

# INVESTIGATION OF HISTORICAL AGRARIAN LAND USE WITHIN A TEMPERATE NORTHERN HARDWOOD FOREST

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## ABSTRACT

Historical agrarian land use potentially caused notable long term effects to woodlots. Field investigation was conducted to observe evidence of historic livestock grazing and other agricultural practices at the E.S. George Reserve within an 18 ha temperate northern hardwood forest plot locally known as Big Woods Field. Investigators utilized metal detectors and visual observation to find historic barbed wire fencing and other artifacts such as an early 20<sup>th</sup> century shotgun shell. One observable barbed wire fence line was mapped out and georeferenced with an existing data set identifying all woody species within the Big Woods plot greater than 10 cm girth at breast height (GBH). Statistical comparisons were made to determine any difference in forest community species composition and GBH inside and outside of the fence line. The georeferenced fence line was overlain on historic plat maps of the area in an effort to correlate the fence location with any historic property boundaries.

## INTRODUCTION

Disturbances affect the formation of landforms and the function of ecosystems. The greatest transformative disturbance of southeast Michigan in recent geologic history was the Wisconsinan Glaciation, which receded some 10,000 years ago (Barnes et al., 1998). As the glaciers receded, melt waters cut river valleys, wind and animals dispersed seeds helping the forest expand, and lightning sparked fires which have leveled sections of forest and rejuvenated others. Since glacial times, however, no natural force has shaped the landscape of southeast Michigan more than humankind. In order to understand current landforms and ecosystem community characteristics, knowledge of human activities within an area is as important as knowing the glacial history.

The E.S. George Reserve (ESGR), located in southwest Michigan, encompasses moraine and basin landforms on the edge of an interlobate moraine (Scheuller et al., 2008) and includes forest, wetland, and old field ecosystems. While it may be assumed that Native Americans historically used this area, no definitive evidence exists of Native American influence, and such disturbance is not within the purview of this paper considering more recent agrarian history. Prior to the purchase of the ESGR by Colonel Edwin S. George in 1927, the land encompassed approximately twelve farms. Agricultural practices included production of row crops, orchards, and raising livestock. Most agricultural practices declined since around 1900. No significant logging occurred in the wood lots, though they were used for pasture and firewood (Scheuller et

al. 2008). Dominant livestock was presumably sheep, though other livestock may have been reared. What was the effect of livestock browsing on today's forest? One might postulate that historically browsed areas would have evidence of growth suppression, resulting in smaller (i.e. younger) individuals and/or fewer species.

With very limited knowledge of the extent of agriculture practices within forested portions of the ESGR, only existing physical evidence and historic aerial photography can provide direction for where to search. The Big Woods plot within the ESGR is a heavily researched woodlot, including a mapped inventory of every living woody plant with 10 cm or greater girth at breast height (1.37 m), tagged with a circular aluminum numbered disc, and plotted onto a grid system. Historic aerial photography review identified some patchy canopy cover within Big Woods, and subsequent field investigation resulted in the discovery of degraded barbed wire providing physical evidence of historic agrarian land use. Through broader field investigation utilizing metal detectors to find old barbed wire fencing, attempts were made to map historic barbed wire enclosures and extrapolate effects on current forest plant community composition.

