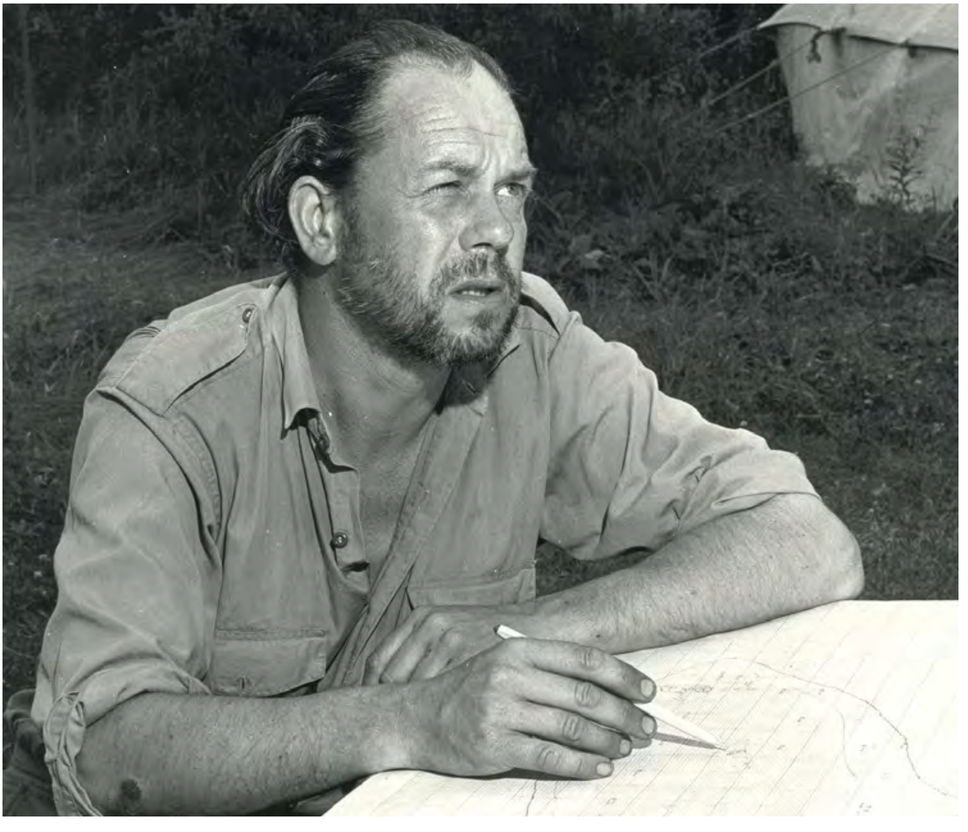
Ontario Archaeology

Journal of The Ontario Archaeological Society



Papers in Boreal Forest Archaeology in Honour of Ken Dawson

Edited by Jill Taylor-Hollings and Matthew Boyd

Number 98, 2018

Cover photo of Kenneth Dawson provided by him to Taylor-Hollings in 2009 for the Department of Anthropology, Lakehead University website (and it is one of his wife Mary's favourites). Photographed while completing mapping during fieldwork, perhaps at the "Big Dig" in Wawa.

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Contemporary Perspectives of the Central Canadian Boreal Forest: Papers in Honour of K.C.A. Dawson

Jill Taylor-Hollings and Matthew Boyd

Introduction

It is our pleasure to present this *Ontario Archaeology* Special Section about the central Canadian Boreal Forest in memory of pioneering archaeologist Major and Professor Kenneth Cephus Arnold Dawson, MA, CD. The idea for this volume evolved after the May 2009 Canadian Archaeological Association (CAA) annual conference in Thunder Bay. Along with William Ross, we had organized a session called *Papers in Honour of K.C.A. Dawson: Northwestern Ontario and the Canadian Boreal Forest.* Fourteen people participated and presented on a variety of topics related to the Subarctic to recognize Dawson's many achievements as well as to highlight the interesting research taking place there. Happily, Dawson was able to attend that session and the conference banquet that day. Unfortunately, he passed away soon after the conference, on July 24, 2009 (Hamilton et al. 2009). As a result, we decided to further recognize Ken for his contributions to Ontario and Canadian archaeology in a printed volume. Several years passed, with many complications ensuing for the editors and authors (as often happens!). However, quite fittingly, we are finally able to share this special section in the same journal in which Ken had so frequently published his work (e.g., Dawson 1966a, 1966b, 1969, 1978, 1980, 1981, 1983a, 1984, 1987, 1999; he also supported the broader society in the newsletter *Arch Notes* [e.g., Dawson 1972, 1982, 1983b, 1983c, 1988]). Clearly, a special section in his memory is long overdue. And given that a large portion of Ontario is comprised of the Boreal Forest ecozone (see Hamilton 2013), this is also an opportunity to provide several valuable new contributions about this part of the province.

The geographical focus of this volume is a natural fit given Professor Dawson's decades-long (ca. 1961–2009) interest in the central Canadian Boreal Forest. Dawson's commitment to completing archaeological fieldwork and research, particularly in northwestern Ontario, is evident in his publication record (see Taylor-Hollings and Boyd in the next paper in this issue). He published frequently and completed a large number of reports to various government institutions and museums. Dawson was always promoting the importance of archaeology to a diverse audience in a wide range of venues. Along with our colleagues, we hope that this special section, in addition to honouring K.C.A. Dawson, will also provide a glimpse of important themes in current archaeological research taking place in the vast Boreal Forest ecozone of Canada.

Papers in the Special Section

While compiling a short biography about Dawson and his impressive bibliography we started finding out so much information about his amazing and interesting life that we wanted to tell his life story in more detail. Accordingly, we offer the "Biography of K.C.A. Dawson: Airman, Academic, Archaeologist, and Adventurer," the next contribution to this issue. One reason for doing this is to acknowledge our archaeological predecessors, in the same way as do the

"Retrospective" sections of the *Canadian Journal of Archaeology* (e.g., Dyck 2009; Kehoe 2010; Kelley 2008) and the many examples in *Ontario Archaeology* recognizing the work of researchers—in "Profiles" and previous special volumes (e.g., Ellis et al. 2013). Dawson was a pioneering archaeologist in the Thunder Bay area, in northwestern Ontario, and the central Canadian Boreal Forest in general. As the late Jane Kelley (2008:186), so aptly stated, "I have a healthy respect for what happened in anthropology and archaeology way before 2002 and feel there is much that we can learn from our own past." Kelley (2008) was making the point that we need to keep learning from past research and earlier archaeologists. In preparation for this volume, we did not know that we would also be honouring another long-time Boreal Forest archaeologist Terry Gibson, who passed away in August, 2018 (see Boyd and Hamilton paper in this guest edited section). His passing represents a great personal loss to us as well as to the discipline (in particular, pioneering work in Canadian geophysics, advancing cultural resource management methods, and creating new business models in archaeology).

The papers in this volume deal with diverse themes that relate to studies that Dawson completed during decades of archaeological research. His work provided one of the first culture history outlines for northwestern Ontario (Dawson 1983d, which is affectionately known by many of us as "Ken's little red book"). In addition, his research focused on a wealth of information about specific sites (see the Bibliography of K.C.A. Dawson included in as the next article in this issue). The breadth of his studies includes some of the earliest research on the Palaeo or Early period (e.g., Dawson 1963) through postcontact timeframes, but he is particularly well known for Woodland period research (e.g., Dawson 1979, 1984).

Some common themes in this special section include the central Canadian Boreal Forest, northwestern Ontario archaeology, and using new methods to address research problems at previously known sites. The paper by Boyd and Hamilton discusses returning to the Martin-Bird site, which was first documented by Dawson (1987) in the 1960s. This site is an unusual one on an island that also contains two burial mounds along with the Macgillivray site (Dawson 1980). Those locations are also part of the larger locality of Whitefish Lake near Thunder Bay in northwestern Ontario, where Dawson documented seven other important archaeological sites that helped him develop an early understanding of the Woodland period in that area and the Lake Superior basin (e.g., Dawson 1978). Returning to the Martin-Bird site and using different and improved techniques of geophysical analysis, excavation methods, and food residue analysis, has made new interpretations possible. Boyd and Hamilton's paper also provides information for other researchers about the rarely used techniques (in Canada) of magnetic gradiometer and ground penetrating radar surveys, as well as how carbonized residue analyses can be used for understanding the larger context of Indigenous subsistence. By following Dawson's initial excavations, Boyd and Hamilton had the opportunity to build on that information while using modern techniques that were not available when the site was first studied.

Langford's article builds on previous research about the Shield Archaic (also known as Middle or Shield period) discussed by Dawson (1983d), Wright (1972, 1995), and others. Most Boreal Forest archaeologists recognize this timeframe to be the least understood, albeit longest, precontact period. Langford discusses early views about the development of the Shield Archaic concept by Wright (1972), while also choosing to examine the intriguing transition of Late Palaeo/Early Shield timeframes. Wright (1972) proposed that the origin of Shield cultures was in the Keewatin District, but Langford argues that southern populations in northwestern Ontario were more likely influenced by and developed through contact with other cultures to the south during that time. This alternative hypothesis is proposed using a review of environmental influences, cultural interactions, and specific artifacts of Late Palaeo and Early Shield populations within the Thunder Bay region during the transitional period from approximately 8800 to 6800 cal (8000–6000 14C) BP.

The article authored by Syms focuses on a recently much debated aspect of radiocarbon dating, namely the recently discovered potential for reservoir effects on Subarctic radiocarbon ages. Given the abundance of fresh water in the Boreal Forest ecozone, this question has important implications for the interpretation of results obtained through this method. This issue is made more challenging because there are often minimal available samples due to site formation processes, limited funding, and the small number of researchers who actually work in the central Canadian Boreal Forest. Thus, every date is of utmost importance. A better understanding of the potential effects on dating results has critical implications for Subarctic archaeology, and Syms' paper is important for research in this area.

Robertson and Saxberg's paper discusses a rare example of one of the largest lithic extraction and processing locales in Canada's Boreal Forest, the Quarry of the Ancestors. Located in northeastern Alberta in the oil sands development zone, this quarry is known for Beaver River Sandstone sourcing and offers a rare opportunity to investigate Indigenous usage of the material. There are hundreds of sites associated with the quarry, which has been the subject of much study to determine how they relate. In their paper, Robertson and Saxberg share insights about heat-treating experiments on Beaver River Sandstone and archaeometric methods that will have wider applications for lithic studies in the Subarctic and other locations.

In conclusion, we would like to thank Bill Ross and all those researchers who participated in the original CAA conference session in honour of K.C.A Dawson. We also acknowledge the various authors who submitted papers to the special section, which will help promote Canadian, and particularly Ontario, Boreal Forest archaeology. Lastly, we thank Chris Ellis and the entire *Ontario Archaeology* editorial team for their patience with us as well as their tireless efforts regarding this special section for Ken.

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Biography of K.C.A. Dawson: Airman, Academic, Archaeologist, and Adventurer

Jill Taylor-Hollings and Matthew Boyd

*This **Ontario Archaeology** includes a special guest edited section in honour of Ken Dawson. Based through much of his career at Lakehead University in Thunder Bay, Ontario, Ken was a major contributor to our knowledge of Boreal Forest archaeology largely through the lens of his work in Northern Ontario. This paper outlines Ken's life and career and enumerates his various contributions including a compiled bibliography of his written works.*

Introduction

In compiling this biography of Kenneth Cephus Arnold (K.C.A.) Dawson, we used many different sources of information. First, it builds on an interview that Taylor-Hollings completed with Dawson in 2009 to write a biography about the Emeritus Professor for the departmental website. Shortly before he passed away that same year, Dawson donated his library to the Department of Anthropology at Lakehead University. It includes journals and books but also his publications, reports, and some personal papers, forming a great source of information. We also read many of his publications and talked with his last wife Mary Jean Robinson and daughter Debra along with other archaeologists who knew him. Along this journey we discovered a considerable amount of information about this very interesting colleague and that he was, as his family described him, an "Airman, Academic, Archaeologist, Adventurer" (Robinson 2009:1). As is too common, we had missed getting to know him while he was alive. Thus, what follows is our effort to honour a veteran, fellow academic archaeologist, and explorer in the pages of one of his favourite academic journals.

K.C.A. Dawson was born on June 2, 1923 in Toronto to a family of farmers who originally came from Ireland in 1820 (Dawson 1996, 1999). Having spent summers on a family farm in southern Ontario instilled in Dawson an impressive work ethic and gave him skills that would later be useful as a field archaeologist, as he explains (Dawson 1999:29):

> Growing up in a sparsely populated area with a strong respect for the [Indigenous] people of the land whose lives were often at variance with those of the expanding urban population, I became a secure, hard-working, independent person who liked to collect relics. On the farm, and the grazing lands in the transitional forest to the north, I acquired an awareness of weather conditions, the nature of the bush, and knowledge of plants, animals, insects, predators and firearms that enabled me to make an easy transition to life in the Boreal Forest.

In 1939, Dawson joined the Toronto Garrison Militia and enlisted in the Irish Regiment of Canada at 15.5 years old; his father later disclosed his age so that he would be discharged from war service, which frustrated him at the time (Dawson 2004). Dawson (1996:1) notes that, "In 1939 the family rescued the precocious youth from enlistment in the Irish Regiment of Canada and placed him in the planning department of a munitions plant." He explains that "I continued in high school and enrolled in technical school courses at night in aero engines and theory of flight acquired a Will[y]s Overland car to communicate between the plant, the schools and home." Thus, early on in life, Dawson was also involved in military service to his country.

Wartime Experiences

Although we realized that Ken was a veteran, he had not discussed this with Taylor-Hollings in 2009, reflecting a modesty that was fairly common amongst World War II veterans. However, in the K.C.A. Dawson Library, we were surprised to locate an amazingly detailed diary that Dawson had put together, later in his life, about his wartime experiences as a young man (Dawson 2004). It is an intriguing, frank, day-to-day account of his training and wartime experiences with nuanced entries from events during World War II that only those who were there could truly comprehend. Dawson's wife Mary Jean Robinson explained that he was limited to tiny journals available to him in order to record his experiences (apparently as a precursor to very organized field notes as an archaeologist). Dawson (2004:1) further explains: "The original amount of detail was restricted as the publisher of the blank daily diaries issued printed a note to advise that by the direction of Paper Control the number of pages had been reduced…" However, he also kept key postcards, photographs, and other information from his wartime service in the 1940s, some of which has been donated to the University of Western Ontario in his honour (Debra Dawson, personal communication 2018; Dawson 2017).

Dawson enlisted in the Royal Canadian Air Force (RCAF) in Toronto during 1942, at just 19 years old (Figure 1), and started taking Initial Flying Training School; however, he was disqualified after testing positive for night blindness, leaving him disgruntled and considering a transfer to the army (Dawson 2004). This event altered his path during the war, since he was posted back to Toronto and then eventually sent to Wireless School in Montreal, and next to Dartmouth, Nova Scotia, in 1943. Shortly thereafter he was sent to the United Kingdom and was able to use those skills (Dawson 2004).

Figure 1. *Young Ken Dawson is pictured here during the early 1940s in Toronto, after he had enlisted in the RCAF (photo courtesy of Debra Dawson).*

Many of the entries from Dawson's (2004) diary discuss his everyday activities: waiting until he is sent to the next location, what he ate or drank with whom, books he was reading, people he knew who became casualties, weather, seeing specific musical shows during off times, what planes and crew were doing, and where he was located. There are some intriguing comments about the roles of various women during this time including the Women's Royal Canadian Naval Service (WRENS), Polish enlisted women, going out with various ladies, and comments about "professionals" he recorded during this time. However, some of the entries describe to the reader, in no uncertain terms, about the danger of his tenure in the RCAF (Dawson 2004:3):

> … arrived in Halifax at 6pm and boarded the ship with full kit. My draft # is 1821, the ship is the MS [Motor Ship] Ile de France T E806, a 42,000 ton vessel. Aboard the ship everything is crowded…. Noted that the lower decks are equipped with water tight doors between compartments which shut automatically in case of an emergency. I am glad I am not bunked there. We get rather hungry on two meals a day…. The ship moves at a high speed but not in a straight line, it is a continuously clear target to German submarines.

