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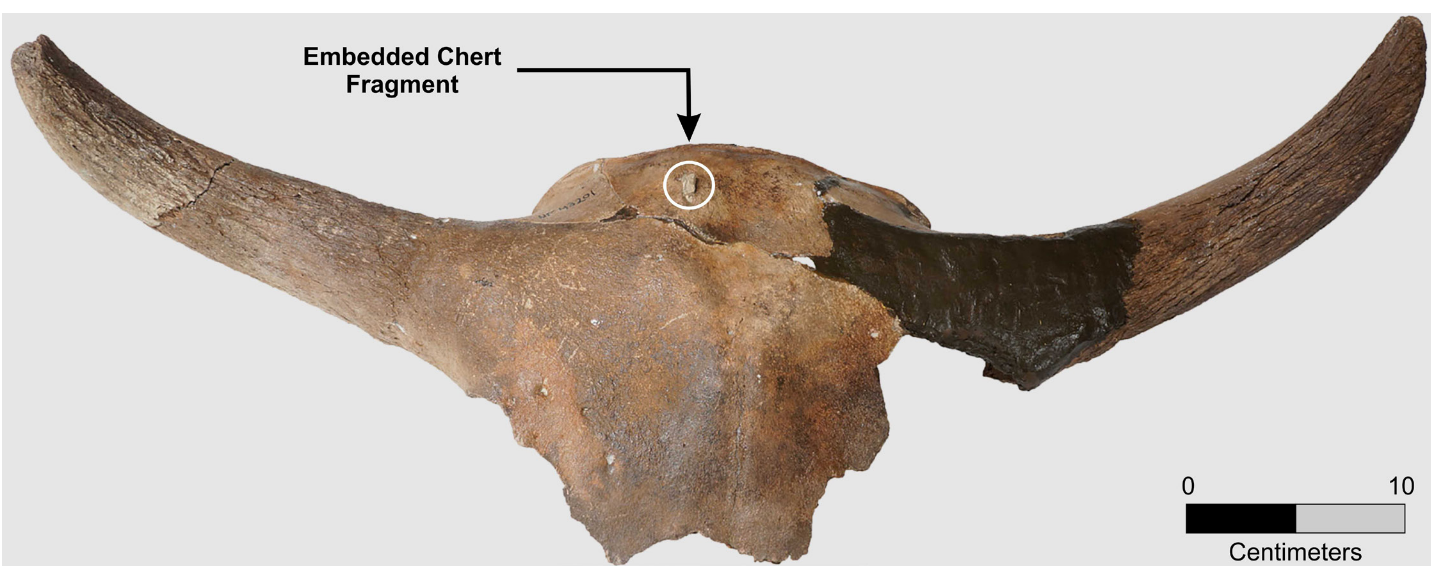

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Cover: Human figure provides scale for *Bison antiquus*. The upper right image is from an exhibit at the Bishop Museum of Science and Nature, in Bradenton, Florida. Lower image shows refitted fragments of *Bison antiquus* skull cap with embedded lithic from Wacissa River, provided by Jim Dunbar of Aucilla Research Institute.

A REEXAMINATION OF THE REEXAMINATIONS OF THE ALEXON BISON SITE (8JE570)

James S. Dunbar,[1] C. Andrew Hemmings,[1] Tom Harmon,[1] Emilee McGann,[2]

[1] *Aucilla Research Institute Board Members, 555 North Jefferson Street, Monticello, FL 32344*
jimdunbar@gmail.com ahemmings@paleotopioneer.com cfiinc@centurylink.net

[2] *Aucilla Research Institute, Research Associate, Department of Anthropology, 1112 Turlington Hall, 330 Newell Drive, University of Florida, Gainesville, FL 32611-7305 emcgann@ufl.edu*

Introduction: Prior Research and Publications

In 1981, Mr. Roger Alexon and his fellow divers were exploring the Wacissa River when they encountered remains of an assumed long-horned cow.[1] Later that night, at their Goose Pasture campsite, they noticed a piece of stone stuck in the back of a skull fragment, between the horn cores. They took the finds to paleontologist Dr. David Webb, who identified them as the remains of an extinct late Pleistocene *Bison antiquus*. Further, the chert piece was deemed by a forensic anthropologist, Dr. William Maples, as having become lodged in the animal's skull shortly before or at the time of the animal's death.

After an inspection of the site by archaeologist Jim Dunbar, two articles were published about the find, in which the imbedded chert fragment was described as part of a chert projectile point fragment. Two radiocarbon dates (on bison bones) were secured, the first on a surface-collected specimen and the second from a sample excavated from undisturbed sediment. The surface-collected specimen yielded a calibrated 1-sigma age range of 11,585 +/- 316 cal YBP and the excavated specimen yielded a 1-sigma age range of 13,058 +/- 135 cal YBP (Table 1), a difference of approximately 1,500 years (Webb et al. 1983, 1984).

Table 1. Radiocarbon Ages and Calibrations Cited in the Text. Florida sites: Alexon Bison (8JE570), Sloth Hole (8JE121), Fowler Bridge Mastodon Site (8HI393), and Page-Ladson (8JE591). YBP = years before present (present = A.D. 1950). STD = standard deviation. Beta = Beta Analytic Laboratory. SL = Stafford Research Laboratory. I = Teledyne Isotopes. Ya = Yale University. UCI = University of California at Irvine, Keck-Carbon Cycle AMS Facility. Calibrated ages based on Cologne Radiocarbon Calibration and Paleoclimate Research Package (CalPal for Windows V 2022.04) (Weninger 1986; Weninger and Joris 2008).

Site #	Lab Number	Corrected 14C Age (YBP)	1-Sigma STD	Calibrated Age (YBP)	1-Sigma STD	Material Dated	Source
8JE570	Beta-5941	9990	200	11585	316	Bison bone exposed	Webb et al. 1984
8JE570	Beta-5942	11170	130	13058	135	Bison bone *in situ*	Webb et al. 1984
8JE121	Beta-12345	10680	110	12625	107	Ivory shaft found 1999	Hemmings communications with Dunbar, 2000
8JE121	SL-2850	11050	50	12976	75	Same ivory shaft found in 1999	Hemmings 1999, Waters and Stafford 2007
8HI393	Beta-3503	3070	70	3261	87	Bone heavily tannin-stained	Palmer et al. 1981
8JE591	I-13591	13130	200	15746	296	Wood below Unit 3	Webb and Dunbar 2006
8JE591	I-13590	12570	200	14783	390	Plant material in Unit 3	Webb and Dunbar 2006
8JE591	Beta-8360	10520	130	12385	239	Partially exposed stained bone in Unit 3	Webb and Dunbar 2006
Mud Lake	I-8160	8160	200	9063	280	Organic material	Watts 1969
Lake Louise	Ya-1770	8510	100	9491	93	Organic sediment	Watts 1971
Tulsa bison	UCI-0011696	5120	25	5846	68	Bison bone	Bement et al. 2005

Fifteen years later, paleontologist Matt Mihlbachler, archaeologist Andy Hemmings, and Webb (2000), took a fresh look at the bison remains via a computed tomography (CT) scan of the Alexon bison refitted upper skull curated at the Florida Museum of Natural History (FLMNH). Their findings mostly concurred with the original interpretation that the imbedded chert fragment was part of a chert projectile point, yet they had reservations about the differing radiocarbon dates. At that time, the vagaries of radiocarbon dating bone were not well understood. In addition, their findings indicated that the skull bones stored at FLMNH had been treated with multiple chemicals, rendering them unsuitable for radiocarbon dating.

In 2019 and 2020, two decades after the CT scan article, the bison remains and the Alexon Bison Site were reexamined by investigators from Texas A&M University (TAMU) and the University of Tennessee, Chattanooga (UTC) (Waters et al. 2021). They discuss:

1) No collagen for radiocarbon dating is left in the bison bones examined from the site; therefore, the bones are not candidates for direct radiocarbon dating.[2]

2) The Alexon Bison Site bison level may correlate to a >57,000 cal b2k YBP[3] deposit located 7.5 km (4.7 mi) downstream at the Ryan-Harley Site (8JE1004) in the Wacissa River.

3) Perhaps the bison skull was impaled on weathered chert, when a rock fragment became stuck in the skull and broke off in two possible scenarios: a) the bison was dead, and its carcass floated downstream and impacted a chert boulder head-on before settling to the bottom; b) the bison fell off a cliff at Big Blue Spring and bumped its head on a chert rock before floating downstream some 6.7 km (4.2 mi) and sinking/settling at the Alexon Bison Site.

4) New micro-CT scans are said to provide an "accurate, high-resolution, three-dimensional rendering of the stone," surpassing information provided by the original CT scan.

5) The stone embedded in the bison's skull is posited to be coarse-grained with no intentional shaping and the white area of the chert object exfoliated after impact.

6) The chert object is posited to have entered the cranium from behind.

7) The portion of the embedded chert fragment on the interior of the skull is bright white and weathered and said to resemble the natural cortex of a chert boulder.

Using these points, the team of TAMU and UTC investigators concluded:

> The bison skull fragment at the Alexon site was found *ex situ* and its exact geological provenance and age still remain equivocal. However, we can determine that the chert object embedded into the cranium of the bison is not a human-made projectile point or other type of tool. Instead, it is an unmodified natural fragment of poorly silicified Suwannee chert. How it became lodged into the skull is unknown but given that it is shallowly embedded into the bone at a thin and weak point in the cranium suggests that it was naturally introduced. The Alexon site should no longer be considered an early Paleoindian archeological site. [Waters et al. 2021:285]

Their interpretation that the Alexon Bison Site is not archaeological is believed to be an incomplete interpretation not shared by the authors of this article. On August 27 and September 17, 2021, members of the Aucilla Research Institute, Inc. (ARI) returned to the *actual* site location for an inspection.

Considerations

Alexon Bison Site is Archaeological

When Webb and Dunbar started research in the Aucilla-Wacissa basins, they agreed that all fossil remains would be curated by FLMNH in Gainesville, and that all artifacts would be curated by the Florida Bureau of Archaeological Research (BAR) in Tallahassee. Artifacts were surface collected at the Alexon Bison Site in 1982. They were not mentioned in the published articles simply because they were *ex situ* surface finds, and the pottery post-dated the Pleistocene, while the lithic artifact could be of any age. Nevertheless, the Alexon Bison Site has archaeological components and, as we will discuss, a plausible Paleoindian component.

A few years after the initial site inspection, a diver came to BAR with a container filled with bison bones from the Wacissa River, in or very near the Alexon Bison Site. The diver, Dr. Lou Hill, donated them after reading the 1983 article about the site in *The Florida Anthropologist* (Webb et al. 1983). Those fossils were turned over to Webb at FLMNH, where they were accessioned with other specimens residing there. Webb et al. (1984:390) list additional remains from the site of *Chrysemys* sp. (turtle shell pieces), alligator, *Equus* sp., *Hemiauchenia* sp. (a camelid), *Palaeolama* sp., and *Odocoileus virginianus*. After that, no other visits to the Alexon Bison Site were documented until recent ARI field inspection in 2021.

Site Location

In 1982, Global Positioning System (GPS) devices were not available. The accepted way to plot site locations was on paper, using United States Geological Survey (USGS) 7.5-minute quadrangle (quad) maps or aerial photographs. It was prior to widely available Geographic Information System (GIS) mapping software. USGS quad maps often lacked details, such as the number of channels in the Wacissa River. That problem was overcome using Florida Department of Transportation (FDOT) aerial photographs to georeference a section of the aerial to the USGS Wacissa quad map. That site plot was later transferred to the Florida Master Site File (FMSF) quadrangle map and GIS maps.

Today, the FMSF shows the 1982 plot is approximately 375 m (1230 ft) north of the actual site location. During our recent inspection of the site, ARI staff surface collected the proximal end of an *Equus* sp. scapula in a similar state of preservation as other bone samples from the site. As originally recorded, the Alexon Bison Site is located “where an elongate boulder bar extends across the channel at a 90° angle… on the down current side of the boulder bar” (Vickery and Dunbar 1982). It is the only boulder bar in that area of the Wacissa River. We believe the UTC dive team did not inspect the correct location of the Alexon Bison Site. A recent search of the FMSF and BAR records found no site file update, report, or permits associated with the UTC work. Therefore, further understanding about their investigation (other than the article published in *PaleoAmerica*) will need to address that issue.

