NEITHER OCEAN NOR CONTINENT: 
CORRELATING THE ARCHAEOLOGY AND GEOMORPHOLOGY OF THE 
BARRIER ISLANDS OF EAST CENTRAL FLORIDA 

By 
ALAN BRECH 

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The dynamic geomorphology of barrier islands exerts a controlling influence on the ecology and prehistoric settlement patterns of the people who lived there. Conveniently, the cartographic and topographic signatures of geomorphic instability and stability in the Indian River Lagoon are easily recognizable by non-experts on any county-scale map. These signatures directly correspond to spatial and temporal patterns in archaeological site distributions. The pattern they describe is an arc-shaped one whereby the most recent landforms and archaeological sites are in the middle sections of the barrier island—from Sebastian to Fort Pierce—while the most ancient landforms and sites occur in the northern and southern sections of the barrier system. This arc-shaped correlation also corresponds to recent studies of ecological diversity and biological production in the Indian River Lagoon. All three factors correspond to the arc-shaped bathymetric contours off the coast of east central Florida from Patrick Air Force Base to the Jupiter Inlet in the south.
One implication of this correlation is that geomorphic stability is not necessarily beneficial to biological diversity and production, nor the prehistoric human exploitation thereof. Most prehistoric reconstructions of Florida and the southeast, however, are premised on the idea that it was the geomorphic stability of the Middle and Late Archaic that allowed for coastal adaptations to develop and flourish. The existing archaeological data from the Indian River area, taken at face value, seem to verify this fluorescence of, or shift towards, coastal adaptations beginning in the Late Archaic and Transitional Woodland periods, c. 4,000 to 2500 B.P. Under Late Holocene and recent conditions, however, this study shows that geomorphic instability is most beneficial to the ecologies and human inhabitants of the Indian River Lagoon.

Thus, for quick and limited archaeological surveys and investigations, the cartographic and topographic signatures of geomorphic stability and instability provide a quick and easy means for identifying ancient versus more recent landforms, while for more intensive or scholastic research, the implications of these correlations between barrier island geomorphology and archaeology challenge many of the fundamental assumptions of Florida and southeastern United States archaeology.
CHAPTER 1
INTRODUCTION

The correlations between geomorphology, ecological production and archaeological site distributions within the Indian River Lagoon ("IRL") and barrier islands of east central Florida are so strong that information and theoretical developments from any of these fields can greatly illuminate the interpretive abilities of the other fields. Wave-dominated barrier island systems are especially convenient for prehistoric reconstructions, since the mostly contiguous, ribbon-like, shore-parallel morphology of such landforms (Figure 1-1) better reveals the shore-perpendicular transgressive events— inlet cuts and barrier island overwash—that have occurred in the last several thousand years. In this study, the wave-dominated barrier island system that extends from Cape Canaveral to the St. Lucie Inlet was divided into segments based on several key signatures of geomorphic stability and instability. These segments were found to show a direct correlation between more stable landforms and sites of greater antiquity. The overall picture derived for the entire barrier island system that encloses the Indian River Lagoon is an arcuate one, whereby the most stable landforms and the most ancient archaeological sites occur in the northernmost and southernmost segments of the barrier island, while the most recent landforms and the most recent sites are found in the middle segments.

This arcuate distribution of geomorphic stability and archaeological site distributions refines previous geomorphic studies that divided the barrier island system ("BI" hereafter) into a stable northern zone and an unstable southern zone (Almasi 1983;
Bader and Parkinson 1990; Parkinson 1995; Mayhew 2000). This arcuate distribution pattern also corresponds to ecological studies of the IRL’s species diversity and biological production (Bader and Parkinson 1990; Brown-Peterson and Eames 1990; Gilmore 1995; Mikkelsen and Mikkelsen 1995; Parkinson 1995; Schmalzer 1995; Virnstein 1990 & 1995), where distance from inlets has often been noted as a second controlling variable accompanying the trends associated with latitude. Cartographic and topographic evidence clearly indicates a greater number of inlet cuts in the middle sections of the system, inlet cuts being the most drastic form of geomorphic instability in this barrier island system (Almasi 1983; 1985). The current tidal amplitudes in the IRL are also arcuate—highest in the middle and lowest at the ends (Smith 1990). The natural longevity of various historical inlets in the IRL is also arcuate, the Old Indian River Inlet just north of the current (artificial) Fort Pierce Inlet having been in existence from the 1500’s to the late 19th century, while all others have been artificially cut and stabilized.

The most densely deposited archaeological sites from the most recent culture period in the IRL Area (which includes the Upper St. Johns River Basin and interior marshes in addition to the IRL itself, see Figure 2-3), called Malabar II (c. 750 A.D. to 1763) are located in these middle sections, and historical documents also show that the Ais political center (and, presumably, population center as well) was in the area from Sebastian to Fort Pierce (Rouse 1951; Davidsson 2001). Spanish documents indicate that the Ais were the most numerous of all the coastal Indians of Florida (Davidsson 2001). If Ais political power was in any way related to relative population levels, then it is also worth noting that the Ulumay and Surruque to the north of the Ais (in the Cape Canaveral area), and the Guacata and Jaega to the south (in the area from St. Lucie to the Jupiter
Inlet), were clearly subordinate to them (Rouse 1951; Davidsson 2001). Similarly, a study of prehistoric habitation on the barrier islands of Georgia found that the most densely deposited sites were located near inlets and major tidal creeks (McMichael 1977). In eastern Florida, the most populous coastal Indian tribe, the Ais (Davidsson 2001), centered itself along that part of the IRL which shows the most evidence of recent inlet cuts. This correlation between geomorphic instability, high biological production, and archaeological site distributions, challenges many fundamental assumptions of Florida and southeastern United States archaeology.

McMichael’s study found another trend that is also evident in the IRL and many other coastal systems in Florida—the hugging of the lagoonal shore by prehistoric sites (1977; cf. Doran and Dickel 1990; Dickel 1992; Milanich 1994). But this pattern is only observable in the northern geomorphic province of the IRL, however, since the migratory nature of unstable barrier island segments causes archaeological sites on the former backbarrier lagoonal shore to “migrate,” relatively speaking, toward the new oceanic shoreline. Thus, sites located on current lagoonal shorelines of unstable landforms are likely more recent than sites located east, toward the ocean. The strictness with which barrier island sites tend to hug the lagoonal shoreline means that geomorphologists can use the dates and locations of various archaeological sites to reconstruct the prehistoric locations of former backbarrier island shorelines and thus compare rates of island migration (i.e., geomorphic instability) from one locale to the next.

This arcuate distribution of geomorphic instability, biological production, and archaeological sites corresponds very closely with offshore bathymetric contours, which are widest (i.e., least steep) in the middle and tightest (steepest) at the ends. It is well
known that shore systems with gentler slopes are less stable during changes in sea levels than ones with steeper slopes, since there is greater lateral distance of shoreline change for every vertical rise or fall in sea levels (Widmer 1988). In effect, then, the considerable influence of the arc-shaped bathymetric contours east of the current IRL on its geomorphic stability, biological production, and prehistoric human habitation patterns almost amounts to a “unified field theory” of the IRL, tying together the geomorphology, biological production, and ancient land-use patterns.

Coastal geomorphology has yet to resolve many fundamental questions regarding BI/lagoon origins and development (Pilkey and Dixon 1996). Three different groups of theories have held sway in the last thirty years, a rate of turnover comparable to the social sciences. The first wave of theories presumed that BI’s and lagoonal basins were static (cf. Almasi 1983). The second wave acknowledged that BI’s were not static, that they generally retreated towards the mainland under rising seas through the processes of overwash and inlet cutting (a discovery first made by botanist Paul Godfrey, according to Pilkey and Dixon [1996], and not by coastal engineers or geomorphologists), but presumed that BIs could not develop or maintain themselves during periods of quickly rising sea levels such as the late Pleistocene and early Holocene (Davis 1994a & b). Consequently, current BI’s and lagoons along Florida’s coasts were presumed to have formed only within the last 8,000 – 5,000 years, prior to which they existed fleetingly at best. The third wave of BI theory, following chaos theory and Pilkey and Dixon (1996), presumes that BI’s have always existed no matter what the rate of sea level rise, and that they have migrated across the entire continental shelf since 18,000 B.P, merely slowing their rate of migration, (i.e., achieving greater stability) c. 8,000 B.P.
Each of these theories has a radically different implication for archaeology, especially for potential underwater sites. For archaeological taphonomy, the differences between the latter two theories are perhaps less significant regarding post-8,000 B.P. sites, since the theories do not differ beyond that point. But for paleo-environmental reconstruction, however, the second wave of BI theory would suggest that lagoons and BI-protected estuaries did not exist during the Paleo-Indian and Early-Mid Archaic, and that after their initial formation c. 7,000 B.P., their biological production was limited until c. 3000 years ago, when fully modern climate regimes were established. This is the geomorphic reasoning underpinning Goggin’s early study (1952), Marquardt’s and Widmer’s study of the Calusa from SW Florida (Widmer 1988; Marquardt 1992), Glen Doran and David Dickel’s overview of Indian River archaeology (1990); Dickel’s survey of Indian River County (1992), Milanich’s 1994 state-wide synthesis, as well as the “Rousean” notion of a settlement shift from the interior marshes to the coast in east central Florida (Rouse 1951). The third wave of BI theory, however, would dispute the idea that estuarine productivity was limited during the early Holocene—any settlement shift to the coast is either an analytical fiction caused by the destruction and occlusion of early coastal sites—a position taken by Michael Russo (1991; 1996)—or a culturally induced resource shift caused by the loss of an earlier avoidance of fish and mollusks.

Despite the daunting literature, and despite the challenges for archaeologists not trained in coastal geomorphology to attempt to mine the geomorphic literature for archaeologically significant facts and patterns, the effort is well rewarded, since coastal ecology and coastal archaeology are so heavily conditioned by coastal geomorphology (LaRoe 1976), and since the geomorphic signatures of stability vs. instability are very
easy to understand and recognize. Every geomorphic subdivision of the IRL BI is
matched by a corresponding temporal/spatial pattern in the location of currently detected
archaeological sites. Where BI segments are thick and stable, older sites are present.
Where BI segments are thin and stable, older sites are also present, but very often on or
near the beach. Where segments are thick and unstable, older sites are not present. Sites
on stable BI segments almost always hug the lagoonal shore. Sites on unstable segments
do not always do so, due to BI migration. Very recent sites, such as mid-late
Malabar/Glades II, are almost always on the lagoonal shore even in unstable areas.

Figure 1-1. Typical microtidal (wave-dominated), mesotidal, and macrotidal (tide
dominated) coastal configurations. Since they are more contiguous and linear
than other barrier systems, wave-dominated barrier islands, such as in the
Indian River Area, better reveal the shore-perpendicular transgressive events
that have transformed its landscape and backbarrier shoreline. From Davis
1994a
CHAPTER 2
STUDY AREA AND ARCHAEOLOGICAL PROBLEMS ADDRESSED

Florida’s peninsular nature makes its bathymetric outline the most recognizable of all the states in America; its marine-dominated geologic history makes viewing Florida first by its bathymetry (Figure 2-1), by its absence of land, or land covered by ocean, and then only secondly by its subareal land cover and smaller scale continental topography (Figure 2-2) a useful inversion of our normal terrestrial biases. The way the near-shore bathymetric outline of Florida “emerges” from the less recognizable bathymetries beneath deeper waters is a good visual metaphor for the way Florida itself has emerged from the constant reworking of the land by rising, falling and "still-standing" ocean levels (Schmidt 1997).

Figure 2-1. Nearshore and deep bathymetric contours off Florida
Much of the topography of peninsular Florida, all of it in the Indian River Lagoon and the Upper St Johns River areas, is the relict of previous bathymetry, and vice-versa, the ocean having been as many as 10 - 12 meters above current levels 120,000 years ago, and having receded as much as 120 meters during maximum glaciation (“the Wisconsin”) 20,000 – 18,000 years ago (Davis 1994; Randazzo 1997).

Figure 2-2. Florida landcover and near-shore bathymetric contours

Florida’s landforms lend themselves especially well to detecting previous oceanic shorelines, and thus the area attracted quite a lot of geologic attention early in the last century (Brooks and Brooks 1964). Eight former shorelines have especially imprinted themselves upon the landscape of the peninsula (Brooks and Brooks 1964), some with barrier island configurations both similar to and different from modern BI’s (White 1972;
Pilkey 2003), like variations on a theme (Figure 4-3). In terms of the most recent oscillation of sea-levels, the Wisconsin - Holocene, c. 18,000 BP to the present, offshore bathymetry provides clues to the coastal conditions of the past, while Atlantic Coastal Ridge topographies and configurations indicate the likely future of the BI system given continual sea-level rise (White 1972). The non-linearity of BI morphology, however, precludes predictive or retrodictive certitude (Gleick 1987; Pilkey and Dixon 1996).

The Indian River Area and its “Malabar” archaeological culture were first defined by Irving Rouse (1951). It includes the three main physiographic provinces highlighted in Figure 2-3—the Upper St. Johns River Basin on the west (“UStJ” herein, including the edge of the Osceola Escarpment/Tablett Terrace), the Cape Canaveral/Merritt Island and barrier island complex on the east, and the Atlantic Coastal Ridge (“ACR”) in between the two, itself a former barrier island during the higher sea levels of the Pamlico seas, c. 120,000 years ago (White 1972: 93). While its eastern and western limits are unambiguously defined by topography and coastline, the northern and especially the southern extents of the IRL area as a coherent archaeological unit cannot be clearly drawn.

This befits the culture-historical description of the IRL culture area as transitional between the St. Johns culture of northeast Florida and the Glades tradition of south Florida (Rouse 1951; Goggin 1952; Milanich 1994); its transitional nature had been noted by Alfred Kroeber as early as 1939 (Doran 2002: 42). On the east, the southern “boundaries” of this Malabar culture area are often drawn at the current St. Lucie inlet (Milanich 1994), but the “boundaries” can be extended the whole length of the barrier island to Jupiter Inlet (Davidsson 2001), where the contact-era Jaega resided, a tribe of
Figure 2-3. Topography of East Central Florida in 5 foot contours
Figure 2-4. Geology of East Central Florida, with key. Map illustrates Holocene origin of Upper St. Johns infilling. Barrier island information is out of date. Source: United States Geologic Service web page.
junior lineage to the Ais, also spelled Jaece in some early accounts (note that “Ay-ee-ga” and “Ay-ee-z” are quite similar). On the west, the southernmost extent of the Malabar culture area corresponds with the southernmost reaches of the Upper St. Johns River Basin. The Northern boundary is traditionally drawn in the area of the Haulover Canal on the Cape Canaveral-Merritt Island complex based on the linguistic and political differences between the Ais and the Timucuans to the north (Rouse 1951; Davidsson 2001). Contact era natives north of this area spoke dialects of Timucuan and practiced at least limited agriculture, while the Ais were speakers of a Muskogean language, it is presumed, based on the few place names that have survived (Swanton in Rouse 1951), and steadfastly non-agricultural to the end. Regarding the northern “border” of the Ais/Malabar culture area, it is interesting to note that Fontaneda, shipwrecked on Cape Canaveral in 1541 at age 13, was not traded or tributed to the Ais but rather to the Apalachee in northwest Florida, and later the Tocabaga and Calusa of southwest Florida (Fontaneda 1945), suggesting that Ais control of the Cape up to Haulover Canal, where the Surruque resided, is questionable, at least up until 1541.

The study area for the part of this project that deals with Irving Rouse’s hypothesized settlement shift to the coast is defined on the north by the Brevard-Volusia county line, as it was for Rouse and Goggin, and on the south by the St. Lucie-Martin County line, and thus may be somewhat smaller than the actual Ais/Malabar culture area to the south and slightly larger to the north. There is some precedence for these general boundaries, and their analytical flexibility. Davidsson lists the northern Ais boundary as coincident with today’s Brevard-Volusia county line. For the main part of this project, however—correlating geomorphic landscape signatures and archaeological site
distributions, the northern boundary is the southern shore of Mosquito lagoon. The present boundaries were also chosen out of analytical convenience and the quality of data available in each county—state archaeological files for Martin County sites are especially broad in their temporal designations, and thus not very useful for detecting distribution patterns over time. The site data (i.e., culture sub-periods) gets more specific as one travels north into St. Lucie, Indian River, and especially Brevard County. Two sites from below St. Lucie County are particularly important to the findings of this study, however, despite the overall lack of temporal data from Martin and Palm Beach Counties—the Hutchinson Island Burial Mound (8 Mt 37) and the Joe Reed Shell Ring (8 Mt 13).

The Indian River area is thus composed of three linear/elongate bodies of water and three linear/elongate stretches of land. The three “rivers”—Indian, Banana, Upper St. Johns, are all misnamed—two are actually lagoons and the latter a vast freshwater basin and marsh, the second largest in Florida behind the Everglades (Sigler-Eisenberg 1985). These two water systems (lumping the Banana and the Mosquito Lagoons in with the IRL, as is customary) parallel each other in their configuration along the east central Florida coast, never more than 30 kilometers apart south of Cape Canaveral, and usually within 20 (Figure 2-3). Thus, a generalized archaeological site catchment zone of 10 kilometers would mean that IRL, ACR and UStJ site catchment areas would most often overlap. As will be shown in Chapter 5, the instability of both the IRL and the UStJ during floods and storms necessitated frequent and reliable recourse to the higher elevations of the ACR (Rouse 1951; Russo 1988a), and so the human habitation and use of these three areas overlapped in other ways as well.
The three linear landforms of the IRL area include the Talbott Terrace that forms the western topographic boundary and drainage source of the UStJ, as well as the Cape/Merritt Island/BI complex, and the ACR, which borders both water systems (Figure 2-3). Even more so than the UStJ or the IRL, the ocean is actually “linear” relative to this study area in that its various zones—backshore, surf, swash, foreshore, nearshore, breakers, etc.—if drawn on a map of the study area, would extend as a series of lines paralleling the five other linear configurations just mentioned (Figure 2-5). In fact, it is the ocean itself which is responsible for the linearity of all the other landforms in east central Florida, the strength and consistency of its north-south longshore current along this high energy shoreline having reworked the land for eons (Parkinson and White 1994).

Figure 2-5. Cross-section of typical beach profile. In plan view (i.e., on a map), these shore zones would extend parallel with the entire coastline. From Davis 1994a

The IRL Area’s “transitional” cultural designation thus matches its climatic status as transitional between the temperate and subtropical zones (Figure 4-9), not just terrestrially (Doran 2002), but atmospherically (Almasi 1983: 7 – 9), geologically (a siliciclastic to carbonate transition zone; Parkinson and White 1994) and oceanographically as well (Virnstein 1995; Hargraves 2002: 225 - 226). The warm-
temperate Carolinian faunal zone gives way to the Caribbean subtropical zone near Cape Canaveral (Doran 2002: 40). The NNW to SSE linearity of this region’s land and water configurations thus cross its east-west climatic and culture-historical boundaries at nearly right angles, facilitating travel and interaction, and perhaps “transitional” material culture as well.

The material culture of the IRL Area has been repeatedly described as simple and conservative—not changing much over time—and even “remarkably non-descript” (Rouse 1951), its ceramics dominated by plain undecorated bowl forms without much variation or elaboration (Ferguson 1951; Sears 1982; Cordell 1985). Cultural conservatism is also evidenced in the Ais’ fierce resistance to Spanish and European power and influence (Rouse 1951; Davidsson 2001). Unlike the Timucua to the north, the Ais were barely pacified, even during Rouse’s “Period of Friendship” (AD 1603 to 1703), never successfully missionized, and never adopted agriculture. They were reluctant to even enter into negotiations with the Spanish at St. Augustine, and during the initial Period of Friendship the Ais chief repeatedly declined to visit, despite profuse Spanish incentives, sending a string of delegates instead to the frustration of the Spanish (Rouse 1951; Davidsson 2001). According to the journal of Jonathan Dickinson’s shipwreck in 1696, the Ais showed no interest in recovering any of the liquor or sugar and molasses that survived the wreck (Dickinson 1945), two items of white culture that often corrupted and weakened North American aboriginal cultures. Yet the Ais’ later decline (c. 1704 to 1763) is sometimes attributed to alcohol (Dickel 1992: 44); if true, consumption began sometime after Dickinson but prior to the disappearance of the Ais in 1763. Ais indifference to these items in 1696 can be seen as a healthy sign of cultural
conservatism, especially since much of the Ais elite economy at this time was based on
the recovery and trade of other shipwrecked European goods and people (Rouse 1951;
Davidsson 2001).

A strong theme of cultural conservatism comes across in any regional synopsis
even when the authors do not intentionally make it their focus (cf. Griffin & Miller 1978;
Espenshade 1983; Sigler-Eisenberg 1985; Dickel 1992; Milanich 1994; Bense 1994; Pepe
2000; Doran 2002). As each cultural period is summarized and a new one is introduced, it
is quite common for writers to speak of relatively unchanging subsistence and settlement
patterns in east central Florida, beginning as early as the Paleo-Indian period. The
changes that do occur are summarized in Chapter V of this text.

