e. blocks or cobbles versus already manufactured biface preforms). Weight frequencies should reflect exponentially small distributions (Patterson, 1990). Also expect broken biface blanks and unfinished tools (Callahan, 1979). Soft hammer core reduction yields assemblages that have higher percentages of flake fragments and lower percentages of whole flakes and debris (shatter) according to Sullivan and Rozen (1985).
Tertiary reduction
Tool edge maintenance (expect crushed and polished edges on biface (or other) flakes). Some crushed platforms could be mistaken for flake preparation activities just before flaking a biface and *vice versa*

The following discussions summarize the analytic protocols, the number (N), the average weight ($\bar{X}$), and the standard deviation of weight (σ) for the lithic items from each site (Table 8.02). The frequency of chipped stones exhibiting cortex, the frequency of bifacial flakes and the frequency of tools are presented for each site in Table 8.03. Bifacial flakes are those exhibiting acute angled platforms with evidence for previous flake scars, grinding or pounding of the platform edge, and possibly lipping on the bulb of percussion. Tools include bifacially flaked or unifacially retouched chipped stones, use worn items (i.e. exhibiting nibbling or polishing) and cores. The frequency of Sullivan and Rozen (S&R) debris types is given in Table 8.04. This method of sorting debris distinguishes between flakes, broken flakes, flake fragments, and shatter (or other) and as described by Sullivan and Rozen (1985). These are defined below.

Flake:	Striking platform and all edges intact.
Broken Flake:	Intact platform and bulb, one or more edges missing.
Flake Fragment:	Lacks striking platform and bulb, but direction of blow can be estimated.
Shatter (other):	Pieces from which the orientation of the blow cannot be detected.

The chipped stone tools and retouched items are described in the text for each site. A more detailed analysis of chipped stone debris was made at the J&J Hunt Site, and this is presented in the section regarding J&J Hunt. Any additional items, in addition to chipped stone, such as fossil bone, are also described in the text.

Table 8.02 Summary of artifact statistics (N, $\bar{X}$, σ)

Site	N	Average Weight (Grams)	Standard Deviation
Econfina Channel	517	30.8 grams	74.3 grams
Fitch Site	477 (464 weighed)	118.6 grams	398.9 grams
J&J Hunt - Area A	513	13.8 grams	40.0 grams
J&J Hunt - Area B	165	7.2 grams	21.0 grams
Total	1674	47.8 grams	221.1 grams

Table 8.03 Summary of cortex, biface flakes and tool frequencies

Site	Total Cortex	Biface Flakes	Tools / Use Wear / Cores Combined
Econfina	43% (N=222)	14% (approx)	1.4% (N=7) (2=cores)
Fitch	22% (N=105)	0%	1.7% (N=8) (4=retouched, 4=cores)
J&J Hunt Area A	23% (N=120)	12%	5.3% (N=26) (15=retouched, 11=cores)
J&J Hunt Area B	26% (N=43)	15%	4.8% (N=8) (7=retouched, 1=core)

Table 8.04 Comparison of debitage characteristics

Site	Flakes	Broken Flakes	Flake Fragments	Shatter
Econfina	21.4%	10.1%	39.2%	29.3%
Fitch	Combined total of 7.2%			92.8%
J&J Hunt Area A	28.4%	19.7%	37.8%	8.8%
J&J Hunt Area B	29.4%	19.2%	39.1%	7.0%

In 1989 the chipped stone debris from Econfina Channel was sorted through 1.25 centimeter (1/2 inch) mesh to quantify the amount of large and small chipped stone material in order to have a statistic with which to characterize the assemblage from the perspective of both site formation processes (Chapter Seven) and reduction strategies (Table 8.01) (Faught, 1989). Only weight was used to quantify size at the other two sites, but the original data from Econfina allowed comparison of the chipped stone sizes with weights for descriptive clarity. This comparison showed that a flake less than 1.25 centimeter (1/2 inch) in size also had mass less than 22 grams. Since the chert sources were relatively similar at Econfina and J&J Hunt sites, that is fine grained cryptocrystalline cherts, data from these sites are directly comparable (Table 8.05). The Fitch Site materials were also chert, but they were coarser grained, and perhaps more dense. The calculations for Fitch are also presented, but with this caveat.

Table 8.05 Ratios of small to large sized artifacts

Based on a definition of small as less than or equal to 22 grams		
Site	**Percent of Large Items in the Assemblage**	**Percent of Large items exhibiting Cortex**
Econfina	29%	72%
Fitch	69.5%	(not determined)
Area A	22%	32.5%
Area B	5%	7%

Econfina Channel Site (8 Ta 139)

At Econfina, artifacts were counted and sorted to chipped stone debris types (S&R) (Faught, 1989). The presence or absence of cortex was tabulated and the condition of the artifacts was assessed based on the extent of corrosion (as described in Chapter Seven). An attempt was made to identify flakes removed during biface reduction activities, given the principles outlined above. This was done to investigate if these flakes had been removed as part of tool edge maintenance activities or if they represented biface preform manufacture. At a later date each of the items was assigned a unique number and weighed for comparison with the other sites. No attempt was made to refit this assemblage and more detailed analyses were not attempted. Both kinds of analysis would be fruitful in the future. Tools and other retouched items are described below and illustrated in Figures 8.02 a and 8.02 b.

Context

Chipped stone artifacts were found both within and immediately south of the probable inundated channel segment of the Econfina paleochannel (Chapter Seven, Figures 7.19 and 7.20). Two linear transects were laid out and six hand fanned collections were taken at 10 meter intervals. Eight one meter square induction dredge test pits were excavated at the Econfina Channel Site. No artifacts were observed in the sea grass beds on either side of the paleochannel, but artifacts may be present within or below the sandy matrix of this cover. The sediment cover of the channel margins was a brown sandy biogenic hash as described in Chapter Seven. This sediment cover was dispersed across the local karstic landscape and interrupted by outcropping rocks.

Some artifacts were observed directly on the sandy surface but the majority of artifacts were located within the shelly sand below the surface at varying depths up to about 20 centimeters (Figures 7.20 and 7.21). The artifacts generally appeared black and angular against the brown shell hash. Included in this fill were the "popcorn" limestone chunks and oyster shells described in Chapter Seven. Artifacts were also found within the paleochannel proper, in the clean quartz sand matrix and at depths of approximately 70 centimeters, down near the bedrock.

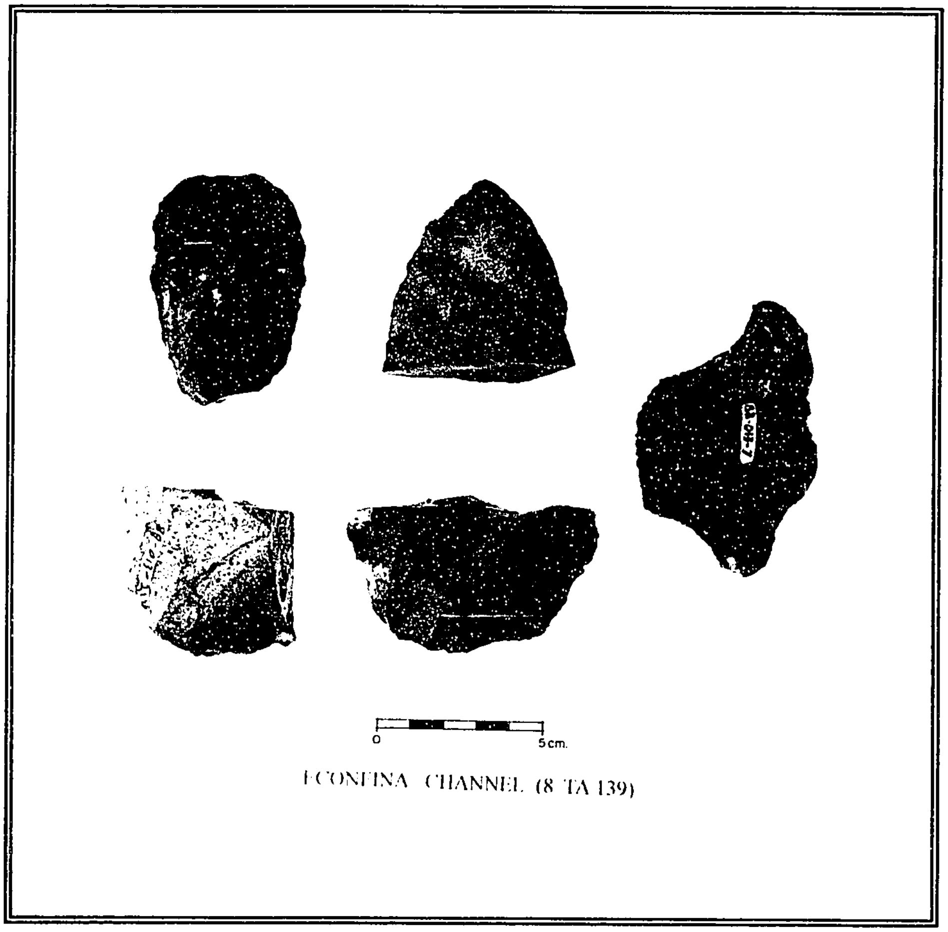

Figure 8.02a Tools from the Econfina Channel Site (obverse)

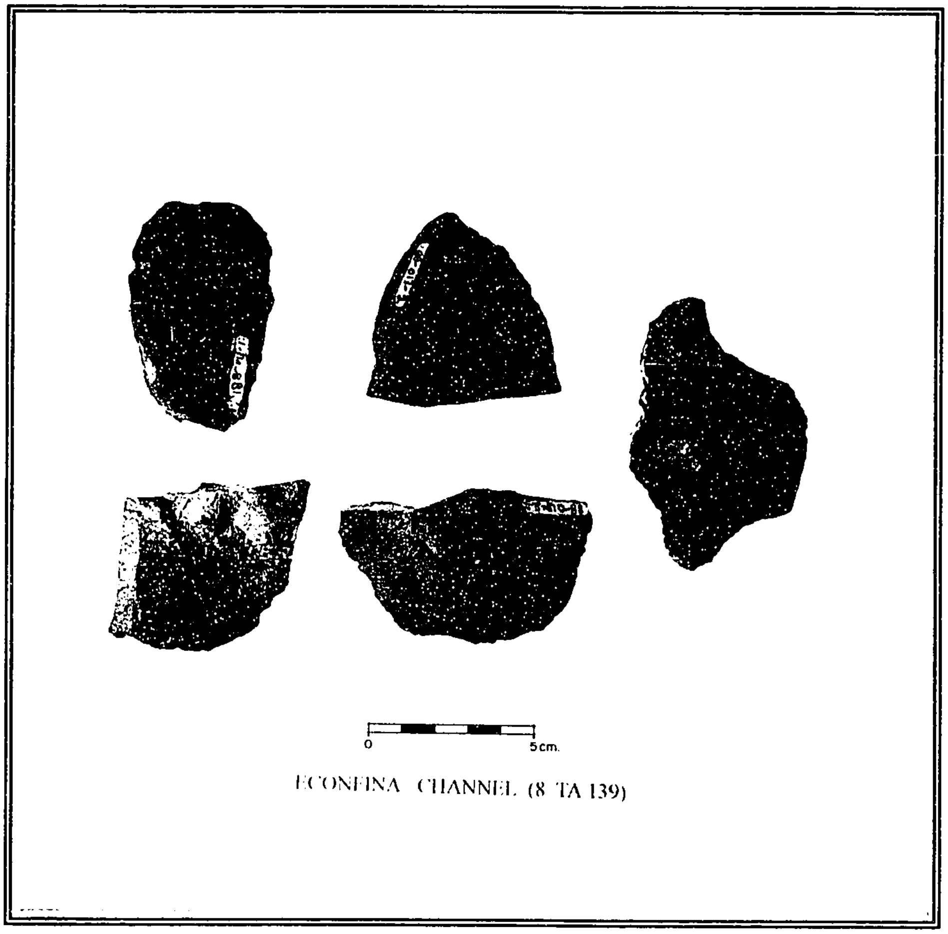

Figure 8.02b Tools from the Econfina Channel Site (reverse)

Character

517 pieces of chipped stone were collected at the Econfina Channel Site, including biface preforms and a single diagnostic tool. The range of artifact weight was from 37 grams to .1 of a gram, with an average of 30.8 grams and standard deviation 74.3 grams (Table 8.02). Of the lithic items collected at Econfina Channel, 98.6% were chipping debris (N=510), 1.4% were tools. These tools included four biface fragments, one broken projectile point and two core fragments (Table 8.03). The biface artifacts are shown in Figures 8.02a and 8.02b. Forty three percent of the debitage exhibited cortex (Table 8.02). Almost a third, 29%, of the chipped stone debris was large sized according to the criteria presented above (i.e. >22 grams).

Of the flakes and broken flakes, 73 (14.2%) were designated as unambiguous bifacial flakes, that is, thin flakes with narrow platform angles, and which exhibited either prepared platform edges, evidence for abrasion or evidence for polishing (usewear). Some of these flakes also had lipped bulbs of percussion which can reflect soft hammer blows, but not always. Most of these flakes exhibited bashed platforms as if for preform manufacture, but there was little evidence for unambiguous use wear in the form of edge polish.

The chipped stone debris sorted to the four S&R categories included 21.4% flakes, 10.1% broken flakes, 39.2% flake fragments and 29.3% "shatter" (Table 8.04). This shatter frequency is robust and suggests quarry activities according to Sullivan and

Rozen (1985). Tabulation of high frequencies of items exhibiting cortex agrees with this interpretation (43%), as does the observation that most of the larger items had cortex (72%) (Table 8.05).

The five tools collected at the Econfina Channel Site include a fragment of a diagnostic Florida Archaic Stemmed point, as well as one whole and three broken biface preforms (Figures 8.02a and 8.02b). No use worn flakes were recorded. The diagnostic point fragment fits the description of either a Marion or Putnam stemmed point as defined by Bullen (1975:32). This piece appears to have been broken by a twisting motion and then discarded.

Bullen (1975) estimated a wide temporal range for this diagnostic item, placing the type between 7,000 and 3,000 years ago. This is at least in range with radiocarbon date of 5,160 +- 100 (A-4696, Table 7.14) obtained in 1986 from the biogenic shell hash unit and which possibly represents the post-brackish water phase of inundation. These two items (the point and the radiocarbon sample) were not found in the exact same area, but their stratigraphic position is analogous. The implication is that the point fragment was discarded in a coastal setting, before full inundation. Sea level rise probably reached the brackish water phase before the date of the radiocarbon sample, which is considered here as waterlogged flotsam. Thus, the point might be bracketed between 6,500 and 5,500 rcybp.

Other items collected included three fragments of manatee (dugong) rib, two pebble sized, $CaCO_3$ cemented conglomerate sandstones and three geode fragments with crystals. The geodes are probably fortuitous components of the chert source rocks. The $CaCO_3$ cemented sandstone concretions appear out of place in the geologic setting, and are inferred as manuports. Several identical rocks are described below from the Fitch Site. Likewise, the manatee rib fossils had some evidence for flaking in the form of both small flakes and equivocal flake scars. Examples of manatee rib fossils were also found at the J&J Hunt site. No terrestrial faunal bone was observed and no ceramics were found in any of the deposits.

At the Econfina Channel site the high frequency of shatter debris and items with cortex, along with a relatively low frequency of tools, combine to suggest this site was a locus of quarrying activities with access to raw materials and immediate biface preform reduction. The proximity of chert outcrops adds support to this conclusion. The presence of broken biface preforms and bifacial reduction flakes also agree that a combination of quarry and bifacial reduction activities were taking place at this location.

Fitch Site (8 Je 740)

At Fitch the chert items were counted, weighed, and the presence or absence of cortex was recorded (Faught, 1990). The items were sorted into several categories based on an expedient set of morphological criteria, particularly the degree of faceting. Debris types (sensu Sullivan and Rozen, 1985) were not analyzed at that time, because of the unusual fracture characteristics of the assemblage. However, an attempt was made to reconstruct this statistic from the analysis data, and the results are presented in Table 8.04, but with this caveat in mind. Refitting was not attempted. Selected artifacts are illustrated in Figures 8.03a and 8.03b and 8.04a and 8.04b.

Context

The Fitch site can be described as an expanse of outcropping limestone and chert formations interspersed between large areas of sandy shell hash sediments with sparse biota (Figures 7.22 and 7.23). The artifacts were easily visible while hand fanning because they were generally large, and appeared black and angular against the grey-brown of the shell hash and rounded limestone fragments. The full extent of the site is unknown, but it was surveyed to the west and north of the collection transects and found to extend in lesser densities over an area of at least one square kilometer.

As described in Chapter Seven, four linear collection transects running both N-S and E-W were laid out and 32 hand fanned collection units of 50 by 50 centimeter (.25 m^2) size were sampled to depths of 20 centimeters if possible (Figure 7.23). Three one meter square induction dredge test pits were dug, near the main datum (Locus 1). Artifacts and pieces of chert and limestone were found on and in the sandy shell hash sediments of Fitch stratigraphic Units 1 and 2 described in Chapter Seven, Table 7.03. Some isolated chert flake artifacts were also found in the lower levels of Fitch stratigraphic unit 3 in Test Pits 1 and 3.

Figure 8.03a Cores from the fitch Site (obverse)

Figure 8.03b Cores from the Fitch Site (reverse)

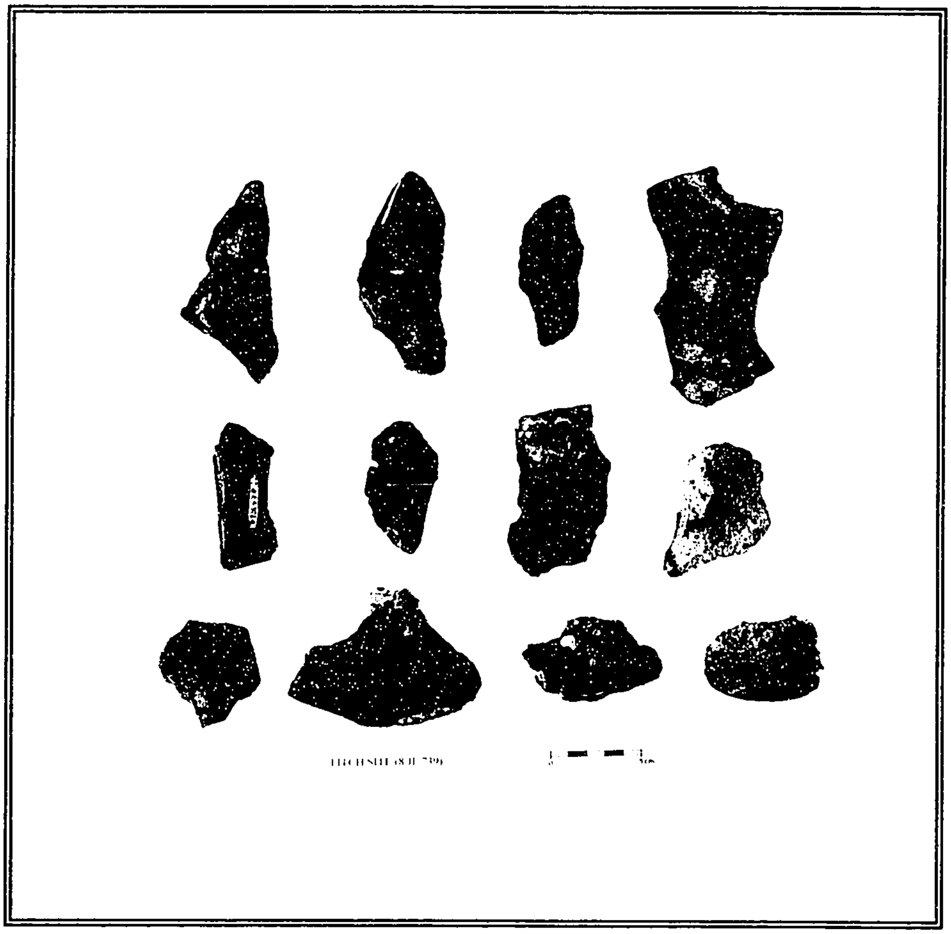

Figure 8.04a Selected flakes from the Fitch Site (obverse)

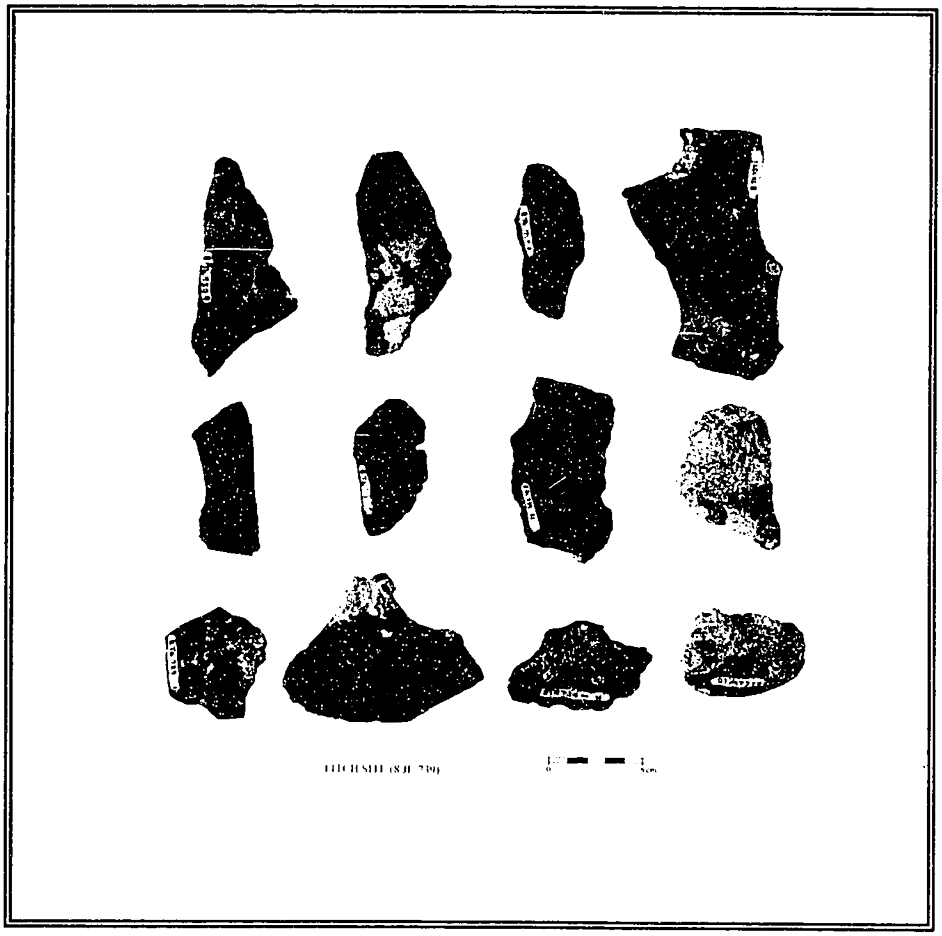

Figure 8.04b Selected flakes from the Fitch Site (reverse)

As described by Chapter Seven, the majority of cultural items overlaid the marine sediments of Fitch stratigraphic Unit 3 (Table 7.03). It was also observed that the mass of individual artifacts generally decreased with distance north (shoreward) from the main datum at Locus 1 (Figure 7.29). These facts imply a natural, possible storm surge dispersal and therefore a post-inundation site formation process (Dunbar et al., 1992:138). The hypothesis of shoreward movement by storm surge is also supported by the general lack of small debitage, and suggests the possibility that small debitage might be dispersed in sediments farther to the north.

Character

When the site was discovered in 1988, the survey team reported that artifacts were abundant. These perceptions were confirmed during the transect collections in 1989. A total of 477 artifactual and geofactual items have been studied and retained from an original collection of over 550. Furthermore, items greater than 15 centimeters on a side were left in place as part of the offshore collection strategy and approximately 40 items meeting these criteria were recorded as not collected. The overall artifact density was about 11 items per cubic meter. The collected items ranged in weight from 8,197.2 grams to .2 of a gram. The average weight was 118.6 grams and the standard deviation was 398.9 grams (Table 8.02). The smallest pieces of debitage came from the sediments of Test Pits 1 and 3. Using the criteria defined at Econfina more than two thirds, 69.5%, of the debris was large and this was considerably more than any of the other offshore examples (Table 8.05). Only 20% of the items exhibited cortex. Four of the items exhibited bifacial retouch, but this flaking was minimal and no bifacial flakes were observed, nor were formal bifacial tools or preforms located. Four unequivocal cores were identified in the collections.

The attempt to sort the items to Sullen and Rozen debitage types in 1990 was unsuccessful because the majority of items (almost 93%) at Fitch would have been categorized as shatter or other (Table 8.04). Therefore, a robust sample of the items was studied to determine their salient characteristics (N=394) and an expedient system of nomenclature based on gross morphological characteristics was developed (Faught, 1990:15). From this analysis it was clear that five percent (N=21) of the items were unquestionably artifactual. That is, flakes with striking platforms and bulbs of percussion, items with multiple flake scars on the exterior of flakes, or cores with more than two interior scars of percussion[1]. Two examples of cores are shown in Figures 8.03a and 8.03b, and several flakes are shown in Figures 8.04a and 8.04b.

Another sixty eight percent of the items (N=268) represented faceted angular fragments of chert which appeared to be artifactual in nature either by elongation of shape or multiple fracture scars or both. However, upon closer scrutiny these items

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[1] The terms "interior" and "exterior" are also commonly referred to as "ventral" and "dorsal" but are considered better descriptors of the placement of the flake with respect to the core, and not to zoomorphic reference. Jelinek, personal communication.

revealed no bulbs of percussion or the interior scars of previous flakes. Examples of these kinds of items are also shown in Figures 8.04a and 8.04b. Another 23% (N=91) of the items were amorphous chunks of chert of equivocal origin (natural or manmade) and 4% were considered natural items.

The mechanism for a fracturing pattern of multiple angular facets without evidence of percussion is perplexing. Multiple working hypotheses to explain the high frequency of "percussion-less" breakage patterns include: frost, marine growth, salt evaporation, or heat fracturing. Percussion by human or natural agents is ruled out because of the lack of bulbs of percussion and the lack of rounding such as might be expected by high energy wave action.

Frost was ruled out because of the sub-tropical nature of the regional climate, even in the past. Wedging by marine growths could conceivably cause fractures, but there was no uniform evidence for it on the surfaces of fracture in the assemblage. Salt evaporation could have enabled the fracturing at a tide controlled shoreline. However, with all three of these processes the geofactual materials should be interlocked and rejoinable with the parent material, which was not the case. The chert items found at Fitch were jumbled when viewed near the bedrock as in Test Pit 1. Furthermore, the bedrock in this case was limestone and not chert. This process of elimination leaves the possibility of intentional heat fracturing as a potential explanation.

Because, the materials were jumbled when found together (that is, apparently not coming directly off of the parent material), because of the multiplicity and apparent regularity of flake scars on many items, and because there were other, unambiguous artifacts in close proximity, I offer the interpretation that many of these pieces were intentionally heat fractured, perhaps as a raw material procurement and processing technique. A similar process was described and tested by modern analog studies by Purdy (1981:94-97). A few of the items at Fitch also exhibited additional evidence for heat fractures in the form of spherical spalling. Further research and analysis will be necessary to confirm or revise this conclusion.

In addition to the chert artifacts and items, N=12 $CaCO_3$ cemented conglomerate sandstones were found at the Fitch Site, and these are virtually identical to those found at the Econfina Channel site reported above. Because they are not familiar in the local geologic setting, it is assumed that these too are manuports, but none exhibited identifiable use wear patterns. Faunal bone was found during excavations, but none in contexts implying association with the artifacts.

The chronological placement of the Fitch Site must remain vague, since no diagnostic items were found and no radiocarbon control is available. Human activity at the site certainly predates its inundation, which possibly occurred between 7,500 and 7,000 rcybp. This chronology is determined solely on the depth of the site in the water column and evidence for local sea level rise history presented in Chapter Seven regarding the J&J Hunt Site (cf. Figure 6.02). The flake cores presented in Figures

8.03a and 8.03b are quite large, as are some of flaked items. Several of the flakes are blade-like (Figures 8.04a and 8.04b). These characteristics could be used to make an argument for Paleoindian or Early Archaic period activities having occurred at the site. The absence of formal tools or evidence for tool manufacture suggests that this site is a primary quarry, but the lower frequencies of cortex on the items is contradictory.

J&J Hunt Site (8 Je 740)

All of the chipped stones from the J&J Hunt Site were given unique numbers, counted, weighed, sorted to Sullivan and Rozen debris type and tabulated as to the presence or absence of cortex. Flakes and broken flakes (i.e. debris with intact striking platforms) were then subjected to a more detailed analysis to determine the raw material blank or preform type, and the regularities of reduction technique. Each item was also studied so as to identify possible use wear and an attempt was made to refit the debris, but without success. Several pieces appeared to come from identical source rocks, representing perhaps five or six stones, but no actual refits were found. Tools and other retouched items found at the J&J Hunt Site are illustrated in Figures 8.05a through 8.09b. Faunal bone items are shown in Figure 8.10.

Context

The J&J Hunt Site formally includes those artifacts found in two distinct clusters near the margins of the head of the Aucilla paleochannel segment at Locus L_1 designated Areas A and B and shown in Figure 7.30 through 7.33. However, other sediment samples and encounters of isolated artifacts have also occurred in other areas of the paleochannel. These include the Stump and Area C, both located near Locus L_2, (Figure 7.33). In all, a total of 63 hand fanned collection units of 50 by 50 centimeter (.25 m^2) size were sampled to depths of 20 centimeters in the paleochannel area. Induction dredge testing included a one meter square excavation unit at the Stump, and a four meter square test pit in the sinkhole at Locus L_1. These were described in Chapter Seven.

All of the artifacts were found in the marine sand and shell hash sediments of the paleochannel margins. The artifacts were found in sediments amongst the rough textured bedrock exposures and karst voids of the channel margins of the paleochannel. These sedimentary contexts were most similar to the Econfina Channel Site contexts, but on larger scale. One exception to this is two pieces of chert debitage found in the zone of dark organics exposed in Test Pit 1, Locus L_1 in the Aucilla paleochannel.

Character

Five hundred thirteen artifacts were collected from area A, 165 from Area B. However, the artifacts at Area A were more dispersed with an average of three items per cubic meter, versus a more concentrated collection at Area B with a density of almost nine items per cubic meter. The range of weights was 377.4 grams to .1 of a gram at Area A, and 187.6 grams to .1 of a gram at Area B. The average weight of materials from A was 13.8 grams, and from B was 7.2 grams. Area A exhibited more

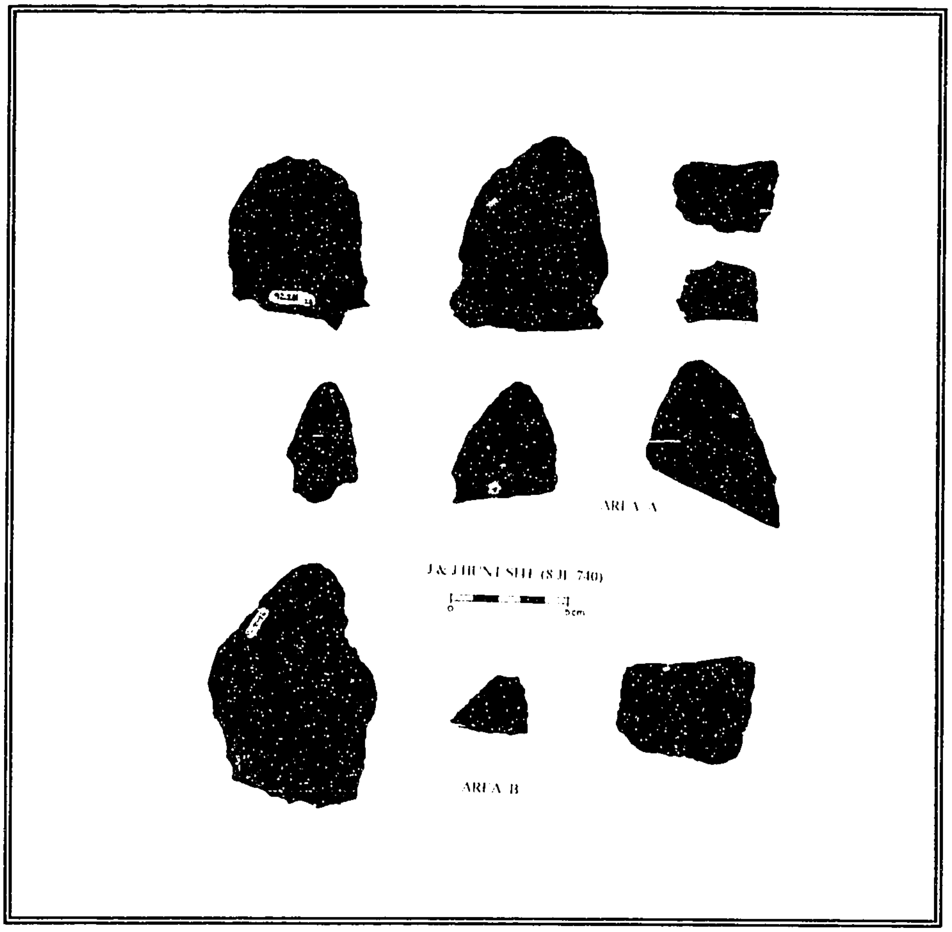

Figure 8.05a **Biface tools from the J&J Hunt Site (obverse)**

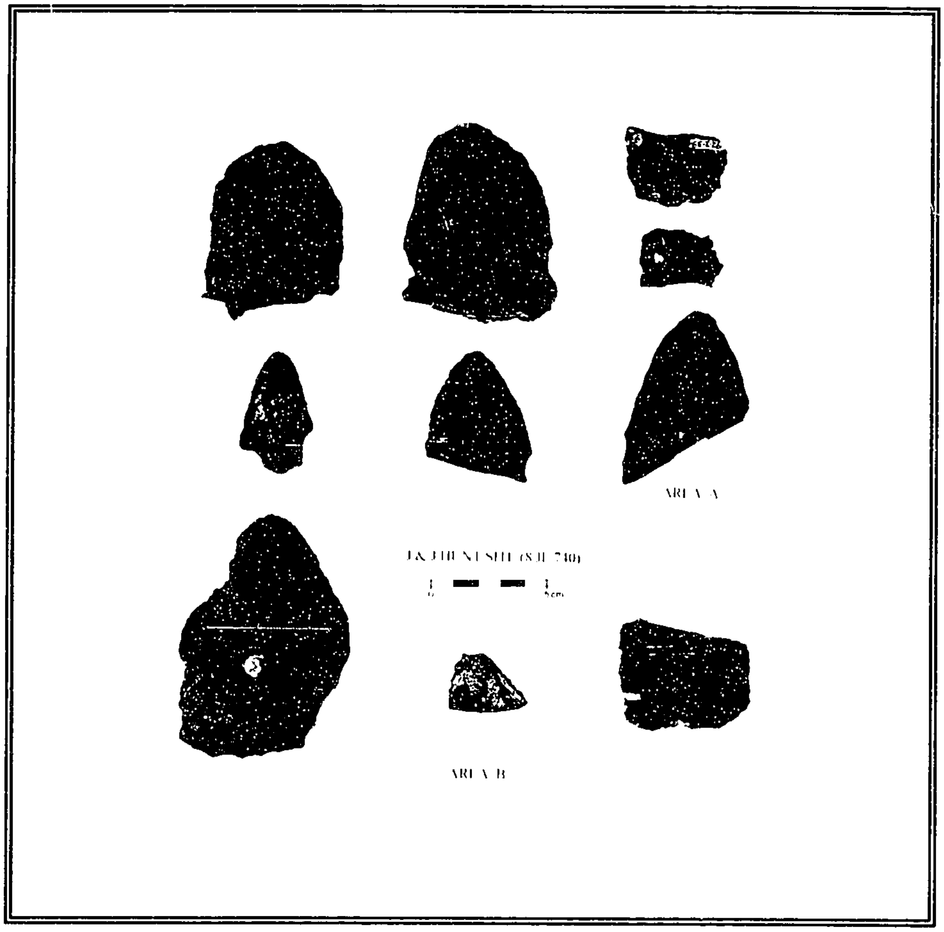

Figure 8.05b Biface tools from the J&J Hunt Site (reverse)

variation in the mass of artifacts ($\sigma=40$) than Area B ($\sigma=21$) (Table 8.01). The standard deviation of weight at Area A was 40 grams, and 21 grams at Area B.

Chipping debris constituted 95% of the artifacts at Area A and 95.5% at Area A (Table 8.02). At Area A 23% of the items retained cortex, 26% at Area B. The frequency of biface flakes was similar from the two areas, on the order of 12% of the whole sample at Area A, and 15% of the whole at Area B. These figures are similar to the inventory from the Econfina Channel Site. Tools represented 5.3% of the assemblage at Area A, 4.8% at Area B. The Sullivan and Rozen debitage type distributions were essentially identical between the two Areas and both locations exhibited very low frequencies of shatter (Table 8.03). At Area A 12% of the items were large, but only 5% were large at Area B. At Area A 32.5% of the large debris exhibited cortex, but only 7% of the large pieces from Area B retained this marker.

Tools represented 5.3% of the assemblage from Area A and 4.8% from Area B. Seven bifacially flaked items were found at Area A, including an unfinished or degraded Bolen or small Kirk projectile point (Bullen, 1975; Figures 8.05a and 8.05b, center left). Two broken biface fragments resemble broken bifacial adze bits (Figures 8.05a and 8.05b, upper right, Gerrell et al., 1991; Morse and Goodyear, 1973). Three biface fragments were found at Area B, including the base of a Suwannee Preform, a probable Paleoindian diagnostic (Figures 8.05a and 8.05b, bottom right). Similar artifacts are described and illustrated from Harney Flats, a Paleoindian and Early

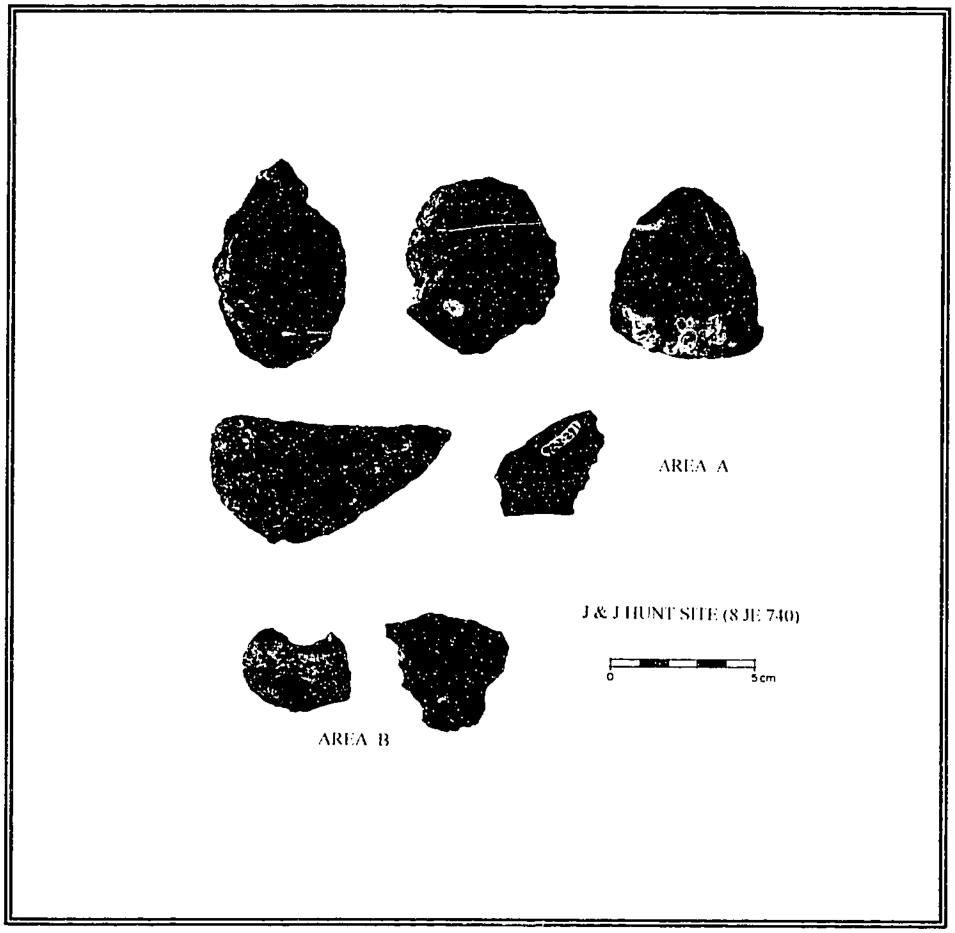

Figure 8.06a Unifacial tools from the J&J Hunt Site (obverse)

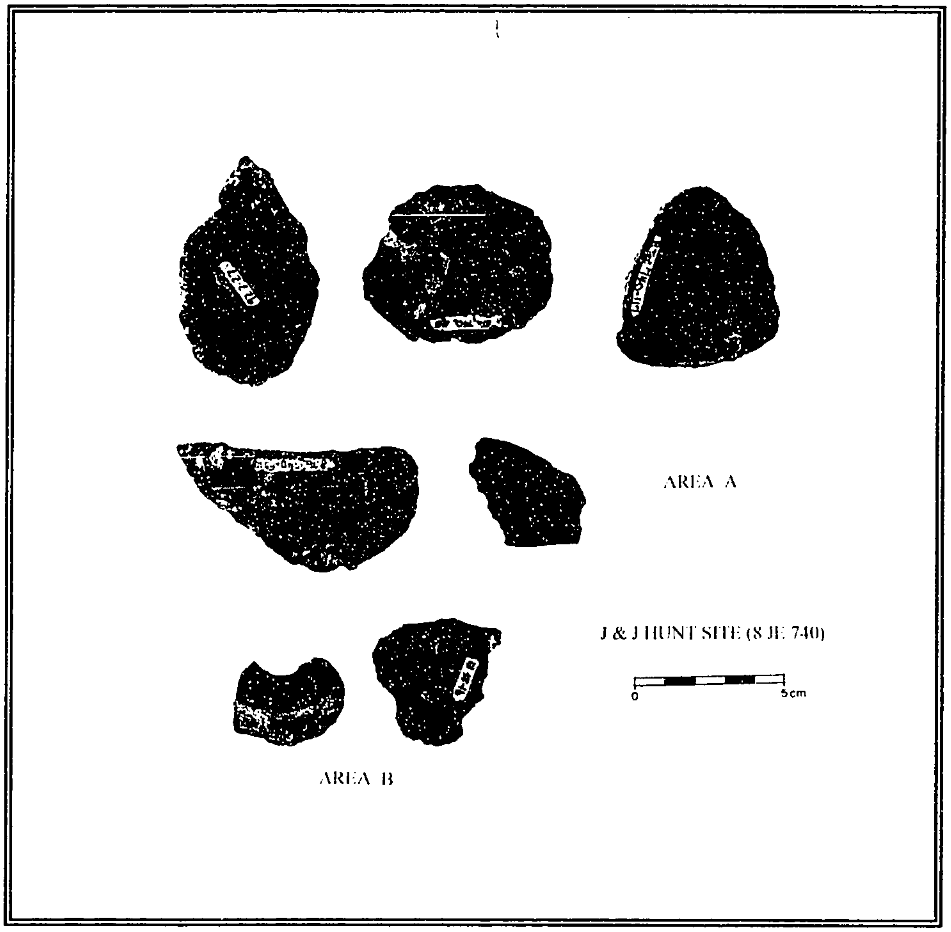

Figure 8.06b **Unifacial tools from the J&J Hunt Site (reverse)**

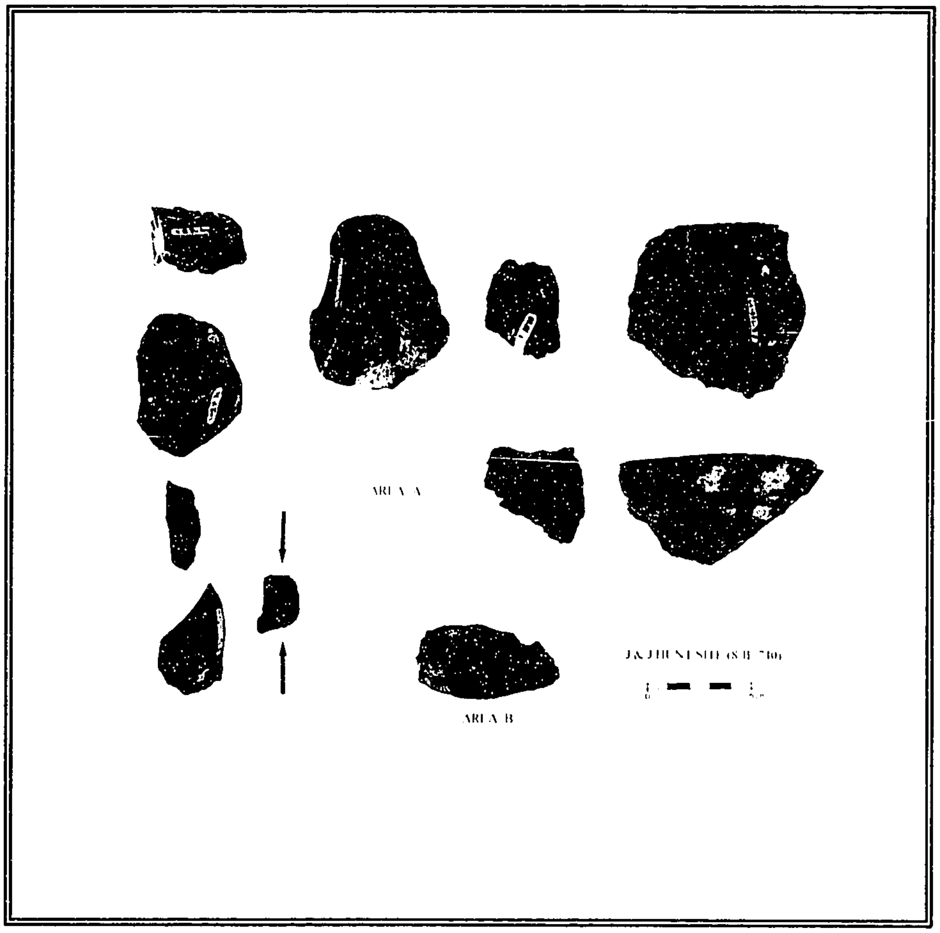

Figure 8.07 Cores and battered stones from the J&J Hunt Site

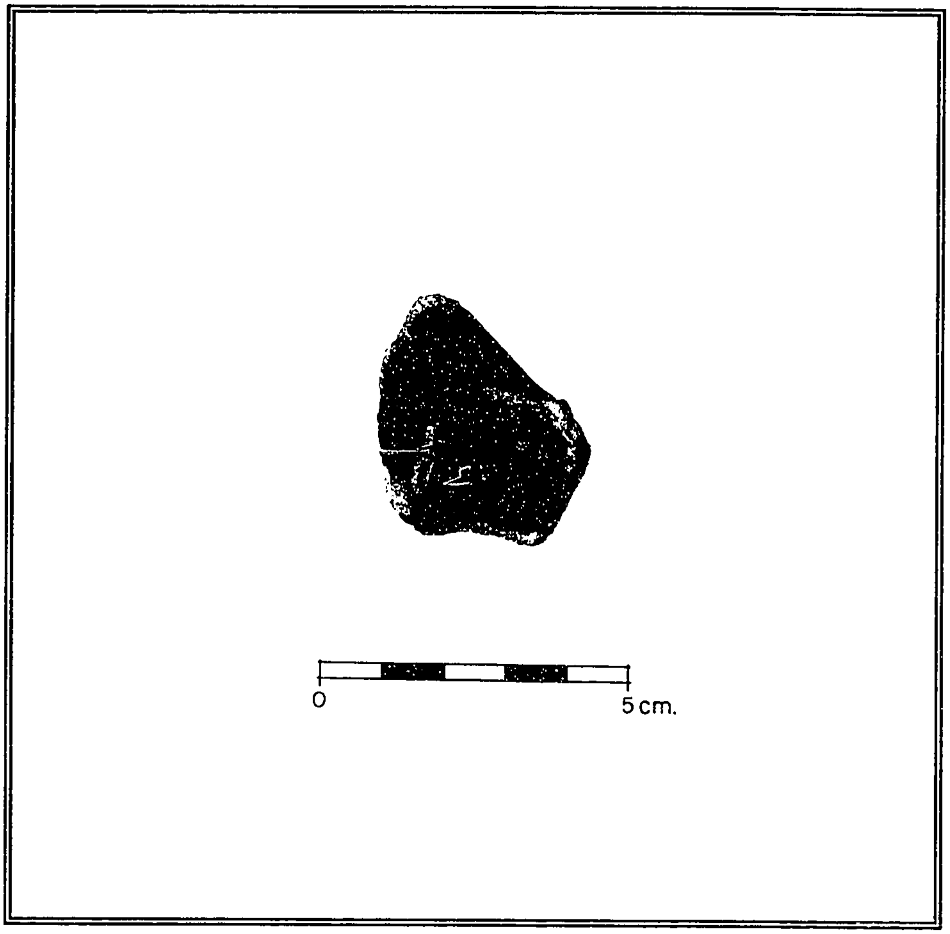

Figure 8.08a Fluted biface base from Area C, J&J Hunt Site (obverse)

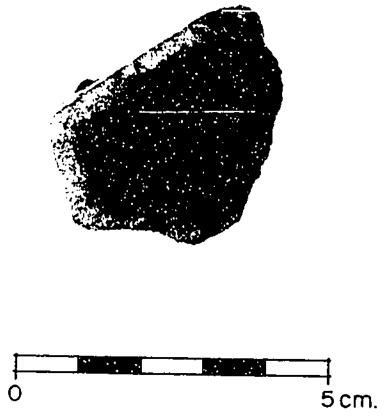

Figure 8.08b Fluted biface base from Area C, J&J Hunt Site (reverse)

Figure 8.09a **Indeterminate projectile point from the Stump Area (obverse)**

Figure 8.09b Indeterminate projectile point from the Stump Area (reverse)

Archaic archaeological site near Tampa Bay, Florida (Daniel et al., 1986; Daniel and Wisenbaker, 1987:52).