Dawson served in Europe during some of the most dangerous and challenging times from 1944 to 1945 and was posted to the 2nd Tactical Air Force, 83 Group, 143 Wing, 439 Squadron that was dominantly Canadian and had been deployed in Alaska to protect the USA against potential Japanese intrusions (Dawson 2004). Dawson (2004:85) explains further about why the Royal Air Force formed the 2nd Tactical in the UK:

> This unit took part in the air operations over Europe which preceded the invasion of the continent and commenced landing on 'D' day of June 1944. It fought in support of the 21 Army Group over France, Belgium, Holland and into the heart of Germany in the Campaign which Liberated Europe.

In February 1944, Dawson was sent to Glasgow and then eventually England, where the German air raids were almost continuous. He details further training and his activities while waiting to be sent to France a few weeks after D-Day on June 6, 1944. One photograph of pilots that he worked with in the UK indicates how many were lost in the first few months when he was there with an X in front of the deceased (Dawson 2004). Half of the men in the photo had been killed and these were only the individuals that Dawson had met before being shipped out to France. Having just turned 21 years old, he arrived on June 27, 1944 to the aftermath of the Normandy landings by Commonwealth forces.

> We arrive off the French coast by 1:10 pm. And see the artificial harbour built by sinking boats well off the shore in front of the beach attack landing area. Battle remains are very evident, shot up boats, trucks, tanks and guns etc. We land on a dirt strip a couple of miles inland about 2:30 pm. then are trucked to our airstrip arriving about 4:30 pm. It is a flat farmers field very near the German lines, we can see the Jerrys [Germans] on other side of line of brush.

Dawson (2004) explains a frightening few months of surviving constant bombings, artillery shelling, planes in dog fights or being shot down, land mines, V1 and V2 rocket raids, and hand to hand combat. He often mentions scrounging for food. Then, Dawson also participated in the liberation of Brussels, Belgium, and Eindoven, the Netherlands, over the next nine months. In March of 1945, he went to Germany and was there during its defeat up until just after VJ Day on August 14, 1945. Dawson returned home to Toronto in September 1945 to figure out the next steps in his life. He was awarded the France and Germany Star, the 1939–45 Star, the Defence Medal, and the Canadian Volunteer Service Medal and Bar (Dawson 2004).

Dawson (2004) describes his life following 1945 as the "aftermath," the war having altered and impacted his life in so many ways. It is also intriguing that in the mid-1950s Dawson reenlisted in the intelligence unit of the Air Force Reserve. Of course, there is almost no information about this timeframe in his diary, possibly due to the classified nature of his work, but he did note: "This was at the time of the Arvo [Avro] Arrow and, when for political reasons it was closed down, so was the airforce unit so I transferred to the Army reserve" (Dawson 2004:83). The Avro Arrow (CF-150) was a Canadian supersonic jet plane with advanced technology for its time but was cancelled by the Diefenbaker government in 1959 due to the high cost, amongst other political reasons (Britnell 2015). Thus, Dawson moved to serve with the famous Lake Superior Scottish Regiment (1961–1968), in what is now Thunder

Bay, and retired as a Major in 1965 (Dawson 2017). He maintained these ties with the military that would become very useful for archeological projects: "It was the period of the 'Cold War' and as a Field Officer, I was called upon to establish a weather fallout centre, a process which introduced me to municipal officers from across the region. This would eventually prove to be useful as many of these people knew local artifact collectors" (Dawson 1999:30).

Additionally, upon reflecting on Ken's various titles—Major and Professor Kenneth Cephus Arnold Dawson CD MA—we learned what *CD* means. It is the Canadian Forces Decoration awarded to officers and non-commissioned members of Canadian Forces with 12 years of service or more and is a prestigious award.

Both farming/rural living and his long-time military service clearly influenced him from early on and caused him to "go back to the land" with archaeology (Dawson 1996, 1999). These factors also provided practical skills for pursuing both large and smaller projects in archaeology such as mapping, working outdoors, interpreting landscapes, organizing people, setting up camps, and adapting to almost any circumstances (Dawson 1999). Those of us who also work in the Boreal Forest appreciate these honed survival skills when dealing with the bush!

Early Archaeological Experience

After World War II, Dawson went back to school for upgrading, which was one of the opportunities for returning veterans. In 1947, he began studies in anthropology at the University of Toronto to complete an undergraduate and Master's degree by 1951 (Dawson 2004). From 1948 until 1960, Ken gained archaeological experience in southern Ontario working with some of the great names in the discipline, including Richard "Scotty" MacNeish, Tom Lee, Kenneth E. Kidd, Norman Emerson, Edmund S. Carpenter (a protégé of William Ritchie), William Taylor, Walter Kenyon, and James V. Wright (Dawson 1996, 1999). The latter two worked with Dawson at the Cummins site, one of the best-known Early period (Palaeo) locations in the Thunder Bay area (Dawson 1983a). He also worked with or for the National Museum of Man, the Royal Ontario Museum, and the University of Toronto.

Moving to the Lakehead

After graduating from the University of Toronto, Dawson (1999:29) worked in finance for over 10 years:

> At the time, archaeology was considered an occupation only to be enjoyed by the establishment, or by esoteric academics who lived in garrets. Being neither, and being married with a family when I attained my MA in 1951, I found that it was necessary to reassess my life. Otherwise, I would have had to continue to earn my keep as a taxi driver who catered to those indulging in the night life of the city. It became apparent that revealing the highly specialized nature of my studies was of no advantage in seeking conventional employment. As a veteran who had taken an array of courses, however, I could stress my familiarity with economics or the study of government. Eventually, fortune smiled on me when I turned to business and for a decade, I enjoyed a successful career in finance, culminating in 1961, when I opened the Industrial Development Bank in Thunder Bay.

In 1961, after working for the Industrial Development Bank of Canada, Ken moved to Port Arthur (now Thunder Bay) to establish a new branch, which would change his life forever, since he resided there for the rest of his life. Dawson (1996:2) explains the future significance of this bank position in his resume: "his role as a Federal Bank Officer and an Officer in the local Regiment had enhanced his position with the business and government agencies at all levels far in excess of the conventional academic sources" (perhaps something for us to learn!). Professor Dawson was indeed adept and innovative at fundraising for archaeological endeavours, eventually obtaining major funding from a wide variety of sources, including the Canada Council, National

Museums of Canada, Indian Affairs and Northern Development, the Ontario Archaeological and Historic Sites Board, the Ontario Heritage Foundation, the Quetico Foundation, and the Arctic Institute (Polar Gas Impact Study).

In 1965, the newly established Lakehead University appointed Dawson as Director of Northern Area Studies as well as Professor of Anthropology in the Department of Psychology and Sociology (Dawson 1999). As the chair, he led the development in 1973 of the Department of Anthropology with the appointment of Professors T. Kreps and M.H. Greenwood. In 1976, Ken achieved a second major initiative by establishing the Lakehead University Native Studies program within that department. Later, that would be expanded to become a separate unit. Since then, many anthropologists and archaeologists have completed studies at Lakehead University.

Dawson served on many committees and organizations within Lakehead University including appointment as Director of the Lakehead University Centre for Regional Development in 1981 and in the Lakehead University Senate. A prevalent theme in his writing is that he was always promoting the archaeology of northwestern Ontario and trying to find out more through meeting and networking with people: "In the 1980s, after the Indiana Jones movies, objectionable as they might have been to archaeologists, I received an abundance of information in the bars from prospectors and the like on possible sites in the north" (Dawson 1999:31). Thus, Dawson realized the importance of working with the public to find out about site leads and also promoting the discipline.

Dawson was a founding member of the Canadian Archaeological Association in 1968, the Society for Historical Archaeological in 1967, and the Canadian Rock Art Research Association (no longer in existence) at about the same time. He and others hosted one of the first annual Canadian Archaeological Association conferences in Thunder Bay during 1975. This event is infamous amongst older archaeologists for having an open bar at the back of sessions (note: we considered replicating this feature at the 2009 conference as a gesture of tradition but modern liability issues nixed that idea!). He sat on numerous committees and boards associated with heritage concerns such as the Ontario Archaeological and Historic Sites Board as well as the Board of Directors of the Thunder Bay Historical Museum Society. Dawson also served on the editorial boards for the journals *Multiculturalism* and *Man in the Northeast*. In addition to his academic activities, he found time to establish Ken Dawson and Associates Subarctic Archaeological Consultants (1978) in the mid-1970s. In the course of his life, Dawson often worked together with Ojibwe and other Indigenous peoples in Ontario and abroad as: "Canoeing the rivers with the Original People of this land, he developed and maintained a profound respect for the people, their knowledge and their culture" (Robinson 2009:1). Dawson was also an expert witness in several cases in support of his wife, who is an Indigenous rights lawyer (Dawson 1996, 1999). He retired from Lakehead University in 1988, becoming an Emeritus Professor.

The "Big Dig" and Others

As soon as Ken arrived in Thunder Bay in the early 1960s, he began completing fieldwork in different locations (Figure 2) as the first resident archaeologist (Dawson 1999). He initiated a seven-year study of the original site of the Northwest Company location of Fort William in 1968. This information would later provide basic data for the reconstruction of Old Fort William, which is now a popular heritage tourism attraction in Thunder Bay. Although there are too many surveys and excavations that Dawson completed to discuss in this venue (see bibliography), particularly significant archaeological investigations include the following sites: McCluskey (Dawson 1974), MacGillivray (Dawson 1980), Martin-Bird (Dawson 1987a), Wabinosh (Dawson 1981), and the Early Period Cummins site (Dawson 1963, 1983a). In addition to these important contributions focusing upon material culture definition, Dawson also undertook some of the first cultural historical syntheses in several regions (Dawson 1975, 1983a, 1987a). Additionally significant for Subarctic

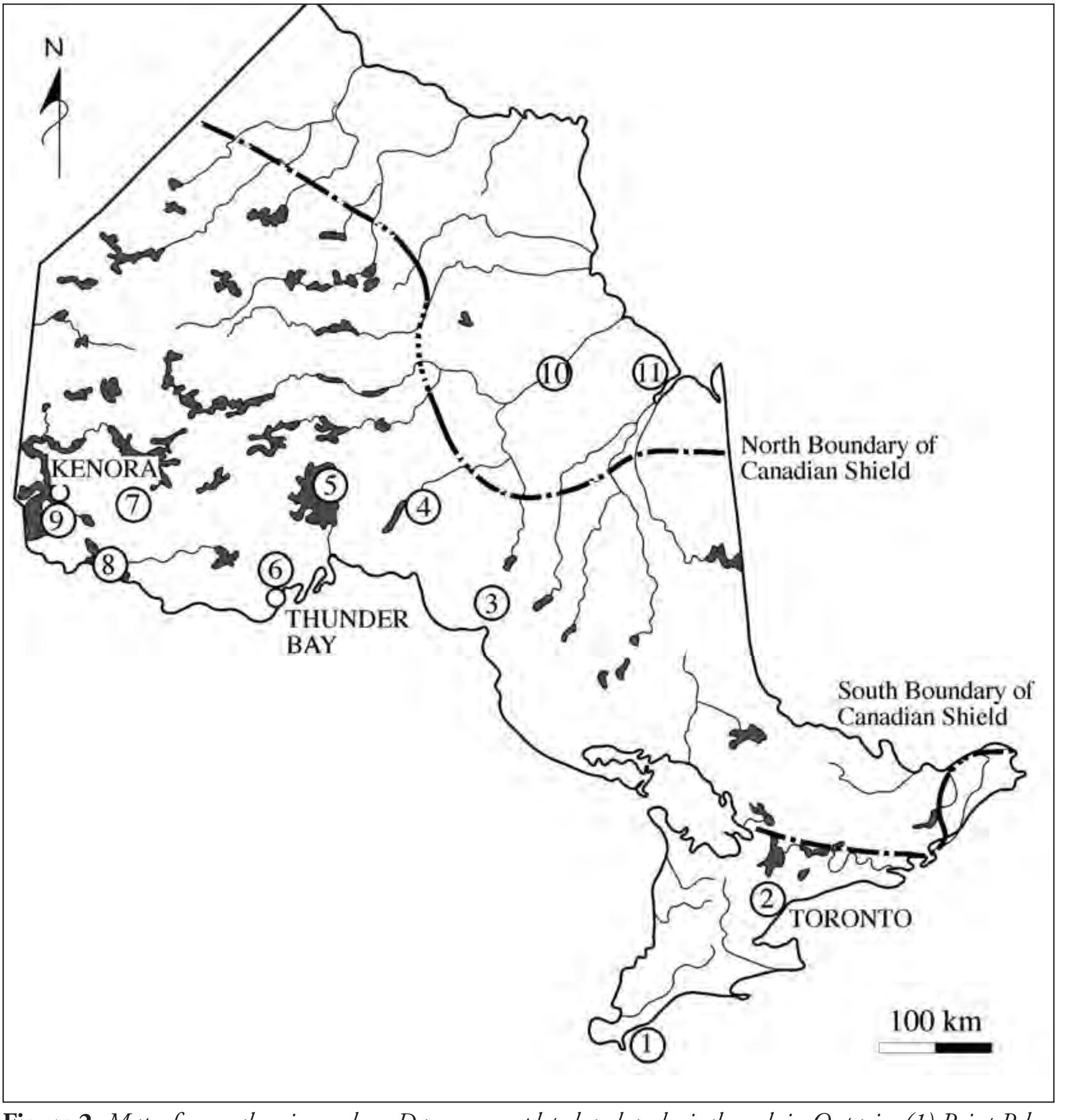

Figure 2. *Map of general regions where Dawson completed archaeological work in Ontario: (1) Point Pelee, (2) Toronto area, (3) Wawa and Michipicoten, (4) Longlac, (5) Lake Nipigon and environs, (6) Thunder Bay, Dog Lake, Whitefish Lake, and Lac des Mille Lacs, (7) Dryden and Wabigoon, (8) Rainy River, (9) Lake of the Woods, (10) the Albany River, and (11) Moose River near James Bay.*

Ontario archaeology were his reconnaissance surveys, beginning in the mid 1960s, in the regions of Lake Nipigon (Dawson 1976a), along the Albany River (Dawson 1976b), Pukaskwa National Park (Dawson 1979), and other locations. He worked at many postcontact sites such as fur trade posts at Longlac and Fort William (Dawson 1969, 1970). Many of his publications continue to be referenced as an integral part of central Canadian Boreal Forest archaeology. His last publications include reminiscent overviews about pioneering Boreal Forest archaeologists (Dawson 1997, 1999) and a 2004 book that reviews interactions between Indigenous and Euro-Canadian populations during the nineteenth century in northwestern Ontario.