For archaeological analysis and interpretation, cultural conservatism has its benefits
and drawbacks. On the negative side, the dominance of plain undecorated forms of
pottery for thousands of years means that many sites can only be broadly dated without
expensive C-14 dates. A collection of plain sherds on St. Johns or sand-temperd pastes
from the IRL area can date anywhere from 500 B.C. to 1700 A.D.—perhaps even as early
as 2000 B.C. if Michael Russo’s startling dates from the Joe Reed shell ring in Martin
County are taken into account (Russo and Heide 2002). Another drawback is that
“ceramic conservatism” can hide the fact that many other aspects of perishable material
culture may be quite expressive and change over time and thus not be so conservative or
simple. William Sears’ excavations at Fort Center near Lake Okeechobee, and Frank
Hamilton Cushing’s work at Key Marco, both in south Florida, each found highly artistic,
naturalistic wood carvings and paintings in areas that are even more conservative in their
ceramics than central Florida (Sears 1982; Cushing in Gilliland 1989). One wonders if
the IRL area would have been designated as culturally non-descript, as “simplistic”
(Rouse 1951: 69) if the massive aboriginal shell mounds of the IRL Area (e.g., Kroegel Mound, Grant Mound, Turkey Creek, etc.) had not been destroyed for road-fill for US-1, A1A and other highways and train beds.

The benefits of cultural conservatism to later archaeological interpretation is that ethno-historic accounts and archaeological information from more recent periods, which are usually much more abundant than that from more ancient periods (cf. Doran 2002:35-37), can be used to analyze more ancient sites with a higher degree of confidence than in areas where material culture and subsistence economy have been changing more quickly. Early cultural traits and complexes are more likely to survive in recognizable form in societies that pursue the same subsistence patterns and produce similar material items as their ancestors.

Interestingly, this region of east central Florida may have been culturally and biologically conservative as far back as the Late Paleo-Indian/Early Archaic era, several authors having noted archaeological and paleontological evidence for late survivals of Pleistocene megafauna throughout Brevard and Indian River Counties (cf. Dickel 1992:15). The basal levels of the once-famous Vero Man site (8 IR 9), which contained numerous Pleistocene species such as mastadon and mammoth, have been carbon dated to an astonishingly late 8,200 B.P. (Milanich and Fairbanks 1980). Rouse recorded 15 paleontological sites in Brevard County, one of which is near the Old Haulover site on the Cape/Merritt Island complex (Rouse 1951: 235 - 236). No work has been done on these sites, probably because Rouse subscribed to Ales Hrdlicka’s view that the Vero and Melbourne man sites were disturbed and not in original association. Unfortunately, the
legacy of Hrdlicka’s now-discredited short chronology still afflicts the archaeology and paleontology of the IRL Area, despite widespread acceptance of the Vero and Melbourne finds by geologists. As David Dickel wrote “the line was pretty much drawn between geologists who accepted Vero and Melbourne finds as being in primary association with extinct mammals from the Melbourne [geologic] formation, and anthropologists who thought the finds were likely to be intrusive and in secondary association” (1992:15).

Despite this conservatism, most accounts agree that there was a shift in settlement and exploitation from the UStJ and interior marshes to the IRL sometime after the Middle Archaic and prior to Malabar II. Similar coastal settlement shifts have been postulated for south Florida (Griffin 1988) and southwest Florida (Widmer 1988). Rouse timed this shift to the middle of Malabar I based on the lack of incised St. Johns pottery on the barrier island (Rouse 1951); later writers have tended to push back the date of this settlement shift, or, like Michael Russo, doubt its validity altogether (1996: 177; personal communication, 2003). Glen Doran and David Dickel, based upon the lack of significant quantities of marine shell or even fishing equipment in the Early Archaic components of the Windover site in Titusville (8 BR 246), place it in the Middle to Late Archaic (Dickel 1992:21; Doran 2002). Griffin and Miller place it at the end of the Orange Period (1978: 55), noting that no early Orange sites have been found on the Cape and BI, only late Orange—called Orange III, IV, and V by Ripley Bullen based on surface treatment, thickness and temper (Bullen 1972). However, recent work by in the middle St. Johns River Valley has overturned this chronology—incised and plain Orange forms are contemporaneous, and their occurrence or absence at various sites is spatial, not temporal (Sassaman 2003). Similarly, Rouse’s Malabar I vs I’ distinction, based upon incised St.
Johns wares, has been abandoned for some time (Cordell 1985; cf. recent Florida DHR site files).

It is from the Orange Period and the following Transitional Period, when Orange fiber tempering mixed with St. Johns/Malabar tempers, that archaeologists have obtained the strongest evidence for extensive coastal occupations in the IRL Area (Figures 3-11 and 3-12). Campbell et al. noted that interior Orange sites are larger and denser than Cape/BI Orange sites, while the reverse holds true for Transitional sites (1984). In south Florida and southwest Florida, where a similar coastal shift has been postulated at a somewhat later date than in this study area, Widmer and Griffin each found that trends towards coastal occupations hit two or three recurring watershed periods: 5500-5000 BP, 2700 BP, and 280 AD (Widmer 1988; Griffin 1988). Following the “second wave” of BI theory, the first is interpreted as the time at which sea level rise slowed enough to allow stable and extensive coastal estuarine resources to flourish, and for interior water tables to be raised such that Lake Okeechobee and the Everglades begin forming at this time and then draining towards the coast. 2700 B.P. marks the full establishment of modern climatic and coastal conditions in south and southwest Florida. A.D. 280 - 400 AD marks a re-rise in sea levels to near-current levels (Griffin 1988). The Little Ice Age that lasted from 1450 to 1850 would imply that sea levels fell somewhat during this period, not because of glaciation but because of the significant effect of temperature on eustatic sea levels (Davis 1994b). As will be shown, the extant evidence from the IRL Area, if taken at face value, shows a similar, but slightly earlier, developmental sequence in the IRL area if we adopt a first or second wave BI theory (as per Sigler-Eisenberg 1985), with 5000-7000 BP corresponding to the initial inundation of the IRL “paleo-lagoon/basin” (a
distinctly First Wave BI term) and the “initial formation” of the northern zone of the Cape/BI complex (as per Second Wave BI theory), and 3200+ BP corresponding to the general time in which large Transitional Period middens appear along the east central Florida BI.

If we follow the third wave of BI theory, however, which posits that BIs and lagoons have always existed or were formed as soon as sea levels began to rise c. 18,000 B.P. (Pilkey and Dixon 1996), then issues of a prehistoric coastal settlement shift can no longer be made based upon biological production alone, but must consider other factors such as cultural preferences and shoreline accessibility and predictability. Ultimately, of course, the question of whether there was an actual settlement shift to the coast following the Early Archaic or whether this is just a preservation issue can only be resolved by underwater exploration—increases in the size of coastal middens are not necessarily indicative of a shift if regional populations and site sizes everywhere are also increasing during this same Late Archaic/Early Woodland period. A rapidly changing coastline not only taphonimically erases and buries earlier sites, it also prevents the accumulation of cultural material in one location for long periods of time. Further, even if one could prove, geomorphically, that barriers, estuaries and lagoons have always existed and have always been incredibly productive biologically (a case made here, in Chapter IV), you would still have to prove that these biological resources were culturally desirable to the people in question. Fish and mollusks may have always been abundant, for instance, but people may have preferred to follow grazing herds, or ambush deer instead (e.g., the abundance of antler but lack of any kind of fishing equipment from the well-preserved Early Archaic Windover site).
Indirect evidence is not entirely lacking—for instance, the absence of Paleo-Indian and Early Archaic sites on Merritt Island, a mostly pre-Holocene landform (Figure 2-4), and located closer to the coast than Windover, seems suggestive of a genuine coastal settlement shift. The proof is in the spade, of course, and the underwater spade is very expensive indeed, but barrier island geomorphology would be a prerequisite consideration for any underwater (not just terrestrial) survey or investigation (Murphy 1990), as it indicates likely areas of better preservation, likely sediment stratigraphies, and what sort of “obfuscatory data” or stray finds, that can be expected.

As mentioned, second wave versus third wave BI theories only affect Paleo-Indian and Early Archaic taphonomy, since both theories agree on a moderate rate of BI migration during the last 8,000 years (~10 kilometers), the time period under consideration in this study. For prehistoric reconstructions, the difference between second and third wave BI theories is most significant in terms of the oft-assumed “maturation” of estuarine productivity c. 4,000 B.P. A geomorphic approach informed by chaos theory, biology, and third wave BI theory would question whether barrier islands, estuaries and lagoons did not exist or existed only fleetingly in the Early and Early-Middle Holocene (cf. Griffin 1988; Widmer 1988: 169-188; Marquardt 1992: 426; Milanich 1994), and whether geomorphic and oceanic instability would necessarily be inimical to estuarine life when it is this very instability upon which estuarine life thrives and depends (Godfrey 1976). In the IRL, the stable northern zone is now “distinctly depauperate” in species diversity (fish, mollusks, and overall) and is presently not as biologically productive as the less stable south (Brown-Petersen and Eames 1995: 254; Snelson 1983, in Virnstein 1995: 250). In the colonial era, the most numerous of the coastal Indians, according to
Spanish documents, were the Ais (Davidsson 2001), whose political center (and, presumably, population center as well) was along the most geomorphically unstable stretch of the IRL BI—the Sebastian-to-Vero (“S-V”) and the Fort Pierce (“Ft.P”) segments (Rouse 1951; Davidsson 2001). Again, geomorphic stability is not necessarily beneficial to estuarine systems or the human exploitation thereof, yet most reconstructions of Florida prehistory are based upon this very questionable assumption (Goggin 1951; Rouse 1951; Griffin and Miller 1978; Widmer 1988; Griffin 1988; Marquardt 1992; Dickel 1992; Milanich 1994). Geomorphic stability is really only beneficial to site preservation and concentrated accumulations of human material.

The extant evidence, taken at face value, shows that the shift in settlement towards the coast, if genuine, is certainly one of degree, and spread out over time, as there exists scattered evidence of coastal exploitation, coastal megafauna, and perhaps even habitation of the coast as early as the Paleo-Indian/Early Archaic periods (Murphy 1990). Also, Paleo-Indian and Early Archaic coastlines would have been much further from current mainland sites, so lack of marine fauna in the Windover assemblage, while strongly suggestive, is by no means definitive. Further, this “settlement shift” must have continued throughout the Malabar I - II periods (again, if extant evidence is taken at face value), presumably because IRL productivity and predictability remained incredibly high while nearby UStJ and interior marsh predictability and accessibility decreased over time despite increasing biological productivity (Rouse 1951:249; Russo 1988a; Doran 2002).

Taphonomically, coastal geomorphic processes destroy, inundate and/or cover over earlier sites. Ecologically, however, those same destructive actions yielded highly productive ecosystems that drew contemporary sites towards them, and allowed for
higher levels of population without any increase in per capita labor needed. Thus, any coastal settlement shift, if real, was not as drastic or as abrupt a simple chart of currently detected sites would indicate (Figures 3-11 and 3-12), due to taphonomic destruction/inundation/occlusion of earlier sites. Whether the UStJ – IRL settlement shift is really just an analytical fiction imposed on the data by different preservation rates and different levels of site visibility is a question that involves many unresolved geomorphic, ecological and anthropological issues—the configuration of barrier island coasts during rapidly rising seas (Figure 4-18), the biological productivity and regime therein, and whether an abundance of food would necessarily bring forth people to exploit it while other food sources remain abundant and, perhaps, more “glamorous” to obtain and more in keeping with tradition.
Figure 2-6. Archaeological survey coverage of Brevard, Indian River, St. Lucie and Martin Counties. Red indicates survey coverage.
Geomorphologists and ecologists divide the barrier islands and lagoons south of Cape Canaveral in east central Florida into two major zones. The northern zone extends from Hog’s Cove (opposite the mainland town of Malabar) up to the Cape itself, and is characterized by a stable, mostly cuspat e lagoonal shoreline and an oceanic shoreline undergoing progradation (i.e., the land has advanced sea-wards) since 7,000 BP. The southern area, from Hog’s Cove south to the man-made St. Lucie Inlet near the mainland town of Stuart, is characterized by an irregular, unstable lagoonal shoreline and an oceanic shoreline undergoing shoreface retreat, called transgression (Almasi 1983; Bader and Parkinson 1990; Mayhew 2000). It is shown here that while each of these geomorphic zones appear to have different patterns of archaeological site distributions, they both obey a single underlying pattern that is heavily conditioned by the geomorphology of the barrier island system. Smaller scale geomorphic subdivisions within these broader zones also correlate to site distributions at that scale.

It is argued here that coastal geomorphology, which is much more dynamic than that of most terrestrial landforms inhabited by people (Davis 1994a & b; Pilkey 2003), is especially important to coastal archaeology: the geomorphology of the barrier island system of east central Florida does much to explain the patterns of currently-detected archaeological sites both taphonomically and ecologically; it also predicts where currently undetected sites would likely lie, as well as simplifies the complicated
stratigraphy of the barrier island sediments, and predicts random associations of water-worn “stray finds” throughout the Indian River Lagoon.

Figure 3-1. Barrier island segments. A) abbreviations and geomorphic stability levels (left). B) Northern and southern geomorphic provinces (right).

Archaeology, in turn, can inform geomorphology and coastal geology of the former locations of backbarrier lagoonal shorelines and other pre-modern shore configurations; a geomorphic history of the barrier island (“BI” hereafter) is mapped out herein based on archaeological information and other data (Figure 5-1). Archaeology can also contribute
to other geomorphic questions such as the different locations for the transition zone between these geomorphic provinces as given by different authors (cf. Almasi 1983; Stauble 1990 Mayhew 2001). Most importantly, archaeological site distributions, offshore bathymetry, ecology and geomorphology reveal that the north-south division of the barrier island system, while useful as a good introduction, is, by itself, insufficient. It is shown here that the archaeology, ecology and Late Holocene history of the barrier island system is best described by an “arcuate” pattern whereby the oldest landforms and sites occur in the northernmost sections (Cape Canaveral and the segment from Patrick’s Air Force Base to Hog’s Cove—“PAFB-HC” hereafter) and southernmost zones (Martin and Palm Beach Counties), while the most recent landforms and sites are found in the middle zone of the barrier island (Indian River and northern St. Lucie Counties—the “S-V,” “Ft.P” segments).

Figure 3-2. Cape Canaveral sites.

The stable northern zone of this study area is characterized by a regular, if not regimented, distribution of sites—all occur along the current lagoonal shoreline with the exception of two sites, 8 Br 1642 and 8 BR 240-B (Figure 3-2). The latter site, excavated
by Elizabeth Horvath and this author in April 1999, is actually road-fill that contained
middens and should be stricken from current site maps; the former site is also suspect, as
it, too, is part of a historic village (Figure 3-13). A statistical study by Levy et al. on Cape
Canaveral (1984) found that river margin and marsh margin were the primary
physiographic settings for archaeological sites. Similarly, most of the archaeological sites
in the other stable sub-zone of the northern area (the PAFB – HC segment, Figure 3-3)
also hug the lagoonal shore. Those sites that do not are generally more ancient, as will be
shown. Another characteristic of the stable northern zone is that it contains more ancient
sites on the barrier island, beginning with the fiber-tempered pottery sites of the Orange

Figure 3-3. Cuspate shores and archaeological sites of the stable PAFB-HC segment.
Same key as Fig. 3-2
Period (c. 4000 BP - 3200/3000 BP), followed by Transitional sites (semi-fiber tempered pottery, c. 3200 BP - 2700/2500 BP). There is also one Archaic (c. 8500 BP - 4000 BP) site, 8 Br 82, “DeSoto Groves” on the lagoonal shore of Cape Canaveral, although subsequent investigations by Joan Demming, Elizabeth Horvath and this author in 1999 found no confirmation of a pre-ceramic component.

The archaeological record of the southern zone, like its lagoonal shoreline, is characterized by an irregular distribution of sites spatially—they do not all hug current lagoonal shores—and a temporal distribution dominated by most recent sites, with Malabar II/III and Glades II/III sites (both date from A.D. 750 – 1763) more prevalent than previous site components: Malabar/Glades II/III = 27 sites or 46% of all BI sites south of Hog’s Cove; Malabar/Glades I (both date from 500 B.C. to A.D. 750) = 17 sites or 29%, Late Archaic/ Orange/ Transitional = 4 sites, or 7%, and Archaic and earlier = 0%; 11 sites, or 19%, are vaguely classed as “prehistoric,” “prehistoric with pottery,” or “Malabar/Glades unspecified”. In comparison, the numbers for BI sites north of Hog’s Cove show less preponderance of recent sites: there are 26 Malabar/Glades II/III barrier island sites, or 30%, 36 Malabar/Glades I sites, or 41%, 14 Orange & Transitional sites, or 16%, and one possible Archaic site, or 1%. 11 sites, or 13%, are vaguely classified as “prehistoric” or “prehistoric with pottery.”

South of Sebastian, well into the unstable southern geomorphic zone, archaeological sites on the barrier island date no earlier than Malabar I or Glades, with the majority (15 out of 25) being Malabar II/III or Glades II & III sites. Orange and Transitional sites occur only in the northernmost portion of the unstable southern BI in
Figure 3-4. Prevalence of more recent barrier island sites south of Hog’s Cove (opposite mainland town of Malabar).

This study area, from Hog’s Cove south to Sebastian (i.e., Stauble and Koefed’s transition zone between the Central Lagoon and the Indian River Narrows, not shown on this page, but see Figure 3-1b), a region of cuspat e lagoonal shores despite some sediment starvation and lack of progradation. There are two exceptions to this pattern in the south: 8 IR 973, designated as “Archaic” (c. 8,500 - 4,000 BP) is another mistakenly reported site and should be changed to “prehistoric with pottery,” as will be shown later; 8 Mt 37, the “Hutchinson Island Burial Mound” (not shown, but discussed later), is classified as Late Archaic based on the occurrence of semi-fiber tempered pottery (Carr et al. 1995). In areas of the most recent and drastic geomorphic instability—from Sebastian to just north of the Fort Pierce Inlet (the “S-V” and most of the “Ft.P” segment)—this pattern is amplified, the only sites prior to Malabar/Glades II&III (i.e., pre-750 AD) on uncorrected site maps being “Pregnant Turtle” (8 IR 831), “Castaways” (8 IR 52), and “King’s Island” (8 SL 1113). All of these, it will be shown, are also mistakenly recorded as
Figure 3-5. Pre- and post-A.D 750 sites
containing Malabar I components and should be reclassified as Malabar II instead, (as they are on the maps, figures and calculations in this text). Three of the four vaguely classed “prehistoric with pottery” sites in this segment (the Pelican Island National Wildlife Refuge sites—8 IR 49, 50, and 51) have been carbon dated to Malabar II or Glades II (Campbell et al. 1984). But it should also be noted that the dominance of Malabar II over Malabar I south of Sebastian disappears from the Ft. Pierce segment south to the St. Lucie Inlet (Figure 3-5), where Malabar I sites exceed Malabar II sites by 8 to 5, or 1.6 to 1, a ratio that is similar to the 1.4 : 1 ratio of Malabar-I to Malabar-II sites north of Hog’s Cove; this will be an important point when the “arcuate” nature of the barrier island system is offered as a necessary supplement to the standard north-south dichotomies and sectionings.

Further subdividing these two geomorphic zones into more specific sub-zones allows for even closer correlations between archaeological site distributions and barrier island geomorphology. In the northern zone, in between the thick, stable, prograding Cape and the thick, prograding PAFB - HC segment, lies a thin, sediment-starved section of the barrier island (Figure 3-6) that has an irregular lagoonal shoreline due to a recent storm-induced inlet-cut (Stauble 1990). Thus, within the stable northern zone lies a segment of sediment starvation and shoreline instability, more similar to the unstable areas of the southern zone than to its immediate neighboring barrier island stretches. No archaeological sites have yet been detected on this segment, though survey coverage here has been light (Figure 2-6). This sub-zone can be seen as an archetypal representation of the lagoonal shoreline after major inlet cutting events, which create ecologically productive flood tidal deltas in the backbarrier lagoon. Numerous inlet cuts in the same
area produce an overlapping of these flood tidal deltas, shore-parallel islands, and a recurving of spit formations (Almasi 1983; Stauble 1990), as seen in the backbarrier shorelines of the Sebastian-Vero (“S-V” hereafter) and the Hog’s Cove - Ballard Cove segments (“HC-BC”).

Figure 3-6. Archetypical flood tidal delta, an exception within the northern stable zone. Same key as Fig.s 3-2, 3-3 and 3-5.

Figure 3-7. HC-BC segment
The southern zone of the barrier island can be usefully subdivided into sub-zones of more “recent” geomorphic instability (storm overwash and inlet-cutting events within the last several thousand years)—characterized by a narrower lagoon and a thicker barrier island—versus thinner, more linear, sediment-starved BI segments indicating that they have not been recently cut or overwashed (Stauble 1990). Again, the distribution of currently detected archaeological sites corresponds to these smaller-scale geomorphicsubdivisions: thin linear stretches of the southern barrier island (south of Hog’s Cove) are more likely to have pre-Malabar II/Glades II sites (N = 16 out of 22 total sites, or 73% of all pre-A.D. 800 sites, on only 35% of the total linear distance of the BI segment in question) than the thicker, recently cut/overwashed segments (N = 6 out of 22, or 27% out of a total length of approximately 65% of the BI linear distance).

Weighted for distance, thin BI segments south of Hog’s Cove are five times more likely to have pre-Malabar/Glades II sites than thicker segments. This correlation is actually much stronger given the fact that thicker BI segments have greater land area, and, more importantly, much longer lagoonal shorelines due to the irregularity of their shape.

Malabar/Glades II & III sites, on the other hand, are likely to appear in either subzone of this unstable southern zone—14 sites in the thick segments, and 13 in the thin.

Figure 3-8. Thick (unstable) versus thin (more stable) BI stretches south of Hog’s Cove. The flood tidal delta behind the man-made Sebastian Inlet is counted as thin

* Ignoring the 7 vaguely classed “prehistoric” sites.
Figure III-9. Thick (Less Stable) vs. Thin (More Stable) BI Segments South of Hog’s Cove

Note: Thicker BI segments have much longer lagoonal coastlines, the preferred location for prehistoric sites on the IRI BI

Further subdivision of one of the southern geomorphic sub-zones into two “sub-sub-zones” also corresponds to the archaeological site distributions at that scale.