ARI Site Inspection

The outcrop at the Alexon Bison Site is like many others scattered through the lower Aucilla-Wacissa basin, especially in terms of their high chert and dolomite content. Chert and dolomite are more resistant to chemical and mechanical erosion, and higher sea stands over geologic time have exposed and elevated them above the underlying limestone (Yon 1966). Some rock outcrops are composed solely of dolomite, others solely of chert, and still others, combinations of both.

On August 27 and September 17, 2021, an ARI crew returned to inspect the Alexon Bison Site (BAR Permit 2122.002 and amendment of August 19, 2021) and updated the site description as follows. The westernmost channel of the Wacissa River runs more or less north-south with the rock outcrop extending across it at a perpendicular angle. The upper part of the outcrop is smooth whereas the bottom, where it becomes embedded in the limestone substrate, is more irregular and chertier. All rock surfaces exposed in the water column were rounded and colonized by red or red-brown biofilms[4] that include algae and other microbial forms (Froehner et al. 2012). The elevation difference from the top of the outcrop to the Alexon Bison Site downstream is about a ~0.75 m to ~1.2 m drop. If any animal attempted to traverse the outcrop when it was exposed above the water level, and tripped or became stuck in voids between the rocks, they would have taken a fall of about 1 m (3 ft).

Rock Types at the Outcrop

A total of 18 rock samples was collected; three in 1982, and 15 in 2021. The samples were tested using a 15% solution of hydrochloric acid (HCl) to determine if materials were dolomite, chert, or a combination of both. Two samples are dolomite, three are dolomite and chert, five are chert and limestone, and eight are chert (Appendix 1). The chert quality for tool-making is inferior because it is dominated by vuggs (voids) mostly filled with limestone. There is little to no evidence that the Alexon Bison Site outcrop was used as a quarry. The collected evidence indicates that the top of the outcrop is dolomite with the frequency of chert lenses increasing with depth.

Paleoenvironment of the Bison Component

Two kinds of gastropod shells have been identified from the Alexon Bison Site in the bison level. They represent two species that prefer slowly flowing rivers and streams as well as still-water ponds and lakes. Thus, the occurrence of both species in the bison level suggests that, in the late Pleistocene, the area of the Wacissa River was either a pond or sluggish flowing river with lush aquatic vegetation. The two gastropod species were:

1) *Viviparus georgianus* (the banded mystery snail) which grazes on diatom clusters and algae common in biofilm communities on aquatic vegetation, rocks, and sunken, waterlogged wood. The banded mystery snail breeds and lives in shallow water, often among aquatic plants (USGS 2022a). It is important to note that the saline intolerant banded mystery snail was extirpated in the Aucilla-Wacissa system by the early Holocene and no longer inhabits the area (Auffenberg et al. 2006:256-257).

2) *Pomacea paludosa* (the Florida apple snail) is a consumer of aquatic plants. The Florida apple snail does not compete with the banded mystery snail. Both often share the same habitats. The Florida apple snail can survive in water bodies that dry out seasonally (USGS 2022b).

Challenges of Dating Bone from Florida Rivers

The radiocarbon dating of Pleistocene bone has a history of frequently yielding ages that are too young (Fiedel et al. 2013; Marom et al. 2012). Bone samples that produce dates that are too old are uncommon because contaminates in the bone must be substantially older than the bone. For example, a specimen that would yield a "too old" result is a bone that has been burned (cremated) with a fuel older than the bone (e.g., peat or coal) (Snoeck et al. 2014).

In Florida, contamination and chemical degradation are problems for bone exposed to the water column. Younger humates in the water and transient organic detritus on the bottom create a soup that permeates bone tissue. Attempting to radiocarbon date a tannin-stained bone has proven to yield erroneous results (Palmer et al. 1981). Further, the collagen content of the Pleistocene bone must be tested to determine if there is sufficient collagen content to allow dating. If not, bone samples should not be dated because they will likely yield the age of the bone contaminants instead of the bone itself.

Bone samples often require amino acid separation pretreatment prior to dating, a process that makes bone dating accurate but more expensive (Fiedel et al. 2013; Marom et al. 2012; Stafford et al. 1988). That said, Pleistocene bone buried in its contemporary sediment can yield good results without the amino acid protocol. For example, a Pleistocene *Palaeolama mirifica* zygomatic skull fragment was recovered in pristine condition from Unit 3 at the Page-Ladson site in the Aucilla River (Figure 1). It yielded an age that agreed with 25 other radiocarbon dates taken on botanical remains from the same level (Table 2). All 26 samples from Unit 3 at the Page-Ladson site (8JE591) are statistically related at a 95% level of confidence, and they provide an average age range of 14,570 +/- 190 cal YBP (Table 3).

In another example, an *in situ* ivory shaft fragment recovered from the Sloth Hole Site (8JE121) in the Aucilla River dated to 12,625 +/- 107 cal YBP without using the amino acid protocol. A second sample of the same artifact, analyzed using the amino acid protocol, dated 12,976 +/- 75 cal YBP (Table 1). The difference is

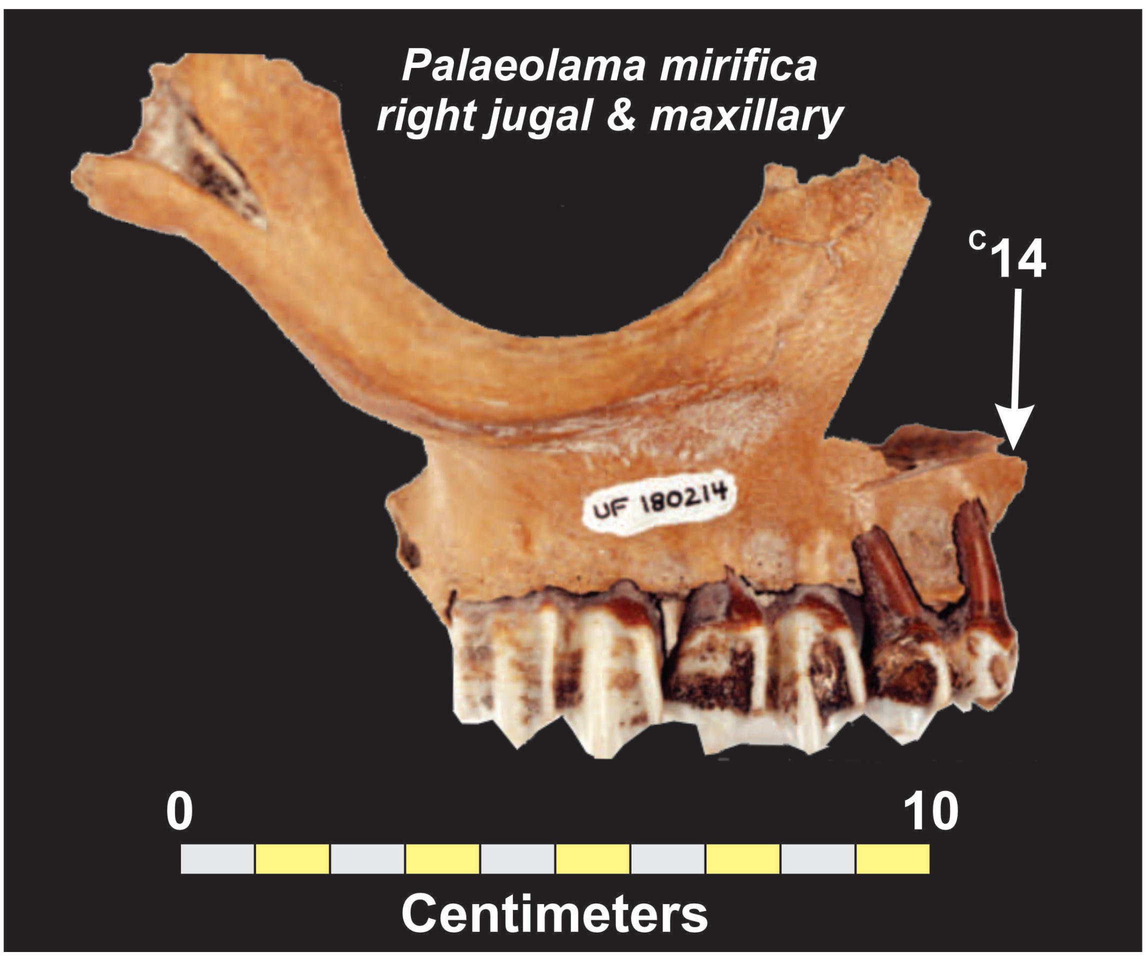

Figure 1. Llama Bone. *Palaeolama mirifica* zygomatic bone fragment from Unit 3 at the Page-Ladson Site is exceptionally well preserved. Radiocarbon sample taken from where the arrow points (FLMNH, Vertebrate Paleontology collection).

Table 2. Page-Ladson Site, Unit 3 Related Radiocarbon Assays (the 26 of 41 that are related). Sources are Webb and Dunbar (2006) for Aucilla River Prehistory Project (ARPP) and Halligan et al. (2016) for Texas A&M University (TAMU). YBP = years before present (present = A.D. 1950). STD = standard deviation. AA = Accelerator Mass Spectrometry Lab, University of Arizona. Beta = Beta Analytic Laboratory. UCI = University of California at Irvine, Keck-Carbon Cycle AMS Facility. Calibrated ages based on Cologne Radiocarbon Calibration and Paleoclimate Research Package (CalPal for Windows V 2022.04) (Weninger 1986; Weninger and Joris 2008).

No.	Lab Number	Corrected 14C Age (YBP)	1-Sigma STD	z-Test	Calibrated Age (YBP)	1-Sigma STD	Material Dated
1	AA-7453	12375	75	-0.48	14516	219	Organic plant material ARPP
2	AA-8760	12385	100	-0.26	14569	251	Plant seed unidentified ARPP
3	AA-11048	12370	90	-0.45	14531	236	Plant seed unidentified ARPP
4	Beta-93653	12400	60	-0.18	14602	174	Plant seed unidentified ARPP
5	Beta-112236	12390	50	-0.41	14598	169	Bone collagen *Palaeolama* jugal ARPP
6	Beta-116493	12480	100	0.69	14761	300	Plant seed acorn adjacent to No. 5 above ARPP
7	Beta-116497	12400	110	-0.1	14690	295	Plant seed acorn with *Mammut* pelvis ARPP
8	Beta-116499	12460	100	0.49	14733	296	Wood unidentified ARPP
9	Beta-116500	12420	130	0.07	14733	341	Wood unidentified ARPP
10	UCI-127302	12425	30	0.48	14609	160	TAMU wood maple
11	UCI-127304	12420	30	0.31	14607	161	TAMU wood fir
12	UCI-141939	12430	135	0.14	14746	347	TAMU twig unidentified
13	UCI-141940	12430	30	0.65	14612	160	TAMU twig unidentified
14	UCI-141941	12365	30	-1.52	14557	156	TAMU twig hardwood unidentified
15	UCI-141942	12440	30	0.98	14619	159	TAMU twig hardwood unidentified
16	UCI-141943	12410	30	-0.02	14601	161	TAMU twig oak
17	UCI-141944	12410	35	-0.02	14602	163	TAMU twig cypress
18	UCI-141945	12400	135	-0.08	14725	345	TAMU twig cypress
19	UCI-141946	12400	35	-0.3	14598	163	TAMU twig ash
20	UCI-141948	12430	30	0.65	14612	160	TAMU wood ash
21	UCI-141949	12385	35	-0.73	14591	163	TAMU wood oak
22	UCI-141951	12415	30	0.15	14604	161	TAMU wood white oak biface level
23	UCI-141952	12385	35	-0.73	14591	163	TAMU wood white oak
24	UCI-141956	12395	30	-0.52	14591	160	TAMU wood cypress
25	UCI-141957	12420	30	0.31	14607	161	TAMU wood oak
26	UCI-143538	12430	35	0.55	14611	162	TAMU root, unidentified wood

Table 3. Weighted Average of 26 Radiocarbon Ages in Table 2 from Page-Ladson Site. YBP = years before present (present = A.D. 1950). STD = standard deviation.