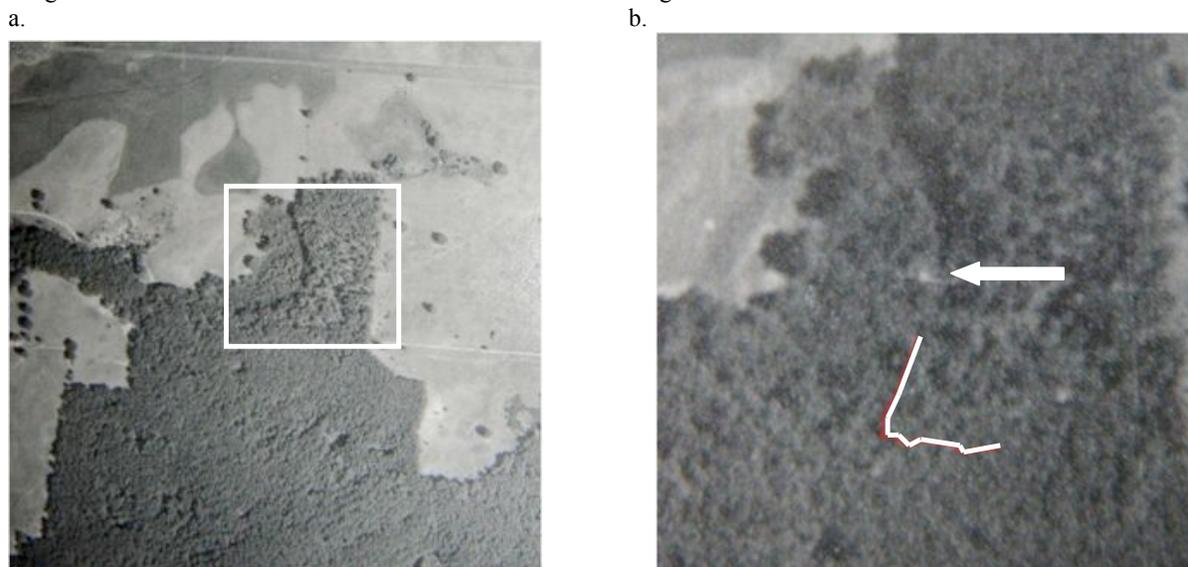
#### METHODS AND RESULTS

The study was conducted at the E.S. George Reserve, a 464 ha tract of forests, wetlands, and old fields, located within Livingston County, MI. This study area was located within an 18-hectare oak-hickory plot locally referred to as Big Woods (Figure 1).

Figure 1. 18 ha. Big Woods plot with individual hectares labeled with letters ranging from A to R. Each hectare represents a 100 meter by 100 meter plot. Hectares were outline and labeled from previous research at the ESGR. The vertical lines within this plot are generally oriented from the northwest to the southeast.

R	N	F	G	
Q	M	E	H	
P	A	D	I	L
O	B	C	J	K

Figure 2. 1940 aerial photographs (not to scale). a. depicts the initial area of investigation and the patchy tree cover. The northwest corner is a wooded swamp. b. the arrow indicates a white spot, an area of interest; the white line is the georeferenced barbed wire fence line determined from tree tag numbers.



In 2007, Professor John Vandermeer of the University of Michigan, Department of Ecology and Evolutionary Biology (EEB), observed a patchy tree cover pattern within the northwest corner of the Big Woods plot, encompassed within plot G (Fig. 2.a.). Upon field investigation, Vandermeer discovered several lengths of rusted, weathered barbed wire within plot G (Vandermeer, personal communication). In 2008, upon inspection of a separate 1940 aerial, a white spot within the vicinity of the patchy tree pattern provided an area of interest to be investigated (Fig. 2.b. arrow). On October 4, 2008, four groups of investigators searched for additional barbed wire and other signs of historic land use.

Group 1 searched within plot G at known locations of barbed wire, proceeding to carry out a systematic survey of plot G with a White's Prizm III metal detector. Investigators in Group 1 realized that the metal detector required setting adjustment to the highest sensitivity in order to detect the degraded barbed wire. The metal detector was maneuvered side to side just above the ground, and an approximate 8 inch hole was dug wherever a clear signal emerged. When barbed wire was found, the wire was flagged with orange flagging tape, and the distance and azimuth (utilizing a compass) to the nearest tagged oak (*Quercus*) was recorded. Tag numbers from identified oak trees were recorded to document the location of any potential historical findings. The barbed wire location measurements were later plotted with respect to the tree grid, and the fence line was georeferenced to the Big Woods plot and overlain on the 1940 aerial photograph (Fig. 2.b. white line). Two types of barbed wire were found: one was a traditional barbed wire with two twisted wires and intermittent 4-pointed barbs (Fig. 3.a.); the second was a twisted iron ribbon approximately 2.5 cm in width with one side sawtoothed (Fig. 3.b.).