In addition to the bifaces from Areas A and B, two other isolated, bifacially chipped stones were found near Locus L_2. One of these was a fluted biface base found at Area C in 1991 (Figure 7.32; Figures 8.08a and 8.08b; Faught et al., 1992) and the other was an indeterminate Florida Archaic Stemmed projectile point found near the Stump excavations in 1992 (Figure 7.32; Figure 8.09a and 8.09b).

Four unifacial scrapers were found at Area A, including one severely degraded Hendricks scraper (Purdy, 1981, Figures 8.06a and 8.06b, center left). Hendricks scrapers are known from the Bolen Bluff and other Early Archaic archaeological sites (Bullen, 1958; Bullen and Dolan, 1959; Purdy, 1981:18-20; cf, Chapter Six). Two other unifacial scrapers came from Area B, one of which resembles a thumbnail scraper diagnostic of Paleoindian assemblages (Figures 8.06a and 8.06b, lower left).

Hammer stones, abraded cores, core fragments and other miscellaneous retouched chipped stones make up the remainder of the tools category from each Area (Figure 8.07). One chunk of chipped stone found at Area A exhibited bipolar fracturing representative of a wedge or *piece esquillee* (Lothrop and Gramly, 1982; Goodyear, 1993; Figure 8.07, lower left with arrows showing the bipolar bashing).

Thirty three of the flakes and/or broken flakes were considered to be blade-like flakes in the sense that their length was well more than twice their width and flake scars on the exterior surface were multiple and parallel (N=29 (5.6%) at Area A, N=4 (2.4%) at Area B). Of these flakes, 21 had flat platforms, and generally unprepared platform edges and flat edge angles. These characteristics also imply the possibility of intentional blade making. The remainder of these blade-like flakes had faceted or biface platforms and somewhat acute platform angles.

Several faunal bones were found amongst the collections at Areas A and B including manatee, extinct panther, and other, small fragments of indeterminate long bone (Figure 8.10). These latter items may be debris from bone pin manufacture or they may be food refuse, or both. No bone was found in the sediment collections outside of the artifact cluster boundaries. The proximal end of a broken deer antler was found at the Stump near Locus L_2. The antler break was not controlled, and there were no cut marks evident. Whether this is a cultural item or not remains ambiguous.

The majority of the tools found at Area A, including the Hendricks scraper, the possible Bolen or Kirk projectile point, the unifacial scrapers and the bipolar wedge suggest a range sometime between 10,000 to 9,000 rcybp, that is the Early Archaic period. The presence of Paleoindian diagnostics such as the fluted biface base at Area C and the Suwannee preform and thumbnail scraper at Area B, are indications that Paleoindians were in the area at some point as well. The presence of a Florida Archaic Stemmed point, and the few chipped stone artifacts from the excavations at Test Pit 1, Locus L_1 suggest that people were also in the area when the site was being inundated

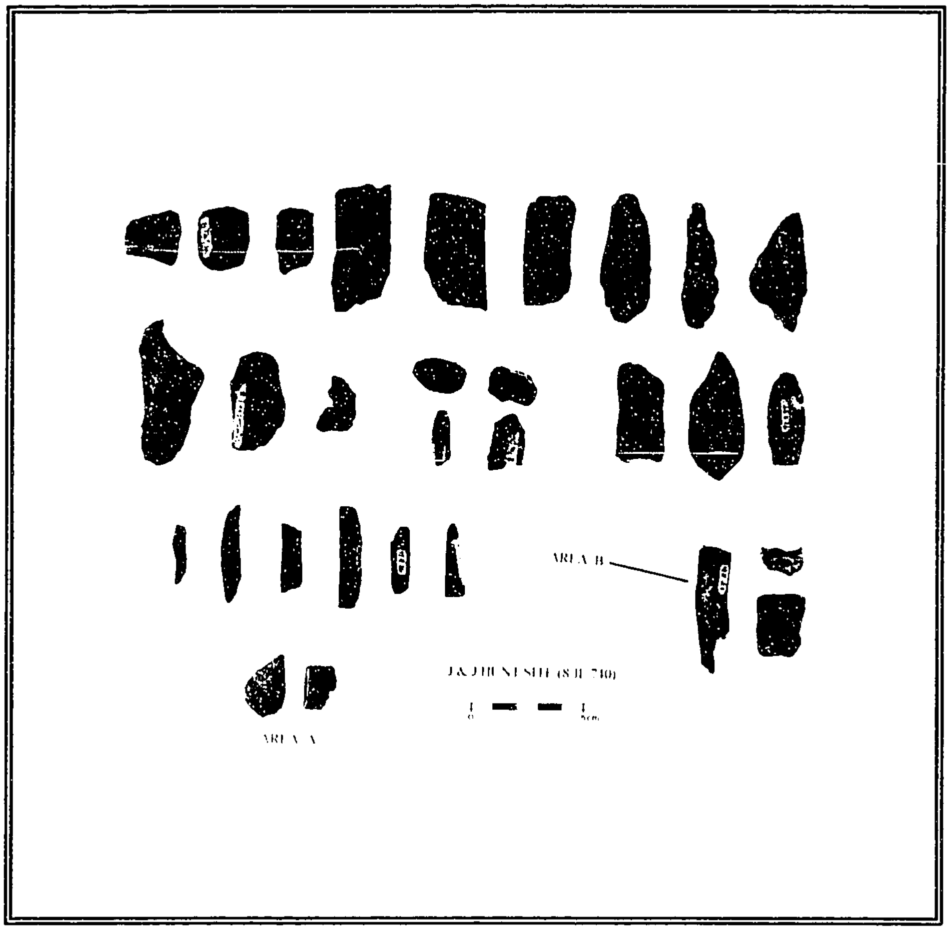

Figure 8.10 Faunal remains from the J&J Hunt Site

between 7,000 and 6,800 rcybp based on data presented in Chapter Seven. This chronology will also be discussed further in Chapter Nine.

Summary of the Artifact Weight Analysis

The weighing of each item of chipped stone debitage at these sites had two purposes. The first was to identify possible artifact sorting by the inundation process. For instance, debitage sizes from Econfina and J&J Hunt are diverse within any particular collection unit, implying minimal horizontal sorting since their discard. This is considered true because the largest chunk of chert was associated with the smallest flake fragment. On the other hand, the size distributional data also showed that there may have been natural sorting at the Fitch Site (Figure 7.29).

The second reason to study the weight characteristics of a lithic assemblage is based on the observation that size distributions of chipped stone debitage have distinct shapes that can be used as a marker for the type, or stage, of lithic reduction activity which produced the array. Patterson (1990) has published experimental data that shows flake size distributions for bifacial reduction produce curve forms with exponentially higher percentages of small flakes. Debitage size distributions from primary reduction activities are more variable across the size spectrum. Other researchers have observed similar characteristics including Ahler (1989) and Stahle and Dunn (1982).

Figure 8.11 compares the distributions of weight at Econfina Channel, Fitch and from Areas A and B at the J&J Hunt Site. This figure shows that the collections from

Econfina and the J&J Hunt Site reflect curves with exponentially greater numbers of small debitage, indicative of bifacial reduction activities, and in agreement with interpretations from other data presented above. This same conclusion is not true at the Fitch Site, where there is a more variable distribution of size, and over 50 percent of the items are larger than the 42 gram cutoff of the graph axis. Areas A and B at the J&J Hunt Site are virtually identical in size distributions, but Area A is slightly more variable and exhibits more larger debris, as does the Econfina Channel Site debris.

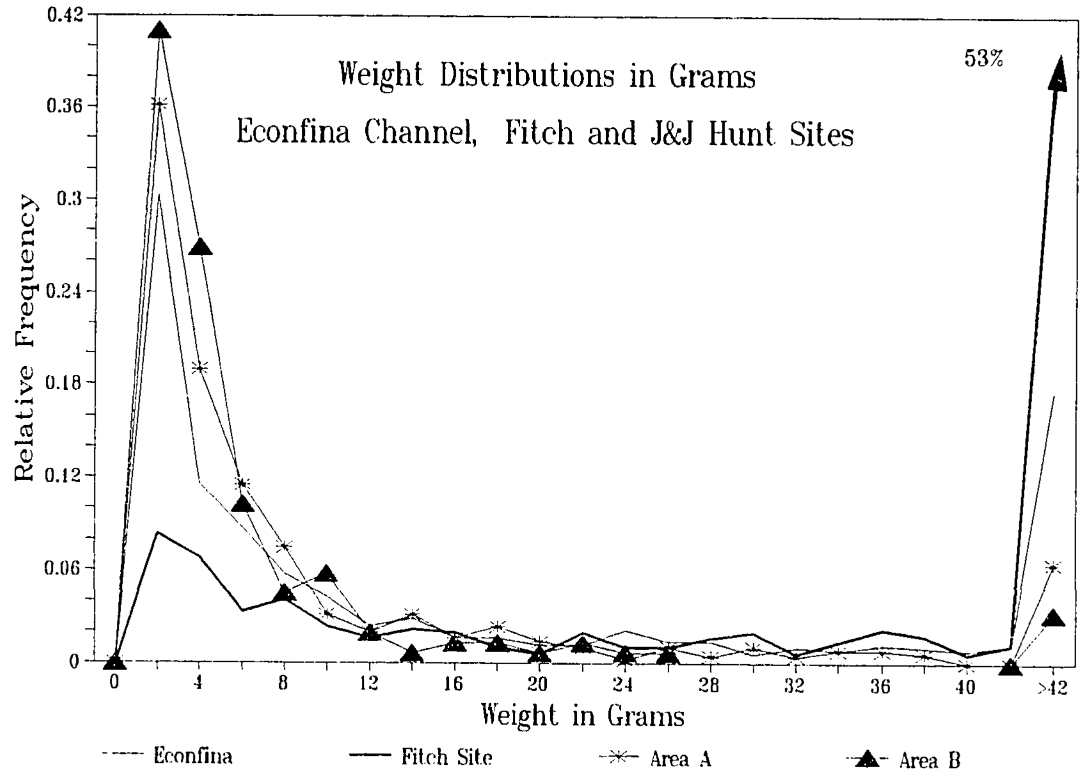

Figure 8.11 Weight distribution comparisons: Econfina Channel, Fitch, and J&J Hunt Sites

Analysis of the Reduction Strategies at Areas A and B, J&J Hunt Site

More analytic attention was paid to the flakes and broken flakes at Areas A and B at the J&J Hunt Site in order to detail the reduction strategies and raw material forms used by the flint knappers. This study was based on the assumption that characteristics of lithic debris can reveal the form of the raw material and the items being made or altered, or both, at the site (Table 8.01). This should be true even if the tools resulting from the reduction activities are missing from the collections, or if the original context was deflated by sea level transgression, as proposed in Chapter Seven for this site. Furthermore, it may be possible that characteristics of the reduction sequence will aide in the determination of the chronology or the ethnic affiliation of the inhabitants of the site given a larger sample of data from other sites in the future.

The attributes of raw material reduction considered most appropriate to do this analysis follow Wilmsen (1970) and include categorical data describing the striking platform, the condition or preparation of the core edge before the blow and characteristics of the bulb of percussion after the blow. Evidence for the strength and angle of the percussive blow were determined from platform angle and platform width metrical data. More detailed descriptions of these attributes are presented in Table 8.06. Summaries of the results are presented in Tables 8.07 through 8.09.

Some general observations from this study include the fact that bigger flakes in the sample tend to have plain/flat and faceted platforms with no edge treatment, light flaking or crushing, thicker platforms and flatter platform angles (weight $\bar{x}=10.2$ grams, width $\bar{x}=.54$ centimeter, angle $\bar{x}=71.5°$, $N=173$). These flakes were probably removed from block or tabular cores with strong blows, in preparation for more intensive bifacial reduction.

Biface platforms, on the other hand, include smaller flakes, with mostly rounded and crushed edge treatment, scars of previous flake removal events, thinner platforms and more acute platform angles (weight $\bar{x}=4.5$ grams, width $\bar{x}=.28$ centimeter, angle $\bar{x}=64.5°$, $N=59$). These kinds of flakes indicate clear evidence for biface reduction activities.

In the combined sample, 38% of the platforms were plain/flat. Faceted/flat and faceted/biface platforms followed in frequency at 27% and 28% respectively. Seven percent of the platforms were indeterminate. Chipping debris with plain/flat platforms were slightly more frequent at Area A than at Area B (40% versus 33%), which is mirrored by the presence of more faceted/biface platforms at Area B (36% at B versus 26% at A). These data indicate the possibility of different reduction strategies or behaviors for the two sample domains.

Chipping debris exhibiting no edge treatment and those exhibiting edge crushing were equable at both areas. However more abrasion and rounding were tabulated at Area B (25.4% at Area A versus 35.7% at Area B). This characteristic is consistent with the technique of rubbing the edge of a biface before removing a thinning flake.

Table 8.06 Variables studied from the J&J Hunt sample

Character Description, Explanation	Justification for Analysis
Provenience data These data included PD/FS and the individual case #. All lithics were labeled with these numbers.	The need to return to specific items for verification of confusing records can be facilitated by this means. Also future researchers can benefit in reanalysis endeavors
Platform Type Categories of platforms were either: "plain/flat", meaning no evidence for flaking or variation in the surface of the platform, "faceted/flat" meaning variation in platform topography from an irregular or possibly flaked surface, or"faceted/biface" platforms which exhibited scalloped flake scars indicative of previous bifacial flaking from the core. Categories also covered items with cortex or flaws or which were simply indeterminate.	Evidence for the character of the source rock (e.g. biface, cobble or block). Flat and faceted/flat platforms imply that the source material was a block or flat surfaced core. Faceted/biface platforms, on the other hand, show clear flake scared platforms retaining the biface morphology.
Platform edge treatment Categories included no edge treatment, "crushed" edges and "light flaking" (items exhibited step fractures or small conchoidal fractures with 10 x magnification). Abraded and rounded edges are treatments which can be misinterpreted as usewear. Cortex/flawed, or indeterminate categories were also available.	This category relates to the treatment of the edge before the blow is made. Evidence for use would be discovered in this category - the main purpose is to look for evidence for tool edge maintenance in the form of polished and rounded edges.
Platform angle Edge angle determination follows Wilmsen, 1970, namely determination of the central axis of the flake versus platform from the exterior of the flake in silhouette, angles were determined from an angle wheel and rounded to 5° intervals.	Evidence for blow angle, stage of lithic reduction (especially tabular core versus biface reducing)
Platform thickness Platform thickness was measured in mm from the approximate center of the bulb (interior) perpendicular to the axis of the flake to the outside edge (exterior).	The thickness of the flake can be used as evidence for the blow force, a way of characterizing the reduction regularities.
Bulb character Categories included "lipped", not lipped, and indeterminate	Lipped bulbs <u>may</u> be evidence for soft hammer reduction, especially when combined with edge angle and treatment data

Table 8.07 Tabulation of platform type and Edge treatment frequencies

Numbers across represent the platform types, numbers down the edge treatments					
Platform Type > Edge Treatment v	Plain / Flat	Faceted / Flat	Faceted / Bifacial	Cortex, Flaw Indeterminate	Totals (N) Percents (in parentheses)
None	49 Area A=41 Area B= 8	21 Area A=14 Area B= 7	10 Area A= 6 Area B= 4	2 Area A= 2 Area B= 0	N=82 (26.1%) Area A=63 (26%) Area B=19 (27%)
Light flaking	23 Area A=22 Area B= 1	8 Area A=8 Area B= 0	1 Area A=1 Area B=0	0	N=32 (10.2%) Area A=31(13%) Area B= 1(1%)
Crushed	31 Area A=22 Area B= 9	41 Area A=33 Area B=8	15 Area A=11 /4)	3 Area A=3 /0)	N=90 (28.6%) Area A =69(28%) Area B = 21(30%)
Abraded / Rounded	9 Area A=5 Area B=4	11 Area A=7 Area B=4	59 Area A=43 Area B=16	8 Area A=7 Area B=1	N=87 (27.7%) Area A=62 (25%) Area B= 25 (36%)
Cortex or Flaw	8 Area A=7 Area B=1	3 Area A=3 Area B=0	3 Area A=2 Area B=1	9 Area A=7 Area B= 2	N=23 (7.3%) Area A=19 (8%) Area B= 4(6%)
TOTALS	N=120 (38.2%) Area A=97 (40%) Area B= 23 (33%)	N=84 (26.7 %) Area A= 65 (27%) Area B= 19(27%)	N=88 (28 %) Area A= 63 (26%) Area B= 25(36%)	N=22 (7 %) Area A= 19 (8%) Area B= 3 (4%)	N=314 Area A=244 Area B=70

Table 8.08 presents the data on edge angles, the average of which was 69.3°. Again, a difference occurs when the assemblages of the two areas are compared. In general, there were more acute edge angles at Area B ($\bar{x}$=69.8°) than at Area A ($\bar{x}$=67.6°), which is a reflection of the increased frequency of biface reduction from biface preforms or biface tools at Area B. The distribution of edge angles from Areas A and B are presented in Figure 8.12. This graphic reveals a bimodal signature at Area B, with a peak around 40° and another at about 70°.

Table 8.08 Platform angle and thickness

Site	$\bar{x}$ Platform Angle	x Platform Thickness	x Weight (whole flakes only)
Area A	69.8	.47	8.9
Area B	67.6	.37	4.8
Combined	69.3	.45	8.0

Table 8.08 also presents a summary of the data gathered on platform thicknesses, the average of which was .45 centimeter. Artifacts from Area A tended to be wider (.47 centimeter) than those from Area B (.37 centimeter) and by this data a portion of the debitage from Area A represents reduction with stronger blows from cores. Narrower platform angles at Area B indicate that less robust percussion, possibly soft hammer biface flaking was taking place more often at Area B.

Table 8.09 shows the distributions of lipping observed on the bulbs of percussion. There is a slightly lower frequency of lipping at Area A (44%), compared to Area B (50%). The Plain/flat and faceted/flat platforms, with no edge treatment or with light flaking or crushing, tend to have fewer flakes exhibiting lipped bulbs suggesting hard hammer reduction. Seventy percent lacked this attribute from a sample of N=173 plain or faceted flat platforms. On the other hand, 71 % of faceted/biface platforms with rounded and crushed edge treatments, that is unequivocal biface flakes, did exhibit lipping. Edge angles of lipped flakes were also narrower than the overall averages. These distributions are consistent with the notion that bifacial reduction usually takes place with a soft hammer, such as an antler billet, and that soft hammers can (but don't always) produce lipped bulbs of percussion.

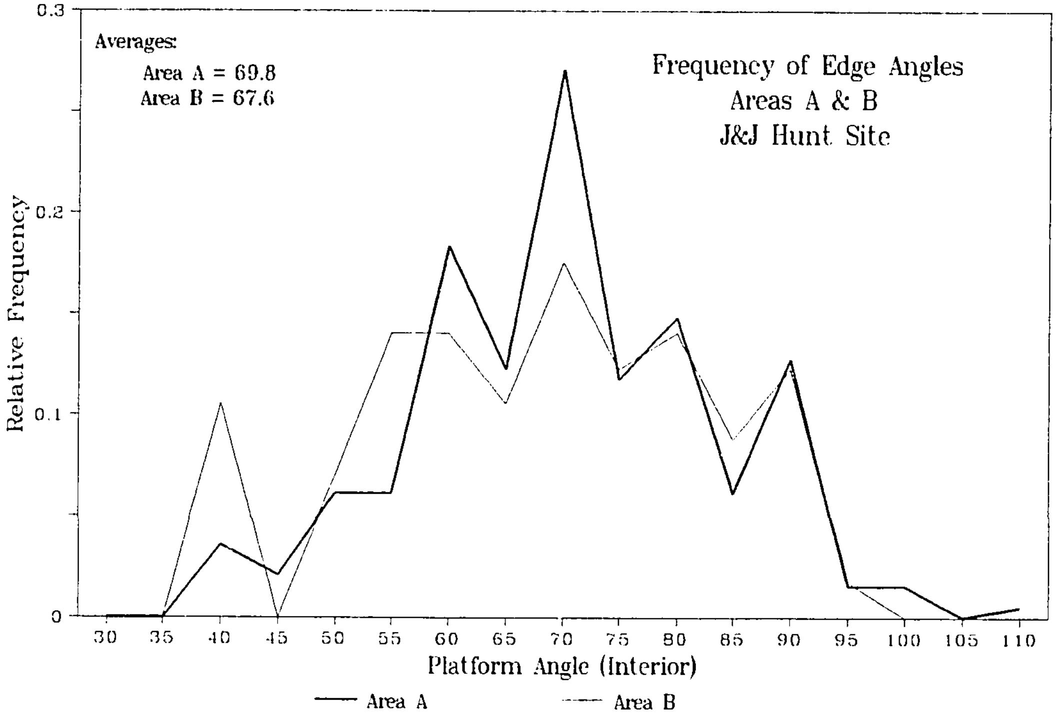

Figure 8.12 Distribution of edge angles: Areas A and B

Table 8.09 Frequency of lipping at Areas A and B, J&J Hunt Site

Site	Frequency of Lipped Flakes	$\bar{x}$ Weight of Lipped Flakes	$\bar{x}$ Platform Angle Of Lipped Flakes
Area A	43.8%	8.5	66.0
Area B	50%	4.1	64.6
Combined	45.2%	7.4	65.7

Given principles presented in Table 8.01, the results of this analysis suggest that both of these areas represent loci of secondary reduction activities. That is, areas where lithic reduction was taking place after raw materials had been gathered from other locations. This conclusion is based on lower frequencies of cortex on all of the items, the low frequency of the debitage category of shatter as presented in the general inventories above and the lack of nearby chert outcrops. It is suggested that bifacial reduction took place at both Areas, but that there is additional evidence for secondary reduction from block or tabular cores at Area A, and more limited evidence for reduction from bifaces at Area B. Just what items or tools were being made, beyond biface preforms, at either locale was not determined. Tertiary reduction activities, that is, tool edge maintenance activities, are not indicated because there is a lack of exhausted tools and only 21 flakes were tabulated as edge maintenance or use worn items during the detailed analysis. Most of these items occurred at Area A.

The differences between chipped stone attributes from the assemblages of these two areas can be interpreted as differences in reduction strategies. Whether these differences stem from contemporaneous, but distinct activity areas around the sinkhole, or whether they represent separate chronological events, or both, is an interesting question. The evidence from Area A for reduction from block or tabular cores and biface reduction activities is associated with diagnostics representing an Early Archaic occupation in the form of the possible Bolen point and the Hendricks scraper (Figures 8.05a and 8.05b, center left; Figures 8.06a and 8.06b, center left). The more restricted evidence at Area B for reduction of biface preforms is associated with evidence for Paleoindian presence in the form of the Suwannee preform and possibly the small unifacial scraper (Figures 8.05a and 8.05b, lower right; and Figures 8.06a and 8.06b, lower left). This interpretation is presented as an hypothesis in need of further data collection and analysis, but it points out the benefits of detailed debitage analysis.

This chapter has presented a description and analysis of artifacts found at three prehistoric sites found underwater. The fact that behavioral differences (reduction strategies) can be discerned between the three clusters of artifacts located at the Econfina Channel Site and at the J&J Hunt Site, after many thousands of years of inundation is encouraging for future underwater prehistoric sites research. These data confirm the notion that studies of artifact arrays altered by sea level rise are warranted and that activity areas and other cultural data might still be determined from these kinds of collections.

In Chapter Nine I present a synthesis of the offshore data presented regarding the offshore research. These discussions are focused on several research questions presented in Chapter Five regarding the character and utilization of past land forms, the identity of the past inhabitants in relation to groups known onshore, the sequence and amplitude of inundation and the concomitant alteration of the local environment and the archaeological sites. I will conclude the dissertation with some final discussions regarding the relationship of this research with the issues of the Peopling of the New World, presenting a new testable model of colonization based on the data presented in Chapter Three.

Chapter Nine

CONCLUSION

This dissertation has dealt with two broad issues: the colonization of the New World by people who made fluted points and the development of a continental shelf underwater archaeological project to find more of their sites. In the first four chapters I presented a robust inventory of isolated fluted points, Paleoindian archaeological sites and radiocarbon controls. From this data, I attempted an alternative reconstruction of the pattern and process of fluted point Paleoindian colonization. Past climatic and geologic data relevant to the conditions that pertained at the end of the Pleistocene were described, and a proposal was made about what motivated people to enter the continent.

I also pointed out the ways in which these processes may have altered the geological visibility of sites, and in particular the inundation of the continental shelves during deglaciation and the possibilities of finding prehistoric sites underwater. Paleoindian and Early Archaic archaeological sites were predicted to exist underwater on the continental shelves of North America, given the combined archaeological and geological data presented. This was especially true in the Gulf of Mexico and along the Eastern Seaboard of North America. I proposed that datable, possibly early, examples of fluted point sites might be found in these areas.

In the last four chapters the history and principles of continental shelf, marine inundated prehistoric archaeology were laid out and a particular region of Northwestern Florida was identified to search for marine inundated prehistoric archaeological sites - the Apalachee Bay. This portion of the Floridian continental shelf is a drowned karst plain offering several overlapping opportunities for the discovery of inundated Pleistocene and Holocene age archaeological sites. The geological, paleoenvironmental and cultural historical backgrounds of the region were described and I presented a narrative history of the offshore research undertaken from 1986 to 1992. The results of geoarchaeological and archaeological analyses applied to the data gathered during the offshore research were then discussed and illustrated.

As presented in Chapter Five, this dissertation research was concerned with gathering data for the reconstruction of past land forms and developing a history of the inundation process. It was also concerned with the reconstruction of the culture history and changing settlement patterns of the human occupants of this inundated region. While the specific goal of locating *in situ* Paleoindian materials in datable stratigraphic contexts offshore was not met, evidence was presented that demonstrates both Paleoindian and Archaic human presence on the continental shelf to a distance of at least 10 kilometers (6.2 statute miles) offshore.

The geoarchaeological approach facilitated the reconstruction of a portion of the past drainage system and confirmed the preservation of stratigraphy in inundated karst features. The data gathered also allowed the reconstruction of a portion of the sea level history for this local area and the pollen analysis revealed some aspects of the changing floral environment that occurred as a result of the inundation. The discovery and assessment of the archaeological sites augments the local cultural history and offers some site formation processes associated with inundation in a karst controlled environment.

Reconstruction of the Paleodrainage System and Site Discovery

The single most important principle tested and confirmed during the course of this research was the use of local terrestrial analogues to discover inundated archaeological sites. There can be no more important aspect of any region with respect to human habitation as the local water resources. Thus, the reconstruction of past drainage systems is a vital first step to begin the search for marine inundated prehistoric sites (Gagliano, 1982; Pearson et al., 1986). Subbottom profiling remains the primary tool for reconstructing past fluvial features. When confronted with massive areas of land submerged by Holocene sea level rise, it also reduces the size of the areas to target for initial diver survey.

Side scan sonar could also be used to discover past drainageways, especially given data presented in Chapter Seven regarding the distribution of finer sediment particles over the paleochannel systems. However, no stratigraphic understanding is gained with this medium. There is also a potential for the use of aerial photography to reconstruct relict topography, if it is undertaken with certain caveats. The benefits of aerial photographic analysis were limited for this research, but a sea floor imaging program could resolve potential problems by initiating flights only with overlapping conditions of clear water, smooth seas, appropriate sun angles, and visible navigational markers in the study area. With this kind of control, features discovered could be returned to for further scrutiny.

Portions of the paleodrainage system reconstructed in Figure 7.18 offer several areas for future research. First, the channel segment of the paleoAucilla, near the J&J Hunt Site, also reconstructed in Figures 7.31 and 7.36, represents the best known offshore geomorphological feature and the most potential area for future research. This single location could probably be returned to for many field sessions without exhausting research the potentials of channel margin transects, vibra-coring or induction dredge excavation.

Referring to Figure 7.11, other potential areas for diver scrutiny include the major channel features between Loci Q-R-S and T (also identified on the 1984 Seagrass Study aerial photos, Figure 7.04), the channel margins near Loci BB and Y farther out to sea, and the possible shell mound (also near Locus BB, Figure 7.12). These areas represent locations for diver surveys and collection transects of channel margins, and deeper sediments for vibra-coring and excavations within and outside the channels. Continued archaeological reconnaissance will surely reveal more inundated sites.

Local Sea Level Inundation

As presented in Chapter Five, a component of the research design for this dissertation was gathering data useful for the construction of a local sea level curve. No such local curve existed at the onset of this research, however most researchers agree that because of tectonism, isostasy, and compaction of sediments, local sea level curves are necessary to understand local sea level histories (Fletcher, 1988:324; Morner, 1971; 1984; van de Plaasche, 1986).

As presented in Chapter 4, the possibility exists for a sea level stillstand or regression during the Younger Dryas (YD) climatic reversal between 11,000 and 10,000 rcybp (cf. Figure 4.01). While no direct data regarding this issue was gathered offshore, at the Page/Ladson Site the major stratigraphic break of sediment induration, pedogenesis and Bolen aged artifact arrays interrupt deposition of calcitic clays. These geomorphological characteristics imply lowered base levels and subaerial exposure between 10,600 and 10,100 rcybp (Chapter 6 and Table 6.11). This exposure could conceivably be recording sea level regression in the YD, and not a stillstand as inferred by Frazier (1974) (Figure 6.2). As discussed in Chapter Four, this possible regression demands further scrutiny and testing.

There is another curious aspect which resulted from the background research done for this dissertation, discussed in Chapter Six, and also in need of further investigation. This is the possibility of a Holocene sea level regression sometime between 9,000 and

7,000 rcybp. This regression has been proposed on the basis of western Gulf of Mexico sea level markers by Curray (1960) and Nelson and Bray (1970) and is shown in figure 6.02 . This regression is counter-intuitive to the early Middle Holocene conditions of generally increased temperature and related glacial melting known as the Hypsithermal in the East and the Altithermal in the West. However, stratigraphic markers implying dry or desiccated conditions exists in terrestrial exposures in several western Floridan sites, such as Camel Lake, Harney Flats, Warm Mineral Springs and Little Salt Springs. The results of this sea level lowering could represent an analogy of the effects of environmental degradation and possible population withdrawal from coastal areas undergoing desiccation and salinization during the Kirk age frame, sometime after 10,000 and before 8,000 rcybp (Chapman, 1985). No data was gathered during the offshore research with which to address this issue.

The primary sea level indicators that have come from this offshore research include the radiocarbon dates from small sticks of wood retrieved from the brackish water sediments in the sinkhole at Locus L_1 (Figure 7.32; 7.34; 7.38). Secondary indicators include the stump and oyster shells found at Locus L_2 (Figure 7.37) and the isolated wood fragments found in the marine sediments at J&J Hunt and Econfina Channel (Table 7.18). These data points are illustrated in Figure 6.02 and summarized in Table 7.14.

These data indicate that fresh water (terrestrial) conditions existed at least until the death of the stump at 7,240 +/- 100 rcybp, that fresh water fine-sandy gray clay was still forming in the karst voids around 7,000 (average of 4) and that brackish conditions accrued by 6800 (average of 2) at a depth of 21' BSL (TP 1, L_1). Water logged limb wood in marine sediments, without evidence for organic rich brackish sediments, occurred at a depth of 3.6 meters (12 feet) BSL at the J&J Hunt Site and returned a date of 6,100 rcybp. Wood from similar stratigraphic settings at Econfina Channel returned a date of 5,100 rcybp at a depth of 5' BSL (Table 7.14). The hypothesis is that these pieces of wood represent waterlogged flotsam deposited in nearshore, but fully marine conditions.

Other possible markers of sea level rise in the study area come from the Ray Hole Spring at a depth of almost 11 meters (35 feet) BSL. Oyster shells within the marine sediments returned a date of 7,390 +/- 60 and oak found below the marine sediments returned 8,220 +/- 80 (Anuskiewicz, 1988; Anuskiewicz et al., 1994). Thus inundation probably took place between these two secondary markers, for a radiocarbon average of 7805. The similarity of Ray Hole Spring and J&J Hunt exhibiting almost 1000 radiocarbon years between dates on wood found in the marine shell hash sandy sediments and the oyster shell is an interesting coincidence which might imply a rather lengthy process for a full transgressive sequence.

Comparison of these data with estimates made for the western Gulf of Mexico

(Figure 6.02) reveal that sea levels in the Apalachee Bay are uniformly higher (less deep) for similar time. This may be due to sampling error, to isostasy of the Ocala Uplift area (Opdyke et al., 1984), to subsidence in the western Gulf of Mexico due to sediment loading or to combinations of the three. Fairbridge (1992) has labeled the Floridian continental shelf as a semi-stable platform, as presented in Table 5.03, however the geological history of its response to meltwater loading has not been reconstructed. More data points will be necessary to resolve this chronology.

Knowing the rate of sea level rise is important in order to predict its impact on the environments and on human populations. If, as presented above, Ray Hole Spring (10.6 meters (35 feet) BSL) was brackish at 7805 rcybp and J&J Hunt (6.4 meters (21 feet) BSL) by 6,800 then water rose approximately 4.3 meters (14 feet) in 1000 years for a rate of .43 meters (1.4 foot) per one hundred years. However, the slope of Florida's western continental shelf is low, and changes in sea levels will have a greater horizontal effect. Since these sites are approximately 19 miles apart[1], the rate of land traversed would be about 3 kilometers (almost two miles) per one hundred years. This represents a lateral land loss of 612 meters (.4 statute miles) per human generation of 20 years and suggests that social groups might have been conscious of and, having to respond to, broadening estuaries during the transgression process.

The floral environment went through several adjustments during this process.

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[1] Ray Hole lies 36.2 km (22.5 statute miles) from the mouth of the Aucilla; Fitch at 10 km (6.2 statute miles); J&J Hunt at 6.1 km (3.8 statute miles) and Econfina at 4.7 km (2.9 statute miles)

Diverse species forests with frequent *Pinus* gave way to dominant *Taxodium* and grasses. Oak pollens remain approximately the same throughout the entire sequence, and oaks are common in the freshwater refugia of the coastal marsh belt (Chapter Six). Increased frequency of water logged wood of all sizes, high absolute frequency of pollen grains per cubic area and higher numbers of charcoal fragments in the pollen samples indicate brackish conditions stratigraphically (Table 7.10). This data suggests that dead trees and bushes with inundated bases and exposed canopy skeletons collected debris and occasionally caught afire during the inundation process. Birds were probably abundant.

As the sea level transgressed over previous marsh grass coastal zone ecotones, the peaty sediments, upon which the marsh cord grasses grow, remained resistant to inundation erosion. This contrasts with the erosion and alteration of the channel margins and thalwegs of the karst paleodrainage ways. I think that after full inundation these sediments encourage the growth of sea grass beds, while the relict sections of paleochannels and exposed bedrock are more barren. This would allow the possibility of reconstructing past terrestrial topology with modern patterns of sea grass beds.

Oyster bioherms occur in the intertidal zone at the rocky mouths of these karst rivers and this regularity has resulted in progressive lines of oyster bars tracking out the repose of the continental shelf (Figure 7.02). As the coastline migrated inland with increasing sea levels, oysters kept up. Studied by radiocarbon and shellring analysis, these oysters might reflect detailed records of the inundation process.

Environmental conditions and sea levels analogous to those of today are usually considered to evolve by 5,000 rcybp but radiocarbon evidence from the Aucilla suggests full inundation of this local area slightly later, between 5,000 and 4,000 rcybp (Hoenstine and Garrett, 1993). Modern barrier island formation begins around 3,000 rcybp (Stapor et al., 1988). Some evidence suggests that around 2500 rcybp sea levels were higher than today's (Donoghue and White, 1994; Stapor et al., 1988; Walker et al., 1994). While no direct evidence regarding high sea level stands was observed during the course of this dissertation research, circumstantial evidence for higher sea levels is offered by the fragments of branching coral observed at both J&J Hunt and the Fitch Sites. No living specimens of branching coral were observed at either sit. Radiocarbon dating of these remains may contribute evidence for higher sea levels at some time during the Holocene, presumably sometime between 5,000 and 2,000 rcybp.

Site Formation Processes

The archaeological sites discovered during these offshore forays often occurred near bedrock outcrops and overlaid bedrock voids and cracks. Sites are mixed with marine sediments but still retain cohesiveness, not unlike artifacts found in plow zones in terrestrial settings. The artifacts were relatively protected in these situations. As expressed and justified in Chapter Eight, these artifact accumulations are considered to be the remains of inundated terrestrial locations in isolated offshore settings. Because of this the possibility of visitation or disturbance by humans, since inundation, is probably remote. Little evidence for tumbling or sorting was observed at Econfina or J&J Hunt. At the Fitch Site, post-inundation processes may have moved the items.

Most of the artifacts found in the marine sediments show at least some form of corrosion from having been in the salt water. Some artifacts also exhibit a patina of possible organic buildup. Artifacts found in the marine sediments are either pristine, black, black/brown with and without edge corrosion or they are fully degraded. Artifacts found with depth in consolidated sediments are more often pristine, even unstained. The black patina staining seems to have something to do with fresh, and not salt water on the basis of data from areas A and B at J&J Hunt Site presented in Chapter 7. The following discussions summarize the culture history of the three sites discussed in this dissertation. The focus is on site function and culture history. Possibilities for further research are also presented.

Culture History of the Econfina Channel Site (8 Ta 139)

Econfina Channel was probably a small Middle Archaic special activity locus or field camp (sensu Binford, 1980) located in a near-coastal setting on the margins of the paleochannel of the Econfina River. It is probable that all of the cultural items were originally deposited on terrestrial sediments such as sand or clay and these sediments were then replaced by marine constituents as sea level rose, leaving behind the lithics and shell remains in the shallow karst voids of the bedrock morphology.

The site is probably older than the radiocarbon date of 5,140 +/- 100 obtained from analogous paleochannel margin sedimentary contexts slightly farther upstream (Table 7.18; Figure 7.20). The estimated time range for the cultural activities might have been 6500 to 5500 rcybp. The cultural representatives were people who made Marion or Putnam projectile points or knives. These people were knapping flint from nearby resources and fabricating biface preforms, but not necessarily specific tools. As described in Chapter Seven, the oyster shell remains found at the Econfina Channel Site were probably cultural, and suggest expedient foraging nearby. The presence of numerous fish and possibly the apple snail remains in Test Pit B in the deposits also suggests their presence as food discard. Data presented by Russo et al. (1992) confirm the use of fish and apple snails in late Middle Archaic contexts from Grove's Orange Midden of similar age and archaeological culture on the eastern side of the state.

Additional survey and site inventory along the paleoEconfina Channel margins could be fruitful. Since two locations of artifacts have been identified there, it is probable that there are more. It is also possible that larger portion of the campsite at the Econfina Channel Site visited in 1989 lies underneath the sea grass bed sediments adjacent to the relict channel margins (Figure 7.20). It may also be that deeper sediments, relict river deposits and possibly evidence for Paleoindian or Early Archaic human presence within sinkhole features can be found along the trend of relict channel. Seismic profiling and vibra-coring would be necessary for this task.

Culture History of the Fitch Site (8 Je 739)

Fitch was probably a large lithic quarry site, possibly of Early Archaic or Paleoindian age. Occupation occurred in an inland setting and it may be that the particular spot we studied represented a specific activity area within a larger, compartmentalized area of occupation. Given the subbottom profiler data presented in Chapter Seven, the area surrounding the Fitch site, the paleoPinhook drainage, may have represented a microenvironment with special resource potentials for prehistoric people. Certainly the area contained a rich lithic resource, and the procurement strategy apparently included the use of heat fracturing. It may also be that the depressed nature of the karst feature allowed for certain aquatic refugia.

Fitch would appear to have had the most energetic marine disturbance by the sea of the three sites observed. However, the main movement of items appears to have occurred as a post-inundational event or process rather than occurrences simultaneous with the inundation sequence. Based on the local sea level chronology and transgression rate presented above, the Fitch Site was inundated before the J&J Hunt site, and probably by 7,000 rcybp. Fitch remains an enigmatic site demanding more scrutiny. In particular, additional survey, coring and excavations of the area could help to develop a clearer understanding the general lay of the past terrestrial landforms and artifact distributions The discovery of diagnostic artifacts would be especially helpful.

Culture History of the J&J Hunt Site (8 Je 740)

By the evidence at hand, the majority of occupation around the sinkhole at Locus L_1 took place in Late Paleoindian and Early Archaic time frames. Evidence for Middle Archaic presence was found, but it is limited. These activities took place around the margins of a sinkhole which drained to the south as a discontinuous river segment, 60 km (37 statute miles) inland from the coastline at that time. At Area A the evidence is robust for people who made Bolen, or late Bolen or early Kirk projectile points, Hendricks, Turtleback and other unifacial scrapers. Area B exhibited evidence for Paleoindian presence in the form of an earlier diagnostic (the Suwannee preform), a thumbnail scraper and chipping of narrow edged bifaces from biface preforms. The fluted biface base found at Area C, on the eastern margins of the paleochannel near Locus L_2 contributes to the argument that Paleoindians were in the area and around the discontinuous river segment.

The artifact accumulations at Area A at the J&J Hunt Site represent the remains of diverse chipping activities beginning with secondary lithic reduction from blocky, prefabricated raw materials to bifaces. Also apparent was biface reduction from biface preforms and some edge maintenance of tools. Tools consisted of unifacial scrapers and biface edges. The use or working of animal bone may also have taken place at Area A. The diversity of items from Area B was more restricted. Bifacial flakes from Area B exhibited thinning of bifaces with generally narrow edges. Published accounts of debitage analysis such as undertaken for this dissertation research is uncommon in local publications, but comparisons in the future could be fruitful.

With regard to the possibility for *in situ* remains in the sediments of the paleoAucilla, and coupled with the interpretation that the dolomite found in the sinkhole of Locus L_1 is a recent formation, continued excavations into the fine-sandy gray clay sediments below the dolomite should encounter older strata. Paleoindian artifacts are possible in lower sediments of the Locus L sinkholes, in situations analogous to the bottom of the Page/Ladson sinkhole. Early Archaic Bolen age activities are also possible on inset sediment banks or limestone platforms within karst sinkholes in river drainageways, given the presence of such analogues on shore.

Continued offshore research designed to discover *in situ* evidence for Paleoindians in or near this sinkhole setting, could obtain a more detailed pattern of coring in Locus L_1, and attempt to penetrate the dolomite, testing the hypothesis that it might be underlain by Pleistocene / early Holocene sediments. This coring pattern would also discover any terracing which might exhibit Late Paleoindian / Early Archaic occupations like the Bolen surface at the Page/Ladson Site. After the sinkhole is better known, it will probably become apparent where to place Test Pit 2, in Locus L_1.

In addition, a settlement pattern can be modeled for Bolen age habitations and landscape utilization within and around karst sinkhole features from evidence accrued from several contemporaneous archaeological sites. These are the Little River and

Page/Ladson sites in the Aucilla River and the Little Salt Spring Site near Charlotte Harbor (Dunbar et al., 1988; 1989a; Clausen et al., 1979; Gifford and Koski, 1994; Willis, 1988). In each case, activities included discard of chipped stone tools and evidence for woodworking. These occupations took place both in and around the sinkhole features, while sea levels were lower but on the rise, probably between 10,000 and 9,000 rcybp. Hornsby Springs, in central Florida, is another example of these kinds of karst spring feature with nearby early sites exhibiting Suwannee and Bolen projectile points, unifacial scrapers and adzes (Dolan and Allen, 1961). It could be that clan or activity related social groups were tethered to these locations in the same sense as drainage basin based, clan related social groups proposed by Anderson and Hanson (1988) for the Carolina Coastal Plain and Piedmont.

