Site Formation Processes of the Gail Stone Archaeological Site (47Tr351) in Trempealeau County, Wisconsin

Tiffany L. Newman

Faculty Sponsor: Dean Wilder
Department of Geography and Earth Science

ABSTRACT

The Gail Stone archaeological site, located in Trempealeau County, Wisconsin has added to our understanding of Paleo-Indian culture because it is one of the few unmixed Paleo-Indian fluted-point components in this region. Fluted points, end-scrapers and other lithic artifacts found along a slope could represent a single short-term occupation for tool production. The location of artifacts on the slope of the terrace raises questions since Paleo-Indian occupations are not believed to have occurred on terrace slopes. This paper has sought answers on how Paleo-Indian peoples occupied the terrace through an interpretation of stratigraphy and site formation processes. Field and laboratory work to evaluate the site stratigraphy and terrace formation revealed the presence of a buried paleosurface over 2 meters below the present terrace surface. Evidence for the buried surface includes an eolian lag deposit and the presence of fossil ostracod shells associated with the lag deposit.

INTRODUCTION

Paleo-Indians entered what is called the Driftless Area in western Wisconsin at about 12,000 years before present. Since glaciers did not directly cover this area the topography tends to be hillier than the surrounding regions. By 13,000 B.P., the glaciers covered only the northern part of Wisconsin, and by 10,000 B.P., all glaciers had left Wisconsin. This was the period when the first Paleo-Indians came to this area.

Pollen data show that at 11,000 B.P. vegetation of the Midwest was predominantly boreal forest. By 10,000 B.P., there was a shift from boreal forests to a more deciduous forest and woodland environment. This trend would continue as the boreal forests moved north and the deciduous forests moved in. The change in vegetation accompanied the great climatic shift from the Pleistocene into the Holocene (Jennings 1983, Pielou 1991, Wright 1983). As a result of climatic and vegetation change, much of the megafauna accustomed to this environment became extinct. These megafauna include bison species, mammoths and mastodont. Another species that may have been in the Driftless Region was the caribou, which continues to flourish today in more northern regions (Boszhardt et al. 1993, Pielou 1991). There are not very many kill sites in the Midwest, so it is hard to know exactly what the Paleo-Indians hunted in this area.

The Paleo-Indians are seen as the first Americans and all had generally similar lifestyles. Because few systematic long-term Paleo-Indian research projects have been done in the

Wisconsin area since 1969, we know very little about their raw material procurement, tool production, or land use (Amick et al. 1999). Paleo-Indians were probably small mobile hunting groups dependent on availability of food sources, seasonality and locality. Due to these conditions their settlements were probably small, single use camps scattered across the landscape. Some ideal locations with good hunting grounds and other food sources may have been used more than once. A place like Silver Mound, in western Wisconsin, would have been visited repeatedly because it was a lithic source and perhaps a place for macroband gathering (Boszhardt 1991, Mason 1997).

The Gail Stone site in Trempealeau County, Wisconsin has added to our knowledge about the Paleo-Indian tradition. The Gail Stone site is located on the western fringe of the Driftless Area (Figure 1). The topography in this region tends to rugged and steep, with tall bluffs. This site is located at the mouth of the Tamarack Valley; on the south-facing slope of a loess terrace that is part of the stream terrace. Tamarack Creek flows south in this valley, around the loess bench, and into the Trempealeau River (Figure 2). It is called Tamarack Valley because of the large stand of Tamaracks that are in the area, and these stands are believed to have been established about 1000 years ago (Amick et al 1999).

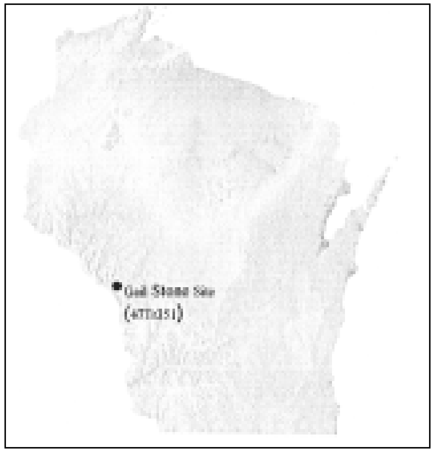


Figure 1. Wisconsin map showing the location of Gail Stone Site (47Tr351)

Figure 2. Aerial view of Gail Stone Site and

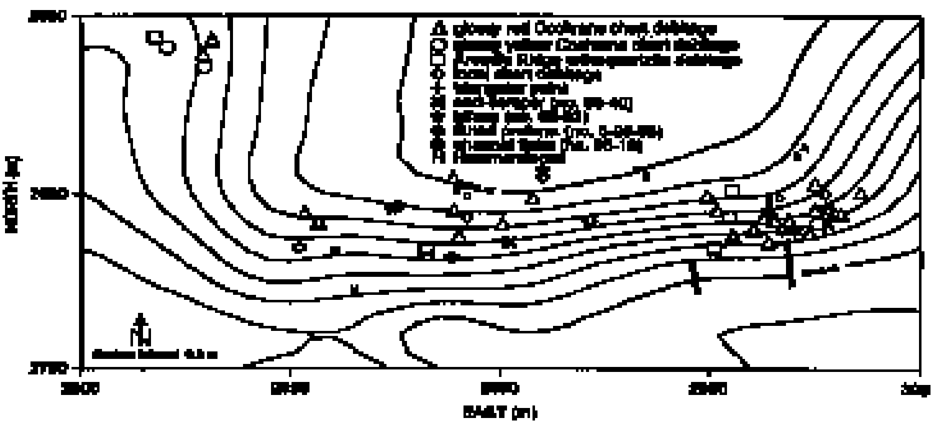


Figure 3. Map of artifact distribution and location of excavated units and trenches