Dawson also directed some of the largest archaeological research projects in the central Canadian Boreal Forest. During the summer of 1971, he began working in the lower Michipicoten River valley (Figure 2) on the largest set of excavations in the history of Ontario archaeology at that time (Dawson 1972). It was known as the Wawa Drop-In Project or the "Big Dig," where young hitchhikers would stop when travelling along Highway 17 in central Ontario,

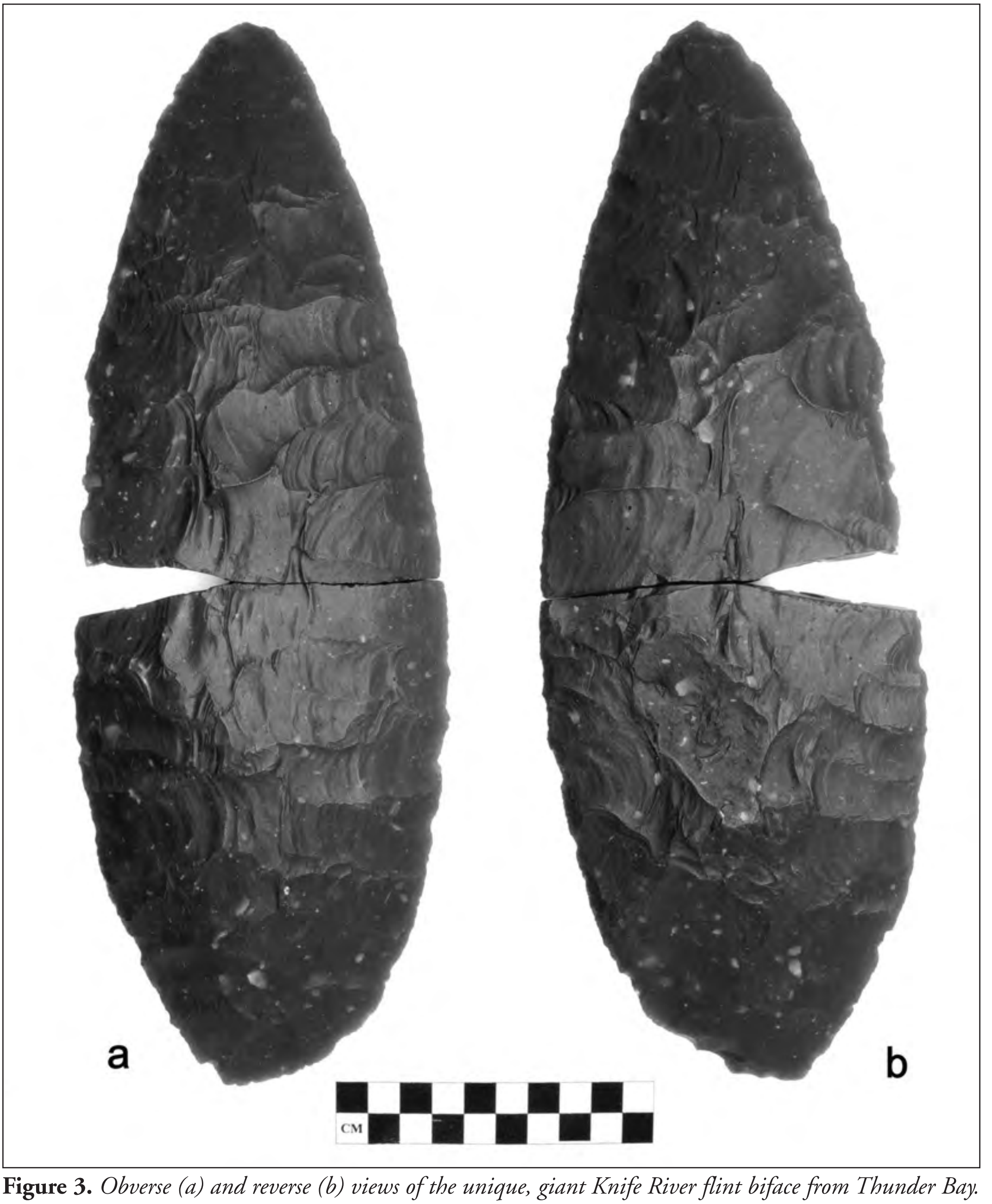

Figure 3. *Obverse (a) and reverse (b) views of the unique, giant Knife River flint biface from Thunder Bay. The bottom half was acquired by Dawson and the other half was given to Bill Ross as an employee of the Ontario Ministry of Culture (photos courtesy of Clarence Surette).*

to excavate and work on surveys of archaeological sites. Dawson (1972:2) explains: "The project designed to introduce Canadian youth to a northern sub-arctic environment in a meaningful way was a co-operative venture of the National Museums of Canada and Opportunities for Youth with logistic support provided by the Department of National Defence" (Dawson 1972:2). This work resulted in the discovery of many new sites and testing at several of the more noteworthy ones (Dawson 1988). There were 50 students engaged in research, along with 50 running the large camp, and 20 people in administration (Dawson 1972). Twenty-two sites were found and five were excavated (Dawson 1972). Some of the records are currently held by the Canadian Museum of History in Gatineau, while others are in the K.C.A. Dawson Library at Lakehead University.

It is impossible to discuss all of the significant archaeological finds that Dawson made or dealt with during his lengthy career. However, there are a number of unique artifacts that he found that are curated at Lakehead University. Perhaps one of the most notable precontact ones is a giant biface made from Knife River flint/chalcedony from North Dakota (Figure 3). As Fox (2010) explains, "a unique 334 mm long leaf-shaped biface of Knife River flint was discovered in two pieces from separate locations on the Kaministiquia delta in Thunder Bay (William Ross, pers. comm. 2010), and may reflect one of the distribution routes for such items from the source area to points east in the lower Great Lakes." William Ross (personal communication, 2018) explains that a person had sent him one half of the tool when he worked for the Ontario Ministry of Culture; he went to visit Dawson at Lakehead University and remembered that there was a very similar one there. Ross borrowed it and found that the two halves of the biface fit together (Figure 3)—so the pieces were a match but had been found in separate locations and several decades apart. It is one of the few giant bifaces found in Ontario (Fox 2010).

Dawson (1969) found a particularly rare postcontact artifact at the Longlac Post, which was an early French, North West Company (after 1783), and Hudson's Bay Company post on the Kenogami River. It is a well-preserved ladle cut out (recycled) from the cast brass butt plate of a musket (Figure 4). Identifying and sourcing trade gun parts is complicated because of the many makers, variable preservation of parts, trading of individual guns back and forth between people, and a lack of recorded information. The ladle has an engraved torch finial (the distal portion of the butt plate that points toward the middle of the gun) and a characteristic crossed quiver, bow and arrow pattern (Evans 1980; Hanson and Harmon 2011; O'Connor 1980) (Figure 4). That design is usually representative of finer grade guns that were sometimes gifted to Indigenous people as part of the fur trade (Hanson and Harmon 2011). O'Connor (1980) suggests that many of these quiver, bow, and arrow engraved patterns on English guns were imitating earlier French 'Type D' gun designs.

Although Dawson (1969) originally described the ladle to be made from a French musketoon introduced around 1730, as identified to him by trade gun expert T.M. Hamilton, the rest of the gun parts (n=35) and accessories (n=198) from the Longlac Post site date later in time and most are derived from England (Dawson 1969:21, 39). He attributes the flints to be from the same country and postdating 1750. With more published examples to compare with now, it is more likely that the Longlac Post ladle is made from a middle to late 1700s English fine or chief's grade gun. O'Connor (1980:76-77) notes that Dawson sent him the ladle in 1972 and that it was similar to several butt plates recovered from sites in the USA that have strong English affiliations. One from Fort Michilimackinac (1715–1781) in Michigan was found in a British latrine dated to between 1775 and 1781 (O'Connor 1980) and is the most similar that we could find to the Lakehead University ladle. Unless that butt plate was also from a French musketoon from the 1730s, the more likely affiliation for both of these gun parts is an English source from the later part of the eighteenth century. The Longlac Post ladle continues to be one of the most intriguing postcontact artifacts found by Dawson.

Figure 4. *Ladle cut from a brass butt plate of an English trade gun recovered from the Longlac Post site (Dawson 1969). Note the distinctive engraved 'torch finial' and quiver, bow, and arrows beneath it towards the bottom of the ladle (photos courtesy of Clarence Surette). It is almost identical to a trade gun butt plate excavated in 1975 from a British latrine at Michilimackinac and dated between 1775–1781 (from O'Connor 1980:77).*

Family

Later in life, Ken enjoyed travelling all over the world with his wife and friends (Figures 5 and 6). After dealing with an illness (Dawson 1999), he visited parts of all seven continents, sailed all of the oceans, traversed Africa, and travelled through hundreds of countries/areas including Uruguay, Brazil, Peru (Figure 5), Central America, Mexico, Nepal, India, Cuba, Martinique, Antigua, Tobago, Ecuador, Panama, Japan, Egypt, Israel, Sinai, Australia, the Arctic, Antarctica, and all over Canada. Much of this travelling was fueled by his love of learning about different cultures and curiosity about various ways in which people lived. During this timeframe he also obtained a permit to work and complete an archaeological survey in Fiji (Dawson 1987b) and worked on a burial mound in Hawaii (Dawson 1996).

In talking with his wife Mary Jean Robinson, it became clear that Ken had a somewhat

Figure 5. *Ken Dawson visiting Machu Picchu in Peru in 1991 (photo courtesy of K.C.A. Dawson Library).*

complicated family life but it was also important to him. He was married three times with the first marriage to Mary Forbes (nee Moyston, now deceased) during his years at the University of Toronto. They were divorced but had one daughter, Dr. Debra Dawson (2017), who also became a very accomplished academic working at the University of Western Ontario. Her son, Avery, is Dawson's grandson. After Dawson and his first wife were divorced, he later met his second wife Irene while working at a bank in Toronto. She also worked on archaeological excavations with him (e.g., Dawson and Dawson 1967). They had no children and, unfortunately, she later passed away from breast cancer.

Dawson is survived by his third wife, Mary Jean Robinson, a talented Indigenous rights lawyer and one of first women working in the discipline in northwestern Ontario. She has worked for Nishnawbe Aski Nation as a defence lawyer and ran the northern Ontario court. Like Dawson, Mary developed many relationships with Indigenous people in her long career in the Thunder Bay area. As Mary discussed her and Ken's relationship, she mentioned that they had met a long time before they became romantically involved and had known each other for a long time. They eventually were married in 1995. Both Ken and Mary described each other as soul mates and they were very happy together until he passed away on July 24, 2009. Mary had four children from a previous marriage who were stepchildren to Ken: Rick Burns, Jamie Rakowski, Lisa Robinson, and Laura Rakowski. Dawson also had three step-grandchildren: Jesse Vantaa as well as Kyle and Sarah Rakowski-Unruh.

Conclusion

Major and Professor K.C.A. Dawson led a very interesting life of hard work—and danger during his military years—and became one of the foremost archaeologists in northwestern Ontario and the central Canadian Boreal Forest in general. He enjoyed spending time with his family and friends, particularly learning more about other cultures as he travelled the world. Dawson served as a teacher and mentor to many while widely publicizing and promoting the importance of Ontario culture history. His name lives on in the Department of Anthropology at Lakehead University, which he helped establish and which continues to inspire new archaeologists. In addition, Dawson's work represents the first research from some areas of northwestern Ontario and has inspired more recent projects due to the importance of sites that he discovered (e.g., Dawson 1970, 1978, 1980, 1987a; Boyd and Hamilton this volume). His summaries of archaeological research in Ontario are still some of the most detailed (Dawson 1984, 1999; "Ken's little red book" or Dawson 1983b). And the donation of his vast book collection to the department now provides anthropology researchers with a means to access unique documents or copies of journals that the Lakehead University library may not hold. Clearly, Ken's legacy lives on in these many ways.

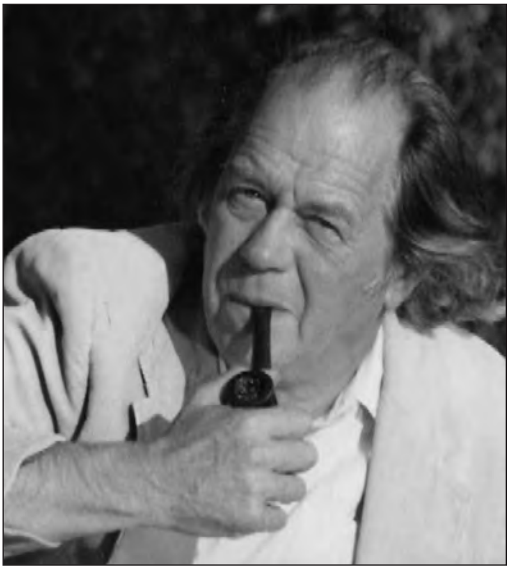

Figure 6. *Ken Dawson, with his iconic pipe, in later years; visitors can still occasionally smell pipe tobacco in the K.C.A. Dawson library room (photo courtesy of Mary Jean Robinson).*

Acknowledgments: We acknowledge the late K.C.A. Dawson for his long-term Canadian military service, for substantial archaeological contributions for Ontario and other locations, for his role in founding the department, for sharing his library with Lakehead University for posterity, and for granting the interview. Thanks to Mary Jean Robinson and Debra Dawson for sharing information about Ken and photos with us. A SSHRC Insight Grant awarded to Matt provided postdoctoral fellowship funding for Jill. Regards to Bioarchaeology Technician Clarence Surette for the artifact photos and assistance with Dawson library research. Thanks to Bill Ross for sharing the information about the KRF biface pieces.

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Le présent numéro comprend une section en l'honneur de Ken Dawson dont la rédaction a été assurée par une rédactrice invitée. Rattaché à l'Université Lakehead de Thunder Bay en Ontario durant une grande partie de sa carrière, Ken Dawson a grandement contribué aux connaissances en archéologie de la forêt boréale notamment grâce à son travail dans le Nord de l'Ontario. L'article décrit sa vie et sa carrière et énumère ses nombreuses contributions y compris une bibliographie de ses travaux écrits.

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[2] This bibliography of K.C.A. Dawson's work was compiled from the following sources: one of his published articles (Dawson 1984a); items such as several of his bibliographies found in the K.C.A. Dawson Library (KDL) in the Department of Anthropology at Lakehead University; and in Thompson et al. (1994), referred to here as LHUL. From this large body of work, it is evident that Ken was a prolific writer, working in diverse areas of Ontario and other parts of the world. It is also evinced through this list that he catered to a wide variety of audiences in promoting Northern Ontario archaeology. In addition to his publications, reports and manuscripts have been included to illustrate the breadth of his studies. Many of these lesser known archaeological reports were the first completed in regions (e.g., Dawson 1962, 1963b) and all have helped to build the culture history of Northern Ontario and the central Canadian Boreal Forest in general.

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The Early Shield Archaic in Northwestern Ontario

Dale Langford

The Shield Archaic culture was initially characterized through the analysis of 11 sites from across the Canadian Shield. Further development of this definition led to the hypothesis that the Shield Archaic culture evolved from the Northern Plano tradition in Nunavut and spread south and east throughout the rest of the Canadian Shield. While limited archaeological evidence exists to expand upon this hypothesis, an argument can be made that southern Shield Archaic populations in northwestern Ontario were more likely influenced by, and developed through, contact with other Archaic period cultures to the south. This alternative hypothesis is proposed through a review of environmental and external cultural interactions of Late Paleoindian and Shield Archaic populations within the Thunder Bay region during the proposed transitional period of ~8800–6800 cal (8000–6000 ^{14}C) BP.

Introduction

The transitional stage between the Paleoindian and Archaic periods is often assumed by archaeologists to represent a fundamental shift in technology and human-environmental relations. Unfortunately, the precise nature of this transition is poorly understood in many regions. The Paleoindian-Archaic transitional period is particularly unclear for most of the Canadian Shield. This problem is due in part to the geographical extent the Shield encompasses and the relative scarcity of known archaeological sites from which meaningful interpretations can be drawn (Wright 1972a).

The works of J.V. Wright (1972a, 1972b, 1981, 1995) represent the base from which the study of Late Paleoindian to Early Shield Archaic cultural development has been interpreted within the Canadian Shield. The limited archaeological materials upon which to base these studies, however, meant that early hypotheses were developed primarily upon the comparative study of 11 Shield Archaic sites from across the Canadian Shield including the former Keewatin District of the Northwest Territories (now Nunavut), Manitoba, Ontario, and Quebec (Wright 1972a). From this study, it was suggested that the development and spread of Shield Archaic culture evolved from early Northern Plano populations in Nunavut and spread south and east throughout the rest of the Canadian Shield (Wright 1972a, 1972b, 1981, 1995).

The objective of this paper is to reassess the transition from Late Paleoindian to Early Shield Archaic traditions within the Thunder Bay region of northwestern Ontario. More specifically, it will explore how Archaic period cultural influence potentially developed and spread through the region. The nature of this influence will be addressed through the observed implications of environmental development and cultural interactions with adjacent Archaic populations during the proposed transitional time of ~8800–6800 cal (8000–6000 14C) BP (Mason 1981; Wright 1981).

