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RESEARCH REPORT

Pre-Clovis to the Early Archaic: Human Presence, Expansion, and Settlement in Florida over Four Millennia

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ABSTRACT

In this article, we review evidence for the initial presence, later expansion, and subsequent settling-in of first Floridians during times when climate change and sea level rise decreased the amount of habitable land. We present projectile-point and formal-tool sequences and estimated chronologies that describe Florida's: (1) pre-Clovis presence (exploration); (2) Clovis presence focused on river channels, springs, chert resources, and possibly megafauna (colonization); (3) continuation and proliferation of Clovis-related, but post-megafauna late Paleoindian lanceolate point makers that remained focused on river channels, springs, and chert (expansion); (4) transition to side- and corner-notched points and a plethora of formal tools, along with significant population increase and landscape use occurring away from waterways (settlement); and (5) possible population decline or abandonment, or both, by 10,000 calendar years ago or soon thereafter.

KEYWORDS

Pre-Clovis; Paleoindian; Early Archaic; sea level rise; paleolandscape

1. Introduction

Eastern North America's robust record of early human occupation extends from the late Pleistocene into Holocene times (Anderson and Sassaman 1996a; Anderson et al. 2015; Eren et al. 2016; Gingerich 2013, 2018; Lothrop et al. 2016). In Florida, this record attests to at least 4500 years (~14,500–~10,000 cal yr BP, all ages in calendar years) of late Pleistocene and early Holocene settlement and cultural-behavioral continuity (Dunbar 2006; Faught and Waggoner 2012; Goodwin et al. 2014; Halligan et al. 2016; Pevny, Thulman, and Faught 2018; Thulman 2012a, 2018). Florida follows the greater Southeast pattern of regionally bounded Early Archaic populations understood to be Clovis descendants (Anderson and Sassaman 1996b; Coe 1964; Eren et al. 2016). This ancestor–descendant relationship is inferred from the Paleoindian and Early Archaic association and continuum of projectile-point forms[1] and manufacturing techniques (O'Brien et al. 2014; Pevny, Thulman, and Faught 2018). These material data represent early Floridians, who for more than 4000 years culturally "mapped" onto a landscape where spring-fed water co-occurred with abundant toolstone (Thulman 2009). In other regions of North America, widely spaced, landscape-prominent toolstone sources are used to estimate hunter-gatherer mobility and territory ranges (Ellis 2011; LaBelle 2012; Tankersley 1989). In Florida, toolstone and spring water resources are spatially confined, and early site- and artifact-based locational data overlap (Figures 1–5). Early sites indicating human settlement are found primarily in the north half of the state to the near exclusion of sites in the south; this is not true for the distribution of Middle and Late Archaic sites, which extend across much of the peninsula.

The artifact sequence, toolstone-procurement patterns, and tool-manufacturing regularities in Florida indicate social-cultural continuity from Paleoindian Clovis through Early Archaic Bolen times. Pevny, Thulman, and Faught (2018) have pointed out specific Bolen biface-reduction characteristics that parallel the Clovis school of knapping (e.g., careful shaping, lateral and end thinning, "fluted" preforms, and hypertrophic bifaces). In addition, there is a diverse tool array produced in the earliest Holocene (about 11,500–11,000 cal yr BP), and these tools were used for a wide range of tasks, including subsistence resource processing.

In this article, we review evidence for the initial presence, later expansion, and subsequent settling-in of first Floridians during a time when climate change and accelerated sea-level rise decreased the amount of habitable land. First, we characterize aspects of Florida's deglacial climate and changing landscape that occurred before and after the Pleistocene – Holocene boundary at 11,500 cal yr BP. Next, we describe Florida's Paleoindian and Early Archaic diagnostic artifact types, distribution, and ratios. We calculate landscape-area reduction – the result of three significant meltwater pulses (MWP) – and assess the role MWP 1b may have played in Florida's

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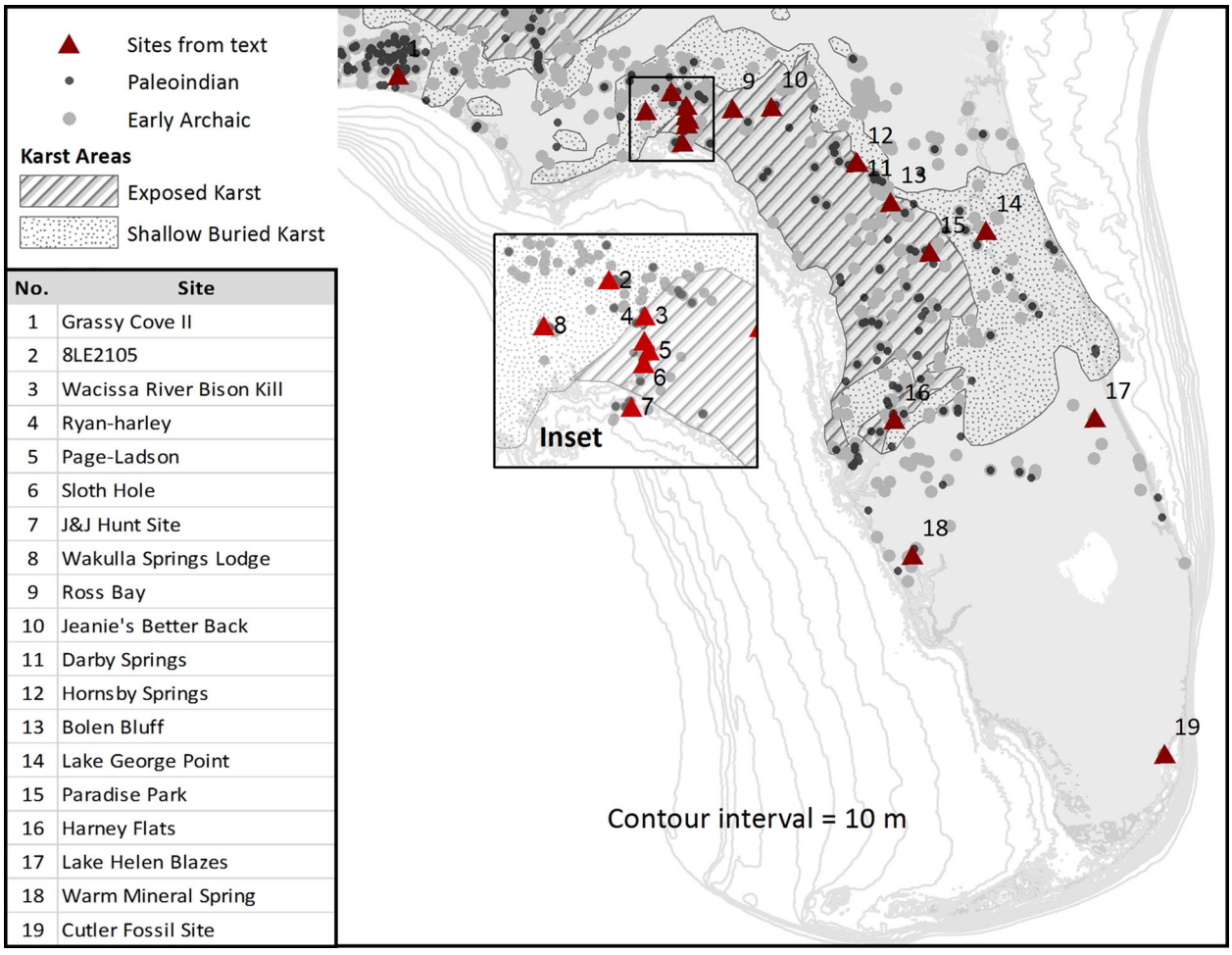