Figure 3. Representative pictures of barbed wire found in plot G. a. is traditional barbed wire; b. is known as Allis Sawtooth – small tooth variety (Brauer, personal communication).



Various tree species within the vicinity of the fence line in plot G were compared using the Big Woods inventory data. The “inside” of the fence line was considered to be the area north of the existing road and northeast of the fence line. “Outside” of the fence line was considered to be the remaining area to the south and west. Several species had significant differences in GBH from one side of the fence line to the other (Table 1). Common shared species on both sides of the fence line include: red maple (*Acer rubrum*), serviceberry (*Amelanchier arborea*), pignut hickory (*Carya glabra*), shagbark hickory (*C. ovata*), witch-hazel (*Hamamelis virginiana*), black cherry (*Prunus serotina*), white oak (*Q. alba*), black oak (*Q. velutina*), and sassafras (*Sassafras albidum*).

Table 1. Comparison of Shared Species GBH Inside and Outside of Fence line. T-tests were used to compare significance (p=0.05). Cells highlighted in gray indicate species with significant difference of GBH inside and outside of the fence as well as the total average GBH comparison for all shared species.

	Total	<i>Acer rubrum</i>	<i>Amelanchier arborea</i>	<i>Carya glabra</i>	<i>Carya ovata</i>	<i>Hamamelis virginiana</i>	<i>Prunus serotina</i>	<i>Quercus alba</i>	<i>Quercus velutina</i>	<i>Sassafras albidum</i>
Mean CBH In	43.7	35.1	14.5	98.8	105.8	10	50.3	122.9	91.8	41.1
Mean CBH Out	30.3	17.6	13.3	101.8	127	11.2	27.3	95.5	122.4	27.1
t	5.19	68.594	0.661	-0.218	-0.344	-1.439	3.789	1.835	-2.867	2.24
P	0.000	0.000	0.514	0.829	0.789	0.155	0.000	0.079	0.005	0.024

Group 2 searched plots A, D, F, G, H, I, M, N, P, Q, and R through a meander search method, looking for evidence of historic land use and using a White’s Prizm II metal detector for buried metal. No systematic route was taken through the plots. The metal detector was calibrated to a low sensitivity setting using a U.S. quarter coin. The metal detector was maneuvered side to side just above the ground, and an approximate 8 to 12 inch hole was dug wherever a clear signal emerged. No barbed wire or other metal was found, but a stone (roughly 40 cm in diameter) with apparent tool markings was found in plot D; the nearest tagged oaks were recorded, but the finding was not georeferenced (Fig. 4.). Professor Catherine Badgely of EEB, a paleoecologist, reviewed pictures of the rock, and stated that it was likely not of Native American origin, but rather from European settlers.

Figure 4. Stone with cut groove around center.