This model implies that excavations in the sinkhole at L_1 (or other similar settings offshore) could encounter Bolen age activity loci in the sinkhole, in addition to Paleoindian associations with extinct fauna farther down in the sediments. Furthermore, the onshore region of site and artifact densities shown in Figure 6.01 continues offshore, possibly as far as the 40 meter contour, 140 km (87 statute miles) out to sea. Sites are now confirmed out to about 36 kilometers (22.5 statute miles, Ray Hole Spring). The higher frequencies of Clovis diagnostics in the Aucilla River, along with abundant Suwannee and Bolen related occupations through out this Northwest Floridian area of clustered remains, make it all the more important to continue research in order to determine the chronology of colonization and the cultural evolution both on- and offshore (Dunbar, 1991, cf. Discussion at the end of Chapter Three).

In addition, this offshore area should be considered a high priority from cultural resource management perspectives, in either coastal or offshore settings. This is true around any karst feature greater than 20 m in size and in particular if those features are or were connected to the aquifer. This is also true in the broad inundated area between Tampa Bay and the Apalachee Bay and out to the Florida Middle Grounds at the 40 meter contour (Figure 6.01).

The Relationship of Offshore Research to the Larger Issue of the Peopling of the New World

I suggest that people who made fluted points and their progeny accessed abundant faunal, chert and wood resources in this Northwest Florida region from base camps located closer to the paleoshorelines of the time. This occupation would have pertained from Clovis fluted point through Early Archaic times, if not more. This patch of possible fluted point related sites may be one of the most promising of such inundated occurrences in the entire North American Continent. This allows for addressing questions about the origins and culture history of fluted point related groups by the practice of marine inundated prehistoric archaeology.

The patterns of fluted point Paleoindian artifacts and sites, reconstructed by computer aided mapping in Chapter Three, do not conform to models of fluted point related population movements from either the ice free corridor or the Northwest Coast of North America. I suggest, as have others, that fluted point Paleoindian sites originated from the South and Southeastern portions of North America, and expanded to the north and west. I add the additional wrinkle that earlier fluted point sites lay offshore in the Gulf of Mexico and the Eastern Seaboard (Mason, 1962; Meltzer, 1984:338; Stanford, 1991; Williams and Stoltman, 1965). A list of other multiple working hypotheses of fluted point origins, distilled from the background research, are shown in Table 9.01.

The data presented in Chapter Three regarding the distributions of both isolated fluted points and fluted point sites can be viewed in the circumstantial light that the colonization of the continent by people who made fluted points may have come through exploration, logistical forays and population growth up major stream trunks from the continental shelves of the southern and eastern portions of North America, possibly spreading out from the south and the east to north and west. A graphic shows this concept (Figure 9.01) and supporting circumstances are listed in Table 9.02. This is, at least, a parsimonious characterization of the evidence at hand.

Conversely, the distribution of sites, and the radiocarbon control for convex based stemmed point assemblages presented in Figure 3.13 and Table 3.05, do exhibit a Wave of Advance (WOA) pattern, particularly if earlier sites of convex based biface assemblages in Northeast Asia are related. The cumulative chronology, presented in Figure 3.11, shows incremental growth as also expected by a WOA migration pattern.

Table 9.01 Models of Colonization

Pre-Beringian Source Populations	
Eastern Europe: Generalized	Alexander, 1973; Epstein, 1963; Howells, 1945; Hrdlicka, 1925; MacDonald, 1968; Mason, 1962; Wormington, 1964
Eastern Europe: Early Arrival	Chard 1959 favored Early Wisconsinan chopping tool cultures Muller-Beck (1966) derived Paleoindians from a Mousterian base entering America after 26,000 rcybp Bushnell and Macburney (1959) postulated an Upper Paleolithic spread between 25th and 20th millennia BC.
Eastern Europe: Late Arrival	Witthoft (1952) called for rapidly moving Upper Paleolithic migrants Haynes (1966) derived the people and tool kit in one migration from central Europe 1975; Mochanov (1978; 1980) and West (1983) derived pre-Clovis from Dyuktai but interpretation has not held up to scrutiny (Bradley, 1993) cf. Mossiman and Martin,
Western Europe	Greenman, 1963 Western Europe via North Atlantic Route
Australia	Biological proposition explored by Birdsell, 1951
Problems with the Beringian Route	
Nenana	Given similarities of lithic tool frequencies, Goebel et al. (1991) have proposed that their Nenana Complex is a precursor of Clovis. Secure radiocarbon control (two or more dates) puts the Clovis site of Aubrey earlier than Walker Road by more than three hundred years. Further dating may resolve this reversed pattern.
Ice Free Corridor	Sites should be progressively later with distance into the High Plains, earlier sites nearer the proposed homeland to the North. Anthony's (1990) Leap Frog concept could negate the smooth distributional data, but the source of the populations should be clear in the homeland, by analogy.
Coastal Hypothesis	Northwest coastal adaptations imply movement by boats, up the major river valleys of the west coast. West Coast more appropriate for Beringian entry but East Coast data more abundant. Addition of Leap Frog concept could negate the smooth distributional data, homeland could be flooded (Fladmark, 1979).
In Situ Development	Kreiger (1964) suggested *in situ* development for fluting Hester (1966) postulated that Clovis developed in isolation from a slightly earlier, but unidentified Upper Paleolithic base. Likewise Rouse, 1976; Stanford, 1979; Bryan, 1978; MacNeish, 1976 have suggested that Clovis developed in situ from a lower "stratum" of pre Clovis people. Hypothesis not supported by the apparent abruptness of appearance, no antecedents for the depth and maturity of the lithic assemblage.

Table 9.02 Data that supports entry from the Atlantic and Gulf Coasts

Distribution
High frequencies of points in the eastern portions of North America with clusters of points along major waterways, indicating possible routes and interaction spheres. Precedence in Australia for a similar counter-intuitive pattern This concept may also help to explain the presence of so many isolated fluted points, being the results of logistical forays from now inundated base camps (Dincauze, 1993; Meltzer, 1988). The test for this is the presence of such base camps at or near the Clovis shoreline. Meltzer has suggested that "(a) regionally homogeneous point style must be early rather than late" (Meltzer 1984:339). Classic Clovis fits this criteria for earliness and its distribution can be characterized as generally southern and eastern. In general, however, there are diverse varieties of fluted points, and ambiguities of nomenclature. The consensus that Classic Clovis points are more widespread than other fluted varieties needs testing (Tompkins, 1994). There is a distinction between blade and flake fluting techniques. Blade fluting appears later and flake fluting is largely restricted to the southern latitudes (Meltzer, 1984:341). There is an overlap of two immediate Clovis progeny: Folsom and Dalton in Texas and the Plains areas. Continuity of lithic traditions <u>most</u> direct and continuous from Paleoindian to Early Archaic in the Southeast and Texas.
Chronological Control
Currently the bulk of radiocarbon data is weighted toward the 11,200 frame in the Southern Plains. Examples include Aubrey (11,565), Blackwater Draw (11,170), Lubbock Lake (11,100), Domebo (11,000) and possibly McFaddin Beach. Lange/Ferguson, in South Dakota (11,140) is also an early example, but not as early as Aubrey. Other early sites are seen between 200 and 300 years after about 11,200 in every region with a possible cluster around 10,900 rcybp (Indian Springs, Murray/Lehner, *Paleo Crossing*, Indian Creek, and Fells Cave in South America). See Table 3.05 for details. Important data to follow: calibrated hydration rates on Dietz site artifacts for Northwestern chronology. The trajectory of extinction might be a related issue, but this has not been determined (cf. Mead and Meltzer, 1985).
Distribution of European Upper Paleolithic Attributes
Appearance of most diagnostic Euroasian Upper Paleolithic diagnostics items tend to be found in southerly latitudes in North America (i.e. bone/ivory foreshafts, blades, billet, shaft straightener, cf. Figure 3.02).
Circumstantial Evidence Against this Proposal
Lack of Paleoindian materials on any Caribbean Islands. Marine based cultures and circumstantial evidence for ocean transits only confirmed in the Early Archaic on West Coast.

However, the distributional and chronological data for fluted point related occurences call into question a WOA incursion by the people who made those points and associated tools. Fluted point related remains are clustered in the Southern and Eastern portions of North America (cf. Figures 3.02 and 3.05). Furthermore, an apparent "pulse" of fluted point related archaeological sites occurs in both North and South America between 11,200 and 10,800 rcybp, as shown in Figure 3.11. These discrepancies from the expected pattern demand further scrutiny and explanation.

The pattern of fluted point Paleoindian remains bears most resemblance to Anthony's proposed "leapfrog" migration pattern (Anthony, 1990; Faught et al., 1994). Anthony has suggested that long distance, empty interval "leapfrog" migrations expand from well defined centers of origin, emerging from focally adapted social groups, and searching for specific resources. North American megafauna may be one such a resource, lithic raw materials another. This procurement strategy may represent an adaptive response to the onset of Younger Dryas conditions, forced by lowering of sea levels and loss of coastal habitats, as discussed in Chapter Four.

Thus, fluted point assemblages may only appear to be without antecedent because of the missing, inundated data base. Furthermore, Widmer (1988) has shown that social groups adapted to coastal environments, at whatever degree of sophistication, tend to be more complex than inland based groups of the same time, due to the organizational skills necessary for most marine activities. Thus, sites farther out on the continental shelves may exhibit different functional assemblages and reflect more social and technological diversity than the early logistic foray assemblages.

Anthony has pointed out that rapid stylistic change and technological innovation often occur in the new homeland of the Leapfrogging groups. He calls this an artifactual "founders effect", which results from an initial, specialized pool of material culture variability (Anthony, 1990:903). The robust fluted point stylistic diversity in the East and Southeast and the subsequent innovation of such tools as the atlatl and notching of projectile points, along with increased lithic tool kit diversity in the Early Archaic, in these same Southeastern areas, can be explained by this analogy (Anderson and Hanson, 1988; Cockrell and Murphy, 1978; Driskell, 1995; Dunbar et al., 1988, Webb, 1957; cf. Stanford, 1991).

It remains a dilemma that a non-New World fluted point homeland is not currently known or geologically visible. It is not necessary to identify the last place people left or the first place people landed, but it is surely possible to identify the patch or patches of early colonization given a sufficient inventory and chronology of settlements. The perceived necessity of bringing these people from an ultimate Northeast Asian homeland remains awkward. There appear to be geographical and stylistic gaps in the developmental pattern.

Current ideas regarding the colonization of Australia may be helpful as a case in point. Several of the earliest known archaeological sites in Australia are in the

Southeastern portions of that continent, away from the logical locations of entry along the northern shore (Bowdler, 1990). This distribution allows for the postulation of coastal movements and adaptations which have not yet been identified from underwater research, but which certainly explain the archaeological pattern (Beaton, 1991). The analogy in North America may be a pattern of movement and exploration along the western coastal margins, traversing the Isthmus of Panama and then settlement and expansion from the Gulf Coast regions.

By this model, the first exploration and collection forays inland would have taken place from locations along the paleocoastline of Texas. Continued exploration and exploitation then occurred to the west (Arizona) and north (High Plains) and up the larger order streams of the Mississippi drainages, with particular concentration along the Ohio and Tennessee Rivers. The Great Lakes occurrences remain undated at the time of this writing, but colonization of the Eastern Seaboard and Maritimes occurred toward the late end of the pulse, after 10,600 rcybp (Figure 3.11). The lack of fluted point remains in the islands of the Caribbean, especially Cuba weakens this proposal. Perhaps they will be forthcoming. Where Florida and the Southeast fit in this scenario is also unknown.

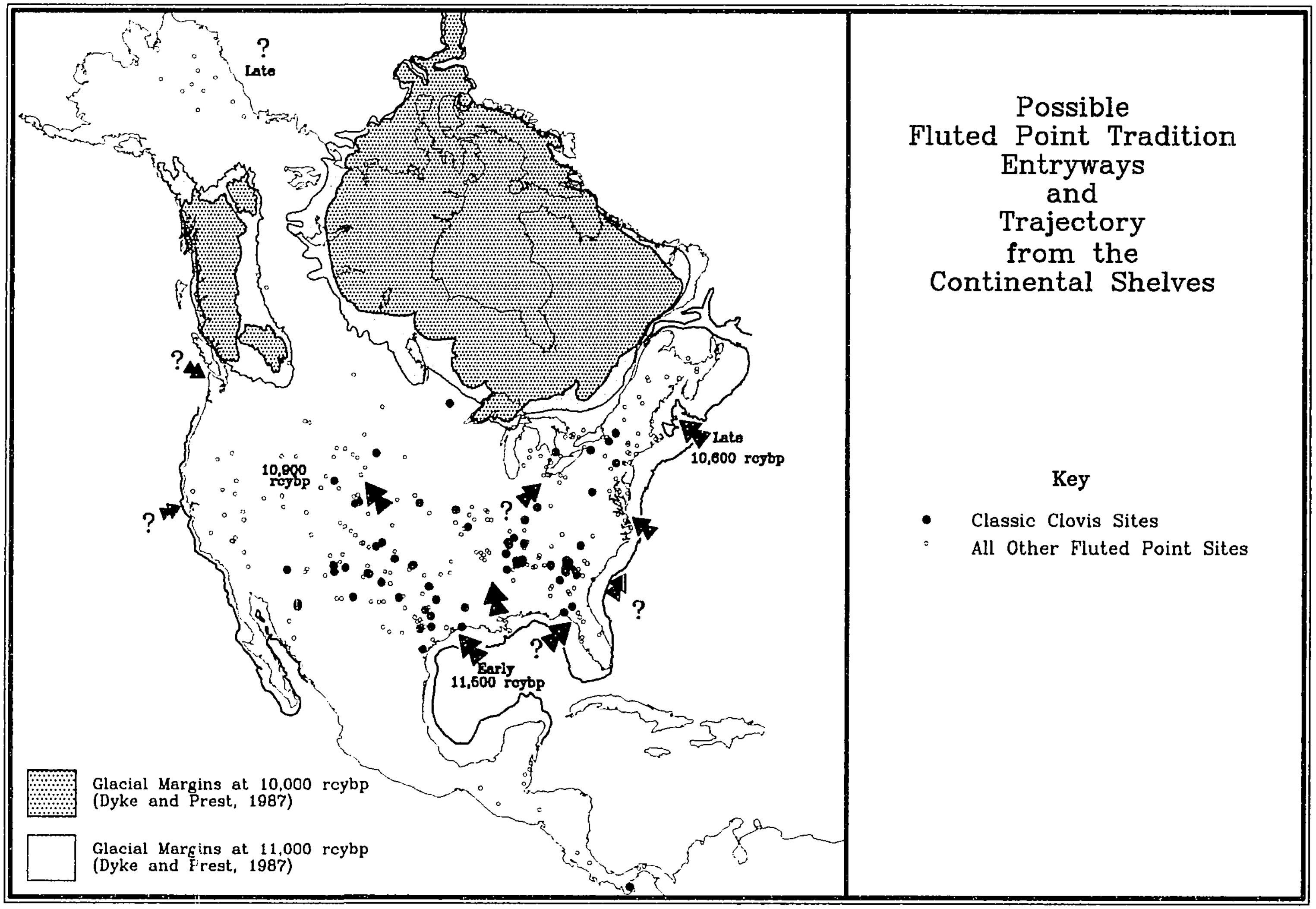

Figure 9.01 Possible fluted point tradition entryways and trajectory

One view making up the current paradigm of the Peopling of the New World is that a terrestrial route across Beringia and into the center of the continent, is necessary because of a lack of technological expertise for marine travel by upper Paleolithic hunters and gatherers. Hrdlicka (1925) and Fladmark (1979) have addressed the possibilities of early boat travel, as have others (cf. Greenman, 1963), but the only way to know when boats were first made and used is by finding examples of specific boats, or by circumstantial evidence for island crossings.

Abundant circumstantial evidence has accumulated for island crossings across ocean water in the late Pleistocene in the Pacific and evidence appears even more robust in the early Holocene in Japan, the Mediterranean and the West Coast of North America. Some of these examples are presented in Table 9.03. The question might be asked, then, which Upper Paleolithic groups had this expertise? Most of the examples occur in the Sahul shelf region and imply that people of Southeastern Asiatic roots were sea worthy by the beginnings of deglaciation and subsequent shelf inundation 14,000 radiocarbon years ago.

Table 9.03 Evidence of Upper Paleolithic sea-going capabilities from sites on islands without continental shelf connections.

Transit to:	Date (rcybp)	Reference
Sundaland to Sahul	Circumstantial by 40,000	Jones, 1989; Jelinek, 1992; Birdsell, 1977
Australia	Circumstantial by 40,000	Wisner, 1993
New Ireland	Circumstantial by 33,000	Allen et al. (1988, 1989) in Dixon, 1993 Wisner, 1993
Matenkupkum Cave	Circumstantial by 31-33,000	Dixon, 1993
Okinawa	Circumstantial by 32,000	Ikawa-Smith, 1986
Kozushima Island	Circumstantial by 21,000	Ikawa-Smith, 1986 Oda, 1990
Misisil Cave - New Britain	Circumstantial by 12,000	Specht et al. 1981 in Dixon, 1993,
Ogasawara Islands	Circumstantial by late Pleist.	Oda, 1990
Solomon Island - Buka Island -	Circumstantial	Wickler and Spriggs, 1988 in Dixon, 1993
Admiralty Islands - Manus -	Circumstantial	Spriggs, 1992 in Dixon, 1993
Santa Rosa Island, California	Circumstantial by 10,000	Erlandson and Moss, 1994
Initial Jomon, Southern Japan	Circumstantial by 9,000 Boat remains by 7,300-5,600	Chard, 1974:118-119

Coastal adaptations and travel by boats may have allowed people to circumnavigate the western portions of the continent, which then may have given rise to populations coming into the Gulf and along the western Gulf of Mexico Coast and eventually to the Eastern Coasts of North America. Remember from Chapter Four that transgression enhances the development of estuarine environments. Thus, coastal habitats could have lured more activities because estuarine based subsistence would have been available, if not abundant, given the transgressing conditions leading up to the first melt water pulse (MWP I).

This model explains the apparent existence of multiple entry points of fluted point related artifact clusters, given the distributions of sites and isolated artifacts presented in Chapter Three. If evidence exists for subsequent, Early Archaic, coastal or maritime adaptations, these too would be inundated on the continental shelves. The intentional discovery of sites inundated on the continental shelves can address these issues. Until such evidence has accrued, however, these ideas are simply possibilist fodder.

The final issue to be discussed concerns the relationship between archaeological assemblages and past social groups. I suggest that peoples making fluted points were linguistically and biologically affiliated, but this is an hypothesis demanding more disciplined scrutiny. Specific issues which need resolution include whether fluted points and their associated tool kits represent technological developments spreading by diffusion amongst groups already in place on the landscape - for which only an equivocal data base exists, whether they represent technological solutions developed independently by several groups simultaneously - which has little precedent, or whether they represent the shared material cultural characters of biologically and linguistically related social groups - which, to me, is what they appear to be (Bonnichsen, 1991; Bryan, 1988:56; Meltzer, 1984:338; Young and Bonnichsen, 1985).

In this same ethnic light, the relationship between convex based stemmed point and concave based fluted point chipped stone assemblages is also a matter in need of resolution. The spatial distribution of stemmed point related sites, particularly earlier stemmed point sites, is more apparent to the west in both North and South America. This contrasts the generally higher frequency of fluted point related sites in the eastern portions of North and possibly South America as well (Ardila-Calderon, 1991; Politis, 1991). What is the meaning of these distributions? Are two major population aggregates being defined by this accumulating data? These questions remain unanswered.

In Appendix A it was suggested that disciplined and critical comparison of (roughly) contemporaneous skeletal populations from Asia, or any other parts of the world, is inadequate and often controlled by preconceived doctrines of the possible outcomes. Furthermore, there has been no recent analysis which has specifically investigated variation of early biological samples from North and South America, to allow for testing for multiple biological population aggregates. The need for these kinds of studies also implies the need for disciplined principles as to which biological characteristics are useful for reconstructing past social group relationships (affinity) and which are not. The same holds true for data presented by linguistic and archaeological subdisciplines.

As this dissertation is written, the biological affinities of indigenous Americans are under review and renewed scrutiny (Appendix A). The distributions of the Diego antigen (Salzano, 1985), certain GM allotypes (Kirk, 1979; Schanfield, 1992), skeletal characteristics (Steel and Powell, 1992) and mtDNA (Torroni et al., 1994) suggest that a robust sample of individuals of Southeast Asian ancestry were involved in peopling the New World. These characteristics cast doubt on Turner's conclusions that Northeast (Sinodont) Asians are the sole relatives of all Amerindians through the Paleoindian line and that the Southeast Asian (Sundadont) dental pattern is not present in the New World (Turner, 1985). It also re-introduces the possibility of trans-Pacific migration routes to the New World, regardless of the technological difficulties of crossing such a major body of water (Meggars et al., 1965; Smith, 1953; Torroni, et al., 1994). However, the biological data cannot unequivocally indicate when this happened, or how it resonated linguistically. There is a great need for archaeological correlates to be restudied in order to resolve the culture history.

Regardless, an unequivocal Clovis precursor is no more apparent in Southeast Asia than in Northeast Asia. One thing is clear, the end to this story has not been written. I foresee a time when the potentials of continental shelf prehistoric archaeology will contribute significant data to the problems of Paleoindian and Archaic culture history and the processes outlined above. The inventory of continental shelf inundated archaeological sites has grown from this research, but many more discoveries remain.

APPENDIX A

LANGUAGE AND BIOLOGY: ANCILLIARY DATA

APPENDIX A

Language and Biology: Ancilliary Data

There were some issues brought up in Chapters Two and Three which are germane to deciphering how the New World was peopled, which could benefit from more discussion, but which would be cumbersome in that setting. These issues revolve around the number of, and the biological, linguistic and cultural relationships between, people colonizing the New World during the (late) Pleistocene and early Holocene. From this perspective various early Holocene cultural groups developed from Paleoindian stocks into numerous socially cohesive clusters of people through the climatic and cultural processes of the middle and late Holocene, evolving into the well known and diverse linguistic and biological patterns of modern indigenous peoples.

Questions that drive this review include:

> "What were the biological characteristics of the people who made Clovis points at the time of their arrival in the New World? With whom were these characteristics most similar elsewhere in the world <u>at that time</u>?"
>
> "Do the distributions of fluted and stemmed point chipped stone assemblages reflect the distributions of biologically and linguistically related social groups or were they groups of people with separate biological and linguistic ancestries?
>
> "Do the biological and linguistic affinities of some recent (late Holocene) indigenous peoples of the Western Hemisphere retain more evidence of fluted point Paleoindian affinity than others?"
>
> "How many migrations are perceivable from the biological evidence of living descendants today? How much biological variation is due to the original characteristics of those people, how much to microevolution since, and how much to gene flow from other migrations?"

I propose that the tripartite model should be altered. First it should be expanded to include the possibilities of more source (original, migrating) populations. Second, I propose that substantial internal contact, migration, gene flow and language sharing occurred during middle and late Holocene times. These interactions masked earlier distinctions and they must be identified and analyzed in the light of cultural (ethnic) evolution.

The first order of business is to define a vocabulary to describe relationships, then to present an inventory of early skeletal material which might help resolve the nature of relationships between different Paleoindian and Early Archaic archaeological assemblages in the New World (Figure A.1 and Table A.1). Other selected biological and linguistic studies of North American populations are then explored to expose the value of holistic research and to strengthen the idea that gene flow, linguistic borrowing and material cultural sharing during the mid-Holocene Altithermal climatic interval might have masked our understanding of early Paleoindian biological variability (Tables A.2 through A.13). All figures and tables are located at the end of this Appendix, following the text.

Certain concepts which refer to the nature of similarity in language, biology, and archaeology overlap. Namely, similarities have three possibilities of relationship: homology, analogy, and hybridization (cf. Hennig, 1986; Hoenigswald and Wiener, 1987; Clarke, 1978:145). Homologous (genetic, patristic, cognate) characteristics designate similarities resulting from a common ancestor. Analogues are similar characteristics acquired outside of patristic relationships by chance or by parallel adaptations to similar social or natural environments (also known as "convergence"). "Reticulation" is a term used here to refer to combining, mixing, admixing, gene flow, borrowing, or diffusion (Faught, 1990). It is used to avoid the term "hybridization", which carries some past negative conceptual baggage (e.g. Schindler, 1985), but they are the same.

The image of trees or bushes are used to illustrate patterns of evolution by both biologists and linguists. These conceptual patterns only allow bifurcation and diversification. This dendritic image was first employed to describe biological speciation and it has been used by linguists to describe linguistic splitting as well (Hoenigswald and Wiener, 1987). However, modern human diversity - especially in the fully encircled and increasingly crowded post-Pleistocene world - is partly, if not substantially, the result of unions of groups of differing ancestries (cf. Clarke, 1978; Weiss and Maruyama, 1976; Weiss, 1994). In this regard, anastomosing patterns - reticulations - might be more useful metaphorically than dendritic ones.

Branching remains an appropriate model for early human evolution, but evolutionary paths were "bent" toward each other with the encirclement of the planet at the end of the Pleistocene. Interactions between diverse groups has increasingly become the norm in the Holocene, and social complexity, the introduction of agriculture, and development of states societies follow. Axiomatically, anthropological modeling of the process can only exist within a frame of both the environmental and the social forces of attraction and repulsion occurring in space and through time.

Early Skeletal Record

The physical similarity of proto-Historic and Historic indigenous people of the New World with people of Asiatic biological heritage is apparent and legendary. In fact, one of the strengths of the tripartite model proposed by Greenberg et al (1986) is their appeal to shared biological characteristics. However, there is enough diversity amongst these indigenous people to question whether the tripartite model explains all of the variability.

Early attention to the attributes of skeletal remains focused on questions of antiquity and classification. Who were they and when did they get here? Analyses of skeletal material in the Western Hemisphere have identified "longheaded" (dolichocranic) people as the earliest inhabitants, with later "roundheaded" (brachycranic; Mongoloid) elements "overlying" (Birdsell, 1951; Hrdlicka, 1925:493; Hooton, 1933:138; Neumann, 1952; Willey, 1966). Imbelloni sorted North and South Americans into nine cranial types, including seven for North and South America, and the Eskimo and Na-Dene (Newman, 1951) for a total of 11. Ales Hrdlicka, a conservative in building chronological and typological categories, actually sorted New World skeletal diversity into four, temporally ordered types (Hrdlicka, 1925). The earliest was a low vaulted, longheaded folk found in both North and South America; next a roundheaded series found in the Gulf States, Central America, and Northern South America, third the longheaded Eskimos, and finally the roundheaded Na-Dene. Current controls on chronology reverses the last two.

"Primitive" features, such as massive brow ridges, low frontals, postorbital constriction, thick cranial elements, protruding occipital, small mastoid process and massive facial size, have been mistaken as markers of antiquity. Steele and Powell, 1992:309 cite crania such as Tranquility, Calavaras, Del Mar and a series from the Texas coast studied by Neumann (1952, as examples of these kinds of misinterpretations. An interesting aspect of these characteristics is that their discontinuous spatial distribution is congruous with archaeological distributions of Hokan speaking people (Table A.06).

In 1985 and 1986 Turner presented the results of an analysis of selected Paleoindian crania representing approximately 21 individuals from 11 data sets or series (most of which are single examples). However, not all of these samples were from Paleoindian contexts, four or five are of middle Holocene age (Old Crow, Texpexpan, Melbourne, Del Mar and possibly Palli Aike). This analysis revealed surprisingly little within group variation. For example, the hypocone, single rooted upper first premolars, and Carabelli's cusp were listed as 100% frequent.

Carabelli's cusp is considered to be a Caucasian marker, just as shoveling is considered Asiatic, but Turner doesn't address this discrepancy in his conclusion (Dahlberg, 1951). Only 83% of the sample had shovel shaped incisors. The protostylid and incisor winging were missing in the Paleoindian samples, but frequent in his other, more recent sample sets.

Turner only includes the "Paleoindian" sample in the clustering algorithms of Turner (1985). These dendrograms (his Figures 7 & 8) show that Paleoindians are extreme outliers when clustered with the more recent North and South American samples (his Figure 8). Paleoindians also fell between (outside of) the two major clusters of worldwide samples (his Figure 7). One of these major clusters includes Northeast Asian and Amerindian samples and the other contains Southeast Asian, Northwest European, and African samples. This position is in relative agreement with observations by Steele and Powell on Paleoindian and other late Pleistocene crania (Steele and Powell, 1992; 1994). That is, Steele and Powell lacked confidence in telling which groups Paleoindians most resembled from early samples from Northeast Asia, Northwest Europe or Southeast Asia. The latter two were considered more similar to each other than either was to Northeast Asians.

Comparing these samples with more temporally mixed, mostly late Holocene series from both Asia and Europe, Turner concluded that Paleoindians more closely resembled Asiatics than Europeans. The fact that the "Europeans" in Turner's sample domain are late Holocene populations, without clear archaeological continuity from Paleolithic cultures is not addressed. Turner states that all North and South Americans are more similar to Northeast Asians than to Southeast Asians on the basis of what he has defined as a "Sinodont / Sundadont" dichotomy. One of the markers is shoveling, characterized as in lower frequencies in the Southeast Asian cluster.

Furthermore, Steele and Powell's more recent comparison of eight continuous (as opposed to discrete variables like dentition) cranial attributes from skeletal samples is more controlled chronologically. They only compared samples dating between 11,000 rcybp and 8,000 in North America, Asia and Central Europe. Their study has not revealed as clear a similarity between the Northeast Asian (Sinodont) pattern and North and South Americans, as Turner stresses (N= 8 samples, represented by 10 individuals; Steele and Powell, 1992). They stated (ibid:329): "(i)t appears ... that some discernible differences are present in earlier Archaic and Paleoindian populations, and (that) these differences seem to be toward less marked Mongoloid-Sinodont appearance in the cranium and face of earlier populations." They also state: "...Paleo-Indians appear more like Southern Asians and Europeans than other American Indian populations do" (ibid:330).

One principal distinction they point out is a difference between dolichocranic (Southeast Asia) and brachycranic (Northeast Asia) cranial characteristics (Steele and Powell, 1994). They state that they were unable to differentiate the source of this dichotomy, that is whether brachycrany was due to environmental adaptation or to ancestry (i.e. analogy or homology). In this same light, and to my knowledge, no comparisons have ever been made that include contemporary western European, Upper Paleolithic crania with those from the New World, particularly in more recent time with improved techniques, more disciplined principles and larger sample sizes. The doctrine of singular Asiatic ancestry may be more powerful than scientific curiosity in this case.

The skeletal remains in Table A.01 include those sites accumulated during the site inventory presented in Chapter Three (cf. Appendix B.02). Thirty early sites with skeletal remains were recorded (N=13 for the time period 11,000 to 10,000 rcybp; N=12 for 10,000 to 9,000 rcybp; N=13 for the period 9,000 to 8,000 rcybp; and N=16 were indeterminate, but probably early remains). Other examples were discovered during the course of the research, including several examples from South America. These are also presented in Table A.01, but they have not been plotted.

A review of Table A.01, at the end of this Appendix, shows that only two crania were compared by both research projects, i.e. Gordon Creek and Pelican Rapids, from a potential sample of N=18 [see Table A.01, column four: Turner =T; Steele and Powell =S&P; co-included =BOTH)]. This observation indicates that it is possible that differences in interpretation between these researchers are due to different sample domains.

Not all of the remains include crania or dentition, not all of have been incorporated in comparative studies. For those remains that have been incorporated, the results and sample domains of recent skeletal analyses were reviewed with reference to specific characteristics shared with other remains outside of the New World and with an eye to any internal variation (Turner, 1983; 1986; 1992 and Steele and Powell, 1992; 1994).

Steele and Powell do not address variation within different Paleoindian populations at the end of the Pleistocene or in the early Holocene, nor does Turner. Turner's (1992) publication recorded variation of a larger, but weakly provenienced, sample set which included most of the original Paleoindian set (Turner, 1985), the early Holocene Lagoa Santa series of Brazil (LS) and several others (including what he termed "Archaic" and "Paleoindian" representatives). These samples are listed in Table A.1. A singular benefit of this 1992 publication is that Turner presented the data without summarizing for us, allowing the possibility of analysis by others. Cursory review of the data reveals differences in the expression of Carabelli's cusp (only 33% of the LS sample, to 100% of the others), and the maxillary torus (0% (LS) to 50% of the others). It remains to be seen what the principle components of similarity are, and how they are dispersed across the spatial, temporal and material cultural landscape.

While roundheaded (Brachycranic) remains are generally described as either the result of (Na-Dene) migration or derivation during the Holocene in the New World as adaptation, there are examples known from early contexts, well away from the limits of early microblade sites, which might suggest population differences (e.g. Marmes Rock Shelter and Gordon Creek). At the least, these facts show that uncertainties in anthropology allow the possibility, if not suggest it, that there may be more biological populations involved in the late Pleistocene colonization of the continent than is generally considered in most modeling exercises. The mere discipline of chronological control of these samples by Steele and Powell represents a robust contrast to virtually all other large skeletal comparisons (e.g. Imbelloini, Nuemann and Turner). The resolution of these possibilities will have to await further research.

To this end, research analysis should be able to sort the samples chronologically, as Steele and Powell did, but it should also sort the samples to cultural or traditional categories. For instance, the two skeletal associations which exhibit brachycranic vaults might be representatives of stemmed point assemblages: Gordon Creek (Breternitz et al., 1971; Frison, 1978:423) and Marmes Rock Shelter (Fryxell et al., 1968). The remains at Fishbone Cave may have been associated with stemmed point assemblages as well, but there are no cranial elements, or diagnostics to test.

The skeleton at Anzick (10,600 +/- 300; Taylor et al., 1985) was associated with fluted points but the remains are those of a child and therefore not reliable for morphological or dental analyses (see discussion in Haynes, 1982). The burials at Warm Mineral Springs (Clausen et al., 1975; Morris, 1975) and Midland (Wendorf et al. 1955) are also possible candidates because of the coincident ages of the remains near high fluted point frequencies in those areas. This is also based on the proposed continuity of the point styles associated with these people and with fluted points (e.g. "Greenbriar" and "Midland" points respectively). Both of these latter crania are dolichocranic and their dental characteristics are recorded, but not analyzed in Turner (1992).

This short review points out that early skeletal material is not uniform and not thoroughly analyzed. The major distinction of longheaded versus roundheaded people appears to be present in the New World in the early Holocene, if not in late

Pleistocene time. A more inclusive sample of dental characteristics is accumulating but needs further analysis, as well as material cultural and temporal control. What other characteristics might contribute to the resolution of this dilemma remain to be worked out, in particular the potentials for mtDNA analysis of bone (Kurosaki et al., 1993). At the least, the notion that all Pleistocene/Holocene North American biological variability is the result of a single - "Clovis" - precursor is equivocal and in need of continued data recovery and testing. This is an ironic statement as NGPRA regulations continue to diminish, and rightly so, earlier collections.

Other Biological Characteristics

Blood groups have been used to compare the biological variation of people in the New World and others worldwide, but they have the handicap of no temporal depth. For instance, Cavalli-Sforza et al (1988) used 42 blood group systems taken from 42 living populations worldwide to assess similarities and cluster the results. Their New World sample included selected (but unprovenienced) groups of indigenous North, South and Central Americans. The South American and Central American groups share more characters with each other than either does with North Americans and that these three combined are more similar to each other than to Na-Dene groups in the Northwest (Nei's distances of .004, .006, .008 respectively).

When these four New World groups are compared to other populations in the world, they are most similar to Northeast Asians and to Caucasians than to Southeast Asians at distances of .010 (NE Asian) and .016 (Caucasian) and .020 (SE Asians). These associations mirror Turner's interpretations from dental data and, also like Turner's, reflects recent and inadequate sample domains and sample provenience data. Tables A.02 and A.03 show a general inadequacy of sampling of the full range of the available linguistic stocks of the New World. These tables follow the text, at the end of this Appendix. Inadequate sampling of South Americans is particularly acute in this regard, until recently (Torroni et al., 1994).

The suite of dental characteristics developed by Dahlberg (1951) has been expanded by Turner to a suite of 28 to 34 crown and root traits used by him to analysis more than 15,000 historic and prehistoric crania (Turner, 1994). Shovel shaped incisors, as a well known example, have been used to support the ancestral connection of Asiatic and New World people. Shovel shaped incisors, once considered an ancestral, or primitive character, are equally or more frequent among native Americans when compared to Asiatics, while Europeans retain the character in smaller percentages (Carbonell, 1963; Hinkes, 1990; Hrdlicka, 1920, 1925; Turner, 1985; 1986). Turner's most comprehensive publications, and ones in which he presents substantial data regarding the distributions of these characters include: (1983; 1985; 1986; 1992). Turner's reconstruction of New World dental variation includes mostly recent (middle to late Holocene) skeletal populations (Turner, 1983, 1985).

In a broad statistical comparison, Turner proposed that Southeast Asia and Micronesia formes a Sundadont cluster, Northeast Asia and some Chinese represent Sinodonts, and another cluster was represented by Africa and groups from Melanesia/Australia. Northwest Europeans were linked to the Southeast Asian/Polynesian cluster by the statistical method of pairwise comparison he uses, and in agreement with conclusions of both Steele and Powell (1992) and Brace and Hunt (1990) based on cranial and facial attributes of the skeleton.

Turner's work with dentition has proven to be an important factor in our modern perception of population differences and similarities (Greenberg et al., 1986; Turner, 1971; 1985; 1986; Turner and Bird, 1981). But there are problems. Already mentioned is the lack of temporal provenience control. Another is the pairwise comparisons which are converted to "Mean Measures of Divergence" or "MMDs". By Turner's numbers the Eskimo are consistently more than .100 divergent from other American Indians, Na-Dene between .100 and .050, while variation within the "Macro-Indian" stock has MMD's generally less than .050. Variation within the "Macro-Indian" set, on the order of .30 to .40, is hypothesized to be the result of post-migrational microevolution from a single group of "Clovis" progenitors (Turner, 1985:37-41). The figures of the clustering algorithms are confusing and the use of this kind of statistical technique for these kinds of data has been criticized by Powell (1993).

Perhaps the major handicap is Turner's undisciplined lumping of sample populations before clustering. This problem is evinced by the nomenclature he has chosen for his sample populations. These categories reflect inconsistent use of the variables of time, geographic location, and linguistic or cultural affinity - for example "Paleo-Indian", "Southwest" or "Athapaskan". It is difficult to trace the archaeologic assemblages associated with these samples because the provenience and bibliographic references of several samples are inadequate (Turner, 1985; cf. Brace and Hunt, 1992 for a similar problem). Since Turner does not allow the entire data set to cluster without the interpretive structure, as Spuhler (1979:151, Figure 7.3) did with blood groups, it is difficult to determine how much statistical noise is involved.

Those samples representing North America were combined from groups from the Northwest, California, the Southwest, and the East in the 1983 publication. Individual data were not presented to allow independent analysis or see if other groupings would strengthen or revise his interpretations, only the calculated MMD's were presented. This same MMD data was presented in Turner (1986), but as larger lumped categories (e.g. he subsumed the data to North, Central and South America). It is this lumping and the difficulty in assessing the cultural/temporal provenience of his sample that weakens Turner's conclusions.

Brace and Hunt (1990) have published a recent computer cluster algorithm analysis that focused on skeletal attributions of archaeological populations. Specifically, attributes of the of the face and cranium including 24 cranio-facial measurements taken from 39 linguistic groups and related archaeological samples in the Pacific, Australia and the New World. This publication revealed several interesting associations. Particularly surprising was the fact that their Amerind samples (Southwest, Midwest, Plains, Northwest Coast, California, and Peru) were linked first to a cluster of Europeans (Italy, Germany, England, Norway, Denmark, France, Danish Neolithic and French Neolithic), but not to a cluster which included Northeast and Southeast Asia, or another one which included Polynesia and Australia (Brace and Hunt, 1990:353).

This publication reflects a similar inadequacy of provenience as does Turner's. Their New World sample included one cluster of Midwest (Michigan) and Plains groups, another which included Northwest Coast (Admiralty Island), California (South), and Peru. From this analysis it was determined that groups labeled "Southwest" fall as outliers to five these other groups. No temporal or cultural or linguistic provenience is given for these samples, their categories are geographical and ambiguous. This kind of presentation is not as useful for the reconstruction of relationships between biology, language and archaeology as one which sorts by linguistic and cultural or traditional affiliation.

Language stocks and temporally controlled archaeological culture designations are the most useful and logical labeling mechanism for describing any biological sample, but they are not consistently employed. Neumann's (1952) study of skeletal populations in North America which were named by reference to known cultural groups. The remains were analyzed for continuous variables, with a sample population of N=471 individuals. This study resulted in eight cranial varieties. While Nuemann's study suffered greatly from the lack of radiocarbon dating and computer clustering, his attempt was to decipher cultural history by associating samples with known cultural groups. Long (1966) re-examined the Eastern components of Neumann's types (i.e. Eastern *Otamid*, *Lenapid*, *Walcolid*, and *Ishwanid*) using multivariate analysis. He concluded that Neumann's Eastern *Otamid* type did not exist, but that the *Lenapid* (M-Algonquian), *Walcolid* (Gulf) and *Ishwanid* (Southeast Archaic) types were replicated. Furthermore, he was able to distinguish an "*Iroquoian*" (M-Sioux) type which was not recognized by Neumann at the time. Ossenberg (1994) has recently pointed out that sophisticated clustering algorithms, based on discrete cranial characteristics, confirm Nuemann's suggestion of an ancestral relationship between Na-Dene and M-Sioux groups (Nuemann's *Ashiwids* and *Deneids*).

Language

Before proceeding further with a focus on biology, some linguistic structure should be clarified. Biological characteristics tend to cluster more with language systems than with ecological or geographical boundaries (Cavalli-Sforza et al., 1988; Sherzer, 1979; Spuhler, 1979). Language is the means by which people identify themselves, and a means by which social groups exhibit various degrees or strengths of social cohesion. It is logical to assume that some elements of proto (ancestral) languages are retained in the daughters (progeny). Which words are more stable, or how long characteristics might be carried by progeny groups remain major dilemmas in the field of linguistics. Certainly the time frame is in the thousands of years. Regardless, language stocks remain as a logical and useful method of labeling biologic and archaeological samples, if possible.

However, there is considerably more variation between languages of the New World, than the biology, or so it would seem. Ruhlen (1987) stated there were "more than one thousand different native languages" at contact, 600 of which remain. Recent compendiums of these linguistic stocks in North and Central America include Campbell and Mithun (1979), Greenberg (1987), and Sebeok (1976). Comparative studies for South American languages lag those of North America but include: Landar (1977), Greenberg (1987) and Key (1991). Most of these studies attempt to combine language groups into larger clusters, looking for ancestrally related groups. Tables A.6 through A.13 lay out the structure of linguistic stocks in North America, and a sample of congruities of archaeological and biological data. These major stocks include: Eskimo-Aleut, Na-Dene, Macro-Sioux, Hokan, Uto-Aztec, Penutian, Macro-Algonquin, Gulf and Timucuan.

Greenberg (1987) focused on the patristic relationships of these same language families, including South America, and he reduced all linguistic stocks into 11 major subgroups, 6 major branches and a single superfamily, "Amerindian". This was not the first attempt at such an extreme reduction, and his methodology has been criticized as not able to distinguish sharing based on homology, from sharing based on reticulation (Campbell, 1988; Matisoff, 1990; Matteson, 1972; Radin, 1919). Greenberg does not propose how this main group branched into 11 major subgroups from the first node below Amerind through to the six major branches. Even the six major branches are in question, according to different researchers. Greenberg linked Amerindian to Clovis Paleoindians by invoking Clovis as the sole Pleistocene colonizers of the continent, before Na-Dene and Eskimo-Aleut. He did not associate the smaller language groups with archaeological cultures or biological samples, later in time, to show how the developments resulted in the diversity observed at contact.

Nichols' (1990) approached her analysis of New World language stocks in a different way. She focused on rates of linguistic separation and presented the result of an inventory of 140 different Amerindian stocks, defining a *stock* as the oldest grouping reachable by the comparative method (i.e. about 6-8,000 years ago; ibid:477) and a *family* as the ordered splits between languages at 2-4,000 years ago and 4-6,000 years ago.

Her results can be interpreted to read that there would have been between 50-70 language stocks already dispersed throughout the continent 10-12,000 years ago. Nichols uses this result to infer that people must have been in the New World as early as 40,000 years ago, in direct conflict with the archaeological probability of a 12,000 rcybp ceiling as presented in Chapter Three. What Nichols does not propose is that indigenous New World linguistic diversity may be due to additional late Pleistocene / early Holocene colonizing groups or more Holocene reticulation, or both, than we currently take into consideration. These other factors might predict the patterns of indigenous diversity observed given the limited archaeological chronology presented in Chapter Three.

Tables A.06 through A.13 also present some examples of possible resonance (congruence) between these linguistic groups and archaeological and biological data. It fleshes out some details discussed in the following paragraphs and shows that some North American language stocks might have more potential for relationships to fluted point progeny than others, particularly the Macro-Algonquin language stocks (Faught, 1990a).

Assessing Linguistic Relatedness and Homelands

Inspired by the development of radiocarbon dating, Morris Swadesh (1954) developed a means of estimating distances between pairs of languages simply by counting how many words were shared from a uniform list of either 100 or 200 words. The list was complied from words which he considered to be more stable across languages. The calculations of temporal distance are based on a proposed rate of 20% loss of shared words per 1000 years. These estimates are not currently given much credence as chronological tools, although instances do exist for their accuracy (Moratto, 1984). In particular, linguistic borrowing (reticulation) can alter the actual dating estimates if it is not recognized. Regardless, the statistic is a valuable tool for ranking how and which languages are related to each other. Table A.14 lists examples of glottochronological estimates within North American families and stocks. Also included are some archaeological references to linguistic groups. This table shows that few linguistic links to archaeological culture groups break a mid-Holocene "ceiling" (e.g. approximately 5,000 rcybp).

One problem of linguistic comparisons is their generally limited inclusiveness, analyses most often approached in pairs. If two language stocks have not been compared, how would we know if they are related? For instance, and to my knowledge, no one has compared Proto Na-Dene to proto Macro-Sioux to assess their relationship given biological data presented by Suarez et al. (1985) and Ossenberg (1994) which might link the two groups. A most inclusive study, using the lexico-statistic technique, is that of Matteson et ai. (1972).