No.	Site
1	Grassy Cove II
2	8LE2105
3	Wacissa River Bison Kill
4	Ryan-harley
5	Page-Ladson
6	Sloth Hole
7	J&J Hunt Site
8	Wakulla Springs Lodge
9	Ross Bay
10	Jeanie's Better Back
11	Darby Springs
12	Hornsby Springs
13	Bolen Bluff
14	Lake George Point
15	Paradise Park
16	Harney Flats
17	Lake Helen Blazes
18	Warm Mineral Spring
19	Cutler Fossil Site

Figure 1 Sites mentioned in the text, the distribution of Paleoindian ($n = 291$) and Early Archaic ($n = 673$) sites, and areas of exposed or shallowly buried karst. The distribution data are from the Florida Master Site File (FMSF), updated January 2018. Note: The "Paleoindian, 10,000 B.C.–8500 B.C." sites are from the "culture type," as opposed to "site type," attributes found in eight FMSF database fields.

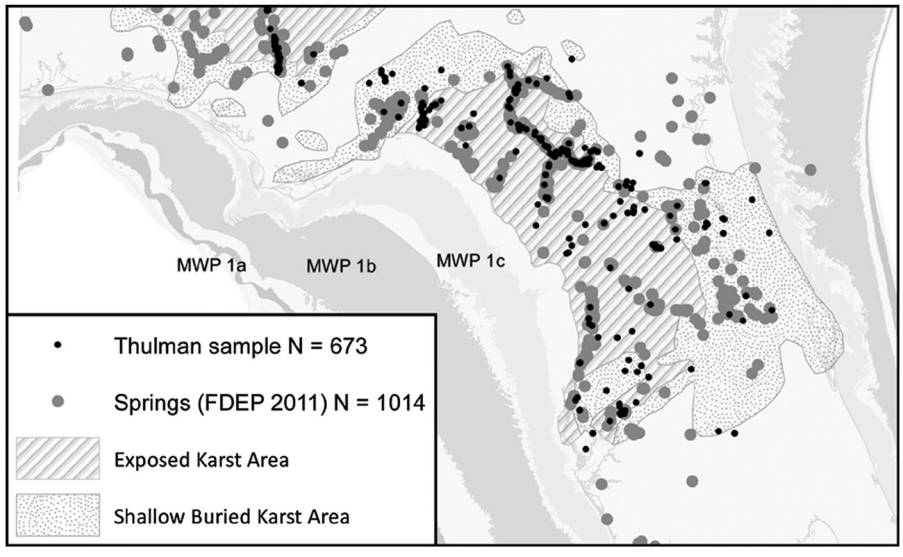

Figure 2 The distribution of Thulman's (2006, 2009) Paleoindian point data ($n = 673$) compared with the Florida Geological Survey spring locations ($n = 1014$). The MWP 1a, 1b, and 1c shelf transgression areas are shown in shades of gray; the timing and extent of the pulses are presented in Table 1. Bathymetric data from NOAA; sea level magnitude and rates from Joy (2018, forthcoming).

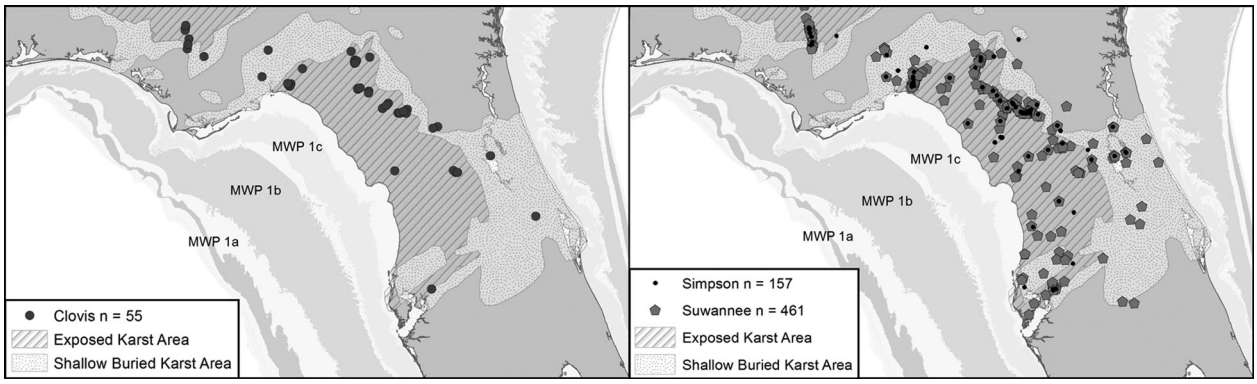

Figure 3 The distribution of Thulman's (2006; 2009) Clovis point data (left) contrasted with the distribution of his Simpson and Suwannee point data (right). The MWP 1a, 1b, and 1c shelf transgression areas are shown in shades of gray; the timing and extent of the pulses are presented in Table 1. Bathymetric data from NOAA; sea level magnitude and rates from Joy (2018, forthcoming).

demonstrable early-Holocene population increase. Finally, we discuss the distribution of Florida toolstone resources, and we present tools types associated with Early Archaic assemblages.

2. Environment: Karst geology, sea level rise, and fresh water

The Florida peninsula has exposed, shallowly buried, and deeply buried karst formations (Figures 1–4). Unlike northern Florida, limestone in the southern part of the state is deeply buried, artesian springs are scarce, and the only early site identified to date is the Cutler Fossil site, a sinkhole site south of Miami near Biscayne Bay (Figure 1; Carr, Armelagos, and Austin 2015).

A recent reanalysis of evidence for sea-level rise and its effects in the Gulf of Mexico (Joy 2018) indicates that transgression was a continuous process, beginning about 18,000 cal yr BP and ending roughly 4000 cal yr BP. However, this process was accentuated by three major meltwater pulses of melting ice, rising seas, and shoreline retreat that would have affected human settlement (Anderson and Bissett 2015; Anderson, Bissett, and Yerka 2013; Blanchon 2011; Joy 2018). Table 1 provides the data used to estimate land loss at the end of each of the three pulses based on Joy's (2018, forthcoming) updated Gulf of Mexico sea-level curve; the estimated land loss is illustrated in Figures 2–5.

Table 1 Ages and sea-level depths used to calculate paleolandscape-area reduction.

MWP	Date (cal yr BP)	Depth estimate (m) (Joy 2018, forthcoming)	Area (sq km)
	Modern	0	160,429
	5000	−5	178,851
End MWP 1c	6000	−8	186,266
MWP 1c	7000	−12	201,645
Begin MWP 1c	8000	−20	224,097
End MWP 1b	9000	−23	235,638
MWP 1b	10,000	−35	275,540
Begin MWP 1b & Bolen	11,000	−46	300,233
End MWP 1a & Clovis	12,000	−64	325,313
Begin Clovis	13,000	−70	332,018
Begin MWP 1a & pre-Clovis Page-Ladson	14,000	−87	342,005
	15,000	−98	345,540
	16,000	−103	347,037
	17,000	−108	349,557
	18,000	−113	350,000
	19,000	−118	351,552
	20,000	−123	353,327
	21,000	−125	354,006
LGM	22,000	−132	355,777

The first of the three meltwater pulses – MWP 1a – began roughly 14,500 cal yr BP, coincident with the pre-Clovis presence at the Page-Ladson site (see Figures 1 and 2; Blanchon 2011; Halligan et al. 2016; Joy 2018, forthcoming; Webb 2006a). During MWP 1a, the sea level rose roughly 20 meters over an 800-year period. MWP 1b occurred around 11,500 cal yr BP, and this pulse marks the Pleistocene–Holocene boundary and the end of the Younger Dryas (YD; Fiedel 2011). MWP 1b was similar in timing and magnitude to MWP 1a, but it was the most dramatic of the three pulses in Florida in terms of landscape loss due to the low continental-shelf gradient. MWP 1b corresponds to the technological shift from lanceolate to notched points, an increase in the number of sites and artifacts, and a change in Early Archaic site and artifact distribution to landscape positions that were not previously used in the Paleoindian period. Finally, MWP 1c occurred around 8200 cal yr BP, resulting in a 10-meter sea-level rise that occurred over 1000 years.