A Brief Definition of Shield Archaic Material Culture

Sites associated with the Shield Archaic culture have been recorded throughout the Canadian Shield from Nunavut to Cape Breton Island (Dawson 1983; Wright 1972b). The development of the Shield Archaic is generally identified by the transition in projectile point morphologies from the lanceolate forms of the Late Paleoindian Plano cultures, to those of side and corner notched varieties with more triangular body shapes (Wright 1972a, 1981). Raw material selection to produce these new notched projectile points, along with other lithic tools, shifted away from the exploitation of tabular bedrock sources to focus instead on materials derived from secondary source cobbles (Dawson 1983; Wright 1981).

It is during the Archaic period that we also see the introduction of copper tool manufacture within the southern Shield Archaic. Copper was used in the manufacture of spear points, adzes, chisels, fishhooks, and gorges (Wright 1981). Early dates for the use of copper have been recovered from surface-collected materials in Vilas County, Wisconsin, dating to between 8430 cal (7690 ^{14}C) BP and 8145 cal (7305 ^{14}C) BP (Mark Bruhy, personal communication 2014). Dates have also been obtained from copper artifacts recovered from the South Fowl Lake (northeastern Minnesota) and Renshaw (northwestern Ontario) sites, dating to 6800 cal (5940 ± 90 ^{14}C) BP and 5320–5020 cal (4630 ± 60–4420 ± 60 ^{14}C) BP respectively (Beukens et al. 1992). The use of copper by southern Shield Archaic populations has resulted in some researchers distinguishing them as part of a separate 'Old Copper' culture (Dawson 1983). However, Dawson (1983:12) refers to the use of copper by Archaic period populations in northwestern Ontario as part of a discrete regional population, and contends that copper manufacture represents a key aspect of the southern Shield Archaic tool kit in Ontario.

Notably absent from the Shield Archaic tool kit is the frequent, in-situ, production of ground-stone tools often associated with the transition to Archaic culture (with the exception of OSA Lake site near Georgian Bay discussed by Wright 1995). The presence of ground-stone tools on Shield Archaic sites is often interpreted as the result of trade or cultural contact with southern Archaic period populations (Dawson 1983; Hamilton 2004; Wright 1972a, 1981, 1995).

Current Theoretical Framework for Shield Archaic Development

Wright (1972a) initially proposed two alternate hypotheses to determine the origins of the Shield Archaic culture. The first suggests that the Shield Archaic culture evolved out of the Northern Plano tradition, located within the former Keewatin District of modern-day Nunavut, and spread southeast throughout the Canadian Shield. A second hypothesis suggests that cultural influence was introduced from southern Archaic period populations and developed within the lower regions of the Canadian Shield. Wright (1972a) tested these alternate hypotheses through the analysis and comparison of the lithic assemblages from 11 sites he defined as representing Shield Archaic culture.

Based on his assessment of the archaeological assemblages, Wright (1972a) argued that the Shield Archaic likely originated in the Keewatin District and diffused south and east throughout the Canadian Shield (Figure 1). Wright (1972a, 1981) observed the transition from a generalized lanceolate point form to the notched points of the Shield Archaic culture by comparing projectile point morphologies to those from Keewatin District sites such as Grant Lake (Wright 1976), Aberdeen (Wright 1972c), and Migod (Gordon 1976). In addition to changes in point morphology, Wright (1972a:73) observed the continued trend of reworking broken projectile points into burins throughout both the Northern Plano and Shield Archaic cultures. Wright (1981) further solidified the hypothesis for the southward diffusion of the Shield Archaic from Keewatin after incorporating the point typologies and lithic tool morphologies of the Sinnock site (Buchner 1984).

However, Buchner (1979, 1980) challenges Wright's (1972a) conclusion that the Shield Archaic developed from a Northern Plano

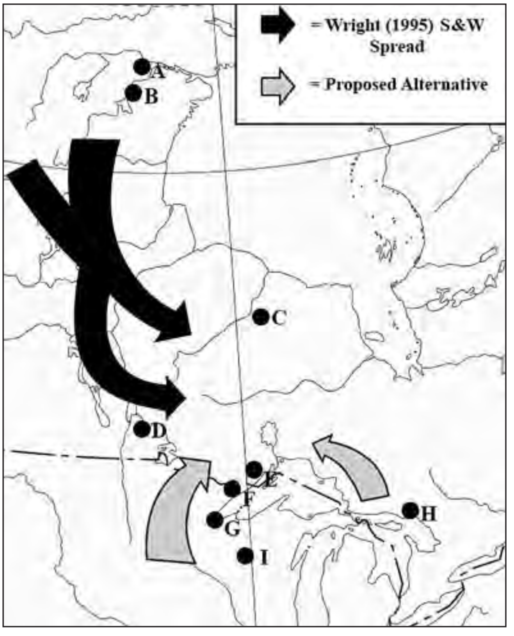

Figure 1. *Map of eastern Canada with indications of Wright's (1972a, 1995) hypothesis for Shield Archaic influence within the southern Canadian Shield with counter proposition indicated. Approximate location of various sites discussed: (a) Aberdeen, (b) Grant Lake/Migod, (c) Wapekeka, (d) Sinnock, (e) Renshaw, (f) South Fowl Lake, (g) Sucices, (h) OSA Lake, and (i) Deadman Slough (modified from Wright 1972a, 1981, 1995).*

tradition. He proposes instead that influence would have likely developed along the margins of the Canadian Shield in areas of cultural overlap between the Shield Archaic and other adjacent Archaic period populations (Buchner 1979:7). He further suggests that some sites identified as Shield Archaic within the southern Canadian Shield may represent seasonal camps of adjacent populations travelling north, calling into question the validity of the Shield Archaic as a distinct culture. Wright (1979) dismisses this critique and maintains that the Keewatin District represented the most likely place in which the Shield Archaic developed.

The Paleoindian to Archaic Transitional Period in Northwestern Ontario

It has been proposed that the transition from Paleoindian to Archaic period life ways was the result of human adaptation to environmental change during the Hypsithermal climatic interval of the Early/Middle Holocene (Fiedel 1987). The current idea that Shield Archaic culture developed and spread from the Keewatin region suggests that there was limited opportunity for meaningful cultural exchange between pre–Shield Archaic groups and more southern Archaic period populations prior to the southward spread of Shield Archaic ideas or populations. The following sections will explore the environmental and external cultural interactions of Late Paleoindian period and Shield Archaic populations within the Thunder Bay region to assess the possibility that these southern Shield Archaic populations were exposed to and likely gained influence from adjacent Archaic period groups as opposed to the southward dispersal of Shield Archaic culture from Keewatin.

Environmental Conditions Surrounding the Paleoindian to Archaic Transition

The Hypsithermal period affected most regions by ~10,000–8000 cal BP, resulting in a seasonal environment that was warmer and drier than today (Williams et al. 2010). This warming period resulted in the northward movement of floral, and likely faunal, maximum boundaries. It has been interpreted that this northward movement of plant and animal species resulted in a necessary change within subsistence practices to cope with new environments (see Anderson et al. 1996; Dumont 1981; Hayden 1982; Robertson 2004; Stoltman 1997). The effects of this Hypsithermal period warming on the development of the Shield Archaic, however, have not been fully explored.

By ~10,700 to 10,000 cal (9500–9000 ^{14}C) BP the Laurentide Ice Sheet (LIS) had retreated east of Lake Nipigon (Loope 2006). With the retreat of the LIS, the biotic capacity of the Thunder Bay region began to develop. Regional vegetation initially consisted of tundra-adapted plants but transitioned over the next 50 to 100 years into a forest/tundra–to–closed-forest environment (Björck 1985). Cores from Oliver Pond and Cummins Pond near Thunder Bay suggest that by ~11,500 cal (10,000 ^{14}C) BP the region was comprised of a spruce (*Picea*) dominated forest (Julig et al. 1990). As Hypsithermal warming increased, jack pine (*Pinus banksiana*) and birch (*Betula*) became increasingly present (Björck 1985; Julig et al. 1990). Julig et al. (1990) suggest that by ~8800 cal (8000 ^{14}C) BP pine (*Pinus*), birch, and alder (*Alnus*) had become the dominant tree species within the Thunder Bay area. Organics associated with a buried forest component along the Kaministiqua River Valley suggest that Boreal Forest cover was established by at least 9100 cal (8140 ^{14}C) BP (Boyd et al. 2012). Areas with wetter conditions, such as along waterways, may have continued to maintain a spruce-dominated environment. This results in variable interpretations of local forest landscapes based on geographic location, while maintaining a general Boreal Forest composition (Boyd et al. 2012; Julig et al. 1990).

Environmental Implications for Paleoindian-Archaic Period Subsistence

If the Paleoindian-Archaic transition did occur between ~8800 and 6800 cal (8000–6000 ^{14}C) BP (Mason 1981; Wright 1981), it is likely that a Boreal Forest environment was present in the Thunder Bay region prior to Shield Archaic development. Although changes in some of the vegetative species did occur, the overall boreal assemblage was not replaced. This evidence suggests that the faunal resources available within the region may not have differed greatly between the Late Paleoindian and Early Shield Archaic groups. However, interpreting subsistence use for either group is difficult. The high acidity of podzolic soils within the Canadian Shield has limited the preservation of organic remains, resulting in a vague understanding of faunal exploitation for both Palaeo-Indian and Archaic groups. Most interpretations regarding subsistence practices are based on material culture, site location, and extrapolation from comparable regions.

From these lines of evidence, most interpretations for Late Paleoindian subsistence in northwestern Ontario propose a focus on the use of caribou (Dawson 1983; Fox 1975; Hinshelwood 1990). This idea is based on the presence of larger lanceolate style projectile points and the location of sites focused along major waterways that may have functioned as caribou crossings (Dawson 1983). Further support for interpretations of caribou exploitation is provided by the recovery of a caribou antler from Steep Rock Lake near Atikokan, Ontario, dating to 11,400 cal (9940 ± 120 ^{14}C) BP (Jackson and McKillop 1989). While not associated with cultural material, this recovery indicates the presence of caribou within the region following deglaciation.

Similar interpretations for large game exploitation have been proposed for the Shield Archaic (Dawson 1983; McAndrews 1982). The presence of copper fishing implements in the Shield Archaic tool kit and results of stable isotope analysis on skeletal recoveries from Wapekeka suggest that marine resources may have also been a primary food source (Hamilton 2004; Mason 1981; Wright 1972b). However, it has also been proposed that small to medium game and wild edible plants were included within the subsistence resources (Mason 1981; Wright 1972b).

Research by Kuehn (1998) has suggested that the Late Paleoindian and Early Archaic period groups of northern Wisconsin were subsisting on a much broader faunal base than previous interpretations have suggested. Using faunal remains from the Sucices and Deadman Slough sites, Kuehn (1998) proposes that Late Paleoindian and Early Archaic period populations were employing a broad foraging strategy, visible in the high representation of small and medium game. The understanding that Late Paleoindian groups were utilizing a broader subsistence base than previously thought has been gaining wider recognition (see Hill 2007; Kornfeld and Larson 2008).

The use of blood residue analysis by Newman and Julig (1989) on 36 lithic artifacts from the Cummins site in Thunder Bay, Ontario, may suggest that this interpretation could also apply to some Late Paleoindian groups of the southern Shield. Artifacts were tested for animal biomarkers using crossover immuno-electrophoresis (CIEP). Although CIEP residue results did indicate the presence of larger animals, they also indicated a greater presence of small- to medium-sized game than expected. This finding could suggest a broader subsistence focus than those suggested by a caribou dominated diet. These results however must be viewed with caution.

Fiedel (1996) questions the validity of the Cummins CIEP results, stating that the interpretation of residue results is neither truthful nor representative. Issues arise in the selection of tools to be tested, the antiserums to which reactions were made, and the interpretations of the results. Other issues regarding CIEP include the understanding that the presence of an animal residue on a tool does not guarantee that it was consumed. The influence of site seasonality and location of faunal resources may also have an effect on the presence or absence of different faunal resources.

Without fully understanding what subsistence strategies were used during the Late Paleoindian and early Shield Archaic in the Thunder Bay region, it is difficult to determine if a shift in local fauna was a contributing factor to Archaic period cultural developments. The timing for the emergence of a closed Boreal Forest and a broad based subsistence strategy could have existed during the Late Paleoindian period. With no clear indication of a catalyst event (e.g., substantial floral or faunal shift) apparent during the suggested initial transition period of 8800 cal (8000 ^{14}C) BP, it is not possible to suggest which of Wright's (1972a) hypotheses is most likely. Both hypotheses, for either a Northern Plano origin or an in-situ Shield Archaic development stemming from a southern influence, are possible.

Exploring Trade and External Interaction during Archaic Period Development

Assuming that a shift in floral or faunal resources did not favour Shield Archaic development in either the north or the south, the characteristics of trade interactions may provide insight into adjacent regions through which stimulus may have travelled. Unfortunately, sites displaced and buried by fluctuating lake levels associated with Hypsithermal period warming (Hinshelwood 2004) and a lack of site-specific studies and published excavation reports have resulted in no clear Paleoindian-Shield Archaic transitional sites upon which to base this hypothesis. As a result, trade/cultural interaction must be examined from before and after the development of the Shield Archaic to see if observed trends continued or changed over time.

Trade and interaction during the Late Paleoindian period within the Thunder Bay region is interpreted within the context of the Interlakes composite (Ross 1995, Figure 2). This term is used to group patterns of shared traits found within the Lake of the Woods/Rainy River, Quetico/Superior, Lakehead (Fox 1975), and Reservoir Lakes complexes (Ross 1995:258). Within this network of complexes, Ross (1995) identifies shared characteristics within projectile point typologies as well as the use of Hixton Silicified Sandstone as an exotic raw material for tool manufacture. Ross (1995) proposes from these shared traits that the spread of technological ideas and raw materials likely occurred between groups. It is possible that following the transition to the Shield Archaic, contact with these adjacent groups would have remained active.

However, similar trade during the Shield Archaic has been regarded as being brief and limited to the cultural margins (Fagan 2005; Wright 1972a, 1972b, 1981, 1995). The recovery of a ground and polished stone gouge from the Wapekeka site near the Wapekeka First Nation in Northwestern Ontario suggests that this perspective may not be true (Hamilton 2004). Hamilton (2004) proposes that the presence of the ground-stone gouge may be the result of trade between Laurentian or Maritime Archaic and Shield Archaic populations. Although the burials recovered from the Wapekeka excavations could not be directly associated with the ground-stone gouge (Hamilton 2004:364), other recorded burials within the southern Shield Archaic appear to exhibit characteristics associated with southern Archaic burial cult rituals such as the placement of objects within graves (Dawson 1983:12–14; Wright 1972b).