^{14}C Average (YBP)	1-Sigma STD	Calibrated Age (YBP)	1-Sigma STD	Probability
12411	8	14570	190	1

about 350 years between the midpoint results. Although the first Sloth Hole radiocarbon assay was younger, it was not too different. There was sufficient collagen content for dating, but perhaps there had been some depositional humate contamination.

In a third example, a proboscidean long bone fragment from Test A at Page-Ladson Site was partially exposed to water of the Aucilla River and extended vertically into Unit 3. The part exposed to the water was dark and tannin-stained, while the part embedded in Unit 3 was tan with some darker staining. The tan, straw-like vegetation mat of Unit 3 rested above a second level of woody-sand. The proboscidean bone yielded an age range of 12,385 +/- 239 cal YBP, while the organic material yielded age ranges of 14,783 +/- 390 cal YBP (Unit 3) and 15,746 +/- 296 cal YBP (below Unit 3) (Table 1). In this example, the partly exposed bone dated some 2,370 years younger than the sediment level itself. In 1983, tests to determine the collagen content of bone had not been developed; therefore, it is uncertain if the bone actually had any surviving collagen.

Another example of the humate contamination problem is a fully exposed mastodon long bone fragment from the Fowler Bridge Mastodon Site (8HI393) in the Hillsborough River (near Tampa, Florida), which yielded an age of 3,261 +/- 87 cal YBP (Table 1), while another sample from the same bone yielded no results (Palmer et al. 1981:124). The exposure of bone to tannin-rich river water clearly results in postmortem contamination. Thus far, the surface-collected bone and ivory samples exposed to tannic-charged water, and which were tested for collagen, have had none.

There were two radiocarbon dates taken of bison bone samples from the Alexon Bison Site in the early 1980s. The first sample came from a displaced context and had humate contamination. The second sample was recovered by Dunbar in 1982 from an undisturbed context. This second sample "was the distal end of a Bison humerus collected within 1 m of the skull and notable for its lighter tan color and its excellent state of preservation" (Webb et al. 1984:390). It had no apparent humate contamination and produced a date that we interpreted as correct or nearly so. Since we now definitively know that the Aucilla-Wacissa area was occupied by Paleoindians some 14,500 cal YBP (Halligan et al. 2016; Waters 2019; Webb and Dunbar 2006), the Alexon Bison Site age of 13,058 +/- 135 cal YBP (Table 1) seems reasonable, even if it may be a hundred years or so too young.

The >57,000 cal b2k YBP age that the TAMU team references in their article came from a quartz sand sample recovered from a level at the Ryan-Harley Site in the Wacissa River. The sample was analyzed using Optically-Stimulated Luminescence (OSL) dating techniques, and it was correlated by the TAMU team with the bison level at the Alexon Bison Site (Waters et al. 2021). We view that stratigraphic correlation as incorrect. Again, it appears that the TAMU diver team inspected an unknown third location and the stratification they observed cannot be compared to that at the Alexon Bison Site.

River Channels and Stratigraphic Correlations: Aucilla versus Wacissa

With the exception of the Apalachicola River, all other river systems in Florida have their drainages confined within the Coastal Plain. As a result, many Florida rivers are low-energy systems, unlike high-energy braided channels in the western United States. Most of the channel systems in the Tertiary karst regions of Florida owe their base flow to the Floridan Aquifer (Clarke 1949; Meyer 1962). This is particularly true in regions where the Floridan Aquifer is unconfined and therefore not under artesian conditions. Between Tampa (to the south) and Crawfordville (in Wakulla County to the north) and extending eastward to the Ocala Ridge, then northward to the Cody Scarp, the Floridan Aquifer is unconfined, and the limestone is near, or at, the ground surface. The absence of artesian conditions in this region means that there is no head-pressure and the local water table is the Floridan Aquifer's surface.

When the unconfined aquifer's surface fell below the Econfina River channel bottom (at the U.S. Highway 98 bridge) in 2007, the river ceased to flow and the channel went dry (Figure 2). When the Floridan Aquifer drops, it may leave ponds in deeper portions of an otherwise dry channel, or it may leave a totally dry river bed, depending on how far the aquifer surface recedes (Cooke 1945:92) (Figure 3b, c). Today's upland cave systems were formed by, and are aligned with, higher Floridan Aquifer stands that correspond with higher sea levels in geologic time (Florea et al. 2007). Similarly, abandoned river channels also have been observed, such as a dry river bed near High Springs that is estimated to have ceased flow after the Talbot sea level stand (+7.5 m to +13 m) subsided

Figure 2. Econfina River. Dry channel on the north side of U.S. Highway 98 during the 2007 drought.

(Edwards 1948; Healy 1975). Sloth Hole would become an isolated pond with a water drop of only 1.2 m (4 ft).

The Floridan Aquifer has experienced major elevation fluctuations over geologic time (Meyer 1962; White 1970) (Figure 3b, c). Today, the aquifer's surface fluctuates largely due to changes in: 1) rainfall, 2) natural ground water discharge, 3) barometric pressure, 4) earth tides, and 5) modern pumping (Meyer 1962). Today's aquifer surface fluctuations are minor and take place during protracted droughts or, conversely, during excessive rain fall (Figure 3a). Stated succinctly, in places where the Floridan Aquifer is unconfined, such as the lower Aucilla and Wacissa basins, the inland water table is the aquifer's surface. The Floridan Aquifer surface has been relatively stable in the Aucilla-Wacissa basins since the mid-Holocene (about 5,500 cal YBP). Florida river and lake systems became inundated in the latter part of the Early Holocene around 9,000 to 9,500 cal YBP (Watts 1969, 1971, 1975).[5]

Prior to that time, when sea level was much lower, inland water tables fluctuated more frequently, sometimes wildly. Rivers such as the Santa Fe, in the area below River Rise in O'Leno State Park, once had an odd type of Pleistocene multi-channel system that was both wide *and* shallow. It was a river system very much like today's Wacissa River.

This type of multi-channel system is known as anastomosing, which is a geologic term for low- to very low-energy fluvial systems (Neuendorf et al. 2005:23). Anastomosing rivers in Florida carry little to no sediment load, do not have natural levees, and are unconfined in flatland areas. Anastomosing systems are known for organic, carbonate-precipitated, and biogenetic sediment as well as aeolian and colluvial deposition from adjacent riverbanks. These sediments are collectively considered channel-fill deposits.

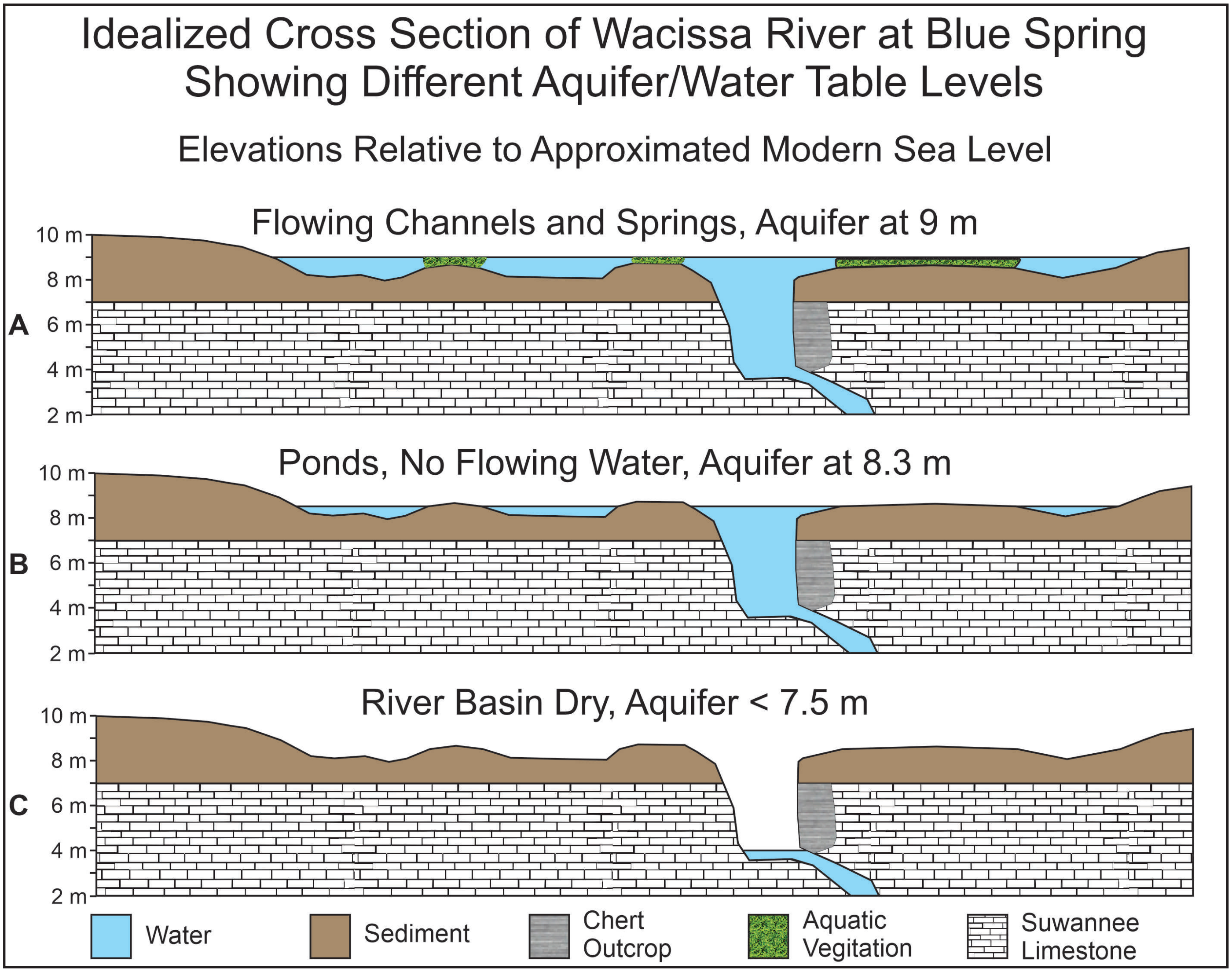

Figure 3. Idealized Pleistocene Water Table Fluctuations. Shown are east-west cross-sections of the Wacissa River and Big Blue Spring.

In contrast, braided channel systems in the western United States carry considerable sediment loads, and when the largest and most dense objects, such as boulders, settle out, they force the transport of lighter debris around them. Braided channel systems are on the high-energy spectrum of channel systems that also form networks of ever-changing multiple channel networks (Neuendorf et al. 2005:81-82; Rittenour 2004; Rittenour et al. 2003, 2005). In the southeastern United States, Pleistocene braided channel systems formed in the Mississippi River and in coastal rivers on the Atlantic seaboard with headwaters in the mountains (Leigh 2008; Leigh et al. 2004). Braided channel systems may superficially resemble the morphology of anastomosing systems, but they were formed by different processes.

Anastomosing channels form slowly over time. An open channel may change, such as due to a tree fall or beaver dam that partially blocks its flow. Water flows around these obstructions and becomes partly diverted to other routes that also form multi-channel systems. One channel may experience reduced flow as another one increases in volume, or begins to backfill, or, in time, becomes reestablished.

The Wacissa River has maintained a mosaic of channels with preserved channel-fill sediments (Figure 4). Its channels have opened, been blocked, reopened, or filled during different periods. Some channels formed only once, then became backfilled with channel-fill sediment and were never disturbed afterward. Other channels saw subsequent episodes of water flow and possible deflation from the same, or a different, channel.