Lower sea levels at the end of the Pleistocene depressed the Floridan aquifer, and in much of the state surface water was scarce (Thulman 2009; Watts, Hansen, and Grimm 1992). Aquifer exposure occurred mostly within the near-dry channel thalwegs of the Aucilla, Chipola, Suwannee, and Santa Fe rivers

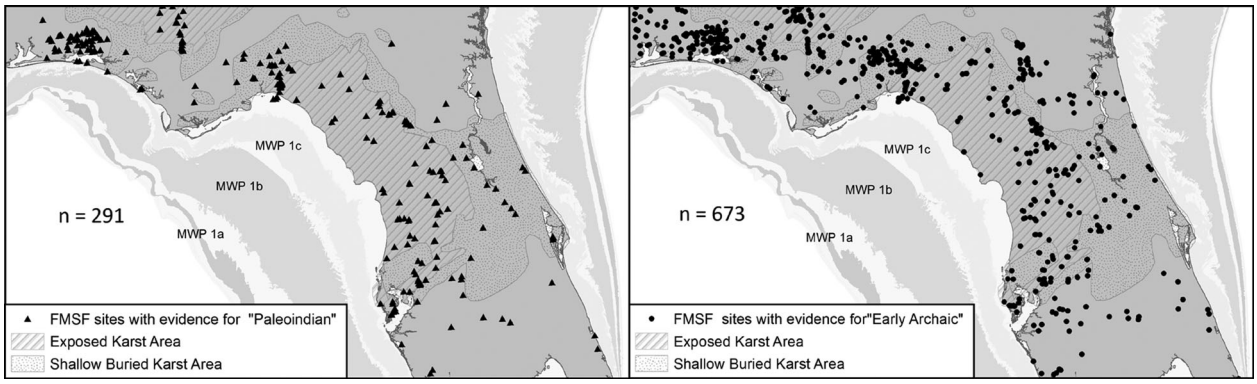

Figure 4 Sites from the FMSF database using "Paleoindian, 10,000 B.C.–8500 B.C." (left) and "Early Archaic" (right) attributes. The MWP 1a, 1b, and 1c shelf transgression areas are shown in shades of gray; the timing and extent of the pulses are presented in Table 1. Bathymetric data from NOAA; sea level magnitude and rates from Joy (2018, forthcoming)

(Thulman 2009). These rivers and related springs were foci of animal and human activity (Dunbar and Vojnovski 2007; Dunbar and Waller 1983; Scott et al. 2004; Thulman 2009). Figure 2 shows collector-found Paleoindian points overlain with the Florida Geological Survey's artesian-spring database (FGS 2011; Thulman 2012a). Paleoindian surface finds are not found at springs outside of the main river distributions; the

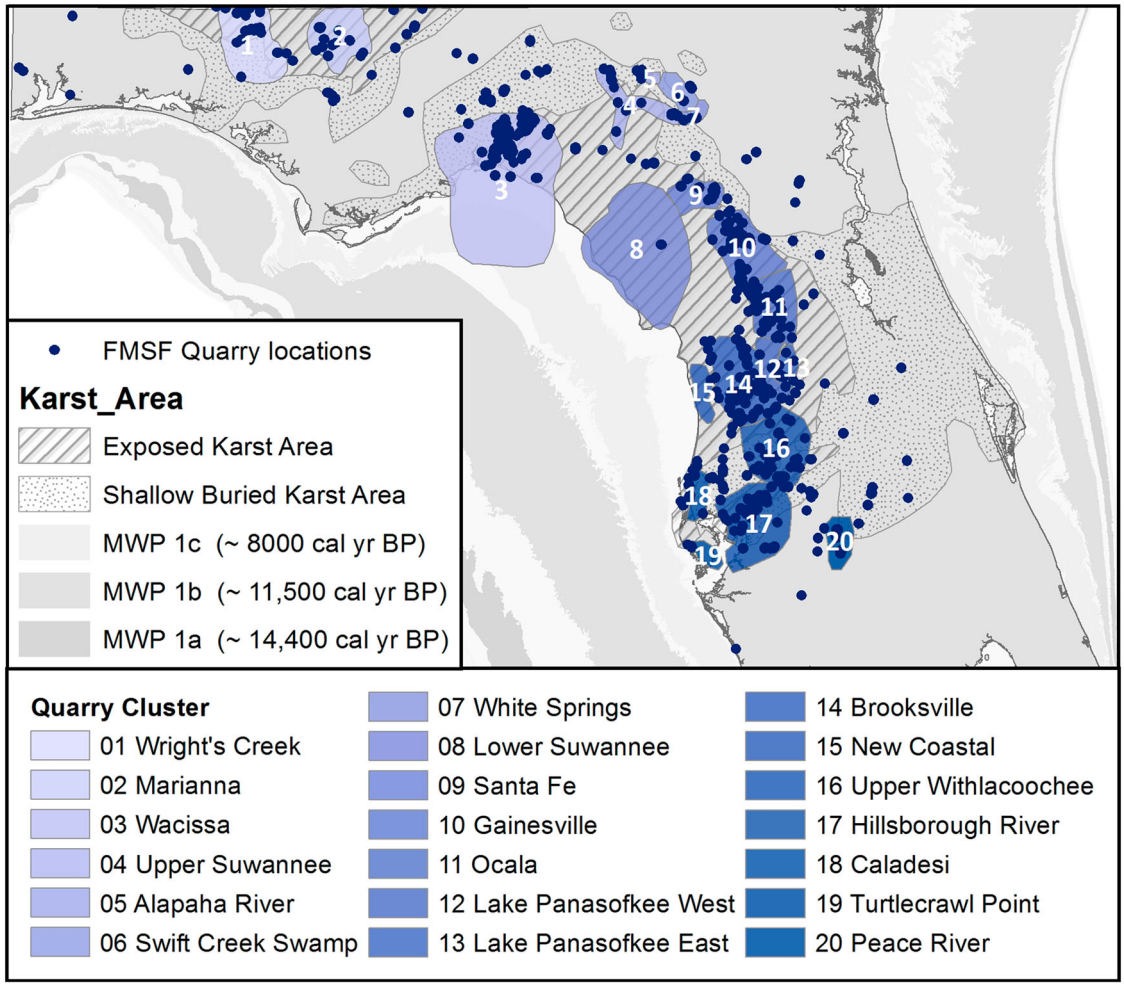

Figure 5 Quarry and quarry cluster locations in Florida (adapted from Austin et al. 2018 and FMSF data). The MWP 1a, 1b, and 1c shelf transgression areas are shown in shades of gray; the timing and extent of the pulses are presented in Table 1. Bathymetric data from NOAA; sea level magnitude and rates from Joy (2018, forthcoming).

surface-find locations generally correspond with the Floridan aquifer surface extent.