Paleo-Indian artifacts found along the slope of the terrace include lithic flakes, scrapers, and fluted points (Figure 3). The majority of these tools are made out of Cochrane chert, a high quality chert found in western Wisconsin. The Gail Stone site is believed to be a short-term occupation with the Paleo-Indians stopping at this location to rework their tools and perhaps make new ones with Cochrane chert. The lithic assemblage recovered to date includes channel flakes that are from fluting the points. Other lithic tools present at the site include bifaces and endscrapers. It was probably a small family group that occupied the area for a short time (Amick et al 1999).

Test excavations were done by MVAC in the summer of 1998 (Figure 3). These consisted of three 1x2m test units (Units A-C) along the top of the terrace and trenches below. The 1x2 units went through the plowzone into a Beta B horizon, which was 40cm below the surface. All of these units were sterile of artifacts except Unit B, which contained one Prairie du Chien flake. Also in this area a 1” diameter sediment core was taken 1.5 m below the surface but did not encounter any buried soils. Unit D, a 1x4-meter unit on the slope contained artifacts in the plowzone but no artifacts were found in the underlying soil. Near Unit D, Trench D was put in and revealed a stepped profile sequence. Trenches E and F were at the toe of the terrace and went into an adjacent swale. A buried A horizon was found 2m below the surface, but there were no artifacts found in or below it (Amick et al 1999).

The 1998 MVAC excavations added important information on the Paleo-Indian period. The presence of rhyolite chert and some orthoquartzite suggest that there was long distance trade or regular migrations to sources for certain rock materials that were suitable for tool making (Amick et al 1999). While this site did contribute information on this area, questions remain on the site formation processes and how these artifacts came to be found on the slope of the terrace.

The need for a more complete understanding of the geomorphology at the Gail Stone site in Trempealeau County has bearing on how future surveys for Paleo-Indian sites are conducted, as well as understanding site formation processes. This site has already added to the knowledge of raw material procurement of the Cochrane chert by Paleo-Indian people. The work presented here can further the understanding of these people and their environment.

STATEMENT OF THE PROBLEM

Gail Stone was a Paleo-Indian work area based on the presence of lithic debitage scrapers, fluted points and hammer stones. It was assumed that in the past that all people prefer flat surfaces to camp, but at Gail Stone site the Paleo-Indian artifacts were found on the lower portion of a terrace edge. One possible explanation for this artifact distribution is that the artifacts were buried in the terrace and are now eroding from the edge.

Hypotheses on the origin of the terrace and how the artifacts came to be located along the terrace slope include the following: a) The terrace formed before the Paleo-Indians occupied the terrace slope. After they were gone site formation processes occurred that would not significantly change the terrace or the location of the artifacts. As a result the artifacts were left behind on the slope. b) The Paleo-Indians occupied the upper part of the terrace surface, which was subject to erosion and the artifacts were washed down from the upper surface of the terrace to rest on the terrace slope. c) The Paleo-Indians occupied a lower terrace surface then left the artifacts behind. The artifacts were then buried by wind deposited sediment. The terrace was cut back, perhaps by stream erosion, and in modern times, affected by plowing, exposing some artifacts.

OBJECTIVES

In order to better understand how Paleo-Indian people occupied the site and how the artifacts came to be located on the slope, geoarchaeological work was done. A more complete stratigraphic description of the site would greatly add to the understanding of how this terrace was formed, how it was used, and how the artifacts came to be on the slope. My objective in doing this project is to be able to answer the question of how the artifacts came to be on the slope. To reach my objective I established a more complete picture of the terrace formation through the stratigraphy, geomorphology and soil analysis.

Figure 4. Coring at core location D, one meter down-slope

METHODS

In July and November 2000 the Gail Stone Site was visited three times to recover four core samples A-D. At each location the core extended about 4.5 meters below the surface and I cored two holes spaced about 10cm apart. To do the coring I used a hand driven JMC Environmentalist's Sub-Soil Probe (Figure 4). Each core section was about 90cm in length and was numbered successively from 1 to 10 at each location. Core-A and Core-B were on the top of the terrace about 30m apart. Core-C was 30m from Core-B and is just above the slope of the terrace. Core-D was taken in the month of November and was taken in the same manner as the first three. This core was 60m south of Core-C or about half way down the slope of the terrace. Core-D is also 10m west of the other three cores. Core-D is from the area where the artifacts were found. The cores were roughly in a north-south transect across the terrace (Figure 3).

One core from each location was used for color and particle size analysis; the other set was reserved for future laboratory analysis as further questions develop. All four cores were split open and colors and horizon depths were taken (Figure 5). All analysis was done under a fluorescent light. The soil was moist and color descriptions are based on the standard Munsell soil color book.