The results of this study showed that Hokan and Sioux groups exhibit 19.7% shared cognates, in congruence with an hypothesis originally suggested by Sapir (1929) of their ultimate association. Likewise Uto-Aztec shared more cognates with M-Sioux than with the others (at 13.9%). They observed that Gulf groups shared 15% of their linguistic elements with Mayan and 13.9% with M-Algonquian. Gulf groups shared only 6.8% of their word with M-Sioux and 6.7% with Hokan (Matteson, et al., 1972:26-27). I believe this data resolves conflicting interpretations by Haas (1958) and Greenberg (1987) regarding Gulf and M-Algonquin, supporting an hypothesis that M-Algonquin and Gulf groups may be ancestrally related, but that Gulf has also had contact (reticulation) with Penutians (Mayans) (Tables A.8, A.9 and A.11).

Diebold (1986) has pointed out linguistic ways to determine the homeland of a proto-language. One way is by plotting the distributions of flora and fauna designated by cognates in different but related languages. The intersection of the distributions of these species is considered the homeland of the proto language. Another method is to ascertain the geographic area of greatest linguistic diversity within a particular stock (Szathmary, 1985:84 for Athapaskan). Gruhn (1988) and Rogers (1986) used this concept to propose that a coastal migration route for the first Americans is reflected by the extreme linguistic diversity of Northwestern North America. However, when \viewed from a continental perspective, languages are most densely diverse in Northwestern South America (Greenberg, 1987). Furthermore, it would also be necessary to document ultimate ancestry of those languages, when it is more apparent that these clusters result from the congregation of various linguistic stocks to a desirable area.

No homelands for New World languages have been determined in Northeast Asia, with the exception of Eskimo-Aleut and Yupik on both sides of Beringia (Fitzhugh and Crowell, 1988). Locally, homelands have been proposed for Eastern Algonquian in the Far Northeast (Fiedel, 1987; Seibert, 1967), and for Uto-Aztecan in the Southwest (Fowler, 1983; Swadesh, 1964:549). A Northwestern homeland for Wakashan is mentioned by Jacobsen (1979:766), but without justification or specific area.

Timucuan, one of the languages of the Floridian Peninsula has recently been demonstrated to be a South American language whose origins were reconstructed by lexical and grammatical similarities of the languages (Granberry, 1991). Chipaya and Mayan have been proposed as ancestrally related (Olson, 1965 in Sebeok, 1976), as have Panoan and Uto-Aztecan (Wistrand-Robinson (1991) in Key (1991)). Homeland proposals for Hokan, Penutian, Sioux, or the Gulf languages have not been located during the course of this research.

Spuhler (1979) published an computer analysis and clustering of blood groups from a large sample of indigenous North Americans and capable of being sorted by linguistic stocks and families. Of two dendrograms published by Spuhler, one restricts clustering to the eight linguistic stocks, another clusters the on biological characteristics without regard to language, although the same nomenclature is retained. In the latter dendrogram, M-Algonquian, M-Sioux, Na-Dene, and Eskimo groups split from Uto-Aztec, Hokan, and Penutian groups at the most distant nodes. A portion of this splitting agrees with Greenberg's connection of M-Algonquian ("Almosan") and M-Sioux ("Keresiouan") (Spuhler, 1979:151; node 104). However this same connection links Na-Dene and Eskimo-Aleut to the "Almonsan-Kerisiouans" instead of to Hokan, Penutian, and Uto-Aztec. These latter groups are those more likely as relatives by the tripartite model and other biological analyses. These kinds of conflicting associations (dissonances), as well as linguistic methodological criticisms, question whether Greenberg is exposing homologous or reticulated relationships (Campbell, 1988; Matisoff, 1990). The same inability to explain the source of variations (homology, analogy or reticulation) holds true with most biological samples to some degree.

The recent spotlight in biological anthropology is the determination of the number of migrations estimable from frequencies of particular mtDNA sequences between groups. These estimates are based on the assumption that more diversity equals more time in the continent. This kind of research is made robust and useful by the use of computer clustering algorithms, but it also suffers from lack of time depth or the ability to discover congruities with archaeological culture groups (Greenberg et al., 1986; Schanfield, 1992; Torroni et al., 1994; Wallace and Torroni, 1992; Wallace et al., 1985).

These studies are perhaps most useful because they structure their groups according to linguistic affinities. For instance, Williams et al (1985) compared four linguistic stocks (Hokan, Uto-Aztec, Penutian (Zuni) and Na-Dene) from the Southwestern U.S. and commented on several others in South America. They identified four major GM allotype systems present in varying frequencies and suggested that distributions of those systems supported Turner's 1983 tripartite migration hypothesis.

However, in a larger sampling of seven linguistic stocks, Schanfield (1992:383) identified five major GM allotype systems and, using cluster analysis with Caucasian and African populations for control, recommended that four migrations better explained the data (ibid, 1992:395). Likewise, four migrations are being inferred from the study of mtDNA distributions in native Americans. By 1992 Wallace and Torroni (1992) had sampled 5 linguistic stocks, and showed four major mtDNA lineages. Since one of these linguistic stocks is Na-Dene, and there are no Eskimo groups, they have added a "migration" over the tripartite model. There are several new studies of mtDNA which include even more linguistic groups than any previous analysis of genetic characteristics (9 out of 11; Torroni et al., 1994). These studies not only confirm a four migration scenario, but also indicate significant similarities between South and Central Americans and Southeast Asian groups. By this data they propose that a different migration route than Beringia must have been used. This association of South and Central Americans with Southeast Asians is confirmed in Kirk's robust review of Pacific, Australian and New World GM allotype distributions (Kirk, 1979).

However, no one has attempted to link these new "migrating" groups with archaeological cultures, and for the most part these samples are still limited with regard to the number of New World languages included (Table A.02 and A.03). Torroni et al. (1994) is a notable and important exception. How do we know how these blood groups are related to ones represented in the past? How can we determine the source of variation? Searching for explanations of similarity means sorting out the chronology and pattern of reticulations, analogies, and homologies.

The point is that these soft tissue studies - like languages - have the disability of limited temporal control, and thus might be the results of shared or separate ancestries, as well as combinations of *in situ* evolution and population mixing through time. These variables can be sorted out using modified Hennigian principles and his can be done by tracing the development of groups from early times to late and from late times to early, dating the spread of particular attributes and linking archaeological cultures to known cultural systems, wherever possible.

Holocene Migrations and Reticulations

If a result of reticulation is increased diversity (biologic, linguistic, and material cultural) and significant diversity is a problem in the explanation of New World populations, then it is probable that reticulation is at least one key to resolving the problems. Can we separate ancestral relations from reticulations by the use of biological, linguistic and archaeological (e.g. holistic) analysis? Clearly, some diversity in native Americans can be explained by reintroducing and reanalyzing evidence for Holocene population movements to and within the New World.

Hypotheses regarding known migrations within the New World which could influence the outcomes of linguistic, biological, and archaeological studies include the possibility of terminal Pleistocene people who made concave based fluted points, convex based stemmed points, and those who made microblade. Middle Holocene (Altithermal or Hypsithermal) population movements include the migration of the Inuit across Canada (Dorset and Thule cultures). Arguments have been made regarding movements of people out of dry Altithermal climates such as the Southwest, southern California, the Great Basin, and the Southern Plains and of movement into more mesic environments such as the Great Lakes, the Northwest coast and the Southeast (Benedict and Olson, 1978; Irwin-Williams and Haynes, 1970; Coe, 1964; Wallace, 1978; Mason, 1981; Meltzer and Collins, 1987). These arguments are all the more compelling when taken together.

Late Holocene movements have been demonstrated in the Caribbean as intrusions from South America (Rouse, 1986). Various shorter migrations are known within Meso-America (e.g. Toltecs at Chitzen Itza are Aztec people who moved into the Yucatan), a possible Late Archaic migration of Early Farmers into to the Southwest has been investigated by Huckell (1995). Other, very late Holocene examples from the Southwest include Mogollon and Hohokam interactions in the Tonto Basin (Stark et al., 1995). Eastern North America also exhibits various possible movements of people given the complex distributions of Adena, Hopewell, and Mississippian sites. Timucuan has already been introduced as a migration (Granberry, 1991; Table A.13). M-Algonquin Wiyot and Yurok people moved into the Northwest in late Holocene times (Moratto, 1984), and, of course the Athapaskans have moved into the Southwest over the last 1000 years (Wilcox, 1988). The point here is considerable opportunities for reticulation and concealing of original distinctions.

Other, controversial, migrations include the possibilities of late Holocene Chinese intrusion (Shao, 1983); and the Japanese Jomons and South American Valdivia

(Meggars et al., 1965). The recent mtDNA research discussed above, and showing a connection between South Americans and Southeast Asians, may bring the latter hypothesis back to the literature. Tuck has noted the possibilities of movements to Europe out from the New World and across the Arctic circle by Red Paint people in the early to middle Holocene. These migrations are not held in good favor in the discipline, nor are they discussed within the frame of resolving colonization models with observed diversity. Neither have they had the benefit of holistic analysis. It remains to be seen how much detail can be squeezed out of this kind of research and interdisciplinary cooperation.

Discussion

Referring to the Tables A.6 through A.13, if a general continuity from the early Holocene through the middle Holocene and of people related to those people who made fluted points is assumed in areas east of the Mississippi, as proposed in Chapter Three, then there are three languages possible for linkage with fluted point makers: Macro-Algonquin, Macro-Sioux, and Timucuan. Since Timucuan is a recent South American intrusive population related to ceramic period culture history (Granberry, 1991), it is out of the picture. Thus, either M-Algonquian or M-Sioux, or both, represent possible progeny of fluted point makers (Faught, 1990).

My interpretation of the literature is that there are more references regarding the link between fluted point Paleoindians and M-Algonquins found in the far Northeastern lexicon than in any other area of North America (cf. Table A.10). This connection hinges on Haas' interpretation that the major portion of the ancestors of the Southeastern Gulf languages spoke proto M-Algonquian. This combines with apparent archaeological continuities there from Paleoindian and Early Archaic periods through the middle Holocene to contact. By this observation, Greenberg's association of Gulf with Penutian would be due to post-middle Holocene reticulation. I propose that M-Algonquins (including Gulf) are the most likely candidates for the progeny of fluted point makers of any of the linguistic stocks of North America.

On the other hand, if M-Algonquian and M-Sioux are patristically related to each other, as proposed by Greenberg, then their branching (or reticulation) could be roughly equivalent to Paleoindian time. This is based on the equivocal possibility that there are more than 8,000 years of lexico-statistical diversion. Since these two groups are known in areas with both concave based fluted point and convex based stemmed point assemblage distributions (i.e. the Plains and Eastern North America), it is possible they were ultimately related. If the archaeological variation seen in the earliest Holocene is the result of the ultimate ancestral connection of convex based stemmed and concave based fluted point makers, then Greenberg is right and these assemblages may be reflecting the initial bifurcation and dating the linguistic split (e.g. the hypothesis of Folsom evolution into Agate Basin and Hell Gap stylistic modes discussed in Chapter Three). This pertains after about 10,400 rcybp, the earliest unequivocal time for Agate Basin at the Agate Basin Site. However, convex based stemmed points are earlier farther west, while fluted points remain undated. The ultimate nature of the relationship of stemmed to fluted point assemblages is equivocal in both regions.

A case can be made that M-Algonquian, including Mosan and Gulf groups, form one gross ancestral clade (based on linguistic and archaeological similarities) and roughly M-Sioux, Hokan, Uto-Aztecan and possibly Na-Dene form another (based on linguistic and biological similarities). These distinctions have been corrupted through time as shown by the lexico-statistics (Matteson et al., 1972) and biological cluster analysis (Spuhler, 1979).

This hypothesis would imply that distinct cultural, linguistic and biological differences existed between the makers of stemmed and fluted points in the late Pleistocene and earliest Holocene. It would also mean the characters shared between these communication systems (e.g. M-Sioux and M-Algonquian) seen by Greenberg (1987) are not the result of shared ancestry but rather might stem from early (fluted point-stemmed point) contacts (reticulation) in the Northwest and Plains, as well as possibly in Altithermal and post-Altithermal reticulations between 6,000 and 4,000 years ago at the Plains/Woodland ecotone (Benedict and Olson, 1978; Irwin-Williams and Haynes, 1970; Johnson, 1989; Wallace, 1978).

What are comparable arguments regarding the connection of South American linguistic groups to archaeological cultures or traditions? How far back in time have South American linguistic groups been linked to archaeological cultures? Given an hypothesis of approximate M-Algonquian association with fluted point makers versus approximate M-Sioux/Uto-Aztec/Hokan /Na-Dene with stemmed point makers in North America, then there should be a similar kind of bifurcation with South American languages, i.e. gross clades which might represent the progeny of the makers of fluted and stemmed point assemblages (Chapter Three). There is more apparent continuity of traditional assemblages with the stemmed point related sites. Did the fluted point related cultures survive in South America throughout the Holocene? Are there languages in South America with evidence for relationships with M - Algonquians? Furthermore, the possibility of an additional migration into South America from Southeast Asia, as reflected in the mtDNA and GM allotype studies presented above, suggests there is considerably more diversity down there to be sorted out.

Linguistic, biological and material cultural data are independent, but ultimately related systems. There is agreement that biological similarity is linked with linguistic and cultural sharing more than it is with with geographical or environmental associations (Spuhler, 1979; Jantz et al., 1992:458) but there are fewer "kinds" of people biologically than linguistically (Jantz et al., 1992; Spuhler, 1979; Szathmary and Ossenberg, 1978; Zegura, 1975; cf. Schindler, 1985). Thus the overlap of biological data onto linguistic or material culture distributions, or both, is likely to result in ambiguities and mixing at the boundaries (Clarke, 1978).

Remember from Chapter 2 that the explanation of linguistic, cultural, and biological diversity demand either longer in situ development (earlier sites) or multiple population sources (i.e. multiple migrations). Since the late Pleistocene / early Holocene boundary exhibits, approximately, the first "clear" appearance of people in the Western Hemisphere and if that time is held as a constant, then population sources and *in situ* microevolution are the only variables to alter in the linguistic or biological subdisciplines. I suggest that the only way to approach these issues effectively is with interdisciplinary teams of researchers focused on similar problems and sharing a similar lexicon and goal.

APPENDIX A

TABLES

Table A.01 Early skeletal samples from North, Central and South America

Table A.01 Early Skeletal Samples from North, Central and South America				
Sample Name	Date	N	T/ S&P	Reference
Skeletal Samples Older than 8,000 rcybp				
Fishbone Cave, Nevada	11,075 +/- 192	1		Orr, 1974; Steele and Powell, 1992:307
Cerro Sota 1, Chile	11,000 +/- 170 (I3988); 10,720 +/- 300 (w915); Cremation	7	T	Turner, 1992:18-26; cf. Oakely et al., 1975
Palli Aike, Chile	10,800 rcybp; Cremation	4	T	Turner, 1992:18-26
Anzick (Wilsal), Montana	10680	1		Steele and Powell, 1992:307; Stafford et al., 1991
Marmes Washington	10,680 rcybp (avg) of 3 10,750 +/- 100 (WSU211) 10,810 +/- 275 (WSU363) 10,475 +/- 270 (WSU366) shell dates, over Glacier Peak ash at 11,200 rcybp; Cremation	3		Steele and Powell, 1992:307
Buhl Woman, Idaho	10,600 rcybp	1		Mammoth Trumpet; Fenton pers. comm.
Warm Mineral Springs Florida	10,300 rcybp	1		Turner, 1992:18-26; Steele and Powell, 1992:307; cf. Cockrell and Murphy, 1978, who mention 12 remains in all.
Lapa Vermelha Rock Shelter, Brazil	11,960 - 10,200	1		Prous, 1986:173; cf. Dillehay et al., 1992:149
Midland Texas	10,100 rcybp; c14 calibrated from U-Th of 11,6	1	T	Turner, 1992:18-26; Mammoth Trumpet 8(1):7 U-TH date = 11,600 +/- 800 ; Stuart, 1955
Arlington Springs California	10,000 +/- 200 (L650); 10,000 +/- 310 (UCLA 1899) on bone post cranial items	1		Orr, 1962; Steele and Powell, 1992:307

Table A.01 Early Skeletal Samples from North, Central and South America

Sample Name	Date	N	T/ S&P	Reference
Shifting Sands, Texas	Folsom age	1	S&P	Steele and Powell, 1992:307
Whitewater Draw, Arizona	10,000 - 8,000 rcybp	2	S&P	Steele and Powell, 1992:307; Waters, 1986
Witt Site (Borax Lake) California	ca 10,100 radiocarbon equivalent calibration of U-TH date of 11,380 +/- 70	1		Riddell and Olsen, 1969
Tlapacoya Mexico	9,900 rcybp	1		Irwin-Williams??? see MacNeish, 1983
Gordon Creek Colorado	9,700 +/- 250 (GX530) on bone "possible agate basin"	1	BOTH	Breternitz et al., 1971; Steele and Powell, 1992:307; Turner, 1992:18-26
Lauricocha Cave Peru	9,525 +/- 250 (I1959) Lauricocha culture (stemmed)	5		Dillehay et al., 1992:174; Cardich, 1964; Oakely et al., 1975
Diablo Canyon California	9,320 +/- 140 (UCLA 1686A) on bone (Millingstone)	1		Greenwood, 1972 in Moratto, 1984:107; Oakely et al., 1975
Big Sandy Site Tennessee	ca 10,000 - 9,000 rcybp?? (Big Sandy I = Bolen)	?		cf. Lewis and Kneeberg, 1959:162
Crowfield, Ontario	ca 10,000 - 9,000 rcybp (late paleo?)	?		Deller and Ellis, 1984
Gorto Site, Michigan	10,000 - 9,000 rcybp?; Cremation	?		Buckmaster and Paquette, 1988
Horn Shelter, Texas	10,000 - 9,000 rcybp	2	S&P	Steele and Powell, 1992:307
Icehouse Bottom South Carolina	9,500 - 8,900 rcybp; Cremation	?		Chapman, 1977
La Brea ("LA man") California	9,000 +/- 80 (UCLA 1292) bone date	1		Steele and Powell, 1992:307; Moratto, 1984:53-4; Kroeber, 1962

Table A.01 Early Skeletal Samples from North, Central and South America

Sample Name	Date	N	T/ S&P	Reference
Lagoa Santa, Brazil	10,000 - 9,000 rcybp	17		Turner, 1992:18-26; cf. Oakely et al., 1975
Wilson-Leonard Texas	before 9,500 rcybp soil dates	1	S&P	Steele and Powell, 1992:307; Mammoth Trumpet (Leanderthal lady)
Namu, British Columbia	9,000 - 8,000 rcybp	2	T	Turner, 1992:18-26
Browns Valley, Minnesota	8,700 rcybp, Pleistocene/Holocene?	1	S&P	Steele and Powell, 1992:307; Oakely et al., 1975
Anzick, Montana	8,600 rcybp	1		Stafford et al., 1991(AKA Wilsal)
Russell Cave, Alabama	ca 8,500 rcybp	1		Walthal, 1980:?
Arroyo Seco Locality Argentina	ca 8,300 rcybp (but burials may be intrusive)	20		Politis, 1992 mammoth trumpet, Dillehay et al., 1992:168
Gore Creek British Columbia	8,250 rcybp (no cranium)	1		Cormie, 1981 ; cf. Carlson, 1983:81-2,
Modoc Rock Shelter Missouri	8,200 rcybp	5		Fowler, 1959:262 ("5 fully flexed burials")
Black Rock Cave #1 Utah	ca 8,000 rcybp guess (underside notched)	1		Wormington, 1964:199
Cummins, Ontario	ca 8 k??	?		Dawson, 1983; Stothers and Abel, 1991:220
Intihuasi Argentina	8,060 +/- 100 (P345); 7,970 +/- 100 (Y228) both bone dates	>1		Oakely et al., 1975
Pope Site, Wisconsin	ca 8,000 rcybp (Scottsbluff); Cremation	?		Rizzenthaler, 1972

Table A.01 Early Skeletal Samples from North, Central and South America

Sample Name	Date	N	T/ S&P	Reference
Renier, Ontario	ca 8,000 rcybp (Scottsbluff); Cremation	?		Mason & Irwin, 1960
L' Anse Amour Pinware New Foundland		1		Tuck, 1977 in Doyle et al., 1985
Windover Florida	Between 7,950 +/- 140 (Beta 10855) rubber peat and 7,360 +/- 70 (Beta11381) peat in cranium	165		Doran, 1988; Purdy, 1991
Samples of Younger Provenience or Questionable Chronology				
G.S. Lewis South Carolina	6,950 +/- 400 in Anderson, 1992:16, "poorly preserved"	1?		In Anderson, 1992:16
Little Salt Spring Florida	5,220 +/- 90 (GAK-3548) in basin; 6,830 +/- 155 (um-1157) in slough	>10		Clausen et al., 1979; Gifford and Koski, 1994
Ventana Cave, Arizona	6,000 rcybp	2		Turner, 1992:18-26; Huckell, pers comm
Texpexpan, Mexico	3,000 rcybp	1	T	Turner, 1992:18-26; Oakely, 1975
Arvilla, South Dakota	Burial with Ivory			Sellards, 1952
Natchez Pelvis Mississippi	Pleistocene??	1		Oakely et al., 1975
Confins, Brazil	late Pleistocene, early Holocene	1?		Oakley et al., 1975
Astahuacan (Santa Maria ?), Mexico	?	3	T	Turner, 1985; 1992:18-26
"limestone caverns" California	? "early"	?		Wallace and Lathrap, 1952

Table A.01 Early Skeletal Samples from North, Central and South America

Sample Name	Date	N	T/ S&P	Reference
Candonga, Argentina	late Pleistocene, early Holocene	1		Oakely et al., 1975:4
Cimarron, New Mexico	Burial near Folsom Locality			Sellards, 1952:119-146 (AKA Novus Mundo)
Columbus, Nebraska	?	1		Turner, 1992:18-26
Cuchipuy 10, Chile	8,000 - 5,000 rcybp	3		Turner, 1992:18-26
Del Mar , California	5,000 rcybp	2	T	Turner, 1992:18-26
Fontezuela, Argentina	Pleistocene	1		Oakely et al., 1975
Guitarrero Cave, Peru	late Pleistocene	3		Oakely et al., 1975
Lecanto I, Florida	?	1		Turner, 1992:18-26
Melbourne, Florida	6,000 rcybp?	1	T	Turner, 1992:18-26
Pelican Rapids Minnesota	early archaic	1	BOTH	Jenks, 1936; Steele and Powell, 1992:307; Turner, 1992:18-26; cf. Oakely et al., 1975 (AKA Minnesota "Man")
Mostin California	Middle Archaic? original estimated 11,000 - 10,000 radiocarbon control contaminated	1		Kuafman, 1980; Taylor et al., 1985; Steele and Powell, 1992:307
Mulberry Creek, Alabama	ca 6,000 rcybp (Morrow Mountain)	>10		Walthal, 1980:64 (WARFARE)
Old Crow , Yukon		?	T	Turner, 1985:59
Punin, Ecuador	late Pleistocene early Holocene	1		Oakely et al., 1975
Russell Cave, Alabama	6,255 avg2 (Morrow Mountain)	5		Walthal, 1980:61

Table A.01 Early Skeletal Samples from North, Central and South America

Sample Name	Date	N	T/ S&P	Reference
Sauk Valley. Minnesota	?	1	S&P	Steele and Powell, 1992:307
Savannah, Georgia	?	1		Turner, 1992:18-26
Schutz Cave, Texas	?	1		Turner, 1992:18-26
Stanfield-Worley Rock Shelter, Alabama	>6,000 rcybp? (Morrow Mountain)	1+		Senseng and Hoar, 1962
Tehuacan Tc272-4 Mexico	6.500 - 5,000 rcybp	3	T	Turner, 1992:18-26
Vero Beach, Florida	?	1		Steele and Powell, 1992:307
Windust Cave Washington	?	?		Check Bryan, 1980

Table A.02 Examples of linguistic provenience for major biological samples - North America

Reference	Eskimo	Na-Dene	Algonquian	Sioux	Gulf	Uto-Aztecan	Penutian	Hokan
Suarez et al., 1985	x	x	x	x	x	x	x	x
Spuhler, 1979	x	x	x	x		x	x	x
Lampl & Blumberg, 1979	x	x	x	x		x		
Jantz et al., 1992 (Boaz)	x	x	x	x		x	x	
Jantz et al., 1992 (Analytic)								
Schanfield, 1992		x	x	Hokan-Sioux		Zuni	Maya	
Williams et al., 1985		x				x	x	x
Szathmary & Ossenberg, 1978	x	x	x	x				
Ossenberg,	x	x	x	x				
Nei and Roychoudry, 1982	x	x	x					
Neel and Salzano, 1966	No North Americans							
Fitch and Neel, 1969	No North Americans							
Brace and Hunt, 1990	Southwest, Midwest, Plains, Northwest Coast, California							
Turner Dental samples, 1986	Several groups discussed in text							
Turner, 1985	Above groups combined to three							
Wallace and Torroni, 1992		x				x (Pima, Papago)	x (Maya)	x (Pomo)
Cavalli-Szforza et al., 1988	"5 Groups" - groups not named in published paper							

Table A.03 Examples of linguistic provenience for major biological samples - South America

Reference	Hokan	Chibchan	Paezan	Andean	Equatorial	Macro-Tucanoan	Macro Carib	Macro Panoan	Macro Ge
Suarez et al., 1985	No South America Samples								
Spuhler, 1979	No South America Samples								
Lampl & Blumberg, 1979	No South America Samples								
Jantz et al., 1992 (Boaz)	No South America Samples								
Jantz et al., 1992(Analytic)	No South America Samples								
Schanfield , 1992	Jicaque			x					Chaco ?
Williams et al., 1985	"34 South and Central American Indian Tribes"								
Szathmary & Ossenberg, 1978	No South America Samples								
Ossenberg,	No South America Samples								
Nei & Roychoudry, 1982		Yanoama	x	x			x		
Neel and Salzano, 1966	Selected, but restricted groups								
Fitch & Neel, 1969	Selected, but restricted groups								
Brace and Hunt, 1990	Peru								
Turner, 1985	18 samples lumped and listed by geographic region: Panama, Ecuador, Peru, Brazil, Bolivia, Chile								
Turner 1986	Lumped sample, no provenience data presented								
Wallace and Torroni,, 1992						x (Ticuna)			
Cavalli-Szforza et al., 1988	"5 Groups" - groups not named in published paper								

Table A.04 Summary of Eskimo-Aleut archaeological and biological congruity

ESKIMO-ALEUT

People speaking dialects of the Eskimo-Aleut are skeletally, serologically and linguistically distinct from all other native Americans (Hooton, 1933:150; Dummond, 1987; Laughlin, 1963; Neumann, 1952:25; Rouse, 1986; Szathmary, 1985; Szathmary and Ossenberg, 1978:673; Zegura, 1975). Distributed in the circum-Polar regions of Alaska and Canada, Eskimo-Aleut (including Aleut and Inuit in Alaska and Yupik in Siberia) is the only language stock in the New World with clear and recent representatives in Northeast Asia (Fitzhugh and Crowell, 1988).

Robust overlapping of linguistic, biological and archaeological data (resonance) traces their continuity from the Arctic Small Tool Tradition through Norton and historic Thule. However, this chronology is too recent to be of interest for Clovis origins.

Table A.05 Summary of Na-Dene archaeological and biological congruity

NA-DENE

Speakers of Na-Dene related dialects are genetically and skeletally more similar to speakers of Eskimo-Aleut, than to M-Algonquians of the circum-Polar regions of North America (Szathmary and Ossenberg, 1978:682-3; Szathmary, 1985:95). Na-Dene speakers are distributed in Alaska, NW Canada, along the NW Coast, over portions of the High Plains and down into SW North America. There is biologic (i.e. dental) data in resonance with archaeological data at the early Holocene site of Namu in British Columbia showing Na-Dene association with microblade assemblages of the greater NW Coast (Turner, 1983; 1985). The Northern Archaic tradition of Alaska probably represents Na-Dene related speaker.

The modern distributions of Navajo, Apache, and Kiowa-Apache are the results of migration into the Central and Southern Plains over a period of at least 2000 years. Krauss (1979:874) has suggested on the basis of language similarities that these Athapaskan families are most closely related to Sarcee, Carrier, and Beaver Athapaskans which is in agreement with biological data presented by Spuhler (1979:151; Node 99, Figure 7.3). Data presented by Suarez et al., (1985) possibly reconstructs the pattern of this migration as reflected by the geographic distribution of blood group frequencies. Sharing of Albumin Naskapi by several M-Algonquin and Na-Dene groups suggests supports Wilcox' observation that Sarcee (ND) and Blackfoot (MA) were allied in historic times, although there may be other situations of contact at various times in the Holocene which would result in these patterns (Lampl and Blumberg, 1979, Wilcox, 1988; Faught, 1990:28-30).

Table A.06 Summary of Hokan archaeological and biological congruity

HOKAN
Because of its extreme dialectic diversity and patchy distribution Hokan is often described as an "old language" (Langdon, 1979:595). The "core" consists of Hokan, Yana, Pomo, Yuman, and Salian-Seri of the Great Basin and California (including Baja). Greenberg's (1987) addition of the Coahuiltecan groups of southern Texas and northern Mexico was proposed by others as well, but it is not universally accepted (Langdon, 1979; Campbell, 1988; Campbell and Mithun, 1979:34). Hokan speaking groups are also known from western Central America and from Northwestern South America (Greenberg, 1987). Summarizing an unusually robust amount of linguistic and archaeological data, Moratto (1984:530-574) outlines the probabilities of ultimate archaeologic connection of Hokan speakers with Western Fluted Point, through Western Pluvial Lakes Tradition (stemmed point) through the Encinitas and Campbell Millingstone traditions to protohistoric Diegueno and Chumash. As pointed out in Chapter Three, the connection of Fluted Point and Stemmed Point assemblages is equivocal. The continuities from WPLT through Archaic and subsequent traditions represents the stronger tie.

Table A.7 Summary of Uto-Aztecan archaeological and biological congruity

UTO-AZTECAN
Uto-Aztecan is distributed from Mexico up to the Great Basin (Fowler, 1983; Miller, 1983). It includes Shoshonean, Kiowa-Tanoan, Sonoran, and Nahualtecan. Uto-Aztecan speakers represent most of the Southwestern Puebloan societies, and Aztecs in Mexico. Possible resonance between material culture (Pinto projectile points) and linguistics of ca 5000 years has been proposed for the Numic speakers of the Great Basin and California with a time depth of 5000 or more years (Willey, 1966:231; Aikens and Witherspoon, 1986; Fowler, 1983; Moratto, 1984:549-551). Post Altithermal Early Farmers in Southern Arizona (Cochise and San Pedro) through the development of Hohokam and to the proto-Historic Tohono O'odham represents at least 4000 years of continuity. Wider connections have been proposed with Panoan speakers in South America suggesting a case of the movement of ceramics, but with painted versus incised decorations (Wistrand-Robinson, 1991). While Fluted point hunters are well known from areas of current Uto-Aztecan occupation (i.e. San Pedro Valley of Arizona, and central New Mexico, Haury et al., 1959; Judge, 1973; Hester, 1972), there are gaps in the archaeological records suggesting low to no population during Altithermal time in the desert southwest and thus breaking the possibility of continuity or relation (e.g. early to middle Holocene time, Berry and Berry, 1986; Irwin-Williams and Haynes, 1970; Faught, 1990:62-65).

Table A.08 Summary of Penutian archaeological and biological congruity

PENUTIAN
Macro-Penutian is a controversial language stock with somewhat vague archaeological connections. The clearest relatives of this stock are the Mayan languages of Central America, but as originally constructed "Macro-Penutian" includes several languages in California and the Northwest Coast, and Zuni in the Southwest (Trager, 1945; Greenberg, 1987). Campbell has countered with the alternative that these outlying similarities are actually the results of sharing by contact (reticulation) (Campbell, 1988). Mayan archaeological continuity is clear from Olmec assemblages on the eastern coast of Mexico and Yucatan. Moratto equates the Californian Windmiller and Lovelock archaeological cultures as ancestral to known historic Penutian speakers and offers a time depth of at least 4500 years. Croes proposes that stylistic elements of basketry distinguish Tsmishian (Penutian) from Mosan speakers from artifacts 1500 to 2000 years old (Croes (1989:114). Greenberg includes the Northwest and Californian Penutian groups, and Mayan in Mexico. The more controversial connection he makes is with the Gulf groups of the Southeast, in contrast to Haas who combines Gulf with Macro-Algonquian (Haas, 1958; 1976; 1979). This contrast points out the necessity to investigate groupings with biological and archaeological sets as well as linguistic characters. Archaeological continuity from Early Archaic through complexity to contact would favor Haas' contention of ultimate ancestry in M-Algonquian. On the other hand, Greenberg's association also has resonance with archaeological evidence for contact (reticulation) with Meso America in Mississippian, and perhaps Woodland times. Biological evidence also suggests reticulation has occurred in this time frame as well in the Southeast (Faught, 1990:39; Figure 5). A larger connection, between Maya and South American Chipya has been proposed by (Key, 1992) which would agree with the movement of incised ceramics from northern South America into North America and through Olmec, Poverty Point and along the Gulf Coast to the Florida Peninsula and the Southeast Atlantic coast (Granberry, 1990; Milanich, 1994). Archaeological gaps between early Mayan Olmecs and the Archaic cultures known from Central America, along with possibilities of reticulation with the Northwest Coast and Southeastern regions weaken proposals of ultimate connection with the makers of Fluted points.

Table A.09 Summary of Macro-Sioux archaeological and biological congruity

MACRO-SIOUX
Macro-Sioux is comprised of three major linguistic families: Sioux (Plains), Iroquois-Cherokee (Northeast and Southeast), and Caddo (western Southeast) (Chafe, 1976; Campbell and Mithun, 1979:38). Greenberg adds Keresan, a Puebloan group in the Southwest - as did Sapir - even designating the stock as "Keresiouan". Another hypothesis has been made by Davis (1979), placing the Keresan speakers with Uto-Aztecs. This contradictory (dissonant) situation could be related to late prehistoric interactions between Plains and Pueblo groups (Jelinek, 1967), making the linguistic resonance the result of late Holocene reticulation rather than homology. On the other hand, earlier Southwest and Plains culture group contiguity between Plains Archaic and early Basket Maker cultures are also possibilities (Irwin-Williams, 1979; Neumann, 1952). The biological similarity of some Caddo, Cherokee, Uto-Aztec and Hokan groups (Spuhler, 1979:151; node 98 and 101); as well as statistical similarities of anthropometric variation recorded by Jantz et al., (1992:447) suggests affiliation between these three linguistic groups. The connection of Hokan and Sioux was proposed by Sapir (1929) and supported by statistical analysis (Matteson et al., 1972), but Campbell and Mithun (1979) doubt its reality. The biological data indicates that this hypothesis at least has merit for further inquiry. There is a marked artifactual similarity between Gypsum Cave, Morrow Mountain, and various Tamaulipas points of mid Holocene age. Moratto has associated the Gypsum points with Uto-Aztec speakers, while the Morrow Mountain intrusion into the southeast may document the movement of Cherokee speakers. In the Southeast there is evidence for the Altithermal intrusion of migrating people including discontinuities of artifact assemblages and possible warfare, suggesting the people were unwelcome, with Morrow Mountain groups (Coe, 1964; Walthal, 1980). The presence of numerous skeletal remains from this time period offer the possibility of biological analysis focused on affinity to test and refine the culture history. M-Sioux speakers who resided in the Plains areas of Paleoindian occupation and continuity have potential for connection with either fluted or stemmed point traditional groups. Likewise, Iroquois and Cherokee reside in areas of intense fluted point occupation and continuity. However, the potential for their arrival during Altithermal time weakens the proposal that they are connected. Haas proposed linguistic similarities between Sioux and Athapaskan (1964) and recently Ossenberg (1994) has proposed a similar connection based on cranial characteristics shared by both groups.

Table A.10 Summary of Macro-Algonquian archaeological and biological congruity

MACRO-ALGONQUIAN
Macro-Algonquian is represented by four major language families - Eastern, Central, Western, and Ritwan (Teeter, 1976; Goddard, 1979). The Ritwan languages (Wiyot and Yurok) in California are linguistically confirmed M-Algonquian groups with archaeological expression in Northwestern California of at least 1,000 years (Haas, 1958b; Moratto, 1984:564-5). Perhaps most importantly, Carlson (1983), Snow (1977) and Tuck (1977) have proposed archaeological continuity from later fluted point Paleoindians in the East, through Maritime and Coastal Archaic traditions, to the historic Eastern Algonquians of New England and the Atlantic Provinces. Siebert (1976) has proposed that the that the linguistic homeland for eastern M-Algonquian is also in this area (although see Fiedel (1987b) regarding a middle Holocene chronology for this). Connections have been proposed between middle Holocene Sheild Archaic archaeological assemblages and M-Algonquian speakers (Wright, 1972; Tuck, 1975; 1978; Szathmary, 1985:84). Early to Middle Archaic aged archaeological sites in the Central States, like Koster, Graham Cave, and Modoc Rock Shelter, record stratified evidence from late Paleoindian times, continuity and development through the Early Archaic to Middle Archaic (e.g. Helton Phase, which retains side and corner notched points related to the Greenbriar\Bolen\Big Sandy\Taylor points of the Southeast (and their assemblages). Extension of convex based stemmed point related artifacts into these areas, and sharing of artifact types is also possible in these Central States by the post-Altithermal arrival of Nebo Hill related assemblages (Reid, 1983). Benedict and Olsen (1978) present convincing evidence for the homeland of their Altithermal age Mount Albion Complex being the Front Range of the Rocky Mountains, with central Ohio Valley Archaic complexes as sites such as Koster, Modoc Rock Shelter, and Carlson Annis. They propose, and document radiocarbon and other data from 110 Altithermal aged sites over North America to show movements of people out of arid regions and into more desirable, but already populated. M-Algonquin presence in the Plains probably begins after this time, rather than exhibiting continuity from the Early Archaic. However, since M-Algonquian speakers have considerable time depth in areas of fluted point frequency, along with Early and Middle Archaic continuity in the Northeast and Central States, they have a potential for representing their ultimate ancestors.

Table A.11 Summary of Gulf archaeological and biological congruity

GULF

The Gulf languages, originally defined by Haas (1952), are perhaps the most difficult to reconstruct because the Southeast was significantly impacted by the Spanish in the early 16th century and therefore this became an area of less anthropological and ethnological interest and sampling . Regardless, few biological samples include Southeastern Groups (cf. Table A.02).

Gulf is comprised of mostly Muskogean languages, with several isolates not known well enough to classify (e.g. Yuchi). One language of the Gulf group - Mobilian - may have been a functional dialect used for trade relations (Haas, 1975). Haas considered an ancestral association of Muskogean with M-Sioux (1952), which initially postulated by Swanton in 1936, but found stronger evidence of connection with M-Algonquian (1958). Chafe has supported this Gulf / M-Algonquian connection (1976:576). This association is corrupted by age and possible reticulation with M-Sioux speakers (Cherokee and Iroquois) and South American Timucuans.

Because the Southeast area represents one of clear fluted point settlement and habitation, with very good evidence for continuity through the early archaic/Holocene it also represents a source of association with M-Algonquian speakers.

Table A.12 Summary of Mosan archaeological and biological congruity

MOSAN

The Northwestern Mosan groups consist of three weakly linked languages. The suggestion of ultimate affinity with M-Algonquian was originally made by Sapir (1929), later by Haas (1965), and most recently by Greenberg (1987). Other possibilities are associations with Eskimo-Aleut (Thompson, 1976), which is supported by evidence from biology (Spuhler, 1979: node 89). If demonstrable, the association with M-Algonquian would be old (Campbell and Mithun, 1979:38). Mosan affinities with either Na-Dene or Penutian, two other groups in this complex linguistic region, have not been presented as alternatives.

A distinction between basketry styles of Salishan and Wakashan linguistic groups has been presented by Croes (1989:113-114) with a ^{14}C depth of about 3000 years. These distinctions cut across established cultural phase designations built on lithic and bone artifact classifications (Locarno Beach and Gulf of Georgia). Croes proposes that lithic styles cross cut some cultural distinctions because lithics are more likely to be the result of similar adaptations to environment.

If the Mosan families have an ancestral relationship with M-Algonquian then this could conceivably resonate with fluted point distributions in the Far West, and represent a third case of M-Algonquian / Fluted point association (i.e. East, Southeast, and Northwest). However, archaeological continuity from fluted point Paleoindian through Early Archaic/Holocene stemmed point cultures is equivocal (Willig and Aikens, 1988).

Table A.13 Summary of Timucuan archaeological and biological congruity

TIMUCUAN
Known from Northern and Central Florida, and originally designated as an "isolate", Timicuan is a Warao or Arawakan language which arrived in the area by a post Altithermal migration . This relationship has recently been demonstrated by Granberry (1991). Greenberg classifies these languages as "Equatorial" (Greenberg, 1987). The fact of migrating Equatorial group into the Southeast is an association which has strong resonance with an archaeological hypothesis of external intrusion of ceramic technology (via migration of people) into North America ca 4000 years ago, The archaeological continuity of early ceramics from Orange through Swift Creek-Deptford ceramic sequence of the lower Southeast may be attributable to Timucuans, or Gulf groups such as the Apalachee, or combinations of both (Tesar, 1980; Granberry, 1991; Milanich, 1978; Rouse, 1986). Hrdlicka (1925) pointed out biological similarities between his "Gulf type" in the Southeast and South American samples, which were also observed by Nuemann (1952). Turner's (1983) dental studies reveal some similarities as well (Faught, 1990:Figure 5). The recency of this linguistic group in this area, negates connection of these speakers with fluted point traditions.

Table A.14 Summary of linguistic divergence estimates

Table A.14 Temporal Summary of Linguistic Divergence

Stock/Language	Separation Estimate	Reference
ESKIMO-ALEUT		
	2,900 - 5,600	Greenberg, 1987; Dumond, 1987
NA-DENE		
Athabascan - Haida	9000	Kraus, 1976:73
Athabascan - Tlingit	5000	Kraus, 1976
Tlingit (archaeological evidence - RCYBP)	1600	Moss et al., 1989
North from Southern Athabascans	1300	Hoijer, 1956 (from Hoijer, 1971)
MACRO-SIOUX		
Cherokee - Iroquois	3500 - 3800	Mithun, 1979:159
Tuscarora	900 - 2400	Mithun, 1979:159
MACRO ALGONQUIAN		
Eastern Homeland - split between Eastern and Central Algonquian	3200	Siebert, 1967
Ritwan/Proto-Algonquian	3000	Haas, 1966 in Fiedel, 1987
M-ALGONQUIAN - GULF	5000 - 6000	Haas, 1958
MOSAN		
Mosan - Salish	9000	Jacobsen, 1979:978
Salishan-Wakashan-Chimakuan split	9000	Swadesh, 1953
Wakashan - Chimucuan	6500	Jacobsen, 1979:798
Salishan various	3000 - 5500	Swadesh, 1954
Salishan-Wakashan (archaeological evidence the basketry types in Gulf of Georgia/Puget Sound were "taking form", Croes, 1989:124	3000	Croes, 1989:116
Nootka - Kwakiutal	2900	Jacobsen, 1979:798
Tsimshian (archaeological evidence of continuity 1500 - 2000 bp, Croes, 1989:117)	Continuity to the historic	Croes, 1989:117

Table A.14 Temporal Summary of Linguistic Divergence

Stock/Language	Separation Estimate	Reference
UTO-AZTECAN		
Uto-Aztecan	1000 - 5000	Aikens and Witherspoon, 1986; Fowler, 1983
Numic from Sonoran	4000	Hopkins, 1965:50
Numic from Tubatulabalic	3000 - 2300	Hopkins, 1965:50
Kiowa from Tanoan	2800 - 3300	Jelinek, 1967:163
Numic	1000 - 1500	Hopkins, 1965
Uto-Aztec from Penutian	10,000	Aikens and Witherspoon, 1986
PENUTIAN		
Penutian - various	5500 - 4500	Swadesh, 1954
Tsimshian (archaeological from basketry Lachane Culture in NW coast)	1500 - 2000	Croes, 1989:117
HOKAN		
Hokan	3500 - 5500 (various)	Swadesh, 1954
Hokan - Coahuiltecan	9000	Swadesh, 1967
Pomo-Yanan from Cochimi-Yuman	8000	Moratto, 1984:547
Washo-Yana	5500	Moratto, 1984:536
MACRO-AMERINDIAN (not a lexico-statistic estimate)	9000 - 11000	Greenberg, 1987

APPENDIX B

SITE DATA BASE

APPENDIX B - SITE DATA BASE

This Appendix contains the sites gathered during the background research and inventory (Table B.02) and a key for its interpretation (below). The total number of sites in Table B.02 is N=1076, the total number of sites with coordinates for mapping is N=1053. Of these, 131 were indeterminate for both time and point (assemblage) class. Table B.01 shows the distribution of the remaining N=922 sites sorted to class.