Dunbar and Waller (1983) used collector-found Paleoindian point-distribution data to develop the "Oasis Hypothesis," which modeled animals and people at karstic spring features where people may have dispatched animals and procured chert (Dunbar 1991; Faught and Carter 1998; Pevny, Thulman, and Faught 2018). At the Page-Ladson site, the pre-Clovis Unit-3-sealed mastodon-digesta bed indicates these megaherbivores were at the site during MWP 1a; unequivocally human-made artifacts from the same unit (Dunbar 2006; Halligan et al. 2016) demonstrate that people were there at the same time. Butchery evidence, however, is lacking, except for possible cut marks circumscribing one mastodon tusk and a mastodon vertebral process with a green fracture (Halligan et al. 2016, supplemental online material; Webb 2006b).

It is also likely that megafauna roamed expansive coastal-plain grasslands, an environment inferred from state-wide pollen analyses (Grimm et al. 1993; Hansen 2006; Perrotti 2016; Watts and Hansen 1994). At Lake Tulane, Grimm et al. (1993) interpret *Pinus* (pine) and *Quercus* (oak) with Ambrosia (ragweed) oscillations as wet-dry climatic fluctuations between pine forest and oak savanna or grassland. The latest Pleistocene–earliest Holocene environmental conditions were likely dry and windy, with active sand dunes and local sand and silt deflation during periods of oak/grassland dominance (Dunbar 2016; Faught and Carter 1998; Hansen 2006; Watts and Hansen 1994). Early Floridians possibly hunted in this environment, away from rivers and springs.

Pollen analysis has identified pine–oak fluctuations at the Page-Ladson site, with an increase in ragweed and oak pollen around 14,400 cal yr BP, coinciding with evidence for human presence at the site (Halligan et al. 2016). Hansen's (2006) suggestion that ragweed reflects megafaunal rutting and feeding disturbance is buttressed by *Sporormiella* identified by Perrotti (2016) in sediment samples from Page-Ladson units 3 and 4. *Sporormiella* abundance is correlated with herd size and is used as an indicator of megaherbivore activity. At Page-Ladson, *Sporormiella* peaks parallel an increase in ragweed pollen and charcoal at 14,400, 13,700, and 12,950 cal yr BP. *Sporormiella* are absent by 12,600 cal yr BP, signifying the extinction of megaherbivores. After 12,600 cal yr BP, increased aridity and human disturbance are inferred from the disappearance of pine forest taxa, amplified Chenopodiaceae (goosefoot) pollen, and increased charcoal (Perrotti 2016).

Around 10,400 cal yr BP, an anomalous reoccurrence of *Sporormiella* is interpreted to represent Early-Holocene bison expansion into Florida. Bison presence and procurement also are inferred from blood residue on Early Archaic Bolen tools (Table 2; Fagan 2014; Goodwin et al. 2014) and a bison cranium found in the Wacissa River that is embedded with a possible point fragment[2] (Webb et al. 1984). *Sporormiella* influx again declines at Page-Ladson about 10,100 cal yr BP and then disappears from the record. Find locations and uses for Early-Archaic formal or curated tools indicate a diverse upland adaptation (Table 2); whether early Floridians were coastally adapted or focused solely on upland resources remains to be determined by submerged prehistoric geoarchaeology (Faught 2004, 2014). No unequivocal marine shell or other maritime resources have been reported from early sites, with the possible exception of the Cutler Fossil site in southern Florida (Carr, Armelagos, and Austin 2015).

Table 2 Faunal resources identified from blood residue analysis of artifacts from site 8LE2105.

FS number	Morphological class	Named type	Antiserum reacted with
TU-53B-10	Adze	Dalton	Bear
TU-74A-09	Adze	Dalton	Pigeon
3–4427	Adze	Aucilla adze	Rabbit
TU-21B-07	Hafted biface	Bolen	Deer
3–4208	Hafted biface	Bolen	Rabbit
TU-34B-01	Hafted uniface	Waller knife	Bear, bovine, and pigeon
TU-18A-05	Plane	Scraper	Bovine
TU-52B-10	Scraper	Scraper	Bear
TU-19B-07	Scraper	Scraper	Pigeon

3. Artifact tradition and trend proxies: The confirmed, the inferred, the estimated, and the assumed

A pre-Clovis human presence in Florida was established by the recovery of unequivocally human-made bifaces and flakes from the Page-Ladson site. The artifacts were identified in strata with ages that range between 14,500 and 14,000 cal yr BP; however, the bifaces are not temporally diagnostic (Dunbar 2006, 419, specimen D; Halligan et al. 2016, 3, specimen F). Dunbar and Hemmings (2004) have proposed a proto-Clovis "Page-Ladson" point type that is a concave-based, basally-thinned, edge-abraded, lanceolate point made on a large flake (Figure 6(a)). The interior surface of the flake resembles a flute or end-thinning scar, but it is not. Several similar points have been identified in Florida, but not in the stratigraphic contexts necessary to resolve the question: Does this point form predate the Clovis era (Pevny, Thulman, and Faught 2018, 225; Thulman 2018)?

We consider Florida Clovis points (see Figure 6(b)) to be contemporary with points recovered from dated