Southern barrier island segments outside of the highly unstable HC – BC, S – V, and FortPierce segments (i.e., not as drastically unstable as these three; much less inlet cutting) can be divided into two kinds—those with thicker, lobate, lagoonal shores, signifying “recent” overwash (n = 29% of BI linear distance), and thinner, more linear, sediment-starved stretches of barrier beach (n =71% of BI linear distance). Of the 33 known sites in this region (lumping all culture periods together), only three are on the thicker, less stable segments, or 9%. Weighted for BI length, thin sections are 41/2 times more likely to have detected sites than thick sections. 14 pre-Malabar II/Glades II sites in the southern sub-zone outside of the HC-BC/S-V/&FtP segments have been found on the thin, non-overwashed stretches, whereas only two have been found on the lobate, overwashed stretches, despite their greater land mass and longer lagoonal coastline. Only
one Malabar II site has been found in these thicker sections of the southern BI outside of the HC-BC, S-V, and Ft. Pierce segments, suggesting the possibility that most of these overwash events have occurred since Malabar II times. Carbon dating of the many plain pottery sites in St. Lucie and Martin Counties would of course clarify these patterns further.

The barrier island in Martin County, outside this study area to the south due to its lack of dated sites on the barrier island (n = 2), has the most stable recent geomorphic history (Stauble 1990) and, correspondingly, at least two archaeological sites of greater antiquity than on any stretch of the BI south of Sebastian, the Hutchinson Island Burial Mound (8 Mt 37), dated to 3000 B.P, and the Joe Reed Shell Ring, dated to 4,000 B.P. (Russo and Heide 2002). This and the transition points between the northern and southern zones, the HC-BC and the BC – S segments (Figure 3-1B) will be discussed later.

Compared to the northern geomorphic zone, the irregularity of the southern lagoon shorelines and its barrier island landforms are directly related to the irregularity and
relative modernity of its archaeological site distributions—all three are the result of higher levels of geomorphic instability. Conversely, the regular, “rhythmic” lagoonal shoreline of the northern zone (often cuspate or “crescentic” in plan view) is directly related to the greater antiquity of its sites and the strict regularity of their distribution, all three being the result of geomorphic stability for the last 5 - 7,000 years (Mayhew 2000). It is proposed here that the archaeological distribution patterns of the northern barrier island—the hugging of the lagoonal shore, especially—can be used as a key to decode the southern barrier island site distributions, revealing the patterns that have been hidden by its unstable geomorphology. A fuller understanding of barrier island site distributions then allows for a more refined barrier island geomorphology, since likely prehistoric coastlines are indicated by the distributions of known sites, the implications thereof affecting some of the many unresolved issues in coastal geology and geomorphology (Davis 1994a&b; Parkinson and White 1994; Pilkey and Dixon 1996).

Moreover, two archaeological problems or limitations endemic to the Indian River/Upper St. Johns River Basin area (first called the Indian River Culture Area by Irving Rouse in his 1951 survey, and “IRL Area” hereafter) are afforded greater resolution by this geomorphic perspective: 1) the apparent “settlement shift” from the Upper St. Johns River Basin (“USTJ” hereafter) and other interior marshes to the IRL during the Archaic/Orange/Transitional/Malabar I period (depending on the author; cf. Rouse 1951, Griffin and Miller 1978; Doran 2002), and 2) the problem of dating sites by ceramic types in an archaeological area dominated by plain, undecorated pottery on similar pastes for almost three thousand years. Plain pottery is especially prevalent as one moves further south in this study area, with lesser occurrences of incised or check-
stamped decorations than in the north. Unlike incised designs, check-stamped pottery has so far tested positive for temporal reliability (= A.D. 700/800+, excluding Georgian Deptford Check-stamped), and much of peninsular Florida’s ceramic chronology is heavily dependent upon its presence/absence for discriminating between pre- and post-AD 750 time periods (Cordell 1985, 1992; Pepe 2000).

In the first case, since most of the settlement shift is statistically based on a large, steady increase in barrier island and Merritt Island sites over time (\(N = 0\) Paleo; 1 Archaic; 0 Late Archaic; 37 Orange and Transitional; 68 Malabar I; and 65 Malabar II; or, relative \(\% = 0/3/0/45/49/61\)) and on a much smaller and less steady drop in the number of UStJ sites (\(N = 3\) Paleo; 22 Archaic; 15 Late Archaic; 24 Orange and Transitional; 59 Malabar I; 25 Malabar II; \(\% = 60/63/83/31/43/24\)), and since the increase in BI sites over time occurs especially in the southern, unstable zone south of Sebastian, a geomorphic understanding of BI sites alone does much to resolve the settlement-shift dispute regarding the entire area. In the second case, plain pottery sites in the unstable southern area of the BI can be relatively dated using this model by their location and/or proximity to current lagoonal and oceanic shorelines. In highly unstable areas, only recent sites are likely to be found along current lagoonal shorelines. In all areas south of Hog’s Cove, sites east of current lagoonal shorelines (i.e., towards the ocean) are likely earlier. This model was originally developed based on existing, uncorrected site data. It was tested by examining discrepancies between the model and the existing data, sites which “stuck out,” and then re-examining current site data and correcting errors in the culture-periods designated for various IRL sites. It was found that all the corrections corresponded to the model, making the resultant data even more
suggestive. Eleven Indian River Lagoon sites were found to be mis-recorded; of these, one was mistakenly designated Archaic, three were vaguely designated “Prehistoric with pottery,” six were mistakenly designated as Malabar I, two major sites were missing altogether (Pentoya and the Kroegel Mound), and one was found to include Transitional
(semi-fiber tempered) pottery in addition to Malabar I. The mistakenly designated Archaic site (8 IR 973) was visited by the author in 2003, and should be relabeled as “Prehistoric with pottery,” although it is almost certainly Malabar II based on this model. The three “Prehistoric with pottery” sites should be reclassified as Glades II-III based on carbon dates. Three of the five mistaken Malabar I sites were found to be Malabar II based on existing site data; one on historical maps of the old Indian River Inlet; the last was not a site at all but road-fill (8 Br 240-B), excavated by Elizabeth Horvath and this author in April 1999. One site listed as “Glades Unspecified” has been carbon-dated to early Malabar II c.AD 740 – 850 (Wheeler 2003). The Cato site is missing from the electronic site files but not the paper files. The Pentoya site is discussed in a forthcoming article by J. F. Lanham and this author. A carbon-14 target list of sites that are not currently typed or which are likely mistyped according to this model is given in the concluding section; carbon dating these sites would also provide valuable geomorphic information.

The divisibility of the east central Florida BI into these easily recognized geomorphic zones and sub-zones based on their lagoonal shorelines, identifiable on any county-scale map with minimal instruction, means that this geomorphic model can be easily communicated to cultural heritage managers (CHM* nee “CRM” or “contract archaeology”) and other archaeological investigators of BI sites or the east central Florida region in general. In computer-speak, it is a user-friendly data model, efficient for the “business” of archaeology in terms of the minimal investment of time and learning required for the amount of information returned: the correlation between BI

* Steve Brandt is correct in proposing that we change the name to heritage management. “Resources” are something an American uses up, whereas “heritage” better predisposes one towards conservation.
geomorphology and site distribution is especially strong, and the geomorphic “signatures” of stability vs. instability are easy to spot by non-experts (Figures 4-19 and 4-20). Site prediction models could also be greatly enhanced using this model, both for terrestrial and sub-aqueous (inundated) sites. BI geomorphology also explains the “pastry-layer” sedimentology and soil stratigraphy of unstable barrier island landforms (Hennesey and Zarillo 1987; Parkinson and White 1994), a very important consideration for archaeological fieldwork and analysis that is commonly overlooked or misunderstood. For regional analyses, geomorphology also helps illuminate the overall site distributions of the entire IRL Area, including the UStJ.

And for geomorphology, archaeology can provide broad scale snapshots of barrier island configurations for the last 4 to 5,000 years (Chapter 5). The scale is broad temporally, spatially and quantitatively—the temporal broadness of 1000-year culture periods being a handicap, spatial broadness being an asset, and large sample size very valuable (n = 171 total BI site components with at least relative dates). Four snapshots of the prehistoric BI were generated based on the changing distribution of archaeological sites and other geomorphic information (Figure 5-1). These snapshots support the erosional shoreface retreat model for most of the BI south of Hog’s Cove for at least the last 5,000 years. They show that while the north-south division of the BI is useful ecologically (cf. Bader and Parkinson 1990: 212; Brown-Peterson & Eames 1990: 234; Virnstein 1990: 250 & 1995: 76; Mikkelsen and Mikkelsen 1995: 97; Parkinson 1995: 33; Schmalzer 1995: 37-38; Gilmore 1995: 156; Hargraves 2002: 225-6) and useful on a broad scale for geomorphology (cf. Almasi 1983; Bader and Parkinson 1990; Parkinson 1995: 33 – 34; Mayhew 2000) and archaeology (it is at this scale that one notices the
hugging of the lagoonal shore by sites in the north, the “decoding key” of the entire system), finer scales of analysis lead to an arcuate view of the BI system, with the middle of the arc being the most unstable and recently formed, and lacking more ancient archaeological sites, while the ends of the arc are the most stable and most ancient. This arcuate pattern of development corresponds very closely to offshore bathymetric contours, BI topographies, ecological productivity levels, and archaeological site distributions, and is similar, on a smaller scale, to Mile O. Hayes’ arcuate picture of BI formations along the Georgia Bight or Georgia Embayment immediately north of this study area. There, at the ends of the arc, where the barrier island system attaches to a headland (Cape Canaveral on the south), the system shows the most stability and least amount of inlets, while the middle of the arc (Hayes’ “apex”) is the opposite (Hayes 1979: 20 – 22; Hayes 1994: 237 - 243). The same arcuate distribution of geomorphic stability vs. instability, and, correspondingly, ancient vs. more recent archaeological sites, is presented here for the barrier island of the IRL.

Thus, for time-constrained, budget-conscious archaeology, such as is common in CHM, coastal geomorphology gives archaeologists a quick and easy guide to identifying ancient versus less ancient BI landforms and shorelines, while for more extensive investigations and archaeological research the unresolved issues of coastal geomorphology are crucial to any theory of early Holocene coastal adaptations. Finally, archaeological data can be used to reconstruct prehistoric BI configurations and improve coastal geomorphology and ecology.
Figure 3-13. Hotel Site (left) and Canaveral Town historic site (right), the only two prehistoric sites on Cape Canaveral not adjacent to the IRL. The Hotel Site is actually road-fill that contained midden (Joan Demming, personal communication 1999). 8 BR 1642 is also suspected of being road-fill with midden.

**Meditating on Maps: GIS, Spatial Analysis and Intuitive Discovery**

Examining the geomorphic stability levels for various segments of the BI quickly revealed the arcuate pattern discussed throughout this text, the same pattern shown by the prevalence of Malabar II over Malabar I in the S-V and Ft.P segments. IRL ecologists report a similar distribution pattern, though they do not refer to it as such. This arcuate pattern quite obviously corresponds to the offshore bathymetric slope, a correspondence that would not be obvious without the map-making tools necessary to put several different kinds of data on one map while also excluding anything unwanted. Discovering such a correlation would have been much harder, perhaps impossible, if this investigator had to consult numerous different hard-copy maps for each piece of information looked into. Conventional bathymetric maps, for instance, are usually about six feet long and full
of information and symbols extraneous to this study. Nor do they show much in the way of continental topography, and so finding correlations between continental topography and oceanic bathymetry would have been much harder. The inflexibility of scale on paper maps is also a hindrance to investigation; GIS allows a micro- and macro-view all in one sitting.

Chaos theory and non-linear dynamics show that shape-based reasoning can be profitably used to investigate the behavior of complex systems whose workings defy the mathematical capacities of the average archaeologist or geomorphologist. Indeed, shape-based reasoning was one of the foundations on which early geomorphology was built. But shape based reasoning is much less linear than propositional logic or computation, and therefore much more open to “intuitive moments” of discovery or mere hunches. GIS greatly facilitates this kind of exploration into the complex system known as the coast since it can reveal whatever shapes are queried by the investigator, allow them or the data behind them to be fully manipulated by the investigator, and, just as importantly, allow the investigator to eliminate shapes and data that are not helping the investigation, and to change scales of perspective instantly.

The arcuate distribution pattern discovered during this investigation is new to the science of the IRL. Instead, ecologists of the IRL have referred to “distance from inlets” as a controlling variable. While valid, inlets are a function of geomorphic instability, which are a function of bathymetric slope (if sea-level, sediments, wave and tide are held equal). Thus, ecologists will be surprised to hear that the bathymetric slope offshore from the current IRL BI exerts a controlling influence on the species diversity and richness of the IRL!
Further, this arcuate distribution pattern challenges the fundamental assumptions of Florida archaeology and 2nd Wave BI theory, for it shows that geomorphic instability is beneficial to estuarine ecology and prehistoric exploitation, and challenges the validity of the “maturation” model of estuarine development c. 4,000 years ago.

**Tracking the Rousean Settlement Shift**

This work began innocently enough as an attempt to use GIS and the State of Florida’s electronic site files to review Irving Rouse’s concept of a shift in settlement from the UStJ and other interior marshes to the IRL during the Late Archaic or Early Woodland Period. Eight maps were generated that seemed to confirm Rouse’s 50-year-old hypothesis. The first four maps, divided into pre-ceramic (Paleo- and Archaic), Orange and Transitional combined, Malabar/Glades I, and Malabar/Glades II/III, plotted only the main prehistoric components of sites. The other four maps plotted all site components from these same four periods. The landscape was divided into UStJ, ACR, and IRL, and the site components were counted. A site was considered UStJ if it was inside or bordering the river basin. IRL sites included Merritt Island locations but not ones on the ACR. Sites along the western edge of the ACR—i.e., also along the eastern edge of the UStJ or interior marshes—were actually counted twice, adding to both the UStJ and ACR categories. This equivocation and statistical fudging were permitted because the number of ACR site components has always been very small compared to the IRL or UStJ, and because a precise distinction is not possible, and also because the “cheating” did not artificially augment the confirmation of Rouse, but rather worked against his hypothesis. That is, the number of interior marsh sites was slightly increased by including western ACR sites, while the number of IRL sites was slightly decreased by excluding ACR sites, even ones directly bordering the west shore of the lagoon. Even
with this slight handicap in the data, the Rousean settlement shift clearly suggested itself in the charts generated from these numbers (same as Figures 3-11 and 3-12, but without the eleven site corrections and two site additions later derived in this study).

An interesting “coincidence” arose when just the primary site components were mapped—the most southern Orange/Transitional site exactly matched the geomorphic transition point between the stable northern IRL BI landforms and the unstable ones as given by Parkinson and White (1990:205; see Figure 3-14). This culture period, of course, is considered transitional from the Archaic to the Woodland, and is often designated as the time during which the Rousean settlement shift began in earnest. In other words, the spatial distribution of a very transitional time period coincided with the geomorphic transition zone between stable (more ancient) landforms and unstable (more recent) landforms.

When all Orange and Transitional site components were mapped (Figure 3-15), however, the southernmost site occurred in Sebastian, an area considered by other geomorphologists as the real transition zone between the stable north and the unstable south (Almasi 1983; Stauble 1990). North of Sebastian to Ballard Cove, the BI is thin and linear, indicating that while this segment is sediment-starved and in danger of future overwash or inlet cuts, the land has nevertheless been stable for some time. The flood tidal deltas behind the Sebastian Inlet and the failed attempt to cut an inlet just north of that are, of course, not part of the natural configuration of the BI and thus cannot be construed as indicators of geomorphic instability. The segment from Ballard Cove north to Hog’s Cove (HC-BC) exhibits the shoreline signatures of geomorphic instability, although perhaps somewhat less fractured in outline than a more recently cut/overwashed
segment such as the S-V or Ft.P segments. In fact, Mayhew found that this segment has actually been prograding for the last 1,500 years (2000). Its inclusion in the stable northern zone by Stauble and Almasi is thus perfectly acceptable.

Information from other culture periods did not prove so coincidentally convenient. The distribution of Glades/Malabar I vs. Glades/Malabar II sites, for instance, did not show the same north-south cut-off noted for the Orange/Transitional sites. While there were more Malabar II than Malabar I sites south of Sebastian, in no sense did Malabar II “spread south” beyond the extent of Malabar I. In fact, the actual pattern seemed to be that Malabar II spread into the middle, so to speak—the two culture periods share the northern and southernmost stretches of the BI in almost equal numbers, while the earlier period, Malabar I, is almost completely absent from the middle segments even on uncorrected site maps (Figure 3-15). Checking the site files and correcting several recording mistakes resulted in no currently detected Malabar I sites existing in the middle segments from Sebastian to the Fort Pierce Inlet. Clearly, then, a simple north vs. south dichotomy of the IRL based on overall geomorphology would not be overly very helpful in investigating the regional distribution of archaeological sites over various time periods.

In terms of the apparent settlement shift to the coast, unresolved issues in geomorphology are absolutely crucial to any prehistoric reconstruction of ancient coastal adaptations or the lack thereof. If lagoons and estuaries have only recently become productive, as per 2nd Wave BI theory, then the Rousean settlement shift is correct, just as the extant evidence shows on its face. If the third wave of BI theory is correct, however,

* For convenience, “Glades” will be dropped, but is implied in all references to “Malabar.”
then issues of a coastal settlement shift cannot be resolved based on mere biological productivity alone. Other factors such as shoreline accessibility and cultural preferences must be considered instead.

Figure 3-14. IRL sites with Orange and Transitional primary components (A). Center (B) is magnification of map on left (A). Right (C) is map of all IRL sites with Orange and Transitional components.
Figure 3-15. Malabar I sites (A) and Malabar II sites (B) from Cape Canaveral to the St. Lucie Inlet, showing the expansion of the latter into the middle sections of the barrier island (i.e., Indian River and northern St. Lucie Counties)

wetlands that separate the barrier island from the mainland typically include both intertidal and subtidal environments” (1994a: 2) which are presumably shore-parallel in aggregate. Fisher and Simpson note that washover sediments typically cover the backbarrier of the BI and not the mainland side of the estuary/lagoon (1979). The oceanic shoreline and offshore areas are also divisible into several migrating sub-zones, as shown in Figure 2-6. The shore system is also temporally bifurcated between a winter (storm) shoreface in which beach sediment is pulled offshore and a summer one in which the sediment is returned and the former beach profile restored (Davis 1994b). The continent, too, can be bifurcated into different zones based upon proximity to oceanic influences in both time and space. A diagram of the fractal bifurcations of the IRL area is presented in Figure 4-2. Note that each of these sub-bifurcations (based on the “original” bifurcation
of ocean and continent) possess their own unique ecological characteristics and productivity levels; they also possess their own characteristic archaeological site densities and distributions as well (cf. Sigler-Eisenberg 1985).

Figure 4-2. Bifurcations of the IRL Area landscape based on continental vs. oceanic influences over geologic time

Another fractal quality of east-central Florida’s coastal system is self-similarity (and variation) across different scales. The Upper St. Johns Basin is thought to have once been analogous to the current Indian River Lagoon (White 1972: 93); William White pointed out an analogous Cape Canaveral-like feature in the Orlando-Lake Wales ridge terrace further inland, visible in Figure 4-3. The Atlantic Coastal Ridge along the western shore of the IRL is considered by most to be a former barrier island (White 1972: Pilkey 2003). Others have pointed out the resemblances between Merritt Island and the Green Ridge and Ten Mile Ridge to the south (cf. White 1972). Changing spatial locations east-
west in peninsular Florida is thus very similar to changing one’s point in time (Brooks and Brooks 1964; White 1972); doing so reveals recurrent shapes and landforms, but with some variation on the basic theme, like a fractal equation “iterated” over geologic time.

![Figure 4-3. Former barrier island chains over the last one million years. From Winkler and Howard 1977, in Pilkey 2003:197.](image)

Perhaps the most striking self-similarity within east central Florida’s topographic features is that between the current oceanic shoreline of the BI and the current lagoonal shoreline of the mainland south of Merritt Island, even to the point of replicating two seemingly anomalous “kinks” in the oceanic shoreline of the BI. The parallelism evident in these duplicated small scale recurvatures (Figure 4-4c) and between the mainland lagoonal and BI oceanic shoreline (Figure 4-4a), as well as the overall parallelism over
Figures 4-4. Tendency towards parallelism in IRL mainland and oceanic coastlines (A) Outline of IRL mainland and oceanic shorelines. Lagoonal shoreline of BI has been erased to emphasize parallelism of both coasts (B) IRL outline with oceanic BI shoreline erased (C) Two anomalous recurvatures duplicated in the oceanic BI shoreline and the mainland shore much of the topography of east central Florida (Figures 2-3 and 3-3) suggests that there is a tendency in this particular BI coastal system towards parallelism, a tendency that strengthens as the barrier island and coastline is driven closer to the mainland. The
parallelism in Figure 4-4a is all the more striking given the great amount of variability in
the width of the BI and the lagoon between Merritt Island and the St. Lucie Inlet (Almasi
1985; see Figures 4-4b & c). By corollary, it would seem that those portions of this BI
system with oceanic shorelines that are least parallel to the mainland lagoonal shore
(Figure 4-4a) should be under the most systemic pressure to retreat to the mainland so as
to maintain stricter parallelism. If true, then shape-based logic can be used to generate
non-mathematical predictive models, and Pilkey and Dixon’s caution against US Army
Corps’ and other coastal engineers’ repeated failures to predict short-term beach behavior
(Pilkey and Dixon 1996) need not leave us completely despairing of any predictive
abilities whatsoever.