Table B.01 Summary of Paleoindian and Early Archaic sites and localities from Background Research - Inventory sample

Points (Assem.)> Site Type V	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	2	3	4.*	5	6	9	Total
Sites	69	47	56	12	7	103	9	10	114	24	175	5	17	19	667
Localities	52	80	10	0	1	65	4	0	0	0	43	0	0	0	255
	121	127	66	12	8	168	13	10	114	24	218	5	17	19	922

KEY FOR TABLE B.02

TIME
1 Earliest unequivocal through 10,000 rcybp
2 10,000 through 9,000 rcybp
3 9,000 through 8,000 rcybp
4 8,000 through 7,000 rcybp

DATES
1 Radiocarbon control available

POINTS (assemblages)
1.1 Classic Clovis
1.2 Folsom related
1.3 Dalton related
1.4 Great Lakes
1.5 Vail, Debert like
1.6 "Other" fluted
1.7 Fishtail fluted
1.8 Suwannee, Simpson

2.0 Stemmed points
3.0 Microblade sites

4.0 "Other" (bifurcates, Lovell Constricted, Pryor Stemmed, Kessel Side Notched)
4.1 Hi-Lo (as in Ohio)
4.2 San Patrice (TX, LA)
4.3 Plainview, Midland, Golondrina, Belen, Firstview
4.4 Big Sandy, Bolen, Taylor, (Late Paleoindian, early Archaic notched)
4.5 not used
4.6 Hardaway, Greenbriar
4.7 Angostura
4.8 Kirk, Palmer, Stanley
4.9 Scottsbluff, Eden, Cody

5 Nenana, Chindadn, Beringian
6 Faunal Localities

CONTINUITY
1 Sites or Localities displaying a variety of diagnostic items indicating repeated occupation

BLADES
1 Sites exhibiting items interpreted as blades

OTHER
1.0 Miniature point
1.2 Miniature and crystal point
2.0 Crystal point
3.0 Art
3.2 Art and crystal point
4.0 Cache
4.1 Cache with miniature point
4.2 Cache with crystal point
4.3 Cache with art
4.5 Cache with miniature and crystal

KEY FOR TABLE B.02 - Continued

AENA	Archaeology of Eastern North America
CRP	Current Research in the Pleistocene
PA	Plains Anthropologist

Table B.02 Sites gathered from background research - inventory

Table B.02 Sites Gathered from Background Research - Inventory

ON MAP	SITE	ST.	DESCRIPTION	REFERENCES	TIME	DATE	POINT	CONTINUITY	BURIAL	BLADES	OTHER
1	Aberdeen	NW TERR	no dates, late Agate Basin / notched, structures	Bryan, 1980:99 pp 104	4		2.0				
1	Abilene	TX	Meserve points	Wormington, 1964:113	1		1.3	1	1		
1	Abilene	TX	Clearfork, burials	Sellards, 1952:119-146	1		1.3	1	1		
1	Acasta Lake	NW TERR	6.9k, ? late agate basin	Bryan, 1980 pp 104	4	1	2.0				
1	Acton	TX	Angostura, Golondrina, Meserve, Plainview, Scottsbluff, San Patrice	Thurmond, 1990:35-131	1		1.3	1			
1	Adair-Steadman	TX	Folsom "extensive" campsite, Bryan 1980:98	Shutler, 1983;Bonnichsen et al., 1987	1		1.2				1.2
1	Adkins Site	ME	fluted point site near Vail	Gramly, 1988	1		1.5				2
1	Adobe	COLO	Folsom site Ingbar, 1992:170 red ocher in Roper, 1991	Ingbar, 1992:170	1		1.2				
1	Agate Basin (Sheaman Site)	WY	Multicomponent - Folsom, Agate Basin :415; Hell Gap - habitation :417; 10.4, 9.9, 9.3K basal thinned pt, beveled ivory pt @ Agate Basin locale, red ocher	Sellards, 1952:119-146; Frison, 1978: 29; 1991:148; Frison and Stanford, 1982; Bonnichsen et al., 1987; Wormington, 1964 :141; Bryan, 1980	1	1	1.2	1			
1	Agua Hedonda Lagoon	CA	San Dieguito @9k stratified Moratto 84:107 Paleo Coastal Trad.	Wallace, 1978:26	2	1	2.0				
1	Ake	NM	fluted point locality	Carlson, 1983:84 Fluted Points	10		1.6				

Table B.02 Sites Gathered from Background Research - Inventory

1	Akmak	ALK	9.6k blade and microblade levels, cf Dumond 80:987 "Beringian" to West, 1983	Shutler, 1983 site list (:221-222)	2		4.0	1		1	
1	Alford Basin	OR	fluted point locality	Carlson, 1983:84 Fluted Points	10		1.6				
1	Alkali Springs	ID	Clovis locality	Titimus and Woods, 1991	10		1.1				
1	Allatoona Res.	GA	Clovis, Dalton, Greenbriar :17-19	Anderson et al., 1990:11 MAP	1		1.1	1			
1	Allen Site	NB	8.274(500) frontier complex, bone items= plano listed as having red ocher	Wormington, 1964:137 Roper, 1991:294	3	1	4.0				
1	Allumette	ONT.		Funk, 1978	xx		xx				
1	Alpine Creek	TX	Angostura, Golondrina, Midland, Plainview	Thurmond, 1990:35-131	2		4.3	1			
1	Amherst Shore	N.S.	Keenlyside 1991 - locality	Bonnichsen and Turnmire, 1991	10		1.5				
1	Anadarko	OK	Western (Clovis) Paleoindian sites blade cache	West, 1983; Hammatt, 1970 Rule, 1983:21	1		1.1			1	
1	Anagula Island	ALK	Blade Microblade Clark, 1991:37;	Bonnichsen et al., 1987 Shutler, 1983; Carlson, 1983:92 ; 1984:69; Dumond, 1980:98; Willey, 1966	3	1	4.0				
1	Anatuvuk Pass	ALK		Clark, 1984, and Wilmsen, 1970	xx		xx				
1	Anderson	BC	fluted pt site/locale Carlson :92:82	Bonnichsen and Turnmire, 1991	10		1.6				
1	Angus	NB	Clovis, mammoth, may be spurious association Wormington, 1964:43	Rule, 1983:21 Sellards, 1952:36,132	1		1.1				
1	Anzick	MT	Western (Clovis) Paleoindian Rule, 1983:21 burial and cache sites, red ocher on items - Roper, 1991 10.680(50)avg5 Haynes 1992:360	Frison, 1978: 29 Shutler, 1983 site list (:221-222) West, 1983 Bonnichsen et al., 1987 Davis, 1988:26	1	1	1.6		1		4
1	Arc	NY	fluted, tools, debitage, surface, Gramly and Vanderlaan, 1986	Gramly and Vanderlaan, 1986	1		1.6				
1	Arcade Crk.	CA	<8k stemmed, milling tools	Wallace, 1978:26	3		2.0				

Table B.02 Sites Gathered from Background Research - Inventory

1	Arenal	C.R.	Clovis on map pp:239 near town - locality	Ranere and Cooke, 1992	1		1.6				
1	Arnold Cave	MO	??? (excavated sites, 12-8k SE(map))	Smith, 1986:8; Shippe, 1966	1		1.3	1			
1	Arvilla	ND	poss ivory w/burials	Sellards, 1952:138	xx		xx		1		
1	Ashworth	KY	??? (excavated sites, 12-8k SE(map))	Smith, 1986:8	xx		xx				
1	Astoria	WA	stemmed	Carlson, 1983:77 "Stemmed Point"	xx		2.0				
1	Aubrey	TX	10.946(87)(SMU-2194)over Clovis, stratigraphic excavations	Haynes, 1991; Ferring, 1989; 1990	1	1	1.1			1	
x	Aurora Run R.S.	OH	plano and kirk together ca 9110	Mason, 1980: cf Doyle et al., 1985:11	2	1	4.8	1			
1	Avery Island	LA	extinct fauna w/ basketry(@4.2k), 10.9(300); 12.0(400)poss paleo, archaic, no diagnostics	Neuman, 1984:63-65 Gagliano, 1977	1						
1	Bacon Farm	SC	fluted pt, deep strata, early archaic	Anderson et al., 1990:11 MAP	1		1.6	1			
1	Baker Cave	TX	9.025(avg2) 9k (avg4) Golondrina, clear fork biface	Thurmond, 1990:35-131 Hester, 1990 CRP 7:16,	2	1	4.3				
1	Baker II	OHIO	fluted Gainey "sites and/or find spots representing Gainey"	Stothers and Abel, 1991:199	1		1.4				
1	Bannock Creek	ID	Clovis - locality	Titimus and Woods, 1991	10		1.1				
1	Banting	ONT	fluted pts, with tools etc.:99	MacDonald, 1983:107	1		1.4				
1	Barden #2	OHIO	Hi-Lo complex	Stothers and Abel, 1991:207-8	1		4.1				
1	Barnes	MICH	Paleoindian" Stothers and Abel, 1991:198 Parkhill complex fluted :99	Funk, 1978 MacDonald, 1983:107 Anderson et al., 1990:52	1		1.4				
1	Barnett Shoals (9Oc25)	GA	fluted(3 sites), unfluted, Dalton (10 sites), unifacial tools	Anderson et al., 1990:11 MAP	1		1.3	1			
1	Basin Head / Little Harbor	PEI	Late Paleo locality, Keenlyside, 1991	Bonnichsen and Turnmire, 1991 site list	20		4.8				
1	Bat Cave	NM	how old are the lowest? corn in level 3	Wormington, 1964:174	xx		4.0				

Table B.02 Sites Gathered from Background Research - Inventory

1	Batza Tena	ALK		Carlson, 1983:92 Fluted Shutler, 1983 site list (:221-222)	1		1.6				
1	Baucom	SC	Hardaway site, Clovis??	Anderson et al., 1990:52:11 MAP	1		1.1				
1	Bear Cove	BC	pebble tools	Shutler, 1983; Carlson, 1983:87	xx		4.0				
1	Bear Crk.	CA	<5k "period III"	Wallace, 1978:26	4						
1	Beatty-Goldfield	NV	fluted (49 pts Davis and Shutler, 1969:170)	Davis and Shutler, 1969:163 Nevada	1		1.6				
	Beaver Dam A		NO RECORD		2		4.3				
1	Bedier	BC	fluted locality	Carlson, 1983:92 Fluted	10		1.6				
1	Bee County	TX	Scottsbluff, Yuma, "plano" 6 sites Berclair Terrace, Clovis, Scottsbluff, corner notched	Sellards, 1952:119-146 Wormington, 1964	1		1.1	1			
1	Beidleman Rnch	TX	Plainveiw	Thurmond, 1990:35-131	2		4.3				
1	Bell	OK	Dalton Wycoff, 1968	Perttula, 1985 CRP 2:25 Johnson, 1989:15 (#30)	1		1.3				
1	Belmont I&II	N.S.	@ Debert, Keenlyside, 1991:164	Bonnichsen and Turnmire, 1991	1		1.5				
1	Bentzen - Kaufman Cave	WY	Goshen under rockfall, no date	Grey, 1962; Frison, 1991:147	1		1.2				
1	Beta R.S.	ID	8.175(230)(WSU-402)) = Shoup site? Western Stemmed	Willig and Aikens, 1988:13-15	3	1	2.0				
1	Betty Greene	WY	7.8k - Lusk	Frison, 1978: 29 Shutler, 1983 site list (:221-222)	4		4.0				
1	Big Bone Lick	KY	10.600(250)(W-1358) on redeposited fauna Clovis in 1898; cf Tankersley, 1987	Walthal, 1980:26; Anderson et al., 1990:52; Tankersley, 1987 CRP4:36	1	1	1.1				
1	Big Flat	ID	Clovis Folsom - locality	Titimus and Woods, 1991	10		1.1	1			
1	Big Hill #2	OHIO	plotted as 1 of 11 sites in Locus county - Hi-Lo complex	Stothers and Abel, 1991:207-8	1		4.1				

Table B.02 Sites Gathered from Background Research - Inventory

1	Big Horn Basin	WY	not a site = "stemmed"	Carlson, 1983:77 Related components"Stemmed Point"	xx		2.0				
1	Big Kiokee Crk	GA	"Paleoindian"	Anderson et al., 1990:11 MAP	xx		xx				
1	Big Meadow	CA	"period I fluted point locale"	Wallace, 1978:26	10		1.6				
1	Big Sandy Site	TN	type site for points, Lewis and Kneeberg, 1947 in cards	Lewis and Kneeberg, 1959	1		4.4		1		
1	Bighorn Canyon Caves	WY	8.6k earliest - Agate Basinoid/Scottsbluffoid	Frison, 1978: 29 Stanford and Day, 1992 :frontspiece	3	1	2.0				
1	Billy Ross	OK	Dalton site in southern Arkansas basin, E OK	Perttula, 1985 CRP 2:26	1		1.3				
1	Birch Bay	WA	Pebble Tool	Carlson, 1983:87	xx		4.0				
1	Birch Creek Caves	ID	= Bison and Veratic R.S. - Bitteroot side notched, stemmed, concave based :91	Bryan, 1980 pp 104	10		1.2	1			
1	Birch Creek Sinks	ID	Folsom locality	Titimus and Woods, 1991	10		1.2	1			
1	Bison R.S.	ID	10.3 western stemmed, Intermountain Lanceolate, Glacier Peak Ash @ 12k >10k "stemmed points" Mt Moraih / Lake Mohave, Pintoid under Mazama, Gatecliff above, Elko also	Willig and Aikens, 1988:13-15 Bonnichsen et al., 1987 Homer, 1986:103 Bryan 1980:91	1	1	2.0	1			
1	Black Lake		agate Basinoid w/structures :99 SASKATCHEWAN	Bryan, 1980 pp 104	4		2.0				
1	Black Rock Cave No. 1	UT	8.5k to 4k (Touhy, in Davis & Shutler, 1969:17 concave based points=type name side notched points infant burial	Bryan, 1980:84 pp 104 Wormington, 1964	3		4.0	1	1		
1	Black Rock Desert	NV	stemmed and fluted locality, Scottsbluff / Cody complex Great Basin Concave and stemmed	Davis and Shutler, 1969:163 Carlson, 1983:84 :77 cf Wallmann and Amic, 1991 CRP 8:51	10		1.6	1			
1	Black's Fork	WY	early looking artifacts, SW WY, like Lively in Ala. axes choppers scrapers worm 219-20	Willey, 1966:fig 2.2 Wormington, 1964:220-121	A		9.0				

Table B.02 Sites Gathered from Background Research - Inventory

1	Blackwater Draw No. 1	NM	mammoth and bison kill Clovis; Folsom (dated); Agate Basin:415 Western (Clovis) Paleoindian sites Agate Basin, Eden, Merserv, Plainview, Scottsbluff Art comes from Sellards, 1952	Bryan, 1980 pp 104; Bonnichsen et al., 1987; Rule, 1983:21; West, 1983 Shutler, 1983 site list (:221-222) Stanford and Day, 1992 :frontspiece cf. Thurmond, 1990:35-131	1	1	1.1	1		1	3
1	Blue Lakes	ID	Clovis locale	Titimus and Woods, 1991	10		1.1				
1	Bluefish Caves	ALK	>10k - Blade Microblade 14k dates - Equiv. earliest microblades at base" cf Cinq-Mars	Bonnichsen et al., 1987; Carlson, 1983:92; Clark, 1991:37; 1984:69	1	1	3.0				
1	Boaz	WISC	poss man/mastodon site		1		6.0				
1	Bolen Bluff / Whitehurst	FLA	Suwannee, Arredondo, Bolen :type site Bolen pts. ceramics and late archaic too paleo below archaic=Bolen Bluff??	Milanich & Fairbanks 1980:36 Daniel and Wisenbaker 1987:146 Bonnichsen and Turnmire, 1991 site list Bullen, 1958; Dunbar, 1991	1		1.8	1			
1	Bonanza Creek	ALK	fluted w/ microblades	Clark, 1991:37; 1984:69	1		1.6	1			
1	Bonfire R.S.	TX	10.090 (100) avg4 (Haynes nd) Rule: Folsom - preFolsom (Johnson 92 12k dates with "anvils") also Arenosa R.S. Dibble, 1967; Baker et al., 1983 slackwater 10k Folsom -kill site (Frison 1978:114) late date, Plainview?? cf Hester 1990 CRP 7:16 10.2k midland, Plainveiw (?)	Rule, 1983 Shutler, 1983 site list (:221-222) Bonnichsen et al., 1987 Thurmond, 1990:35-131 Largent et al., 1991	1	1	1.2	1		1	
1	Bonner Springs	KS	poss 10.4k skeletal, dolichocranic elements, one killed with point, no mention of types	Steele et al., 1991 CRP 8:57-59	1		4.0		1		
1	Borax / Clear Lake	CA	fluted point site with stemmed Western (Clovis) Paleoindian sites (20 pts in Willig and Aikens, 88:17) Clovis - Western 3 times represented Moratto 1984:82-84 Also = Witt Site burial/skeletal	Carlson, 1983:84; West, 1983; Rule, 1983:21; Davis and Shutler, 1969:163; Wormington, 1964; Bryan, 1980 pp 10; Willig and Aikens, 1988:18 ; Wallace, 1978:26; Sellards, 1952:119-146; Willey, 1966:fig 2.2	1		1.6	1			

Table B.02 Sites Gathered from Background Research - Inventory

1	Boss Hill	ALB	7.7k agate basin and side notched :98	Bryan, 1980 pp 104	4		2.0				
1	Bostrom Site	IL	fluted bifaces, unifacial tools, blades (Clovis, Gainey, Holcombe)	Tankersley and Wiant, 1991 CRP 8:49;	1		1.6			1	
x	Bottleneck Cave	WY	listed as having red ocher, Husted, 1969 in	Roper, 1991:294	xx		xx				
1	Boydston Creek	AL	Cumberland at base, fluted frag. and Dalton age rock shelter	Walthal, 1980:31, 48	1		1.3	1			
1	Brand	ARK	Dalton open air, diverse activity assemblage adzes and woodworking	Smith, 1986:8 Anderson et al., 1990:52 Bonnichsen et al., 1987:418	1		1.3				
x	Breckinridge R.S.	ARK	Dalton Rock Shelter in Goodyear, 1982:384	Goodyear, 1982:384	1		1.3	1			
1	Brewerton/Clay/ Lysander	NY		Doyle et al., 1985	xx		xx				
1	Brewster	SD	"lanceolate" (Folsom under agate basin Bryan, 80:95 10.4-9.9k?)	Bonnichsen et al., 1987	1		1.2	1			
1	Brier Creek Loc	GA	:31 unfluted lance, Dalton	Anderson et al., 1990:11	1		1.3				
1	Brigham and Derby sites	ME	10.290(460)(beta-7183), multicomponent but geoarch, unifacial	Petersen, J.B. 1986 CRP 3:16	1	1	4.0				
1	British Mountain	Yukon	Early Early = Engigstiak	West, 1983	A		9.0				
1	Brohm Site	ONT	Plainview points	Wormington, 1964:109	2		4.3				
1	Brohm etc.	ONT	plano? indented base, Eden like, Brohm/Cummins/Lakehead Complex	Funk, 1978; Doyle et al., 1985 cf Julig, 1984 AENA 12:192 MacDonald, 1983:107	2		4.3				
1	Brown's Valley (skeletal)	MINN	skeletal w/ artifacts, 8.7k to Steele&Powers, 1992	Sellards, 1952:119-146	3		4.0		1		
1	Brown's Valley (skeletal)	MINN	parallel flaked points" with skeletal w/ red ocher = browns valley points according to Worm.	Wormington, 1964:143:237	3		4.0		1		

Table B.02 Sites Gathered from Background Research - Inventory

1	Buena Vista Lk	CA	ca 8k "C.W. Harrisoid assemblage"	Wallace, 1978:26; Moratto 1984	3	1	2.0				
1	Buena Vista Lake (19)	CA	8.2(400)(Lj-1357);8.2(400)(Lj-1356); 7.600(200)(I-1928); Western Stemmed	Willig and Aikens, 1988:13-15	3	1	2.0				
1	Bull Brook	MA	"Northern Fluted" - dated (9k equiv.) Eastern Paleoindian Sites "Gainey like" points, cf Gramly 1988:266 habitation 3k artifacts, 100 fp Wormington, 1964:75-6	Willey, 1966:fig 2.2; West, 1983 Bonnichsen et al. 1987; Rule, 1983:22; Funk, 1978, Anderson et al., 1990:52; Shutler, 1983 (:221-222); MacDonald, 1983:107; Doyle et al., 1985	1		1.5				1.2
1	Burnett Cave	NM	Fluted - followed by "desert culture remains" fluted below archaic, c14 7.432(300):53	Sellards, 1952:119-146 Willey, 1966:59 Wormington, 1964:52-3	1		1.1	1			
1	Burnham	OK	early early dates (>25k) on bison w/ flake debitage	Wycoff et al., 1990 CRP 7:60	A		9.0				
1	Bush Shelter	WY	lanceolate, concave based 9k	Shutler, 1983: Frison 1978:120	2		4.0				
1	C.W. Harris Site	CA	8.670(220)(avge 3) from Willig/Aikens: ca 9k Western Stemmed Moratto 1984:97	Willig and Aikens, 1988:13-15	2	1	2.0				
1	Cache RiverBsn	AR	50 Dalton "sites", Anderson, 1990	Schiffer and House, 1975	1		1.3				
1	Cajon Pass	CA	"period III"	Wallace, 1978:26	4						
1	Cal Smoak	SC	Early Archaic, " excavated sites, 12-8k	Anderson and Hanson, 1988 Smith, 1986:8	2		4.0	1			
1	Calico Mtns.	CA	Early Early claims	West, 1983; Willig and Aikens, 1988:6; Stanford, 1983:66	A		9.0				
1	Camaleyucan	MEX	Folsomoid Pt, Camaleyucan, Chihuahua "Llano-Cordilleran" - locality	MacNeish, 1983:127	10		1.2				
1	Camanche Res.	CA	"period III	Wallace, 1978:26	4						
1	Campus Site	ALK	core and blade industry undated microblade, Nelson, 1935	Wormington, 1964; Clark, 1991:37; 1984:69; Dumond, 1980:986	xx		3.0	1			
1	Caneadea	NY		Doyle et al., 1985	xx		xx				

Table B.02 Sites Gathered from Background Research - Inventory

1	Canton Street	FLA	v. Late Archaic	Milanich & Fairbanks 80:36 Daniel and Wisenbaker 1987:146	4						
1	Canyon Creek	Yukon	7.1k v. late agate basin or micro???:101	Bryan, 1980 pp 104	4	1	2.0				
1	Cape-au-Renard	Quebec	8-9k "plano" with 6k date	Doyle et al., 1985; Benmouyal, 1978 in Funk, 1984	3	1	4.0				
1	Caribou Lake, 4th of July	COLO	mid archaic caribou=Kersey pts @9k. 5BI70 = mt Albion @7.6k, 4th July = Allen 6k includes 5 BL 70	Stanford and Day, 1992 Benedict 1992:351-356	2		4.0				
1	Carlson Annis	KY	2 fluted at base	Wormington, 1964:66	1		1.6	1			
1	Carmouche	GA	:30 Dalton woodland Tallahassee=woodland	Anderson et al., 1990:11 MAP	1		1.3				
1	Carter-Kerr McGee	WY	10.4k Folsom Goshen; Agate Basin; Hell Gap habitation, bison bone bed, Goshenoid at bottom, cf Frison 1991:148 Frison 1993 revises Clovis as Goshen	Frison, 1978: 29; 1984 Bonnichsen et al., 1987:415 Shutler, 1983 site list (:221-222) Stanford and Day, 1992 :frontspiece	1		1.2	1			
1	Cascadia Cave	OR	"pebble tool"	Shutler, 1983; Carlson, 1983:87	xx		4.0				
1	Casper	WY	9.830(350)(RL-125)10.060(170)(RL-208) Hell Gap points, bison kill bison bone bed "lanceolate"; Hell Gap kill	Bryan, 1980:97; pp 104; Frison, 1978: 29; Shutler, 1983 (:221-222) Bonnichsen et al., 1987:417	1	1	2.0				
1	Catlow Cave No. 1	OR	human bones, Harney county, not necessarily early.	Wormington, 1964	xx		xx				
1	Catoctin	MD	fluted (2), surface scatter, discoidal core, etc.		1		1.6				
1	Cattle Guard (Stewart's)	COLO	Folsom - mapped red ocher	Bonnichsen et al., 1987 Stanford and Day, 1992 :frontspiece	1		1.2				
1	Caulapan	MEX		Shutler, 1983; MacNeish; 1983;1986	xx		xx				
1	Cave Springs	AL	Big Sandy points	Walthal, 1980:50	2		4.4				
1	Cedar Creek	OK	Folsom locality w dates 9.1-9.7, Clovis, Plainview, Dalton, Scottsbluff,	Hofman, 1992:210; 1990CRP:19-23 Stanford and Day, 1992 :frontspiece	1		1.2				
1	Cedar Creek Res	AL	Clovis, Dalton, Big Sandy, Kirk corner ntched	Futato, 1983in Anderson, 1990:198	1		1.1	1			
1	Cereal	ALB	fluted point locale, Plainview, microblade	Wormington, 1964	10		1.6	1			

Table B.02 Sites Gathered from Background Research - Inventory

1	Cerro Prieto	SON	fluted point locale	Ortiz, 1974: map pp25	10		1.6				
1	Cerro del la Zabal	SON	fluted point locale	Ortiz, 1974: map pp25	10		1.6				
1	Chajbal	GUAT	Fishtail Trad - locality	MacNeish, 1983:127	10		1.7				
1	Chandalar R.	ALK	fluted point locale - with microblades	Clark, 1991:37; 1984:69	10		1.6				
1	Chapala Lake	CA	Early-early claims ?? BAJA??	Willig and Aikens, 1988:6	A		9.0				
1	Chapala Lake	BAJA	early early claims	Willey, 1966:fig 2.2	A		9.0				
1	Chaparrosa Ranch	TX	Angostura, golondrina, Scottsbluff	Thurmond, 1990:35-131	2		4.3	1			
1	Charley Lake	BC	"Northern Fluted" dated cf Fladmark et al., 1988	Bonnichsen et al., 1987 Bryan, 1980 pp 104	1	1	1.6				
1	Charley Terrace Thurmond Rnch Beaver Dam A	OK	Plainview, uniface tools	Thurmond, 1990:35-131	2		4.3				
1	Cherokee Sewer	IO	Agate Basin Eden like, excavated lanceolate 3 horizons, 8.4,7.3,6.3k time	Bryan, 1980:99 pp 104 Bonnichsen et al., 1987:415	3		2.0				
1	China Lake	CA	fluted (49 pts in Willig and Aikens, 1988:17) Clovis - Western and "Stemmed" fluted, heat treated, crescents fluted points excavated w/extinct fauna, numerous items Moratto 1984:85	Davis and Shutler, 1969:163 Willig and Aikens, 1988:18 Shutler, 1983 site list (:221-222) Carlson, 1983:84 Fluted Points; :77 West, 1983; Wallace, 1978:26	1		1.6				
1	Chinitna Bay	ALK		Sellards, 1952:119-146	xx		xx				
1	Christy's Beach	CA	mapped on island as "period I fluted point sites" not in Moratto	Wallace, 1978:26	xx		xx				
1	Chugwater	ALK	Chindadn?		xx		xx				

Table B.02 Sites Gathered from Background Research - Inventory

1	Cimarron	NM	HOMO NOVUS MUNDUS: 137, possible Folsom??	Sellards, 1952:119-146	1		1.2		1		
1	Circle Area	ALK	isolated fluted point find	Clark, 1991:37; 1984:69	1		1.6				
1	Clarks Flat	CA	9-11k stemmed points	Rondeau, 1991 CRP 8:70	1	1	2.0				
1	Claypool	COL	"Paleo" site, Cody complex, cf Kreiger64:63 Cody complex, knives, pond deposits listed as having red ocher	Frison, 1978: 29 Wormington, 1964:131-3 Roper, 1991:294	3		4.9	1			
1	Clovis	NM	Clovis - several localitiesSellards, 1952:119-146; Wormington, 1964:47-8	Willey, 1966:fig 2.2 ; Haynes, 1991 Bonnichsen et al., 1987	1	1	1.1	1			
1	Clovis-Portales	NM	Clovis - three horizons - blowouts		1		1.1	1			
1	Colby	WY	"mammoth kill"; Western Paleoindian sites Clovis - "Western Clovis" 10.8k?? review 11.032(120)(avg 2)	Rule, 1983:21; Bonnichsen et al., 1987; West, 1983; Frison, 1978: 29 Shutler, 1983 (:221-222)	1	1	1.6				
1	Concho	AZ	Folsom like fluted, stemmed?	Carlson, 1983:77 ; Huckell, 1982:19	1		1.2				
1	Congaree Creek	SC	Early Archic	Anderson, 1990:201, Anderson 1979 Anderson, 1992:16	2		4.0				
1	Connley Caves	OR	Haskett points w/ 9 dates 11.5-91.5 Bedwell (1973); 9.540(260)(Gak-1744); 7.430 (140) (Gak-2135) from Willig/Aikens, 1988:13 Haynes(1987:86) mentions fluted found in #5, with dates around 9.5k (mixed) Haskett, concave based, cascade, dates mixed up Bryan sez 1980:86 Western Stemmed >10k 11.2(200)(Gak-2141)(Bryan 1980:86 has more dates to 7.2)	Homer, 1986 Carlson, 1983:77 "Stemmed Point" Shutler, 1983 site list (:221-222) Bryan, 1980 pp 104 Bonnichsen et al., 1987 Willig and Aikens, 1988:13-15	1	1	2.0	1			
1	Cooper's Ferry	ID	Windust phase oid:88 "Stemmed Point"	Bryan, 1980 pp 104 Carlson, 1983:77	1		2.0				

Table B.02 Sites Gathered from Background Research - Inventory

1	Cooperton	OK	Western (Clovis) Paleoindian sites (early early dates on mammoth w/poss intentional bone fractures and hammer stones) POSS. FAUNAL ASSOCIATION	Rule, 1983:21; Johnson, 1991:224	A		9.0				
1	Corditaipe	NY	Small fluted point site	Funk & Wellman, 1984	1		1.1				
1	Cougar Mtn. Cave	OR	8.5(250)(UCLA-112) Willig Aikens, 1988:13 8.5k sandal, cougar Mtn pts below, Cascade pts later?:84 "lanceolate" 11.950(350)(Gak-1751) = Western Stemmed of Clovis age	Carlson, 1983:77 "Stemmed Point" Bryan, 1980 pp 104 Shutler, 1983 site list (:221-222) Bonnichsen et al., 1987 Willig and Aikens, 1988:9; 13-15	2	1	2.0	1			
1	Cow Point / Frenchman's Lk		Late paleo, lanceolates, pp13 NEW BRUNSWICK	Doyle et al., 1985	2		xx				
1	Cowboy Cave	UT	8.275(80)(SI 2418) first cultural (no diagnostics), then Elko,@ 6k, then gypsum @ 4k	Homer, 1986; Berry and Berry, 1986	3	1	4.0	1			
x	Cowpath	Belle Isl.	8.6(315)(SI-2606), early archaic McGhee and Tuck, 1975 in Keenlyside, 1991:171 = "Maritimes late paleo concave based"	Keenlyside, 1991	3	1	4.0				
1	Coxackie	NY	no date, late Paleo, 9k? est,	Funk and Schambach, 1964 in Doyle et al., 1985	2		xx				
1	Coyote Flat	NV	stemmed site?	see Butler, 1970 in Willig, 1991	xx		2.0				
1	Crane Point	MD	Dalton / Hardaway, large tools, celts adzes, grinding abrading	Lowery and Custer 1990 CRP 7:31	1		1.3	1			
1	Crawford	NB	artifacts below varves	Sellards, 1952:119-146	xx		xx				
1	Crow's Nest Pass	ID	stemmed point?	Bryan, 1980 pp 104	xx		2.0				
1	Crowfield	ONT	cremation poss fluted pts, burned, bifaces, no scrapers	Stothers and Abel, 1991:220 Anderson et al., 1990:52	1		1.6		1		
1	Crowfield	ONT	"Northern Fluted"	Bonnichsen et al., 1987	1		1.6		1		

Table B.02 Sites Gathered from Background Research - Inventory

1	Crumley	TX	Angostura, Meserve	Thurmond, 1990:35-131	1		1.3	1			
1	Crystal Springs	ID	Clovis - locality	Titimus and Woods, 1991	10		1.1				
1	Cueva Blanca	MEX	10-11k dates listed:129, Mitla Oaxaca "stage 3",	MacNeish, 1983:127 Shutler, 1983 site list (:221-222)	xx	1	xx				
1	Culbreath Bayou	FLA	"Late Archaic"	Milanich & Fairbanks 80:36 Daniel and Wisenbaker 1987:146	4						
1	Cummins	ONT	8.4k on cremation, other sites in area Julig, 1984 AENA, 10.1k dates in Jackson CRP 6 1989:73	Stothers and Abel, 1991:220	3	1	4.9		1		
1	Cumro	NB	Angostura points artifacts w/ bison	Wormington, 1964:141 Sellards, 1952:119-146	2	1	4.7				
1	Currant Creek	OK	Plainview	Thurmond, 1990:35-131	2		4.3				
1	Cutler Ridge	FLA	Bolen points, with fossil locale	Carr, 1986:231-232	1		4.4				
1	Dallas	TX	skeletal with fauna not plotted	Sellards, 1952:119-146	xx		xx				
1	Dalton	MO	excavated sites, 12-8k SE(map)	Smith, 1986:8	1		1.3				
1	Dalton Sites	MO	Cole county, Logan, 1952	Wormington, 1964:114; Willey, 1966:fig 2.2; MacDonald, 1983:107	1		1.3				
1	Danger Cave	UT	Western Stemmed >10k, single Clovis point with date at base cf Homer, 1986 in Haynes, 1967:270; 10.2, Bryan sez Lovell constricted like:94; early dates on basal level = 10.355 mf avg of (4), other = early & mid Holocene diagnostics (cf Haynes, 1967:270) >6k pinto,"early pinto", GYPSUM, series of Elko	Willey, 1966:fig 2.2 Willig and Aikens, 1988:13-15; :8 Bryan, 1980 pp 104 Wormington, 1964 Homer, 1986	1	1	1.6	1			
1	Darby & Hornsby Sprngs	FLA	9.880(270) Suwanne/Bolen/Arredondo below archaic, Dunbar, 1991:186; Bullen 58:33-4	Milanich Fairbanks 80:36 Daniel and Wisenbaker 1987:146-7	1	1	1.8	1			
1	Davis	NY	fluted point hunting camp Funk, 1977:325	Funk, 1978:17	1		1.6				
1	DeWitt	OHIO	Gainey, Hi-Lo, Holcombe Complexes	Stothers and Abel, 1991:199, 206-8	1		1.4	1			

Table B.02 Sites Gathered from Background Research - Inventory

1	Dean	ID	no dates: stemmed (Parmanlike), then Angostura like, then side notched	Bryan, 1980:86 pp 104	xx		2.0				
1	Death Valley	CA	WPLT isolated finds locale Moratto 1984:103 stemmed	Wallace, 1978:26 Carlson, 1983:77 "Stemmed Point"	1		2.0				
1	Debert	N.S.	Gainey like points, = Debert like points cf Gramly, 1988:266 "Eastern Fluted" - dated additional eastern sites	MacDonald, 1983:107 Anderson et al., 1990:52 Shutler, 1983 (:221-222) Bonnichsen et al., 1987 West, 1983; Doyle et al., 1985 Rule, 1983:227 = lithics studied	1	1	1.5				1.2
1	Del Mar	CA	Holocene Skeletal "La Jolla (Scripps)"	Shutler, 1983 site list (:221-222) Willey, 1966:fig 2.2; West, 1983	4				1		
1	Deluge R.S.	UT	Pintoid, no dates but prob >6k	Homer, 1986	4		4.0				
1	Dent	COLO	Fluted "Mammoth kill" Western (Clovis) Paleoindian sites 10.810(40)6 protein dates Haynes 1992:360 Clovis, Mammoth, first known association Clovis - "Western Clovis"	West, 1983 Rule, 1983:21; Sellards, 1952:119-146; Frison, 1978: 29 Wormington, 1964:43 Bonnichsen et al., 1987	1	1	1.1				
1	Devil's Den	FLA	human skeletal remains same fluoride content as extinct animals	Milanich & Fairbanks 80:36 Daniel and Wisenbaker 1987:146	1				1		
1	Devil's Mouth R.S.	TX	8.780(310)(Tx526) "Scottsbluffish", also Plainview, Golodrina, Lerma-planoid Stage 4 Planoid-Cordilleran Trad Agate Basin, Angostura, golondrina, Meserve, Plainview	Shutler, 1983; MacNeish :127-128 Thurmond, 1990:35-131	1	1	1.3	1			
1	Diablo Canyon	CA	9.3-8.4 early Millingstone, PCT, Moratto 1984:107+ human bone date 9.3k	Wallace, 1978:26	2	1	2.0	1	1		
1	Dietz (Alkali Lake)	OR	Clovis - Western"lanceolate" Cougar Mnt, Parman, Windust, Lake Mohave Silverlake Haskett, Cascade plano GB concave base cf Willig 1990 CRP :52	Haynes, 1991 Willig and Aikens, 1988:18 Bonnichsen et al., 1987	1		1.6	1			

Table B.02 Sites Gathered from Background Research - Inventory

1	Dirty Shame R.S.	OR	Western Stemmed 7 dates listed in Willig/Aikens 1988:13 (9.5k-7.8k) 5k to 2k gatecliffoid bifurcates, >5k concavae based lanceolates, Elko	Carlson, 1983:77 "Stemmed Point" Willig and Aikens, 1988:13-15 Homer, 1986	2	1	2.0	1			
1	Diskau	KS	fluted pt. site	Schmits, 1987	1		1.6	1			
1	Dismal Swamp	VA	Eastern Paleoindian Sites (locale)	Rule, 1983:22	10		1.6				
1	Doblaar	MICH	fluted points on east side of lake mich.	Shutler, 1983; McDonald, 1983	1		1.6				
1	Dodge	OHIO	Hi-Lo complex	Stothers and Abel, 1991:207-8	1		4.1				
1	Doering Site	TX	fluted locale / San Patrice site , "archaic site",	Wormington, 1964:47; Wheat, 1953 from Johnson, 1989	1		1.6	1			
1	Doerschuk	NC	excavated sites, 12-8k SE Stanly earliest	Smith, 1986:8	3		4.8	1			
1	Dog Creek	Yukon	fluted site excavated, poss microblade assoc	Clark, 1991:37; 1984:69	1		1.6	1			
1	Domebo	OK	Fluted - dates Western (Clovis) Paleoindian sites "mammoth kill" Clovis - "Western Clovis"	West, 1983; Haynes, 1991 Rule, 1983:21 Bonnichsen et al., 1987	1		1.1				
1	Dona Ana	NM	Folsom "camp"	Amick, 1991 CRP 8:4	1		1.2				
1	Donnelly Ridge		10k microblades (poss) cf Dumond, 80:987	Clark, 1991:37; 1984:69; Dumond, 1980:986	1		3.0				
1	Donnet Mam.	AZ	Mammoth	Haynes, 1987a	1		6.0				
1	Double Adobe Site	AZ	grinding stones point 10k-8k? "grinding stones with extinct fauna" =not	Wormington, 1964:172-3 cf Waters CRP 3, 1986	1	1	4.0				
1	Drake Cache	COLO	"cache"	Stanfordand Jodry 88:21-22 CRP	1		1.6				4
1	Driftwood Crk	BC	fluted locality	Carlson, 1983:92 Fluted	10		1.6				
1	Dry Creek	ALK	Component I=Nenana:415; >10k Blade Component I = Nenana Microblade = Component II Beringian; 11.1?-10.6 II = Denali or Paleoarctic microblades	Bonnichsen et al., 1987 Powers and Hoffecker, 1989 Clark, 1991:37; 1984:69 West, 1983; Bryan, 1980 pp 104 Shutler, 1983 site list (:221-222)	1	1	3.0	1		1	

Table B.02 Sites Gathered from Background Research - Inventory

1	Dry Creek	Belize	Fishtail Trad (site 158)	MacNeish, 1983:127	1		1.7				
1	Drynotch Slide	BC	"earliest known microblades in souther BC, below Mazama ash, 7.53\(270)(GSC 530)	Shutler, 1983 site list (:221-222)	4		3.0				
1	Duewall - Newberry	TX	poss man mammoth association - no artifacts	Bonnichsen and Turnmire, 1991 site list Jonhson 1991:226	1		6.0				
1	Durango	MEX	isolated fluted point locale, plotted w/ DeWitt	Wormington, 1964:84	10		1.6				
1	Dust Cave	AL	Fluted, Big Sandy, stratified cave	Driskell, 1992	1	1	1.8				
1	Dutchess Q.C.	NY	"Eastern Fluted" - dated Eastern Paleoindian Sites	Bonnichsen et al., 1987; West, 1983 Rule, 1983:22; MacDonald, 1983:107; Doyle et al., 1985; Funk, 1978; Anderson et al., 1990:52 Shutler, 1983 site list (:221-222)	1	1	1.8	1			
1	Dutton	COLO	Western (Clovis?) Paleoindian sites Early Early ?	Rule, 1983:2; Stanford, 1983:66 Shutler, 1983; West, 1983	1		6.0				
1	Eagle Hill II / Ft. Polk	LA	Clovis, san Patrice, etc	Anderson, 1990:200-201; Gunn and Brown, 1982	1		1.1	1			
1	East Branch	ME		Doyle et al., 1985	xx		xx				
1	Edisto Beach	GA	cut-marked proboscidean rib, washed up on beach	Anderson et al., 1990:11; Goodyear et al., 1990	1		6.0				
1	Ediziza	Yukon	microblade site	Carlson, 1983:92 Microblade	xx		3.0				
1	El Bajio	SON	8 fluted points, numerous other later types, cf pp 28, cf Ortiz and Taylor, 1972	Ortiz, 1974: pp25	1		1.6				
1	El Bosque	Nicara gua	Early-Early "Stage 1"	MacNeish, 1983:127; West, 1983 Shutler, 1983 (:221-222)	A		9.0				
1	El Cedral (etc)		Early-Early "Stage 2"	MacNeish, 1983:127	A		9.0				
1	El Desemboque de los Seris	SON	fluted point locale	Ortiz, 1974: pp25	10		1.6				
1	El Horno	MEX		Shutler, 1983 site list (:221-222)	xx		xx				

Table B.02 Sites Gathered from Background Research - Inventory

1	El Plomo	SON	fluted point locale	Ortiz, 1974: pp25	10		1.6				
1	Elida	NM	Folsom - ped	Bonnichsen et al., 1987	1		1.2				
1	Ellis	ID	Folsom - locality	Titimus and Woods, 1991	10		1.2				
1	Ellis Landing Shellmound	CA	"period III" late site	Wallace, 1978:26	4						
1	Engigstciak	Yukon	Lanceolate points, Holocene, Angostura like Wormington :141	Wormington, 1964:217 Willey, 1966:fig 2.2	2	1	2.0				
1	Escapule	AZ	Western (Clovis) Paleoindian sites	Haynes, 1987a Rule, 1983:21	1		1.1				
1	Esperanza Lb20		Fishtail Trad HONDURAS	MacNeish, 1983:127	1		1.7				
1	Estancia Valley (Basin)	NM	Agate Basin:415; cf Haynes, 1955 (mf assuming E. Basin and E. Valley are the same (Sellards, 1952) Folsom (Agate basin in Bonnichsen et al., 1987:415)	Bonnichsen et al., 1987 Sellards, 1952:119-146	1		1.2	1			
1	Etna Cave	NV	gypsum, with more below, extinct - not plotted gypsum point of crystal	Sellards, 1952:119-146 Wormington, 1964:190	4		4.0				2
1	Eva	TN	7150(500)(M-357) component 1, lewis and Kneeberg 59:162	Wormington, 1964:149	4	1	4.0	1	1		
1	Evant Cores	TX	polyhedral blade cores	Goode and Mallouf, 1991 CRP 8:68	1		1.1			1	
1	Everson Creek/ Black Canyon Quarry	MT	9.390(90)(TO-1976) Cody work shop	Turner et al., 1991 CRP 8:119	2	1	4.9				
1	Falcon Hill Shinners Site	NV	listed as a fluted point locality, but Touhy states "no fluted points in vicinity (88:225) cf 9.450(120)() on woven artifact in Touhy 1988:225Western Stemmed	Carlson, 1983:84 "Fluted Points" Willig and Aikens, 1988:13-15	2	1	2.0	1			
1	Fallon	NV	fluted (3 pts) in Davis and Shutler 1969	Davis and Shutler, 1969:163	1		1.6				
1	Falmouth	MA		Doyle et al., 1985	xx		xx				

Table B.02 Sites Gathered from Background Research - Inventory

1	False Cougar Cave	ID	8k poss on notched and Pryor stemmed	Davis, 1988:26 Bonnichsen et al., 1986	3	1	4.0	1			
1	Fenn Cache	ID	Cache with crescent	Stanford, 1991:5	1		1.6				
1	Feronia Locality	GA	:42 Suwannee Dalton nipple side notched archaic edgefield bolas, cf Anderson 1990:201 trans site paleo archaic	Anderson et al., 1990:11:52	1		1.3	1			
1	Field Ranch	TX	Hell Gap, Plainview	Thurmond, 1990:35-131	2		4.3	1			
1	Fifty	VA	9.2k Kirk Anderson et al., 1990:52 Flint Run Sites	Shutler, 1983 site list (:221-222) Stothers and Abel, 1991:213	2	1	4.8				
1	Finley	WY	Eden points, w/ Scottsbluff & bison Eden, Scottsbluff 9k :93-4 9k ca Cody complex :23	Wormington, 1964; Bryan, 1980 pp 104; Willey, 1966:fig 2.2; Sellards, 1952:119-146; Frison, 1978: 29	2	1	4.9				
1	Fishbone Cave	NV	horse camel people, may be mixed up 11.2k - human remains, plus more	Wormington, 1964:192-3 Willig and Aikens, 1988:9	1	1	xx	1	1		
1	Fisher	ONT	Anderson et al., 1990:52	Shutler, 1983 site list (:221-222) MacDonald, 1983:107	1		1.6				1.2
1	Fisherman Lake			Bryan, 1980 pp 104	xx		2.0				
1	Fivemile Rapids	OR	7.675(100)(Y-341) in Willig/Aikens19 88:13; Western Stemmed 9.785 (220) (Y-340), early = cascade points@7.6:88 Pebble Tools to Carlson; continuous occupation, burins	Carlson, 1983:77 :87 ; Willig and Aikens, 1988:13-15; Shutler, 1983(:221-222); Bryan, 1980 pp 104; Wormington, 1964:186;Willey, 1966:fig 2.2	2	1	2.0	1			
1	Flambeau / Minocqua	WISC	late paleo, review Mason 80 notes	Doyle et al., 1985	2		xx				
1	Fletcher	ALB	9.380(110)(TO1097) below Cody bone bed - Davis et al 1991 CRP 8:19 Alberta site, cf Tratebas CRP4 87:39	Frison, 1978: 29 Bryan, 1980 pp 104	2	1	4.9				
1	Flint Creek R.S.	AL	Quad @ bottom Beaverlake, Greenbriar, kirk excavated sites, 12-8k SE()	Walthal, 1980:31 Smith, 1986:8	1		1.8	1			