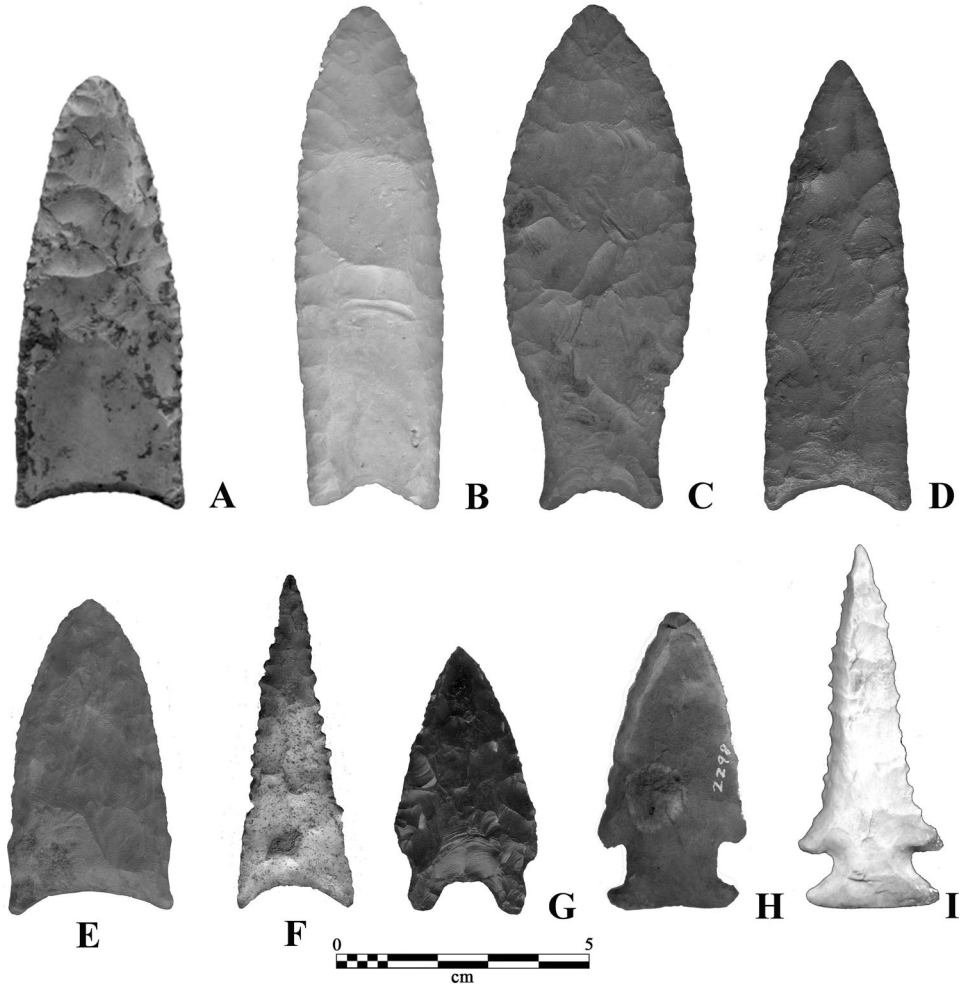

Figure 6 Diagnostic projectile point types: (A) Page-Ladson, (B) Clovis, (C) Simpson, (D) Suwanee, (E, F) Dalton-like forms, (G) Transitional side-notched, (H) side-notched Bolen, and (I) corner-notched Bolen. Images courtesy of David Thulman.

North American Clovis sites (13,000–12,700 cal yr BP; Waters and Stafford 2007), although only one Florida Clovis point has been identified in stratigraphic context – a point recovered during excavations at the Paradise Park site at Silver Springs (see Figure 1; Neill 1958). No dates are associated with the point or the site. However, an ivory-rod fragment recovered from the Sloth Hole site, which is located on the Aucilla River downstream from Page-Ladson (see Figure 1), has an early Clovis radiocarbon age of $11{,}050 \pm 50$ ^{14}C yr BP (13,058–12779 cal yr BP (SL-2850); Hemmings 1999, 2004; Waters and Stafford 2007). Other known Florida fluted points are isolated finds mainly recovered from the Santa Fe, Suwannee, and Aucilla Rivers.

We believe unfluted lanceolate Suwannee and Simpson points (see Figure 6(c,d)) are forms that occurred after Clovis and before notched Bolen points (Bullen 1975; Thulman 2012a, 2018). Suwannee points are unfluted, lanceolate bifaces with straight lateral margins and concave and abraded bases (Figure 6(d)). The basal "ear" shape varies from pointed to rounded, straight to curved. Simpson points are distinguished by their narrow, waisted bases and wide, spatulate blades (Figure 6(c); Thulman 2007, 2012a). Simpson points are more often fluted than Suwannee points, possibly indicating closer temporal proximity to Clovis (Thulman 2012a, 2018). There certainly is a cultural-behavioral relationship between Clovis-point knappers and unfluted-lanceolate-point knappers. While Florida Simpson points have few waisted bases, spatulate counterparts in the Southeast, similar and potentially contemporary Fishtail (also referred to as Magellan) points are known from Panama, Ecuador, Argentina, and Uruguay (Faught 2006; Miotti and Terranova 2015; Pearson 2017). In these South American regions, points are made from flakes and bifaces.

At sites like Harney Flats, Bolen Bluff, Darby Springs, and Hornsby Springs, late Paleoindian lanceolate points are found in association with notched Bolen points (Figure 1; Austin 2006; Bullen 1958; Daniel and

Wisenbaker 1987; Dolan and Allen 1961). At these sites, the contiguity makes it difficult to discern which curated tools are associated with the late Paleoindian period and which tools are associated with the Early Archaic period. The Ryan Harley site is the only known Suwannee site where points and curated tools have been recovered from sealed contexts (Balsillie, Means, and Dunbar 2006; Dunbar et al. 2005; Smith forthcoming). To date, there are no radiometric ages from the site, but a publication describing the assemblage is forthcoming (M. F. Smith, personal communication).

Figure 3 contrasts Thulman's (2006; 2009) Clovis ($n = 55$), Simpson ($n = 157$), and Suwannee ($n = 461$) point locational data. Clovis points represent slightly more than 8 percent of the sample; the Simpson and Suwannee points in the Thulman database comprise 23 and 68 percent of the Paleoindian data, respectively. Examples of these point types are shown in Figure 6. We believe Figure 3 data suggest territorial expansion of lanceolate point knappers over time. However, if a post-Clovis population decline created a lacuna between Clovis and Simpson-Suwannee, as Anderson et al. (2011) have proposed with Paleoindian Database of the Americas (PIDBA) data, that gap will not be perceivable in Florida without better age constraints on these point types. Much depends on when the early "fluters" came into Florida and whether they stayed and prospered, which we think they did. The basal-shape details of some Florida Clovis fluted points are repeated in unfluted Suwannee and Simpson lanceolate points (Thulman 2007, 2012a), lending support to the idea of cultural-behavioral continuity (at least of knappers) without interruption (see Pevny, Thulman, and Faught 2018, 226, figure 10.5, for similarities).

Near the end of the Pleistocene and the transition to fully notched points, we infer an interval of time and apparent behavioral influence from outside of Florida – what might be called the "Dalton influence" (Thulman 2019). We interpret point types such as Greenbriar, Chipola, Union Side-notched, and Gilchrist (see Figure 6; Bullen 1975; Emerson, McElrath, and Fortier 2009; Thulman 2012a) as local variations of incipient-notched, waisted-base, and retouched-blade Dalton-point attributes. However, except for the points recovered from the Lake Helen Blazes site (Figure 1; Rink, Dunbar, and Burdette 2012; Thulman 2012b) along the St. Johns River, few of these points have been recognized in stratigraphic context, and most known examples are from private collections and are isolated finds. We estimate the age of these points as roughly 12,400 cal yr BP to 11,500 cal yr BP. Farr (2006, 73) has proposed the name "Transitional Side-notched" to capture the interim forms between Suwannee and Bolen, including Greenbriar and Union Side-notched points, and we adopt that term here. We envision the evolution toward notched points as a process and not an immediate replacement. On the other hand, it was an apparently rapid process that indicates point-shaping information-sharing over an immense portion of eastern North America – information traceable to Clovis-knapping ancestors through Dalton and other late-Paleoindian point forms (Thulman 2018).

Compared to earlier Paleoindian points, Early Archaic Bolen notched points are constrained at the Page-Ladson and 8LE2105 sites (Figure 1) by stratigraphic occurrences and radiocarbon ages, about 11,500–11,000 cal yr BP (Carter 2003; Carter and Dunbar 2006; Faught et al. 2003; Faught and Waggoner 2012; Goodwin et al. 2014; Hornum et al. 1996). The Wakulla Springs Bolen occupation is likely later in time with two radiocarbon ages around 10,200 cal yr BP, and perhaps as late as the most recent age estimate of 9800 cal yr BP (Faught and Waggoner 2012; Tesar and Jones 2004). Side- and corner-notched points occur together at most Bolen sites, although in different percentages depending on location, possibly indicating social-group territories (Pevny, Thulman, and Faught 2018; Thulman 2018). Cremation burials are associated with the Bolen occupation at the Wakulla Springs Lodge (Tesar and Jones 2004) and Grassy Cove sites in Walton County (Figure 1; Pevny, Thulman, and Faught 2018, 233; Thomas et al. 2013). The Grassy Cove cremation, radiocarbon dated at 10,800 cal yr BP, was associated with a hypertrophic Bolen point, a size attribute shared by Clovis and Early Archaic Bolen point-making Floridians.