Cuspate shorelines exist at numerous spatial scales as well, from individual beach
cusps caused by the regular spacing of returning rip currents, measured in tens of meters
(Figure 4-5), to the cuspate shorelines of the PAFB-HC segment, some of which are over
a kilometer long (Figure 4-19), to the cuspate shorelines of the southeastern United
States which measure hundreds of kilometers (Figure 4-6). Fractal logic asserts itself here
once again, for while all these cases occur at different spatial scales and under different
proximate causes, they are all similar in shape and are all indicative of relative
g geomorphic stability at that scale. Miles O. Hayes’ arcuate model of the Georgia
Embayment is similar to the arcuate erosion patterns of cuspate shorelines at all scales—
the middle of the arcs erode and retreat landward while the cusps prograde slightly
against the water. The erosional nature of cuspate shorelines and its effects on
archaeological sites is discussed in the next sub-section.
Figure 4-5. Small scale beach cusps due to regular spacing of rip currents. From Pethick 1984.

Figure 4-6. Large-scale cuspatc shorelines along the Carolina Coast.
Interestingly, the smaller-scale manifestation of barrier spit-like formations (tongues of sediment/land attached to cuspate spits or headlands at acute angles) and shore parallel islands occur on this BI system in its zones of highest geomorphic instability. Looking at an aerial photo of the HC-BC segment (Figure 4-7), we see “mini-barrier islands” pulled away from protruding landforms by the flow of nearby inlets now closed. Magnifying and inverting them results in Cape Canaveral-like features—a headland with a tail of extruded sediment. Shore-parallel islands, which are characteristic of overlapped flood tidal deltas, while not visually resembling the BI’s of eastern Florida, are at least conceptually similar, and do bear some resemblance to the kind of BI’s that
develop under meso-tidal conditions, such as in SW Florida, a resemblance worth mentioning given that both formations are the result of stronger tidal influences, albeit at different spatial scales. This point will be reconsidered when discussing the BI system of the Paleo-Indian and Early Archaic eras, when tidal influences were stronger, later in this section.

“Fractal dimensionality,” which essentially means “squiggliness” or “crinkliness” (technically defined as the extent to which a normally one-dimensional line fills up two dimensional space and thus takes on some attributes of a two-dimensional plane), and its converse, linearity, are also useful indicators of east central Florida’s geomorphic history. Differences in coastal linearity have been used by geomorphologists as an indication of erosion long before chaos theory (cf. Parkinson and White 1994). We have already seen that a relatively low fractal dimensionality on the cuspate lagoonal shore of the Cape and PAFB-HC segments indicates a relatively long period of stability. Comparing the linearity of eastern versus western terrestrial contours and oceanic bathymetries, linearity increases as one goes west from offshore bathymetry to current BI to ancient BI (the ACR) to most ancient shoreline (Talbott terrace). Thus, the bathymetric features corresponding to the Cape and the S - V segment are both much more arcuate (convex) in their bathymetric contours than in their current BI configuration, slightly more arcuate than in their analogous ACR formation, and even more so than the slight bulge in the Talbott Terrace (Figures 2-1 and 2-3).

What this suggests for archaeological interpretation, and what the site distribution patterns confirm, is that current BI configurations are straighter, less curved, less “arcuate” than more ancient ones, and that the likely direction of future BI morphologic
development is towards more linearity and parallelism, as per the ACR and other inland topographic features. Thus, it was those areas of the BI south of the Cape that were most outwardly curved (Hog’s Cove to Vero Beach, or HC-BC + BC-S + S-V) which were also most susceptible to recent landward migration (instability) as the coast tried to straighten itself out, so to speak. At two points along the coast, near St. Lucie and Vero Beach (Figure 3-4), it even appears that the more stable areas to the south have had to “catch up” with the rapid retreat of the more unstable central segments to its north by “pivoting,” forming an anomalous twist or recurvature in the otherwise linear BI coastline, which normally only recurves around headlands such as Cape Canaveral.

The most important similarity between fractal boundaries and the estuarine/lagoonal boundaries of oceans and continents is the incredible diversity and productivity of both of these areas. In fractal iterations of the now-famous Mandelbrot sets, these boundary areas are actually infinitely complex—repeated iterations of the formula give greater and greater levels of detail that, while similar to the details of the larger scales, are nonetheless different and unpredictable enough to contain new shapes and new information ad infinitum (Figure 4-1). Biologically, the intersections of water and land are the most highly productive areas on the globe (Odum 1988). According to some experts, estuaries are among the most biologically productive habitats in the world (Figure 4-8), hence oil companies’ interests in finding ancient ones (Morton 1994). The otherwise “harsh” difference between land and fresh water on the one hand, versus ocean, salt and sand on the other is mediated by the highly productive estuaries which mix fresh and saline waters together, forming sediments that are a mix of sand and organic peats, and waters that continually exchange fresh and saline.
In addition to biological abundance, the IRL also boasts an exceptionally rich diversity of species. The incredible biodiversity of the IRL (Virnstein 1990; IRLNEP 1996) is often attributed to its transitional location, its generally north-south orientation, and its elongate configuration perpendicular to various oceanic, climatic, and geographic boundary lines (Virnstein 1990). In other words, the IRL resembles a fractal mixing zone both east – west (ocean vs. continent) and north – south (southern temperate vs. subtropical; or Carolinian vs. Caribbean). Mixing zones and boundaries are an important subfield within chaos theory and non-linear dynamics.

“When scientists moved from the Mandelbrot set itself to new problems of representing real physical phenomena, the qualities of the [Mandelbrot] set’s boundary came to the fore. The boundary between two or more attractors in a dynamical system served as a threshold of a kind that seems to govern so many ordinary processes, from the breaking of materials to the making of decisions. Each attractor in such a system has its basin, as a river has a watershed basin that drains into it. Each basin has a boundary. For an influential group in the early 1980’s, a most promising new field of mathematics and physics was the study of fractal basin boundaries…At the boundary there is life.” (Gleick: 1987: 232 – 233).
It is argued here that barrier islands and lagoons embody the qualities of fractal basin boundaries, and that, following Pilkey and Dixon, much of the thinking and the debate on BI’s and coastal geology has been limited by the reductivism of linearization or “engineering approaches” (1996). Linear science has been puzzled, if not stumped, by the origin of barrier islands (Davis 1994a & b; Parkinson and White 1994; Pilkey and Dixon 1996); even their short-term behavior is hard to predict with any confidence. Nonlinear dynamics, however, would expect just such energy-dissipating formations on the dynamic boundaries of two steady states, and would instead be puzzled by their supposed non-existence during the Paleo-Indian/Early Archaic era in this study area. Lest one object to the “fuzzy,” shape-based, impressionistic thinking implied by resorting a lay understanding of fractals and nonlinear dynamics, math-heavy “hard science” is not
without its problems, even for short-term beach models, according to Orrin Pilkey in an address he gave to the American Association for the Advancement of Science (“Duke Geologist Decries Using Engineering Models to Predict Natural Phenomena,” ran the headline for the 1999 press release [Pilkey 1999]). In that paper and in his 1996 book on U.S. shoreline policies, Pilkey also stressed the need for coastal geomorphologists to embrace or at least consider chaos theory when explaining and predicting shore behavior. For this study, there are at least two important implications of Pilkey’s approach: 1) If math-heavy engineering approaches to coastal geomorphology are dangerously unreliable for periods as short as 15 years, then such approaches will be of even less assistance in exploring the BI and lagoons of prehistory; 2) Chaos theory is not only useful for coastal geomorphology and other scientists, it is also useful for introducing the topic to non-specialists (hence its use in the press release cited above).

It should be noted, however, that while Pilkey and Dixon are deploying chaos theory in order to reign in the wasteful overconfidence of “can-do” American engineering approaches and the over-simplicity of their mathematical models, there is another side to chaos theory other than the ultimate unpredictability of otherwise orderly systems—there is also the tendency towards order, emergent order and/or self-organization in seemingly chaotic systems (Gleick 1987). Interestingly, the patterns and regularities lurking beneath the choppy surfaces of chaotic systems are most often found in spatial, shape-based patterns that arise when the system is analyzed or mapped from the broader perspective of a higher dimension, or from several different dimensions at once. Hence the confusing references to “phase space diagrams” in chaos literature, where the behavior of a chaotic system is mapped on a grid often using the extra dimension of imaginary numbers (which
are based upon the impossible square root of negative two). Such phase space maps have many characteristics similar to Mandelbrot’s fractals—lines in phase space maps prove to be infinitely open to bifurcation under increased magnification (accomplished via increased reiterations of the underlying formula or system, as in fractals, see Figure 4-1). As one “chaologist” put it, “if you understand the shape, you understand the system” (Gleick 1987).

With coastal geomorphology, at least in east central Florida, one “extra dimension” needed to make a kind of phase space map of the chaotic behavior of modern coastal systems is, of course, geologic time, and the use of shape-based reasoning for prehistoric reconstruction goes back to the earliest days of the discipline in the 19th century, long before chaos theory. In that regard, the latter merely refines and reaffirms, via numbers and computers, the validity of investigations into complex systems based not just on numbers but on shapes and spatial patterns as well. But chaos theory also provides a sort of “comparative method(s)” for understanding the behavior of numerous (all?) complex systems, since many features are common to all such systems, including the coast—bifurcation, self-similarity across spatial and temporal scales, infinite complexity at boundary zones, self-organized energy-dissipating structures therein, input-output uncertainty, exceptions within systems generalizations, long-term unpredictability, and “non-equilibrium but persistence,” contra the old insistence on equilibrium in pre-chaos systems theory (Gleick 1987; Barker and Gilbertson 2000). With these implications from chaos theory in mind, both “negative” (agnostic unpredictability) and “positive” (regularity-revealing, often via shapes) it is useful to look more closely at the controversy
concerning BI origins and the three or four background conditions considered necessary for BI’s to form:

Barrier islands are a common coastal configuration on the trailing edge of drifting continents such as the east coast of North and South America (Davis 1994b: 153), but barrier spits also occur on some leading-edge continental plates as well, such as the western coast of the United States in Oregon and Washington (Davis 1994a: 2-3). They also occur in the Great Lakes of North America (Davis 1994a: 1). In fact, they will develop “in any geologic and tectonic setting that has plenty of sediment, agents to transport it, and a site where it can accumulate:” (Davis 1994b: 166). G.K. Gilbert found traces of barrier islands in the ancient Lake Bonneville of Utah. Fifteen percent of the world’s coasts are fringed by barrier spits and islands (Davis 1994b: 166). They occur in all latitudes and on all continents except Antarctica (Davis 1994a: 1). Most of the eastern coast of North America is fringed by barriers, forming a more or less continuous chain of

Figure 4-10. World Wide Distribution of Barrier Islands and Tidal Levels. Question marks indicate areas with BI’s that are also possibly macrotidal, a condition generally inimical to BI formation. From Hayes 1979.
estuaries and lagoons from Massachusetts to Mexico (Clark 1976), one of the longest and most unique in the world (Godfrey 1976).

The function of a BI, teleologically speaking, and any beach for that matter, is to absorb and dissipate the tremendous amount of oceanic energy that would otherwise slam against the mainland directly (Clark 1976; Davis 1994: 153). BI’s are tremendous energy-dissipating systems, which is an important sub-field within non-linear dynamics and chaos theory (Gleick 1987). Many coastal geologists have noted that beaches are vastly superior at dissipating coastal energies than are man-made walls, as they constantly reshape themselves in response to different energy budgets while rigid walls inevitably fail (Pilkey and Dixon 1996).

Another function of a BI and lagoon is to entrain continental run-off (water and sediments) that would otherwise flush directly into the ocean. Sediments tend to settle out as streams and rivers lose their velocity upon discharge into the estuary or lagoon (Freeman and Lynde 2003). Instead of the mainland losing all its fine-grained and organic-laden sediments directly into the ocean, lagoons trap that sediment, “losing” it only when overwashed by oceanic sediments, under which it is then buried and compacted, producing hydrocarbons for later geologic eras. Stauble’s summary of his own study of sediment flows in and out of a BI tidal inlet in this study area (the man-made Sebastian Inlet) is worth quoting for it shows that even at tidal inlets, where ocean and lagoon directly mix, lagoons manage to retain fine-grained continental and organic sediments, rather than discharge them directly into the ocean:

“…the flood tidal currents transport sediment from the ocean though the narrow throat section [of the inlet] into the lagoon. As the flow enters the larger lagoon from the restricted throat section, the velocity slows and the sediment is hydraulically sorted and deposited in a fan-like pattern (Stauble et al. 1987). The
coarsest and most poorly sorted material is deposited immediately adjacent to the throat. The grain size distribution decreases, while the sorting increases as the tidal flow slows. The finest clean quartz sands, with some shell material, is found on the shoals [of the flood tidal delta] while coarser material is found through the channels of the delta. Since the lagoon is shallow, returning ebb flow [towards the ocean] does not reach significant velocity to transport sediment back to the ocean until it is well in the throat section. Therefore, little transport of lagoonal sediments into the ocean occurs” (Stauble 1990, emphasis added).

Theories of BI origins are controversial according to geologists’ own admissions—“discussed in scientific literature for more than a century… there is [still] no common agreement as to the primary mode or modes of origin” (Davis 1994b: 168; 1994a: 1, 5). Three theories were first proposed in the 19th century and have been argued over without resolution: 1) wave-generated sandbars accumulating to the point of becoming supertidal and then later vegetated and stabilized; 2) the drowning of already in-place dunes and ridges; and 3) spit formation from a headland elongates and then becomes cut and detached. This latter theory is commonly used for the BI in this study area (Stauble 1990) although Davis claims it is generally not applicable for most of the eastern US coast (1994b: 168), while Pilkey and Dixon (1996) take an opposite view.

Another type of “antecedent landscape” theory (i.e., related to #2 above) is often used for the IRL BI when various writers talk about it being “perched” above the partially lithified Anastasia Formation of 120,000 B.P. (Almasi 1983; Davis 1997: 158; Eck et al. 1998). Both Parkinson and White (1994) and Mayhew (2000), however, found little evidence for preexisting topographic relief in the IRL. Chaos theory is equivocal in this regard: extreme sensitivity to initial conditions is characteristic of all non-linear systems, and thus antecedent topography should be an important consideration; and yet the similar recurrence of persistent, self-organized, energy-dissipating fractal boundary systems is something to be expected of most natural systems, so chaos theory also liberates us from
the need for a simplistic “cause” such as a lithified older BI anchoring down current ones. Also, if massive seawalls have proven themselves useless against even short-term shoreline retreat (Pilkey and Dixon 1996), looking for natural sea walls as an explanation of long term shore behavior seems dubious. Antecedent topography without chaos theory also fails for begging the question—if the current BI is based on previous BI locations, what was the original one based on?

On the regional scale of this study, Parkinson and White found that the BI model predicated on in-place drowning of pre-existing barriers did not match the data from their sediment studies. Their study, based just south of the Fort Pierce Inlet in this study area (Figure 3-5), found very little evidence for preexisting topographic relief. The layer-cake stratigraphy of alternating lagoonal and overwash sediments (Figure 4-25) suggested that the model based on erosional shoreface retreat was more appropriate for South Hutchinson Island (the name of the BI segment from the Fort Pierce to the St. Lucie Inlet). Field and Duane (1976) found evidence for relict barriers out on the Atlantic Shelf, suggesting to them that barrier islands migrated towards shore over great distances as sea levels rose. But the random angles of intersection between Holocene and pre-Holocene coastal configurations led them to also conclude that pre-existing topography was a minimal factor at best in the location of present BI’s (Field and Duane 1976: 701). The archaeological data from this study also points towards that model for the late Holocene BI in this study area, albeit not retreating over exceptionally “great distances” since c. 4,000 BP; it also pinpoints segments of the BI that have retreated further than other segments—the middle of the arc, from Sebastian to the Fort Pierce Inlet (Figure 4-12).
The current “consensus” over BI origins seems to be that multiple causes are operative on a global scale (Schwartz 1971, in Davis 1994a: 6), but four general conditions always pertain: 1) a low gradient of bathymetric slope, generally between c. 0.001 and 0.005 (Gregory 1984), 2) a supply of sediment, such as an eroding headland, 3) relatively stable sea levels (2nd Wave theory) or rising sea levels (3rd Wave) and 4) an energy regime based on wave rather than tidal power. These four background conditions necessary for barrier island development—gentle slope (provided by coastal plains), sediment supply, relatively stable (or rising) sea levels, and an energy regime dominated by wave rather than tide—each have important implications for the archaeology of this area. BI’s on coasts with a steeper offshore slope (within the limits) do not retreat as quickly under rising seas as on coasts with a gentler slope since there is less horizontal difference per same unit of ocean rise. Hence the west coast of Florida has retreated landward at a much greater rate than Florida’s east coast (Figure 4-11), and thus has always been less geomorphically stable. The implication of this is that within the coastal zone of east central Florida, those areas that have flatter offshore slopes (i.e., more space between bathymetric contours) have retreated to the mainland over greater distances and

Figure 4-11. Profile of the Florida Peninsula at 28 degrees latitude (near Hog’s Cove in this study area), showing much greater shoreline shift in west Florida (left) than East Florida (right). From Schmidt 1997.
have thus been geomorphically less stable than those areas of the east central Florida BI that have steeper bathymetric contours. This corresponds to the “prediction” in the above paragraph based on linearity—the S - V segment also has the widest offshore bathymetries. Conversely, the area with the steepest offshore bathymetric contour is along the PAFB - HC segment, one of only two segments of BI to have remained stable and undergone progradation since 5,000-7,000 BP (Mayhew 2001).

We should also note that the bathymetric contours become steeper once again as one moves south out of this study zone into Martin and Palm Beach counties (Figure 4-12) where the BI is eventually welded onto the shoreline. The implication is that the southernmost part of the BI has transgressed over much less lateral distance than to the north, inside this study area, and thus this part of the BI has in a sense “pivoted”—its northern part having transgressed at a rate similar to the BI in St. Lucie County, while its southernmost portion in Martin and Palm Beach counties has remained more stationary during the Mid to Late Holocene. Archaeological evidence of greater antiquity can be found in the Hutchinson Island Burial site (8 SL 37) in the southernmost part of the Martin County BI, where Transitional and “possible Archaic” remains have been discovered (Pepe 2000a). Michael Russo and Gregory Heide’s investigations at the Joe Reed BI site in Martin County to the south have returned carbon dates nearly 4,000 years old (2002). The predominance of Malabar I over Malabar II south of the S – V segment in existing site data (Figure 3-5), and the complete absence of pre-Malabar II sites between the Sebastian and Ft.P segments, also suggests that the southernmost part of the BI has retreated more slowly than the central S – V and Ft.P sections. As mentioned, pivoting is also implied by the anomalously recurved shape of the barrier island opposite
the mainland towns of Vero and Stuart (Figures IV-4a-c). Geomorphically, this southernmost zone has a semi-cuspatc shoreline (Stauble 1990), finer sized sediments indicating more terrestrial input and BI stability (Stauble 1990), less tidal prism (Smith 1990), less inlet activity, and less cartographic evidence of ancient inlet activity.

Figure 4-12. Offshore slopes in study area

Two other important implications of coastal offshore slope gradients: one, during times of decelerated sea level rises (i.e., the Early-Mid Archaic) BIs should form (2nd
Wave BI Theory) or attain stability (3rd Wave theory) on steeper slopes somewhat earlier than on coasts with shallower slopes (Widmer 1988), and thus data from western Florida (timing of BI/estuary development or stability, etc.) are generally more recent than that for eastern Florida, especially in its central and southern portions—to the north, the offshore slope becomes very broad as one moves north into NE Florida and the “Georgia Bight” (Hayes 1994: 233 - 243), although sediment supply is more abundant in the latter (Figure 4-13). Second, the steepness (indicating geomorphic stability) of the bathymetric contours offshore from the PAFB-HC segment relative to the broadness (geomorphic instability) offshore from the S-V segment reverses itself as one moves east (i.e, back in time) beyond the 60 meter contour, as seen in Figure 4-12. Thus it is likely that while the PAFB-HC segment has been one of the most stable landforms of the east central BI system since c. 7,000 B.P, prior to that time it was one of the least stable. Conversely, the S-V segment, the most unstable segment of this BI system for the last 7,000 years, was probably among the most stable during this same 10,000 B.P. – 7,000 B.P. time period (i.e., the 100 meter to 60 meter contours; see Figure 4-21 for sea level curves).

Sediment supply is the second necessary background condition for BI development, and it too, carries some important archaeological implications. Figure 4-13 shows the decreasing rates of longshore sediment transport as one moves south down the east Florida coast. We should note two major drops in sediment levels—one around the Cape Canaveral headland, and the other around the headland surrounding Palm Beach. We should also note that the rate remains constant from Vero Beach to Palm Beach, meaning that the curved protrusion of BI called the S-V segment in this study (protrusion not visible in Figure 4-10, but see Figure 2-3) is currently not enough of a protrusion to
create a significant sediment shadow as does Cape Canaveral, and thus transgression and
retreat characterize the entire BI south of Sebastian, but with different degrees of retreat
therein. 8,000 years ago, however, the S-V segment was more curved and stuck out
further east (Figure 4-12), possibly enough to shadow the segments below it; this may
partly explain the greater antiquity and stability of those landforms relative to the S-V
and Ft.P segments to its north. Now that the S-V segment has retreated to the point of no
longer being any kind of headland, the BI to its south is more exposed and probably
needs to retreat again (as per the arguments based on parallelism). This might explain the
infrequency of currently detected archaeological sites of all culture periods on
overwashed segments from this area—i.e., the overwash/retreat has been taking place
since Contact times.