The soil was sampled in 10cm increments and then oven dried at 105 degrees for 24 hours. The particle size analysis was then done using a modified Day method

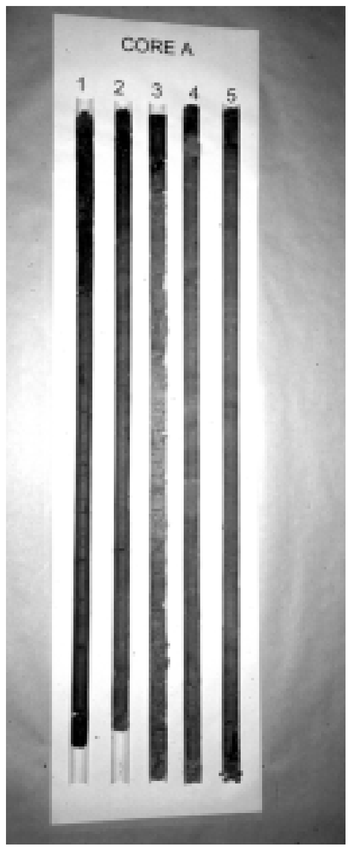


Figure 5. Core-A, segments 1-5

(Gee & Bauder, 1979). Particle size analysis was done on cores A, C, and D. Since Core-B's color/stratigtraphy pattern was the same as C it was assumed to be the same. However, sections 180-240cm and 380-451cm of Core-B were analyzed to see if a sand peak occurred.

Because a sand peak appeared in cores A-C at about 210-220cm and for Core-D at 110 cm, the sediment sample that was left over from the particle size analysis was rinsed through a 230-mesh sieve to retain only the sand. Since there seemed to be a coating of clay on the grains, the sand particles were soaked overnight in sodium hexametaphosphate to disperse the clay. They were then rinsed through the 230-mesh sieve again. This was done so the sand grains could be examined to see whether they were eolian or alluvial in origin.

When examining the sand grains an item was found which was, fossil ostracod shells, which are aquatic crustacean microfauna. Because of this, more samples were looked at above and below this original sand peak layer. Cores B and C lacked any ostracod shells. Core-A lacked ostracod shells above the 210cm depth, but contained shells from this depth to the bottom of the core. Core-D had ostracod shells only from 110-165cm. Samples of the ostracods were sent to Dr. Alison Smith at Kent State University for identification. The samples that were sent were as follows, 2 from core segment A-3 (210-220cm), 1 from core segment A-3 (240-250cm), 2 from core segment A-4 (270-280cm) and 1 from core segment A-4 (310-320cm).

RESULTS

Color patterns can be seen in the cores. Both cores B and C are almost the same color pattern, while A has similarities to them (Tables 1-4). For all four cores, the sandy peak corresponds with the color 2.5Y 6/6 (olive yellow). For the cores A-C the colors go from the 10YR to more 2.5Y hues at about 1.5 meters down. In Core-D this occurs about one meter down. All of the cores have a 2.5Y 5/4, in the lower part of the core, except for Core-A. The lower part of Core-B extends from 370cm. The lower part of Core-C extends from 280cm. Both lower parts for Core B and C are inter-banded with other soil colors. The 2.5Y 5/4 for Core-D extends from 90cm to 370cm. There is a large band of a different color in Core-D at 170-220cm that is 10 YR 4/6.

The particle size analysis showed that the terrace is made up primarily of silt. The top 200-cm (or 100cm for Core-D) is, for the most part, clay loam/ silty loam. A sand peak shows up at 200-220 cm for Core-A, 220-230cm for Core-B and Core-C, and 100-120cm for Core-D. (Figures 6-9) Below this sand peak the texture for all the cores is primarily silty loam. However, there is a change in the clay that is especially evident in Core-D and somewhat in Core-A. For Core-D the clay percentage decreases from 180cm to 310cm. Within this bracket, the percentage of clay goes from 30 percent to about 10 percent. For Core-A, there is also a trend that starts at 270 cm where the percentage of clay is 25 percent and decreases to 10 percent at 420 cm. In Core D sandier layers occur again at 360 cm, but this is below the terrace base and is not important to how the terrace was formed. Sand grain samples were examined between 210-220cm from Core-A, 220-230cm from both Core B and C, and 110-120cm from Core-D (Figure 10). These samples had the highest percentage of sand according to the particle size analysis. The quartz sand grains are representative of fine sand. The grains are fairly rounded and are matte in finish. Other mineral grains that were presents in the samples were mica flakes and possibly feldspar.

Table 1. Horizon depth, color and texture of Core-A

Depth/Boundaries	Color & Misc	Texture
0-26cm	10YR 3/2	Silt loam
26-51cm	10YR 4/4	Silty clay loam/clay loam
51-83cm	10YR4/6	Clay loam/silty clay loam
83-89cm*	10YR 3/2	Silty clay loam
89-91cm*	10YR 4/4	Silty clay loam
91-145cm	2.5Y 5/3-mottled-5% w/ 10YR 4/3, 10YR 5/4	Silty clay loam/ clay loam
145-157cm	2.5Y 5/4 @155cm-streaks of 10YR 2/2	Silt loam
157-164cm	2.5Y6/6 @157cm-1mm pebble	Silt loam
164-174cm*	10YR 3/2 & 10YR 5/4	Silt loam/silty clay loam
174-176cm*	10YR 5/4	Silty clay loam
176-178cm*	10YR 3/2	Silty clay loam
178-194cm	2.5Y 5/4-mottled-3% w/ 2.5Y 6/3	Silt loam
194-254cm	2.5Y 6/6 @199, 241, 245cm-2.5y 6/3 @ 203, 206cm-2.5Y 5/4	Silt loam/loam+
254-269cm*	10YR 4/4 w/ 10YR 3/2	Silt loam/silty clay loam
269-345cm	2.5Y 6/6 @291, 299cm-2.5Y 6/3	Silty clay loam/silt loam
345-347cm*	10YR 4/3	Silt loam
347-351cm	2.5Y 5/4 @348cm-10YR 3/2	Silt loam
351-407cm	2.5Y 6/6 @382, 393cm-2.5Y 6/3	Silt loam
407-415cm	2.5Y 6/4	Silt loam
415-432cm	2.5Y6/6-mottled-6% w/ 2.5Y 6/3, 10YR 3/6	Loam/silt loam

*This is possible contamination from the coring process in that the topsoil can fall into the coring hole.
+The loam texture is defined from 210-220 cm.