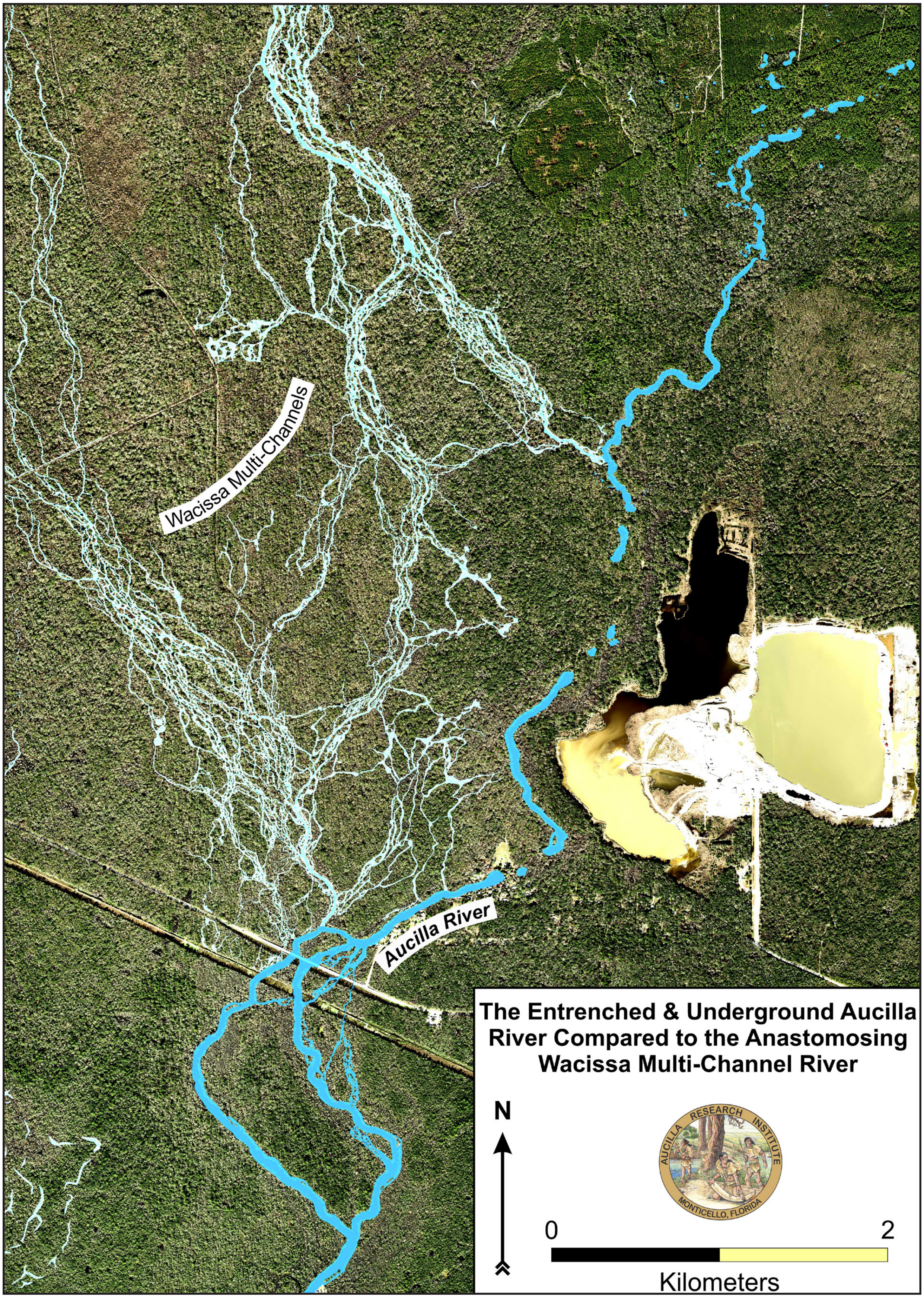

Figure 4. Basins Compared. The Wacissa River's countless anastomosing channels stand in sharp contrast to the Aucilla River's discontinuous surface and underground channel system.

Anastomosing rivers are a patchwork of channel segments that weave in and out, with channels that have crosscut each other at different times and places. These processes of shifting channels that formed and reformed in the Pleistocene continue today in cases like the Wacissa.

Thus, stratigraphic correlation of the Alexon Bison Site to another channel segment some 7.5 km (4.5 mi) downstream cannot be made with present knowledge. The geologic history of water flow, sedimentation, and temporal relatedness is very complex in anastomosing systems. They cannot be understood based on generalized observations.

The comparison of yet another type of channel system, meandering rivers (with their laterally migrating channels within a restricted channel belt) to an anastomosing, avulsion-dominated[6] system (that does not have confined, restricted channel belts) is not possible for a number of reasons. Foremost, they have dissimilar channel deposits. The meandering system generates sand sheets and channel-lag deposits compared to an anastomosing system, with its channel-fill deposits (Behrensmeyer 1988:195).

Meandered river systems often have scattered artifacts and disarticulated fossil elements dispersed downstream in channel-lag accumulations that are in different stages of mechanical alteration. Anastomosing river systems have channel-fill deposits that may remain undisturbed after deposition or, if a later flowing water event results in erosion, artifacts and fossils are likely to be vertically deflated. Fossil and archaeological assemblages in anastomosing systems show little to no impact from mechanical erosion and, in Florida at least, have yielded *in situ* articulated Pleistocene megafaunal remains. The Wacissa River is a classic example of an anastomosing system with great research potential in its late Pleistocene levels (Figures 4 and 5).

Freshwater shell marl is a form of channel-fill sediment found in anastomosing rivers and in places such as the Everglades, Lake Okeechobee, Corkscrew Swamp, and former Lake Flirt along the Caloosahatchee River. In such places, it formed and/or forms in wet-dry seasons, as the water table fluctuates between total inundation and subaerial exposure (Stone 1986; Stone and Gleason 1974). In the past, intervals of subaerial exposure led to places where human habitation or other activities took place (Dunbar 2016).

Other locations in Florida confirm the development of near-modern inland water tables during the late Pleistocene Allerød[7] phase of the late glacial recession (event strata GI-1d through GI-1, dated at 14,075 to 12,896 ±4 cal b2k YBP [Rasmussen et al. 2014:22, Table 2]). For example, elevated water tables are indicated by radiocarbon dates from Corkscrew Swamp (Gleason and Stone 1994) and Lake Okeechobee (Brooks 1974; Gleason 1972) in southern Florida, in core MD02-2582 in Tampa Bay in central Florida (Willard et al. 2007), and from the Page-Ladson Site in the Aucilla River (Dunbar 2016:177) and Gilchrist Blue Springs along the Santa Fe River (Tanner et al. 2020) in north Florida. The Allerød phase was one of the Pleistocene intervals when sea level was lower, yet precipitation was sufficient to result in active anastomosing channels.

Aucilla Versus Wacissa: Water Flow and Stratification

Variations in karst river channels result in unique characteristics. For example, the Aucilla River into which the Wacissa River flows, has steep limestone walls, unlike the Wacissa. Indeed, the Aucilla has an entrenched channel locked in place that does not migrate or meander. Webb described the Aucilla sinks section of the river best when he stated: "The middle portion of the Aucilla River becomes extraordinarily elusive, disappearing under the surface limestone, reappearing in multiple short channels, and disappearing again" (Webb 1974:480).

The Wacissa River was, and has remained, a surface channel. In contrast, the Aucilla has its origins as an underground river, emerging at the surface in numerous places. Therefore, stratigraphic correlations in the Aucilla River are possible because the channel sections have remained in the same locations for thousands of years and, as former points of egress (springs or river rises) and ingress (siphons or river sinks) shift to other locations, they become inactive depressions that fill with sediment. When the lower Aucilla floods, water emerges from its unconfined banks and saturates the surrounding flat terrain for kilometers in all directions. The Aucilla's floodwaters are known to back up into the Wacissa drainage.

The Wacissa River differs in part because its headwaters emerge from numerous headsprings. Rather than rapid surface runoff, the water emerges from springs in a delayed action. Water must percolate into the ground prior to entering the ground water system, after which it reemerges as discharge from springs. As such, the underground flow to the springheads takes time, and it takes place after most or all surface runoff has already drained away.

Over a 13 year period, the surface of the Wacissa River has fluctuated ±36 cm, whereas the Aucilla River surface has fluctuated ±1.60 m.[8] The flooding potential in the Aucilla, particularly above the Aucilla Sinks, is much greater due to direct surface runoff. Because the Wacissa is a surface expression of the Floridan Aquifer,

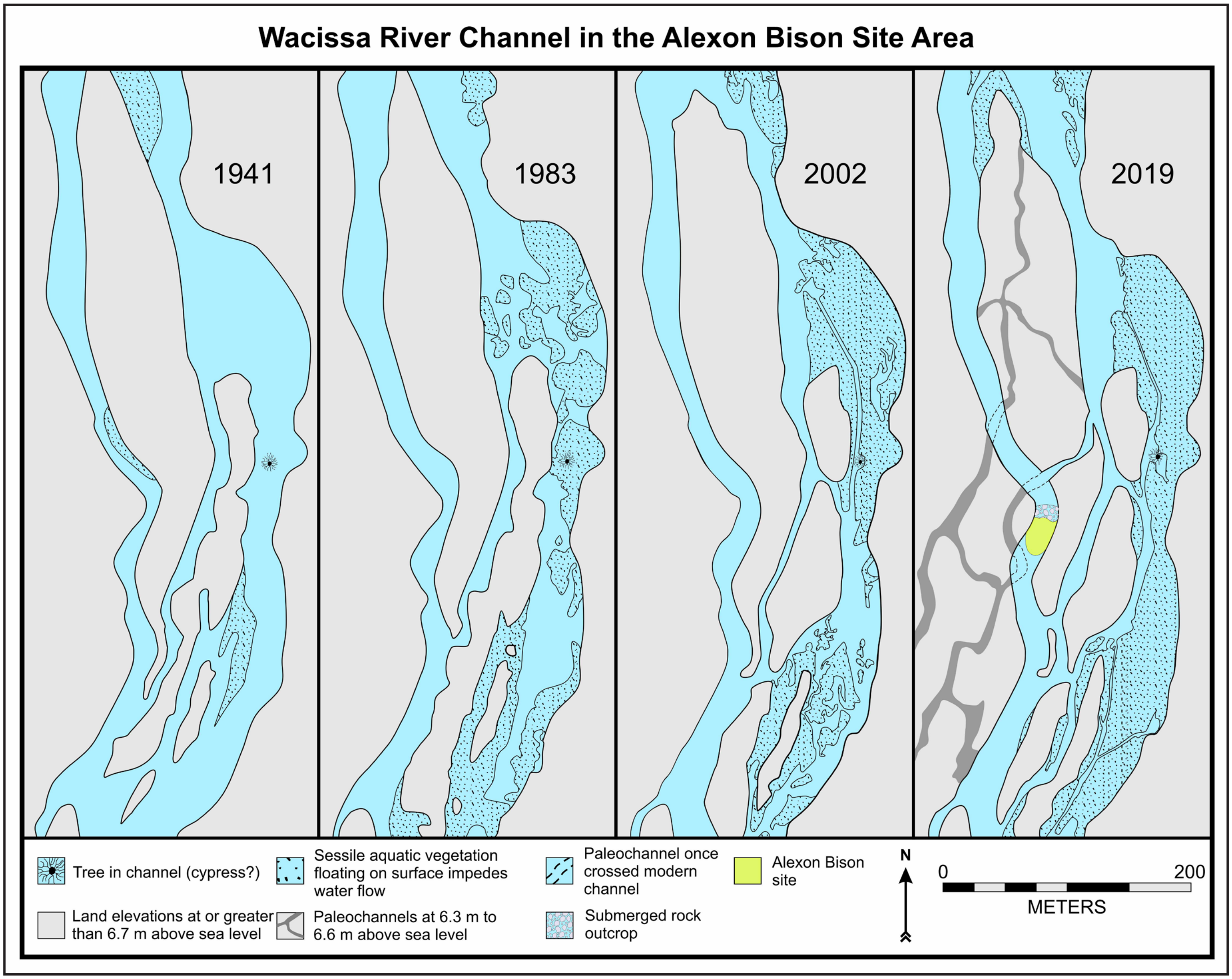

Figure 5. Channel Shifts. The Wacissa River channels at the Alexon Bison Site in 1941, 1983, and 2002 are based on aerial photography. The 2019 image is based on aerial photographs and USGS 2019 LiDAR. The LiDAR allowed the paleo channels hidden under tree cover to be plotted.

its potential for flooding is muted, a factor directly reflected in its minimal fluctuations and flood water backing up from the Aucilla.