Early Archaic Bolen sites and isolated finds are significantly more numerous across the landscape than Paleoindian sites and isolated finds in Florida, indicating increased population size (*sensu* Meeks and Anderson 2012). Though more data are needed, points from the Rainey Collection and Florida Master Site File (FMSF) data were used to estimate this increase. The Rainey Collection has almost twice as many Bolen points as Paleoindian points: 1104 Paleoindian points (Clovis, Suwannee, Simpson combined) and 2161 Bolen notched points (side- and corner-notched combined). The FMSF database records 291 sites with evidence for "Paleoindian" and 673 sites with evidence for "Early Archaic" (in most cases, this evidence was Bolen points). The nearly identical evidential ratios for a Bolen population increase are 2.2 times greater than Paleoindian estimates using Rainey Collection point data and 2.3 times greater than Paleoindian estimates using FMSF site data.

These differences are more relevant when the point numbers are divided by the estimated time spent on

the landscape producing the tools – roughly 2.5 thousand years (13,000 cal yr BP-11,500 cal yr BP) for Paleoindian and 1.5 thousand years (11,500 cal yr BP to 10,000 cal yr BP) for Early Archaic folks. Using Rainey data with these chronologies, Paleoindian knappers produced 116 points per thousand years, while Early Archaic knappers produced 449 point per thousand years, which is almost four times as many points produced per thousand-year period. From these data we infer a population-density increase that may have been influenced by any combination of several factors, including landscape loss due to sea-level rise, increased inland surface-water availability related to sea-level rise and its positive effect on water tables (Thulman 2009), and Early Archaic tool and toolkit adaptation and effectiveness in a changing environment.

Using artifact-increase ratios and the areal-loss GIS data illustrated in Figures 2–4, we estimate the population increase expected given sea-level rise and land loss. Anderson, Yerka, and Christopher Gilam (2010), Anderson, Bissett, and Yerka (2013), and Anderson and Bissett (2015) developed this methodology using Balsillie and Donoghue (2004) sea-level data. Joy (2018, forthcoming) ranked these sea-level data and later additional estimates, and discarded many, thereby providing a more accurate curve. Using Joy's (2018, forthcoming) Bayesian-calculated time/depth curve, sea-level depth estimates were calculated at 1000-year intervals. Bathymetry data were downloaded from the National Oceanic and Atmospheric Administration (NOAA) website, using the ETOPO1 1-arc-minute scale dataset (Amante and Eakins 2009). The data were "clipped" to encompass the Florida peninsula (submerged and exposed) to a maximum depth of 132 meters from the eastern Atlantic at 31.000 degrees North latitude to the western Gulf of Mexico at 87.351 degrees West longitude. ESRI ArcGIS 10.3® was used to process the GIS data. The ETOPO1 binary-grid file was imported and converted to a raster dataset that was queried for depths (Table 1). The queried depths were saved to polygon shapefiles, each representing the area of the continental shelf at that depth. The area was then determined in square kilometers (km^2) using the "Calculate Geometry" option in ArcGIS® (Table 1).

The data show that MWP 1a resulted in a 16,692 km^2 land loss, MWP 1b resulted in a 64,595 km^2 loss, and MWP 1c resulted in a 37,831 km^2 loss. MWP 1b represents 33 percent of the total landscape lost during deglaciation.

To see if the population increase was equal to or different than the land-loss estimates, we see that the area of Florida before MWP 1b was 325,313 km^2 in size and the area after was 235,638 km^2 – a 1.38 times decrease in land size compared to the artifact increase at four times as many "per-thousand-year-production-of-collector-found artifacts." The population rise is not just related to sea-level rise, so there must be other explanations.

Finally, and with regard to the fate of Bolen people in Florida, Faught and Waggoner (2012) argue for population decline or abandonment between 10,000 and 9500 cal yr BP based on stratigraphic and radiocarbon lacunae between Early Archaic and Middle Archaic archaeological culture groups, as well as changes in chipped-stone technology, including an increase in the use of expedient tools and a concomitant decrease in curated tools. At the Windover burial site, the first post-Bolen radiocarbon-dated site in Florida, and in Middle Archaic tool assemblages, straight to contracting stemmed-base points were hafted with bitumen adhesive and wrapping presumably into socketed shafts (Dickel 2002, 90). This hafting configuration contrasts with the Clovis school of basal thinning and edge abrasion necessary for securing Paleoindian lanceolate and Early Archaic notched points in a split stick, wrapped haft (Bryan 1980). From these interpretations, Faught and Waggoner (2012) argue for replacement of Clovis and other late Pleistocene–early Holocene peoples by extra-territorial groups migrating to the peninsula rather than population persistence and cultural continuity. Additional distribution data and theory about how to distinguish social groups using chipped-stone data are necessary for future investigations of these issues.

4. Abundant toolstone but circumscribed territory

One method of perceiving hunter-gatherer social-group mobility range, or changes in range through time, is to investigate lithic raw-material sources and to study toolstone movement across the landscape (Ellis 2011; LaBelle 2012; Tankersley 1989). Chert is abundant on the Florida landscape and 20 recognized chert sources (Austin et al. 2018; Austin and Estabrook 2000; Endonino 2007; Upchurch, Strom, and Nuckels 2008), which occur mostly in exposed karst areas coincident to springs, early sites, and isolated finds, particularly in the crescent-shaped area along the peninsula's west coast (Figure 5).

Florida chert, referred to as Coast Plain chert, is found as uneroded packages of silicified material in beds of limestone, often outcropping with relief from the surrounding matrix. Each geologic formation contains distinctive fossilized benthic foraminifera (corals) that are specific to geologic formations and therefore can be used to facilitate chert sourcing to a stratigraphic bed

or quarry (Figure 5; Austin et al. 2018; Upchurch, Strom, and Nuckels 2008). Some formations are geographically localized, such as the Citronelle, St. Marks, and Peace River formations. Other formations, namely Ocala and Suwannee, have chert exposures at multiple locations that were frequently used by early Floridians.

Chert provenience studies have shown that Paleoindian and Early Archaic artifact assemblages from Florida sites are dominated by chert that was obtainable from local sources less than 30 km away (Austin et al. 2018), implying restricted social-group foraging and procurement ranges and minimal sharing of distant "exotic" cherts found outside the state. At Jeanie's Better Back (Figure 1), a north Florida Early Archaic Bolen site, most artifacts were manufactured from chert found at sources located within 30 km of the site, although foraminifera analysis identified chert from the Tampa Bay region, roughly 140 miles southwest of the site (Austin and Mitchell 1999; Sweeney 2013). At the Paleoindian and Early Archaic Harney Flats site (Figure 1), toolstone was found in "the immediate vicinity […] or the Tampa Bay area" (Austin et al. 2018; Daniel and Wisenbaker 1987, 169). Northern and west-central Paleoindian and Early Archaic Florida points are primarily manufactured from nearby chert sources (Sweeney 2013). Ocala chert has been identified at outlier sites such as Lake Helen Blazes, which is south and outside of the exposed and shallowly-buried karst areas (Figure 1; Austin et al. 2018).