Table B.02 Sites Gathered from Background Research - Inventory

1	Folsom	NM	Folsom type site 10.890(50)(avg6 Haynes, 1992:362)	Sellards, 1952:119-146; Willey, 1966:fig 2.2; West, 1983; Stanford and Day, 1992 :frontspiece; Wormington, 1964; Bonnichsen et al., 1987	1	1	1.2				
1	Fort Benning / Lawson Field	GA	isolated fluted pt	Anderson et al., 1990:11	1		1.6				
1	Fort Gordon	GA		Anderson et al., 1990:11	xx		xx				
1	Fort Irwin (est)	CA	fluted, stemmed pt locality Warren and Phagan 1988:121; Basgall, 1991 CRP	Bonnichsen and Turnmire, 1991 site list	1		1.6				
1	Fort Rock Cave	OR	early ?dates, "Lake Mohave" plus indented base point:83 Intermntne lance - poor date 9.053(350)(C-428) on sandals cf Haynes, 1967:271 10.200(230)(Gak-2147); 8.550(150)(Gak-2146) Western Stemmed >10k	West, 1983; Carlson, 1983:77 Shutler, 1983(:221-222); Bryan, 1980 pp 104; Bonnichsen et al., 1987:418 Sellards, 1952:119-146; Wormington, 1964; Willey, 1966:fig 2.2; Homer, 1986; Willig and Aikens, 1988:13-15	1	1	2.0	1			
1	Fossil Spring	CA	"period I fluted point locality" not discussed in Moratto?	Wallace, 1978:26	10		1.6				
1	Fowler-Parrish	COLO	Folsom eastern limits Folsom.	Shutler, 1983; cf Agogino and Parrish, 1971 in Frison 1978:111	1		1.2				
1	Frank Bay	ONT		Doyle et al., 1985	xx		xx				
1	Frazer Canyon	BC	Early Early discounted	West, 1983	A		9.0				
1	Frazier	COLO	Kersey terrace site with agate basin Black mat 9.070(90)(SI-3726 need to check BC/AD ?)"lanceolate"; Agate Basin	Frison, 1978: 29;; Wheat, 1979:151 Haynes, 1990:65; McFaul et al 1991 CRP 8:118; Bonnichsen et al., 1987:415	2	1	2.0				
1	Freisenhahn Cave	TX	flaked items, no points, fauna many mammoths, cf Soffer, 1993 for details scraper illustrated pp92, found under tiger remains	Wormington, 1964:218; Willey, 1966:fig 2.2; Stanford, 1983:66 Shutler, 1983 (:221-222) Sellards, 1952:119-146	1		xx				
1	Frightful Cave	MEX	7.3k at bottom Kreiger64:63 8k dates	Willey, 1966:fig 2.2 Wormington, 1964	3		2.0				

Table B.02 Sites Gathered from Background Research - Inventory

1	G.S. Lewis East	SC	Dalton, Kirk, Morrow Mtn, etc.	Anderson et al., 1990:52 Anderson and Hanson, 1988	1		1.3	1			
1	Gainesville	GA	excavated sites, 12-8k SE()	Smith, 1986:8	xx		xx				
1	Gainey	MICH	"Eastern Fluted" - ped	Bonnichsen et al., 1987 Anderson et al., 1990:52	1		1.4				
1	Gallager Flint. Station.	ALK	10.540(1250)(SI-974) on paleoarctic blades >10k "Blade" Haynes, 1982:395 says its "Denali" = micro to Dikov, 1988 says the date comes from Locality I	Clark, 1991:37; 1984:69; Dumond, 1980:986,988 Bonnichsen et al., 1987	1	1	3.0	1			
1	Gardepe	NY	9.380(100)(Dic 261) bifurcate	Funk, 1978; cf Funk, 1984:82-3; Doyle et al., 1985	2	1	4.0				
1	Gasconade	MO	Koch	Sellards, 1952:119-146	xx		xx				
1	Gatecliff R.S.	NV	<3k "Gatecliff pts", concave based Humboldts 5-2k, short Elko series	Homer, 1986	4	1	4.0	1			
1	George Lake	ONT	Scottsbluff-like	Wormington, 1964; Doyle et al., 1985	3		4.9				
1	Gifford	ID	Folsom - locality	Titimus and Woods, 1991	10		1.2				
1	Gingery Cache	FLA	Alexon in Fla Anth 1988 biface cache	Alexon, 1988	1		1.8				4
1	Girl's Hill	ALK	Beringian 4.440(190)(),fluted points, microblades, and notched points\Northern Archaic tradition-like	West, 1983 Clark, 1991:37; 1984:69:72; Dumond, 1980:986	1		1.6	1			
1	Glenrose Cannery	BC	8-6k cascade points:90 Pebble Tool	Bryan, 1980 pp 104; Carlson, 1983:87; Shutler, 1983 (:221-222)	3		2.0				
1	Goldendale	WA	no date: Lind Coulee w/ milling stones:88	Bryan, 1980 pp 104	xx		2.0				
1	Gordon Creek Burial	COL	9.700(250)(GXO-530); bifaces, end scraper, perforated elk incisor, red ocher on faunal ribs	Breternitz et al., 1971 Frison, 1978: 29	2	1	4.0		1		
1	Gore Creek Skeleton	BC	"archaic" 8.250(115)(S 1737) Carlson, 1983:77 ="Stemmed Point"	Shutler, 1983; Carlson 1983:82 Cormie, 1981 in Shutler (MA thesis)	3	1	2.0		1		

Table B.02 Sites Gathered from Background Research - Inventory

1	Graham Cave	MO	excavated sites, 12-8k SE() 9.700(500);8.830(500); fluted, points, lanceolate, Dalton sequence	Smith, 1986:8 Willey, 1966 fig 2.2 Wormington, 1964:64	1	1	1.3	1			
1	Grand Island	NB	w/ bison	Sellards, 1952:119-146	xx		xx				
1	Granite Beach	TX	Angostura, Golondrina, Meserve, Midland, Plainview	Thurmond, 1990 PA 35-131	1		1.3	1			
1	Granite Point	WA	Windust phase materials:87	Bryan, 1980 pp 104 Carlson, 1983:77 "Stemmed Point"	1		2.0				
1	Grant Lake/Migod	NW TERR	7.7k, prob dates, but late agate basin:99-100	Bryan, 1980 pp 104	4		2.0				
1	Green creek	OHIO	Hi-Lo complex	Stothers and Abel, 1991:207-8	2		4.1				
1	Greenhaw	TX	angostura, Plainview	Thurmond, 1990 PA 35-131	2		4.3	1			
1	Gregg Ranch	TX	Golondrina, Hell Gap, Meserve, Plainview excavated sites, 12-8k SE() early archaic, continuity through Missississippian	Thurmond, 1990 PA 35-131; Smith, 1986:8; Anderson et al., 1990:11 Anderson and Hanson, 1988 Anderson et al., 1992:251	1		1.3	1			
1	Grey-Seff	AZ	Faunal Locale.	Haynes, 1987	1		6.0				
1	Grogitsky Site	MICH	"sites and/or find spots representing Gainey"	Stothers and Abel, 1991:199	1		1.4				
1	Ground Hog Bay	ALK	Microblade 10k - Blade	Carlson, 1983:92; Bonnichsen et al., 1987; Shutler, 1983 (:221-222)	1		3.0				
1	Gualt	TX	engravings, Clovis, flake of crystal, Plainview, Folsom, Midland, Hell Gap, Scottsbluff, Angostura, Golondrina, Archaic	Collins et al., 1991 CRP 8:13	1		1.1	1			3.2
1	Gypsum Cave	NV	Gypsum points	Wormington, 1964; Willey, 1966 fig 2.2 Sellards, 1952:119-146 Homer, 1986	xx		4.0				
1	Habron	VA	E. Archaic Site	Rogers, 1969 in Gardner,1974:42-6	xx		xx				
1	Hadley	MA	fluted point, thumbnail scraper, surface site - locality	Curran and Dincauze, 1977; MacDonald, 1983:107	10		1.6				

Table B.02 Sites Gathered from Background Research - Inventory

1	Handprint Cave	NV	stemmed point cave, 10.740(70)(Beta 21885), hair	Gruhn and Bryan, 1988 in Bryan, 1988:55	1	1	2.0				
1	Hanging Rock Shelter		hydration date, stratigraphic sequence,:84	Bryan, 1980 pp 104	xx		2.0	1			
1	Hanson	WY	Folsom - dated 10.26(90)avg4 Folsom red ocher on living floor "extensive" campsite Bryan 1980:98	Bonnichsen et al., 1987; Frison, 1978: 29; Stanford and Day, 1992:frontispiece; Haynes 1992:95 Shutler, 1983 site list (:221-222)	1	1	1.2				
1	Hardaway	SC	excavated sites, 12-8k SE() fluted, tools and implements transition from fluting to notching	Coe, 1964; Willey, 1966 fig 2.2 Anderson et al., 1990:52; Smith, 1986:8; Wormington, 1964	1		4.6	1			
1	Hargis Bison Site	AZ	Faunal locality no association with Clovis, San Pedro Valley	Haynes, 1987a; Rule, 1983	1		6.0				
1	Harney Flats	FLA	Suwannee, Bolen some Kirk under Newnan like stuff Lithic workshop	Anderson et al., 1990:52 Milanich&Fairbanks 1980:36 Daniel and Wisenbaker 1987:146	1		1.8	1		1	
1	Harney Lake	OR	Western Stemmed 8.680(55)(USGS-461B)	Willig and Aikens, 1988:13-15	3	1	2.0				
1	Harrisena	NY	7.135(200)(SI2638) Kanawha stemmed cf Snow, 1977	Stothers and Abel, 1991:217	4		4.0				
1	Harrisena	NY	also Queensbury	Doyle et al., 1985	4		4.0				
x	Harrison Branch	TN	Kirk site in KY	Chapman, 1977	3						
1	Harry's Farm	NJ	archaic	Funk, 1978	xx		xx				
1	Haskett	ID	"Stemmed Point" Intermountain lanceolate :418	Bryan, 1980 pp 104; Carlson, 1983:77 ; Frison, 1978:29 Bonnichsen et al., 1987	xx		2.0				
1	Hatwai	ID	Western Stemmed >10k 10.8; 10.1; 9.8;9.8; 9.3 5k-3k bifurcate stemmed Gatecliffoids, cf Homer 1986:98	Shutler, 1983 site list (:221-222) dates in Willig/Aikens, 1988: 15 Willig and Aikens, 1988:13-15 Carlson, 1983:77 "Stemmed Point"	1	1	2.0	1			

Table B.02 Sites Gathered from Background Research - Inventory

1	Haverstraw Bay	PA		Funk, 1978	xx		xx				
1	Haw River	NC	Dalton (Goodyear et al., 1990) excavated sites, 12-8k	Anderson et al., 1990:52; Goodyear et al., 1990; Smith, 1986:8	1		1.3	1			
1	Hawkins Cache	AR	Dalton cache	Morse, 1971 Morse and Goodyear, 1973	1		1.3				4
1	Healy Lake	ALK	10k Chindadn??,microblades:101, "willow leaf points" (?):82 11.090(170)(GX-1340) on Chindadn; 10.150 (250) (SI-737) Beringian Chindadn and Microblade >10k - Blade (PaleoArctic Chindadn pts- cf Dumond, 1980:988)	Bryan, 1980 pp 104 Carlson, 1983:92 Microblade Shutler, 1983 site list (:221-222) Bonnichsen et al., 1987:409 West, 1983 in Clark, 1984:6 Clark, 1991:37; 1984:69	1		3.0	1			
1	Hebe Plantation	MISS	page 52	Anderson et al., 1990:52	xx		xx				
1	Helen Blazes	FL		Milanich, 1994; Purdy, 1991	1		1.8	1			
1	Hell Gap	WY	Goshen, Folsom(dated); Agate Basin:415; Hell Gap habitation 10.8k Agate Basin? 10.3k folsom @ Brewster frison:23-25 folsom rare frison :30 11-8k - Goshen, Folsom, Midland, Agate basin, Hell Gap, Cody complex(8.5k) Frederick (8.6k), Lusk:95-96	Bonnichsen et al., 1987:415 Shutler, 1983 site list (:221-222); Stanford and Day, 1992: frontispiece Willey, 1966 fig 2.2 Frison, 1978: 29; Haynes, 1991 West, 1983; Bryan, 1980 pp 104	1	1	1.2	1			
x	Henderson	KY	Lyon county, Dalton, Greenbriar, Cumberland (along Cumberland R.)	Rolingson and Schwartz, 1966	1		1.3	1			
1	Henry	ID	Folsom - locality	Titimus and Woods, 1991	10		1.2				
1	Hermit Cave	NM	bones w/ possible human association	Sellards, 1952:119-146	xx		xx				
1	Hester	MISS	Clovis, Cumberland, quad, Dalton, side/corner notched, Eva / Morrow Mtn. excavated sites, 12-8k	Anderson et al., 1990:52; McGahey, 1992:307; Smith, 1986:8	1		1.1	1			
1	Heuerman	OHIO	plotted as one of 11 in Lucas County - Hi-Lo complex	Stothers and Abel, 1991:207-8	1		4.1				

Table B.02 Sites Gathered from Background Research - Inventory

1	Hi-Lo	MICH	similar/related to Dalton,	Funk, 1978; Anderson et al., 1990:52 Stothers and Abel, 1991:19206	2		4.1				
1	Hidden Cave	NV	5k-3k Gatecliff like points, with Humboldt concave based, GYPSUM, short series of Elko	Homer, 1986	4		2.0				
1	Hidden Falls	BC	10k-9k microblade ("Blade") Microblade	Bonnichsen et al., 1987 Clark, 1991:37; 1984:69; Dumond, 1980:986; Carlson, 1983:92 Shutler, 1983 site list (:221-222)	1	1	3.0				
1	Hiscock	NY	10.450(400) Mastodon, Clovis date/point associated?	Laub et al., 1988; Haynes, 1991 cf Steadman et al . 1986 CRP 3:22	1	1	1.1				
1	Hogup Cave	UT	>6k pinto pts, 7.815 earliest Elko, long series of Elko x2 Western Stemmed says dates on Black Rock Concave Base points from here = 8.4k to 3.2k	Homer, 1986; Willig and Aikens, 1988:13-15 (Touohy, 1969 in Davis and Shutler, 1969:170)	4		4.0				
1	Holcombe Beach	MICH	fluting drops out Eastern Paleoindian Sites Fluted	Stothers and Abel, 1991:206 Rule, 1983:22; Funk, 1978 West, 1983; Anderson et al., 1990:52	1		1.4				
1	Holdsworth	TX	Plainview	Thurmond, 1990 PA 35-131	2		4.3				
1	Horn R.S.	TX	10.3k Meserve, Plainview, Scottsbluff, San Patrice, 9.9k ca, Suwanne/Simpson below Folsom, burials (Young 1985 CRP 2)	Thurmond, 1990 PA 35-131 Redder, 1985; Sanford, 1991 Bonnichsen et al., 1987	1	1	1.8	1			
1	Horner	WY	8.8 ca Cody complex ca 8.7 - Scottsbluff, Eden, Cody knives:94 6.920(500); bison Scottsbluff, Eden, Cody complex, Cody knife	Sellards, 1952:119-146; Frison, 1978: 29; Wormington, 1964:128 Shutler, 1983 site list (:221-222) Willey, 1966 fig 2.2 ; Stanford and Day, 1992: frontspiece Bryan, 1980 pp 104	3	1	4.9	1			
1	Horseleg Mtn.	GA	Fluted with tools, burins hardaway like	Anderson et al., 1990:11	1		1.6	1			
1	Huasabas	SON	fluted point locale	Ortiz, 1974 pp25	10		1.6				

Table B.02 Sites Gathered from Background Research - Inventory

1	Hudson - Meng	NB	bison bone bed 9k ca (3 dates), Alberta pts 9.82(160) Alberta points	Shutler, 1983 site list (:221-222) Frison, 1978: 29 Bryan, 1980:96 pp 104	2	1	4.9				
1	Hungry Creek	Yukon	early-early? micro flint in sediment	Shutler, 1983; Morlan 1983:56	A		9.0				
1	Hussey	ONT	fluted, plano, archaic, woodland	Shutler, 1983; MacDonald 1983:99; Doyle et al., 1985	1		1.6	1			
1	Icehouse Bottom	TN	deeply stratified, points Kirk, St. Albans, Lecroy, Kanawha, Stanley, *pieces esquilles*, fabric impression Cremation possible	Anderson et al., 1990:11 Chapman, 1977; Stothers and Abel, 1991:220	2		4.8	1	1		
1	Ichetucknee Springs	FLA	possible Mastodon and artifacts, paleo locale, Dunbar, 1991	Bonnichsen and Turnmire, 1991 site list	1		1.1				
1	Indian Creek	MT	10.9k (avg3 Haynes 1992:361) folsom 11.125(130)(Beta 4951) Folsom, Hell Gap, Agate Basin	Bonnichsen et al., 1987; Stanford and Day, 1992: frontspiece; Davis and Greiser, 1992; Davis, 1988:26	1	1	1.2	1			
1	Itchtucknee Spring	FLA	ivory foreshafts - Columbia county	Sellards, 1952:119-146	1		1.1				
1	Iyatayet	ALK	Denbigh Flint Complex, small tool, burins parallel flaking fluted point w/ Denbigh flints Denbigh flint complex = 5k?	Wormington, 1964:208 Clark, 1991:37; 1984:69 Sellards, 1952:119-146	1		1.6	1			
1	J-2 Ranch	TX	Angostura, Golondrina, Meserve, Plainview, Scottsbluff	Thurmond, 1990 PA 35-131	1		1.3	1			
1	Jaguar Cave	ID	11.58 or 10.3 w/extinct fauna, worked bone:90 (early domesticated EARLY DOG Western Stemmed? >10k	Bryan, 1980 pp 104 Willig and Aikens, 1988:9	1	1	2.0				
1	Jake Wade	ALK	Faunal locality - 29k	Shutler, 1983 site list (:221-222) Morlan and Cinq-Mars, 1982	1		6.0				
1	Jalowica		MANITOBA Agate Basin / Hell Gap like	Bryan, 1980:99 pp 104	2		2.0				

Table B.02 Sites Gathered from Background Research - Inventory

1	James Allen Site aka: Jimmy Allen	WY	Late Paleoindian "Archae. sites of Paleo period" 7.9k bison kill Angostura like Jimmy Allen Points concave based points, bison, "browns valley like points	Shutler, 1983; Frison:120 Bryan, 1980:94 pp 104 Wormington, 1964: Frison, 1978: 23:29	3	1	4.7				
1	Jaybird Branch	VA	excavated sites, 12-8k SE()	Smith, 1986:8	xx		xx				
1	JeVd-4 & others	Yukon	isolated fluted point locale - locality	Clark, 1991:37; 1984:69	10		1.6				
1	Joe Bell (9 mg 28)	GA	Dalton, adze, Edgefield scraper, notched Kirk or Hardin	Anderson et al., 1990:37	1		1.3	1			
1	Joe Powell	PA	Dalton	Anderson et al., 1990:52 Ensor, 1985	1		1.3				
1	John Pearce	LA	San Patrice site: excavated sites, 12-8k SE()	Anderson et al., 1990:52 Smith, 1986:8	1		4.2				
1	Johnson Hawkins Site	TN	Clovis, Cumberland, Beaverlake, unifacial tools	Broster and Norton, 1990CRP 7:6-7	1		1.1	1			
1	Johnson Site (COLO)	COLO	Folsom	Wormington, 1964:40; Frison, 1978: 29; Sellards, 1952:119-146	1		1.2				
1	Johnson Site (TN)	TN	9.9k mostly Kirk/Flutedbifaces / Cumberland / Dalton / Harpeth River / Greenbriar / Lecroy/Kirk Serated, Kirk corner notched	Broster et al., 1991CRP8:8	1		1.3	1			
1	Johnson - Cline	OK	Agatebasin, Angostura, Meserve, Plainview, Scottsbluff	Thurmond, 1990 PA 35-131	1		1.3	1			
1	Johnston	(TX)			2		4.3	1			
1	Johnston Loc.	ALB	fluted point locality	Carlson, 1983:84 Fluted Points	10		1.2				
1	Jones Site	PEI	excavated, late paleo points Keenlyside, 1991	Bonnichsen and Turnmire, 1991	2		4.8				
1	Jones-Miller	COLO	"Lanceolate"; Hell Gap - kill 104 points, Agate Basin Hell Gap like points, bison kill:97 10-9.5k bison bone bed, also discussion of Miniature Hell Gap	Bonnichsen et al., 1987:417 Shutler, 1983 (:221-222); Bryan, 1980 pp 104; Mallouf 1990CRP7:32 Frison, 1978: 29	2		2.0				

Table B.02 Sites Gathered from Background Research - Inventory

1	8 XK 8	NM	"proto-folsom" site	Judge, 1973:63-64	1		1.6				
1	4 MI 8	NM	Judge ? paleo	Judge, 1973:63-64	10		1.6				
1	45 JR 4	NM	Judge ? paleo	Judge, 1973:63-64	10		1.6				
1	13 GD 5	NM	Judge Belen	Judge, 1973:63-64	20		4.3				
1	13 LM 8	NM	Judge Belen	Judge, 1973:63-64	20		4.3				
1	19 JN 5	NM	Judge Belen	Judge, 1973:63-64	20		4.3				
1	19 JR 1	NM	Judge Belen	Judge, 1973:63-64	20		4.3				
1	12 WG 5	NM	Judge Belen site	Judge, 1973:63-64	2		4.3				
1	13 BR 3	NM	Judge Belen site	Judge, 1973:63-64	2		4.3				
1	13 BX 9	NM	Judge Belen site	Judge, 1973:63-64	2		4.3				
1	13 FJ 8	NM	Judge Belen site	Judge, 1973:63-64	2		4.3				
1	13 LG 9	NM	Judge Belen site	Judge, 1973:63-64	2		4.3				
1	14 CS 5	NM	Judge Belen site	Judge, 1973:63-64	2		4.3				
1	19 JL 5	NM	Judge Belen site	Judge, 1973:63-64	2		4.3				
1	9 SJ 5	NM	Judge Belen site	Judge, 1973:63-64	2		4.3				
1	9 VD 9	NM	Judge Belen site	Judge, 1973:63-64	2		4.3				
1	12 FT 9	NM	Judge Cody Site	Judge, 1973:63-64	3		4.9				
1	12 JV 5	NM	Judge Cody Site	Judge, 1973:63-64	3		4.9				
1	13 DR 4	NM	Judge Cody Site	Judge, 1973:63-64	3		4.9				
1	45 JP 9	NM	Judge Cody Site	Judge, 1973:63-64	3		4.9				
1	5 DR 1	NM	Judge Cody Site	Judge, 1973:63-64	3		4.9				
1	10 UY 7	NM	Judge Cody locality	Judge, 1973:63-64	30		4.9				
1	12 KX 2	NM	Judge Cody locality	Judge, 1973:63-64	30		4.9				
1	14 XN 4	NM	Judge Cody locality	Judge, 1973:63-64	30		4.9				

Table B.02 Sites Gathered from Background Research - Inventory

1	9 VD 7	NM	Judge Cody locality	Judge, 1973:63-64	30		4.9				
1	12 QY 3	NM	Judge clovis locale	Judge, 1973:63-64	10		1.1				
1	13 JB 5	NM	Western (Clovis) Paleoindian sites Judge clovis site	Rule, 1983:21 Judge, 1973:63-64	1		1.1				
1	13 JB 5	NM	Judge clovis site	Judge, 1973:63-64	1		1.1				
1	12 OA 3	NM	Judge folsom site	Judge, 1973:63-64	10		1.2				
1	13 BA 8	NM	Judge folsom site	Judge, 1973:63-64	10		1.2				
1	13 ES 8	NM	Judge folsom site	Judge, 1973:63-64	10		1.2				
1	13 FR 1	NM	Judge folsom site	Judge, 1973:63-64	10		1.2				
1	13 GX 5	NM	Judge folsom site	Judge, 1973:63-64	10		1.2				
1	13 LC 8	NM	Judge folsom site	Judge, 1973:63-64	10		1.2				
1	13 LH 9	NM	Judge folsom site	Judge, 1973:63-64	10		1.2				
1	13 LI 17	NM	Judge folsom site	Judge, 1973:63-64	10		1.2				
1	13 LI 4	NM	Judge folsom site	Judge, 1973:63-64	10		1.2				
1	13 LN 1	NM	Judge folsom site	Judge, 1973:63-64	10		1.2				
1	13 XP 3	NM	Judge folsom site	Judge, 1973:63-64	10		1.2				
1	18 AG 7	NM	Judge folsom site	Judge, 1973:63-64	10		1.2				
1	19 JM 9	NM	Judge folsom site	Judge, 1973:63-64	10		1.2				
1	2 GD 2	NM	Judge folsom site	Judge, 1973:63-64	10		1.2				
1	9 CM 3	NM	Judge folsom site	Judge, 1973:63-64	10		1.2				
1	13 KC 5	NM	Judge multicomponent locality	Judge, 1973:63-64	10		xx	1			
1	13 TD 7	NM	Judge multicomponent locality	Judge, 1973:63-64	10		xx	1			
1	9 GU 3	NM	Judge multicomponent site	Judge, 1973:63-64	10		xx	1			

Table B.02 Sites Gathered from Background Research - Inventory

1	Jurgens	CO	listed as having red ochre 9.070(90)(SI3726), Scottsbluff, other concave and straight based, like Plainview	Roper, 1991:294 Frison, 1978: 29; Wheat, 1979 Shutler, 1983 site list (:221-222)	2		4.9				
1	KI	VT		Funk, 1978	xx		xx				
1	Kagati Lake	ALK	no date, microblade	Carlson, 1983:92 Microblade	xx		3.0				
1	Kanapaha	FLA	mid archaic, small sites in the research area	Milanich & Fairbanks 80:36:57; Hemmings and Kohler, 1974 in Milanich, 1994:78	4						
1	Kasta	ALK	microblade 7.4k	Shutler, 1983 site list (:221-222)	4		3.0				
1	Kevin Davis Cache	TX	blade cache in TX	Young and Collins, 1989	1		1.1			1	
1	Kikavichik Ridge	ALK	isolated fluted point locale	Clark, 1991:37; 1984:69	10		1.6				
1	Kimmswick	MO	"mastodon kill" Eastern Paleoindian Sites Fluted Point Sites	Anderson et al., 1990:52; Rule, 1983:22 Shutler, 1983 site list (:221-222) MacDonald, 1983:107; West, 1983	1		1.6				
1	Kincaid R.S.	TX	10.150(85)(avg3) fluted bifaces, Folsom, extinct fauna, stone pavement	Sellards, 1952:93; Collins et al., 1989:3-5; Largent et al., 1991:332	1	1	1.2			1	
1	King's Dog	NV	(Surprize Valley) 2-3k Gatecliff like points, short series of Elko	Homer, 1986	4		4.0				
1	King's Road	NY	Fluted Eastern Paleoindian Sites	West, 198; Funk, 1978 Rule, 1983:22	1		1.6			1	
1	Kingsclear	NB	Munsungunlike paleo	Bonnichsen and Turnmire, 1991	1		1.6				
1	Klamath Lake	OR	leaf shaped points	Sellards, 1952:119-146 Wormington, 1964: Sellards, 1952:119-146	1		1.6	1			
1	Klein II	COLO	Clovis, Mammoth, horse surface	McFaul et al., 1991CRP8:117-118	1		1.1				
1	Klein Site	AL	Dalton - Red Hill Phase Franklin County	Walthal, 1980:47	1		1.3				

Table B.02 Sites Gathered from Background Research - Inventory

1	Koggiung	ALK	7.830(avg2) (micro?) blades like Anagula and Gallager flint = Paleoarctic in Dumond	Clark, 1991:37; 1984:69; Dumond, 1980:986,9	3		4.0			1	
1	Kogruk	ALK	(Anatuvuk Pass) cf Wilmsen, 1964	Clark, 1991:37; 1984:69 Willey, 1966:fig 2.2	xx		xx				
1	Komodo	CA	fluted point site	Basgall, 1987 CRP4:50	1		1.6				
1	Koster	IL	long sequence from later Early Archaic through Woodland	Funk, 1978	4		4.0	1	1		
1	Kugururok	ALK	fluted point locale - with microblade cores - locality	Clark, 1991:37; 1984:69	10		1.6				
1	L'Anguille River Basin	AR	Dalton	Anderson, 1990:200; Anderson, and Delcourt, 1989	1		1.3				
1	L'Anse Amour/Pinware Hill		8.855(100)(); Early Archaic, multicomponent, Keelyside91:Tuck, 19777.4k burial, cf Tuck, 1977 NEW FOUNDLAND	Bonnichsen and Turnmire, 1991 Doyle et al., 1985	2	1	4.0	1	1		
1	La Calzada	MEX	9.94k, planoid-cordilleran, 'stage 4" lerma	MacNeish, 1983:127 Shutler, 1983	2	1	2.0				
1	La Esperanza		HONDURAS fishtail locality	Ranere and Cooke, 1991 Willey, 1966:fig 2.2	10		1.7				
1	La Grange	AL	excavated sites, 12-8k SE ()	Smith, 1986:8	xx		xx				
1	La Mula West		Clovis "workshop", no dates pp 249 PANAMA	Ranere and Cooke, 1991	1		1.1				
1	La Playa	SON	fluted point locale	Ortiz, 1974: pp25	10		1.6				
1	Lac Nemiskachi		QUEBEC	Doyle et al., 1985	xx		xx				
1	Lace Place	ARK	Major Dalton site, potted	Anderson et al., 1990:52 Morse and Morse, 1983:82	1		1.3				
1	Laddie Creek	WY	6.8-5.7k - early plains archaic	Frison, 1978: 29	4						
1	Ladds Quarry	GA	palaeontological site pp40	Anderson et al., 1990:11	1		6.0				

Table B.02 Sites Gathered from Background Research - Inventory

1	Ladiesville	Belize	3 sites, Fishtail Tradition	MacNeish, 1983:127 Ranere and Cooke, 1991	1		1.7				
1	Laffingall	GA	Clovis, Dalton, Greenbriar:17,19	Anderson et al., 1990:11	1		1.1	1			
1	Laguna man	CA	5.1k Taylor et al., 1985	Shutler, 1983 site list (:221-222)	4						
1	Lake Channel	ID	Folsom locality no dates. Haskets first identified here, dune blowouts	Titimus and Woods, 1991 Bryan, 1980:91 pp 104	10		1.2	1			
1	Lake Helen Blazes	FLA	near Melbourne, lancelates and notched below ceramics Suwanne, below stemmed forms.	Bonnichsen and Turnmire, 1991 site list; Bullen, 1958:29; Edwards, 1954 in Dunbar, 1991; Milanich and Fairbanks, 1980	1		1.8	1			
1	Lake Hubbs	NV	Clovis - Western (21 pts recorded)	Willig and Aikens, 1988:18	1		1.6				
1	Lake Linette	ALB	"related to stemmed point"	Carlson, 1983:77	xx		2.0				
1	Lake Manly	CA	Early-early claims	Willig and Aikens, 1988:6	A		9.0				
1	Lake Mohave	CA	"lanceolate" Lake Mohave points, assemblage - stemmed WPLT San Dieguito like Silver Lake, Lake Mohave points 1st stemmed points 1937:82 ca 9.6k in Moratto 1984:93-5 "Fluted Point"	Bonnichsen et al., 1987 Wormington, 1964161-2 Carlson, 1983:77 :84 Shutler, 1983 site list (:221-222) Willey, 1966:fig 2.2; Sellards, 1952:119-146; Bryan, 1980 pp 104 Wallace, 1978:26	1	1	1.6	1			
1	Lake San Augustine	NM	stemmed and fluted	Carlson, 1983:77 "Stemmed Point"; :84 "Fluted Point"	1		1.6	1			
1	Lake Theo	TX	Folsom 9.360(170)(Tx-2879) folsom, briscoe county, v.late bone dates 9.950(110)(SMU-866) soild date Above, Eden, Plainview, bison kill	Hofman, 1992:210; Johnson and Holiday CRP 1985 2:22; Largent et al., 1991:330; Shutler, 1983; Frison, 1978:111; Thurmond, 1990 PA 35-131	1	1	1.2	1			
1	Lake Thunderbird	TX	Golundrina	Thurmond, 1990 PA 35-131	2		4.3				
1	Lamb Cache	NY	"cache", Gainey like, exotic chert	Gramly, 1988	1		1.1				4

Table B.02 Sites Gathered from Background Research - Inventory

1	Lamb Springs	COLO	Early Early Stanford and Day, 1992: frontspiece	Stanford, 1983:66; West, 1983; Frison, 1978: 29; Shutler, 1983 (:221-222)	1		6.0				
1	Lane Springs	GA		Anderson et al., 1990:11	xx		xx				
1	Lange-Ferguson	SD	10.670(300) "mat" ; 11.140(140) in Haynes, 1992:360 clovis, Bone Date 10.730 (530) "mammoth kill"	Hannus, 1990; Haynes, 1991 Bonnichsen et al., 1987 Martin CRP 1 1984:69	1	1	1.1				
1	Lansing	KS	5.5k skeletal, cf Bass, 1973	Sellards, 1952:129	4				1		
1	Las Penitas	SONA	fluted point locale, end scrapers, blades	Ortiz, 1974: pp25	1		1.6			1	
1	Las Vegas	NV	Tule Springs?	Sellards, 1952:119-146	xx		xx				
1	Last Supper Cave	NV	8.6 est. avg of 4; Western Stemmed	Willig and Aikens, 1988:13-15; Homer, 1986	3	1	2.0				
1	Lawn Point	BC	microblade (>7400)	Shutler, 1983; Carlson, 1983:92-91	4		3.0				
1	LeCroy	TN	fluted including (Meserve) excavated sites, 12-8k SE()	Wormington, 1964:74; Smith, 1986:8 Anderson et al., 1990:11:52	1		1.3				
1	Leavitt	MICH	Barnesoid fluted	Anderson et al., 1990:52; cf Simons et al., 1984 CRP 1 1984:21	1		1.6				
1	Lebanon	OR	not plotted	Sellards, 1952:119-146	xx		xx				
1	Lehner	AZ	Clovispoints with multiple fauna mammoth, horse Western (Clovis) Paleoindian sites Clovis - "Western Clovis"	Haynes, 1991; Willig and Aikens, 1988:11; Rule, 1983:21 Wormington, 1964; Carlson, 1983:84 West, 1983; Haynes, 1987; Shutler, 1983 (:221-222); Bonnichsen et al., 1987; Willey, 1966:fig 2.2	1	1	1.1				2
1	Lenore	ID	no date, Windust phase like Stemmed Point	Carlson, 1983:77 :88 Bryan, 1980 pp 104	1		2.0				
1	Leonard R.S.	NV	Heizer dated atlatl 7.038(50) 11.199(570)(C-599) on humboldt culture	Sellards, 1952:119-146 Wormington, 1964::191	4		2.0				
1	Leopold	MO	excavated sites, 12-8k Dalton; cf Goodyear, 1982:384	Smith, 1986:8; Anderson et al., 1990:52; Bonnichsen et al., 1987:418	1		1.3	1			

Table B.02 Sites Gathered from Background Research - Inventory

1	Levi R.S.	TX	fluted, Angostura, stemmed, 10-9k, listed as having red ochre Angostura, Golondrina, Plainveiw	Stanford, 1983:66; Shutler, 1983 cf Collins, 1990 CRP 7; Roper, 1991:294; West, 1983 Thurmond, 1990 PA 35-131	1		1.6	1			
1	Lewisville	TX	Clovis with v. early c14 date (>37k) Western (Sandia (?) Paleoindian sites	Rule, 1983; Shutler, 1983; Wormington, 1964:58; Willey, 1966:fig 2.2 ; West, 1983; Rule, 1983:21; Stanford, 1983:66	1		1.6				
1	Liekum	AZ	Clovis - Mammoth association	Rule, 1983, Haynes, 1987	1		1.1				
1	Lime Creek	NE	listed as having red ochre 9.524(450) plainview - frontier county, cf Davis, CRP :53 9.524(450) straigt based Scottsbluff type	Roper, 1991:294 Sellards, 1952:119-146; Kreiger, 1964:61; Wormington, 1964:122 Willey, 1966:fig 2.2	2	1	4.3				
1	Lime Ridge	UT	folsomoid called "clovis" clovis lithic scatter	Davis and Brown, 1986 Copeland and Fike, 1988	1		1.6				
1	Lincoln Hills / Ready	IL	fluted point site	Anderson et al., 1990:52	1		1.6				
1	Lind Coulee	WA	8.720(200)() stemmed points, cresents, bone shafts; 18.7k (ca), buffalo hunting camp?:87 Western Stemmed	Daughter, 1956 in Willey, 1966:fig 2.2 ; Wormington, 1964:; Bryan, 1980 pp 104; Willig and Aikens, 1988:13-15 Carlson, 1983:77 ; Shutler, 1983 (:221-222)	3	1	2.0				
1	Lindenmeier	COLO	Folsom - dated 10.660 (60) avg3 Haynes 1992b:95; Folsom. Gypsum point found above:160 red ochre on living surface "extensive" campsite Bryan, 1980:98	Bonnichsen et al., 1987; Sellards, 1952:119-146; Frison, 1978: 29 Stanford and Day, 1992:frontspiece Wormington,1957::31-39;160 Roper, 1991; Haynes, 1991;Shutler, 1983(:221-222); Roberts, 1935	1	1	1.2				1.2
1	Lindoe	ALB	9.7k, Lind Coulee / Parman / Windustoid, on mat? 9.9k early northen plains:89 "Stemmed Point"	Bryan, 1980 pp 104 Shutler, 1983; Carlson 1983:82:77	2	1	2.0	1			

Table B.02 Sites Gathered from Background Research - Inventory

1	Lindsay Mammoth	MT	additional western sites = lithics studied 11.9 or 10.8?haynes92:360 no artifacts	Rule, 1983:226; Davis, 1988:26 Frison, 1978: 29	1		6.0				
1	Linger	COLO	Folsom "kill site" Frison 1978:114	Sellards, 1952:119-146 Bonnichsen et al., 1987 Wormington, 1964:	1		1.2				
1	Linn Woods	DEL	Dalton / Hardaway locale	Custer and Mellin, 1991CRP8:17	1		1.3	1			
1	Lipscomb	TX	Folsom - ped, bison kill (frison78:114) largest kill known, no dates, origiginal = 1939 Folsom, cf Todd et al., Plains Anthro 37(139):137 1992	Bonnichsen et al., 1987; Wormington, 1964:40 Sellards, 1952:119-146; Stanford and Day, 1992:frontspiece	1		1.2				
1	Lisburne	ALK	microblades and fluted points, Cape Denbigh as well	Clark, 1991:37; 1984:69	1		1.6	1			
1	Little Arm	Yukon	microblades? poss Agate Basin like	Bryan, 1980 pp 104	4		3.0	1			
1	Little Canyon Creek Cave	WY	preclovis poss (:27); 10.2-8.8k no diagnostics Early Early	Frison, 1978: 29; Stanford and Day, 1992:frontspiece; West, 1983	A		9.0				
1	Little Pin Oak Creek	TX	Clovis, Plainview	Thurmond, 1990 PA 35-131	1		1.1	1			
1	Little River - Adams	KY	Clovis, blades	Anderson et al., 1990:52	1		1.1			1	
1	Little River - Boyd/Ledford	KY	Clovis, blades, Little River complex	Smith and Freeman, 1991 CRP 8:41	1		1.1			1	
1	Little River - Ezell	KY	Clovis, blades	Smith and Freeman, 1991 CRP 8:41	1		1.1			1	
1	Little River - Ledford/Boyd	KY	blades, Gramly book 1990 from stanford 1991:2	Bonnichsen and Turnmire, 1991 site list	1		1.1			1	
1	Little River - Roeder	KY	Clovis, blades	Smith and Freeman, 1991CRP8:41	1		1.1			1	

Table B.02 Sites Gathered from Background Research - Inventory

1	Little Salt Spring	FLA	big list of radiocarbon dates 9.920(160)(TX 2461) hearth. nuts; 10.190(1450)(TX 2595) charcoal; 9.645(160)(I-6460) stake; 9.080(250)(TX 2594) oak mortar possible early tortis w/stake early and later occupations	MacDonald, 1983:107 Anderson et al., 1990:52 Smith, 1986:8 Shutler, 1983 site list (:221-222) Clausen et al., 1979 Gifford and Koski, 1994; MilanichFairbanks80:36 Daniel and Wisenbaker 1987:146	1	1	4.0	1	1		
1	Livengood	ALK	10-8k poss, no date, not fluted, concave base - locality, counts as microblade locality also	Clark, 1991:37; 1984:69	2		4.3	1			
Locales											
1	(41 FD 44) TX	TX	Plainview - locality	Thurmond, 1990 PA 35-131	20		4.3				
1	Beaver Dam A	OK	Plainview - locality	Thurmond, 1990 PA 35-131	20		4.3				
1	Caliente	NV	fluted point locality (1? pt)	Carlson, 1983:84 Fluted Points Davis and Shutler, 1969:163	10		1.6				
1	Calvin Graybill #1	OK	Clovis locality	Thurmond, 1990 PA 35-129:291	10		1.1				
1	Carlin	NV	fluted locale	Davis and Shutler, 1969:163 Carlson, 1983:84 Fluted Points	10		1.6				
1	Cibolo Creek	TX	Plainview - locality	Thurmond, 1990 PA 35-131	20		4.3				
1	Cuyamaca Mtns	CA	isolated fluted points locale Fluted Points cf Moratto, 1984:87	Wallace, 1978:26; Carlson, 1983:84; Davis and Shutler, 1969:163	10		1.6				2
1	Dry Lake Valley	NV	fluted point locality	Carlson, 1983:84 Fluted Points Davis and Shutler, 1969:163	10		1.6				
1	Ebbett's Pass	CA	isolated fluted point locale	Davis and Shutler, 1969:163 Wallace, 1978:26; Carlson, 1983:84 cf Moratto, 1984:87	10		1.6				
1	Eclcto Creek	TX	Angostura, Golondrina - locality	Thurmond, 1990: PA 35-131	20		4.7	1			

Table B.02 Sites Gathered from Background Research - Inventory

1	Garcia	OK	Plainview locality	Thurmond, 1990: PA 35-131	20		4.3				
1	Goodwin-Baker	OK	Hell Gap, Midland, Plainview - locality	Thurmond, 1990: PA 35-131	20		4.3	1			
1	Groom Dry Lake shore	NV	fluted point locality	Carlson, 1983:84 Fluted Points Davis and Shutler, 1969:163 Nevada	10		1.6				
1	Huntoon Valley	NV	fluted point locality	Carlson, 1983:84 Fluted Points Davis and Shutler, 1969:163	10		1.6				
1	Johns Creek	OK	Plainview - locality	Thurmond, 1990: PA 35-131	20		4.3				
1	Johnston (TX)	TX	Golondrina, Plainview - locality	Thurmond, 1990: PA 35-131	20		4.3	1			
1	Lake Mohave	CA	fluted, cf Moratto, 1984:87 (dry lake shore)	Davis and Shutler, 1969:163	10	1	1.6	1			
1	Lovelock	ND	fluted point locality	Carlson, 1983:84 Fluted Points Davis and Shutler, 1969:163 Nevada	10		1.6				
1	M-175	CA	fluted point locality Mohave Desert	Davis and Shutler, 1969:163	10		1.6				
1	Moccasin Creek	OK	Golondrina, Plainview - locality	Thurmond, 1990: PA 35-131	20		4.3				
1	NE of Lovelock	NV	fluted locale	Davis and Shutler, 1969:163 Nevada	10		1.6				
1	Old Neal Place	OK	Hell Gap, Meserve, Scottsbluff - locality	Thurmond, 1990: PA 35-131	10		1.3	1			
1	Primrose	OK	Golondrina, Hell Gap, Plainview, Scottsbluff - locality	Thurmond, 1990: PA 35-131	20		4.3	1			
1	Rhoton-Keyes	OK	Meserve, Plainview locality - locality	Thurmond, 1990: PA 35-131	10		1.3	1			
1	San Miguel Creek	TX	Angostura, Golondrina, Plainview - locality (41AT3/4/7)	Thurmond, 1990: PA 35-131	20		4.3	1			
1	San Miguel Creek (41MC1)	TX	Angostura, Plainview - locality	Thurmond, 1990: PA 35-131	20		4.3	1			
1	San Miguel Creek	TX	Angostura, Plainview - locality (71A4-1/2/3)	Thurmond, 1990: PA 35-131	20		4.3	1			
1	Smith IV	OK	Plainview locality	Thurmond, 1990: PA 35-131	20		4.3				

Table B.02 Sites Gathered from Background Research - Inventory

1	St. Mary's Hall	TX	Golondrina, Plainview locality	Thurmond, 1990: PA 35-131	20		4.3					
1	Suzanne West	OK	Plainview locality	Thurmond, 1990: PA 35-131	20		4.3					
1	Thurman /Skidmore	TX	Meserve, Plainview, Scottsbluff, Angostura, Plainview (@ Skidmore) - locality	Thurmond, 1990 PA 35-131	10		1.3	1				
1	Thurmond Ranch	OK	Meserve - locality	Thurmond, 1990 PA 35-131	10		1.3					
1	Wharton	TX	Meserve, Plainview, Scottbluff, San Patrice -	Thurmond, 1990 PA 35-131	10		1.3	1				
1	Willeke	TX	Angostura, Golundrina - locality	Thurmond, 1990 PA 35-131	20		4.3	1				
1	41 CK 35/41/90	TX	Angostura, Plainveiw	Thurmond, 1990 PA 35-131	20		4.3	1				
1	41 CK 59/63	TX	Angostura, Plainview	Thurmond, 1990 PA 35-131	20		4.3	1				
1	41 UV 29	TX	Golondrina	Thurmond, 1990 PA 35-131	20		4.3					
1	42Be703	UT	Clovis isolate	Copeland and Fike, 1988	10		1.1					
1	42Be93	UT	Clovis lithic scatter	Copeland and Fike, 1988	10		1.1					
1	42Bo463	UT	Folsom -	Copeland and Fike, 1988	10		1.2					
1	42Dc221	UT	Folsom isolate	Copeland and Fike, 1988	10		1.2					
1	42Dc353	UT	Folsom lithic scatter	Copeland and Fike, 1988	10		1.2					
1	42Dc502	UT	Clovis lithic scatter	Copeland and Fike, 1988	10		1.1					
1	42Em8	UT	Folsom R.S.	Copeland and Fike, 1988	10		1.2					
1	42Ga3034	UT	Folsom lithic scatter	Copeland and Fike, 1988	10		1.2					
1	42Ga3049	UT	Clovis lithic scatter	Copeland and Fike, 1988	10		1.2					
1	42Ga312	UT	Folsom lithic scatter	Copeland and Fike, 1988	10		1.2					
1	42Ga899	UT	Folsom lithic scatter	Copeland and Fike. 1988	10		1.2					
1	42Gr1564	UT	Clovis lithic scatter	Copeland and Fike, 1988	10		1.1					
1	42Gr1565	UT	Clovis lithic scatter	Copeland and Fike, 1988	10		1.1					