Figure 4-13. Sediment budget of Florida’s east coast, in cubic meters/year. From Davis
1997

Relatively stable sea levels are considered necessary for BI development according
to 2nd Wave BI theory, but measuring average global sea-level rise is so complex that
experts now insist on only location-specific data and correlations (Almasi 1983: 191; Kellogg 1988: 82, 93; Griffin 1988). Many other factors besides melting of the polar ice caps are responsible for fluctuating ocean levels: oceanic temperatures can increase the same volume of ocean water by two feet per one degree increase Celsius, and Pleistocene ocean temperatures may have fluctuated as much as 10 degrees (Emiliono 1955, in Brooks and Brooks 1964). There are also problems caused by isostatic rebound, ocean floor subsidence, tectonic plate movements, sediment-loading of the continental shelves, etc. (Almasi 1983: 191; Davis 1994). Fortunately, the Florida shelf is tectonically stable, and has experienced very little in terms of continental rebound and other such obfuscatory processes (Davis 1994; Schmidt 1997: 25).

Unfortunately, much of the data for creating sea-level curves, especially the Fairbridge one, is based upon problematic evidence (Kellogg 1988: 82-87) such as prograding beach ridges, which, as we have seen, are not simple linear phenomena that reflect ocean levels in a one-to-one fashion. Thus Brooks (1972) used the Cape Canaveral ridge-and-swale topography to support Fairbridge’s oscillating curve (Figures 4-21 & 40), yet Stauble (1990) and others have noted that the southern shore of Cape Canaveral has prograded many meters in the last 150 years, a time during which ocean levels have begun to increase their rate of rise—certainly no still-stand or recession. Numerous other barrier islands worldwide (and thus beach ridges as well) have been created within the last 150 years of rapidly rising sea levels (Gregory 1984; Gibbs 1997).

The final background condition needed for BI development is an energy regime based upon higher wave energies than tidal energies (Figure 4-14). East Central Florida is positioned in a favorable microtidal zone, as shown in Figure 4-10, and is thus a wave-
dominated coast. West Florida experiences more tidal variation and smaller waves and thus is classed as both micro- and mesotidal (Figure 4-10). High tides and low wave energies are called macrotidal, and are considered unfavorable for BI development, although Figure 4-10 shows some barrier-fringed coasts in possibly macrotidal areas. Tidal influences are thought to have been generally stronger during the late Pleistocene/Early Holocene, and thus BI development/stability was inhibited. But again, east Florida, especially in the center and south, with its higher wave energies and lower tides (Davis 1994a) should have had less inhibition to BI development during the Paleo-Indian/Early Archaic than western Florida, northeast Florida, or the Georgia Embayment, since mesotidal conditions prevail north of Matanzas inlet (Davis 1997), although, again, the higher sediment budgets of northeast Florida may have offset this handicap.

Figure 4-14. Davis and Hayes’ (1984) chart of wave vs. tide conditions favorable for barrier island formation.
It should also be noted that Davis and Hayes’ wave/tide diagram (Figure 4-14) is a typical sine curve representing the behavior of a complex, non-linear system. Chaos mathematician Mitchell Fiegenbaum found that all non-linear systems behave according to these sine curves, and that if the values for both axes are significantly increased, predictable, universal patterns of bifurcation and chaos follow (Figure 4-15). This is known as the principle of universality. It is counterintuitive to say the least—why should incredibly complex, and vastly different non-linear systems, whose individual behavior is ultimately unpredictable according to chaos pioneer Edward Lorenz (Gleick 1987), behave according to the same overall patterns, predictable on a two-dimensional graph? The answer is that “there is a tendency for complex systems to resolve themselves along one dimension” (Gleick 1987) a statement which certainly has strong implications for studies on BI origin and development (and perhaps even anthropology if culture is conceived as a complex non-linear system). If we place Davis and Hayes’ sine curve inside a typical sine curve (i.e., nestle Figure 4-14 inside Figure 4-15), the implication of the universality principle for the debate on BI origins is that there was likely a time early in the Holocene when BI development was “bifurcated”—either appearing and disappearing (the traditional view anyway), or, more likely, reconfigured in a manner somewhat different than at present (Figure 4-18).

There are some inadvertent references to such a period of bifurcation and instability in the literature on coastal geology and BI origins: Gilbert (1885, in Parkinson & White 1994) and Swift posit a “surf-zone jump” whereby preexisting barrier islands are submerged in situ by rapidly rising sea levels and reformed along the new surf
Figure 4-15. Typical sine curve representing the behavior of a complex system, in this case population dynamics. All complex systems behave according to similar sine curves, with similar ratios of period doublings, bifurcations, and chaos (the Feigenbaum constant). It is argued here that Davis and Hayes’ sine curve of tide vs. wave power (Figure 4-14), if extended, would obey these same universal patterns. Figure and text from Gleick 1987:59.
zone closer to the mainland. But Fiegenbaum’s principle would apply to more than just sea-level rise—any increase in the wave/tide ratio beyond the normal conditions plotted in Davis and Hayes’ chart should result in a “period two” phase of bifurcation. Of course, a momentarily large input of wave energy often does literally bifurcate the BI/lagoon system by cutting an inlet through it, or overwashing oceanic and shoreline sediment onto its backbarrier, but a sustained period of large wave inputs is likely to have reconfigured the entire system in a bifurcated manner (Figure 4-18).

Randolph Widmer, writing about the Calusa of southwest Florida, and using Gagliano’s geomorphic information and interpretations, noted that there may have been periods during the Early Holocene when BI’s came in and out of existence ephemerally, due to the rapid rate of sea level rise (1988). It is unlikely that Widmer got his source or his inspiration from Fiegenbaum or chaos theory—he probably was thinking of Swift and Gilbert’s 19th century surf-jump model—but it is clear that BI and coastal specialists, geological and archaeological, can derive much benefit from chaos theory and non-linear dynamics.

To be fair, an alternately appearing/disappearing BI complex for east central Florida during the Early Holocene, while not adopted here, does not necessarily contradict the sedimentary evidence from the IRL, nor does it militate against acceptance of the erosional shoreface retreat model as Parkinson and White seem to assume (1994). The former model could work best for the unstable seas of the late Pleistocene and early Holocene, while the latter could hold true for the more stable seas of the last 8,000 or 6,000 years ago, as per 2nd Wave BI theory. The two authors note that current eastern U.S. barrier islands, Fire Island NY in particular, have retreated “as much as 10 km”
(1994). This is a considerable distance less than that between current BI locations and presumed Paleo-Indian shorelines (cf. Milanich 1994:39), leaving a lot of time and space for other coastal processes to occur. Figure 4-16a shows submerged ocean floor features indicative of reefs, spits and other shore parallel coastal formations from the IRL Area.

Figure 4-16. Relict BI or reef features of the IRL (A). From Gilmore 1995. Relict BI’s off southwest Florida (B). From Gagliano in Widmer 1988.

Figure 4-16b shows similar formations from the southwest Florida coast that Widmer and Gagliano considered to be submerged barrier islands from the early Holocene transgression. Both Mayhew and Almasi found initial transgressive facies underlying even the stable prograding areas of the PAFB-HC segment, indicating to them inundation by the rapidly rising ocean c. 7000 BP, after which the BI formed behind this flood impulse. An alternately appearing/disappearing BI system prior to the mid-late Holocene would not contradict this information, as it too would also leave initially
transgressive facies throughout the IRL BI system. A different model is now presented, however.

It should noted again in this context that estuarine life (such as oysters and clams, for instance) is highly adapted to unstable geomorphic conditions—overwash and inlet events producing especially productive salt marshes, mangrove stands, mud flats, oyster reefs, sea grass beds, etc., upon which most higher trophic creatures such as man directly or indirectly depend. The thickness of a typical clamshell, for instance, is directly related to the dynamic geomorphic conditions under which it normally flourishes, allowing itself to close up and survive turbulence and/or change locations when needed by tumbling with strong currents (Griffin and Miller 1978). If lagoonal and estuarine ecosystems flourish under geomorphic instability (Godfrey 1976; LaRoe 1976), even depend on it in terms of inlet cuts and oceanic interchange, it is illogical (though admittedly not impossible) that lagoons and estuaries did not exist or were not biologically productive in the past due to highly unstable ocean levels. “We are learning that most natural ecosystems of barrier islands are capable of surviving sea level rise, storm flooding and sand migration…These communities are unique in that they can respond to powerful forces without being destroyed by these forces. The barrier island ecosystems may not remain in the same place over time, but they have persisted and will continue to perist, through time” (Godfrey 1976: 5). Or, as archaeologist Elizabeth Reitz expressed it, regarding the Carolina Province “Estuaries and salt marshes may have become more extensive [during the Late Archaic] and they certainly have been relocated but they are too important in the life cycles of Carolina Province organisms to be a new ecological type.” Rather than a depauperate Early-Mid Holocene coastal estuarine system, Michael
Russo has argued: “In fact, mid-Holocene coastal cultures were widespread along the Gulf and Atlantic coasts and represent some of the most permanent sedentary societies of the time… The rapidity of sea level rise as an obstacle to pan-regional estuarine development is questionable” (1996:178 – 179). Within this study area, almost all ecological indices of diversity and production coincide with levels of geomorphic instability—highest in the middle and lowest at the ends.

Field and Duane found much greater evidence for Late Pleistocene/Early Holocene BI’s off the mid-Atlantic coast than off the southeastern US coast, where “based on the absence or scarcity of Holocene lagoonal deposits on the south Atlantic shelf, that coast many times apparently had no barrier islands along the Holocene shoreline, and those that did exist probably had a short survival time” (1976: 701). A different hypothesis for the lack of early Holocene lagoonal sediments offshore that does not assume an absence of BIs and lagoons is included in this Early Holocene model.

- It has already been shown that drastic BI modifications such as inlet cuts and overwash can occur in a matter of minutes or hours. The most rapid rise in Paleo-ocean levels is thought to have been around 100 cm per century (Widmer 1988; Davis 1994a). The current rate of rise, as mentioned, is about 25 or 30 cm/century, while on the coast of Texas, near Galveston, the rate of rise is about 60 cm/century due to groundwater removal by Houston (Pilkey and Dixon 1996: 14); yet even this rate of rise has not resulted in any “surf-jumped” barrier islands. Each year, seasonal differences in air and ocean temperatures result in “mean sea levels along coasts throughout the world typically show[ing] seasonal differences of 10 to 30 centimeters” (Davis 1994b:42). Since inlets and overwash occur so quickly, albeit dependent upon storms to occur (Riggs 1976), it is hard to see how constantly shifting inlets and repeated overwash events could not keep apace with such “quickly” rising ocean levels.

- We have already seen that wave power is not inimical to BI development or preservation; tidal power is. In fact, large waves that overtop the BI do not destroy it but rather strengthen it by replenishing it with sediments, albeit thinning the lagoon behind the BI. It is inconceivable that ocean levels could rise without the effect of such rise being transmitted into larger wave energies slamming against the coast (see Figure 4-17). Further, since Late Pleistocene/Early Holocene
environmental conditions were windier due to a compressed thermal gradient between the ice caps and the equator, coastal wave energies were likely higher. Such large wave energies would merely replenish the backbarrier with sediment.

- Headland shadows and converging/diverging littoral currents almost certainly existed in the Early and Middle Holocene as they do today (Figure 4-23); these convergence zones would be likely to support BI development, even under 2nd Wave theory, no matter what the rate of sea level rise and its presumed inhibitory effects.

- Deep, “heavy breathing” inlets that continually broke through the shoreline and rapidly migrated downdrift would scour away any lagoonal deposits that existed there previously. While Parkinson and White noted that inlets can scour as deep as 10 meters (1994), a hypothetical inlet scour of only 3.5 meters deep at Parkinson and White’s St. Lucie BI location would remove all Holocene sediments, leaving no trace that a BI ever existed there (Figure 4-25). These authors also note that lagoonal sediments near inlets are less muddy than away from inlets. If inlet cutting was more prevalent than overwash during rapidly rising seas, then Early Holocene lagoonal sediments should be less muddy and thus less easily detected than later ones. BI preservation is also much better under overwash conditions than inlet cutting events since overwash events really only truncate the front part of the beach (Pilkey 2003).

- Other, non-linear compensatory processes associated with quickly rising sea levels are predicted by typical non-linear systems behavior—an increase in sediment load for every increase in ocean level, for instance, should offset any BI-inhibiting effect of rapidly rising sea levels. Pilkey and Dixon’s “dynamic equilibrium” model below would suggest that any increase in sea levels leads to an increase in wave height relative to the shore which leads to greater portions of the shore eroded which results in greater sediment supply, etc. The implication is that BI’s could withstand any rise in sea level since sediment supply would keep apace.

Figure 4-17. Pilkey and Dixon’s diagram of the dynamic equilibrium of beach systems (1996).
Thus, rather than no BI at all, or simply a modern-looking one that appears and disappears, the unstable Paleo-Indian/Early Archaic coast might instead have looked like the IRL’s currently most unstable section—the S-V segment—writ large (Figure 4-18). Note that in much of the S-V segment the lagoon itself is physically bifurcated such that the main tidal creek—creeks caused by the tidal pull of nearby inlets—known as Spratt’s Creek, parallels what would normally be the main channel of the lagoon but which has been so filled in with inlet sediment that it is more like a shallow marsh, and is actually bypassed by the Intracoastal Waterway in favor of Spratt’s Creek. The BI itself is also bifurcated into one contiguous landmass on the oceanic side and an archipelagic group of tidal islands on the lagoonal side.

![Figure 4-18](image)

Figure 4-18. Hypothetical reconstruction of wave-dominated BI system during rapidly rising seas of Early-Mid Holocene (A), based on current configuration of the unstable S-V segment (B) and bifurcation principles of chaos theory.

Prehistoric reconstructions of the Late Holocene BI based on archaeological data are given at the end of Chapter 5 (Figure 5-1). Since there is no archaeological data on the BI prior to c. 4,000 B.P., the reconstruction of the BI for that time period in Figure 4-
Coastal Geomorphology and its Archaeological Implications in East Central Florida

Archaeology and geomorphology are especially important to each other for studying barrier islands and the lagoons, estuaries, and bays that they enclose (cf. Kellog 1988: 87). “Quite young” (Davis 1994: 167) and “sub-mature” (Johnson 1919 in Cotton 1954: 68) by 1st and 2nd Wave geologic standards, barrier islands and lagoons develop and change at rates much faster than most terrestrial landforms commonly inhabited by people (Davis 1994; Pilkey 2003), and much more in tune with the human time scales (Parkinson 1995: 28) that archaeologists can detect or hypothesize about in Holocene culture periods. In fact, many coastal geomorphologists have agreed that their sub-discipline needs to employ a three-scale hierarchy of time periods, one for events and changes that occur in matters of minutes and days, another scale for changes that take from several decades to a couple centuries, and another scale for changes that typically take a few centuries or millennia to complete (Davis 1994: 2-3; Schumm and Litchy 1965 in Pethick 1984). This, of course, is the exact same three-scale time model that was suggested by Annales historian Fernand Braudel for the study of human history (Braudel 1980), and which has gained much currency in recent archaeological theory (Knapp 1992).

The geomorphology of barrier islands and lagoons is so dynamic—the most dynamic landform on earth according to Orrin Pilkey (2003)—that it exerts a controlling influence on the ecology (LaRoe 1976) and archaeological record of such coastlines. Under rising sea levels, BI’s migrate towards the mainland though a combination of the relatively steady processes caused by long shore current (depositional and erosive), plus
the chaotic actions of storms, northeasters and hurricanes, which cause inlets to be cut and/or the barrier island to be overwashed, all set against a background of fluctuations within the overall rise of Holocene sea levels (Figures 4-21 and 40). Both these chaotic and steady landform modification processes leave distinctive BI shorelines, configurations, and topographies that can be recognized on any aerial photo or county-scale map (Figures 4-19 and 20).

The steady forces of long shore drift have operated over the eons to produce not just the current BI and previous BIs such as the ACR on the mainland, but even the peninsula of Florida itself (Schmidt 1997). The strong linearity of the east central and southeast Florida coastline, its low fractal dimensionality (Rial n.d.), indicates the steadiness and consistent directionality of these forces. Chaotic events like storms, on the other hand, produce drastic BI and lagoonal modifications via overwash and tidal inlet cuts, and leave chaotic, or irregular (“squiggly”) backbarrier shorelines, the former producing overwash fans, and the latter producing flood tidal deltas (Figure 3-6).

Figure 4-19. Cartographic signatures of geomorphic stability and instability. Map to left is most north, right map is most south
Repeated overwash events in the same locale can result in an overwash apron, such as what we see south of the Ft. Pierce Inlet; individual overwash fans can reach as far as the mainland shore of a lagoon (Davis 1994: 169), though this has not yet occurred in IRL. Both of these transgressive events actually strengthen the BI system by thickening the BI (albeit thinning the lagoon) and depositing large quantities of sediment in the backbarrier and lagoonal areas. BI segments that migrate towards the mainland via overwash do so by rolling over on themselves like the treads on a tractor or a tank (Pilkey and Dixon 1996). Inlet cuts, however, are much more disruptive of BI/lagoon sediments, including ones laid down by human habitation, and require higher energy inputs. Whereas inlet cuts can scour away all previous BI sediments, overwash events really only truncate the front part of the beach and dune (Pilkey 2003). The Zaremba site (8 IR 56), investigated by Brenda Sigler-Eisenberg (nee Sigler-Lavelle) and Michael Russo, is a good example of such truncation (1982). Its Malabar II culture period and its location 0.75 kilometers due east of the large Blue Goose Midden (carbon dated to A.D. 890 - 1300) offers geomorphology some valuable data concerning that part of the BI—the S-V segment—and the timing of its most recent retreat towards the mainland (Figure 4-29).

By converse, geomorphic stability often results in regular-spaced circulation cells within the lagoon that carve out cuspat e or crescentic shorelines, such as in the PAFB-HC segment (Figure 4-20). These shorelines indicate a more ancient, undisturbed landform, and archaeologists can expect to find sites of greater antiquity along its current lagoonal shoreline than on unstable BI landforms. In the IRL, some cuspat e shorelines occur on thick, prograding BI segments while others exist on thin, linear, sediment-starved segments. Archaeological sites as early as the Orange Period can be found on these latter
segments, often close to the dune line or on the beach itself, in danger of being torn apart or truncated and buried by future inlets and overwash, respectively. The former segments (thick island, cusptate lagoonal shores) are the last to respond to rising sea levels. These prograding BI stretches exhibit well-developed ridge and swale topographies that parallel the entire shore system (Figure 4-20); geomorphically unstable landforms have only a single low dune line. Semi-cusptate shorelines exist along the lagoonal shore of Cape Canaveral and the lagoonal shore of the BI in southern St. Lucie and Martin Counties (Stauble 1990). The implication is that the southernmost segments of the BI system have been more stable than the middle segments (S-V and Ft.P).

Figure 4-20. Topographic signatures of geomorphic stability (left, middle) and instability (right) in five-foot contours. Map on left is most north, right map is most south

The low energy level of the Indian River Lagoon itself, and the sediment-trapping and sediment-stabilizing effects of salt grasses and mangroves (Davis 1994: 121 –126) allows for the subsequent preservation of these backbarrier shoreline features for thousands of years (Almasi 1983), which greatly assists the geomorphic interpretation of its archaeological site distributions over time. Archaeologists on the IRL BI need only
consult a county-scale map in order to be able to tell, prior to excavation, the relative age of the landscape and likely soil sediment profiles that they will encounter.

Besides taphonomy, coastal geomorphology exerts another powerful influence on the archaeological record in that geomorphic instability—inlet cuts and overwash events—produces highly productive backbarrier and lagoonal flats with substrates beneficial to mollusks, sea grasses, mangroves, fish and numerous other species (Godfrey 1976; Davis 1994b). Not surprisingly, then, nearly every study of species diversity and richness in the IRL finds two dominant correlations—a north-south trend towards richness and increasing diversity (cf. Snelson 1983 in Brown-Peterson and Eames 1990; Buzas 1995; Gilmore 1995; Mikkelsen and Mikkelsen 1995; Parkinson 1995; Schamlzer 1995; Hargraves 2002), and one based on distance from inlets (cf. Buzas 1995; Brown-Peterson and Eames 1990; Gilmore 1995; Mikkelsen and Mikkelsen 1995; Schmalzer 1995). Just as latitude is inversely proportional to species diversity and richness in the IRL, so too is distance from inlets, due to greater levels of salinity, greater levels of oceanic interchange, sandier sediments and substrates, and migratory access.

These two controlling variables overlap in some respects since the northern part of the IRL is generally more stable (i.e., less inlets and overwash) than the southern zone. But they do not overlap entirely. Like tidal amplitudes, which are greatest “in the northern part of the southern section and the southern part of the central section” (Smith 1990:217), ecological diversity and abundance exhibit an arcuate distribution in the IRL—highest in the middle and lowest at the ends. This distribution pattern coincides exactly with the relative levels of recent geomorphic instability throughout the IRL, and both correspond inversely with the offshore bathymetric slope, which is least in the
middle and highest near the ends. Geomorphic stability, then, is not necessarily beneficial to lagoonal or estuarine ecologies. For further evidence, it should be noted that inlets, which represent a more drastic form of geomorphic instability than overwash events (Almasi 1983), are also more biologically productive than the latter, and show the richest archaeological sites.