The Cutler Ridge Bolen points were manufactured from Suwannee and Ocala Limestone chert from the Upper Withlacoochee River, Lake Panasoffkee East, and Ocala quarry clusters, which are minimally 200 miles to the northwest of the site and potentially as far away as 275 miles (Austin et al. 2018). These extreme distances are unusual, however; for Paleoindians and Early Archaic folks, a restricted chert procurement range was possible because of the localized occurrence of abundant toolstone near springs (Dunbar 1991; Pevny, Thulman, and Faught 2018; Thulman 2009). To our knowledge, no artifacts made of Florida cherts have been identified outside of the state. The chert-bearing Middle Miocene Hawthorn Formation extends from Florida into western South Carolina. Coastal Plain chert was used at Paleoindian sites such as Topper (Goodyear 1999; Smallwood 2010, 2012), but few foraminifera studies have been conducted outside of Florida.

Another way to understand past social–behavioral networks and potentially emic (i.e., unequivocal) "types" is to conduct landmark geometric morphometric (LGM) analysis using large point samples. Thulman (2012a) demonstrated that Suwannee, Simpson, and Transitional Side-notched point types are statistically distinguishable, and therefore indicate forms intended by Paleoindian and Early Archaic knappers (Thulman 2012a). Based on a study of 329 side- and corner-notched Bolen points, the basal-shape variation has been interpreted to reflect contemporaneous and evolving social group territories (Thulman 2018). Spatial analysis of Bolen side- and corner-notched point distributions indicates that approximately two-thirds of the corner-notched points are found northwest of the Suwannee River and two-thirds of the side-notched points are found southeast of the river. These distributions reflect two distinct, but related and interacting, social groups that contemporaneously occupied the region (Pevny, Thulman, and Faught 2018; Thulman 2018).

5. Early Archaic tool assemblage and use

In addition to projectile points, Early Archaic curated tools also are temporally diagnostic. At the Page-Ladson, Jennies Better Back, Ross Bay, and 8LE2105 sites (Figure 1), similar curated tools have been identified in stratigraphically constrained or radiometrically dated contexts with Early Archaic Bolen points. At Page-Ladson and 8LE2105 several tool types have been radiocarbon dated to the earliest Holocene, after the manufacture of lanceolate points is abandoned. These include bifacial and unifacial implements of variable sizes and shapes, many of which were hafted. These indicate significant behavioral diversity in procurement, processing, and fabrication of items such as wood, bone, and other materials, which is why we believe the Bolen Early Archaic evidence demonstrates "settling in."

Two tool types common to Early Archaic assemblages are Edgefield scrapers and Waller knives (Figure 7). Both types have been recovered from Bolen contexts at a number of sites in Florida and from dated contexts at site 8LE2105. Edgefield scraper-like tools are known in late Paleoindian contexts in Uruguay (Nami 2015, 290), offering another similarity of Florida and South American artifacts along with Simpson points. The Albany scraper (Webb 1946; Webb, Shiner, and Roberts 1971) is a similar transitional Late Paleoindian – Early Archaic hafted tool commonly found in association with San Patrice projectile points. A Waller Knife tested positive for bear, bovine, and pigeon blood antigens (Table 2). Hendrix scrapers (Purdy 1981, 18–19) also were associated with the 8LE2105 Bolen assemblage (Goodwin et al. 2014) and have been found in submerged offshore contexts (Faught 2004).

Unifacial Aucilla adzes (Figure 8) are another component of the Bolen tool assemblage (Gerrell, Scarry, and Dunbar 1991); Aucilla and bifacial Dalton-like

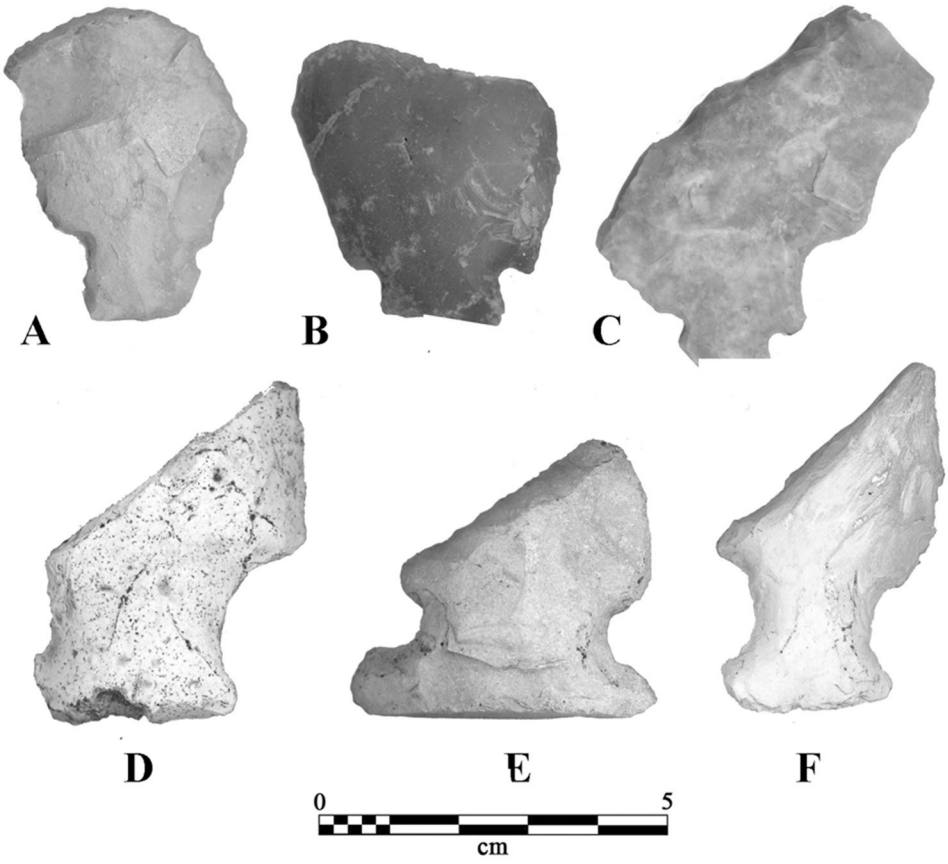

Figure 7 (A–C) Waller knives and (D–F) Edgefield scrapers. Both tool types are commonly identified in Bolen stone-tool assemblages. A Waller knife from site 8LE2105 tested positive for blood serum (Table 2). Images courtesy of David Thulman.

adzes have been recovered from the same context at 8LE2105 (Goodwin et al. 2014). At Page-Ladson Aucilla adzes and wedge-like tools were found in association with Bolen points, wooden stakes, and a chopped cypress log (Carter and Dunbar 2006); wedges were identified with Bolen points in the assemblage from the offshore site, J&J Hunt (Faught 2004). Though wood working was probably the primary use of Aucilla adzes, these tools have also tested positive for blood residues. Bifacial and unifacial adzes were recovered from the Ross Bay Site (Gramly 1994). Tool abundance at the site is either indicative of a long-term data palimpsest or a few instances of intensive occupation. There are no radiocarbon ages from Ross Bay, however, and no faunal remains.