Table 2. Horizon depth and color for Core-B

Depth/Boundaries	Color & Misc.
0-10cm	10YR 4/2 (drier)
10-25cm	10YR 3/2 2
5-35cm	10YR 3/2 w/ 10YR 4/4
35-43cm	10YR 4/4 w/ 10YR 3/2
43-92cm	10YR 4/4
92-101cm*	10YR 3/2
101-121cm	10YR 4/4
121-141cm	10YR 4/4-mottled-5% w/ 2.5Y 5/3
141-176cm	2.5Y 5/4-mottled- w/ 10YR 2/2 2.5Y 5/3
176-179cm*	10YR 4/4 w/diagonal stripe of 10YR 3/2
179-186cm*	10YR 4/3 186-190cm 2.5Y 5/4
190-191cm*	10YR 3/2 191-196cm 2.5Y 5/4
196-197cm*	10YR 3/2 197-202cm 2.5Y5/4
202-212cm	2.5Y 6/6-mottled-3% w/ 10YR 3/3
212-267cm	2.5Y 6/6 @ 263cm 2.5Y 6/2
267-276cm*	10YR 4/3 cm
276-277cm*	10YR 3/2
277-280cm	2.5Y 5/4
280-281cm*	10YR 3/2
281-357cm	2.5Y 6/6 @ 291, 294, 301cm 10YR 3/3
357-374cm*	10YR 4/3 374-375cm* 10YR 3/2
375-394cm	2.5Y 5/4-mottled-2% w/ 10YR 3/3
394-453cm	2.5Y 5/4-mottled-5% w/ 2.5Y 6/2 10YR 4/6

*This is possible contamination from the coring process in that the topsoil can fall into the coring hole.

Table 3. Horizon depth, color and texture for Core-C

Depth/Boundaries	Color & Misc	Texture
0-18cm	10YR 3/2	Loam
18-32cm	10YR 3/2-mottled-2% w/ 10YR 4/3	Loam/silt loam
32-36cm	10YR 4/3 w/bioturbation trail-1.5cm long-10YR 3/2	Silt loam/loam
36-52cm	10YR 4/3	Loam
52-87cm	10YR 4/4-mottled-1% w/ 10YR 2/2	Clay loam
87-89cm	10YR 4/3 Clay loam 89-97cm* 10YR 3/2	Loam
97-137cm	10YR 4/4-mottled-5% w/ 2.5Y 6/3 2.5Y 5/3	Loam/clay loam
137-178cm	2.5Y 5/4-mottled-5% w/ 2.5Y 6/2 10YR 2/2	Silty clay loam
178-193cm*	10YR 4/3 @181-2cm irregular spot of 10YR 3/2	Clay loam/silty clay loam
193-196cm*	10YR 3/2	No data
196-199cm	2.5Y 5/3 w/ 10YR 2/2 No data	
199-220cm	2.5Y 5/4-mottled-7% w/ 10YR 2/2 2.5Y 5/3	Silty clay loam/silt loam
220-268cm	2.5Y 6/6-mottled-&% w/ 2.5Y6/3	Sandy loam+/silt loam
268-277cm*	10YR 4/3	Silt loam
277-282cm	2.5Y 5/4 @281cm 10YR 3/2	Silt loam
282-297cm	2.5Y 5/4	Clay loam/silt loam
297-302cm	2.5Y 6/3	Silt loam
302-316cm	2.5Y 5/4-mottled-3% w/ 2.5Y 6/3 10YR 5/6	Silt loam
316-321cm	2.5Y 5/3	Silt loam
321-346cm	2.5Y 5/4	Silt loam
346-357cm	2.5Y 5/4-mottled-7% w/ 10YR 5/6, 2.5Y 6/3	Silt loam
357-368cm*	10YR 4/3 @ 357, 368cm 10YR 3/2 @ 364-5cm 2.5Y 5/3	Silty clay loam
368-395cm	2.5Y 5/4-mottled-5% w/ 10YR 4/4 10YR 2/2 2.5Y 6/3 (damp)	Silt loam
395-413cm	10YR 4/4 striped w/ 2.5Y 6/3 mottled w/ 10YR 2/2(damp)	Silt loam
413-435cm	2.5Y 6/3-mottled-5% w/ 10YR 4/4 (wet)	Silt loam
435-441cm	7.5YR 3/4 w/ 10YR 2/2 2.5Y 6/3 10YR 5/4 (wet)	Silt loam
441-445cm	10YR 4/3 (wet)	Silt loam/loam
445-447cm	10YR 4/4 (wet)	Silt loam/loam

*This is possible contamination from the coring process in that the topsoil can fall into the coring hole.
+The sandy loam texture is defined from 220-230cm.