Working on the Sapelo barrier island of the Georgia coast, and reviewing previous BI studies from Georgia, Alan McMichael found two recurring patterns. The first was that archaeological sites were located mostly along the backbarrier, away from the ocean and close to the lagoon/estuary (1977), a pattern also noted for Florida coastal groups by Jerald Milanich (1994) and David Dickel (1992), and one which is clearly visible in Figures 3-2 and 3-3, especially in light of the fact that both of the ocean-side sites on the Cape, 8 BR 240-B and 8 BR 1642, are actually road-fill from a historic settlement (Figures 3-13). The second correlation was that the largest and most densely deposited sites were often adjacent to inlets, former inlets, and tidal streams (1977). Similarly, one of the most extensive and densely deposited BI archaeological sites from this study area is the Blue Goose Midden (8 IR 15), located squarely in the middle of the S-V segment, the shoreline of which shows the repeated overlapping of flood tidal deltas from deep, “heavy-breathing,” migrating inlets now closed, as well as the largest and most well-defined tidal stream of the entire system, Spratt’s Creek, currently part of the Intracoastal Waterway. McMichael’s results show once more that the most extreme form of geomorphic instability (inlet cutting and tidal creeks) is the most ecologically productive, and most conducive to the accumulation of dense archaeological remains.
It is only in the northern geomorphic province of this study area that archaeological sites can be said to strictly hug the lagoonal shore. In the south, many sites are found on or near the beach and primary dune line. This too is the result of geomorphic instability. Since the southern zones have generally retreated towards the mainland over greater distances after 8,000 B.P. than the northern sections, many of its archaeological sites have “migrated” (de facto) towards the current beach. Just as barrier island ecologies are typically arrayed in linear elongate bands of greater to lesser salt-and-wind tolerant species (Pilkey 2003), so too prehistoric settlement and exploitation of BI’s is much more intense along its protected and productive lagoonal shore. Some oceanic shoreline habitation or visitation is not entirely out of the question, however, since Ponce de Leon encountered Ais or Surruque huts along the ocean shore of Cape Canaveral a good six months before the nesting season of the giant sea turtles (Ehrenhard 1976). Beached marine fauna such as whales and historic shipwrecks have been suggested as other potential resources of the oceanic shoreline. Nevertheless, dense archaeological sites located along the current beach or dune line are a reasonably sure indicator of recent BI migration, just as a hammock of oak trees growing incongruously close to the beach is also a sure sign of very recent BI migration (Pilkey 2003). On less stable BI segments, therefore, sites located along current lagoonal shorelines are likely more recent than sites located in the middle of the BI or towards its ocean beach. Archaeological sites can thus be used to time the location of former backbarrier lagoonal shorelines.

The main drawback of BI geomorphology for archaeological interpretation is of course the destructive loss or covering over of earlier sites on those parts of the BI that are transgressing—retreating to the mainland—under the slowly rising sea levels of the
last 6,000 - 8,000 years or so (Davis 1997: 157; Figure 4-21). Paradoxically, not all areas of the BI have retreated or been transgressed during these slowly rising sea levels; some areas, such as the southern shore of Cape Canaveral and the PAFB - HC segment to its south, have prograded outwards against the sea following the *“initial transgression”* (c. 7,000 BP), building a characteristic series of high parallel beach ridges and swales. The southern shore of Cape Canaveral has continued to prograde even during the last 150 years (Stauble 1990), despite faster rising sea levels after the end of the “Little Ice Age” c. 1450-1850 A.D.—about 30 cm per 100 years according to Davis: a “trend [that] may be toward the condition that prevailed about 5 – 6,000 y.b.p., when the rate of rise was at a moderate rate” (1997: 158).

Figure 4-21. Composite of various Holocene sea level curves. From Davis 1994a.

*“Initial transgression,” “initial inundation,” “paleo-lagoon,” and “paleo-basin” are all 1st and 2nd Wave BI terminology, and are thus used with reservation.*
Unlike linear systems and linear equations, where changes in input yield proportional changes in output, non-linear systems and equations (a.k.a. “chaos theory” “complexity” “fractals” etc.) do not necessarily output proportional to changes in input. “More is different” (Gleick 1987). Barrier islands, of course, are highly non-linear at all scales—even the equations governing the interaction of sediment particles and individual waves passing overhead have non-linear components (Pethick 1984)—and so we should actually expect that the system’s response to the same changing input (rising sea levels) would not be the same throughout, but rather marked by a general tendency towards transgression with smaller exceptional areas of progradation.

At least three factors can cause a BI to prograde even under slightly rising sea levels—a headland or point of land that deflects or shadows the BI from the dominant littoral drift, as well as provides a source of sediment for down-current formations; river mouths that deposit large quantities of sand (silt and other fine-grained sediments do not contribute to BI deposition); and a convergence of littoral currents flowing in opposite directions (Figures 4-23 a and b). Littoral or longshore currents are caused by wave energy hitting the beach at oblique or acute angles, as shown in Figure 4-22:

Figure 4-22. The generation of longshore currents from waves breaking at angles to the beach. From Pilkey and Dixon 1996
In the case of the northern geomorphic zone of this study area, the “littoral drift shadow” produced by Cape Canaveral’s deflection of the dominant N-S littoral current helps produce sedimentation rates that exceed the effects of oceanic sea level rise, resulting in progradation and stability, the beneficiary being the southeast shore of the Cape and possibly the PAFB-HC segment. A similar phenomenon occurs in the Outer Banks of North Carolina where the barrier island “behind” Cape Lookout is also shielded from the dominant littoral current and is one of the few areas undergoing progradation in an otherwise transgressing system (Moslow and Heron 1994).

![Diagram](image1.png)

Figures 4-23A and B. Top (A) is idealized version of littoral cells along coasts. Bottom (B) is application of ideal to the IRL BI.

Prograding BI segments such as Cape Canaveral and PAFB-HC offer terrestrial archaeology the best chance for recovering undisturbed multi-component sites of greater
antiquity. For potential sites inundated beneath the IRL, lagoonal areas behind prograding segments of the BI exhibit simpler and better-protected sediment profiles than behind unstable BI segments (Figure 4-24). The overburden is much shallower also, as the lagoon is deeper and “protected” by the ridge and swales to the east. First Wave BI theory presumed the existence of a “paleo-lagoon” beneath the current IRL, either as a land depression or a freshwater body of some kind between the two outcrops of the 120,000 year-old Anastasia Formation—the ACR and the location of the current BI (cf. Almasi 1983). If true, then after the “initial inundation” of the IRL “paleo-lagoon” (c. 7575 BP according to Almasi, 7000 BP according to Mayhew), numerous archaeological sites could have been quickly buried and protected in a Pompeii-like manner. Second and third wave BI theory, however, would call for a more gradual inundation or oceanic transgression. Nor would there have existed any “paleo-lagoon” in the location of the

Figure 4-24. East-west (left) and north-south (right) profiles of IRL sediments, showing deeper sediments in north. From Parkinson and White 1994.
current lagoon, but rather a gently sloping plain. Thus, any Early-Mid Holocene archaeologica
sites in that area would more likely be found near the presumed drainages of terrestrial streams flowing from the ACR, such as Crane Creek in Melbourne.

Presumably, most sites seawards of a retreating BI will be destroyed or dispersed by the encroaching surf, but the Paleo-Indian/Early Archaic/Middle Archaic Douglass Beach Wreck site (8 SL 17, see Figure 4-26) and the Transitional/Early Malabar I Homer Cato site (8 IR 25), offers the hope that not all such sites have been completely dispersed (Bullen et al. 1968: 14; Bullen 1969; Pepe 2000). Both sites, in fact, seem to have undergone truncation (Murphy 1990), as at Zaremba. Parkinson and White (1994), following second wave BI theory, predict a greater level of preservation for Early Holocene sediments than for later Holocene deposits since the faster rise in sea level would, in their view, entail less oceanic re-working of these early sediments. We can detect here some vestiges of the surf-zone jump model! A different possibility was offered in the first subsection of Chapter Four—that rapid rises in sea level increase the frequency and strength of inlet cutting relative to overwash events but do not inhibit the “formation” or persistence of BIs (since sediment levels are greater). These deep, migrating inlets scour away all previous BI sediments (Figure 4-18). Therefore, the preservation potential for Early Holocene sediments offshore should be less, not greater, than for Late Holocene deposits.

Within the IRL, offshore areas on steeper bathymetric slopes should exhibit greater preservation potential than on more gently sloped areas, since bathymetric slope is an excellent indicator of relative geomorphic stability levels. It was noted earlier that the broadness of the slope offshore from the S-V and Ft. P segments—relative to the
steepness of the PAFB-HC segment—reverses itself as you pass the 60-meter contour. Between 60 meters and 100 meters it is the PAFB-HC segment which is the most gently sloped; the S-V slope steepens considerably, while the steepest slopes occurs offshore from southern St. Lucie through Palm Beach Counties. Following Parkinson and White (1994) and other “surf-zone jump” models, preservation potential for sediments laid down 18,000 to 8,000 B.P. should be highest on the gently sloped areas and lowest on the steeper sloped areas, since the latter are attacked by the oceanic swash zone for more extended periods of time. Abandoning the surf-zone jump model, however, would lead one to conclude that preservation potential should be greatest on the steeper slopes and lowest on the broad slopes. By this model, future underwater investigations of potential coastal sites dating before 8,000 B.P. would want to focus on the southernmost sections of this study area, and perhaps Palm Beach County as well.

As mentioned, inlets and overwash increase the biological productivity of the lagoon and are the mechanisms by which rising sea levels cause BIs to migrate towards the mainland. In addition to the taphonomic effects of truncation and burial (via overwash) and complete site destruction (via inlets), these processes also leave distinct sediment stratigraphies. Overwash events produce a layer-cake stratigraphy of alternating lagoonal (muddy *skeletal sand) and paralic/oceanic sediments (clean skeletal sand), though post-depositional penetration by buried grasses and plants can quickly complicate the sediment profile (Davis 1994b: 169; Parkinson and White 1994: 413). Tidal inlets produce less lagoonal mud in the immediate backbarrier, as semi-diurnal tidal currents in and out of the inlet ensure a sandier bottom (Parkinson and White 1994). Chaos theory

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* "Skeletal" mostly refers to mollusk shells.
once again avails itself here, as the resultant pastry-layered stratigraphy of overwashed BIs (Figure 4-25) closely resembles the “folded space” diagrams that were part of Stephen Smale’s pioneering work in non-linear dynamics (cf. Gleick 1987:45-53). What is important here is that chaos theory predicts that despite the orderly appearance of the stratigraphy, the mixing zones—in this case, the overwash strata—will be entirely random; two originally adjacent points that get “folded” into the system will end up infinitely and unpredictably mixed within those strata.

The offshore Douglass Beach Site (8 SL 17), for instance (Figure 4-26), discovered during treasure salvaging, contained extinct camel, horse, and mammoth remains, an

Figure 4-25. The pastry-layered sediments of a repeatedly overwashed BI system in cross-section, St. Lucie County, Florida. Text and figure from Parkinson and White 1994
Early Archaic Bolen point, a Middle Archaic Newnans point, human remains, sand tempered plain ceramics, and wooden stakes with carbon dates ranging from 4630 B.P. to 5080 B.P. (Murphy 1990). This 5,000+ year span of artifacts (excluding the treasure) is most likely not indicative of a multi-component site, however, despite its designation as such by Murphy in the title of his report. It is doubtful any sites could have accumulated in one spot over 5,000 years on a rapidly retreating, low-elevation BI segment during the Early and Middle Holocene. Rather, the mixture of prehistoric artifacts is likely due to the mixing effects of overwash and inlet cutting.

Figure 4-26. The offshore Douglass Beach Site, 8 SL 17.

The wooden stakes, however—likened to Windover burial stakes by Murphy (1990) and Pepe (2000b), but described as a fish weir by the Windover investigators themselves (Doran 2002)—are more likely in original association, and thus more useful to geomorphology for dating BI migration, since several of them were found in line with each other (Murphy 1990). Also, in the sandy acidic soils of the IRL Area, wood would only preserve in an overwash deposit if that stratum stayed consistently submerged under water. Fisher and Simpson’s results from Rhode Island showed that only 34% of
washover deposits were subtidal (1979:142)—a one-in-three chance of permanent submersion. Thus it is likely that these stakes were not part of a randomly mixed overwash stratum. Further, radiometric dating of core samples showed that most of the lagoonal deposits are no older than 4800 BP (Murphy 1990), which is the approximate age of the stakes themselves. Geomorphologists can use this data to suggest the location of the backbarrier-lagoonal shoreline at c. 4800 B.P. This section of the BI has obviously retreated at least one kilometer in almost 5,000 years, and perhaps more if the fish-weir or wetland burial stakes were located out into the lagoon.

Figure 4-27. Semi-cuspate shorelines and archaeological sites of Cape Canaveral

The geomorphic stability indicated by cuspate lagoonal shorelines (Zenkovitch 1959) should not be confused with lack of erosion altogether. Denser sediments from the “bay” sections of a cuspate shoreline are eroded laterally towards the cusps on each side, while lighter material is drawn out into the lagoon. A cuspate shoreline, then, can be seen as the bifurcation of a stable shoreline into eroding and prograding features. Several sites
on Cape Canaveral’s semi-cuspate shoreline show a correspondingly crescentic site plan (Figure 4-27), although it is not yet possible to say whether the sites merely accommodated an already-crescentic shoreline, or whether the sites were eroded in that manner without underwater investigations. Man’s recent interference with the natural circulation patterns in the lagoon (motorboats, causeways, bridges, mosquito impoundment, etc.) may alter these cuspate shorelines and thus cause more intense and unpredictable lagoonal erosion patterns (IRLNEP 1996).

Archaeological investigations on BIs done for cultural heritage management firms often suspend their excavation units after two or three sterile 10 centimeter levels, having reached “Pleistocene beach.” In fact, on retreating segments of the BI, these are almost certainly overwash or inlet fill. Maximum thickness of overwash sediments is about 50 centimeters according to Parkinson and White, based on St. Lucie County data (1994:409). Inlet flood-tidal delta sequences are generally much thicker—up to 10 meters according to Parkinson and White, and up to 25 meters thick according to Moslow and Heron (1994). To reach Pleistocene deposits at Parkinson and White’s geomorphic study area (Figure 4-25), you would have to excavate over three and a half meters!

Archaeologists also typically pay close attention to nearby sources of fresh water. On the mainland, the probability of finding cultural material almost always increases on well-drained land adjacent to fresh water. On barrier islands, however, fresh water is not really an issue since lenses of fresh water always sit hydrostatically atop the saline waters further below (Godfrey 1976). One need only “scratch a few feet into the sand” to obtain it, as Martin Dickinson, shipwrecked on the east central Florida BI in 1696, observed of his Ais Indian captors (Dickinson 1945). In the future, archaeologists should not even
concern themselves with locating nearby sources of fresh water on the IRL barrier islands, as is perfectly appropriate on the mainland.

Figure 4-28. Age of Cape Canaveral, northern PAFB-HC segment, and Merritt Island.

It is often assumed that Cape Canaveral is the most ancient landform of this entire BI system (Stauble 1990; Davis 1997), since headlands are a major source of sediment for down-current BIs (Pilkey and Dixon 1996). Implicit in this statement, however, is a residual 1st and 2nd Wave BI theoretical approach. If, instead, BIs formed as soon sea levels rose c. 18,000 B.P. (Pilkey and Dixon 1996), and migrated great distances west toward their current location, then the relative age, or relative geomorphic stability, of the Cape vs. other BI landforms at, say 6,000 B.P., is not related to whether the Cape formed first. Thus, a comparison of the Cape and the PAFB-HC segment, the two most stable segments of the BI since at least 4,000 B.P., shows that the latter has better defined
cuspate shorelines and earlier geologic dates than the Cape (Figure 4-28 for carbon dates and Figure 4-20 for shoreline comparisons). Moreover, the bathymetric slopes offshore from the Cape and the PAFB-HC segment (Figure 4-12) are clearly steeper off the PAFB-HC segment. The ridges and swales are perhaps better developed on the Cape than PAFB-HC, but this is only evidence that suggests that the Cape attained geomorphic stability prior to the PAFB-HC segment. There is as yet insufficient archaeological data to weigh in on this discrepancy, unfortunately. Figures 3-2 and 3-3 do seem to show a greater density of fiber tempered pottery sites (i.e., the earliest sites we have, dating from 4,000 B.P. to c. 3000 B.P.) on the Cape than on PAFB-HC, but the meaning of this is not certain, since archaeological survey coverage along the PAFB-HC segment has been almost non-existent, whereas the Cape has been surveyed several times (Figure 2-7).

Taking the extant evidence at face value, the density of archaeological sites along the Cape’s lagoonal shoreline suggests a greater level of geomorphic instability in the Cape area from 4,000 – 500 B.P. than at the Cape presently. The massive inlet cut visible in Figure 3-6, now closed, may have provided this northern area with life-giving oceanic interchange, hence the abundance of Cape Canaveral sites from all culture periods.

Future archaeological studies in the IRL that wish to contribute to geomorphic questions and problems should look at the density and antiquity of sites along the unsurveyed PAFB-HC segment. Its steep offshore bathymetry, cuspate lagoonal shorelines, and well-developed ridge and swale topography offer the possibility that the oldest sites on the IRL BI lie here, and not on Cape Canaveral.
Figure 4-29. Map of the Zaremba site and nearby Blue Goose Midden from the recently unstable S-V segment, indicating c. 750 meters of BI retreat sometime between A.D. 750 and the initial occupation at Blue Goose. Compared with the c. 1000 meters of retreat since 4,800 B.P. at 8 SL 17 (Figure III-27), this indicates that the S-V segment has been retreating to the mainland faster than at 8 SL 17 to the south. The fictitious “Archaic” site, 8 IR 973, is clearly a mistake (see Section IV).

Figure 4-30. Magnification of the Fairbridge Curve for the last 7,000 years. From Stauble 1990.
CHAPTER 5
OUTLINE OF EAST CENTRAL FLORIDA PREHISTORIC CULTURE PERIODS

There has been no real synthesis of this area since Irving Rouse in the late 1940’s, and Jerald Milanich’s overviews of Florida archaeology tend to neglect this area relative to the Glades and St. Johns regions proper, between which this Malabar area is considered merely a simplistic, conservative transitional zone (1994). CHM firms often give regional outlines and overviews as a part of their overall report, some of which are entirely “boiler-plated” and without new ideas, but many of which are insightful and worthy of being distilled into a new regional synthesis to supplement or replace Rouse’s. Such a re-synthesis is beyond the scope of this work, although the statistical predominance of coastal sites in this area (relative to the Upper St. Johns and other interior marshes) for the last 3000 years means that any new understanding of coastal archaeology in this area almost amounts to a new understanding of the region as a whole. This section will concentrate on summarizing the culture history of this area in light of landscape changes in the UStJ, the current IRL (as “Paleo-basin” or sloping plain, and, later, lagoon), and the coast. Attention will also be paid to common confusions regarding the culture history of this area, especially ones that have resulted in vague or incorrect site designations.

Several themes of IRL Area archaeology have already been mentioned in the introduction: its ceramic conservatism, the subsistence conservatism of these steadfastly non-agricultural peoples, the apparent settlement shift from the UStJ to the IRL during the Middle or Late Archaic/Transitional period, and the temporal problems with dating
small site samples that contain only plain pottery. This section will explore these issues further within the chronological framework of culture-history periods and sub-periods. It should be remembered that these temporal divisions are analytical categories imposed on archaeological materials and information by modern researchers. That is, these are “archaeological cultures” and not necessarily actual group self-definitions. Quite possibly, some of these categories might overlap with native self-understandings (e.g., people with different pottery forms might have thought of themselves as members of different groups) but more often than not “emic” (insider-view) aspects of culture are not easily recognizable in the material remains recovered by archaeologists. Tribal affiliations before the Contact-era are almost impossible to pin down without documents, and even with documents there is a time limit to how far back one may retrodict (“predict the past”) based on Contact-era information. Cultural conservatism in these cases, while leaving behind a less “glamorous” and less temporally demarked archaeological record, nevertheless increases the time depth and the confidence level of such retrodictions.

**The Paleo-Indian Period c. 12,000 to 8500 B.P.**

Controversy surrounds the earliest dates of many archaeological culture periods, and the initial colonization of the Western Hemisphere is certainly one of these. Until the late 1920’s, when a previously unknown type of stone projectile point was found *in situ* with extinct Pleistocene Bison remains, the scientific consensus was that man was a recent immigrant to the Western Hemisphere, about 4,000 years ago. That position was overzealously and prejudicially defended by the Smithsonian’s Ales Hrdlicka, who used his powerful reputation and influence to dismiss all countervailing evidence that indicated ancient human/cultural remains associated with extinct Ice Age megafauna (Brennan 1959). Two such sites which received much scholarly attention, the Melbourne
Man and Vero “bone beds,” were dismissed by Hrdlicka as intrusive and not in original association. Geologists and geomorphologists, on the other hand, have tended to accept the integrity of these sites and the validity of the cultural associations (Dickel 1992). Despite the credence given by geologists to these sites, and despite the complete demise of Hrdlicka’s “short chronology” with the advent of carbon-14 dating in the 1950’s, Hrdlicka’s residual influence still afflicts the IRL Area: Irving Rouse, the first and last comprehensive synthesizer of the area’s archaeological record, accepted Hrdlicka’s interpretation of the sites as intrusive and/or fluvial (stream-jumbled), non-original associations. Consequently, the Paleo-Indian and Early Archaic periods in this area have not received the systematic attention that they deserve despite the extensive outcrops of such “bone beds” throughout this study area, and the surprisingly late dates on Pleistocene megafauna dates obtained at Vero (Milanich and Fairbanks 1980). Rouse cataloged 15 paleontological sites in Brevard County alone (1951). Yet the last Paleo-Indian site investigated in this area was the Lake Helen Blazes site (8 Br 27), a late Paleo-Indian/Early Archaic occupation estimated (pre-C-14) to an incredibly late date of 7500-6000 B.P. (Sigler-Eisenberg 1985), and written up as part William Edward’s 1953 PhD dissertation in political science at Columbia University.