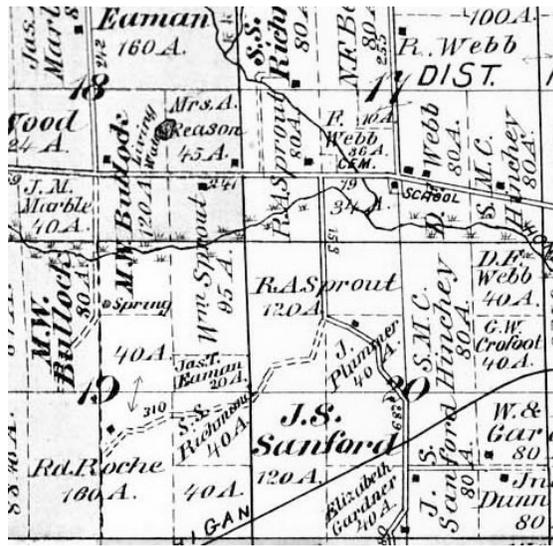


Group 3 searched plot M for a coil of barbed wire described by David Allen, PhD candidate in EEB, and for any other evidence using a White's Prizm III metal detector. The metal detector was calibrated to the highest sensitivity in order to detect the degraded barbed wire. The metal detector was maneuvered just above the ground, and an approximate 8 to 12 inch hole was dug wherever a clear signal emerged. The coil of barbed wire (similar to Fig. 3.a.) was located lying against a tree. The coil was approximately 1 m in diameter and the bundled portion was approximately 30 cm in circumference. The headstamp metal end of a 12 gauge shotgun shell and an unidentifiable piece of rusted metal were also found in the vicinity of the barbed wire coil (both items were removed from the site). Of particular note, the coil of barbed wire was partially buried (assumed to have sunk into the soil over years), and the subterranean portion of the coil had predominantly degraded into rust. Only small portions of the barbed wire could be identified, with the majority disintegrated into the soil. It was observed that the soil in where the barbed wire had formally been was so iron rich (in the form of rust), that the metal detector produced a clear signal. To test this reaction to rust rich soil, handfuls of the rust rich soil was transported meters away to an area that had previously produce no signal. When tested, the transported handfuls of rust rich soil produced clear signals from the metal detector. It is possible (for all groups) that false positives—clear signals without any metal—may not have been false but were rust rich soil from degraded iron.

Group 4 walked to the area corresponding to the white dot on the 1940 aerial photograph (Fig. 2.b). Metal detectors were not utilized; only visual inspection of the area occurred. The plant community was primarily oaks with bigtooth aspens (*Populus grandidentata*), the land sloping westward towards a swamp dominated by red maple (*Acer rubrum*). The area which appeared to correspond with the white spot on the aerial was a small peninsula extending into the swamp, the terminus of a low, gradually sloping ridge. No large trees existed on the peninsula, but no evidence of human disturbance was clearly visible. Walking along the swamp edge to the south, a wire gate was found suspended approximately 1 to 1.5 m off the ground by a black oak (*Q. velutina*) which had grown up in the middle of the gate (apparently laying on the ground when the oak was a sapling). No other evidence of human disturbance was found.

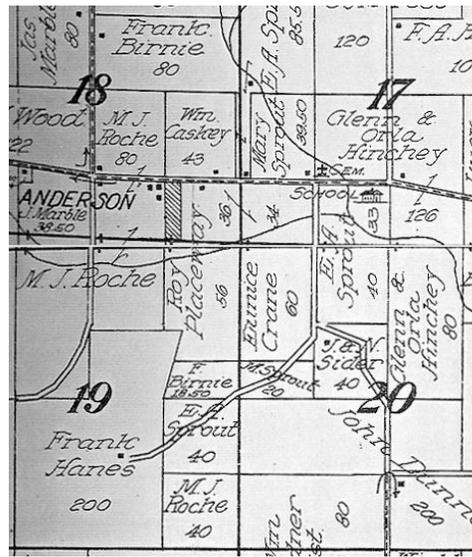
With the knowledge that the ESGR was historically broken into approximately twelve farms, historical plat maps of Putnam Township, Livingston County, MI years 1875 and 1915 were consulted (Fig. 5. and 6.). In an effort to discern if the plotted fence line as identified in the field corresponded to historic property boundaries, the georeferenced Big Woods plot with the fence line was overlain on both plat maps. In both maps, the north-south line of the fence roughly corresponds with a property boundary (Fig. 7. and 8.).