Table B.02 Sites Gathered from Background Research - Inventory

1	42Gr1566	UT	Folsom -	Copeland and Fike, 1988	10		1.2				
1	42Gr1567	UT	Folsom -	Copeland and Fike, 1988	10		1.2				
1	42Gr1568	UT	Folsom lithic scatter	Copeland and Fike, 1988	10		1.2				
1	42Gr1569	UT	Folsom -	Copeland and Fike, 1988	10		1.2				
1	42Gr1570	UT	Folsom lithic scatter	Copeland and Fike, 1988	10		1.2				
1	42Gr1571	UT	Folsom lithic scatter	Copeland and Fike, 1988	10		1.2				
1	42Gr1956	UT	Folsom lithic scatter	Copeland and Fike, 1988	10		1.2				
1	42Gr2130	UT	Clovis lithic scatter	Copeland and Fike, 1988	10		1.1				
1	42In110	UT	Clovis lithic quarry	Copeland and Fike, 1988	10		1.1				
1	42In1132	UT	Folsom lithic scatter	Copeland and Fike, 1988	10		1.2				
1	42In183	UT	Clovis (probably)	Copeland and Fike, 1988	10		1.1				
1	42In462	UT	Folsom lithic scatter	Copeland and Fike, 1988	10		1.2				
1	42Jb180	UT	Clovis lithic scatter	Copeland and Fike, 1988	10		1.1				
1	42Md300	UT	Folsom lithic scatter	Copeland and Fike, 1988	10		1.2				
1	42Md381	UT	Folsom lithic scatter	Copeland and Fike, 1988	10		1.2				
1	42Md454	UT	Folsom lithic scatter	Copeland and Fike, 1988	10		1.2				
1	42Sa11422	UT	Folsom isolate	Copeland and Fike, 1988	10		1.2				
1	42Sa13267	UT	Clovis lithic scatter	Copeland and Fike, 1988	10		1.1				
1	42Sa13268	UT	Clovis lithic scatter	Copeland and Fike, 1988	10		1.1				
1	42Sa4763	UT	Clovis R.S.	Copeland and Fike, 1988	10		1.1				
1	42Sa798	UT	Folsom lithic scatter	Copeland and Fike, 1988	10		1.2				
1	42Sa8540	UT	Folsom midden	Copeland and Fike, 1988	10		1.2				
1	42Sa9799	UT	Clovis lithic scatter	Copeland and Fike, 1988	10		1.1				
1	42Sv1618	UT	Clovis -	Copeland and Fike, 1988	10		1.1				

Table B.02 Sites Gathered from Background Research - Inventory

1	42To13	UT	Folsom R.S.	Copeland and Fike, 1988	10		1.2				
1	42Wn624	UT	Clovis lithic scatter	Copeland and Fike, 1988	10		1.1				
1	SWFAS 1	NM	Plainview - locality	Thurmond, 1990 PA 35-131	20		4.3				
1	SWFAS 10	TX	Meserve - locality	Thurmond, 1990: PA 35-131	10		1.3				
1	SWFAS 16	TX	Plainview - locality	Thurmond, 1990: PA 35-131	20		4.3				
1	SWFAS 17	TX	Plainview - locality	Thurmond, 1990: PA 35-131	20		4.3				
1	SWFAS 18	TX	Golondrina. Plainview - locality	Thurmond, 1990: PA 35-131	20		4.3	1			
1	SWFAS 19	TX	Plainview - locality	Thurmond, 1990: PA 35-131	20		4.3				
1	SWFAS 2	NM	Eden, Plainview - locality	Thurmond, 1990: PA 35-131	20		4.3	1			
1	SWFAS 22-26	TX	Golondrina, Meserve - locality	Thurmond, 1990: PA 35-131	10		1.3	1			
1	SWFAS 28	TX	Plainview - locality	Thurmond, 1990: PA 35-131	20		4.3				
1	SWFAS 34	TX	Plainview - locality	Thurmond, 1990 PA 35-131	20		4.3				
1	SWFAS 36	TX	Plainview - locality	Thurmond, 1990 PA 35-131	20		4.3				
1	SWFAS 4	NM	Plainview - locality	Thurmond, 1990 PA 35-131	20		4.3				
1	SWFAS 40/41	TX	Golondrina, Plainview - locality	Thurmond, 1990 PA 35-131	20		4.3	1			
1	SWFAS 42	TX	Plainview - locality	Thurmond, 1990 PA 35-131	20		4.3				
1	SWFAS 48	NM	Golondrina - locality	Thurmond, 1990 PA 35-131	20		4.3				
1	SWFAS 49	TX	Eden, Meserve - locality	Thurmond, 1990 PA 35-131	10		1.3	1			
1	SWFAS 50/59/60	TX	Golondrina, Hell Gap, Meserve, Plainview - locality	Thurmond, 1990 PA 35-131	10		1.3	1			
1	SWFAS 53	TX	Plainview - locality	Thurmond, 1990 PA 35-131	20		4.3				
1	SWFAS 61	TX	Hell gap, Midland, Plainview - locality	Thurmond, 1990 PA 35-131	20		4.3	1			
1	SWFAS 62	TX	Plainview - locality	Thurmond, 1990 PA 35-131	20		4.3				
1	SWFAS 7	NM	Plainview - locality	Thurmond, 1990 PA 35-131	20		4.3				

Table B.02 Sites Gathered from Background Research - Inventory

1	"Canyon Ferry"	MT	Clovis locality	Davis. 1988:26; pers comm 1/94	10		1.1				
1	"Dry Creek"	MT	Folsom locality	Davis, 1988:26; pers comm 1/94	10		1.2				
1	Ballew/Francis	TX	Angostura, Meserve, Plainview - locality	Thurmond, 1990 PA 35-131	10		1.3	1			
1	MT Clovis	MT	Clovis locality	Davis, 1988:26; pers comm 1/94	10		1.1				
1	MT Clovis	MT	Clovis locality	Davis, 1988:26; pers comm 1/94	10		1.1				
1	MT Clovis	MT	Clovis locality	Davis, 1988:26; pers comm 1/94	10		1.1				
1	MT Clovis	MT	Clovis locality	Davis, 1988:26; pers comm 1/94	10		1.1				
1	MT Clovis	MT	Clovis locality	Davis, 1988:26; pers comm 1/94	10		1.1				
1	MT Clovis	MT	Clovis locality	Davis, 1988:26; pers comm 1/94	10		1.1				
1	MT Clovis	MT	Clovis locality	Davis, 1988:26; pers comm 1/94	10		1.1				
1	- MT Clovis	MT	Clovis locality	Davis, 1988:26; pers comm 1/94	10		1.1				
1	MT Clovis	MT	Clovis locality	Davis, 1988:26; pers comm 1/94	10		1.1				
1	MT Clovis	MT	Clovis locality	Davis, 1988:26; pers comm 1/94	10		1.1				
1	MT Clovis	MT	Clovis locality	Davis, 1988:26; pers comm 1/94	10		1.1				
1	MT Clovis	MT	Clovis locality	Davis, 1988:26; pers comm 1/94	10		1.1				
1	MT Clovis	MT	Clovis locality	Davis, 1988:26; pers comm 1/94	10		1.1				
1	MT Clovis	MT	Clovis locality	Davis, 1988:26; pers comm 1/94	10		1.1				
1	MT Clovis	MT	Clovis locality	Davis, 1988:26; pers comm 1/94	10		1.1				
1	MT Clovis	MT	Clovis locality	Davis, 1988:26; pers comm 1/94	10		1.1				
1	MT Clovis	MT	Clovis locality	Davis, 1988:26; pers comm 1/94	10		1.1				
1	MT Clovis	MT	Clovis locality	Davis, 1988:26; pers comm 1/94	10		1.1				
1	MT Clovis	MT	Clovis locality	Davis, 1988:26; pers comm 1/94	10		1.1				
1	MT Clovis	MT	Clovis locality	Davis, 1988:26; pers comm 1/94	10		1.1				
1	MT Clovis	MT	Clovis locality	Davis, 1988:26; pers comm 1/94	10		1.1				

Table B.02 Sites Gathered from Background Research - Inventory

1	MT Clovis	MT	Clovis locality	Davis, 1988:26; pers comm 1/94	10		1.1				
1	MT Folsom	MT	Folsom locality	Davis, 1988:26; pers comm 1/94	10		1.2				
1	MT Folsom	MT	Folsom locality	Davis, 1988:26; pers comm 1/94	10		1.2				
1	MT Folsom	MT	Folsom locality	Davis, 1988:26; pers comm 1/94	10		1.2				
1	MT Folsom	MT	Folsom locality	Davis, 1988:26; pers comm 1/94	10		1.2				
1	MT Folsom	MT	Folsom locality	Davis, 1988:26; pers comm 1/94	10		1.2				
1	MT Folsom	MT	Folsom locality	Davis, 1988:26; pers comm 1/94	10		1.2				
1	MT Folsom	MT	Folsom locality	Davis, 1988:26; pers comm 1/94	10		1.2				
1	MT Folsom	MT	Folsom locality	Davis, 1988:26; pers comm 1/94	10		1.2				
1	MT Folsom	MT	Folsom locality	Davis, 1988:26; pers comm 1/94	10		1.2				
1	MT Folsom	MT	Folsom locality	Davis, 1988:26; pers comm 1/94	10		1.2				
1	MT Folsom	MT	Folsom locality	Davis, 1988:26; pers comm 1/94	10		1.2				
1	MT Folsom	MT	Folsom locality	Davis, 1988:26; pers comm 1/94	10		1.2				
1	MT Folsom	MT	Folsom locality	Davis, 1988:26; pers comm 1/94	10		1.2				
1	MT Folsom	MT	Folsom locality	Davis, 1988:26; pers comm 1/94	10		1.2				
1	MT Folsom	MT	Folsom locality	Davis, 1988:26; pers comm 1/94	10		1.2				
1	MT Folsom	MT	Folsom locality	Davis, 1988:26; pers comm 1/94	10		1.2				
1	MT Folsom	MT	Folsom locality	Davis, 1988:26; pers comm 1/94	10		1.2				
1	MT Folsom	MT	Folsom locality	Davis, 1988:26; pers comm 1/94	10		1.2				
1	MT Folsom	MT	Folsom locality	Davis, 1988:26; pers comm 1/94	10		1.2				
1	MT Folsom	MT	Folsom locality	Davis, 1988:26; pers comm 1/94	10		1.2				
1	MT Folsom	MT	Folsom locality	Davis, 1988:26; pers comm 1/94	10		1.2				
1	MT Folsom	MT	Folsom locality	Davis. 1988:26; pers comm 1/94	10		1.2				
1	MT Folsom	MT	Folsom locality	Davis, 1988:26; pers comm 1/94	10		1.2				

Table B.02 Sites Gathered from Background Research - Inventory

1	MT Folsom	MT	Folsom locality	Davis, 1988:26; pers comm 1/94	10		1.2				
1	MT Folsom	MT	Folsom locality	Davis, 1988:26; pers comm 1/94	10		1.2				
Sites continued											
1	Locknore Creek/Nesikep	BC	7-6.5k willow leaf and shouldered, Nesikep microblades overlay after :90 no dates, type site for Locknore Complex , Cascade time	Bryan, 1980 pp 104 Carlson, 1983:77 ="Stemmed Point"; ibid:87 ="Pebble Tool" Shutler, 1983 site list (:221-222)	4	1	2.0	1			
1	Loltun Cave	MEX	uniface, bone tools arly-Early "Stage 2", no other reference	Shutler, 1983; MacNeish 1986:127	A		9.0				
1	Lone Butte Site	NM	Folsom locality, poss. kill	Amick, 1991 CRP 8:3	1		1.2				
1	Lone Wolf Creek	TX	Plainview / Milnesand with bison, site excavated in 1924 = Scottsbluff	Wormington, 1964:110 Thurmond, 1990 PA 35-131	2		4.3	1			
1	Lookingbill	WY	7.140(160)(RL554) side notched point :44) Haskett type, stemmed	Frison, 1978: 29; Stanford and Day, 1992; Shutler, 1983 Frison 1978:124	3	1	2.0	1			
1	Los Angeles Man (La Brea)	CA	atlatl dart (4.450(250)(LJ121) skeletal fragments 9.000(80)(UCLA1292), Skeletal La Brea, cf Angeles Mesa (6 individuals) Skeletal 1936, in strata with mammoth Early Early proposals initially	Sellards, 1952:119-146 Wormington, 1964:231 Shutler, 1983 site list (:221-222) West, 1983	4	1	4.0				
1	Los Grifos Cave	MEX	9.5k dated waisted Clovis, fishtail pts Chiapas,	MacNeish, 1983:127 Ranere and Cooke, 1991	1	1	1.7				
1	Los Llanos	SONA	fluted point locale	Ortiz, 1974 pp25	10		1.6				
1	Los Tapiales		10.710(170)(Tx-631) plus more Fluted 10.7k Fishtail & Lerma? GUATEMALA	Ranere and Cooke, 1991 Gruhn and Bryan 1977; West, 1983 Shutler, 1983 site list (:221-222) MacNeish, 1983:127	1	1	1.6				
1	Lost Chicken Crk.	ALK	Early-Early, Morlan and Cinq-Mars, 1982	Clark, 1991:37; 1984:69 Dumond, 1980:986	A		6.0				

Table B.02 Sites Gathered from Background Research - Inventory

1	Lowe	GA	28 Dalton, early archaic	Anderson et al., 1990:11:52	1		1.3				
1	Lowe Ranch	Belize	fishtail locality, pp 239	Ranere and Cooke, 1991	10		1.7				
1	Lubbock Lake	TX	Western Paleoindian sites Folsom/Plainview Scottsbluff (9k (9.9) dates post Folsom 11.1(60)(avg2) Haynes, nd 11.1k(100)(SMU-548) on wood w/ 1 point Johnson, 1991:223 table 2 9.970(60) avg2 soil dates, Plainview, Haynes nd(1 point Johnson 91:223) Clovis - "Western Clovis"	Rule, 1983:21 Thurmond, 1990 PA 35-131 Wormington, 1964:40 Johnson and Holiday CRP 1985:22 Sellards, 1952:119-146 Willey, 1966 fig 2.2 Shutler, 1983 site list (:221-222) Haynes, 1991 Bonnichsen et al., 1987	1	1	1.1	1			
1	Lucy	NM	Sandia points Clovis, Sandia, Folsom mixed fluted Roosa, 1956, prelim. rept on Lucy site, el palacio63(2)36-49	Wormington, 1964:90-1; Willey, 1966 fig 2.2 Rule, 1983 West, 1983 Sellards, 1952:119-146	1		1.1	1			
1	MacHaffie	MT	Folsom, Limecreek-like, Plainview? fluted point locality Folsom, Scottsbluff, notched points 9.3k dates oldest of 4 strata, Folsom, Cody (Scottsbluff), Archaeological Sites of the Paleoindian Period" Clovis(?), Folsom, Scottsbluff. Eden(?)	Sellards, 1952:119-146 Carlson, 1983:84 Fluted Points Wormington, 1964 Davis, 1988:26 Davis et al. 1991 CRP 8:19 Frison, 1978: 29 Willey, 1966 fig 2.2	1	1	1.2	1			
1	MacKenzie R.	OR	fluted point locality	Carlson, 1983:84 Fluted Points	10		1.6				
1	Macon Plateau	GA	"Macon" = classic Clovis with Bolen and Palmer/Kirk	Sellards, 1952:119-146 Anderson et al., 1990:11:12	1		1.1	1		1	

Table B.02 Sites Gathered from Background Research - Inventory

1	Madden Lake	PANA MA	Fishtail Trad	MacNeish, 1983:127 Shutler, 1983 site list (:221-222) Ranere and Cooke, 1991	1		1.7				
1	Madsen Lake	TX	Plainview	Thurmond, 1990 PA 35-131	2		4.3				
1	Magnet	IN	1 Clovis, Quad, beaver lake, Plainview, Agate Basin	Smith, 1987:32 CRP 4:32	1		1.1	1			
1	Malakoff	TX	found with extinct fauna	Sellards, 1952:119-146 Wormington, 1964:155	1						3
x	Mammoth Meadow	MT	listed as having red ocher	Roper, 1991:294	xx		xx				
1	Mangus	WY	8.6k - Stemmed, Agate Basin like listed as having red ocher	Bryan, 1980 pp 104; Frison, 1978:26:92 Roper, 1991:294	3	1	2.0				
1	Manis	WA	Mastodon site to Carlson, 1983:87 = Pebble Tool	Shutler, 1983 (:221-222) Stanford, 1983:66	A		6.0				
1	Manix Lake	CA	Early-early claims	Willey, 1966 fig 2.2 ; Willig and Aikens, 1988:6; Shutler, 1983 (:221-222) Whitley and Dorn, 1993	A		9.0				
1	Manning	SC	Early Archaic,	Anderson et al., 1990:52 Anderson and Hanson, 1988	2		xx				
1	Marmes R.S.	WA	Stemmed Point" 10.6-8.7 skeletal, Lind Coulee-like (Windust?) 10.750 (100) (WSU211) 10.810 (275) (WSU363) 10.475 (270) (WSU366) SHELLDATES	Bryan, 1980 pp 104; Carlson, 1983:77:87 ; West, 1983 Willig and Aikens, 1988:13-15 Shutler, 1983 (:221-222) cf Oakely et al., 1975	1	1	2.0		1		
1	Mathewson/ Gallant	OHIO	Early archaic?	Doyle et al., 1985	xx		xx				
1	Mattassee Lake	SC	excavated sites, 12-8k Palmer occupation, Anderson, 1992:16	Smith, 1986:8	2		4.8				
1	McConnell	OHIO		Doyle et al., 1985; Funk, 1978	xx		xx				

Table B.02 Sites Gathered from Background Research - Inventory

1	McCulley	NY	5.7k Otter Creek pts, cf Funk, 84:91	Funk, 1978	4		4.0				
1	McFaddin Beach	TX	fluted plus numerous other, fishtail, SanPatrice, Kirk 11.100(750)(not given)	Long, 1977	1	1	1.1	1		1	
1	McLean	TX	Clovis man Mammoth association	Rule, 1983 Sellards, 1952:36 Wormington, 1964:47	1		1.1				
1	Meadowcroft R.S.	PA	Eastern Paleoindian Sites Early Early counts as early archaic site Funk 1977:326 Stratigraphic sequence of continuity	Rule, 1983:22; West, 1983 MacDonald, 1983:107 Stanford, 1983:66; Anderson et al., 1990:52; Shutler, 1983 (:221-222) Funk, 1978; Doyle et al., 1985	A	1	9.0	1		1	
1	Medicine Creek	NB	Lime Creek and Red Smoke?, Davis53 Plainview @ 8.274 (500) (C-108a); 8.862 (230) (C-824);10.493 (1500) (C-470)	Haynes, 1991; Sellards, 1952:133; Kreiger, 1964:62	3	1	4.3				
1	Medicine Crow	SD	7k? skeletal, fluted and Plainview below, Duncan points above	Bass, 1975	1		1.6	1	1		
1	Medicine Lodge Creek	WY	9.5k Lind Coulee/Parman like/Windust like 9.7k =earliest, stratified Lovell constricted, Pryor stemmed, Cody complex 10k	Bryan, 1980 pp 104; Carlson, 1983:77 ; Stanford and Day, 1992 frontspiece; Frison, 1978: 29; Shutler, 1983 (:221-222)	2	1	2.0	1			
1	Melbourne	FLA	Skeletal archaic with extinct fauna fortuitous	Wormington, 1964:229 Sellards, 1952:119-146	4		4.0		1		
1	Melinda	Belize	Fishtail Trad	MacNeish, 1983:127	1		1.7				
1	Mendocino	CA	"period III"	Wallace, 1978:26	4						
1	Mendon	NY		Doyle et al., 1985	xx		xx				
1	Mesa (KIR-102)	ALK	10k averg of 7 dates, stemmed "Angostura like" concave (?) and convex based stemmed, early claims equiv.	Kunz and Reainer, 1994; Clark, 1991:37; 1984:69	1	1	5.0	1			
1	Meserve	NB	Dalton associated with bison	Wormington, 1964 Willey, 1966 fig 2.2	1		1.3				

Table B.02 Sites Gathered from Background Research - Inventory

1	Mesilla	CA	"period II": not in Moratto	Wallace, 1978:26	4						
1	Meyer Cave #3	WA	no dates, Windust, cascade, northern side notched sequence:89	Bryan, 1980 pp 104	1		2.0	1			
1	Miami	TX	Fluted Clovis, Mammoth, Western (Clovis) Paleoindian sites	Holliday et al., 1994; Sellards, 1952:119-146; Wormington, 1964:46; West, 1983; Rule, 1983:21	1		1.1				
1	Michaud	ME	fluted @ 10.200(620)(beta-15660); Speiss and Wilson, 1987 in Levine, 1990:58 listed as having red ocher	Bonnichsen et al., 1987; Spiess and Brush 1987 CRP 4:34 Roper, 1991	1	1	1.6				
1	Midland	TX	Folsoms, Midland points, Meserve, just above - Skeletal - good stratigraphic control, ="Scharbauer" Site 11k u/ith dates in CRP 10 (11.6 (800)) Western (Clovis age) Paleoindian sites = ca 10,100 calibrated to C14 from U-Th	Wormington, 1964:41:241 West, 1983; Willey, 1966 fig 2.2 Shutler, 1983 (:221-222) Rule, 1983:21; Roper, 1991:294	1	1	1.2		1		
1	Mill Branch site	GA	Palmer and Taylor points	Anderson et al., 1992:252	1		4.4	1			
1	Mill Iron	MT	11.3 and 10.8k avg4, Frison, 1991, Goshen pts, bison bone bed - wedges, blades	Davis, 1988:26	1	1	1.2			1	
1	Milliken	BC	Western Stemmed 9.0(150)(S-113): 8.150(310)(S-47) 9k-8k dated, pointed or convex laurel leaf stemmed:89	Carlson, 1983:87 Pebble Tool Willig and Aikens, 1988:13-15 Shutler, 1983 site list (:221-222) Bryan, 1980 pp 104	2	1	2.0				
1	Milnesand	NM	Midland, Milnesand type site, includes Ted Williamson Site (Johnson, et al. 1986 CRP 3)	Thurmond, 1990 PA 35-131 Wormington, 1964:112	2		4.3				
1	Minnesota (Pelican Rapids)	MINN	Skeletal - shell and elk bone knife 4-5k poss. skeletal w/ artifacts? cf Haynes, 1990:59, bone date 5.0k()(W-530 may be contaminated "Paleoindian" to Steele and Power, 1992; probably early archaic to Oakley et al., 1975	Wormington, 1964:233-236; Jenks, 1937 Sellards, 1952:119-146 Shutler, 1983 site list (:221-222)	4		4.0		1		

Table B.02 Sites Gathered from Background Research - Inventory

x	Mirador	MEX		Shutler, 1983 site list (:221-222)	xx		xx				
x	Mitchell	NM	Folsom site in New Mexicow/ red ocher	Roper, 1991:294	1		1.2				
x	Mitchell Farm	DEL	Quartz flakes below soil date of 11,480(400)(UGa-4323), fluted points found on the surface around the site as well as tools	Custer, 1994:332; 1989:104	1	1	1.6				
1	Moab sites	UT			xx		xx				
1	Mockingbird Gap	NM	Fluted point site - excavated report mentioned in Judge, 1973 Western (Clovis) Paleoindian	Judge, 1973 Rule, 1983:21	1		1.1				
1	Modoc R.S.	IL	c14 dates - side notched etc Dalton @ base, long sequence archaic development	Fowler, 1959 in Wormington, 1964:148 Willey, 1966 fig 2.2; Funk, 1978	1	1	1.3	1	1		
1	Moe	ND	Folsom	Shutler, 1983; Frison 1978:11	1		1.2				
1	Mono Basin	CA	8K poss, early Holocene, stemmed, concave based, hydration rinds	Hall, 1991 CRP 8:23-4	3		2.0				
1	Mono Lake	CA		Haynes, 1991	xx		xx				
1	Montgomery (MO)	MO	excavated sites, 12-8k SE()	Smith, 1986:8	xx		xx				
1	Montgomery (UT)	UT	Folsom lithic scatter Folsom base camp	Copeland and Fike, 1988 Davis, WE 1985 (CRP 2:11-12)	1		1.2				
1	Moose Creek	ALK	11k dates Nenana:415,	Bonnichsen et al., 1987 Goebel et al., 1991	1	1	5.0				
1	Morgan	WY	Folsom (:114), mixed with other paleo, archaic and late prehistoric items "Archaeological Sites of the Paleoindian Period"	Frison, 1978: 29	1		1.2				
1	Morris	KY	excavated sites, 12-8k SE(), Cumberland, Quad, Dalton, burials (probably archaic)	Smith, 1986:8; Rolingson and Schwartz, 1966	1		1.3	1	1		
1	Morrison Field	OHIO	plotted as one of 11 in Lucas county - Hi-Lo complex	Stothers and Abel, 1991:207-8	1		4.1				

Table B.02 Sites Gathered from Background Research - Inventory

1	Mortlach		Folsom, Eden, Scottsbluff SASKATCHEWAN	Sellards, 1952:119-146 Wormington, 1964	1		1.2	1			
1	Muckafoonee Crk.	GA	:28 archaic & paleo bifaces, mostly lithic debris	Anderson et al., 1990:11 ; Anderson et al., 1992:253	1		4.0	1			
1	Mud Springs	WY	Folsom surface assemblage (:114) "Archaeological Sites of the Paleoindian Period"	Frison, 1978: 29	1		1.2				
1	Mulberry Creek Mound	AL		Walthal, 1980:39	xx		xx		1		
1	Mummy Cave	WY	Lovell constricted, Pryor stemmed 9.2k on Lovell constricted - stratified - stemmed points, concave and straight bases - 9.2k earliest 38 cultural levels, Wedel et al. 1968	Stanford and Day, 1992 frontspiece Bryan, 1980:94 pp 104 Shutler, 1983 site list (:221-222) Frison, 1978: 29	2	1	4.0	1			
1	Muncy	OK	Clovis Hell Gap, Meserve, Plainview, Scottsbluff	Hofman and Wycoff, 1991 CRP 8:30-32 Thurmond, 1990 PA 35-131	1		1.1	1			
1	Munson	NY	7k poss, cf Funk, 1984:82	Funk, 1978	4						
1	Munson Springs Site	OHIO	Kirk, St. Albans, MacCorkle, poss paleo below cf Lepper and Gill 1991 CRP 8:40	Frolking and Lepper, 1990 CRP 7:12-13	2		4.8	1			
1	Munsungun Lake	ME	Eastern Fluted point site	Shutler, 1983 site list (:221-222); Doyle et al., 1985; MacDonald, 1983:107; Anderson et al., 1990:52; West, 1983	1		1.5				
1	Murray Springs	AZ	Clovis mammoth and bison kill Western (Clovis) Paleoindian sites Clovis - "Western Clovis"	Haynes, 1991, Haynes, 1987 West, 1983 Rule, 1983:21 Willig and Aikens, 1988:11 Bonnichsen et al., 1987	1	1	1.1			1	
1	Myers-Hindman	MT	9.4k earliest (stemmed, notched points)	Frison, 1978: 29 Shutler, 1983 site list (:221-222)	2	1	2.0	1			
1	NE of Lovelock				10		1.6				

Table B.02 Sites Gathered from Background Research - Inventory

1	NG-2	ID	Folsom - locality	Titimus and Woods, 1991	10		1.2				
1	NJ East	ID	Folsom - locality	Titimus and Woods, 1991	10		1.2				
1	Naco	AZ	Fluted mammoth and points Western (Clovis) Paleoindian sites	West, 1983; Wormington, 1964 Sellards, 1952:119-146; Rule, 1983:21; Carlson, 1983:84	10	1	1.1				
1	Nalcrest	FLA	poss e. archaic, mid archaic, microlithics	Milanich & Fairbanks 1980:36:45	1		4.4	1			
1	Nall Site	OK	Angostura, Meserve, Midland, Plainview Clovis	Thurmond, 1990 PA 35-131 Hofman and Wycoff, 1991 CRP 8:30-32	1		1.1	1			
1	Namu	BC	"Microblade" "Pebble Tool" 9.140 (100) 9.720 (40) burials	Carlson, 1983:87:92 ; Shutler, 1983 (:221-222); Clark, 1991:37; 1984:69; Dumond, 1980:986	2	1	3.0	1	1		
1	Natalkuz Lake	BC	microblades	Shutler, 1983 site list (:221-222)	xx		3.0				
1	Natchez Pelvis	MISS	Skeletal - no artifacts	Wormington, 1964:226 Sellards, 1952:119-146	1		xx		1		
1	Natvakruak	ALK	fluted location w/ Denbigh and microblades	Clark, 1991:37; 1984:69	1		1.6	1			
1	Navarette	AZ	near Naco, Clovis= Mammoth association	Haynes, 1987a	1		1.1				
1	Nebo Hill	MO	older than 6k	Sellards, 1952:119-146 Wormington, 1964	4		2.0				
1	Neponset	MA	Fluted, with miniature points	Carty and Spiess, 1992	1		1.6				1
1	Neville	NH	7.7k ca Stanley Morrow Mtn.	Funk, 1978	4		4.0				
1	New Garden	AL	Big Sandy	Walthal, 1980:51	1		4.4				
1	New Horton Lake	NB	late Paleo, E. Archaic fluted point locale; Keenlyside, 1985 AENA :85	Bonnichsen and Turnmire, 1991	10		1.6	1			
1	New London Bay	PEI	Late Paleo locality,	Bonnichsen and Turnmire, 1991 Keenlyside,1991	2		4.8				
1	New River	AZ	fluted point locality	Carlson, 1983:84 Fluted Points	10		1.6				
x	New Smyrna	FLA		Sellards, 1952:119-146	xx		xx				

Table B.02 Sites Gathered from Background Research - Inventory

1	Newcastle	ONT	Crystal fluted point	Roberts, 1984	1		1.6				2
1	Newnan's Lake (A-356)	FLA	6.8k Newnan site	Milanich and Fairbanks 1980:36 Daniel and Wisenbaker 1987:146	4	1	4.0				
1	Nipper Creek	SC	Dalton, side notched, Morrow Mtn., Guilford+	Goodyear et al., 1986:6 CRP 3	1		1.3	1			
1	Niska		listed as having red ocher 10.880 (70) (TO956) "paleo"Cody? SASKATCHEWAN	Roper, 1991:294:299-302; Meyer and Liboiron 1990 PA 35:129	1	1	2.0				
1	Nobles Pond	OHIO	Fluted point site Gainey like, cf Gramly, 1988:266	Funk, 1978; Anderson et al., 1990:52	1		1.4				
1	N. Central San Bernardino Co.	CA		Wallace, 1978:26	xx		xx				
1	Nuckolls	TN	Clovis(13), Cumberland(6), Redstone(1), Beaver Lake, Quad, Dalton Broster et al.., 1991 CRP 8:10 cf Lewis and Kneeberg, 1959 Dalton and footed paleos Big Sandy	Anderson et al., 1990:52 Willey, 1966 fig 2.2; Walthal, 1980:50; Smith, 1986:8; Lewis and Kneberg, 1958	1		1.1	1			
1	O'Malley Shelter	NV	5-4k bifurcate Pinto, Gatecliff like, 5k-3k concave lanceolates = Humboldt, Elko @ 7K-6.5k, Elko side notched	Homer, 1986	4						
1	Oconee	GA		Anderson et al., 1990:52	xx		xx				
1	Odell Lake	OR	stemmed older than Mazama ash	Wormington, 1964 Sellards, 1952:119-146	3		2.0				
1	Olcott	WA		Carlson, 1983:87	3		xx				
1	Old Crow Flats	Yukon	early-early claims bone locality, flesher redated to 1300 bp	Carlson, 1983:92 ; Shutler, 1983 site list (:221-222); West, 1983	A		9.0				
1	Old Hickory	OHIO	plotted as one of 11 in Lucas County Hi-Lo complex	Stothers and Abel, 1991:207-8	1		4.1				
1	Old Humboldt	NV	fluted and stemmed locality - Rye Patch Res. Pershing county Willig, 1991:	Bonnichsen and Turnmire, 1991 site list	1		1.6	1			
1	Old John Lake	ALK	(ARC-1) fluted pt w/ microblades	Clark, 1991:37; 1984:69	1		1.6	1			

Table B.02 Sites Gathered from Background Research - Inventory

1	Olsen-Chubbock	OK	10.150(500) - Firstview and San Jon points bison bone bed	Bryan, 1980:96 pp 104 Shutler, 1983 site list (:221-222)	1	1	4.3	1			
1	Olympia	WA	fluted point locality	Carlson, 1983:84 Fluted Points	10		1.6				
1	Onion Portage	ALK	v. late stemmed after notching	Bryan, 1980 pp 104	2		3.0				
1	Onion Portage (Akmak)	ALK	9.6k type site for Anderson's Paleoarctic, Akmak complex = Denali of West67 9.8k dates pp Microblade	Clark, 1991:37; 1984:69; Dumond, 1980:987; Bonnichsen et al., 1987:409; Carlson, 1983:92	2		3.0			1	
1	Onion Portage	ALK	8k "blade" (microblade) dates (Kobuk Phases)	Bonnichsen et al., 1987:409	2		3.0			1	
1	Osceola Site	WISC	old copper - cemetery	Wormington, 1964:152	4		4.0		1		
1	Otter Creek #2	VT	?late archaic	Funk, 1978	4						
1	Owen Site	TX	paleo and E. Archaic in stratified middens Texas coast - Harris county	Aten, 1983:99 Patterson, 1980 in Aten	1		4.2	1			
1	Owens Valley	CA	stemmed and fluted point locale = Owens Lake?	Wallace, 1978:26	10		1.6	1			
1	Owl Cave (Wasden)	ID	Folsom - early date = 10.9k, stemmed above ca 7.9k :92 10.920(150)(WSU-1786) on Folsom, , hydration rate of 10.7 k also discussed; Western Stemmed (& Folsom) Pinto like after Paleo - 7.8k, and Gatecliff later @3.5k	Miller and Dort, 1978; Carlson, 1983:84; Bryan, 1980 pp 104; Frison, 1978: 29; Shutler, 1983 (:221-222); Bonnichsen et al., 1987 Titimus and Woods, 1991; Willig and Aikens, 1988:13-15; Homer, 1986	1	1	1.2	1			
1	Owl Ridge	ALK	11.340(150(B-11209); Nenana:415	Bonnichsen et al., 1987 Bigelow et al., 1990	1	1	5.0				
1	Packard	OK	9.8 (avg3) on Agate Basin; Dalton above @ 9.6=Wycoff CRP 6 1989:24-25	Bonnichsen et al., 1987	2	1	2.0	1			
1	Paddack Valley	ID	Clovis - locality (Cascade Res.)	Titimus and Woods, 1991	10		1.1				
1	Page-Ladson/Wacissa/Aucilla	FLA	fluted, Suwannee, Greenbriar Bolen, *in situ* Bolen U/W site	Anderson et al., 1990:11; Purdy, 1991 Dunbar et al., 1989; 1989; Milanich, 1994	1	1	1.1	1			

Table B.02 Sites Gathered from Background Research - Inventory

1	Paint Rock V	WY	8.2 ca Pryor stemmed:23	Frison, 1978: 29 Shutler, 1983 (:221-222) Stanford and Day, 1992 frontspiece	3	1	4.0				
1	Paisley Caves	OR	no dates/ no diagnostics, obsidian biface, extinct & extant fauna:90 below Mazama ash, cresent, 3 caves	Wormington, 1964 Bryan, 1980 pp 104 Sellards, 1952:119-146	xx		xx				
1	Paleo Crossing	OHIO	12.250(100)(AA8250) fluted, Gainey 21 pts, 9.230(80)(AA8252) on Kirk, lots of debitage	Brose, 1991	1	1	1.6				
1	Palisades I	ALK		Willey, 1966 fig 2.2	xx		xx				
1	Panama Canal Channel site		Fishtail Trad PANAMA	MacNeish, 1983:127	1		1.7				
1	Panamint Valley	CA	fluted and stemmed locale cf Moratto, 1984:87; "Stemmed Point"; & "Fluted Point"	Wallace, 1978:26; Carlson, 1983:77 :84Davis and Shutler, 1969:163;	10		1.6	1			
1	Panguine Creek	ALK	microblades 8.6-7k "younger postglacial variant of Denali Complex", plot in Nenana Valley	Powers and Hoffecker, 1989:276	3		3.0	1			
1	Parkhill	ONT	Fluted point site Anderson et al., 1990:52	MacDonald, 1983:107 Shutler, 1983 site list (:221-222)	1		1.6				1.2
1	Parkhill (west)		no dates, Agate Hell Gap like :99 SASKATCHEWAN	Bryan, 1980 pp 104	2		2.0	1			1.2
1	Parrish Village	KY	Fluted with archaic, transition cf Anderson 1990: "most prominent" Clovis (n=7), then Kirk like?	Webb, 1951 in Wormington, 1964:66-7 Sellards, 1952:119-146; Anderson et al., 1990:52; Rolingson and Schwartz, 1966 Willey, 1966 fig 2.2	1		1.1	1			
1	Pasquotank	NC	Fluted (5), 29 tools, surface,	Brennan, 1982:35; Rule, 1983:227 = lithics studied	1		1.6				
x	Patrick	TN	Kirk site in KY	Chapman, 1977	3						
1	Pauma Valley	CA	ca 8k crescents, leaf pts, millingstones	Wallace, 1978:26	3		2.0				

Table B.02 Sites Gathered from Background Research - Inventory

1	Pavo Real (41 BX 52)	TX	Clovis, Folsom, blades, AKA "Leon Creek" Henderson and Goode, 1991 CRP 8:27-28	Bonnichsen et al., 1987; West, 1983	1		1.2			1	
1	Paw Paw Cove	MD	fluted points and tools, no dates	Lowry, 1989; 1990 CRP 7:29	1		1.6				
1	Payne	OHIO	one of 11 in Lucas county - Hi-Lo complex	Stothers and Abel, 1991:207-8	1		4.1				
1	Pelland Blade Cache	MINN	prismatic blades	Stoltman, 1971	1		1.1			1	
1	Pelly Farm	Yukon	?microblades 8.5K?:101	Bryan, 1980 pp 104	3		3.0				
1	Perry Ranch	OK	7.030(190)(tx2190) Plainview, bison kill	Thurmond, 1990 PA 35-131	4	1	4.3				
1	Petree	TX	Golondrina, Meserve, Plainview	Thurmond, 1990 PA 35-131	1		1.3	1			
1	Phillips Spring	MO	stratified, much c14 for Sedalia phase (3.4-4k)	Kay, 1983:50	4						
1	Phinizy Swamp	GA	Bolen, or Taylor 8.953(51)(not given)	Anderson et al., 1992:251	2		4.4				
1	Pickwick Lake	MISS	page 52	Anderson et al., 1990:52	xx		xx				
1	Pierce	TN	excavated, Clovis(8), Cumberland(1); "plano"(7); Plano = Plainview / Angostura	Anderson et al., 1990:52; Broster, 1982; Broster, 1989 CRP ; Anderson, '90:193	1		1.1	1			
1	Pig	OHIO	one of 11 in Lucas County - Hi-Lo complex	Stothers and Abel, 1991:207-8	1		4.1				
1	Pig Pen	GA	:28 fluted lance nipple Dalton early archaic	Anderson et al., 1990:11	1		1.3				
x	Pigeon Cliffs	NM	fluted Clovis (Meserve), under 8k but with mano metates, Steen, on cards,	Stewart and Gauthier, 1981:295	1		1.3	1			
1	Pigeon Roost	MO	8.500(220)(Tx3289), Dalton, "Dalton preforms"; "Big Sandy"; Kirk stemmed "Hardin"	O'Brien and Warren, 1983:81	1	1	1.3				
1	Pilot Knob Valley	CA	isolated fluted point locale	Wallace, 1978:26	10		1.6				
1	Pine Spring	WY	9.6k + 11.8k (problems) like birch creek, Haskett 9.6k, camel (?), bison, some like Plainview and McLean, open site, levels:93 9.6k "Plano" early early date as well:23	Bryan, 1980 pp 104 Frison, 1978: 29	2	1	2.0	1			

Table B.02 Sites Gathered from Background Research - Inventory

1	Pine Tree	AL	Clovis, Cumberland, Beaver Lake, Quad, Big Sandy (cf Cambron and Hulse, 1964)	Cambron, 1959; Walthal, 1980:31 Anderson et al., 1990:52	1		1.1	1			
1	Pink Mountain	BC	fluted w/microblades, Scottsbluff, etc.	Bonnichsen and Turnmire, 1991	1		1.6	1			
1	Pinto Basin	CA	pinto points, grinding stones, similar to Ventana canyon ca 5k Moratto 1984:410 Pinto points, Stemmed points isolated fluted points, "period III"	Wormington, 1964:165 Carlson, 1983:77 "Stemmed Point" Willey, 1966 fig 2.2 ; Sellards, 1952:119-146; Wallace, 1978:26	1		1.6	1			
1	Piping Rock	NY	paleo, early archaic, surface location? fluted, Lecroy bifurcated, Kanawha, MacCorkle	Brennan, 1977; Stothers and Abel, 1991	1		1.6	1			2
1	Plainview	TX	Meserve, Plainview Suwannee looking point unfluted Folsoms - bison	Willey, 1966 fig 2.2 ; Sellards, 1952:119-146; Wormington, 1964 Thurmond, 1990 PA 35-131	1		4.3	1			
1	Plano Nuevo Leon	MEX	Plano surface find, Nuevo Leon - locality	MacNeish, 1983:127	xx		xx				
1	Plano Tlaxcala	MEX	Plano surface find, Tlaxcala - locality	MacNeish, 1983:127	xx		xx				
1	Playa	CA		Carlson, 1983:77 "Stemmed Point"	xx		xx				
1	Pleasant Lake	WISC	poss man/mastodon site		1		6.0				
1	Plenge	NJ	v. large fluted point site additional eastern sites = lithics studied cf. Dincauze, 1993	Kraft, 1977; Funk, 1978; Doyle et al., 1985; Rule, 1983:227; Anderson et al., 1990:52; MacDonald, 1983:107 West, 1983; Shutler, 1983 (:221-222)	1		1.6	1			
1	Plymouth/Wareham/Ponkapoag	MA		Doyle et al., 1985	xx		xx				
1	Pomme de Terre	MO	Koch	Sellards, 1952:119-146	xx		xx				
1	Pond	OHIO	one of 11 in Lucas county - Hi-Lo complex	Stothers and Abel, 1991:207-8	1		4.1				
1	Poplar	MISS	Dalton, cf McGahey, 1992:312	Smith, 1986:8	1		1.3				
1	Port Mobil	NJ	Fluted Point Sites cf Funk 1977:323 "hunting camp" additional eastern sites	Funk, 1978; Rule, 1983:227;= lithics studied	1		1.6				

Table B.02 Sites Gathered from Background Research - Inventory

1	Powars	COLO	Folsom, cf Ingbar, 1992:171, Kersey Terrace	Wormington, 1964:39	1		1.2				
1	Pozo Valdez	SONA	fluted point locale	Ortiz, 1974 pp25	10		1.6				
1	Promontory Cave	UT	leaf point, pinto point	Wormington, 1964:197	3		2.0	1			
1	Pumpkin Creek	OK	surface: Meserve (Dalton), Plainview,"Greenbriar or Golondrina", notched;	Thurmond, 1990 PA 35-131 Wyckoff and Taylor, 1971	1		1.3	1			
1	Punta Blanca (Guaymas)	SON	isolated fluted point locale cf Di Peso, 1955 Clovis, Guaymas, Sonora "Llano-Cordilleran"	Ortiz, 1974 pp25; cNeish, 1983:127 Wormington, 1964:84	1		1.6				
1	Putu	ALK	Blade Beringian "Lower Terrace" 11k soil date not associated. Haskett/Hell Gap like with the fluted:101	Bonnichsen et al., 1987; Clark, 1991:37; 1984:69; Carlson, 1983:92 Bryan, 1980 pp 104; West, 1983	1		1.6	1			
1	Quaco Head	NB	Debert like paleo	Bonnichsen and Turnmire, 1991 site list	1		1.5				
1	Quad	AL	Clovis, Cumberland, Beaver Lake, Quad, Big Sandy: paleo and Archaic, mixed Wheeler, Dalton Quadand Big Sandy I points in Cambron and Hulse 1964:-10	Wormington, 1964:72 Willey, 1966 fig 2.2 Walthal, 1980:31 Anderson et al., 1990:52	1		1.1	1			
1	Quatsino	BC	Pebble Tool	Carlson, 1983:87	xx		xx				
1	Quiche		GUATEMALA Clovis locality, pp 239	Ranere and Cooke, 1991	10		1.1				
1	Quince Site	OK	Dalton+Plainview, Dalton adze, no dates	Perttula, 1985 CRP 2:25	1		1.3	1			
1	R-6	NM	Scottsbluff	Thurmond, 1990 PA 35-131	3		4.9				
1	Raddatz R.S.	WISC	Early Archaic?, 5k ca, side notched points	Cleland, 1966 in Funk, 1978	4						
1	Rae's Creek	GA	Kirk, Dalton? 9.060(110)(Beta-35235) (also dates of 7.5&8.37)	Anderson et al., 1992:251	3		4.8				
1	Rancho Colerado	MEX	Clovis Rancho Colerado, Chihuahua, "Llano-Cordilleran" - locality	MacNeish, 1983:127	10		1.1	1			

Table B.02 Sites Gathered from Background Research - Inventory

1	Rancho Weicker	MEX	fluted point, Durango "Llano-Cordilleran" - locality	MacNeish, 1983:127	10		1.6				
1	Rangley Lakes	ME		Doyle et al., 1985	xx		xx				
1	Rappuhn	MI	poss man / Mastodon site		1		6.0				
1	Rattlesnake Pass	WY	9.950(150) (tx6304) 9.770 (150) (tx6305) Folsom	Davis et al., 1991 CRP :19	1	1	1.2				
1	Ray Long	SD	"lanceolate" Angostura like points over Agate Basin; 9.380(500)(M-370)	Wormington, 1964:152; Frison, 1978: 29; Bonnichsen et al., 1987; Shutler, 1983 site list (:221-222) Roberts, 1961 in Bryan,1980:95:104	2	1	4.7				
1	Reagen / John's Bridge	VT	Fluted workshop Surface expression = 47 fluted points	Willey, 1966 fig 2.2; Doyle et al., 1985; West, 1983; Funk, 1978 Wormington, 1964 Anderson et al., 1990:52	1		1.6				3
1	Red Creek	NY	no date, late paleo.	Funk and Schambach, 1964 in Doyle et al., 1985	2		xx				
1	Red Hill Site	AL	Dalton - Red Hill Phase	Walthal, 1980:47	1		1.3				
1	Red Smoke Site	NB	8.862(230) x2avg, multicomponent: Plainvie w/ Dalton listed as having red ocher	cf Davis 1953 in Wormington, 1964 Roper, 1991:294	1	1	1.3	1			
1	Redfish R.S.	ID	"lanceolate"; Intermountane 9860 (480) (WSU1395) on cache of Haskett points 10.1-8.7k Western Stemmed 10.1 (300) (WSU-1396) preform cache w/ Haskett @ 9.860(300)(WSU-1395),	Bonnichsen et al., 1987:418 Willig and Aikens, 1988:13-15 Bryan, 1980 pp 104	1	1	2.0	1			
1	Renier	WISC	Mason & Irwin 1960, side notched point as well Scottsbluff cremation	Doyle et al., 1985 Funk, 1978	3		4.9				
1	Reno	NV	fluted point locality fluted (6 pts in Davis and Shutler, 69)	Carlson, 1983:84 Fluted Points Davis and Shutler, 1969:163 Nevada	1		1.6				