Hrdlicka’s residual influence is not the only factor, however, behind the lack of Paleo/Early Archaic investigations in the IRL Area: the tremendous accumulations of peat in the UStJ—as thick as 20 feet near Blue Cypress Lake (Belleview 2000)—and the inundation of the Paleo-Indian coastline and the current IRL location (Almasi’s “paleo-basin”) by the Holocene transgression, has made the cost of investigation prohibitive. These are also areas that are not typically surveyed by CHM firms since very little
construction occurs there. Nevertheless, these same inhibitive factors—rapidly accumulating peat and sudden inundation (1st Wave BI theory)—also provide for excellent preservation conditions, as peat can sometimes preserve soft tissue such as leather, basketry, skin, organs, DNA, etc., while permanent inundation by water and encapsulation in benthic sediments is often equally preservative (Renfrew and Bahn 2000).

The landscape and coastline of the IRL Area were quite different during the Paleo-Indian Period. Seas were 60 – 100 meters lower and the shoreline of the IRL Area stood about 50 kilometers off the current coast, as shown in Figure 4-12. Lower sea levels caused a lower continental water table, faster percolation rates, and a steeper drainage gradient for all freshwater bodies that discharged into the ocean or the UStJ (since it was deeper then). Temperatures were lower and seasonal differences were reduced (Doran 2002) Rainfall levels were also lower, both locally and globally, and the summer thunderstorm pattern for Florida was not yet established (Doran 2002). Conditions were also windier, as the thermal gradient between the equator and the polar region was compressed by expanded glaciation in the Northern Hemisphere, and this too would have inhibited overall rainfall levels*. Pollen samples from peninsular Florida show grasslands dominating, with little evidence of pine (indicative of wetter conditions) and no evidence of cypress in south Florida until 5000 BP. Paleoenvironmental conditions in the IRL Area are often believed to have been inhospitably xeric (dry), with limited sinks of water, such as Lake Helen Blazes in the UStJ, which drew Ice Age megafauna and their human

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*The higher wind conditions of the Paleo-Indian period should also have facilitated the formation and persistence of BIs since wind is an important agent of wave-generation, which causes longshore currents, sediment transport, and barrier island creation.
predators (Griffin and Miller 1978). The paleo-environmental conditions of the Indian River Lagoon itself are less clear due to differences between 2nd and 3rd Wave BI theories. Almasi states that the lagoon was an exposed basin, and that “the manner in which its sediments were deposited is unclear” (Almasi 1983). Parkinson and White found “woody,” non-lagoonal forms of peat on the pre-Holocene transgression land surface east of Fort Pierce in St. Lucie county (Parkinson and White 1994) indicating that the paleo-basin/sloping plain was by no means desiccated.

Instead, there is much reason to believe that the IRL Area and the IRL itself were not inhospitable to megafauna and their predators during the Paleo-Indian/Early Archaic period (Doran and Dickel 1990). Both the paleo-IRL and the paleo-UStJ’s lower elevation levels relative to the surrounding land would have made them a watershed of some sort, even if only seasonally or temporarily. Crane Creek in Melbourne, for instance, is a large Atlantic Coastal Ridge stream that now flows into the IRL on a permanent basis. The Melbourne Man site location on a tributary of Crane Creek, four kilometers west of the current IRL, suggests that Crane Creek itself also existed at that time in one form or another, and would certainly have discharged into (or at least flowed through) the IRL “paleo-basin”/sloping plain. This of course is just one stream on the ACR—the IRL is currently fed by streams and rivers as large and larger than Crane Creek: the Eau Gallie River just nine kilometers to the north, Turkey Creek eight kilometers to the south, the Sebastian River 30 kilometers south of Turkey Creek and, largest of all, the St. Lucie River. Plotting the paleo-drainage patterns of these streams while the lagoon stood 10-50 kilometers east of its current location would vastly improve site prediction models for inundated sites beneath the current IRL.
Whether this rate of run-off equaled the rate of evapo-transportation in the UStJ and the IRL “paleo-lagoon”/sloping plain is questionable, but it does necessitate that periodically heavy run-offs produced at least temporary wetland/stream conditions somewhere in the IRL paleo-basin/sloping plain, probably in the vicinity current ACR streams and river outlets. As the Douglass Beach Wreck (SI-17) and other offshore sites show, wetlands with Pleistocene megafauna and cultural remains that date from the Early Archaic (or earlier) exist off the east central Florida coast. These wetlands could only have been created by backbarrier lagoons/estuaries, which supposedly did not exist until 5-7,000 years ago according to 2nd Wave BI theory, or by freshwater run-off and/or discharge from springs. A few springs occur in the IRL Area (mostly sulfur springs, but still potable), but not to the extent that they do in the northern St. Johns—the Upper St. Johns hydrologic regime is distinctly non-artesian, and the volume of spring water entering the IRL is not large (Sigler-Eisenberg 1985). In either case, it flatly contradicts the bleak picture painted by archaeologists—east central Florida is thought to have been xeric, and its coastal area is thought to have been especially xeric and inhospitable at this time (Griffin and Miller 1978).

Instead, a slightly drier, but by no means desolate Paleo-Indian landscape in east central Florida better accommodates the paleontological and archaeological evidence (Doran and Dickel 1990). Greatly reduced rainfall levels need not be assumed to explain the dominance of grasslands and the absence of pine—a much lower water table, faster percolation rates, grazing megafauna, windier conditions, and much steeper stream gradients could have been sufficient by themselves to prevent extensive peat formation and promote grassland ecologies. Nor are all grasslands biologically unproductive, the
Serengeti in Africa being a classic example, itself a *refugia* for megafauna that have died out elsewhere (Doran et al. 2002). Similarly, the IRL Area’s status as a *refugia* for late survivals of Pleistocene megafauna (as recent as 8,200 BP at Vero) argues against this area being overly xeric and inhospitable. Nothing is impossible in biology and ecology, of course, but “refuge” and “inhospitable” are at least somewhat contradictory. More indirect evidence for wetter Palo-Indian conditions in east central Florida than what is commonly assumed can be seen in the numerous references in the archaeological literature to the “increasing aridity” of the Early and Middle Archaic, implying that the period just prior to that, the Paleo-Indian, was not as dry.

Data from south Florida, which clearly indicates dry and inhospitable Paleo-Indian conditions, should not be extended into east central Florida without serious qualification (Doran and Dickel 1990; Doran 2002): whereas peat did not develop in the Everglades and other areas of south Florida areas c. 5000 years ago (Widmer 1988), the Windover site in Titusville, Brevard County, on the Atlantic Coastal Ridge, within catchment distance of both the St. Johns and the *current* IRL, had peat developing as early 11,000 years ago (Doran 2002). The Atlantic Coastal Ridge, of course, is generally much better drained than the USTJ Basin, and was probably better drained than the IRL “paleo-basin”/sloping plain as well, and thus peat formation on the ACR at this early date indicates that productive wetlands probably existed throughout this study area. The likely location of these Paleo-Indian wetlands and associated archaeological sites is not hard to surmise—the lowest sinks of that period should roughly correspond to the deepest waters and thickest peat deposits within the current USTJ. As Judith Bense noted, many “Paleo-Indian sites are probably buried or submerged in the marshy environment of the Upper
St. Johns River Valley” (Bense 1994:E2). If the IRL “paleo-basin” had some freshwater input and wetlands, then Paleo-Indian sites likely lie inundated and encapsulated beneath the waters and sediments of the IRL as well as the USJ. If there never was an IRL “paleo-basin” (3rd Wave theory), then any such submerged early sites likely lie along the major stream drainages that issue out of the ACR.

No Paleo-Indian sites have been discovered east of the ACR, although one local collector reported finding a fluted point in the current IRL (personal communication 2003). The Douglass Beach Wreck Site, excavated by treasure hunters and ship salvagers using non-archaeological methods, contained Pleistocene megafauna (a camel’s tooth) but also an Early Archaic projectile point, a Bolen Beveled (Murphy 1990). If there is any validity to that association, it would show further evidence for late Pleistocene survivals in east central Florida, since Early Archaic projectile points are generally considered to be a response the extinction of megafauna. Murphy indicated that the site likely contained Paleo-Indian cultural remains as well. However, as noted before, chaos theory predicts that retreating barrier islands will have stratigraphic layers that appear internally consistent and cleanly differentiated from other strata, but which are in fact unpredictable mixtures of previous sites and landforms that have been pushed back by the transgressing, overwashing seas. Thus, the Bolen point and the camel tooth at Sl-17 are probably not original associations, unfortunately.

Our view of Paleo-Indian lifestyles are still dominated by the alluring image of nomadic megafauna hunters, following large grazing herds in small bands over extensive or unlimited territorial ranges, with “little or no development of regional subsistence specializations, or regional cultural traditions” (Dickel 1992:14). Information from the
west-central Florida site known as Harney Flats, however, suggests that these people may have been more sedentary than previously thought, and much more sophisticated and broad-spectrum in their mode of subsistence than just megafauna predation (Daniel and Wisenbaker 1987, in Doran 2002), despite the often noted uniformity of Paleo-Indian tool kits (Dickel 1992).

**The Early Archaic period, c. 8,500 to 6,900**

The extinction of Pleistocene megafauna at C. 10,000 to 8500 B.P. marks the end of the Paleo-Indian period and the beginning of the Archaic, the latter defined by the absence of pottery and the first occurrence of ground-stone cultural materials. Other characteristics of this “transitional period” (Doran et al. 2002: 50) include increases in regionalism, increased economic specialization, restriction of group territories, decreased long-distance interactions marked by a decrease in exotic lithics, beginnings of burial ceremonialism, a wider range of food resources, a reliance on deer and other smaller terrestrial mammals, and more diverse site types. As one student of the Archaic observed, it makes more sense to move your entire camp to the site of a megafauna kill than to bring the huge carcass back to a base camp, whereas with deer it makes more sense to keep the camp location fixed and tote the carcass home (Peter Hallman, personal communication, 2001). Unlike the gregarious Pleistocene grazers, deer are solitary browsers that do not seasonally migrate nor do they generally move long distances.

Despite some indications of Paleo-Indian sedentism at Harney Flats in west Florida (Daniel and Wisenbaker 1987), and despite indications of persisting nomadism or “residential mobility” in the Archaic, the general picture of increasing sedentism during the Archaic is borne out by the one well-researched Early Archaic site in the IRL Area—the famous Windover site in Titusville, Brevard County, where 8,000 year old DNA was
found well-preserved in a wetland pond cemetery. These burials were held beneath the waters by a series of sharpened wooden stakes and a fabric covering. Similar Archaic wetland burials have been encountered at the Bay West Site and the Republic Groves site (Beriault et al. 1981). The recovery of similar stakes at SI-17, dated to c. 4800 B.P. (Murphy 1990), and found in association with wetland sediments and human remains, plus the existence of a Late Archaic possible wetland cemetery* at Lake Poinsett (B Br 193) west of Cocoa (Espenshade 1983), suggests that this burial practice continued beyond the Early Archaic. Since no Paleo-Indian burials have been found in Florida (Andrew Hemmings, personal comm. 2003), it is uncertain whether this burial complex was a new practice of the Early Archaic or a tradition carried down from Paleo-Indian times. Wetland-associated, charnel-pond burials continued in south Florida well into the Glades period (c.f. Sears 1982 at Fort Center, near Lake Okeechobee), though by Malabar/Glades times midden burials were more common in the IRL Area (Doran et al. 2002).

Comparing Windover with SI-17, we should note that the Windover investigators concluded that the well-preserved soft tissues of these burials implied that the people lived adjacent to or near the cemetery for at least much of the year, since the corpses were obviously interred soon after death (Doran 2002). If the wooden stakes from SI-17 performed a function similar to the ones at Windover (burial anchors), then the same implication holds true: the people lived nearby for at least a good part of the year. Scattered evidence for Early Archaic exploitation of the coast is present in the marine shells occasionally found at such sites, but evidence for lengthy habitation of the coast is

* “Possible” in that it may merely be a terrestrial cemetery that became submerged by the expansion of the Upper St. Johns.
almost non-existent for the Early Archaic. Almost all of Florida’s Archaic sites are located in the inland hardwood forests of central and north Florida (Dickel 1992:16). According to 2nd Wave BI theory and the prehistoric reconstructions based thereon, this is both taphonomic and “real”—most early coastal sites have been destroyed or covered over (taphonomic), but the productivity levels of modern estuarine systems had not yet been reached, and thus there was in fact a “real” settlement/exploitation shift to the coast, beyond mere taphonomy. If 3rd Wave BI theory is correct, and if geomorphic instability is beneficial and not inimical to estuarine life, as suggested by this study, then the settlement shift is most likely a result of taphonomy, and much of the archaeology of coastal Florida and the southeastern U.S. needs to be re-explored underwater, and almost certainly rewritten.

The location of Windover within site catchment distance of the northern IRL pool underscores a site distribution pattern that is unique to this sub-zone of the study area: a steady decrease in the relative number of sites over time in the northern IRL zone (i.e., north of Melbourne but excluding the Banana River. More sites (both in absolute numbers and relative to the total number throughout the area) occur in this zone during the Archaic than during the Orange/Transitional Period, with the decrease continuing throughout Malabar I and Malabar II (Figure 5-2). By Mexia’s time, this part of the lagoon was virtually uninhabited, and travel was conducted through the Banana River and portaged overland near the present Haulover Canal (Rouse 1951; Barile n.d.).

Environmentally, the Early Archaic and the beginning of the Middle Archaic correspond to the climatic/geologic period known as the Altithermal—a period of increased heat and decreased rainfall. Ocean levels were still rising too rapidly to allow
BI’s and stable estuaries to develop according to 2nd Wave theory. Inland water tables were still much lower than present. That peat should develop at Windover during this period of relative drought (Doran 2002) implies that the previous period, the Paleo-Indian, was not as xeric and inhospitable in the IRL area as has been assumed based on south and southwest Florida data. “Sacraficing” part of wetland by contaminating or sanctifying it with human burials also seems to imply that the Windover people had other wetlands that they could use for fishing and plant gathering; they were probably not “hard-up” for biologically productive wetlands (Doran 2002).

Projectile point styles from the Early Archaic include Bolen and Kirk. In general, one sees a disappearance of basal fluting and the appearance of side, corner and basal hafting notches. Lithic tools increase in variety, but generally decrease in the quality of workmanship; such “expediency” in lithic tool kits generally taken as an indication of sedentism (Andrefsky 1998). Quantities of lithic material at IRL Area sites generally decrease as one moves from the Archaic to pre-modern times, since this area of Florida is just south of the last outcrops of chert (cf. Milanich 1994:42). Physically, the Paleo-Indian dolocephalic (long-headed) type persists in this area until the Late Archaic/early pottery periods.

**Middle Archaic c. 7000 to 4000 B.P.**

Very little cultural change has been documented for this area during these two periods (Doran 2002: 55) despite the fact that it straddles two “watershed dates” in 2nd Wave geology and coastal morphology—7,000 BP and 5,500/5,000 BP. The former date is the approximate time at which sea level rise slowed enough to allow for more stable coastal conditions; the latter is the presumed date for the earliest development of Florida’s BI’s. Both conditions would have encouraged IRL Area people to take
advantage of the newly increasing coastal resources, and marine objects do tend to increase in inland sites over time (Dickel 1992). The first and only non-inundated Archaic site appears on the BI system along the Banana River at this time (if we exclude the phony IR-973 site), although subsequent investigations found no confirmation of a preceramic component. We should also note the relatively large number of Archaic sites from the northern IRL pool, an area which was almost abandoned during Malabar II and Mexia’s time (Figure 5-2). From a 2nd Wave theoretical perspective, this might suggest that this deeper part of the lagoon held onto the water that initially inundated the coast c. 7,000 BP (Almasi 1982), while to the south the shallower lagoon was evaporated and/or ran off in a northerly direction. Both areas were soon “blocked” by an emerging BI system to the east, according to 2nd Wave perspectives. From a 3rd Wave position, the decreased use of the northern IRL pool over time reflects the lack of life-giving geomorphic instability in this part of the lagoon.

Cemeteries, subsistence, settlement, and physical types do not change much during this period in the IRL Area (Dickel 1992:17), although evidence for the seasonal scheduling of narrow-spectrum resources during at least part of the year appears in the Mt. Taylor phase of the latter part of the Middle Archaic. The absence of coastal sites in the archaeological record of the IRL continues, although Russo’s results from Horr’s Island in southwest Florida show estuarine habitation and exploitation as early as the middle Archaic (1996). The Bay West and Republic Groves sites from western peninsular Florida (c. 6,600 and 6,500 B.P.), the Gauthier Site in Brevard County (c. 4340 B.P.), and perhaps SL-17, the Douglass Beach Site (c. 4800 B.P.), indicate a continuation of Windover Pond wetland burials in the Florida and the IRL almost to the
Late Archaic (Beriault et al. 1981). Projectile points are still large and broad relative to the later pottery periods, but also include specialized microliths, burins, and choppers.

Several climatic periods of drought and relief have been determined from the peat sediments at Windover (Doran 2002). According to Griffin, the Middle Archaic represents a shift to a wetter, warmer, more mesic inland environment, though xeric areas may have still been present in the IRL Area (1988:130). Accordingly, Watts found a shift from hardwood to pine and palmetto c. 4700 B.P. (in Dickel 1992:17). In the more xeric south Florida, Lake Okeechobee was just beginning to form at this time (Widmer 1988). Coastal conditions were marked by aridity and lower sea levels. 1st Wave BI theory presumes that the IRL was less saline and more brackish during this time, since the “initial inundation” of the IRL “paleo-lagoon” would have had to have breached the Anastasia Formation that underlies the current BI. 2nd Wave theory would posit a more saline proto-lagoon since the BI was not yet formed and oceanic interchange would have been high. Both view would entail and less biologically productive lagoon in its early phases. 3rd Wave BI theory, however, would implicate a brackish lagoon only during those periods of temporary decreases in sea levels (Figure 4-41).

In general, the Archaic was time of increasing regional specialization and variability in site and artifact types. Social groups are still thought to have been small and highly mobile, though subsistence became more broad-spectrum, and levels of sedentism probably increased (Doran 2002). Stone projectile points are more common in the IRL Area during the Middle Archaic than in later eras, suggesting either that such materials were still accessible above the water line, or that regional/long-distance trade in lithic material was more active than in later times. Relative to the Early Archaic and Paleo-
Indian period, however, trade in exotic materials such as steatite increases while trade in (or movement of) exotic cherts decreases somewhat (Dickel 1992; Milanich 1994).

Mt. Taylor represents the end of the Middle Archaic and the last pre-ceramic period in east central Florida. Dickel sees this period as a “pre-adaptation to later Formative subsistence and settlement patterns” (1992:18-19), though exploitation of the coast is not yet evident in this study area. Freshwater snails and mussels are first exploited extensively during this period. Cumbaa has suggested that this period marks the beginning of a regular seasonal round, with fall and winter months spent on the St. Johns and summers spent at dispersed, specialized interior camps. According to Dickel’s survey of Indian River County, that particular county may have been only sparsely occupied during the Middle Archaic—i.e., more similar to the archaeological record of south Florida than northern Florida—while in Brevard County Mt. Taylor sites are much better known (1992:19). In the Lower (northern) St. Johns River, large village sites appear for the first time, suggesting increased sedentism and social complexity.

**First Pottery: the Orange Period c. 4000 to 2500 B.P.**

The Late Archaic in North America and the earliest pottery for Florida overlap in time, since North American pottery occurs earliest in Georgia and Florida, with Georgia ahead of Florida by a few hundred years. Orange pottery is defined by its use of plant fibers as a tempering agent in the clay, a practice that was almost universally discontinued by 2700 BP. Ripley Bullen’s Orange Period chronology, based on incised surface designs (Bullen 1972) has been recently dismantled; the variations are spatial, not temporal (Sassaman 2003). Thus, Griffin and Miller’s (1978:55-56) and Dickel’s observation (1992:21), based on Bullen’s ceramic chronology, that the Cape and BI have only “Late” Orange Period Sites, is either unfounded or reflective of spatial or cultural
variations and not relative time depth. Apparently, this spatial or cultural pattern continued into the Malabar I period as well, since very little incised ware has been found on the BI relative to the mainland (Rouse 1951).

Mapping only those sites that have Orange Period material as the dominant component within the site (i.e., eliminating all prehistoric sites that have some Orange pottery but are dominated by other site types) shows a striking coincidence—the site furthest south on the BI, the Bill Herndl site (8 Br 113) is situated exactly on the Parkinson and White’s (1994) geomorphic transition zone between the cuspat e shorelines of the stable north and the irregular shorelines of the unstable south (Figure 3-14a). Plotting all sites with Orange components, however, shows that Orange sites extend south of this region as far as Sebastian, which, coincidentally or not, is the exact location of Stauble’s geomorphic transition zone between the northern and southern geomorphic provinces of the BI (1990). Thus, the Orange-Transitional Period, which is temporally and culturally transitional in terms of interior vs. coastal site distributions (Figures 3-11 and 3-12) is also spatially transitional in that currently detected Orange sites extend only as far south as the geomorphic transition zone.