Figure 5. Portion of 1875 Plat Map of Putnam Township, Livingston County, MI. The dot below 19 is Col. George's home (still standing). not to scale



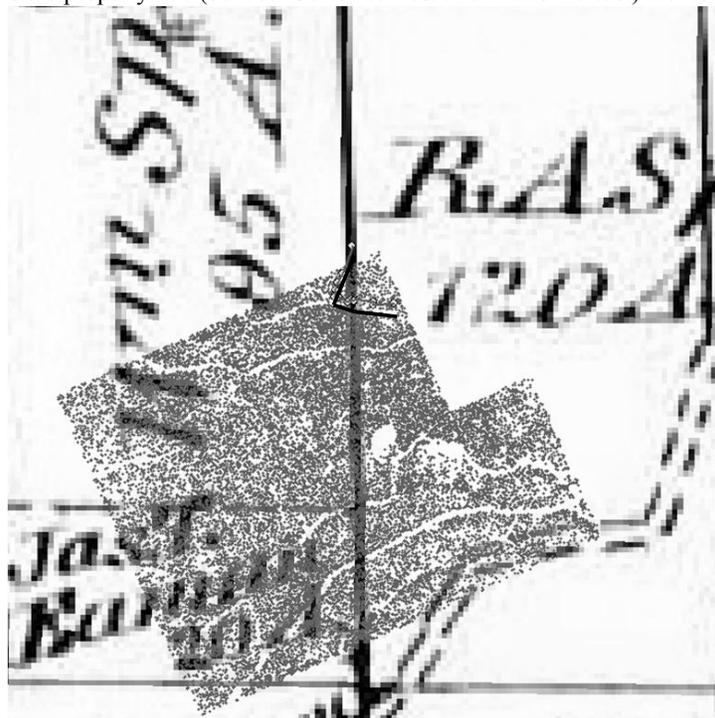
www.memoriallibrary.com

Figure 6. Portion of 1915 Plat Map of Putnam Township, Livingston County, MI. The dot below 19 is Col. George's home (still standing). not to scale



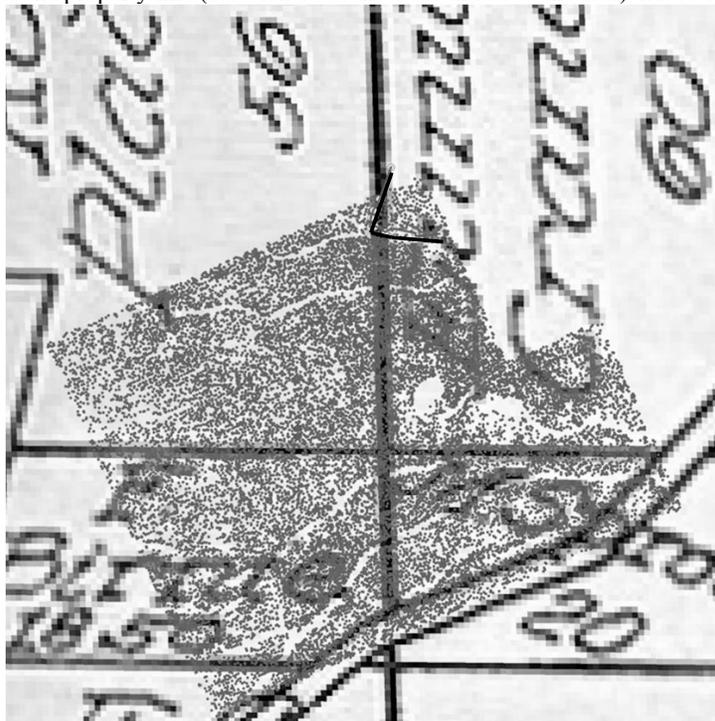
www.memoriallibrary.com

Figure 7. 1875 Plat Map with Big Woods plot with trees and the fence line. The north-south portion of the fence line corresponds to the property line (between 95 to the west and 120 to the east). not to scale



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Figure 8. 1915 Plat Map with Big Woods plot with trees and the fence line. The north-south portion of the fence line corresponds to the property line (between 56 to the west and 60 to the east). not to scale



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## DISCUSSION

The discovery of degraded barbed wire within plot G of Big Woods indicates historic agrarian land use within woodlots at ESGR. As all agricultural practices ceased after the purchase of the reserve by Colonel George, it is reasonable to assume that the barbed wire pre-dates 1927. The condition of the barbed wire itself cannot provide sufficient information about its age or when it was placed, although the wire is significantly degraded and corroded leading one to believe it has weathered the elements for several decades. The sawtooth ribbon barbed wire and the headstamp of the shotgun shell, however, provided some dating information.