At the Alexon Bison Site, the Wacissa River is 145 m (475 ft) wide, with three channels measuring 21 m (69 ft), 19 m (62 ft), and 12 m (39 ft) in width. There are multiple intervening, inundated sections choked by thick, aquatic vegetation (eventual channel-fills). In other areas, there are tree islands between the open, flowing channels (Figure 5).

Thus, the Wacissa is wide and shallow, making it difficult to believe a bison carcass could float downstream 6.7 km (4.2 mi). There are too many snags and other channel obstructions that would stop downstream drifting. The scenario that a bison fell off a cliff at Big Blue Spring "where about 45 feet [~14 m] of silicified Suwannee Limestone is exposed in a vertical section" (Yon 1966:46) is simply not possible. For a bison to have fallen from that cliff, the water table would had to have been ~15 m (49 ft) below its present level. If a bison fell from this particular cliff, it would have died and stayed there because the channels of the Wacissa River would have been dry with a water table well below the cliff (Figure 3c). If there were no water there, a bison would not have floated away.

Artifacts in Anastomosing Channels

For many years, the assumption was that artifacts and fossils in any channel system were eventually transported downstream (Olsen 1961, 1962). Paleontologist Stanley

Olsen's contention was that "fossils and cultural materials are oftentimes dislodged from their original resting place and are carried considerable distances downstream to be redeposited in a gravel bar or depression in the river bottom" (Olsen 1962:25). Olsen also published articles providing information about how and where to find souvenirs for aspiring collectors (Olsen 1963).

Perhaps the most notable example of misinterpreting site integrity is John Clauser's 1973 archaeological survey of Ichetucknee State Park. He concluded that anything inside the flood zone was eroded and had no integrity. He wrote: "If this is true, it would explain the jumbled provenience of the artifacts and the lack of any aboriginal features. Erosion and redeposition from repeated flooding can completely confuse any material present" (Clauser 1973:15).

Olsen's and Clauser's interpretations were made despite Clarence Simpson's discovery of "a chert scraper found in place below a partly articulated mastodon skeleton" at the Simpson's Flats site (8CO174) in the Ichetucknee River (Simpson 1948:13). Artifacts surface collected at this site included several carved ivory shafts as well as Paleoindian projectile points. This is the same site where Olsen excavated *in situ* specimens and encouraged collectors to do the same, while maintaining the view that the specimens were out-of-context (Olsen 1962:26).

Decades later, Dunbar was involved with the recovery of a mastodon tusk in the Ichetucknee River near the Simpson's Flats Site. The tusk project took place when floodwater from the Suwannee River had backed up into the Santa Fe River and, in turn, had backed up into the Ichetucknee River. The flow in the Ichetucknee was almost static. When archaeologist Brent Weisman investigated the Fig Springs Mission (8CO1) situated on land, within the flood zone of the Ichetucknee, he found no evidence of disturbances caused by flowing water. In addition, where Simpson discovered the partially articulated mastodon remains, he also identified *in situ* channel-fill deposits in the river (Simpson 1941, 1948). Simpson's findings countered Olsen's and Clauser's arguments, but they were largely ignored.

An avocational archaeologist and collector, Ben Waller, disputed the view of Olsen and Clauser based on his numerous underwater observations and experiments conducted in river channel settings (Waller 1983:33-34). In his experience in Florida, Waller contended that artifact and fossil concentrations did not wash downstream but remained adjacent to potentially undisturbed sites. Waller's hypothesis has since been confirmed in the Aucilla and Santa Fe Rivers. For instance, at the Sloth Hole Site in the Aucilla River, numerous carved ivory artifacts in fragmentary condition were refit to other pieces from the same site (Bradley et al. 2010; Hemmings 2004).

Furthermore, in 2009, archaeologist Glen Doran was part of a field expedition investigating the Norden Site (8GI40) on the Santa Fe River. He excavated a 1 x 1 m test unit directly adjacent to the river channel where Paleoindian tools and points had been recovered (Dunbar et al. 2010; Dunbar and Vojnovski 2007). A preform tip was excavated from the terrestrial unit *in situ*, in channel-fill sediment 35 cm below the ground surface of the riverbank. That preform tip was subsequently discovered to refit on a preform base recovered from the river channel 35 years earlier (Figure 6A). In addition, several surface-collected partial stone tools were refit to other fragments from the Norden site. This demonstrated the absence of downstream transport at this location.

A Natural or Paleoindian Bison Death?

From the archaeological information we now have, mass bison kill and/or butcher sites are not known in Florida, though we do not discount the possibility of their existence. However, they may be very scarce because bone preservation in upland acidic sediments in Florida is rare to non-existent. In locations where bone preservation occurs, such as in the Wacissa and Aucilla rivers, the remains of an isolated bison or the remains of two to three bison individuals in a particular location have been documented. At the Alexon Bison Site, there are at least two bison represented (MNI=2, possibly 3 MNI).

Mass bison kill/butcher sites are known from the western mid-continental United States and northward into Canada, and some of those sites were reused from early into historic times. Bison hunters in the West utilized topography to drive or to stampede bison into traps (Frison 1998), or to stampede them off cliffs at sites like the World Heritage *Head-Smashed-In Buffalo Jump Site* in Fort MacLeod, Alberta, Canada (UNESCO 2022).

Hunting bison was tricky and sometimes fatal for the hunter. Bison have no problem protecting themselves. They charge head-first to fend off predators and other animals that upset them. After European contact, Native Peoples began to hunt bison on horseback, yet great danger remained:

> When wounded and mad they [bison] turn suddenly round upon the hunter, and rush upon him in such a quick and furious manner that

Figure 6. Banded Chert Artifacts. Left: Norden Site preform refitted. Light tan distal portion was excavated on land and the tannic-stained basal portion was surface collected (underwater) 35 years earlier from the adjacent river channel. Right: Utilized flake from the Alexon Bison Site. Dashed lines separate differing grain size chert (courtesy of BAR collections).

> if horse and rider are not both on the alert, the former is overtaken, hooked and overthrown, the hunter pitched off, trampled and gored to death. [Brink 2009:32]

In North America, stone clubs were employed as part of the hunting tool kit. Bison that were alive, but too wounded to stand, were stunned by a blow to the back of the skull, which was intended to knock them unconscious, after which the hunter(s) could safely begin the butchering process (Brink 2009:163). Historically, safe butchery practices have included clubs, hammers, or axes for stunning, or a bullet to the forehead to kill an animal. The modern use of guns is limited to hunters and small rancher/butchery operations. Stunning the animal by striking the skull with a blunt hammer-like instrument is more common and part of well documented practice.

In Europe, striking a large animal in the head with hand-wielded tools and weapons has been documented since the 7th century B.C. The intent is to stun the animal before slitting its throat to bleed it out. The Romans practiced cattle sacrifice as part of their religious ritual, using hammers to whack a bull in the skull (Aldrete 2014). The use of hammers for stunning cattle, pigs, and other large mammals is also well illustrated (Figure 7).[9] In the 19th and 20th centuries, concerns surrounding the unsuccessful stunning of cattle was not only about the animal's frenzied suffering but also about the safety of the butcher (Eisnitz 2009; Fitzgerald 2010; Gregory 1989).

Figure 7. Medieval Fresco. Man uses the blunt end of an ax to stun a steer while the woman holds the head steady (with permission, Shutterstock image 116933707).

Stunning methods for cattle and bison are employed today as part of butchering. Commercial captive bolt stunning equipment (which uses blank ammunition cartridges or is powered by pneumatic pressure) is available for purchase to simplify this task. These devices do not shoot projectiles into the animal's skull; rather, they drive a retracting bolt onto the animal's skull to stun it before butchering begins. For example, the company Accles and Shelvoke offers 22 and 25 caliber models and the company Jarvis offers a pneumatic high speed captive bolt stunner for cattle.

Figure 8 dipicts today's recommended impact location for cattle and bison. The impact point is at the back of the skull. That is the same location where the chert object is embedded in the Alexon bison's skull.

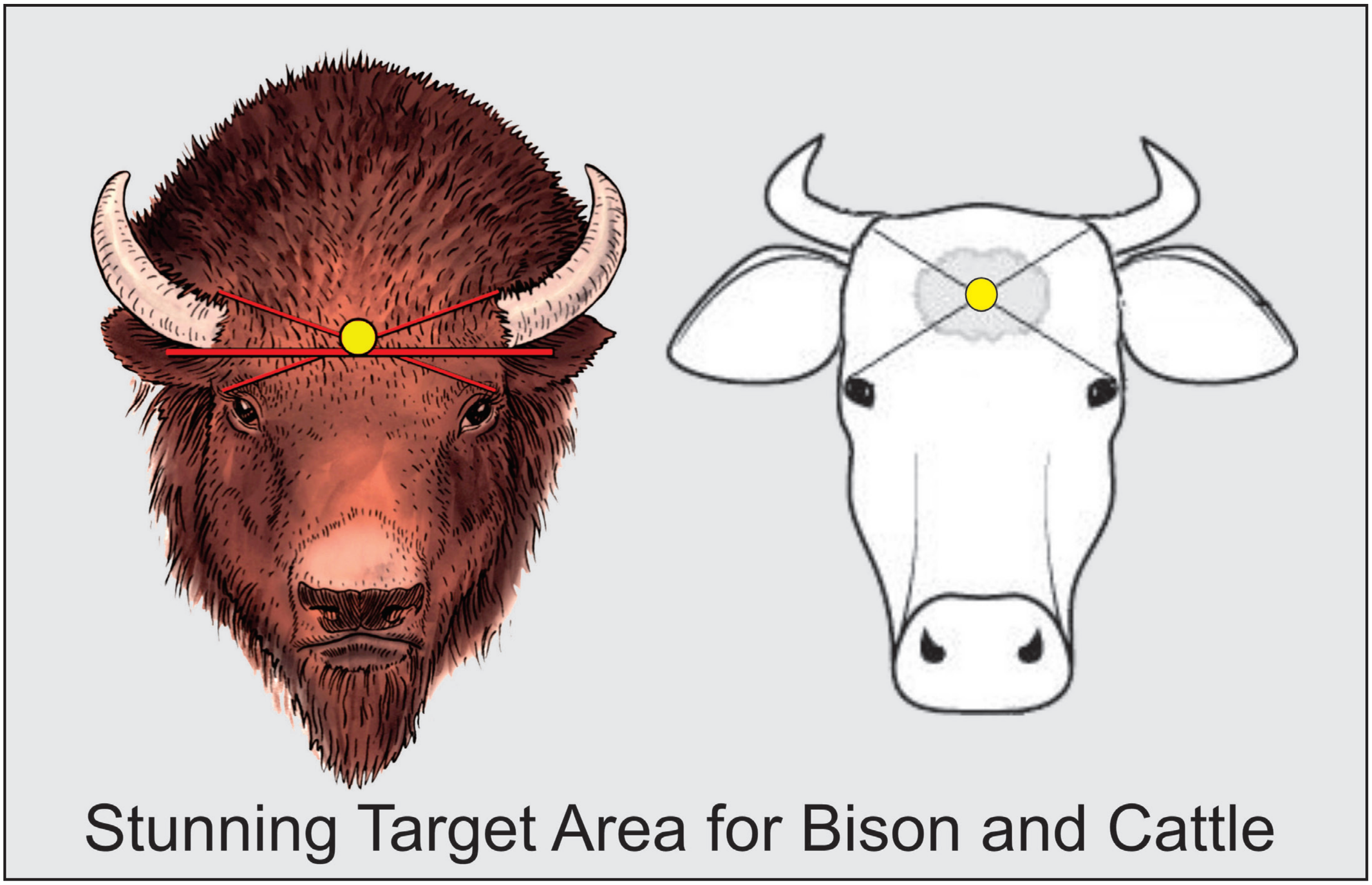

Figure 8. Location for Stunning. These images are available on the internet and in government documents. Left: bison (NFACC 2017). Right: cattle (EFSA 2020).

The chert fragment is said to be embedded in "a thin area of the frontoparietal" (Waters et al. 2021:282) and "at a thin and weak point in the cranium" (Waters et al. 2021:285).