Table 4. Horizon depth, color and texture for Core-D

Depth/boundaries	Color	Texture
0-21cm	10YR 3/2	Silt loam
21-78cm	10YR 4/4	Silt loam/clay loam
78-84cm	10YR 4/3	Clay loam
84-91cm	10YR 4/4	Clay loam
91-92cm*	10YR 3/2	Silt loam
92-101cm	2.5Y 5/4	Silt loam
101-108cm	2.5Y 6/6	Sandy loam
108-172cm	2.5Y 5/4	Silt loam
172-176cm*	10YR 4/4	Silty clay loam
176-222cm	10YR 4/6	Silty clay loam
222-255cm	.5Y 5/4 -gradual and slight color change from 176-222cm section	Silt loam/loam
255-259cm*	10YR 4/3	Loam/silt loam
259-300cm	2.5Y 5/4-mottled-2% w/ 10YR 4/6 10YR 3/2	Silt loam
300-340cm	2.5Y 5/4-mottled-5% w/ 10YR 4/6 10YR 3/2	Silt loam
340-342cm	10YR 4/6 & 10YR 3/4	Silt loam
342-366cm	2.5Y 5/4 @ 342, 350cm 10YR 3/2 @ 356, 359cm 10YR 2/2 @ 356-7cm 10YR 5/6	Silt loam/loam
366-375cm	2.5Y 6/6 @374cm 10YR 6/8	Loam/sandy loam
375-386cm	10YR 5/4	Sandy loam
386-399cm	2.5Y 5/4	Sandy loam/loam
399-406cm	2.5Y 5/3	Silt loam
406-424cm	10YR 5/4 @ 408cm 1 0YR 3/6 & 10YR 2/2	Silt loam/ sandy loam
424-426cm	7.5YR 3/4	Sandy loam
426-429cm	10YR 5/8	Sandy loam

^This core is about one meter down slope from the first three cores.
*This is possible contamination from the coring process in that the topsoil can fall into the coring hole.

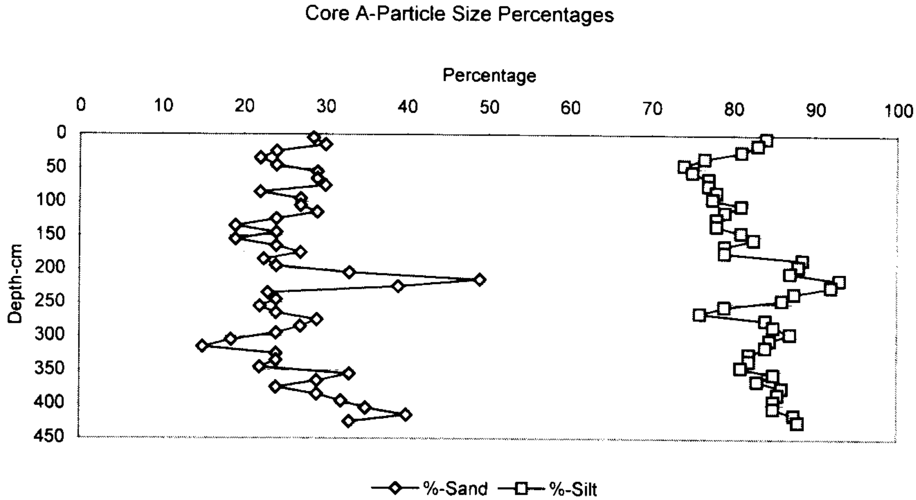
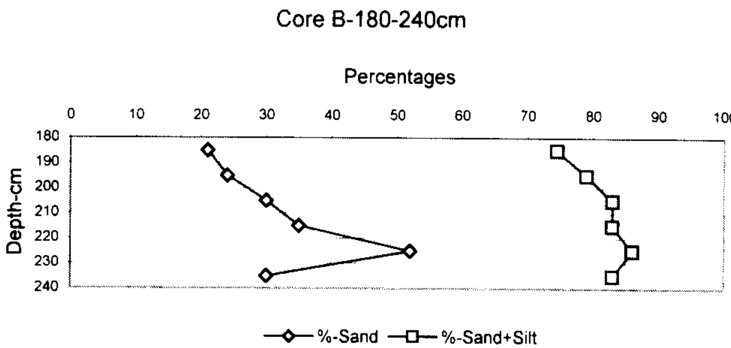


Figure 6. Particle size data for Core-A



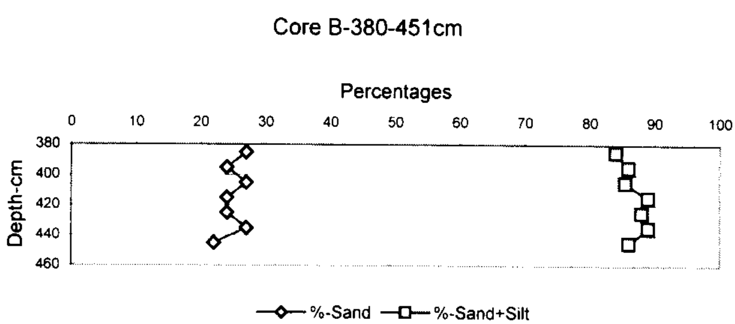
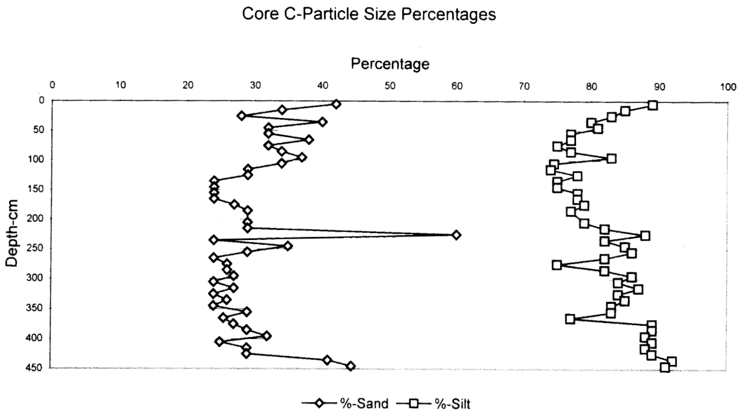