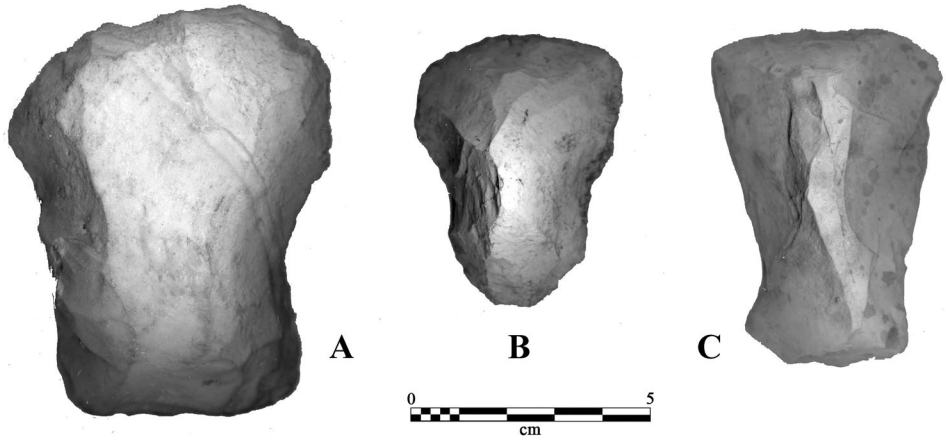

Figure 8 Unifacial Aucilla adzes. Images courtesy of David Thulman.

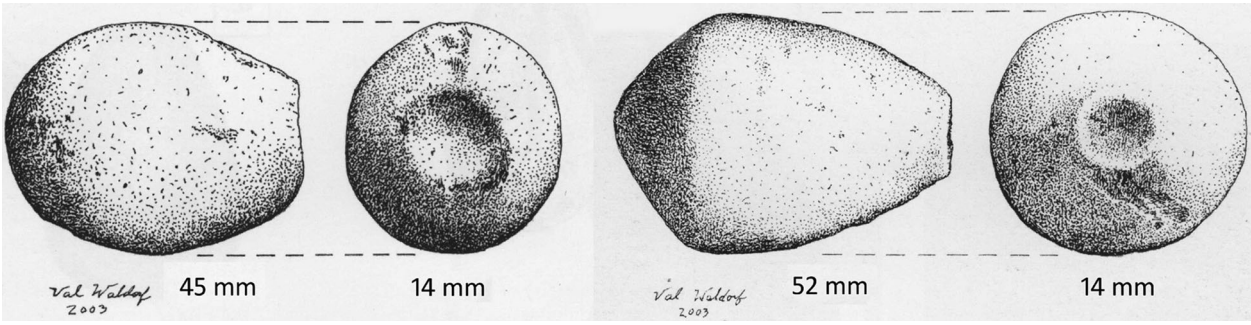

Figure 9 Florida bola or "dimple" stones. Adapted from Rachels and Knight (2004), drawings by Valeri Waldorf.

An intriguing item found in Early Archaic assemblages are ground and pecked stone tools referred to as "dimple" or "bola" stones (Figure 9; Tesar 1994), although the function of these egg-shaped objects is unknown. Dimple stones have been identified in dated Early Archaic contexts at Page/Ladson (Carter 2003; Carter and Dunbar 2006, 505–507) and are often made from limestone and may have red ochre. "Bola stones" are also known from Argentina and other areas of the United States, but so far from middle Holocene contexts (Flegenheimer, personal communication, 2017).

While there is little evidence for Early Archaic middens with unmistakable subsistence resource information, except for the Cutler Fossil site (Carr, Armelagos, and Austin 2015), bone pins and antler tool handles made from white-tailed deer were recovered from the Bolen level (Unit 5) at Page-Ladson (Peres and Simons 2006). Florida's acidic soils have erased Early Archaic faunal evidence, but subsistence procurement and processing information comes from the results of cross-over immunoelectrophoresis (CIEP) analysis conducted to identify blood residues on stone tools recovered from data recovery excavations at site 8LE2105 (Fagan 2014; Goodwin et al. 2014). Thirty-seven tools were tested for blood antiserum and nine (24 percent) tools responded to the antiserums shown in Table 2. Tested tools included 15 Bolen side- and corner-notched points, 1 stemmed serrated projectile point, 1 unidentified point, 2 point preforms, 6 adzes, 1 Waller knife, 1 other unifacial knife, 1 plane, 6 unifacial scrapers, and 3 utilized flakes. Blood residues indicate a number of different tool forms were used to procure and process faunal subsistence resources. Five of the nine tools reacted positively to large- and medium-sized prey with substantial caloric value, such as bison, bear, and deer. Bison and bear blood residues were identified on a uniface and a Waller Knife from the earlier Bolen component at 8LE2105. However, the other four tools reacted to small-prey antiserum, i.e., rabbits and birds (Order Columbiformes, which includes both pigeons and mourning doves).

6. Conclusion

Florida represents a unique patch of Clovis-related Paleoindian and Early Archaic people, self-contained but interacting with others in the Southeast, first exploring, later expanding into, and finally settling in to a shrinking karstic landscape. We measured their visibility using ratios and distributions of projectile points – the most enduring evidence of their existence in the state. Early explorers arrived in this patch by 14,400 cal yr BP, becoming increasingly visible on the landscape by the Clovis era and succeeding late Paleoindian period, with a significant Early Archaic population increase after 11,500 cal yr BP. After this time, the early Floridian presence is less discernable on the landscape and sometime after 10,000 cal yr BP, they are gone, possibly extirpated.

We have reviewed Florida early cultural chronologies and point-type sequences that we believe originated in the Clovis school of knapping. People were present in Florida before, during and after the Clovis era. After Clovis, people stayed and continued to use traditional places on the landscape in peninsular Florida, mainly around water sources, but eventually they expanded out to never-before-inhabited areas after 11,500 cal yr BP. At the Pleistocene-Holocene boundary, we interpret the increased number of sites, isolated finds, and tool types to represent post-Paleoindian peoples settling in to a changed post-Pleistocene environment. Early Archaic Bolen settlers faced a shrinking landscape but a conducive subsistence environment, likely with additional water table exposures.

Megafauna were present during Clovis times in Florida and possibly hunted or otherwise accessed by humans, but no Clovis, Suwannee, or Simpson points have been identified in unequivocal association with megafauna. Certainly, the ivory foreshaft at Sloth Hole and the girdled tusk at Page-Ladson indicate processing of carcasses, but were proboscideans hunted by Clovis Floridians like their western counterparts? If 10,700 cal yr BP represents the end of Clovis, according to Waters

and Stafford (2007), and by 10,600 cal yr BP *Sporormiella* indicate megafauna were gone, could people have had a hand in their demise? We don't know. Is that roughly when Clovis knappers got to Florida? We don't know. Further research is necessary to expand our knowledge of the details of this cultural history. Future research could include more detailed inventories and descriptions of the numbers and kinds of artifacts associated with diagnostic projectile points to compare site sizes and estimate population numbers. But stratigraphic occurrences, like Page-Ladson, are most important for us to fill out our chronologies.

Notes

1. David Thulman (2006, 2012a) scanned and analyzed Paleoindian points from legally procured private collections. We use Thulman's data for Clovis-Simpson-Suwanee ratios. Paleoindian and Early Archaic data also were culled from the Ike Rainey Collection, a spreadsheet database compiled by Monte Pharmer that includes legally procured artifacts. We used ratios of collector-found Paleoindian and Early Archaic projectile-point types as proxies for population structure in the late Pleistocene and early Holocene Florida.
2. See Webb et al. (1984) for a discussion of the context, recovery, and dating of the bison bones. Three skull fragments were dated to 9990 ± 200 ^{14}C yr BP (10,092 cal yr BP (Beta-5941)) and a bison distal-humerus fragment was dated to 11,170 ± 130 ^{14}C yr BP (13,063 cal yr BP (Beta-5942)).

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No potential conflict of interest was reported by the authors.

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