The frontoparietal, forward of the nuchal crest, lies between the horn cores and is posterior to the nasals. It is the bony structure, in combination with the horns, that absorbs the impacts of fighting. There is considerable skin and soft tissue padding as well as hair on that area of the skull, particularly in bulls. These structures have evolved to withstand the impact of protective charges and charges during the rut (breeding season).

In the August 13, 2020, issue of the *Powell Tribune* (Powell, Wyoming), in an article titled *A Fight to the death – Bison rut is on in Yellowstone*, reporter Mark Davis states that the rut "will culminate then in essentially a fight to the death as they butt each other's heads." Davis quotes Chris Geremia, Yellowstone's top bison biologist: "Many bison are killed there. There's really nowhere else in the world to see a breeding season like this with thousands of bison breeding." We conclude that the so-called "weak point in the cranium" is actually the *strongest*, most impact resistant part of the offensive, weaponized end of a bison.

Is it a coincidence that the Alexon bison skull was hit in the location that would stun it? Assuming the bison was tripped-up and unable to stand, but not unconscious, a hunter choosing to deliver a blow to the stunning location is entirely feasible. The skull from the Alexon Bison Site in the Wacissa River is not the only known bison skull with a stone artifact lodged in it. A subadult bison skull with an embedded Calf Creek point in the stunning location provides comparable evidence. It is a skull from near Tulsa, Oklahoma, and was dated 5,846 +/- 68 cal YBP (Bement et al. 2005) (Table 1).

The potential for bison butchery at the Alexon Bison Site is not out of question. Comparison of the Alexon bison skull to the butchered skulls from the Lubbock Lake Site, in Texas (Johnson 1987), provides insight that suggests the potential for similar butchery practices at the Alexon Bison Site. At the Lubbock Lake Site, the Paleoindian component bison skulls were separated from the bisons' bodies by the following butchery actions (see Figure 9):

The nuchal crest and the occipital area beneath it were either battered, with one to several holes evident, or removed. Holes were too small for brain extraction, nor are they carnivore tooth punctures [Action 1]. They more likely were the result of the severing of neck attachments [Action 3]. Angle damage was common on mandibles, and the coronoid process was damaged or snapped off and broken at the symphyseal plate [Action 2]. The ascending ramus was frequently removed through pounding action that left jagged blow fractures. Occasionally a series of cut lines appeared on the mandibular medial border below the tooth row and diastema area [Actions 5, 6, and 7]. Concomitant with this mandibular treatment, the zygomatic arch and molars were broken from the skull [Action 4]. Hyoid bones were broken [Action 2]. Maxillae, together with the nasals, were frequently broken out of the skull by blows to the maxillary area and nasal base [Action 8]. This procedure was probably the mechanism for brain extraction. [Johnson 1987:145]

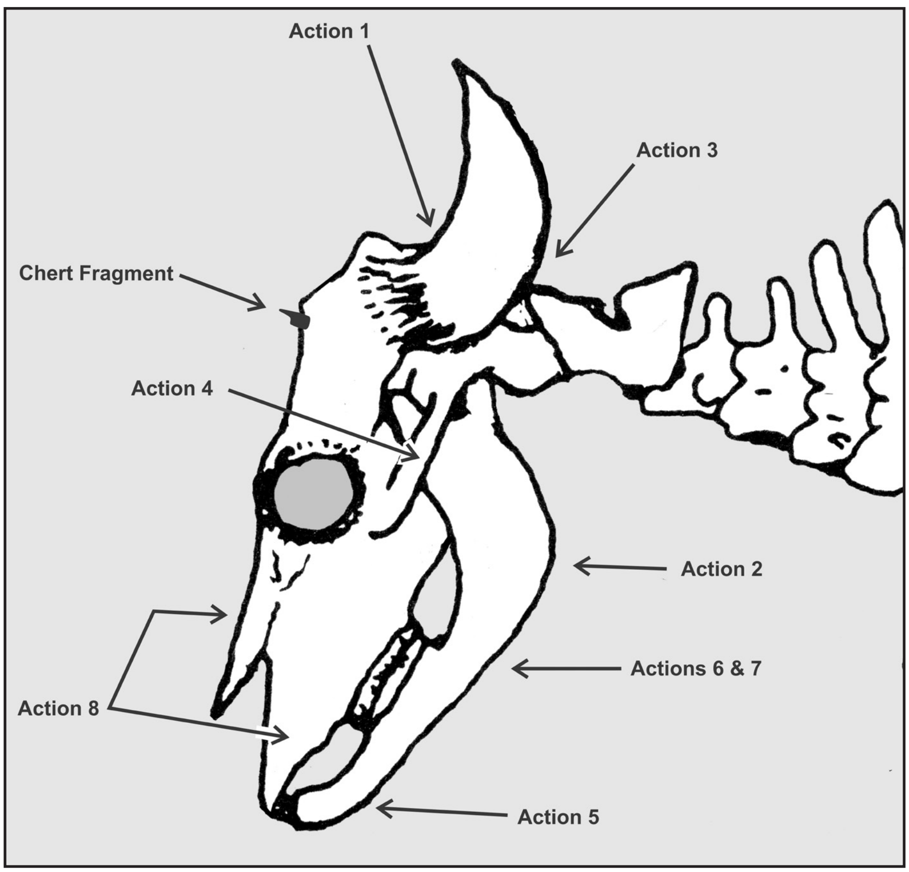

Figure 9. Idealized Bison Cranium Sideview. Note the placement of the embedded chert fragment in the Alexon bison skull. Also shown are the locations of butchery Actions 1 through 8 documented at the Lubbock Lake site and adapted from Figure 10.19 in Johnson (1987:146).

Therefore, we contend that the Alexon bison skull has a fragment of a stone tool embedded in it. It is most likely a projectile point fragment, or if not, it is a stone tool fragment nevertheless. We also contend that the fragmentary nature of the Alexon bison skull cap, missing its nasal, maxilla, incisive, lacrimal, zygomatic, occipital and other elements, could easily have resulted from human butchering practices using stone tools, including hammerstones.

Hunting Terrains

The topography in Florida has few natural features that would have allowed western-style indigenous buffalo hunting. The headwaters (springheads) of the Wacissa River have unconfined swampy margins with elevations no greater than 10 m (33 ft) above sea level. The distance from these headwaters to coastline of the Gulf of Mexico is approximately 30.5 km (19 mi). The elevation slope between those points is 0.057° or a grade of 0.001, indicative of truly flat terrain.

Cenote sinkholes, such as the Iron Ladder Cave in Citrus County near Lecanto, Florida, have sufficient depth for a buffalo jump, but there is a major problem. The ability to access a bison carcass for butchery would be impossible without sophisticated climbing gear to rappel down, butcher the animal, then lift the meat (and the butcher) back up from the 20 m deep sinkhole bottom. Cenote sinkholes without natural access points and with inward sloping walls can be accessed only by dangling on ropes (or, since the 20th century, an iron ladder detached from a 27 m forest tower). While cenote sinks represent natural death fall traps, no evidence of bison jumps or bison butchery has yet been discovered in them.

In the otherwise flat terrain surrounding the Aucilla-Wacissa basins there are isolated patches of karstified limestone as well as small knolls of erosion-resistant dolomite and chert outcrops. Both represent craggy features riddled with open solution features or individual boulders and cobbles of dolomite, and/or chert boulders. These features are exposures of rock with a craggy nature; they are terrain that is difficult to traverse casually because they represent potential foot and leg traps for large animals.

Furthermore, these features have craggy openings spaced close together that would pose challenges to bison-sized animals attempting to stampede over them. Foot and leg traps would potentially fracture long bones and immobilize the animals in a way that would not be immediately fatal. Therefore, due to the general absence of cliffs and blind canyons, patches of craggy rock might have provided alternative hunting terrain. Animals that sustained leg wounds would be fairly easy prey, but would require stunning or dispatching to allow safe butchery.

Wacissa Basin and Large Grazers

When the Aucilla River Prehistory Project (ARPP) was first begun by Webb, Dunbar, and others in the early 1980s, open-range, long-horned cattle still roamed the Aucilla-Wacissa basins in what is now the Aucilla River Wildlife Management Area. The first members of the Aucilla River Prehistory Project often awoke to the noise of small herds of long-horned cattle near their camp at the Page-Ladson Site. The cattle sounded like Sherman tanks as they moved through thickets of tree saplings and Florida cane.

Prior to the Second World War, Cracker families occupied mobile residences up and down the Wacissa River. In the spring and summer, they ran cattle and hogs, and sold some as a source of income (Balfour 2002; Cole and Ladson 2018). Before the cattle were removed to fenced pastures in central Florida, they often were seen on roads and trails in and around the Wacissa River basin.

Perhaps the most interesting cattle encounter was experienced by Dunbar while snorkeling in the Wacissa River, which in many areas is shallow. Dunbar met a long-horned cow grazing on aquatic grass in knee-deep water. This was interesting because the Wacissa was not only a source of drinking water for cattle but also a place to graze on abundant aquatic vegetation. Long-horned cattle gave the Wacissa and Aucilla basins a Pleistocene-like atmosphere.

Suwannee Chert in the Wacissa Basin

Chert in the Wacissa basin is silicified limestone. One uncommon chert type is concretionary chert that formed in solid spheres and rounded, oblong "sausage" shapes. They are known as "cannon ball chert." The internal structure of cannon ball chert consists of concretionary bands of different color and grain-sizes (Figure 10).

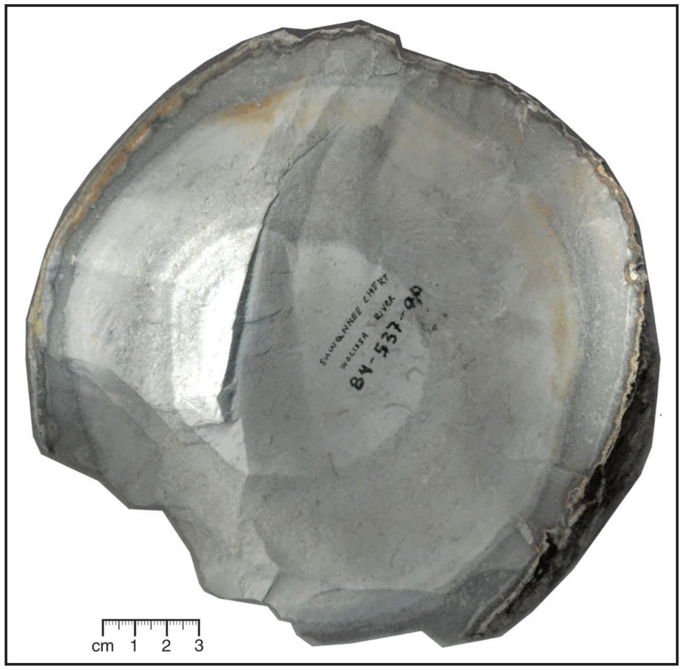

Figure 10. Cannon Ball Chert. This specimen is from a quarry in the Wacissa River. Note the gray and white bands of chert (ARI chert type case collection).

There is at least one outcrop of cannon ball chert in a Wacissa River channel, which is 2.6 km (1.6 mi) downstream from the Alexon Bison Site. This outcrop is known as the 2 ½ Fathom Quarry site (8JE612), where chert extraction took place when the inland water table was low enough to expose it. This quarry site is estimated to have become permanently inundated sometime after the Bolen Drought at 11,400 cal YBP and certainly by 9,000 cal YBP, after the 9,300 cal YBP environmental event (Dunbar 2016).

Other chert sources of this type display varied colors and grain size bands. Examples of stone tools manufactured on concretionary banded chert are shown in Figure 6. A preform from the Norden Site in the Santa Fe River basin, where cannon ball chert nodules also occur, was found in two pieces (Figure 6A), one in the river and the other from a test unit on land. Figure 6B shows the dorsal and ventral sides of the utilized flake from the Alexon Bison Site. The thin, dashed lines in Figure 6A and B show the different grain-size boundaries that occur in the chert. The bands in these chert sources patinate differentially over time, with some becoming chalkier than others.

Compared to other soft tissues of mammals, brain tissue has a unique chemistry that many peoples in the Old and New Worlds used for tanning hide (Covington 1997).