Fish and molluscs became a larger part of inland and coastal diets during the Orange Period (Dickel 1992:22; Milanich 1994) as lagoons matured (2nd Wave Theory) and the USfJ filled with water. Coquina (an oceanic beach species) is especially common in Orange Period coastal shell middens relative to the numbers of clams and oysters in Malabar middens, but Michael Russo has warned that there are many exceptions to this pattern, and that mollusk type or percentage of coquina certainly cannot be used as a temporal indicator, as some had previously hoped (Russo 1988c). Thus, four temporal
indicators in this region of hard-to-date sites have been found invalid by later researchers—Orange Incised, St. Johns Incised, late Malabar sand tempering levels (based on this author’s ceramic analyses at the Lake Washington Site in Melbourne), and mollusks types—thus making the relative dating of sites on the BI provided by this model, while not covering the entire IRL Area, all the more useful.

Inland Orange sites, such as South Indian Field (8 Br 23) tend to be much larger than coastal ones (Rouse 1951;1972; Dickel 1992), suggesting that, if we ignore taphonomic bias towards more recent sites due BI instability, the interior resources of the UStJ were still more of a “pull” than that of the IRL. Another way of phrasing this is to say that the higher productivity levels of the UStJ supported a larger number of people during this period, but then one has to account for the decreasing use of the UStJ during Malabar II when biological production was even higher.

Environmental fluctuations were not as dramatic during the Late Archaic/Orange Period than in previous 3,000 years (Doran 2002:56). The elevation of inland water tables continued to boost the biological production of the interior lagoons. In Randolph Widmer’s model, estuaries became fully mature and productive towards the end of this period and the beginning of the next period. Late Archaic sites without Orange pottery are hard to segregate from earlier traditions, since the same stemmed, broad Archaic points continued to be manufactured without much temporal variation. Griffin and Miller refer to the Orange period in the IRL Area as “basically a continuation of Mt. Taylor” (1978: 54-55), a position reiterated by Milanich (1994:88).

**The Transitional Period, c. 3200 – 2500 BP**

It is during this period, marked by the mixture of fiber, sponge spicules and sand in the tempering of clay pots, that we see the reverse of the above pattern—coastal
Tansitional sites become larger and more numerous than interior sites (Campbell et al. 1984). 2700 BP was posited by Widmer and later adopted by Griffin as a major transitional period in southwest and southern Florida coastal adaptations. Following their 2nd Wave BI model would suggest that this transition towards coastal adaptations would have occurred slightly earlier in east central Florida than in western Florida, since the conditions needed for stable BI/lagoons/estuaries (lower tidal energy, higher wave energy, higher longshore sediment transport, and, most significantly perhaps, a steeper offshore bathymetric gradient) are present in greater degree. 3rd Wave theory, however, which emphasizes the biological productivity of geomorphic instability, would posit the opposite.

Ripley Bullen suggested the term Transitional Period to indicate a period of new traits and radical changes in ways of life over a large area of the state of Florida (1959, in Griffin and Miller 1978). Later investigators, however, have tended to cast doubt on the utility of this term, both in terms of cultural changes and temporal specificity (Shannon 1986 and Russo, Cordell and Ruhl 1992 in Milanich 1994). “The period 1200 or 1000 B.C. to 500 A.D. may not be a cultural transition in eastern Florida” (Milanich 1994:88). If, as noted above, the Orange Period is a continuation of Mt. Taylor, and the Transitional Period is not really transitional, then the meaning of the settlement shift diagramed in Figures 3-11 and 3-12 seems all the more uncertain.

Malabar I, c. 500 B.C. to 800 A.D.

With the disappearance of fiber tempering, the major ceramic regions of Florida were well established (Griffin and Miller 1978). In St. Johns and Malabar pottery, sponge spicules were either added to temper the clay or occurred naturally in the clays selected, giving the pots and sherds a distinctive “chalky” feel. “Malabar” does not refer
to a specific type of pottery as does St. Johns and Glades/sand-tempered, however, but rather to a type of *assemblage* in which sponge spicules and sand are used as tempers in about equal frequency. In other words, Malabar denotes a transitional assemblage between that of the Lower St. Johns and the sand-tempering traditions of south Florida. Malabar I and II, coined by Rouse, basically coincide with Goggins St. Johns I and II.

Similar to the collapse of Orange pottery chronologies based on incised decorations (Sassaman 2003), Ann Cordell’s re-analysis of Irving Rouse’s Malabar I vs. Malabar I’ distinction based upon presence or absence of St. Johns Incised, absence indicating the later Malabar I’ sub-period (Rouse 1951), found this distinction to be inoperative and recommended its abandonment (Cordell 1985). Rouse thought that the relative absence of St. Johns Incised on the BI suggested that the settlement shift occurred between the two sub-periods of Malabar I and I’. Supporting Cordell’s revision, the Futch Cove site on Merritt Island was found to have more St. Johns Incised in the upper, check-stamp bearing levels, than in the lower, plain St Johns levels (Johnson and Russo 1992). A ceramic analysis from Lake Washington in Melbourne, 8 Br 19, conducted by this author, also supports the rejection of St. Johns Incised as a temporal indicator. In both revisions of traditional ceramic chronology, Sassaman’s and Cordell’s, therefore, incised designs have been found not to be temporally diagnostic, although spatially uneven in distribution, the BI of east central Florida generally containing less incised ceramics during both the Orange and the St. Johns/Malabar periods. The meaning of this spatial distribution pattern is not yet clear.

Populations seem to have increased during this period, though of course the widespread use of pottery in an area poor in lithics undoubtedly increases this visibility of
such sites relative to the preceramic periods before it. Burial mounds become common in both St. Johns I and Malabar I, but otherwise this period is seen as continuing the midden burial traditions of the earlier periods (Pepe 2000). Michael Russo noted that the average size of fish captures increases from the Orange Period through Malabar I and into Malabar II, indicating to him that the UStJ was continuing to fill with water during this period (1986).

**Malabar II, c. 800 AD to 1763**

This period is marked by the introduction of check stamped pottery designs on St. Johns pastes c. 750 – 800 A.D. Subsistence and material culture do not change much in the IRL, although burial mounds increase in number and often in size as well. Whereas the rest of what is now the United States was undergoing revolutionary changes in agriculture, the IRL Area remained stuck in its “formative” type culture, though it may have boasted as much political complexity as any other region. The amount of sites and cultural material seems to decrease in the UStJ and increase along the BI during this Malabar II period, and yet the biological productivity of the UStJ probably continued to increase. Russo suggested that there may have been a return to a more residential form of mobility in the UStJ during this time (1998a), and that the UStJ probably flooded out entirely every four years, thus forcing its residents to seek higher ground on the ACR to the east. Similarly, BI inhabitants would also have to be able to relocate and take refuge on the ACR during certain seasons and under severe storm conditions, possible contributing to the pattern of paired towns among the Ais as noted by Rouse.

Two common confusions about Malabar I vs. II have contributed to recording errors in the archaeological site files: one, lack of check-stamping does not necessarily mean that a site or an assemblage is Malabar I and not II. Check-stamped pottery is
neither the majority nor the plurality of pottery types from Malabar II sites (Cordell 1985). Numerous sites in the IRL seem to have been recorded as both Malabar I and II (or “Malabar unspecified” or simply “prehistoric with pottery”) based on small samples and surface collections in which a few check stamped sherds were found with mostly plain sherds. In fact, check stamping only accounts for 8% to 20% of the total Malabar II assemblages from Cordell’s UStJ survey area (1985). Even further north, in the southern part of the St. Johns area proper, check stamped pottery made up only 5 to 7% of the sherds at the Ross Hammock Site in those levels in which it occurred (Bullen, Bullen and Bryant 1967). Occam’s Razor would require that a small sample containing just a few check stamped sherds and many plain sherds be counted as only Malabar II, until further evidence proves otherwise.

A second confusion in the archaeological record of the IRL results from the decreasing frequencies of check stamped decorations as one moves south into St. Lucie and Martin Counties. Much of peninsular Florida’s ceramic chronology is heavily dependent upon the presence or absence of St. Johns (or Malabar) check stamped pottery to indicate post 750 A.D. timer periods, and thus most of the BI sites in these two counties are not distinguished between Glades/Malabar I vs Glades/Malabar II. In fact, in Martin County, which has the highest survey coverage of any of the counties covered in this text (Figure 2-6), only BI site has even this level of relative dating—the Hutchinson Island Burial Mound, and that due to the presence of semi-fiber tempered pottery, not later wares.

The Malabar culture is believed to have persisted into the Contact-era Ais, subsistence and material culture relatively unchanged except for the addition of European
goods and influences, especially via shipwrecks, in the case of the Ais. This makes ethnohistoric accounts of the Ais all the more useful for exploring the prehistory of this area, although European biases must be guarded against when reading the Spanish and English accounts. Dickinson’s “journal” of his shipwreck, for instance, is an intriguing mixture of potentially valuable ethnographic observations, factual clues, and outright misrepresentations. From Dickinson and the Spanish sources the picture of the Ais and their Malabar ancestors that can be derived is one of a proud, extremely fierce people living in an area of barren sands and abundant fish. “Fish they have as plenty as they please,” Dickinson wrote. British surveyor Bernard Romans noted in 1775 that the “Rio d’Ais [IRL] abounds so much in fish of various kinds, that a person may sit on a bank, and stick the fish with a knife, or sharp stick, as they swim by” (in Davidsson 2001:32). Unlike the Timucuans, the Ais did not live in palisaded villages, depending instead upon their military prowess for protection—“Indians of this coast think all the valor in the world resides in them” Governor Canzo of St. Augustine reported to the King, regarding the Ais (Davidsson 2001).

Interestingly, Spanish documents refer to the Ais as the most populous and most troublesome of all the Florida coastal groups (Davidsson 2001), and yet Florida archaeology seems to have ignored the Ais in favor of the socially complex “fierce people” known as the Calusa. Spanish accounts and the historical record seem to indicate that the Ais were perhaps more fierce than the Calusa and just as socially complex (Davidsson 2001). The destruction of countless shell mounds from the IRL Area over the last 120 years has undoubtedly contributed to the relative negligence afforded to the Ais and the IRL Area (cf. Milanich 1994; Pepe 2000:33). Nevertheless, the higher population
levels of the Ais, and the focus of that population in the area of most extreme geomorphic instability in this study area—Sebastian to Fort Pierce Inlet—helps corroborate the correlation between geomorphic instability, ecological production, and prehistoric habitation along the coast of Florida.

Other interesting details about the Ais and possibly their Malabar ancestors are contained in Dickinson and the Spanish accounts—the use of sails and catamarans, a diet based on “roots and shellfish,” a tall and well-statured people, a system of political marriages linking the Mayaca in the Middle St. Johns with the Ais and the Jaega to the south, the number of towns between St. Lucie and St. Augustine (ten), and a ball game in which human heads were used, thus indicating perhaps some difference with the typical Muskogeean ball game where the ball was more lacrosse-sized. Even Levy et al.’s archaeological study of Cape Canaveral (1984), which found a statistical correlation between archaeological site locations and proximity to both lagoonal shorelines and nearby marshes, is anticipated by Dickinson: “Their town [Ais] stood about a half a mile from the seashore within the land on the sound [IRL], being surrounded with a swamp, in which grew white mangrove trees, which hid the town from the sea” (1945).

IRL archaeologist Jeff Lanham is analyzing Dickinson and other Contact-era documents for clues about the religion and cosmology of the Ais and possibly their Malabar ancestors as well. Lanham has noted that the Moon is mentioned numerous times in Dickinson’s account, both in connection with religious events and calendrics. No other heavenly body or spiritual entity is mentioned at all. Since the Ais depended upon the tidal inlets of the IRL and other coastal resources, Lanham proposes that it is quite
likely that the Ais had a religion or cosmology more focused on the moon than other, interior groups had (personal communication 2003).

The Grant site, 8 Br 56, provides coastal geomorphology with some valuable clues regarding one of the most ambiguous segments of the entire BI system—the HC-BC segment. While this entire segment is thick and irregularly shaped, thus indicating prehistoric inlet cuts, the northern part of this segment is unfractured in outline, much smoother than the lagoonal outline of, the S-V or Ft.P segments, whereas the southern part of the HC-BC segment has a much rougher outline, and a BI bifurcated into an oceanic side and an archipelagic group of islands separated by former tidal creeks on its lagoonal side (similar to the S-V segment). Mayhew found that the northern part of this segment has been prograding for the last 1,500 years (2000). The natural, shore parallel island known as Grant Island bespeaks of overlapping flood tidal deltas and thus migrating inlets. The only pre-Malabar I site on any thick, irregular-shorelined BI segment in the IRL occurs in this northern part of HC-BC. Only recent sites have been found in the southern part of this segment. The implication—that the northern part of HC-BC was unstable (inlet-cut) during the Orange to early Malabar I periods, while the southern section was unstable (inlet-cut) during a more recent time period—is borne out by the data from the Grant Site. All of the material excavated by William Sears—5 feet of it—came from the middle of Malabar II (Sears 1958), although Sears does quote Rouse’s primary local informant about excavating to levels where only plain pottery could be found. The implication of the archaeological data is that the northern part of this segment was cut by inlets during the Orange Period, which migrated south to the area of Ballard Cove by the middle of Malabar II. Inlets on wave dominated coasts tend to
migrate in the direction of the longshore current (Mayhew 2000), so positing a north-south migration of this former inlet is probably a safe bet.

Three outlines of the IRL BI with archaeological sites from the Orange/Transitional, Malabar I and Malabar II periods are included below. Since BI sites tend to hug the lagoonal shore, the location of sites not on the current lagoonal shore can be used by coastal geomorphologists to reconstruct the former location of the backbarrier lagoonal shorelines. Unfortunately, the location of BI lagoonal shorelines provides only indirect evidence as to the location of the oceanic shorelines of the BI, since the width of the lagoon and the BI are highly variable throughout the IRL (Almasi 1985). In the geomorphically unstable southern region, a slight westward migration of the BI since the Orange Period can be seen in the distribution pattern of archaeological sites.
Figure 5-1. IRL barrier island sites from the Orange Period (A), Malabar I (B) and Malabar II (C), showing slight westward migration of BI south of Sebastian since c. 4,000 B.P. (D).
Figure 5-2. Abandonment of the northern IRL pool during Malabar II and Ais times. Map (A) is Pre-ceramic Sites, (B) is Orange and Transitional sites, (C) is Malabar I, and map (D) is Malabar II sites.
CHAPTER 6
CONCLUSIONS: TOWARDS A UNIFIED FIELD THEORY OF IRL ARCHAEOLOGY, ECOLOGY AND GEOMORPHOLOGY

1. More ancient landforms (that is, those with greater geomorphic stability) of the IRL BI have more ancient archaeological sites (oldest being Orange and Transitional); conversely, more recent, less stable landforms tend to lack more ancient sites.

2. The antiquity or relative geomorphic stability of any portion of the BI can be easily determined from cartographic and topographic evidence alone: irregular, squiggly lagoonal shorelines indicate tidal inlet cutting, while irregular, lobate lagoonal shorelines indicate overwash, the two primary modes of geomorphic instability and BI landward migration. Another topographic indication of instability is a single, low dune line just behind the beach. Geomorphically stable BI landforms often have cusparse or at least semi-cusparse lagoonal shorelines; they also tend to have high, parallel prograding beach ridges and swales. BI segments that are thin and linear indicate that they are sediment starved and vulnerable to overwash/inlet cutting, but that such events have not yet happened. Thus, thinner more linear segments of the BI tend to have more ancient sites than thick, irregular-shorelined BI segments, although these sites are often dangerously close to the beach, if not on the beach itself, as at the Homer Cato Site.

3. The overall distribution of geomorphic stability and more ancient archaeological sites on the IRL BI is arcuate—greatest at the ends (Cape Canaveral in the north, Palm Beach County in the south), and least in the middle—the segments from Sebastian to the Fort Pierce Inlet (Indian River and northern St. Lucie Counties).

4. Since BI’s retreat to the mainland under rising ocean levels, “rolling over on themselves like the tread of a tractor” (Pilkey and Dixon 1996), archaeological preservation is so low that statements concerning Paleo-Indian/ Early - Middle Archaic coastal adaptations in this area cannot be made without extensive underwater excavations.

5. Most prehistorians of Florida and the coast falsely assume that Early-Mid Holocene estuaries and lagoons were not biologically productive due to the geomorphic instability of rapidly rising seas (Rouse 1951; Goggin 1952; Griffin 1988; Widmer 1988; Milanich 1994, etc.). In fact, estuaries and lagoons thrive under geomorphic instability (inlets and overwash); conversely, geomorphic stability often cuts off the interchange of oceanic and lagoonal waters, thus lowering overall productivity. (Thus, the current distribution of IRL productivity and species diversity is also arcuate.)
6. Consequently, the apparent shift to the coast in prehistoric settlement patterns c. 3200 BP (in east central Florida) or 2700 BP (southwest Florida), if real, cannot be explained in terms of estuarine maturation, nor in terms of biological productivity alone. Cultural factors, and/or shoreline accessibility and predictability, must be examined instead.

7. The stratigraphy of overwashed BI’s will appear orderly in profile—an alternating mix of lagoonal mud strata and sandy overwash strata—but the contents of the overwash strata are in fact random mixtures from sites originally located to the east, and now underwater. Paleo-Indian landsurfaces are now located well below the current BI water table—about 320 cm deep in St. Lucie County, one of the lowest-lying stretches of the entire BI system. Standard CHM practice—ending excavation units after two sterile 10-centimeter levels—is thus inadequate for BI investigations.

8. Archaeological sites on this BI tend to hug the protected and productive lagoonal shore; conversely, archaeological sites indicate former backbarrier locations. Consequently, sites located east of the current lagoonal shoreline in the unstable southern regions south of Hog’s Cove are more likely older than sites located on the current lagoonal shoreline.

9. Cuspate erosion patterns can be expected with sites located on cuspate lagoonal shorelines. Sites in the bay areas of such cusps will be stretched laterally, with finer sized material pulled outwards into the lagoon, while coarser material tends to settle out along the cusps.

10. Bathymetric slope is an excellent indicator of prehistoric levels of BI geomorphic stability. Where bathymetric contours are widely spaced (i.e., gently sloped), such as offshore from the S – V segment, geomorphic instability is indicated for those time periods when the BI occupied those positions. Interestingly, the bathymetric steepness offshore from the currently stable PAFB-HC segment significantly decreases after one passes east of the 60 meter contour, whereas the bathymetric steepness offshore from the S – V segment significantly increases beyond that point. Therefore, the relative stability of the PAFB – HC segment and the relative instability of the S – V segment was likely reversed in the Early Holocene, c. 8,000 B.P.

In a very real sense, bathymetry provides a sort of “unified field theory” for the archaeology, ecology and geomorphology of the IRL BI system, since all other factors besides sediment supply remain the same. The formula or syllogism for this unified field theory of the IRL looks something like this:

Bathymetry = geomorphic instability = ecology/biological production = archaeological site distributions + taphonomy.

Ergo, bathymetry = ecology/biological production. Also, bathymetry = archaeology + taphonomy.
Biologists and other investigators of the IRL should be surprised to learn that the biological distributions patterns in the IRL (north vs. south, and distance from inlets) are largely determined by the offshore bathymetric contours!

11. Obtaining fresh water is not a problem on BIs and need not be discussed in site reports, as is appropriate for inland terrestrial investigations, since lenses of fresh water always hydrostatically sit atop the saline waters below. Any dip in the BI that reaches mean sea level will be filled with fresh water.

12. Eleven site designations were corrected using this model, including one grossly mistaken “Archaic” site reported along the current lagoonal shore of the most rapidly-retreating section of the entire barrier island system, a landform probably not any older than the Malabar II culture period which makes up all of its known archaeological sites.

13. Approximate locations and rates of barrier island migration can be obtained from the presence or absence of archaeological sites from various culture periods.

14. Future archaeological research in the IRL and on BIs should at least include the following: a) better coverage and carbon dates from the PAFB-HC segment so as to test the antiquity of this landform relative to Cape Canaveral; b) carbon dates from the numerous unclassified plain pottery sites south of the Vero Beach area so as to discriminate between pre- and post-A.D. 750 sites and thus measure the rate of BI migration in the southern sections of the IRL; c) better coverage and carbon dates in the geomorphically ambiguous HC-BC segment, an area of ancient instability which has since “recovered” and has actually been prograding slightly over the last 1,500 years; d) correlations or lack thereof between rich archaeological deposits and the timing and proximity of nearby inlets; e) underwater investigations in the current IRL lagoon, especially in the stable northern sections, and e) underwater investigations offshore beneath the Atlantic. If the surf-zone jump model is correct, then the most likely place to explore would be along areas of widest (least steep) bathymetric contours (the S-V segment). If, as this author suspects, the surf-zone jump model is incorrect—that the barrier shore is never jumped but always reworked and pushed towards the mainland via inlets and overwash—then the most profitable areas to explore underwater would be along the steepest bathymetric contours—the PAFB-HC segment for sites dating within the last 8,000 years, and the S-V segment for sites older than 8,000 years.
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BIOGRAPHICAL SKETCH

Alan Brech was born in the lower Hudson Valley of New York and has lived for many years in Palm Bay, a half mile from the Indian River Lagoon. He graduated from the University of Florida in Gainesville with a BA in English in 1988, having been a columnist and editor for *The Independent Florida Alligator* from 1983 to 1988. After graduation, he first worked in the publishing field in New York. In 1991, he began doing legal research and textual analysis for a law firm in New York City. In 1994-1995, he co-wrote the feature-length documentary film *Synthetic Pleasures*, about the replacement of natural life and experience with artificial technologies. In 1998, he left the legal field and began working in cultural heritage management or “contract archaeology,” first in New York, and then, when winter came, in sunny Florida. In 2001 he entered the graduate program in anthropology (archaeology) at the University of Florida.