Table B.02 Sites Gathered from Background Research - Inventory

1	Rex Rodgers	TX	9.3k Plainview, San Patrice Folsom @ 9.180(80)(SMU-274) San Patrice, Plainview listed as western Clovis in Rule	Thurmond, 1990 PA 35-131 Johnson and Holiday, 1985 CRP :22 Rule, 1983:21; Willey et al., 1978	1	1	1.2	1			
1	Reynolds Creek	ID	Folsom - locality	Titimus and Woods, 1991	10		1.2				
1	Richey-Roberts cache	WA	"cache" Clovis - Western	Meringher, 1989; 1990 Willig and Aikens, 1988:18	1		1.6			1	4.3
1	Richmond	VA	additional eastern sites = lithics studied	Rule, 1983:227:22	xx		xx				
1	Richmond Hill / Ward's Point	NJ	9.3k Kirk Funk, 1984:87 also early-early for Doyle et al..; Kirks and bifurcates	Doyle et al., 1985	2	1	4.8	1			
1	Rio Grande Sites		(Comanche Springs)		xx		xx				
1	Rio Rancho	NM	Folsom - ped	Bonnichsen et al., 1987	1		1.2				
x	Roach Site	KY	Quad, Dalton, archaic points, Mississippian	Rolingson and Schwartz, 1966	1		1.3	1			
1	Roberts	ID	Folsom - locality	Titimus and Woods, 1991	10		1.2				
1	Rock Chuck Ridge	ID	Folsom - locality	Titimus and Woods, 1991	10		1.2				
1	Rock House Shelter	AL	Cumberland and Dalton R.S.	Walthal, 1980:31, 48 Anderson et al., 1990:52	1		1.3				
1	Rockelein	NJ	8.2k bifurcates and Kirk corner notched; 8.2k ca bifurcate, 5.3 Morrow Mtn.	Dumont, 1974 in Funk, 1978	2	1	4.8	1			
1	Rockingham County	NH	late paleo, lanceolate, locality	Doyle et al., 1985	2		xx				
1	Rodgers R.S.	MO	fluted, Dalton, Plainview, cf Chapman, 1975' 10.530(650)(ISGS-48)&10.200(330)(M-233) in Goodyear, 1992 = avg 10.365(300)(mf avg)	Haynes, 1991 Chapman, 1975 Smith, 1986:8 Bonnichsen et al., 1987:418	1	1	1.3	1			

Table B.02 Sites Gathered from Background Research - Inventory

1	Rose Island	TN	9.4k on Stratified, Kirk, bifurcates	Stothers and Abel, 1991:213; see Chapman, 1985 for refs Anderson et al., 1990:11	2	1	4.8	1			
1	Rucker's Btm. (Russell Res.(9eb91))	GA	excavated sites, 12-8k SE() Fluted, Clovis, Palmer Clovis, palmer, Hardaway,	Smith, 1986:8 Anderson et al., 1990:11:52 Anderson and Hanson, 1988:274	1		1.1	1			2
x	Rummels - Maske cache	IO	cache in Roper, 1991:292	Roper, 1991:292	1		1.6				
1	Russ /Johnsen	NY	8k(avg3) on Neville, Kanawha, Kirk pts at Russ, dates earlier at Johnsen (up to 9.6k on Kirk like points)	Funk, 1978; cf Funk '84:83 (AENA)	2	1	4.8	1			
1	Russell Cave	AL	Dalton, Big Sandy, lanceolates at base - multicomponent , excavated sites, 12-8k Clovis, Dalton, palmer Kirk, cf Anderson 90:201 transition from paleo to archaic	Wormington, 1964; Walthal, 1980:42, 48; Willey, 1966 fig 2.2 Smith, 1986:8; Anderson et al., 1990:11	1		1.3	1	1		
1	Russell Springs	KS	Logan County - 1885 bison/man association	Sellards, 1952:47	1		6.0				
1	Ryan's Site	TX	ca 10k Plainview CACHE Midland, Plainview	Johnson, et al. CRP 1987; Hartwell et al., 1989:15 Thurmond, 1990 PA 35-131	1		4.3	1		1	
1	Rye Grass Coulee	WA	6.480(80)(UW113) microblades	Clark, 1991:37; 1984:69; Dumond, 1980:986	4	1	3.0				
1	Sacapulas		Clovis locality GUATEMALA	Ranere and Cooke, 1991	10		1.6				
1	Sadmat	NV	no dates, Hasketts, and "hascomats" "Stemmed Point"	Carlson, 1983:77	2		2.0				
1	Saint Anne des Monts	ONT	(St. Anne)	MacDonald, 1983:107	xx		xx				
1	Samuels Field	MICH		Funk, 1978	xx		xx				
1	Samwell Cave	CA	isolated fluted point locality chipped lava ?	Wallace, 1978:26 Sellards, 1952:119-146	10		1.6				

Table B.02 Sites Gathered from Background Research - Inventory

1	San Diego Co. coast	CA	(La Jolla) "period II"	Wallace, 1978:26 Stanford, 1983:66	xx		xx				
1	San Dieguito R.	CA	ca 9k = C.W. Harris site?	Wallace, 1978:26	2		2.0				
1	San Isidro	MEX	Lerma, planoid, Nueva Leon (?); Early-Early "Stage 1" planoid-cordilleran, "stage 4"	Shutler, 1983; MacNeish 1986:127, 128	1		2.0				
1	San Joaquin	BAJA	isolated fluted point locale Clovis, "Llano-Cordilleran" - locality	Wormington, 1964:84 MacNeish, 1983:127	10		1.1				
1	San Jon	NM	Folsom, Scottsbluff, portales complex, Scottsbluff like San Jon points	Willey, 1966 fig 2.2 ; Sellards, 1952:119-146; Wormington, 1964:113:122 Roberts, 1942 in Wormington	1		1.2	1			
1	San Jose de Pimas	SONA	fluted point locale	Ortiz, 1974: pp25	10		1.6				
1	San Marcos	MEX	Clovis Point, San Marcos, Jalisco "Llano-Cordilleran" - locality	MacNeish, 1983:127	10		1.6				
1	San Nicolas Cave	MEX	Lerma, burins, blades, snub scrapers planoid-cordilleran, Queretaro "stage4"	Shutler, 1983 MacNeish; 1983:127-128,	1		2.0			1	
1	San Raphael		waisted Clovis (Suwannee?) locality, Fishtail Trad - locality GUATEMALA	Ranere and Cooke, 1991 pp 239 Coe, 1960; MacNeish, 1983:127	10		1.7				
1	San Sebastian	MEX	Clovis Point, San Sebastian, Jalisco "Llano-Cordilleran" - locality	MacNeish, 1983:127	10		1.1				
1	Sand Hill	Belize	Fishtail Trad ("lowest")	MacNeish, 1983:127	1		1.7				
1	Sandia Cave	NM	"Sandia Mountain" Sandia points Western (Clovis) Paleoindian sites Fluted	Sellards, 1952:119-146; Wormington, 1964; Willey, 1966 fig 2.2; Rule, 1983:21; West, 1983	1	1	1.6				
1	Sandy Ridge	ONT	Gainey complex site	Jackson, 1990 CRP 7:23	1		1.4				
1	Sandy Springs	OHIO	fluted points; cf Meltzer, 1988:9	Anderson et al., 1990:52	1		1.6				
1	Santa Barbara Co. Coast	CA	(Oak Grove), "period II" <5k	Wallace, 1978:26 Moratto 84:124	4						

Table B.02 Sites Gathered from Background Research - Inventory

1	Santa Isabel Itzapan	MEX	blades, weird point, Lerma points Iztapan mammoth Kill Fluted (incorrect?) 9.9k, planoid-cordilleran, "stage 4" "lanceolate" with extinct fauna	Wormington, 1964 Shutler, 1983 site list (:221-222) West, 1983 MacNeish, 1983:127 Bonnichsen et al., 1987	1	1	2.0			1	
1	Santa Marta R.S.	MEX	early-early? Early-Early "Stage 2" 9.3k dated leaf shaped points, Ranere&Cooke 1991:240	Shutler, 1983 MacNeish, 1983:127 Bonnichsen and Turnmire, 1991 site list	2		2.0				
1	Santa Rosa Island	CA	old dates, burials sitting position 7k? initial Early-early claims Arlington Springs or Canyon: 10.00(200)(L650); 10.000(310)(UCLA-1899 on bone); 10.4(2000)(L-568A) on skeletal, Santa rosa Island. no artifacts see Erlandson and Moss, 1994	Wormington, 1964 Willey, 1966 fig 2.2; Willig and Aikens, 1988:7; Wallace, 1978:26 Haynes, 1967:269; Stanford, 1983:66; see Moratto 1984 for more Shutler, 1983 site list (:221-222) West, 1983	1	1	4.0		1		
1	Sasabee	SONA	spurred end scraper locale	Ortiz, 1974: pp25	10		1.6				
1	Satchell	MICH	late paleo, cf Funk, 1978, Storck, 1977:79 late paleo, complex, plano points?:18-9	Doyle et al., 1985 Funk, 1978	2		2.0				
1	Sauk Valley (skeletal)	MINN	skeletal no artifacts? Skeletal - gravel pit	Sellards, 1952:119-146 Wormington, 1964:237-8	1		NA		1		
1	Savanah River Plant Site	SC	paleo- E. Archaic Anderson, 1990:201, Hanson et al., 1978	Anderson et al., 1990	1		1.6	1			
1	Sawmill Site	OHIO	Plano, 100 pts Collected= Agate Basin, Angostura like, Hell Gap	Doyle et al., 1985; Mason, 1981 Stothers and Abel, 1991:211	1		2.0	1			
1	Schaldack Mammoth	AZ	Poss man / Mammoth association	Haynes, 1987a	1		6.0				
1	Schiffer Cave	WY	8.4 ca Pryor Stemmed	Shutler, 1983 site list (:221-222) Frison, 1978: 29	3	1	4.0				

Table B.02 Sites Gathered from Background Research - Inventory

1	Scottsbluff Bison Quarry	NE	stemmed, notched, concave based probably early plains archaic but listed in "Archaeological Sites of the Paleoindian Period"	Sellards, 1952:119-146 Wormington, 1964 Frison, 1978: 29 Willey, 1966 fig 2.2	4		4.9	1			
1	Sebago Basin	ME		Doyle et al., 1985	xx		xx				
1	Selby	COLO	Early Early	West, 1983; Shutler, 1983; Sanford 1983:66	A		9.0				
1	Seminoe Beach	WY	"lanceolate"; Hell Gap - habitation:417	Bonnichsen et al., 1987	2		2.0				
1	Senator Edwards	FLA	excavated sites, 12-8k SE () central base camp settlements, Bolen, Kirk, and mid archaic points	Smith, 1986:8 Milanich, 1994 cf. Purdy, 1981 for primary refs	1		4.4	1			
1	Sevier Desert	UT	Western Stemmed 9.570(430(Beta-12987); 7.930(110)(Beta-12988	Willig and Aikens, 1988:13-15	2	1	2.0				
1	Shafer	NY	6k ca early Laurentian, cf Funk, 1977	Funk, 1978	4						
1	Shawnee - Minisink	PA	Eastern Paleoindian Sites "Eastern Fluted" - dated 10.670(270)(avg2 cf Haynes, 1984&McNett 1985 take out 2 extremes = archaic site Funk, 1977:326	Doyle et al., 1985; Rule, 1983:22 Bonnichsen et al., 1987 Anderson et al., 1990:52 MacDonald, 1983:107; West, 1983 Shutler, 1983(:221-222);Funk, 1978	1	1	1.1	1			
x	Sheaman (=Agate Basin)	WY	Agate Basin Locality = fluted point and ivory foreshaft, fluted point pressure flaked like Goshen or Clovis, ocher stained bones also	Frison, 1991:147 Roper, 1991:292	1		1.6	1			
1	Sheep R.S.	PA	7k ca Kirk	Funk, 1978 Doyle et al., 1985	3		4.8				
1	Sheguiandah (Manitoulin Island)	ONT	early early site initially, Plano artifacts below 9k date, 9.130 (250), late paleo (plano? Eden Scottsbluff w/notched?)	Wormington, 1964:206; West, 1983 Doyle et al., 1985 Lee, 1954,55 in Doyle et al.. 1985 Funk, 1978 Julig et al., 1991 CRP 8:111	2		4.9				
1	Sheldon Mastodon Site	MICH	9.640(120)(Beta10302) Kessell Side notched above fauna	Shoshani et al. CRP 6 1989:24-25	2	1	4.0				

Table B.02 Sites Gathered from Background Research - Inventory

1	Shell Mounds	AL	several locations from site s	Walthal, 1980:39	4		xx				
1	Shields Branch	ME	no dates, late paleo, "plano"?	Doyle et al., 1985	2		2.0				
1	Shifting Sands	TX	Folsom, Midland cf Haynes ms 1993	Hofman, 1992:210 Stanford and Day, 1992 frontispiece	1		1.2	1	1		
1	Shishmaref	ALK	isolated fluted point locale	Clark, 1991:37; 1984:69	10		1.6				
1	Shoop	PA	workshop "Enterline" Witthoft's's work Fluted Point Sites Eastern Paleoindian Sites "habitation" "Gainey like" cf Gramly 88:266	Wormington, 1964:67-8Willey, 1966 fig 2.2; Funk, 1978; Rule, 1983:22; MacDonald, 1983:107 West, 1983; Shutler, 1983 site list (:221-222); Anderson et al., 1990:52	1		1.6			1	
1	Shoup Site	ID	Western Stemmed Windust points, same as Beta R.S.?:88 8.175(230)(WSU-402) Windust phase	Willig and Aikens, 1988:13-15 Carlson, 1983:77 "Stemmed Point" Bryan, 1980 pp 104	3	1	2.0				
1	Shriver	MO	Early Early lithics in strata under Clovis	West, 1983; Stanford, 1983:66 Shutler, 1983 site list (:221-222) MacDonald, 1983:107	1		1.1	1			
1	Sibbald Creek	ALB	Gryba 1985:15 multiple component Cody complex. Midland?, lanceolate, Mt. Albion 9.57k fluted w/ Midland Gryba 1983 in Carlson 1991:82 listed as having red ocher	Carlson, 1983:84 Fluted Points Bonnichsen et al., 1987 Roper, 1991:294	1		1.6	1			
x	Signal Butte	NB		Sellards, 1952:119-146	xx		xx				
1	Silktassel	AZ	Clovis from excavated contexts	Huckell, 1982	1		1.1				
x	Silver Lake	OR		Sellards, 1952:119-146	xx		xx				
1	Silver Springs	FLA	Fluted points (Clovis) found in strata with Suwannee cf Milanich, 1994 Underwater component = Hoffman, 1983	Anderson et al., 1990:11; Hemmings, 1975; Neil, 1958; Willey, 1966 fig 2.2 Milanich and Fairbanks 1980:36 Daniel and Wisenbaker 1987:146; Anderson et al., 1990:52	1		1.6	1			1.2

Table B.02 Sites Gathered from Background Research - Inventory

1	Simon	ID	fluted point locality = Clovis "Northern Fluted"	Carlson, 1983:84 Fluted Points Titimus and Woods, 1991 Bonnichsen et al., 1987	1		1.6			1	4
1	Simonsen	IO	Bison kill, corner notched points @8430(520) side notched,	Kreiger, 1964 Willey, 1966 fig 2.2	3	1	4.0				
1	Simpson's Field	GA	Classic Clovis = Russell Res (38AN8)	Anderson et al., 1990:11:52	1		1.1				
1	Sister's Hill	WY	9.650(250)(I-221) Hell Gap 9.6k (2dates) Hell Gap pts "lanceolate"; habitation:417	Haynes and Grey, 1965 1st dates:96 Bryan, 1980 pp 104; Frison, 1978: 29; Bonnichsen et al., 1987	2	1	2.0				
1	Site (41 CX 12)	TX	Plainview rock shelter	Thurmond, 1990 PA 35-131	2		4.3				
1	Site (42Md300)	UT	10.4k-7.7k C14 Simms - Folsom lithic scatter	Copeland and Fike, 1988	1	1	1.2				
1	Site 36 LA 336	PA	Fluted point site - with archaic items also (2 fluted points)	Custer and Smoker, 1987 CRP:							
1	Site 40 WM 32 Williamson county	TN	Dalton (7), Big Sandy (328), Kirk (155), bifurcates (7) unifacial scrapers (6251) artifacts, 2335 pts all told	Lindstrom, B. 1979 An archaic site in Mid. Tenn. Tenn Archaic v. 35:15-42	1		1.3	1			
1	Site 41 RN 129	TX	Folsom	Hofman, 1992:210	1		1.2				
1	Site 45 OK 49	WA	"Stemmed Point"	Carlson, 1983:77;79	xx		2.0				
1	Site 45 OK 58a	WA	Stemmed	Carlson, 1983:77;79	xx		2.0				
1	Site 48 JO 303	WY	7.8k Pryor stemmed:23	Frison, 1978: 29	4	1	4.0				
1	Site 9 MC 141	GA	Paleo or E. Archaic	Anderson et al., 1990:11	xx		xx				
1	Site 9 OC 30	GA	Paleo or E. Archaic	Anderson et al., 1990:11	xx		xx				
1	Site 9 ge 309	GA	Clovis, Dalton, Big Sandy, Kirk, bifurcate :35,	Anderson et al., 1990:11 cf Anderson et al. 1992:250	1		1.1	1			
1	Site 9 ge 534	GA	Fluted point:37	Anderson et al., 1990:11	1		1.1				

Table B.02 Sites Gathered from Background Research - Inventory

x	Site CA-MNO-473	CA	Great Basin Western Stemmed with hydration dates in 8k range, surface assemblage by lake margins	Hall, 1991 CRP 8:22-24	3		2.0				
x	Site CA-MNO-474	CA	Great Basin concave base or western Clovis, surface with hydration rates	Hall, 1991 CRP:22-24	xx		1.6				
1	Site Deception	OHIO	one of 11 in Lucas County - Hi-Lo complex ped as a single location	Stothers and Abel, 1991:207-8	1		4.1				
1	Skoglund's Landing	BC	Pebble Tool	Carlson, 1983:87	xx		4.0				
1	Skull Creek Dune	OR	concave lanceolates below Mazama, 2.3k Gate Cliff like bifurcates	Homer, 1986	4		4.0				
1	Sloan	AR	Dalton:418, cf Morse, 1975 excavated sites, 12-8k SE()	Bonnichsen et al., 1987; Smith, 1986:8; Anderson et al., 1990:52	1		1.3				4
1	Smith Creek Cave	NV	"Stemmed Point"6 dates, plus more later on 11-10k Mt. Moriah pts:83 "lanceolate", InterMtn. ... Western Stemmed >10k	Sellards, 1952:119-146; Bryan, 1980 pp 104; Carlson, 1983:77 Homer, 1986; Bonnichsen et al., 1987:418; Willig and Aikens, 1988:13-15 cf. Byran, 1991	1	1	2.0	1			
1	Smith's Lk. Crk.	GA		Anderson et al., 1990:11	xx		xx				
x	Sorenson	WY	listed as having red ocher	Roper, 1991:294 Husted, 1969 in Roper	xx		xx				
1	Souris	PEI	late paleo?	MacDonald, 1983:107	xx		xx				
1	South Yale		(Pasika)		xx		xx				
1	South of Juniper	ID	Folsom locality	Titimus and Woods, 1991	10		1.2				
1	Southsider Cave	WY	no clear diagnostics late paleo - 9.360(230)(RL-665) concave etc	Frison, 1978: 29 Shutler, 1983 site list (:221-222)	2		4.0				
1	Spring Lake	TX	Clovis, Folsom, San Patrice, Dalton, Golondrina, Plainview, Angostura like, Mammoth, Bison, Mastodon	Takac, 1991 CRP 8:46-47	1		1.1	1			

Table B.02 Sites Gathered from Background Research - Inventory

1	Squaw R.S.	OHIO	9.480 (160); burial, plano / Kirk together 9-8k archaic stratified, 7.5k on small bifurcates w/ Morrow Mtn..	Mason, 1981; Doyle et al., 1985 Rackerby, 1977 in Doyle et al. 1985, Stothers and Abel, 1991:211	2	1	4.8		1			
1	St. Albans	WVA	9850 (500) () Kirk, bifurcates excavated sites, radiocarbon 9.8k onward	Funk, 1978; Shutler, 1983; Broyles, 1971; Smith, 1986:8; Doyle et al., 1985	2	1	4.8	1				
1	St. Mary's Hall	TX	Plainview, archaic above	Hester, 1990 CRP 7:14	2		4.3					
1	Stahl Site	CA	8k-6k type site for Pinto, Lake Mohave, Silver Lake, milling stones	Wormington, 1964 Homer 1986:97;	3		2.0	1				
1	Stampede	ALB	7.4k side notched, stratified:98	Bryan, 1980 pp 104	4	1	4.0	1				
1	Standing Boy	GA	Big Sandy, Dalton maybe	Anderson et al., 1992:250	1		4.4					
1	Stanfield - Worley R.S.	AL	excavated sites, Quad @ bottom, Dalton Zone D, big sandy, Greenbriar, Kirk	Smith, 1986:8; Anderson et al., 1990:52; Walthal, 1980:31, 48 Willey, 1966 fig 2.2	1		1.8	1	1			
1	Stanford Skull	CA	Skeletal in gravel stratum CA	Wormington, 1964:230	xx		xx		1			
1	Starved Rock	IL	no dates Archaic w / notched and other pts,	Mayer-Oakes, 1951 in Kreiger; 1964	4		4.0	1				
1	Steadman (OH)	OHIO	one of 11 in Lucas County - Hi-Lo complex	Stothers and Abel, 1991:207-8	1		4.1					
1	Steadman (TX)	TX	Fisher county TX, San Patrice site	Hester and Newcomb, 1990 CRP 7:18	1		4.2					
1	Stone Mountain	GA	excavated sites, 12-8k SE()	Smith, 1986:8	xx		xx					
1	Stone Pipe	AL	Clovis, Cumberland, Beaver Lake, Quad, Big Sandy	Walthal, 1980:31 Anderson et al., 1990:52	1		1.1	1				
1	Stone Valley	CA	"period III"	Wallace, 1978:26	4							
1	Stoneham	COLO	"Northern Fluted" - ped	Bonnichsen et al., 1987	1		1.6					
1	Stoney Creek	BC	no date, surface, Windust like "Stemmed Point" Windust-like	Carlson, 1983:77 :81	1		2.0					
1	Storm Creek	ALK	(MIS-215) no date, fluted point - locality	Clark, 1991:37; 1984:69	10		1.6					
1	Stringtown	OHIO		Doyle et al., 1985	xx		xx					

Table B.02 Sites Gathered from Background Research - Inventory

1	Strohacker	TX	Angostura, Golondrina, Plainview	Thurmond, 1990 PA 35-131	2		4.3	1			
1	Sudden R.S.	UT	>6k Pinto pts, concave based lanceolates, early (Humboldt) & late (McKean), Elko x2, Elko side notched	Homer, 1986	4		4.0	1			
1	Sulfur Springs	AZ	= Double Adobe (9k Waters, 1986	Sellards, 1952:119-146 see Berry and Berry, 1986	2		4.0				
x	Sunnyvale Early man	CA	mid Holocene age cf Taylor et al. 1985	Shutler, 1983 site list (:221-222) cf. Moratto, 1984	xx		xx				
1	Sunshine Locality	NV	fluted, cf Davis and Shutler, 1969	Bonnichsen and Turnmire, 1991 site list Willig and Aikens, 1988	1		1.6				
1	Sutter	KS	Frederick / McKean	Katz, 1971	4		4.0	1			
1	Swallow R.S.	UT	5.5-2k bifurcate Gate Cliff like	Homer, 1986	4	1	4.0	1			
1	Sylvan Lake	NY	6.5-6k ca, Neville, Otter creek, side notched, cf Funk, 1978:91, Funk, 1977	Funk, 1978	4	1	4.0	1			
	Taber Child	ALB	Early Early	West, 1983 Shutler, 1983 site list (:221-222)	A		9.0				
1	Tamaulipas	MEX	"Lerma" 9 complexes cf MacNeish, 1986	Wormington, 1964:202; Willey, 1966 fig 2.2 Shutler, 1983 (:221-222)	2		2.0				
1	Tamaulipas (Diablo Cave)	MEX	Early-Early "Stage 2" 9.3k, "planoid-cordilleran", layer 4&5, Taumalipas "Stage 4" (Diablo Complex)	MacNeish, 1983:127	2		2.0				
1	Tamaulipas (La Perra Cave)	MEX	planoid-cordilleran, Layers 4,5, Tmc174, "Stage 4"	MacNeish, 1983:127	2		2.0				
1	Tamaulipas (La Perra)	MEX	"Stage 3" TMC 174	MacNeish, 1983:127	2		2.0				
1	Tamaulipas surface site 305	MEX	planoid-cordilleran, Tamaulipas surface site 305, "stage 4" - locality	MacNeish, 1983:127	2		2.0				
1	Tampa Bay	FLA	Several paleo and E. Archaic sites	Anderson et al., 1990:52	1		1.3	1			

Table B.02 Sites Gathered from Background Research - Inventory

1	Tangle Lakes	ALK	10k - Blade (Denali complex West)	Bonnichsen et al., 1987 Clark, 1991:37; 1984:69	1		3.0				
1	Tastiota	SON	fluted point locale	Ortiz, 1974 pp25	10		1.6				
1	Taunton Basin	NY	Early Archaic, bifurcates	Dincauze and Mulholland, 1977	2		4.8	1			
1	Taylor	SC	"major early archaic assemblage" Hardaway, Greenbriar (Michie calls "Dalton") also Palmer points, also wedges, Dalton adze	Anderson and Hanson, 1988 Anderson et al., 1990:11:52; Michie, 1992	1		4.6	1			
1	Taylor Hill	GA	Clovis (also Dalton) Bolen palmer strat; Goodyear et al., 1990:20 record this as having Dalton also	Anderson et al., 1990:11:29	1		1.1	1			
1	Tehachapi Mts	CA	isolated single point locale	Wallace, 1978:26	10		1.6				
1	Tehuacan	MEX	(Ajuereado Components) blades, burins, leaf points "Stage 3"	Willey, 1966 fig 2.2 MacNeish, 1983:127	1		2.0				
1	Tehuacan (El Riego Cave)	MEX	layer 6, planoid-cordilleran, Tc35 "stage 4"	MacNeish, 1983:127	xx		2.0				
1	Tehuacan	MEX	(Ts 391,39,500)	MacNeish, 1983:127	xx		xx				
1	Tehuacan (late Ajuereado components)	MEX	Tc50 late Ajuereado components, Coxcatlan, Peubla	MacNeish, 1983:127	xx		xx				
1	Tehuacan	MEX	(surface components) planoid-cordilleran "7 surface components", "stage 4"	MacNeish, 1983:127	xx		2.0				
x	Tehuacan Fossil	MEX		Shutler, 1983 site list (:221-222)	xx		xx				
1	Teklanika Mammoth	ALK	(plotted at Teklanika River Sites)	Shutler, 1983 site list (:221-222) cf. Agenbroad et al. 1990	1		6.0				
1	Telanika River Sites	ALK	microblade sites	Powers and Hoffecker, 1989:273	xx		3.0				

Table B.02 Sites Gathered from Background Research - Inventory

1	Tellico	TN	several Early Archaic sites, deeply buried, lots of stuff = Bacon Farm, Rose Island, Icehouse Bottom, Calloway island	Smith, 1986:8	xx		xx	1			
1	Templeton (6LF21)	CT	Eastern Paleoindian Sites 80 artifacts, tools, miniature points, scrapers, hammerstone, spokeshave, debitage=1:9 10.190(300)(W-3931)	Rule, 1983:22; Anderson et al., 1990:52; MacDonald, 1983:107 Haynes et al., 1984; Doyle et al., 1985 Bonnichsen et al., 1987	1		1.6				1.2
1	Ten Mile Creek	OHIO	one of 11 in Lucas county - Hi-Lo complex	Stothers and Abel, 1991:207-8	1		4.1				
1	Tequixquiac Valley of Mexico	MEX	includes Iztapan, Texpexpan mid Holocene early early discounted (Lynch, 1990:16), poss. worked bone?	Wormington, 1964:201; Willey, 1966 fig 2.2 MacNeish, 1983:127	1		xx				
1	Tesaw Creek	AL	page 52	Anderson et al., 1990:52	xx		xx				
1	Teshekpuk Lake (TES-005)	ALK	fluted point locale - mixed contexts - locality-associated with microblades	Clark, 1991:37; 1984:69	10		1.6	1			
1	Teshekpuk Lake (TES-014)		fluted point locale - mixed contexts - locality-associated with microblades	Clark, 1991:37; 1984:69	10		1.6	1			
1	Texas Street La Jolla	CA	Early-early now discounted George Carter's work - San Diego	Wormington, 1964; Shutler, 1983 (:221-222); West, 1983; Willig and Aikens, 1988:6	A		9.0				
1	The Dalles	OR	fluted point locality	Carlson, 1983:84 Fluted Points	10		1.6				
1	Thedford	ONT	cache like Anzick? Storck 1991:158	Anderson et al., 1990:52	1		1.1				4.5
1	Theriault	GA	Clovis, Dalton - quarry excavated sites, 12-8k SE()	Brockington, 1971 in Anderson et al., 1990:11 ; Smith, 1986:8 ; Anderson et al., 1992; Anderson and Hanson, 1988	1		1.1	1			
1	Thompson's Island	ONT	late paleo / E. Archaic, cf Mason, 1980 notes Agate Basin & Eden below archaic	Doyle et al., 1985	2		2.0	1			
1	Thorn Thicket	WA	Stemmed Point	Carlson, 1983:77	xx		2.0				

Table B.02 Sites Gathered from Background Research - Inventory

1	Thunderbird	VA	Eastern Paleoindian Sites habitation Fluted points, stratigrphy, Early Archaic	Gardner, 1974; MacDonald, 1983:107; Rule, 1983:22; Shutler, 1983(:221-222) Anderson et al., 1990:52	1		1.1	1			
1	Tick Island	FLA	Early ceramics, mid Holocene	Milanich Fairbanks 80:36 Daniel and Wisenbaker 1987:146	4		4.0	1			
1	Tiefort Basin	CA	fluted, (4 pts Willig and Aikens, 88:17) isolated fluted point locale	Davis and Shutler, 1969:163 cf Moratto, 1984:87; Carlson, 1983:84; Wallace, 1978:26	1		1.6				
1	Timlin	NY	early-early	Shutler, 1983; MacDonald:107 West, 1983	1		1.6				
1	Tinajas Altas Mtns	AZ	packrat midden w/ evidence for drought not an arhcaoelogical site	Haynes, 1991	1		6.0				
1	Tlapacoya	MEX	Early Early proposals - Skeletal @ 9.9k?, assoc. w/extinct and early c14 "Stage 2" 9.25k, planoid-cordilleran, "stage 4"	West, 1983 Shutler, 1983 site list (:221-222) MacNeish, 1983:127	2		2.0		1		
1	Tombstone Bluff	TX	Angostura, Golondrina, Plainview, Scottsbluff - locality	Thurmond, 1990 PA35-131	2		4.3				
1	Tonopah Lake (also Mud Lk.)	NV	fluted (58 pts Willig and Aikens 88:17) Clovis - Wester "Stemmed Point"; "Fluted Point"	Davis and Shutler, 1969:163 Nevada Willig and Aikens, 1988:18 Carlson, 1983:77 :84; Haynes, 1991	1		1.6	1			
1	Topanga Cnyon	CA	"period III"	Wallace, 1978:26	4						
1	Torrington	WY	Skeletal "like Minnesota"	Wormington, 1964:236	xx		xx		1		
1	Tracer Lake				xx		xx				
1	Trail Creek	ALK	four occupations Angostura like 6k Beringian Microblade Blade, Cave 2 v.late Agate Basin like: 3.5-2.5k pp102 9k old date, caves, microblades, bone with slots(cf Chard 1974)	Wormington, 1964:212; Carlson, 1983:92; West, 1983 Bonnichsen et al., 1987; Bryan, 1980 pp 104 Clark, 1991:37; 1984:69; Dumond, 1980:986	2		3.0	1			
1	Trail Draw Site	SD	Alberta occupation	Tratebas, 1987 CRP:36	2		4.9				

Table B.02 Sites Gathered from Background Research - Inventory

1	Tranquility	CA	Skeletal - artifacts <5k w/olivella beads stemmed and concave pts, crystals, pestles	Wormington, 1964:231 Wallace, 1978:26	4		2.0	1	1			
1	Trenton	NJ		Sellards, 1952:119-146	xx		xx					
1	Tracer Lake				xx		xx					
1	Trilisa Pond	FLA	early archaic (Arredondo pts)	Milanich & Fairbanks 1980:36 Neil, 1964	2		4.4					
1	Trojan	PA	fluted point site	McCracken, R.J. 1986 CRP:13	1		1.6					
1	Tulare Lake (Witt Site)	CA	fluted (N=49 Willig and Aikens, 88:17), Lake Mohave, pinto Western (Clovis) Paleoindian sites fluted w/ extinct fauna fluted, Lake Mohave, Pinto, ElkoClovis age - human remains U/Th >10k	Davis and Shutler, 1969:163 Wallace and Riddell 1988:87-101 Rule, 1983:21; Wallace, 1978:26 Carlson, 1983:84Willig and Aikens, 1988:18; Haynes, 1991 Willig and Aikens, 1988	1	1	1.6	1				
1	Tule Lake	CA	11.450(340)(Beta-39545) no diagnostics	Beaton, 1991 CRP 8:5-6	1	1	xx					
1	Tule Springs	NV		Wormington, 1964 Willey, 1966 fig 2.2	xx		xx					
1	Turin	IO	8k? skeletal - red ocher, archaic point, cf Mason and Irwin 1960:47,	Wormington, 1964:247	3	1	4.0		1			
1	Turkey Swamp	NJ	8.7-7.6 "late paleo?"	Bonnichsen and Turnmire, 1991	3							
1	Turrialba		COSTA RICAFishtail Trad	MacNeish, 1983:127 Ranere and Cooke, 1991	1		1.7					
1	Turtlecrawl Point	FLA	excavated sites, 12-8k SE()	Smith, 1986:8 Goodyear et al. 1980	1		4.4					
1	Twelkemeier Site	TN	"Clovis preforms", Cumberland, Quad, Beaverlake	Broster and Norton, 1990 CRP 7:6-7	1		1.3	1				
1	Twelve Mile Creek	KS	First Folsom *in situ* 1895 10.340 (205) avg 2)	Rogers and Martin, 1984 (Am. Ant. 49(4):757-764)	1	1	1.2					
1	Twin Fields	NY	fluted, unifacial tools mixed with Late archaic	Twin Fields	1		1.6					

Table B.02 Sites Gathered from Background Research - Inventory

1	Tyron	PEI	Debert like Paleo	Bonnichsen and Turnmire, 1991	1		1.5				
1	Udora	ONT	Gainey, Crowfield, woodworking tools, exotic chert	Storck and Tomenchuck, 1991in Storck and Speiss, 1994	1		1.4				
1	Ugashik Narrows	ALK	"Blade" , microblade (8.995(295)(SI-2492), 7.675(260)	Bonnichsen et al., 1987:409; Carlson, 1983:91-92; Shutler, 1983	3	1	3.0	1			
1	Union Pacific Mammoth Site	WY	Clovis - "Western Clovis" Western Paleoindian sites	Bonnichsen et al., 1987; Rule, 1983:21; West, 1983	1		xx				
1	University Village	CA	"period III"	Wallace, 1978:26	4						
1	Unnamed Seris	SON	fluted point locale	Ortiz, 1974 pp25	10		1.6				
1	Unnamed locale	SON	fluted point locale?	Ortiz, 1974 pp25	10		1.6				
1	Utukok	ALK	Fluted point cf Humphrey, 1966 - fluted plus other isolated fluted point locale	Sellards, 1952:119-146 Carlson, 1983:92 Fluted Clark, 1991:37; 1984:69	10		1.6				
x	Uyak	ALK		Shutler, 1983 site list (:221-222)	xx		xx				
1	Vail	ME	Fluted "Gainey like" "Eastern Fluted" - dated	MacDonald, 1983:107; West, 1983 Doyle et al., 1985; Shutler, 1983 (:221-222); Anderson et al., 1990:52 Bonnichsen et al., 1987	1	1	1.4				1.2
1	Valsequillo	MEX	Early Early 9.15k, planoid-cordilleran, "stage 4"	Willey, 1966 fig 2.2; West, 1983 MacNeish, 1983:127 Shutler, 1983 (:221-222)	2		2.0				
1	Valsequillo	MEX	(Armenta) Early-Early "Stage 2"	MacNeish, 1983:127	xx		xx				
1	Valsequillo	MEX	(Caulapan) Early-Early "Stage 2"	MacNeish, 1983:127	xx		xx				
1	Valsequillo		(El Horno, Mirador, Tecancanco) Early-Early "Stage 2"	MacNeish, 1983:127	xx		xx				
1	Valsequillo	MEX	(Hueyatlaco IE) "Stage 3" listed as Hueyatlaco in Shutler	MacNeish, 1983:127 Shutler, 1983 site list (:221-222)	xx		xx				

Table B.02 Sites Gathered from Background Research - Inventory

1	Venice Beach	FLA	Mid Archaic, inundated, Koski, 1989	Koski, 1989	4						
1	Ventana Cave	AZ	most important site in SW Clovis age >10k fluted point locality (equivocal) Western Paleoindian sites	Sellards, 1952:119-146; Willey, 1966 fig 2.2 ; West, 1983 Wormington, 1964; Willig and Aikens, 1988:9; Shutler, 1983 (:221-222); Carlson, 1983:84; Rule, 1983:21	1	1	4.0	1	1		
1	Vera Daniels	TX	Clovis, Plainview, late archaic	Collins et al CRP 7, 1990:8	1		1.6	1			
1	Veratic R.S.	ID	7.222(229)(WSU-?) - Western Stemmed "lanceolate"; Intermntn... concave lanceolates under Mazama Ash in Veratic or bison, Elko, Elko side notched	Willig and Aikens, 1988:13-15 Bonnichsen et al., 1987:418 Homer, 1986	4	1	2.0	1			
1	Vernon	AZ	no proj pts - early looking - surface (Little Colorado Drainage)	Wormington, 1964:220-121 Longacre and Graves, 1976	1		1.6				
1	Vero	FLA	Skeletal - archaic with extinct fauna fortuitous	Sellards, 1952:119-146 Wormington, 1964:229	4				1		
1	Vilna	ALB	fluted point locality	Carlson, 1983:84 Fluted Points	10		1.6				
1	Vulcan site	GA	Kirk	Anderson et al., 1992:253	2		4.8				
1	W. Branch Chesuncook Brassau Lk.	ME		Doyle et al., 1985	xx		xx				
1	W.F. George Lk	GA	minor Dalton, "later paleo" pp22	Anderson et al., 1990:11	1		1.3	1			
1	Walker Road	ALK	Nenana:415	Bonnichsen et al., 1987	1	1	5.0			1	
1	Wallace Res.	GA	Paleo, early archaic trans. 4 kinds of paleo occupation , cf Anderson 1990:201	Anderson et al., 1990:11:33	1		1.6	1			
1	Walls I R.S.	AL	Beaver Lake, Big Sandy	Walthal, 1980:31	2		4.4				
1	Walter Site	MO	large site with Clovis, Dalton, Hardin Barbed, tools	Chapman, 1975	1		1.1	1			
1	Wapanuket	MA	cf entry for Whipple site and referernces	Funk, 1978	1		1.6				

Table B.02 Sites Gathered from Background Research - Inventory

1	Ward's Point	NY	"early archaic", Funk, 1977;	Funk, 1977	2		xx				
1	Warm Mineral Springs	FLA	10.3k plus Cockrell and Murphy graph 16 dates, not specific excavated sites	MacDonald, 1983:107Smith, 1986:8 Shutler, 1983 site list (:221-222) Milanich & Fairbanks 1980:36 Daniel and Wisenbaker 1987:146	1	1	4.6		1		
1	Warner School	MICH		Funk, 1978	xx		xx				
1	Waterton Lakes	ALB	fluted point locality	Carlson, 1983:84 Fluted Points	10		1.6				
1	Weirs Beach	NH	9.615(225), "plano",	Doyle et al., 1985 Bolian, 1980 in Funk, 1984:87	2	1	2.0				
1	Welling/Nellie Heights	OHIO	"habitation"	Anderson et al., 1990:52	1		1.6				
1	Wells Creek	TN	Fluted excavated Paleoindian	Shutler, 1983 (:221-222); West, 198; Anderson et al., 1990:52 Broster, CRP 6 1989:29; Funk, 1978	1		1.1			1	
1	West Athens Hill	PA	Eastern Paleoindian Sites Gainey like points, cf Gramly, 88:266	Rule, 1983:22; Funk, 1978; West, 1983; Anderson et al., 1990:52	1		1.6				
1	West Berkeley Shellmound	CA	"period III"	Wallace, 1978:26	4						
1	West Clover	ID	Clovis (also = Bruneau Desert) - locality	Titimus and Woods, 1991	10		1.1				
x	West Columbia	SC	Fluted (not plotted)	Sellards, 1952:119-146	1		1.6				
1	West Grand Lk	ME		Doyle et al., 1985	xx		xx				
1	West Union Ridge	OHIO	Holcombe, Hi-Lo complex, plotted with Green Creek	Stothers and Abel, 1991:206-8	1		1.6	1			
1	Weston Canyon R.S.	ID	7.25k Pinto like, Gatecliff above @ 3.74, concave lanceolates 3.7k early Elko pts 7.25k	Homer, 1986	4		2.0	1			
1	Wet Leggett	NM	Chiracahua artifacts	Wormington, 1964	xx		xx				
1	Whalen Farm	BC	microblade	Shutler, 1983; Carlson:91	xx		3.0				

Table B.02 Sites Gathered from Background Research - Inventory

1	Whately	LA	San Patrice site	Anderson et al., 1990:52	1		4.2				
1	Whipple	NH	"Eastern Fluted" dated 11.050 (300) (AA-150) averages problematic	Bonnichsen et al., 1987; West, 1983 Anderson et al., 1990:52	1	1	1.6				
	Whitehurst	FLA			xx		xx				
1	Whitewater Draw	AZ	8-9k dates Waters 1985 CRP 2 on Sulphur Spring stuff "Other Stemmed and Desert Sites"	Faught, 1990	1	1	4.0		1		
1	Wilbur Thomas	COLO	listed on all maps including "Archaeological Sites of the Paleoindian Period" but not explained or dated listed as having red ocher	Breternitz, 1971 in Roper, 1991 Frison, 1978: 29	xx		xx				
1	Wildcat Canyon	OR	10.6-7.3K , willow leaf and stemmed, burins, blades :89 Western Stemmed >10k 5 dates listed in Willig/Aikens 88:13	Bryan, 1980 pp 104 Carlson, 1983:77 Willig and Aikens, 1988:13-15	1	1	2.0	1			
1	Williams	MICH		Funk, 1978	xx		xx				
1	Williamson	VA	Fluted workshop Blade cores Prolific site, 200 points, blade cores Eastern Paleoindian Sites "habitation"	Sellards, 1952:119-146; Peck, R.M. 1985; Anderson et al., 1990:52 Shutler, 1983 site list (:221-222) Funk, 1978; Rule, 1983:22 Wormington, 1964; MacDonald, 1983:107 West, 1983	1		1.6			1	1.2
1	Wilson Butte Cave	ID	Gruhn, 1965 from Willig, 1991 Early-early claims - extinct fauna, stemmed, concave bases:90	Shutler, 1983 site list (:221-222) Carlson, 1983:77 "Stemmed Point" Homer, 1986; Willig and Aikens, 1988:7; Bryan, 1980 pp 104 West, 1983	1	1	2.0	1			
1	Wilson-Leonard	TX	Golondrina, Hell Gap, Plainview, Scottsbluff - blades?	Thurmond, 1990 PA35-131	2		4.3	1		1	
1	Winchester Waste Way	WA	fluted point locality	Carlson, 1983:84 Fluted Points	10		1.6				

Table B.02 Sites Gathered from Background Research - Inventory

1	Windust Cave	WA	large sample, stratified, stemmed skeletal material mentioned in Bryan Lind coulee earliest = Windust phase lates Cascade willow leaf:87-8 stemmed point; 9k? Lind Coulee like	Bryan, 1980 pp 104 Shutler, 1983; Carlson:76 Carlson, 1983:77 "Stemmed Point"	2		2.0		1		
1	Windy City	ME	Moosehorn like fluted pointed site	Bonnichsen and Turnmire, 1991	1		1.6				
1	Windy Ridge	SC	E. Archaic, excavated sites, 12-8k SE cf Anderson, 1992:16 for refs	Smith, 1986:8	xx		xx				
1	Winnie's Mound	TX	Plainview, San Patrice	Thurmond, 1990 PA35-131	1		4.2				
1	Winters / Beckner	OK	Folsom also includes Becker site locale?	Hofman, 1992:210; cf Hofman and Wyckoff, 1987 CRP 4	1		1.2				
1	Wiseman	ALK	(WIS-025) isolated fluted pt w/ microblades	Clark, 1991:37; 1984:69	1		1.6	1			
1	Witt Site	CA	11k date on skeletal @ Mud & Tulare Lks	Moratto, 1984; Willig and Aikens, 1988	1	1	xx	1	1		2
1	Workhouse Hill #1	OHIO	one of 11 in Lucus county - Hi-Lo complex	Stothers and Abel, 1991:207-8	1		4.1				
1	Wrens Site	GA		Anderson et al., 1990:11	xx		xx				
1	Wrights	ID	Folsom - locality	Titimus and Woods, 1991	10		1.2				
1	Yale (Pasika)	BC	Pebble Tool; Early Early (Borden, 1968 pebble tool industry, cf Carlson, 83 "pebble tool trad."	Carlson, 1983:87 West, 1983 Shutler, 1983; Carlson:86	A		9.0				
1	Zander	MICH	page 52	Anderson et al., 1990:52	xx		xx				
1	Zapata	COLO	Folsom "kill site" (Frison 1978:114) - ped Folsom blowout	Sellards, 1952:119-146 Wormington, 1964 Bonnichsen et al., 1987	1		1.2				
1	Zierdt	NJ	fluted point, 17 other items, 1st paleo site in NJ, Kraft, 1977:265;	Werner, 1964 in Kraft 1977	1		1.6				
1	Zuma Creek	?	?	?	xx		xx				

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