The fact that the chert embedded in the bison's skull was exposed to brain cavity chemistry might have favored patination, so the chert fragment may not represent outer cortex as suggested by Waters et al. (2021:282-284). It is instructive to view Figure 10 (the sample of cannon ball chert from the 2 ½ Fathom Quarry Site). Note that the chert bands are naturally gray and white. Thus, it is likely that the object embedded in the bison's skull is chert, not considerably softer cortical rind.

Precision of Micro-Computed Tomography Scan

The quality of computed tomography (CT) scanning has greatly improved in the last two decades. Comparison of the CT scan in the article by Mihlbachler et al. (2000:56, Figure 1), which has one digital slice per centimeter, to the micro-CT scan in Waters et al. (2021:283, Figures 3 and 4) shows marked improvement. Nevertheless, the micro-CT scan does not show clear enough detail and leaves interpretation open to debate.

Using an Acrobat digital copy of their paper, one can observe the micro-CT image in Figure 3A at 200% magnification, which shows the chert protruding from the skull (middle row of four images, image to the far right and image second to the left). Comparing their CT scan of the chert fragment to the photographic image of the same fragment, one can see a clear difference. The micro-CT scan appears to represent a series of remote-sensed contour lines or slices separated from one another and lacking sufficient detail to determine if some chert surfaces are flaked or not.

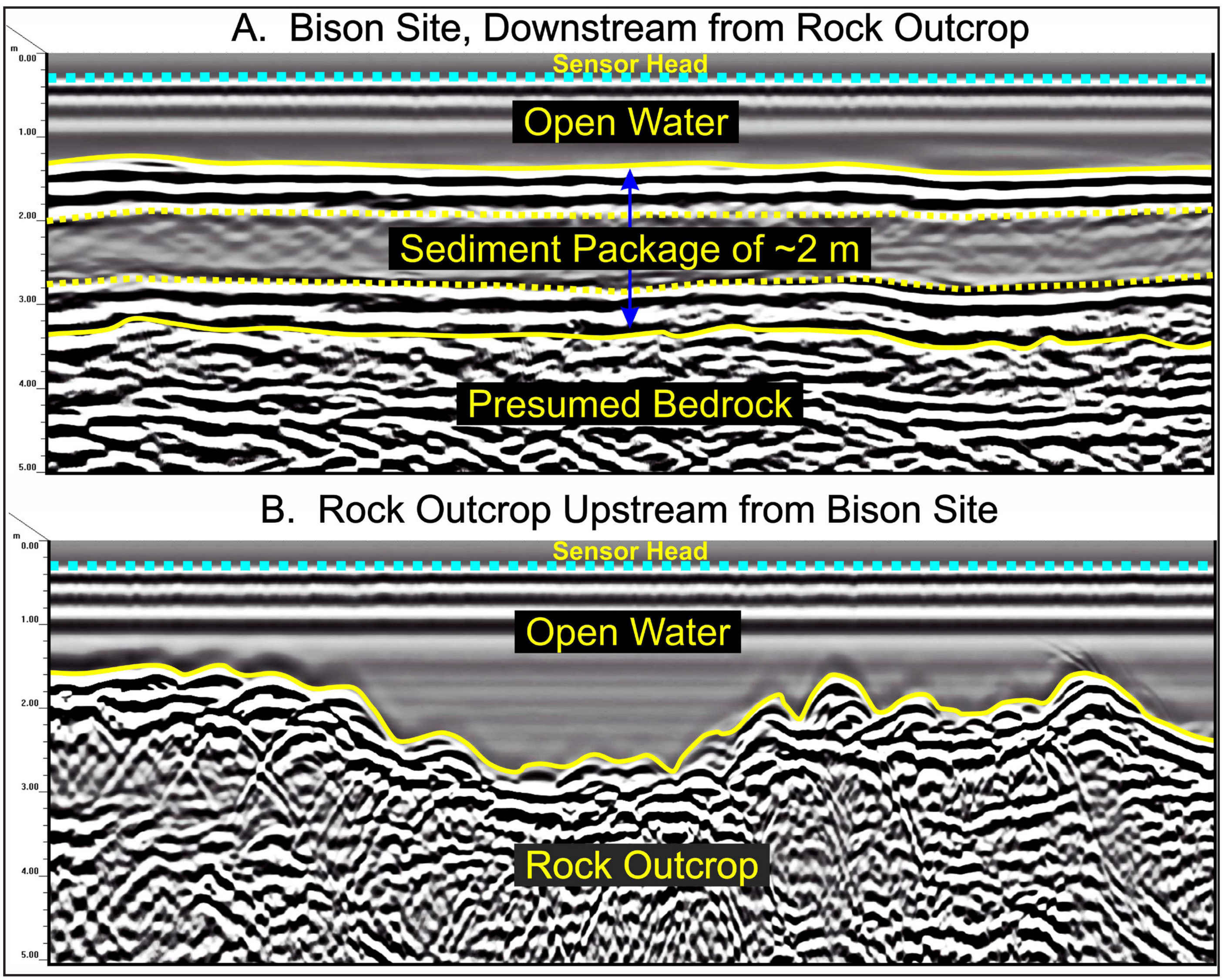

Figure 11. GPR Results to 5 m Depth. Top (A) shows the Alexon Bison Site and its approximately 2 m thick sediment. Bottom (B) shows the rock outcrop just upstream.

Ground Penetrating Radar (GPR) Survey

During ARI's reexamination of the Alexon Bison Site, a survey using ground penetrating radar (GPR) was conducted with a Geophysical Survey Systems, Inc. (GSSI) unit with a 200 HS Antenna and a Panasonic FZ-G1 Touchpad controller operated with Radon 7 software. The GPR unit was used as a sub-bottom profiler operated from a boat. In our case, the antenna, housed in a waterproof box, was floated and stabilized inside a large tractor inner tube.

To secure the GPR sensor further, we designed a custom-built pipe frame (made from polyvinal chloride [PVC] pipe) and tied the antenna and pipe frame together as a single unit. The antenna was set to 50 scans per second, with the scanning depth set to 6 m below the scan sensor. The inner tube/antenna setup was then used by a three-person crew who included a navigator, a GPR operator, and the person holding the sensor head steady against the side of the slow-moving boat.

This method worked well and produced good, unexpected results. We found a complex, approximately 2 m thick sediment sequence preserved at the site. Based on the radiocarbon age of the buried bison bone, the uppermost late Pleistocene level is likely to date to the middle to late Allerød.

In Figure 11A, the sediment is resting above suspected limestone bedrock and has three major units. The first 70 cm unit is banded, and our visual observation of the surface sediments included sand and organic lenses. Below that, we assume that the shell-rich sandy level (originally observed in 1983) is part of the upper Pleistocene sequence. Any other sediment unit below that in the ~70 cm upper reflection has not been directly observed.

The second sedimentary unit (solid gray) is approximately 75 cm thick, followed by a third unit that is ~60 cm thick. A compacted, peat-like level was observed in an erosional cut on the eastern side of the rock outcrop and may represent the middle 75 cm gray level. We did not undertake coring or subsurface testing, and due to the nature of remote sensing, ground-truthing to identify the levels is still required. However, the significant discovery was the sequence of Pleistocene channel-fill sediments.

Discussion

The Alexon Bison Site has at least two horizontally separate sections, the bison remains on the downstream end and the rock outcrop on the upstream end. The rock outcrop consists of dolomite, chert, and a mix of both lithologies (Appendix 1). The quality of the chert is poor, having numerous vuggs of approximately 0.5 to 3 cm diameter, with some vuggs penetrating through the rock. The chert is not concretionary, meaning that the utilized flake from the site came from a different chert source, perhaps the 2½ Fathom Quarry Site.

Pleistocene inland water tables were sufficiently high in the Allerød phase (from about 14,075 until 12,896 cal b2k YBP) to allow the Wacissa-Aucilla basins to hold surface water that formed wetlands, ponds, and through-flowing water (for the Pleistocene climate phase see Rasmussen et al. 2014:22, Table 2). Before and after the Allerød phase, inland water tables were much lower during two separate Heinrich events, H1 (17,430 to 14,642 cal YBP) and H0 (H0 is also known as the Younger Dryas, from 12,846 to 11,653 cal YBP).

The correlation of the Florida data to these climate intervals has been accomplished using ample radiocarbon dated materials and calibrated results in calendar years. With calibration accomplished, it is simple to determine where calendar-years fall within the climate event history (Rasmussen et al. 2014).[10] The radiocarbon date of the bison bone element recovered *in situ* reflects a middle-to-late Allerød age of the level associated with the bison remains.

Wide-ranging stratigraphic correlations in the Wacissa River channels are not possible without major geological investigations and radiometric dating to determine when, where, and how many channel shifts took place in any one location. The channel-fill deposits in the Wacissa basin are complex, and to unscramble that story is daunting. The stratigraphic correlation of a Ryan-Harley Site stratum assessed to date to >57,000 cal b2k YBP and located 7.5 km (4.7 mi) downriver from the Alexon Bison Site is speculation.

Likewise, the hypothesis that the bison fell off the 14 m (46 ft) cliff at Big Blue Spring, which rose 14 m immediately, and then floated downstream to settle in the same location as another bison carcass is unsupported. Fluctuations of the Floridan Aquifer's surface do not take place rapidly. For example, during the later phase of Heinrich 1 (H1), also once known as the "mystery interval" (Denton et al. 2006), the inland water table at the Page-Ladson Site was at least 10 m (32.8 ft) below today's level at around 17,000 cal YBP (Dunbar 2016).

When H1 began to transition toward the Allerød phase (in an interval informally known as the Bølling [GI-1e] from 14,642 until 14,025 cal YBP), the inland water table of north Florida began to rise (Dunbar 2016). The Aucilla-Wacissa basins began to flood by 14,075 cal YBP or, more likely, a few hundred years earlier. Therefore, at minimum, it took about 620 years for the Floridan Aquifer to rise enough to flood Big Blue Spring on the Wacissa River. This rules out the notion that the bison fell off a cliff at Big Blue Spring and died, and then after its body bloated, the water was high enough to float it downstream.

A seemingly unrelated observation deals with the types of Mollusca identified in the bison level versus those of today's freshwater species. Rock specimens from the site also held a number of freshwater mollusk shells stuck inside the larger voids in the rock. The gastropod *Elimia floridensis* and an invasive bivalve native to China, *Corbicula fluminea*, were recovered from the rock voids exposed to the water column. Both species are known to inhabit relatively fast-flowing water in spring-fed runs and rivers. Shells of neither of these species were observed in the shell-rich bison level.

The shells of *Viviparus georgianus* and *Pomacea paludosa* in the bison level suggest a different aquatic environment than exists at the site today. The gastropods from the bison level are known to live in slow-moving water in channel systems and non-flowing water in ponds and lakes. Though further research is needed, this evidence suggests that the water level in the Wacissa River was insufficient to float the bloated body of a bison and to provide sufficient downstream force to embed a chert object in the animal's skull by natural causes. In the Allerød phase, it is possible that the Wacissa basin held a series of still-water ponds that occasionally flowed from one to another after heavy rains.

We view paleontologist Stan Olsen's concept of downstream transport of bone and stone as incorrect. Olsen's first trip to Florida was for the inspection of Clarence Simpson's Ichetucknee River mastodon site (Simpson 1948). Olsen's interpretation of the site included the statement that "the fossils seem to be washing out of a dark gray clay, I believe more material could be recovered by employing some 'mechanical' means…" (Olsen 1949:6). He later said the site was yielding "many fine specimens… retrieved from the submerged clays" (Olsen 1962:26). Olsen maintained a view that flowing water was displacing and damaging specimens, with which we do not agree. In our view, he did not have an accurate understanding of the geology of fluvial environments, including the importance of channel-fill sediments in anastomosing channels of Florida.