Figure 7. Particle size data for sections of Core-B



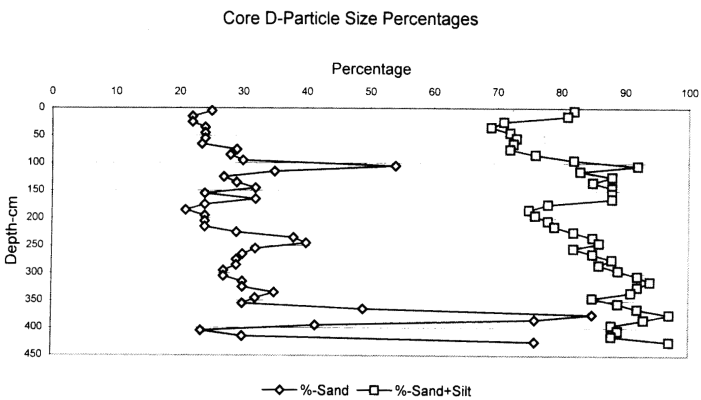


Figure 8. Particle Size Data for Core-C

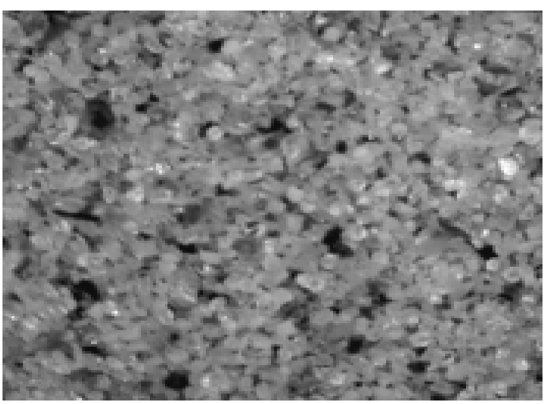


Figure 9. Particle Size Data for Core-D

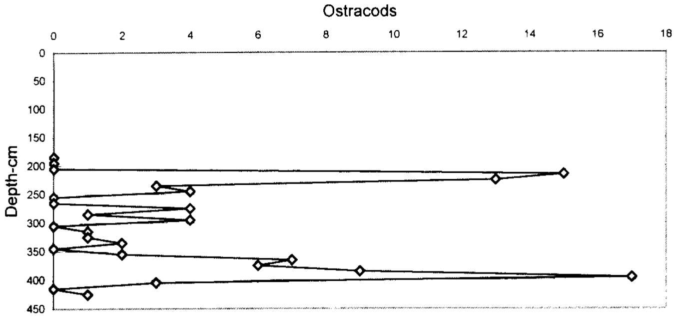


Figure 10. Sand grains from Core segment, A-3 210-220cm

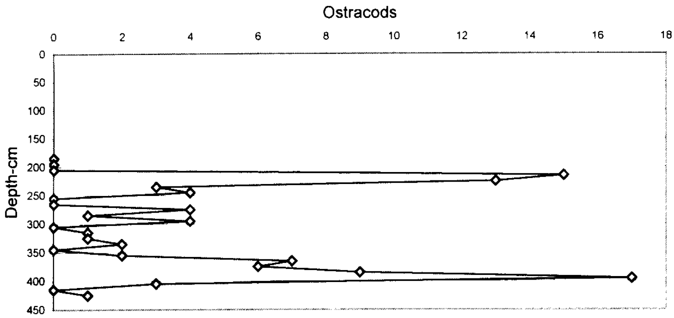


Figure 11. Count of ostracod shells in Core-A

In Cores A and D, the maximum number of ostracod shells found correspond with the sand peak (Figures 11 & 12). In Core-D, ostracod shells are not found below the 165cm, while in Core-A they appear all the way to the bottom of the core. Where the ostracodes stop appearing in Core-D is about where the clay percentage is 25 percent, which is 170cm. There is not such a clear relationship for Core-A. The ostracodes that were sent to Dr. A. Smith were identified as *Candona candida* and a juvenile *Candona* species in core segment A-3 (210-220cm). In core segment A-3 (240-250cm) an adult *Candona* fragment and in core segment A-4 (270-280cm) she identified another adult *Candona*

Figure 13. Ostracod shell fragments from core segment A-5 380-390cm on a 1mm scale

fragment and a *Candona ohioensis*. For core segment A-4 (310-320cm) there was *Limnocythere verrucosa* (Figure 13). All of these occur in shallow permanent freshwater sources like a sluggish stream or a shallow pond. She also noticed the ostracod samples from 210-280cm have iron stains, abrasions, and overgrowths or infillings of calcium carbonate. The sample from 310 cm did not show any of these characteristics. These characteristics that she noticed on the shells could also point to what happened to them after the ostracodes died (A. Smith, personal communication 2001).

Figure 12. Count of ostracod shells in Core-D

DISCUSSION

The main objective for this research was to determine the site formation processes at the Gail Stone Site. This, in turn, would help develop an understanding of the artifact distribution. The first step in doing this was to establish the stratigraphy of the terrace by taking cores across the terrace deep enough to get the entire depositional record. A physical description of the cores helps determine the different horizons and one description that is used is color.