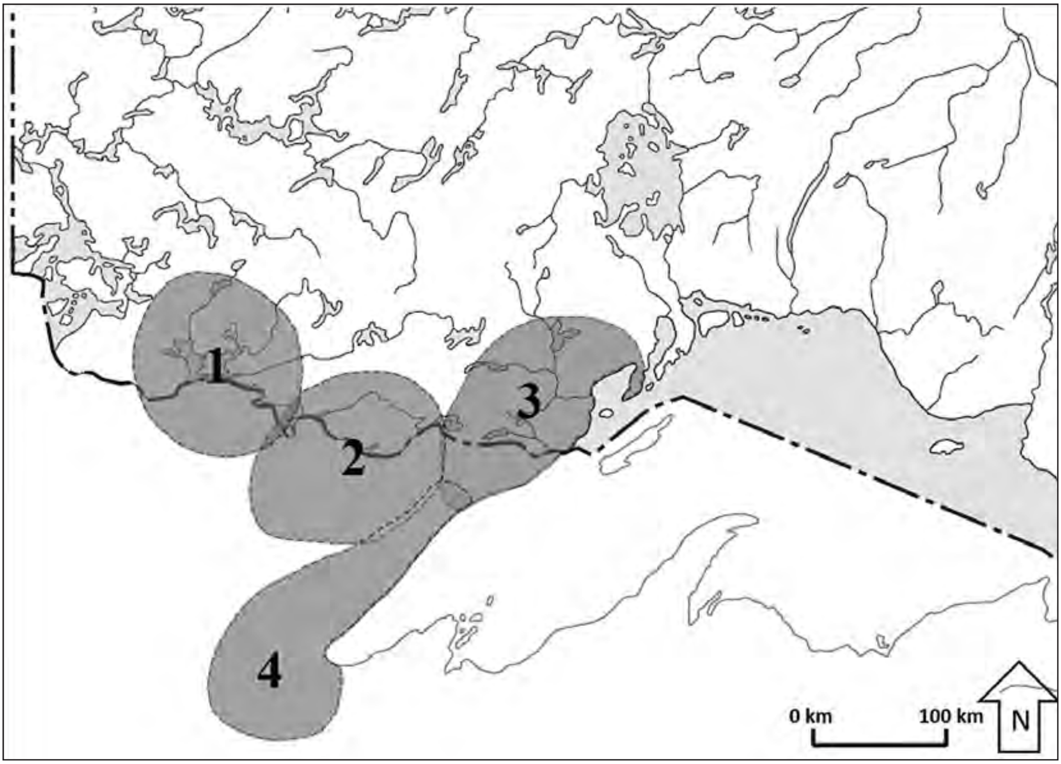

Figure 2. *Location of the Interlakes composite as defined by Ross (1995) with associated sites: 1) Lake of the Woods/Rainy River, (2) Quetico/Superior, (3) Lakehead, and (4) Reservoir Lakes (modified from Ross 1995:246)*

Along with the presence of ground-stone artifacts, exotic materials, such as Knife River Chalcedony/Flint from North Dakota, are found within the southern Shield Archaic. This suggests that some form of trade or interaction was present with Plains Archaic populations. This material has also been recovered from Paleoindian context but is extremely rare in northwestern Ontario, including three projectile points from Black Sturgeon Lake, French Lake, and Namakan Lake (Bill Ross, personal communication 2014).

Observing similar trends of trade or interaction between the Shield Archaic groups of the Thunder Bay region and those from the adjacent northern Shield groups is difficult due to the homogenous nature of the Shield Archaic material culture. It can be assumed, however, that the ability of Shield culture to spread out of the Keewatin District would have been limited by the presence of Glacial Lake Agassiz and associated lakes prior to its final catastrophic drainage at ~8500 cal (7700 ^{14}C) BP (Barber et al. 1999; Leverington and Teller 2003).

Throughout the Paleoindian period the presence of Lake Agassiz and glacial ice prevented the movement of populations from the Thunder Bay region into more northerly regions. Instead, the Keewatin Plano tradition groups are proposed to have migrated into the area from western Plano groups of the central plains (Wright 1976). As time progressed and Lake Agassiz diminished in size, this barrier began to shrink. By the time that a Keewatin-based Shield Archaic culture could have diffused south, the Thunder Bay region would likely have already been open to influence from other regions (see Breckenridge et al. 2010). Hamilton (2004) suggests that the populations inhabiting the Wapekeka site likely evolved out of Lakehead complex Plano groups who moved north as environments became habitable.

Hamilton (2004) proposes this northward movement rather than northern Plano groups from Keewatin moving south given the difficulties associated with travelling through the Agassiz basin at the time of site occupation (~7800 cal [7000 ^{14}C] BP).

Although physical migration may have been impeded by Glacial Lake Agassiz prior to its drainage, it is possible that influences from northern groups could have transferred into the region during the Late Paleoindian period. In their characterization of the Caribou Lake complex, Steinbring and Buchner (1980) compare it closely to that of the Lakehead complex. Contrary to this perspective, the Sinnock site, a component of the Caribou Lake complex, closely resembles the material culture of the Grant Lake site of the Keewatin District (Buchner 1984; regarding Grant Lake see Wright 1976). The Caribou Lake complex could represent an area where similarities were shared between northern and southern Plano groups. However, the importance of this observation in regard to the transfer of cultural traits is not clear.

The possible issues caused by the presence of Lake Agassiz are important when considering the dates related to copper manufacture within the southern Shield Archaic. If Lake Agassiz delayed the ability for the Shield Archaic culture to spread south until after its drainage at ~8500 cal (7700 ^{14}C) BP, it would coincide roughly with the emergence of Archaic copper (8430–8145 cal [7690–7305 ^{14}C] BP), suggesting some level of Archaic period culture was already present along the southern Shield periphery. If the trade networks of the Interlakes composite did persist, then it is likely that southern Late Paleoindian populations within the Canadian Shield were interacting with southern Archaic period groups prior to the diffusion of Shield Archaic culture from Keewatin.

Implications for Shield Archaic Development and Diffusion

One of the most important aspects of the study regarding the Late Paleoindian-to-Shield Archaic transition is that the information available is limited and largely hidden in grey literature. The surface recovery of a projectile point from Lake Elizabeth, just south of Lake Nipigon, exemplifies this idea. Lacking stratigraphic and depositional information, the projectile point (Figure 3) does not fit within the typical projectile point styles for either the Late Paleoindian or the Archaic period, but rather shares a number of typological traits. Its lenticular cross section, constricting lanceolate form, straight base, and meticulous craftsmanship fit well within the morphological characteristics described for Late Paleoindian projectile points of the Lakehead complex (see Markham 2013). However, the presence of fine notches over 10 mm above the base, thin and well flaked profile, and straight base could suggest that it more closely

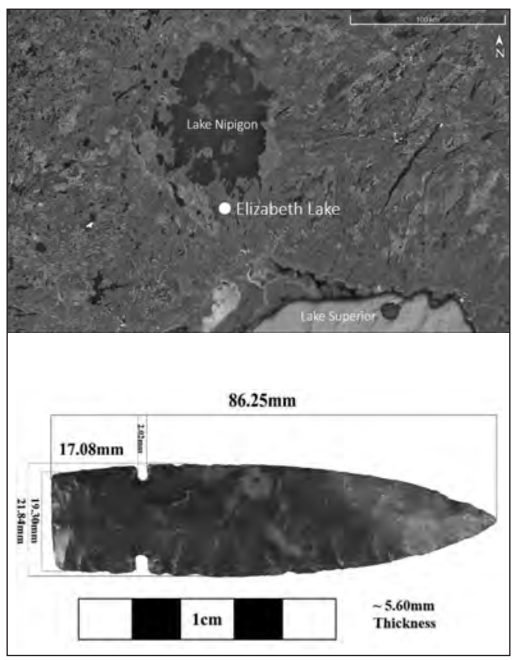

Figure 3. *Surface-found projectile point from Elizabeth Lake, south of Lake Nipigon. With no clear context, understanding how this projectile point fits within the prehistory of northwestern Ontario is unclear, and exemplifies a need for further research.*

resembles the 'box-based' Meadowood variants described by Granger (1978; see also Taché 2011). Without understanding how the Shield Archaic developed and spread, it is more difficult to address such finds. What is clear from this projectile point recovery is that the current understanding of Shield Archaic cultural development is poor and further research and publication beyond the scope of this paper is required to address these variants.

Assuming, however, that the Early Holocene environmental transition would not have produced a more ideal situation for either a northern or southern dispersal of Archaic period ideas, it can be proposed that the transition from Late Paleoindian to early Archaic within the southern boundaries of northwestern Ontario is likely the result of an Archaic period cultural influence from a southern source. This stimulus diffusion would have been supported by trade networks established during the Late Paleoindian period that likely continued into the Archaic period. With Lake Agassiz likely impeding this type of interaction between Paleoindian populations within northwestern Ontario and those of the Keewatin District until after its drainage, it seems less likely for this influence to have spread south from Northern Plano groups (Hamilton 2004). This conclusion opposes the overarching hypothesis that the Shield Archaic developed within modern-day Nunavut and spread southeast around Hudson's Bay (Wright 1972a, 1972b, 1981, 1995).

As a result, Buchner's (1979, 1980) alternative view, that the Shield Archaic within the southern Canadian Shield developed through contact with Archaic populations to the south, provides a more likely scenario than Wright's (1972a, 1972b, 1981, 1995) Keewatin origin hypothesis. This interpretation has been affirmed by Hamilton (2004) and as more research is done this hypothesis can be studied further.

Conclusions

While the original hypothesis for a northern Keewatin origin (Wright 1972a) cannot be disproved, it is more likely that southern Shield Archaic populations were influenced by, and developed through, contact with adjacent southern Archaic populations (Buchner 1979, 1980). It is hoped that this research will update the discussion regarding the transition from the Late Paleoindian to Shield Archaic within northwestern Ontario. It is unfortunate that the current site data base does not contain a sufficient number of sites from which more substantial hypotheses can be generated. Furthermore, hypotheses that are developed suffer from the lack of site survey within the Boreal Forest, largely inaccessible grey literature, and limited artifact recovery context. However, these limitations do not mean that new hypotheses for cultural development should not be explored. As new discoveries become available, researchers will undoubtedly come closer to better understanding the Paleoindian to Archaic period cultural transition in the Canadian Shield.

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Les caractéristiques de la culture de l'Archaïque du Bouclier ont d'abord été définies grâce à l'analyse de onze sites du Bouclier canadien. La poursuite de cette analyse a permis d'émettre l'hypothèse selon laquelle la culture de l'Archaïque du Bouclier a évolué à partir de la tradition Plano du Nord de la période paléoindienne au Nunavut et s'est répandue au sud et à l'est dans le reste du Bouclier canadien. Même s'il existe peu de preuves archéologiques pour étayer cette hypothèse, on peut soutenir que les populations méridionales de l'Archaïque du Bouclier du Nord-Ouest de l'Ontario ont vraisemblablement été influencées par d'autres cultures de la période de l'Archaïque et se sont développées grâce à leurs contacts au sud. Cette nouvelle hypothèse est émise dans le cadre d'un examen des interactions culturelles environnementales et extérieures entre les populations du Paléoindien récent et celles de l'Archaïque du Bouclier de la région de Thunder Bay durant la période de transition proposée de ~8800–6800 cal (8000–6000 14C) BP.

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The Martin-Bird Site Revisited[1]

Matthew Boyd and Scott Hamilton

Martin-Bird (DbJm-5) is a Late Woodland period site on Whitefish Lake (northwestern Ontario) that was first excavated by K.C.A. Dawson in 1970. Due to the combination of rich archaeological deposits and a prominent burial mound, the site played an important role in the development of the Woodland culture history framework of northwestern Ontario. Some 40 years following Dawson's excavations, we re-investigated the site using a combination of remote sensing, survey and excavation, and food residue analysis. This work has resulted in a much clearer understanding of Woodland subsistence choices, and underlines the importance of applying new analytical techniques to archaeological sites in the Boreal Forest.

Introduction

Before the 1960s, northwestern Ontario (like much of the central Canadian Boreal Forest) was largely unexplored by archaeologists. Within a generation, however, a basic cultural framework had been developed for the region that spanned the first peopling to the postcontact period. This pioneering work—the effort of a small number of archaeologists including K.C.A. (Ken) Dawson and J.V Wright—was achieved through the application of professional field methods, radiometric dating, and a heavy emphasis on projectile point and pottery typologies. One of Dawson's major contributions to the nascent field of Boreal archaeology lay in the development of a better understanding of Woodland culture history in the western Lake Superior region. This, in turn, was heavily influenced by excavations he conducted in the 1960s and 1970s at a group of sites on Whitefish Lake.

Whitefish Lake is located approximately 50 km southwest of Thunder Bay and 12 km north of the Minnesota border (Figure 1). The lake itself is a long (~11 km) and shallow basin surrounded by high and rugged bedrock uplands. Due to its shallow and flat-bottomed bathymetry, the lake hosts large populations of aquatic plants including wild rice (*Zizania* sp.). In the western portion of the basin alone, wild rice dominates an area of at least 120 hectares. Not surprisingly, the lake also has a large number of Woodland period archaeological sites along its shoreline and on islands adjacent to extant wild rice fields. The best known of these are McCluskey (DbJm-2), Macgillivray (DbJm-3), and Martin-Bird (DbJm-5), which are described in a series of articles in *Ontario Archaeology* and a *Mercury Series* monograph (Dawson 1974, 1980, 1987). Despite the differences among these three sites, they also have several important similarities: they are all

[1] This paper is dedicated to Dr. Terry Gibson, a pioneer in the field of geophysical site prospecting in Canada, who passed away in August 2018. During his 'summer holiday time,' Terry generously offered to run magnetic gradiometry and GPR transects of the Martin-Bird site in 2009 and 2010. Through this work, he opened our eyes to the potential of geophysical site prospecting in the Canadian Subarctic.

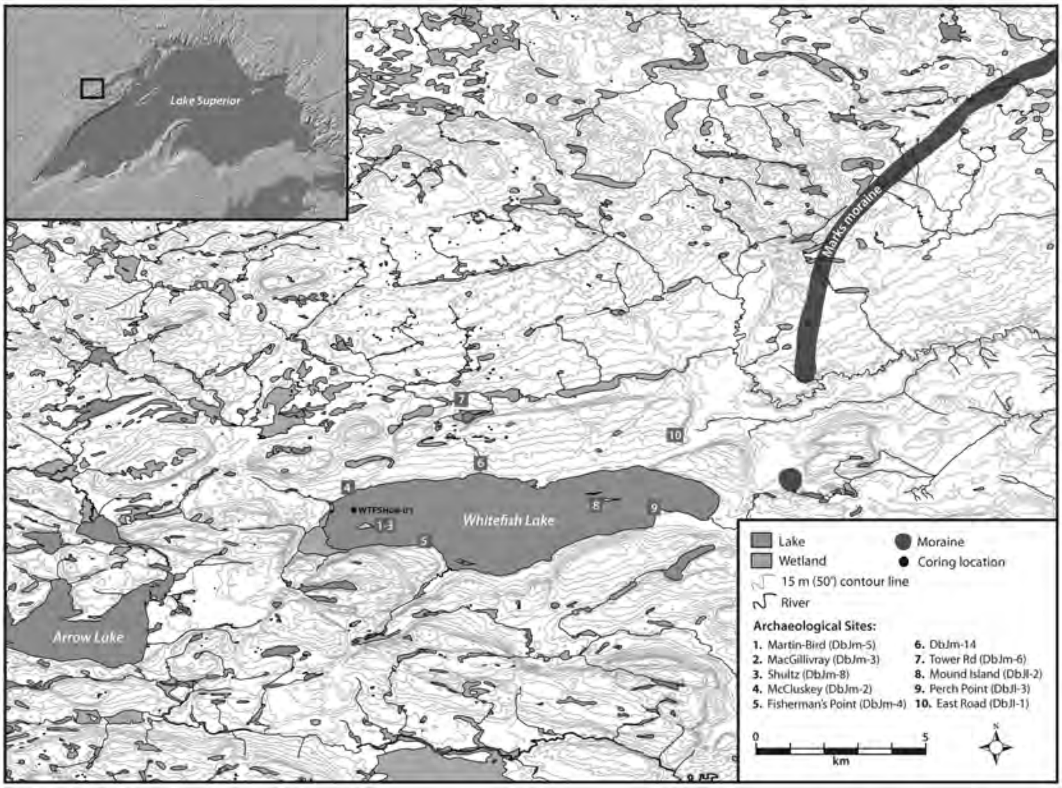


Figure 1. *Map of the Whitefish Lake, Ontario, region showing locations of major Woodland archaeological sites (Boyd et al. 2014).*

relatively large and rich, and have burial mounds situated beside habitation areas.

Beginning in 2009, we returned to the Martin-Bird site in order to develop a better understanding of the dietary choices and subsistence strategies of northern Woodland populations. Our interest in this topic grew out of the recent discovery of domesticated plant food remains such as maize in archaeological residues from sites across northern Ontario and adjacent regions (Boyd et al. 2008, 2014; Boyd and Surette 2010). Dawson's (1987) fieldwork at the Martin-Bird site, like much early research in the Boreal Forest, resulted in almost no information on subsistence. This was due to a combination of poor organic preservation, inadequate methodologies, and a research emphasis on space-time systematics. In order to address this knowledge gap, we employed a combination of remote sensing (e.g., magnetic gradiometry) and plant microfossil analysis of matrix samples and residues preserved on artifacts. We suggest that this strategy provides an effective way of finding buried food processing features, and identifying specific plants associated with these features in sites that yield little conventional evidence of past food choices.