In Florida, a number of archaeological sites are located in the channel-fill deposits in anastomosing river basins: the Simpson's Flats Site in the Ichetucknee River, the Norden Site in the Santa Fe River (Dunbar 1975; Dunbar and Vojnovski 2007; Smith et al. 1997), the Ryan-Harley and Alexon Bison sites in the Wacissa River (Smith 2019; Waters et al. 2021; Webb et al. 1983, 1984), and the Wakulla Springs Site (8WA24a) in the Wakulla River (Dunbar et al. 2007; Hemmings 2019; Hemmings and Dunbar 2019; Porter 2012; Rink and Burdette 2008). Two of these sites have been radiocarbon dated (4 dates), the Wakulla Springs (Vickery Mastodon) and the Alexon Bison sites, and have yielded late Pleistocene Allerød chronologies. At Gilchrist Blue Springs along the Santa Fe River, geological sampling has documented preserved sediment dating to the Allerød phase (3 dates) (Tanner et al. 2020) in a submerged stratigraphic column in a riverine environment. The Gilchrist Blue Springs sediment core location was taken in the Pleistocene anastomosing floodplain of the Santa Fe River.

Rivers such as the Santa Fe, Ichetucknee, and to a lesser extent the Wakulla, have lost their anastomosing character in the Holocene, giving way to single, unified channel systems. The near-surface limestone bedrock in the Santa Fe basin now has an entrenched limestone channel below River Rise in O'Leno State Park. It is the reason why that section of the Santa Fe River failed to develop a meandered pattern in most places. For different reasons, the Aucilla River's channel is entrenched in bedrock south of the Cody Scarp, where it begins its alternating underground and terrestrial course.

We quote Olsen's statement: "Salvage of this material [artifacts and fossils] by careful divers, whether they be professional archaeologists or paleontologists or interested amateurs, save it from being destroyed by further water action" (1962:25). This notion that artifacts and fossils are transported downstream, and are threatened with destruction, is incorrect for sites in anastomosing channels and in entrenched channels like the Aucilla River. Even Olsen commented that "fragile material, usually found broken on the land, is frequently encountered intact under water" (Olsen 1961:375). Indeed, the largest concentrations of Paleoindian artifacts and abundant late Pleistocene fossils occur in the anastomosing river channels of Florida. These sites merit the utmost preservation efforts.

In the Old and New Worlds, the evidence for stunning large animals is well-documented from early times until today. It presents a basic safety maneuver prior to butchery. The chert object in the bison's skull may or may not be a fragment of a projectile point, although its lenticular cross section is consistent with a point tip. We therefore postulate that the chert object is a fragmentary artifact. It is located at the correct location to stun the animal (Figure 12).

The chance of an accidental death by natural causes seems improbable. Whether from a chert-tipped spear thrown with an atlatl, a blow from a stone club, or some other stone-impacting device, we view the blow as having had enough power to render that animal unconscious, and we favor the likelihood of human involvement. As for the hunting terrains in the coastal lowlands of Florida, where cliffs and buffalo jump potentials are absent, a craggy rock terrain might have aided that purpose instead. If the terrain offered foot and leg traps that disabled the mobility of the prey, it would not be lethal, at least not quickly. Thus, stunning the animal would be required to overpower it in this scenario.

Conclusion

The chert embedded in the Alexon Bison Site skull appears to be cannon ball chert that has varied gray and white bands (see Figure 10). The chert exposed on the interior part of the skull might have become patinated via chemical reactions with decomposing brain tissue leaked into the pithy sinus lattice between the frontoparietal and braincase. The chert protruding from the skull would not have experienced that exposure, thus allowing it to maintain lesser degradation via patination.

The utilized flake recovered from the Alexon Bison Site displays two characteristics. First, it is patinated differently on the dorsal side (Figure 6B top) contrasted with the ventral side (Figure 6B bottom). The dorsal side has been exposed to river water and has remnants of algae adhering to its surface. It has a light gray somewhat patinated coloration. The ventral side, which does not appear to have been exposed to river water, has a different coloration (gray-browns and rust) with no evidence of algae or other exposure to river water. The patina on the ventral side appears to be less compared to the dorsal surface. Second, the specimen is banded and displays different grain sizes consistent with cannon ball chert. It lacks vuggs and other aspects of chert at the Alexon Bison Site rock outcrop.

Although the micro-CT scan by Waters et al. is good quality, it does not compare to the higher resolution photographs of the embedded chert fragment. The fracture scar caused by the chert impacting the skull (Waters et al. 2021: Figure 5B) is evidence of considerable force when it broke. Short of a bison charging the rock outcrop head-on with the back of its skull bent well below horizontal, there is no evidence for a natural cause. Further, the butchery modifications to the Lubbock Lake bison skulls resulted in similar conditions as shown by the Alexon bison skull cap.

Our GPR survey of the Alexon Bison Site identified sediment of 2 m thickness resting above bed rock just downstream from the outcrop. Though most of the site is now located in a channel of the Wacissa, it appears that

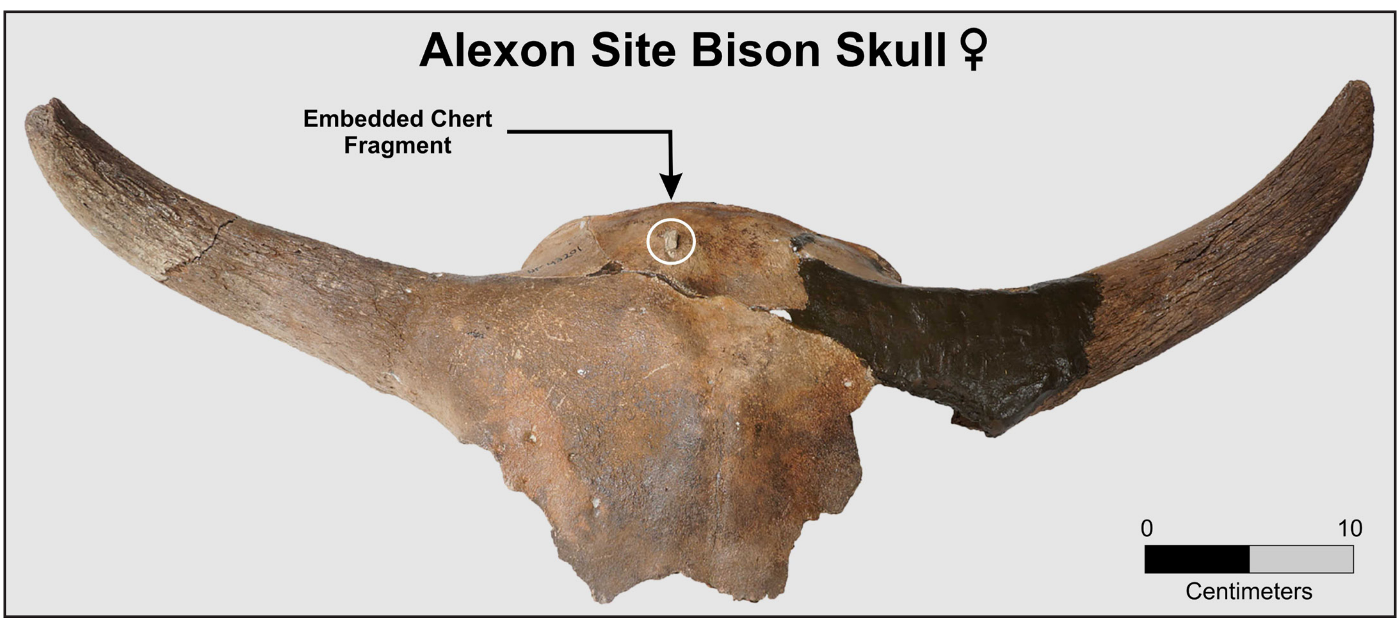

Figure 12. The Alexon Bison Refitted Upper Skull Portion (courtesy of FLMNH, Vertebrate Paleontology collection).

other, older channels did not run over the site. Only the modern channel has affected the site. It appears that the rock outcrop has acted as a buffer that has more or less protected the Pleistocene sediments from undue erosion. It is also possible that the western side of the site extends under the river bank. If that is true, an undisturbed section of the site in that location may offer a full Pleistocene sediment sequence.

Inundated archaeological sites pose challenges to researchers responsible for making interpretations of them. The process to dismiss a site as having no archaeological worth, or for having components of natural causation without human involvement, should not be rushed or developed without informed judgment. The Alexon Bison Site establishes that the bison skull has a chert fragment embedded in the same location that humans have targeted to stun large animals for thousands of years in both the Old and New Worlds.

Can it be said beyond any doubt that there is a Paleoindian component at the Alexon Bison Site? The answer is not yet definitive, but the TAMU team's proposed evidence that the site is not an archaeological site has now been countered to re-demonstrate that there is a high likelihood that it is. The site's minimum number of individual bison of at least two further suggests Paleoindian involvement. The deep stratigraphic profile holds great promise, and we assert that the bison component at the Alexon Bison Site should be considered archaeological until proven otherwise.

Notes

1. At that time, long-horned cattle still occupied the Aucilla-Wacissa open range surrounding and in what is now the Aucilla River Wildlife Management Area.

2. Relatively new radiocarbon pretreatment protocols can, in some cases, purify old bone tissue of its contaminants.

3. Optically-Stimulated Luminescence (OSL) ages and other chronologies, such as ice-core annual years, are expressed as **cal b2k YBP** (years before A.D. 2000), whereas radiocarbon ages are expressed as **cal YBP** (years before A.D. 1950).

4. Biofilms can be defined as complex structures with cells and aggregates of cells. The biofilm is a sessile microbial community with several kinds of organisms such as bacteria, protozoa, fungi, algae, and extracellular polymeric substances, which may be found on almost any surface exposed to water (Froehner et al. 2016:3965).

5. This date range is based on Mud Lake and Lake Louise radiocarbon ages that have been calibrated in this article to calendar years before present (see Table 1).

6. A *vulsion* is the rapid abandonment of a river channel and the formation of a new one.

7. The late Allerød phase (GI-1a) from 13,149 to 12,946 cal YBP represents the interval encompassing the appearance of Clovis culture in the Americas.

8. Wacissa River USGS 02326526 and Aucilla River USGS 02326500 Gage Stations, March 2010 to August 2021.

9. For illustrations, see Fine Art America (2022) and Lee (2022).

10. Rasmussen et al. (2014) is used in this paper as the recognized chronology of Pleistocene climate events developed by the INTIMATE Group (INTegration of Ice-core, MArine and TErrestrial records) under the auspices of INQUA (International Union for Quaternary Research) and represents the climate event history for the late Pleistocene.

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Appendix 1. Rock Types in the Alexon Bison Site Outcrop.

Year Collected	Sample ID	Dolomite	Chert & Dolomite	Chert & Limestone	Chert	Comments
1983*	1	X				Tan-white, no vuggs, looks like limestone, fizzes like dolomite
1983	2		X			Broken from larger rock at outcrop, has a chert vein
1983*	3	X				Tan-brown dolomite
2021**	4				X	Surface at bedrock margin, vuggy chert
2021	5			X		Taken from bedrock, middle-center, vuggy, on surfaces of fresh breaks vuggs are filled with limestone***
2021	6		X			Middle-eastern side bedrock, sample too small to determine if vuggs are present
2021	7			X		Easternmost bedrock, vuggy, on surfaces of fresh breaks vuggs are filled with limestone
2021	8			X		Westernmost bedrock, vuggy chert, on surfaces of fresh breaks vuggs are filled with limestone
2021	9				X	Mid-center bedrock, vuggy chert
2021	10				X	Surface around bedrock margin, vuggy chert
2021	11				X	Surface, vuggy chert, large grain
2021	12			X		Surface, vuggy, on surfaces of fresh breaks vuggs are filled with limestone
2021	13				X	Surface, vuggy chert
2021	14		X			Hard dolomite and chert, smooth inner and outer surfaces, thin, vuggy
2021	15				X	Chalky, easy to scratch and vuggy
2021	16				X	Chalky, easy to scratch and vuggy
2021	17			X		Vuggy chert, on surfaces of fresh breaks vuggs are filled with limestone
2021	18				X	Vuggy chert, large grain
	TOTALS	**2**	**3**	**5**	**8**	

* 1983 samples collected from Alexon Bison Site area downstream from the outcrop.

** 2021 all samples taken from outcrop upstream from Alexon Bison Site.

*** All vuggs are suspected to have been filled originally with limestone. Any vuggs exposed to the exterior surface of the rock had the limestone dissolve chemically away in geologic time giving the chert rock at the outcrop the vuggy appearance it has today. The chert from the outcrop is not banded.