The changes in hues and chromas give clues to the horizon change. For this site the top 25cm is the A-horizon based on the darker color but is anthropogenic because it is also the plow zone. In some of the cores there is a lighter horizon right below this one, which is designated by the color, 10YR 4/3 and this could possibly be the E horizon. Particle size analysis was done to gain more information on the patterns and changes that occurred in the cores. They can add information on the type of horizons. In this case there could be a Bt horizon with the 10YR 4/4 color because of the increase of clay that corresponds with it. Below this horizon is the change to the 2.5Y hues and could mark a second B-horizon. Both the color description and particle size analysis were done to determine if there are buried horizons.

According to Birkeland, (1984) a buried soil should be indicated by the finding of a buried B horizon that has high clay content and is redder or browner. They also have a better-developed structure than the C-horizon. This is because paleosol A-horizons are hard to detect. Other criteria that could be looked at is the abruptness of the boundaries and the weathering and etching on the minerals in the soil. Weathering on the sand grains was looked at in this case. According to Rapp and Hill (1998) one should look for calcareous nodules, phytoliths, fossil root traces, past bioturbation, and higher organic matter. The buried horizons will also have yellower hues and lower chromas and there will be less oxidization, evidence of gleying and compaction of the horizon. For this study not all of these characteristics could be determined based on the small diameter size of the cores.

Yellowed hues were seen from one meter in depth to the bottom of the terrace in all four of the cores. This type of hue change usually does correspond with buried horizons. An initial clay increase was seen right below the plowzone and A-horizon and again further down, at about three meters. This suggests that there was a buried horizon at about 2 meters below the terrace surface. The sand peak is the first evidence and it was consistent in all the cores. Since the sand peak occurred with the color 2.5Y 6/6 in all for cores this means that it represents something more than a sporadic event. In this case it is a lag deposit instead of a sand lens, which tend to be more sporadic. The sand grains were examined and the finish and the roundness of the grains were determined. The finish on the grains determines whether they were eolian or alluvial in origin. The roundness helps determine how long the sand grains were eroded and the distance that they could be carried from (Shackley 1975, Stein 1987).

Characteristics that can occur with wind derived samples include the presence of other grains like clay and mica. If there are a lot of these fine-grained items, and the sand grains are quite angular, then the sample is immature. The fewer fine grains there are present and the more rounded the sand grains become the more mature a sample is (Herz & Garrison 1998). However, with fine sands this does not always apply. Fine sands do not encounter as much abrasion when being transported so they will not have much roundness no matter how far they traveled (Stein 1987). At the Gail Stone Site the sand grains have a matte finish, which suggests wind abrasion on the grains. Mica did occur in the samples along with the clay, which suggests an immature sample. The grains are not well rounded either, but this is expected with fine sand.

Another item found when looking at the sand grains was the ostracod shells. This microfauna are often called "seed shrimp" and preserve quite well because of their calcareous shell, which is almost indestructible. There are many species of ostracodes and certain species are very specific to their environment. They can be sensitive to oxygen levels, temperature of the water, the chemistry of the sediment in the lake or pond and to the biotic environment that is around them (Delorme 1991, Pielou 1991). The three species that Dr. Smith identified all overlap in most of their habitat preferences but there are some distinctions. The biggest distinction between them is their habitat percent probability. *L. verrucosa* has a 90% probability to live in a lake, while *C. candida* has a 60% probability to live in a stream and 40% to live in a pond or lake. *C. ohioensis* has a 60% probability to live in a lake and 20% to live in a stream or pond. Other factors like temperature, pH and dissolved oxygen all overlapped with each other (Delorme 1989, 1991). Because of this, the identification of these is quite important and comparable to the extraction of pollen or phyloliths in finding buried horizons and give clues to past environments. Because only a few ostracodes were identified, we cannot be certain of what the environment was like. More importantly, these seed shrimps point to a terrace surface that was lower in elevation than its present state.

CONCLUSION

Evidence seems to confirm the hypothesis that the Paleo-Indians deposited the artifacts on a low terrace surface, which was then buried, with the artifacts presently being eroded out of the terrace slope. There are two main lines of evidence to support this, the increase in sand and the presence of the ostracods. The terrace was built over time and then a change of environment caused a lag deposit of fine sand when the fine silt and clay were blown away during a period of enhanced eolian activity. After this, the terrace was buried under 2 meters of silt blown from nearby uplands. The eolian activity may correspond with the Altithermal that occurred in the mid-Holocene. Evidence of the Altithermal in southwestern Wisconsin and nearby areas has not been entirely conclusive. Davis (1977) argues that there was not a major expansion of a prairie into the Driftless Area. Pine and oak pollen did dominate the area. Both of these would indicate a drier environment. Similar evidence is presented in Baker et al (1992). This area was a mosaic of forests and open woodland and the ecotone between this and the prairie did move eastward, but perhaps not this far. There is evidence; however, that there was a warmer and drier climate that extended to this area during the Altithermal.