Site Description

The Martin-Bird site (DbJm-5) is located on a small island in the western end of Whitefish Lake, overlooking an extensive field of wild rice (Figure 1). Today, Whitefish Lake is situated within the Moist Low Boreal Ecoclimatic Region (Crins et al. 2009) and the Boreal Shield Ecozone (Wiken 1986); the mean annual temperature varies from 0.2 to 2.7 °C and the growing season length ranges from 168 to 188 days (Crins et al., 2009). The site was first excavated by Ken Dawson in 1970. Like the adjacent Macgillivray site, investigated four years earlier (Dawson 1980), Martin-Bird contains a small conical burial mound as well as extensive habitation zones (Figure 2). The mound itself is situated at the centre of a low, roughly north-south, trending ridge that appears to have been constructed using cobbles and boulders to augment the natural topography of the island. This artificial terrace may have been built in order to enhance the view of the mound from the water, to mimic the shape of the mountains that tower above the southwestern corner of the lake in the Castle Creek Provincial Nature Reserve, or for some other purpose. Excavation of the central portion of the mound by Dawson (1987) revealed a 1.4 m-deep pit containing a bundle burial enclosed by a birch bark container, a miniature Blackduck pottery vessel, clam shell 'spoon,' red ochre, a copper pendant, and a variety of precontact lithic and pottery artifacts. The mound and the surrounding ridge are dotted with looting pits that predate Dawson's investigations.[2] Due to extensive disturbance from looting, little physical evidence of the original mound exists today. Cultural deposits to the west and east of the mound are extensive and interpreted as domestic spaces based on the recovery of numerous hearths, pit features, and a wide variety of artifacts (Dawson 1987). Our testing was restricted to these domestic areas (Areas A and B in Figure 2).

Pottery recoveries indicate that the Martin-Bird site was repeatedly occupied by many different groups of people as represented by Middle and Late Woodland archaeological affiliations, including Laurel, Blackduck, Sandy Lake, and Selkirk. However, based on our minimum vessel counts (Table 1), Blackduck complex (Late Woodland) pottery accounts for roughly 50 percent of the total assemblage, suggesting that the site was predominantly occupied by the makers of Blackduck and related pottery types (e.g., Kathio). One example of a related Kathio series vessel, typically found in Minnesota, was identified from this site and it is, to our knowledge, one of the few known in northwestern Ontario.

Table 1. *Approximate minimum pottery vessel count, Martin-Bird site (DbJm-5). Data based on reanalysis of materials collected by Ken Dawson in 1970 in addition to our recoveries (2009–10). Note dominance of Late Woodland types in addition to presence of numerous 'transitional' or 'syncretic' vessels.*

Type	Minimum Vessel Count
Blackduck	75
Selkirk	22
Laurel	11
Sandy Lake	11
Laurel/Blackduck (shared traits)	6
Rainy River	5
Sandy Lake/Selkirk (shared traits)	5
Miniature vessel	5
Blackduck (combed)	4
Unknown	3
Brainerd	1
Kathio	1
Total:	149

Dawson (1987) reported several radiocarbon dates on charcoal collected from features such as hearths and pits. These dates span the fifth to the eighteenth centuries AD. The oldest was thought by him to pertain to the Middle Woodland Laurel complex occupation while the remainder were attributed to the Terminal (Late) Woodland period. Use of the site into the historic period, furthermore, is suggested by the recovery of European artifacts in "direct association" with Indigenous items (Dawson 1987:37). While Dawson's chronological reconstruction of the Martin-Bird site seems reasonable, the specific dates that underlie his chronology should be viewed with caution due to the potential mobility of charcoal in soil, its uncertain source (whether anthropogenic or natural), as well as errors produced by dating old wood.

[2] Although it is unknown exactly when the mounds were looted, archaeological materials have been reported from the Whitefish Lake region since at least 1882 (Winchell 1911).

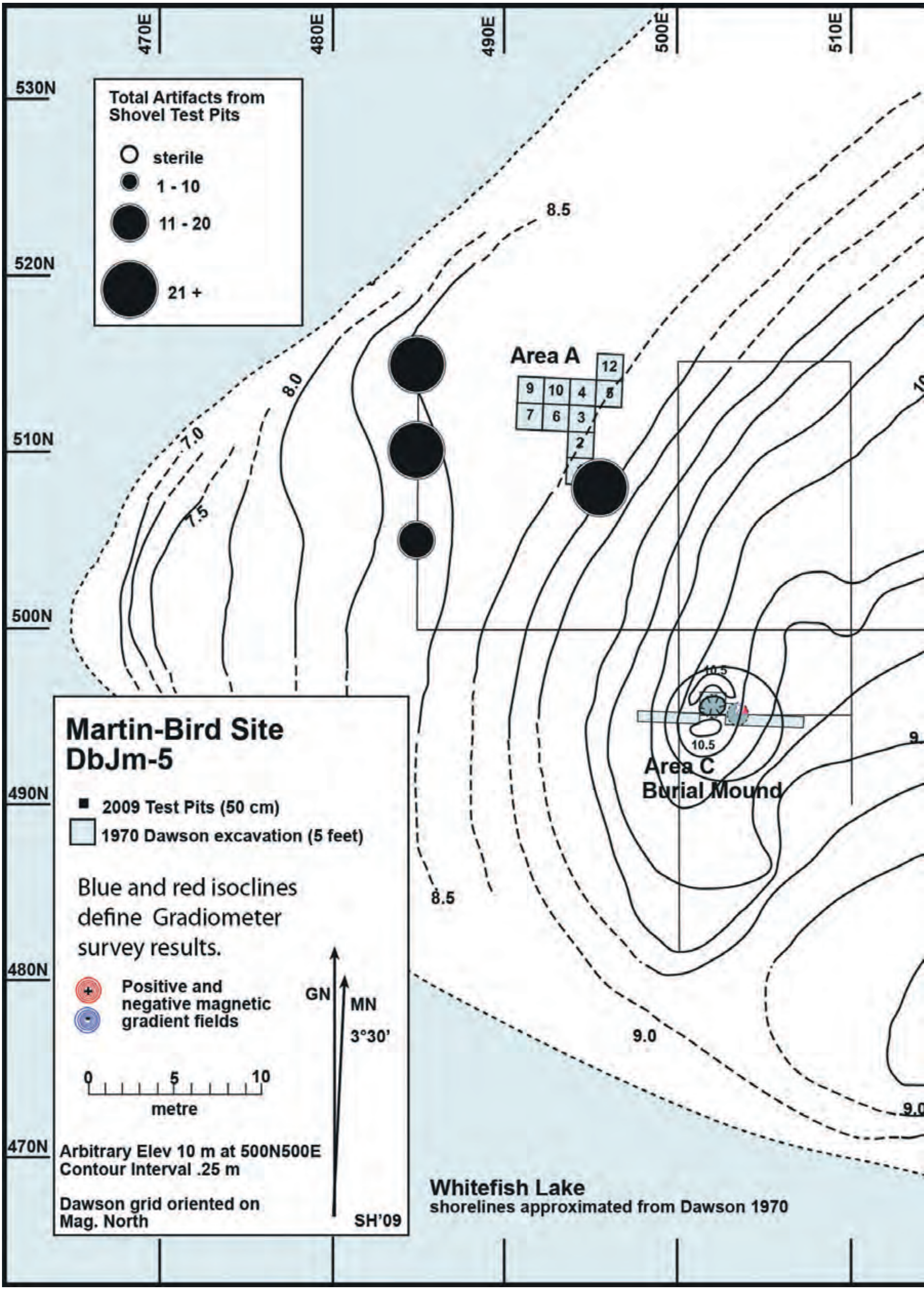
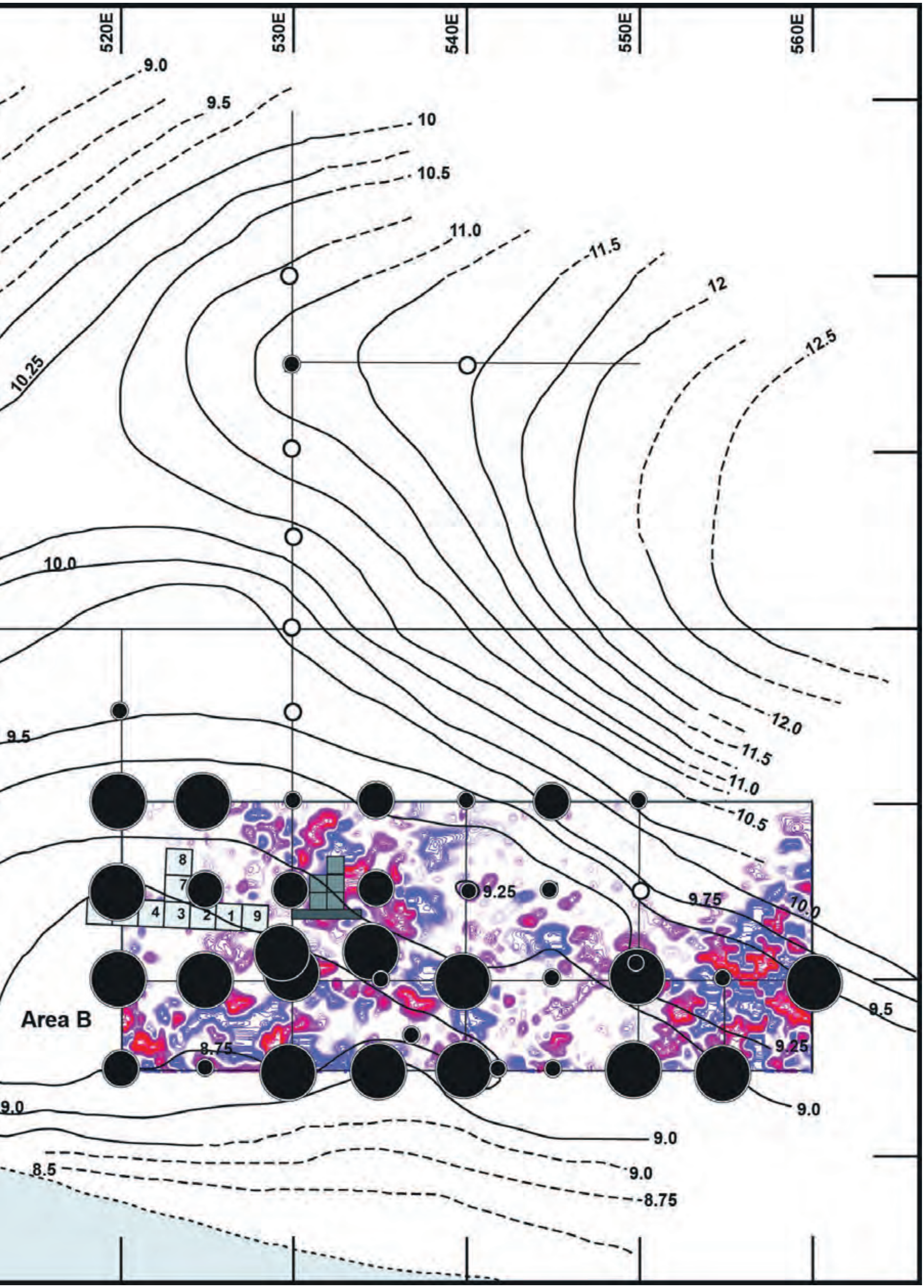


Figure 2. *Topographic map of Martin-Bird Site, with results of 2009 shovel test and gradiometer survey operations.*


520E
530E
540E
550E
560E
9.0
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10
10.5
11.0
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12
12.5
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9.25
9.75
10.0
9.5
9.25
8.75
9.0
9.0
9.0
9.0
8.5
8.75
Area B
8
7
4
3
2
1
9

In addition to the remains of a mound, the site yielded a high number of features during the 1970 field season including: hearths (up to 75 cm in diameter), circular concentrations of boulders and fire-cracked rock (FCR), 'roasting pits,' a copper cache pit, various depressions, and refuse pits (Dawson 1987). With a few exceptions, the function of these features (and similar ones found at other sites of Whitefish Lake) were either entirely unknown to Dawson or were speculatively linked to wild rice processing. Faunal refuse, furthermore, was generally scarce at the site and could not be identified well enough to be informative (Dawson 1987). Despite these limitations, Dawson (1974) portrayed the Woodland occupants of Whitefish Lake as 'textbook' Subarctic hunter-gatherers who lived in the region seasonally and exploited a broad range of wild foods (especially wild rice).

Martin-Bird Revisited

Geophysical Prospecting and Survey/Excavation Results

Our re-investigation of the Martin-Bird site spanned two field seasons (2009 and 2010) and included the following objectives: (a) shovel test reconnaissance in the habitation zone to identify areas with high artifact concentrations; (b) recovery of a wide range of artifacts from these areas for residue analysis; and (c) application of remote sensing methods (magnetic gradiometer and GPR [ground penetrating radar] surveys) in order to locate buried features for archaeobotanical (plant microfossil and macrofossil) sampling. In order to conduct this work in a respectful manner we ensured that the mound area was left undisturbed, and the start and end of each field season was marked ceremonially. Our work on Whitefish Lake also incorporated Indigenous youth training and educational opportunities in collaboration with the Aboriginal Mentorship Program at Lakehead University. Indigenous students from a variety of local First Nations communities participated in a tour of the island and public archaeology opportunities over multiple field seasons.

Shovel test reconnaissance was focused on Dawson's (1987) Area B habitation zone (Figure 2). The artifact density varied across the site although most test pits were positive in this zone.

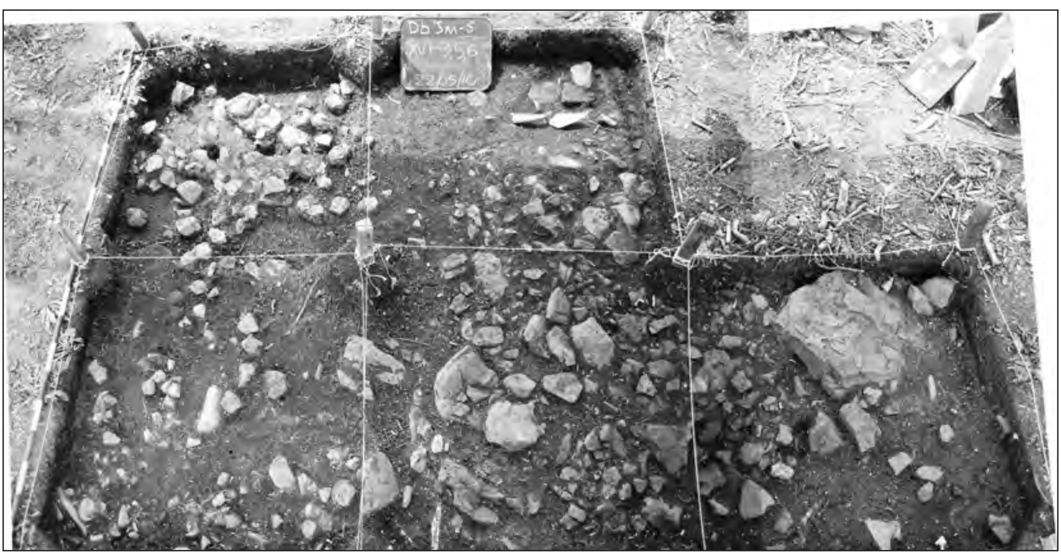

Figure 3. *Composite photo of a large fire-cracked rock (FCR) feature from the Martin-Bird site excavated by the authors in 2010. This feature was identified through a magnetic gradiometry survey conducted by Terry Gibson, and corresponds to a large magnetic anomaly visible in Figures 2 and 4 underlying the 2009–10 excavation block. Several similar features have been located in Area B and appear in some cases to be associated with microremains from domesticated plants and wild rice (Barry 2017). North is to the right.*

Fire-cracked rock was especially abundant, and concentrations of these rocks may correspond to magnetic anomalies documented using a gradiometer. Some of these anomalies are rather large, and one was subject to further investigation in the subsequent field season (Figure 3; see below).