The Ellwood House Museum has thoroughly documented the history of barbed wire since barbed wire was first patented by Joseph Glidden of DeKalb, IL in 1874, and the bulk of barbed wire was manufactured in DeKalb through 1938 (Ellwood House Association, 2008). Knowing that barbed wire first patented in 1874, and all agricultural practices ceased in 1927 with the purchase of the reserve, the potential timeframe for the agricultural practices discussed herein spans no more than 53 years. The sawtooth ribbon narrows the timeframe by at least seven years, thanks to the consultation provided by Mr. Gerald L. Brauer, the Director of the Ellwood House Museum. Mr. Brauer identified the sawtooth ribbon wire from a picture, indicating that the wire is likely US Patent 244, 726 (July 26, 1881) by Thomas V. Allis of New York, NY. Barbed wire collectors refer to this type as the small tooth variety of “Allis Sawtooth” (personal communication). This information implies that the fence was either not built until sometime after July 26, 1881, or a section of the fence was repaired with Allis Sawtooth after 1881.

The headstamp of the 12 gauge shotgun shell provides an even narrower timeframe; however, it is critical to note that the headstamp was found in plot M, over 100 m away from the fence. The shotgun shell does not necessarily have any bearing on the fence line, though it should be noted that the shell was found approximately 7.6 m northeast of the previously referenced coil of barbed wire. The headstamp matches a variety of shotgun shell, Western Field, formerly produced by the Western Cartridge Company (Fig. 9). According to Mr. Curtis Steinhauer, a shotgun ammunition aficionado, the Western Cartridge Company only distributed ammunition from 1898 through 1932. In 1932, Western Cartridge Company acquired Winchester Repeating Arms Company and discontinued the Western Field line and other Western Cartridge Company brand names (Steinhauer, 2008). The shotgun shell indicates discharge of a 12 gauge shotgun as recently as 1898 within the area.

Figure 9. Western Field 12 Gauge Shotgun Shells box. Pictures show the top, bottom, and side of the ammunition box. The headstamp of the shell found in the field matches the headstamp on the side panel of the box. Headstamps varied with each variety of shell (Steinhauer, 2008).



[http://www.antiquemystique.com/pages/7065\\_jpg.htm](http://www.antiquemystique.com/pages/7065_jpg.htm)

In regards to the forest community of Big Woods plot G, significant differences do exist between the average GBH and species inside and outside of the fence line. For the purpose of this paper, it is assumed that livestock grazing occurred within this area until the reserve was purchased in 1927, allowing for 76 years without grazing conditions (GBH was measured in 2003). Only one species was found exclusively inside the fence: sugar maple (*Acer saccharum*). The following species were found exclusively outside the fence: American beech (*Fagus grandifolia*), American elm (*Ulmus americanus*), choke cherry (*Prunus virginiana*), flowering dogwood (*Cornus florida*), hop-hornbeam (*Ostrya virginiana*), and yellow birch (*Betula alleghaniensis*). Although live-stock browsing may have had influence on the additional species found inside and outside, the shared species also represent the dominant species on either side of the fence. One could postulate that fewer exclusive species were found within the fence because of grazing pressure preventing establishment. The comparison of GBH between the inside and the outside of the fence presents an interesting pattern, however.