A study of Lake Ann by Keen and Shane (1990) in east central Minnesota can be compared to what could have happened here in the Tamarack Valley. At Lake Ann pollen and sediment analysis looked at the eolian activity and the vegetation change in the area. They concluded that during the middle Holocene there was a change in vegetation corresponding to the prairie expansion from the west. Along with this there was increased eolian activity marked by large amounts of silt and fine sand deposited in the lake. While here in Wisconsin the vegetation pattern is not quite the same, there does seem to be evidence of a drier and warmer environment. It is possible that there was a silt influx from the nearby uplands during this drier environment and increased eolian activity. This deposition became so large that it could have altered the route of the creek by pushing it to the sharp turn it takes to the east.

The other line of evidence is the ostracods. The species that were identified live in shallow permanent water as ponds, lakes or sluggish streams. The three types that were identified tend to live in different types of water. This means that there was a permanent source of water at this location for a period of time before it was buried under the 2 meters of silt. The absence of ostracodes above the 2-meter level could correspond with the alteration of the creek from a southern direction to its more eastern path. The ostracod samples from 210-280 cm had abrasions and iron stains on the shells and infillings of calcium carbonate. They were interpreted by Dr. Smith to have been tossed around quite a bit and perhaps from a stream overbank deposit. They also could have obtained some of this wear from being tossed around by the wind. The ostracod shell fragment from 310-320 cm sample did not show this type of wear and Dr. Smith interprets that this shell could have been deposited right in place on the floor of a sluggish stream or some other type of water source. While only a small sample was looked at, this does provide interesting information in that it could further suggest an alternate route for the Tamarack Creek.

There are more questions that arose from this study. The deposition of the 2 meters of silt on top of the buried surface and the possibility of the creek being altered could be attributed to the Mid-Holocene during the Altithermal, but it is only a hypothesis. Another question to be addressed is why the ostracod shells from the upper levels are more abraded than the ones at lower levels. More extensive coring of the region could answer this environmental question with pollen or phylolith, and possibly other analyses. There has been pollen work done in the area by Davis (1970) but it only goes back 5000 B.P., which is after the Altithermal. A complete analysis of the ostracodes among other analysis will also contribute to answering questions about the environment prior to and at the time of the Paleo-Indian occupation.

ACKNOWLEDGEMENTS

This research was supported by an undergraduate research grant from the University of Wisconsin-La Crosse. I would like to thank Dr. Dean Wilder for all of his help with this project. I would have never gotten this far with out all of his insights and technical help. I would also like to thank Robert F. Boszhardt for being a reader and answering my questions on the site. I like to thank Dr. Alison Smith in her analysis of the ostracodes and also Karl Lettner for access to his property to carry out the field work at the Gail Stone Site.

REFERENCES

Amick, D.S., R.F. Boszhardt, K. Hensel, M.G. Hill, T.J. Loebel and D. Wilder. 1999. *Pure Paleo in Western Wisconsin.* Reports Of Investigation No. 350 Mississippi Valley Archaeology Center at the University of Wisconsin-La Crosse.

Baker, R.G., L.J. Maher, C.A. Chumbley and K.L. Van Zant. 1992. Patterns of Holocene Environmental Change in the Midwestern United States. *Quaternary Research.* 37: 379-389.

Birkeland, P.W. 1984. *Soils and Geomorphology*. Oxford University Press, New York.

Boszhardt, Robert F. 1991. The Paleo-Indian Study Unit in Region 6, Western Wisconsin. *The Wisconsin Archeologist* 72:155-200.

Boszhardt, R.F., J.L. Theler, D.G.Wilder. 1993. *Megafauna of Western Wisconsin.* Reports of Investigation No. 161, Mississippi Valley Archaeology Center at the University of Wisconsin-La Crosse.

Davis, Anthony M. 1977. The Prairie-Deciduous Forest Ecotone in the Upper Middle West. *Annals of the Association of American Geographers* 67: 204-213.

Delorme, L. Denis. 1989. Methods in Quaternary Ecology #7. Freshwater Ostracodes. *Geoscience Canada* 16:85-90.

Delorme, L. Denis. 1989. Chapter 19: Ostracoda. In: *Ecology and Classification of North American Freshwater Invertebrates.* Academic Press, New York.

Gee, G.W. and J.W. Bauder. 1979. Particle Size by Hydrometer: A Simplified Method for Routine Textural Analysis and a Sensitivity Test of Measurement Parameters. *Soil Science Society of American Journal* 43: 1004-1007.

Herz, N and E.G. Garrison. 1998. *Geological Methods for Archaeology*. Oxford University Press, New York.

Jennings, Jesse D. 1983. *Ancient North Americans.* W.H. Freeman and Company, New York.

Keen, K.L. and L.C.K. Shane. 1990. A Continuous Record of Holocene Eolian Activity and Vegetation Change at Lake Ann, East-central Minnesota. *Geological Society of America Bulletin* 102:1646-1657.

Mason, Ronald J. 1997. Chapter 5: The Paleo-Indian Tradition. In: Birmingham, Robert A., Carol I. Mason and James B. Stoltman. (eds.). *The Wisconsin Archeologist* 78:78-110.

Pielou, P.C. 1991. *After the Ice Age.* The University of Chicago Press, Chicago.

Rapp, G. Jr. and C.L. Hill. 1998. *Geoarchaeology.* Yale University Press, New Haven, CT.

Shackley, Myra L. 1975. *Archaeological Sediments: A Survey of Analytical Methods.* John Wiley & Sons, Inc., New York.

Stein, Julie K. 1986. Chapter 6: Deposits for Archaeologists. *Advances in Archaeological Method and Theory 11: 337-395.*

Wright, Jr., H.E. 1983. *Quaternary Environments of the United States: The Holocene.* University of Minnesota Press, Minneapolis.