Total artifact recoveries, comprising lithics, pottery, and faunal remains, were generally higher in areas on either side of the mound, although we did not test the site uniformly; most of our work was concentrated in Area B due to its greater apparent richness following initial testing. Regardless, Dawson's (1987) interpretation of the site layout suggests that the mound was a focal point for activities during the period of occupation, and our survey results do not contradict this conclusion. Noticeably absent were archaeological remains immediately north of Area B upon the central ridge that runs through the site (Figure 2).

Magnetic gradiometer data were collected in 2009 to help locate features thought to have magnetic signatures (i.e., hearths, concentrations of fire-cracked rock or fired pottery, filled pits, etc.). Terry Gibson (Western Heritage) conducted the survey using a FM256 fluxgate gradiometer. It features two vertically arranged sensors that simultaneously measure the magnetic field, and the difference detected by each sensor. Since magnetic field intensity declines sharply with distance from the source, the vertically arranged sensors offer an effective means of detecting localized magnetic variation despite the surrounding earth and atmospheric magnetic conditions (see Hamilton et al. 2019 for an extended discussion). Within a 40 by 15 m zone in Area B, magnetic readings were collected along a series of east-west oriented transects spaced 50 cm apart (Figure 2). This results in dense linear arrays of data points along each transect, with interpolation of the data trends between adjacent transects. The technique identified magnetic anomalies of either anthropogenic or natural origin that were further characterized with 'ground truthing' (probe coring, shovel testing, metal detector, etc.).

Given the stony character of the sedimentary substrate at the site, some anomalies are readily identifiable as natural. The dense and convoluted anomaly complex noted in the southeastern corner of Area B (Figure 2) likely derives from ground moraine that was observed close to the surface during shovel testing in that area. In a subsequent map of Area B (Figure 4), this zone is removed from consideration to emphasize the western 30 by 15 m area that contains more anomalies of probable cultural origin. We expected that culturally-derived magnetic anomalies would vary significantly in intensity, but would be comparatively localized. This idea is consistent with the expectations of hearths, fire-cracked rock clusters, localized pits, and similar domestic features. While this result was evident in some cases, the mapped output also revealed large anomalies with uniform positive and negative magnetic fields (Figure 2). These larger anomalies are inconsistent with Gibson's (1986) previous experience at precontact sites, and are more normally associated with large metallic objects, or zones of intense thermal alteration. Further, he noted that a cluster of thermally altered and subsequently discarded rocks should appear as a chaotic arrangement of localized magnetic disturbances (both positive and negative) that interact and impinge upon one another. Instead, the large magnetic fields are uniform, either positive or negative, and quite intense. Gibson interpreted this as indicating intense in-situ heating that uniformly realigned the magnetic minerals of both rocks and the sediment, with no subsequent disturbance of their magnetic re-orientation. As a consequence of these unexpected results, a 4 m by 50 cm exploratory trench was excavated across the end of one of these large anomaly complexes. Few conventional artifacts (pottery, lithics, bone) were recovered, but a cluster of shallowly buried fire-cracked rock coincided with the zone of intense magnetic disturbance. Subsequent excavation revealed a dense pavement of fire-cracked rock that coincided closely with the spatial extent of one of the major magnetic fields (Figures 2, 3 and 4). With the exception of large portions of one Late Woodland (Blackduck affiliation) pot that was

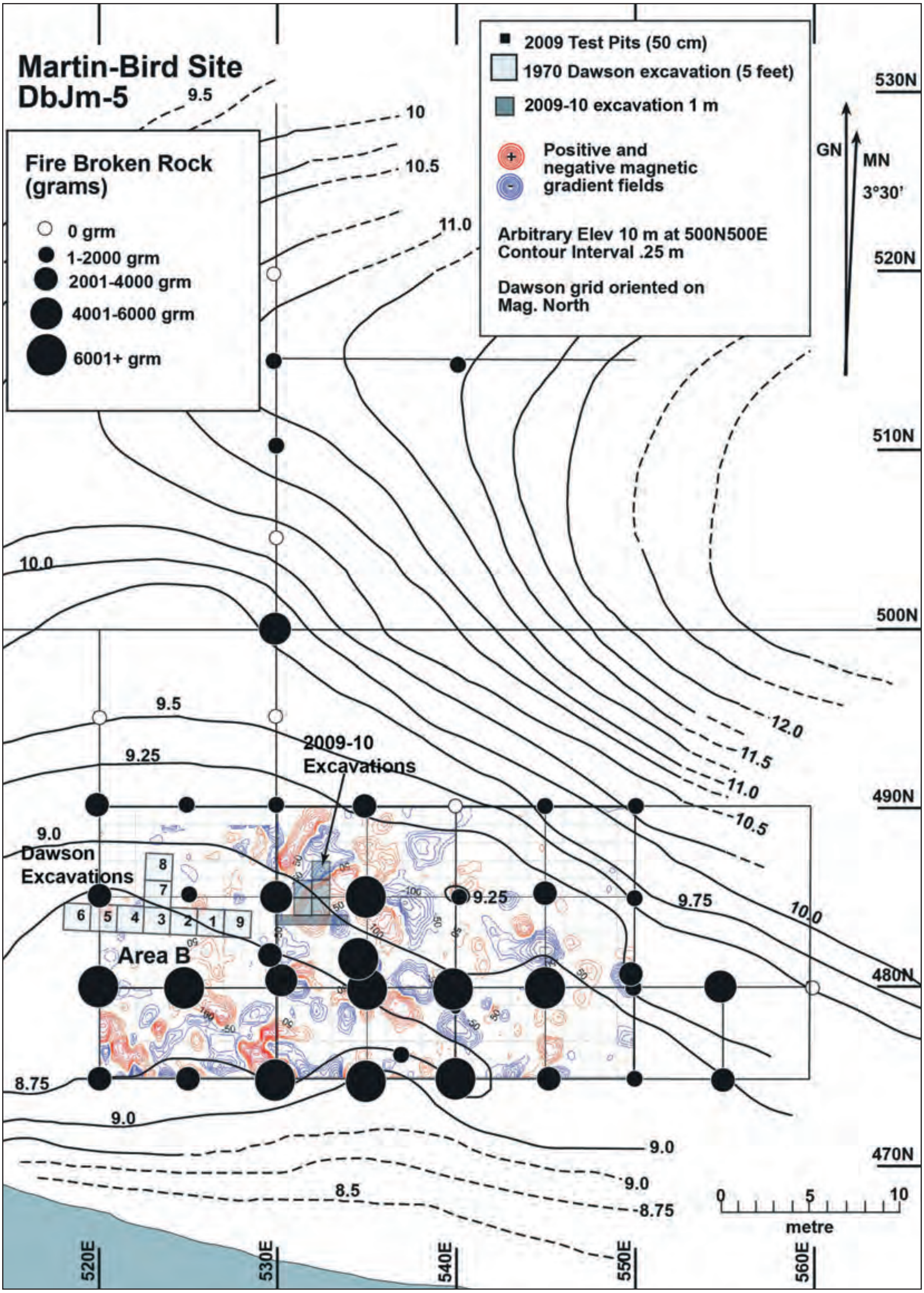

Figure 4. *Detail of Area B, Martin-Bird Site, with shovel test distribution of fire-cracked rock with results of gradiometer survey.*

recovered smashed in place upon the rock pavement, conventional artifacts were rare, indicating that the feature is not a midden. In light of the primary constituent artifact class (fire-cracked rock), and the distinctive magnetic profile, we interpret it to be a large-scale heating or cooking feature.

Residue Analysis

Residue analysis is a relatively new technique in Canadian archaeology that has been applied extensively at Martin-Bird and other sites in the Whitefish Lake region and beyond (Boyd et al., 2014, 2018; Boyd and Surette 2010). Residues of organic matter, including food remains, may be preserved on a variety of artifacts such as pottery (in the form of absorbed residues and/or carbonized encrustations), lithics, and fire-cracked rock. Of course, all of these materials are commonly encountered in Boreal Forest archaeological sites unlike faunal or macrobotanical remains. Thus, archaeological sites in this region, despite their reputation for paucity, are actually replete with potential sources of information on ancient diet and food processing behaviour.

Our research has largely focused on plant microfossil (starch and phytolith) content of archaeological residues. This analytical technique has both positive and negative attributes. On the positive side, the abundance of plant microfossils released by food processing and other activities means that plants that were even only occasionally consumed may be evident. The presence of small quantities of domesticated plant food, for example, may provide crucial evidence of the early stages of the economic transition to food production. Alternatively, rare foods may signal the existence of long-distance food sharing networks; such networks are known to have occurred historically yet are almost never directly recorded in archaeological sites in the region. However, some important limitations also exist in the use of plant microfossils for paleodietary reconstructions, specifically: (a) some domesticated and wild plants may be better represented in residues than others due to the vagaries of microfossil production and identification; (b) due to the occasional use of starch (especially from corn and wheat) as an industrial ingredient (Pearsall 2015), there is the potential for modern contamination of archaeological materials and associated false positive results; and (c) plant remains identified from food residues may represent only a small fraction of the total range of plants utilized at a site, due to differences in the way plants are consumed and/or processed. Raw foods, and foods that require minimal processing, may be much less visible archaeologically.

Some of these limitations are easier to deal with than others. The issue of contamination, for example, can be mitigated by proper lab procedures and the use of multiple lines of evidence for a given plant. In the lab, we reduce the risk of modern contamination by: (a) using a clean facility dedicated to plant microfossil extraction; (b) processing comparative plant materials in a separate lab using separate equipment; (c) running sample 'blanks' at the beginning of a new batch and analyzing these samples for microremains; (d) microscopic analysis of airborne particle traps placed within the lab; and (e) total elimination of starch-containing materials such as food, makeup, and certain detergents from the lab environment, among other procedures (see Boyd et al. 2014 for a complete description of our contamination controls, the microfossil extraction procedure, and identification criteria).

Even with these procedures in place, however, it is impossible to completely eliminate the risk (however low) of modern maize starch contamination especially when dealing with artifacts that have been kept in storage, or on display, and handled over long periods of time. Although this may be so, our identification of maize in archaeological samples relies on multiple lines of evidence of this plant (starch, phytoliths, and occasionally pollen). As well, many of our artifact and all of our matrix samples were collected by us in the field during excavation and were carefully handled in order to ensure that no contamination occurred. We also collected ten control samples from the modern topsoil across a 225 m east-west transect of the island in order to test for modern (airborne) starch contamination; no maize starch granules or phytoliths were found in these samples. For these reasons, we believe that modern contamination is an extremely weak explanation for the presence of maize microremains in association with archaeological materials at the site.

As shown in Table 2, a high proportion (70%) of the samples from the Martin-Bird site yielded domesticated food remains. Evidence of maize, furthermore, was frequently found in more than one form (i.e., both starch granules and phytoliths). We also observed that wild rice phytoliths were recovered from most of the food-residue samples that produced maize microfossils. Starch from common bean (*Phaseolus* sp.) was recovered from four of the samples, and only one squash phytolith was identified. Domesticated plant remains were recovered from both Middle (e.g., Laurel) and Late Woodland pottery (Boyd et al. 2014).

From these results, it seems clear that domesticated plant foods formed a component of the Woodland diet at Whitefish Lake, in combination with local resources such as wild rice. While unexpected in light of previous assumptions about northern Woodland subsistence practices, these results seem to mirror a larger pattern of domesticated plant use in the southern Boreal Forest beginning at least by Laurel times (Boyd and Surette 2010; Boyd et al. 2008). In this same general region, during the historical period, gardening was practiced on a limited scale by Anishinaabek in settings suitable for this activity (Boyd and Surette 2010). These gardens, which were often located on islands due to their favourable microclimatic characteristics and protection from some crop-eating animals, hosted a variety of domesticated plants such as maize, squash, and potatoes (see summary in Boyd and Surette 2010). From historical accounts alone, however, it is unclear if gardening arose as a result of the fur trade (Moodie and Kaye 1969) or whether it has deeper roots. Boreal archaeology, and residue analysis, will likely play key roles in the study of ancient food production at its northern geographical limit in the Americas.

The application of food residue analysis to Martin-Bird and other sites on Whitefish Lake has added new insight into the nature of Woodland subsistence in the southern Boreal Forest, but it has also generated many questions about the importance of domesticated foods (vs. wild resources), as well as the source of these foods (i.e., whether they were grown locally, or transported in). Residue analysis, by itself, is probably insufficient to answer these questions; however, in combination with conventional archaeological techniques (survey, excavation) and remote sensing, it is possible to develop a much fuller picture of ancient subsistence practices. A fuller understanding is possible because: (a) materials collected during the course of earlier excavations may not include matrix samples or boiling stones (FCR), both of which are potentially important sources of ancient plant microremains; (b) older collections are more likely to suffer from residue contamination; and (c) remote sensing techniques, such as the gradiometer survey employed at Martin-Bird, enhances the ability to identify buried features where evidence of food processing may be preserved.

This research is ongoing at Whitefish Lake. Significantly, however, a preliminary microfossil and soil chemistry survey of the Martin-Bird site (Barry 2017) resulted in the recovery of domesticated plant remains and wild rice in association with the FCR 'pavement' features previously identified using the gradiometer (see above). While somewhat equivocal, this raises the possibility that at least some of the maize consumed at the site may have been grown and processed on the island. Of course, the idea that Woodland period Indigenous people practiced horticulture in such a northerly locale, or even simply consumed domesticated plants, did not factor into Dawson's (1987) interpretation of the site. Such subtle behaviours were completely invisible due to the inherent limitations of Boreal archaeological sites, as well as the nature of the methods employed at the time.

Conclusions

This case study of the Martin-Bird site highlights some of the changes that are beginning to take place in central Canadian Boreal Forest

Table 2. *Carbonized food residue samples from the Martin-Bird site and select plant microfossil recoveries (modified from Boyd et al. 2014:Table 1). X = presence.*

#	Cultural Affiliation	*Zea* mays rondel	*Zizania* sp. rondel	cf. *Cucurbita* phytolith	*Zea mays* starch	*Phaseolus vulgaris* type starch
1	Blackduck (rim)	X	X			X
2	Blackduck (rim)	X	X		X	
3	Blackduck (rim)		X		X	
4	Blackduck complete vessel (FCR feature), rim	X			X	
5	Blackduck complete vessel (FCR feature), body				X	
6	Blackduck (rim)	X			X	
7	Blackduck (rim)	X	X			
8	Blackduck/Laurel transitional					
9	Brainerd Parallel Grooved					
10	Kathio Series (rim)	X	X			
11	Late Woodland	X		X	X	X
12	Late Woodland				X	
13	Late Woodland (body)	X				
14	Late Woodland (body)	X	X		X	
15	Late Woodland (body)				X	
16	Late Woodland (body)	X			X	
17	Late Woodland (body)				X	
18	Late Woodland (body)					
19	Late Woodland (body)	X	X			X
20	Late Woodland (body)	X	X		X	
21	Late Woodland (body)					
22	Late Woodland (body)	X				
23	Late Woodland fabric impressed (body)	X	X		X	
24	Late Woodland refit (body, n=4)	X	X		X	
25	Laurel (body), wide CWT impressions	X	X		X	
26	Middle Woodland? net-impressed sherd	X				
27	Selkirk (Clearwater Lake Punctate) rim/neck	X	X		X	X
28	Selkirk (neck)					
29	Selkirk (neck)	X			X	
30	Selkirk (rim)	X	X		X	
31	Duck Bay (rim)	X	X		X	
32	Selkirk/Rainy River	X	X		X	
33	Indeterminate fabric impressed (surface find)					
34	Late Woodland (rim/neck), trailed	X			X	
35	Blackduck					
36	Blackduck?	X				
37	Late Woodland					
38	Late Woodland		X			
39	Laurel					
40	Laurel?		X			
41	Sandy Lake					

archaeology. In 1970, Dawson's work was driven by the need to develop a better regional culture-history framework—a goal that was approached through the use of large block excavations, salvage testing of the burial mound, and an emphasis on the recovery of large quantities of pottery. There is no doubt that the study of space-time systematics is a fundamental aspect of archaeology—and much more work of this sort needs to be done in the region—but it is also important for Subarctic archaeologists to employ new methods in order to develop a fuller picture of the past. In this paper, we argue that the combination of residue analysis and remote sensing is an especially powerful tool for identifying subsistence behaviours that would otherwise be invisible. When applied to Martin-Bird and other sites on Whitefish Lake, we identified a previously unknown pattern of domesticated plant consumption (and perhaps small-scale horticulture) spanning the Middle to Late Woodland periods. This opens up the possibility that the archaeological record of the Boreal Forest—despite its reputation as being information-poor, static, and only of local relevance (Holly 2002)—may play a key role in our understanding of the forager-farmer transition in northern environments. Much of this work lies ahead, and would not have been possible without the efforts of Ken Dawson and other early Subarctic archaeologists.