The investigators assumed that “inside” the fence would have been an enclosure for the grazing animals and that this area would have smaller tree individuals and fewer species from grazing pressures. This grazing pressure would be expected to result in the average GBH of the trees within the enclosure to be smaller than those trees “outside.” Reviewing the shared species data with significant differences in GBH inside and outside of the fence (Table 1), the trend appears to be reversed with the exception of *Q. velutina*. *Acer rubrum*, *Prunus serotina*, *Sassafras albidum*, and the total average GBH of all shared species have larger GBH outside of the fence. One may be inclined to reconsider where the livestock grazed—perhaps the fence line was a livestock *exclosure*, not an *enclosure*. One possible explanation of why *Q. velutina* did not follow the same trend is that this species may have been avoided by livestock; the inner bark of *Q. velutina* is known to be very bitter and may not have been palatable considering the other options available (Barnes, 2004). If this species had been avoided by livestock, one would expect the GBH to be much more similar inside and outside of the fence; however, this is not the case. One possible explanation for more exclusive species outside of the fence, in the heavy grazing area, may be that grazing maintained a relatively open understory allowing for more species to colonize the relatively bare understory one livestock were removed. Further investigation is necessary to determine the limits of the fence line and the boundaries of a potential livestock exclosure.

The findings within this paper merely scratch the surface of investigating the extent of historical agrarian land use within the wood lots of the ESGR. Further study should include establishment of a systematic protocol for searching the remaining plots of Big Woods, as well as attempting to find the limits of the fence extending outside of plot G. Additional research into the use and calibration of the Prizm metal detectors is also recommended. Are the detectors truly sensitive enough to positively signal the presence of rust? If so, many findings may have been overlooked during this study. Although physical pieces of fence or other artifacts may not be present, a fence line could potentially be plotted out through flagging signal locations. Somewhat surprising, the University of Michigan has very little information about the agricultural practices and land owners prior to the purchase of the reserve by Colonel George. Interesting results could be gathered if a chain of title of the reserve properties was established. Ancestors of the former owners could be located through a simple internet search or through historical-genealogical projects such as the Livingston County MI History and Genealogy Project (<http://www.livgenmi.com>). Oral history or old written records could provide robust facts about historic land use, or potentially provide concrete direction for future investigations on the effect of historic agrarian land use on the E.S. George Reserve.

#### ACKNOWLEDGEMENTS

Special thanks to Professor John Vandermeer for sharing his personal metal detectors; to David Allen for his observation of the barbed wire coil during his exploits studying *Hamamelis virginiana*; and to Gerald L. Bauer, Director of the Ellwood House Museum for taking the time to correspond with us regarding the Allis Sawtooth barbed wire.

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## APPENDIX A

### Tag Numbers and Coordinates from Big Woods Plot – Individual Hectares ESGR 2008 (Oaks)

#### Stone Artifact (Plot D):

adjacent tag: 7010; Black Oak; x (coord) 147.8; y (coord) 174; 194.1cm GBH

#### Coil of Barbed Wire (Plot M):

adjacent tag: 5279; Black Oak; x (coord) 86.4; y (coord) 217; 112.9cm GBH

#### Headstamp 12 gauge Shotgun Shell; unidentifiable piece of rusted metal (Plot M):

adjacent tag: 5347; Black Oak; x (coord) 88.6; y (coord) 224.3; 140.6cm GBH

APPENDIX B

Transcript of Personal Communication via E-mail with Gerald J. Brauer, Director of the Ellwood House Museum, DeKalb, IL :

Date: Thu, 16 Oct 2008 12:10:00 -0500  
From: ellwoodhouse@tbc.net  
Subject: Re: Barbed Wire dating  
To: pmw@umich.edu

Hi,

The wire appears to be US Patent 244,726 (July 26, 1881) by Thomas V. Allis of New York, NY. This is known to collectors as Allis Sawtooth (small tooth variety).

In regard to the age of your specimen it would be obviously after the patent date, but it is really impossible to say how much later.

Hope this helps,

Jerry

Gerald J. Brauer, Director  
Ellwood House Museum