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Datant de la période du Sylvicole supérieur, le site Martin-Bird (DbJm-5) sur le lac Whitefish (Nord-Ouest de l'Ontario) a d'abord été fouillé par K.C.A. Dawson en 1970. En raison de la combinaison de riches dépôts archéologiques et d'un important tertre funéraire, le site a joué un rôle considérable dans l'élaboration du cadre historique de la culture du Sylvicole du Nord-Ouest de l'Ontario. Une quarantaine d'années après les fouilles de Dawson, nous avons réexaminé le site à l'aide de télédétection, d'activités de prospection et de fouille ainsi que de l'analyse de résidus alimentaires. Ce travail a permis de mieux comprendre les choix de subsistance de cette période et souligne l'importance d'appliquer de nouvelles techniques d'analyse aux sites archéologiques de la forêt boréale.

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Discovering the Fresh Water Reservoir Effect in the Northern Boreal Forests: Refining the Temporal Framework

E. Leigh Syms

Although the marine reservoir effect of radiocarbon dating is widely known, the freshwater reservoir effect is a much more recently identified phenomenon in Europe and is being recognized only intermittently in North America. Discrepancies in paired radiocarbon dates from single event samples from the Boreal Forest of northern Manitoba exhibited a pattern in which examples from aquatic sources or sources with a fish diet yield dates that are 220–370 years older than samples from terrestrial ones. Where independent dating is available, the terrestrial sources are found to provide the correct date. This pattern is consistent with European dating results. Selection of dating specimens must include multiple dates and, where available, both aquatic and terrestrial samples. Human bone samples must undergo stable isotope analyses including ^{15}N and ^{13}C on both apatite and collagen fractions, and should include δD. The discovery of the freshwater reservoir effect in Europe and northern Manitoba has major implications for choosing, correcting, and interpreting all dating samples that are affected by freshwater resources, which are dates representing vast areas of Canada, the Americas, and the rest of the world.

Introduction

Efforts to date archaeological events in the Canadian Boreal Forest are often severely hampered by the ancient sites having been located in moss and other vegetational surfaces which are periodically burned by forest fires, leaving collapsed stratigraphy and little or no organic material to be dated. However, when organic samples are recovered, as in eroding burial caches and other unusual circumstances, excellent examples may be available to provide radiocarbon dates.

As a result of efforts to date materials in the northern Manitoba Boreal Forest, we discovered the impact of the freshwater reservoir effect, a phenomenon that has a profound impact on dating and interpretations in the Boreal Forest and any area where aquatic resources are consumed. I think that Ken Dawson would have been pleased to see that the research in the Boreal Forest that he loved so much will play a role in changing how archaeology is done.

Starting in the early 1900s, we have been dating organic materials recovered from the central Canadian Boreal Forest as part of the Churchill River Diversion Archaeological Project (CRDAP). Two, and sometimes three, calibrated accelerator mass spectrometry (AMS) dates were used for each event. We were finding that some paired dates were a few hundred years apart and not even quite overlapping at two standard deviations, which should not usually happen for single events. These differences continued to be identified and we believed that it had to have something to do with the fish consumption, which is an important northern dietary resource, but we were not aware of the pioneering work that was beginning in Europe (e.g., Lanting and Van der Plicht 1998).

In order to be certain that reliable dates were being obtained, multiple samples were dated. Discrepancies in paired dates from tight contexts lead us to the conclusion that there is a freshwater reservoir effect. This phenomenon has major ramifications for how we select, process, and interpret dates in any environment where aquatic sources are important food resources.

The Freshwater Reservoir Effect

The freshwater reservoir effect is the production of erroneously older radiocarbon dates on organic materials. These older dates are caused by human consumption of aquatic resources that contain older carbon than that of the atmospheric carbon reservoir when the specimen was alive. It is somewhat related to the marine reservoir effect in which marine materials are consistently older than contemporaneous terrestrial sources. Molto and colleagues (1997), Southon and Fedje (2003), and Stuiver and colleagues (1993) provide summaries for this worldwide phenomenon. Globally there is an average offset of about 400 years although the values vary through time and around the world and include ranges of 600–1000 years. There is now an international database for corrections at the CALIB website (Reimer and Reimer 2001). The implication for coastal researchers around the world is obvious. When they are now dating marine materials or populations with a marine diet, including inland populations with a salmon diet, they must correct for this reservoir effect.

The freshwater reservoir has been identified primarily in Europe. It has been studied extensively in the Netherlands but it is also being tested and found to be an important variable in the Ukraine, England, Ireland, Germany, Sweden, Norway, Denmark, and Serbia (Bocherens 2009; Cook et al. 2001; Fisher and Heinemeier 2003; Lanting and van der Plicht 1996, 1998; Lille et al. 2009). Lanting and van der Plicht (1996, 1998) have been working on bone samples from a variety of rivers in the Netherlands. When they corrected for the freshwater reservoir effect, they were able to account for a number of dating anomalies (e.g., skeletons of the Dutch royal family were no longer 400 years too old). They also identified the pervasive nature of this effect and the efforts required to correct for it (Table 1).

Table 1. *Some important insights on the freshwater reservoir effect in the Netherlands, based on information from Lanting and Van der Plicht (1996).*

#	Insight
1	There are fresh water reservoir effects on samples from both rivers and standing water such as lakes and canals.
2	There are differences in degree of the effect along rivers, with lower effects occurring down river.
3	Any consumers of fish, including human populations and animals such as dogs, will exhibit the fresh water reservoir effect. Even sheep that were eating coastal fish were affected.
4	Changes in cultural patterns such as the medieval Catholic requirements of fish three times a week will increase the reservoir effect.
5	It is crucial to run stable isotopic analyses on bone samples to determine diet, particularly the likelihood of aquatic resources; in addition to measure of ^{13}C on collagen that is routinely run by dating laboratories, it is also necessary to run ^{13}C on the carbonate fraction of bone apatite and to run ^{15}N; without the ^{15}N it is almost impossible to estimate the reliability of age determination. • ^{13}C collagen fraction provides evidence based only on the protein, whereas the bone apatite fraction provides evidence based in the total diet. • ^{15}N is far more positive for fish than for terrestrial foods; it can provide insights into trophic levels of various species in the food chain. • When choosing bone elements for dating and isotopic analysis, it is best to use dense bones rather than porous bones.

Cook and colleagues (2001) were working on Serbian Mesolithic burials and village deposits and were able to coordinate contradictory data between skeletal materials and younger charcoal dates from the settlement occupations when they ran isotopic samples and corrected for the freshwater reservoir effect. They found that a reservoir effect on bones with a 100 percent aquatic diet changed the dates by about 425 ± 55 ^{14}C years; however isotopic analyses indicated that diets were variable, but higher ^{15}N value indicated a higher fish resource use, which in turn produced a higher freshwater reservoir effect.

Fisher and Heinemeier (2003) were addressing the issue of dates from ceramic encrustations from inland sites in Denmark. They

Table 2. *Comparative, multiple-dated samples from Manitoba caches.*

Site Name	Lab Number	Borden Number	Conventional Date, BP
Moose Rack	Beta-163689	GjLp-7	5950 ± 40
Moose Rack	Beta-163690	GjLp-7	5590 ± 40
Island River Burial	Beta-180718	HdLx-1	4100 ± 40
Victoria Day Feature 1	CAMS-13187	GkLr-61	4370 ± 60
Victoria Day Feature 1	CAMS-13187	GkLr-61	4050 ± 70
Victoria Day Feature 1	Stable Isotope (Molto)	GkLr-61	
Victoria Day Feature 2	TO-6031	GkLr-61	3700 ± 60
Victoria Day Feature 2	TO-6032	GkL-61	3920 ± 60
Victoria Day Feature 2	Stable Isotope (Molto)	GkLr-61	
Two Exes	Stable Isotope (SFU)	GlLt-3	Archaic?
Too Hot Site	Stable Isotope (SFU)	GlLk-4	Archaic?
Bone Knives Site	Beta-130154	GkLs-20	1950 ± 50
Bone Knives Site	Beta-130155	GkLs-20	2020 ± 70
The Pas Burial Site	CAMS-13187	FkMh-5	1810 ± 60
The Pas Burial Site	CAMS-13185	FkMh-5	1740 ± 60
The Pas Burial Site	CAMS-13186	FkMh-5	1750 ± 60
Wapisu Cairn Burial	CAMS-13189	GkLt-20	1750 ± 60
Wapisu Cairn Burial	CAMS-13190	GkLt-20	1720 ± 60
Wapisu Cairn Burial	CAMS-13191	GkLt-20	1700 ± 70
Nagami Bay Burial	Beta-106475	HgLt-1	220 ± 50
Nagami Bay Burial	Beta-107745	HgLt-1	440 ± 30
Nagami Bay Burial	TO-5228	HgLt-1	590 ± 40
Oto-Who-Win	Beta-153570	GkLr-11	270 ± 40
Oto-Who-Win	Stable Isotope (Ens)		
Birch Bark Wrapped	Stable Isotope (Ens)	GkLr-5	Historic
Hydro Line Site	Stable Isotope (SFU)	GkLk-7	Historic

dated modern fish, two different species of fish from two archaeological deposits, and pot encrustations from the two occupations. The modern freshwater fish were found to be about 300 years too old as a result of the reservoir effect. These archaeological specimens were also too old but the pike whose diet would include some non-aquatic foods such as ducklings and frogs showed less of a shift (about half the date change) than the tench (*Tinca tinca*), which is a Eurasian member of the carp family (Ontario's Invading Species Program 2017). The latter have a different trophic regime consisting solely of aquatic diet of larvae, bivalves, snails, and slugs. Fisher and Heinemeier (2003) found that ceramic encrustations produced reservoir effects in the range of 500 years. Like the

Calibrated Age Range cal BP	Calibrated Age Range cal BC/AD	Material	Carbon $\delta^{13}C$ (‰)	Nitrogen $\delta^{15}N$ (‰)
6870–6670 BP	4920–4720 BC	Human Bone	–19.9	12.8
6440–6300 BP	4490–4350 BC	Moose Antler		
4720–4510 BP	2770–2560 BC	Human Bone	–20.5	12.3
5053–4831 BP	3104–2882 BC	Human Bone	–21.6	13.9
4741–4405 BP	2792–2456 BC	Moose Bone	–22.1	
		Beaver Tooth	–20.7	
4161–3868 BP	2212–1919 BC	Moose Antler		
4018–3681 BP	2069–1732 BC	Loon Bone		
		Human Bone	–24.1	15.48
		Human Bone	–22.7	14.7
		Human Bone	–22.4	14.3
1930–1710 BP	AD 20–240	?	–21.3	
2065–1725 BP	BC 115–AD 225	?	–21.6	
1873–1597 BP	AD 77–357	Moose Antler	–19.9	
1744–1531 BP	AD 206–419	Moose Antler	–20.0	
1817–1538 BP	AD 133–412	Antler	–20.3	
1817–1538 BP	AD 133–412	Antler	–21.3	
1744–1519 BP	AD 206–431	Human Bone	–20.0	12.9
1739–1476 BP	AD 211–474	Moose Tooth	–19.9	
315–250 BP	AD 1635–1700	Pin Cherry Seed	–25.3	
525–465 BP	AD 1425–1485	Human Bone	–23.3	
675–525 BP	AD 130–1440	Human Bone	–25.0	
170–150 BP	AD 1780–1800	Human Bone		
			–20.4	12.4
	AD 1850?	Human Bone	–20.0	12.7
	AD 1900?	Human Bone	–20.3	12.4

Netherlands research by Lanting and van der Plicht (1996, 1998), they emphasize the need to test both carbon and nitrogen isotopes; higher values of both, but particularly ^{15}N, will indicate high rates of freshwater resources and larger reservoir impacts on the dates.

These few examples show that correcting for the freshwater reservoir effect is very complex. While there are undoubtedly impacts on the dates of the bones, pottery encrustations, and other materials, there needs to be testing of different water sources, species with varying trophic levels, and diets with dissimilar ratios of aquatic versus terrestrial sources.

Discovering the Local Freshwater Reservoir Effect

The local freshwater reservoir effect was discovered through the dating efforts of the CRDAP in the Boreal Forest of northern Manitoba and from a small sample of dated caches from the Woodland Region of southeastern Manitoba in the 1990s (Table 2; Figure 1; Syms 2000, 2001). Many of the dates came from isolated burials that had been found eroding from shorelines and were recovered to be returned to First Nations communities for reburial. Features were dated by two and sometimes three calibrated AMS dates. Dates were sometimes different, not even overlapping at one standard deviation, which should not be the case for single events. At the time, we had not heard of the pioneering work in the freshwater reservoir effect that was underway in Europe.

The Churchill River Diversion Archaeological Project

The CRDAP, later changed to CDAP, is an archaeological impact assessment and salvage project on the Churchill River Diversion System in the northern Boreal Forest of northern Manitoba. Its main focus has been to rescue part of the ancient archaeological heritage that has been inundated and is being destroyed in the development and operation of a series of hydroelectric dams, beginning in the late 1960s (see Badertscher [2001], Kroker [1990], and Syms [2006] for summaries of the history of this project). Renewed monitoring activity began in 1990 when the Cree community of South Indian Lake requested that archaeologists rescue eroding human bones to be returned to the community.

Since then there has been annual monitoring of known sites until the early 2000s, plus discoveries of numerous new sites, and the rescue of eroding burials, involving working in conjunction with the local band councils and elders (e.g., Malasiuk 2001; McKinley 2001; Riddle 1994, 2000a, 2000b, 2000c; Smith 1996; Speidel and Syms 2000; Syms 2006). There are now over 800 archaeological sites, which is one of the largest concentrations of sites in the Canadian Boreal Forest (Historic Resources Branch 1998; Syms and McKinley 2002).

The Churchill River Diversion System consists of many rivers and lakes. These numerous lakes range from widened river channels to the massive Southern Indian Lake that is more than 100 kilometres long in straight linear length. Lakes are so numerous that the Manitoba government at one time printed license plates with the saying "the province with 10,000 lakes." There is a wide variety of resources and the area is particularly rich in fish, the importance of which will become evident shortly. Southern Indian Lake supports a very large and productive commercial fishing industry; it is reported that the current Cree community moved to this lake specifically for the fishing.

The Nagami Bay Woman

The recovery and analysis of the Nagami Bay woman on Southern Indian Lake (Figure 2) provided a dating sample that represented a single isolated feature with an independent dating source of historical documentation (Brownlee and Syms 1999). This eroding burial was a woman from the Protocontact Period, when local Cree First Nations were starting to obtain European goods from the east through intermediary Native traders, but when European traders had not yet reached northern Manitoba. She was accompanied by a large cache of mainly traditional bone and stone items, such as stone whetstones, scrapers, bifaces, an adze, worked flakes, a graphite paint stone,

Figure 1. *Manitoba sites with dated caches having comparative dates (Syms 2001:4).*

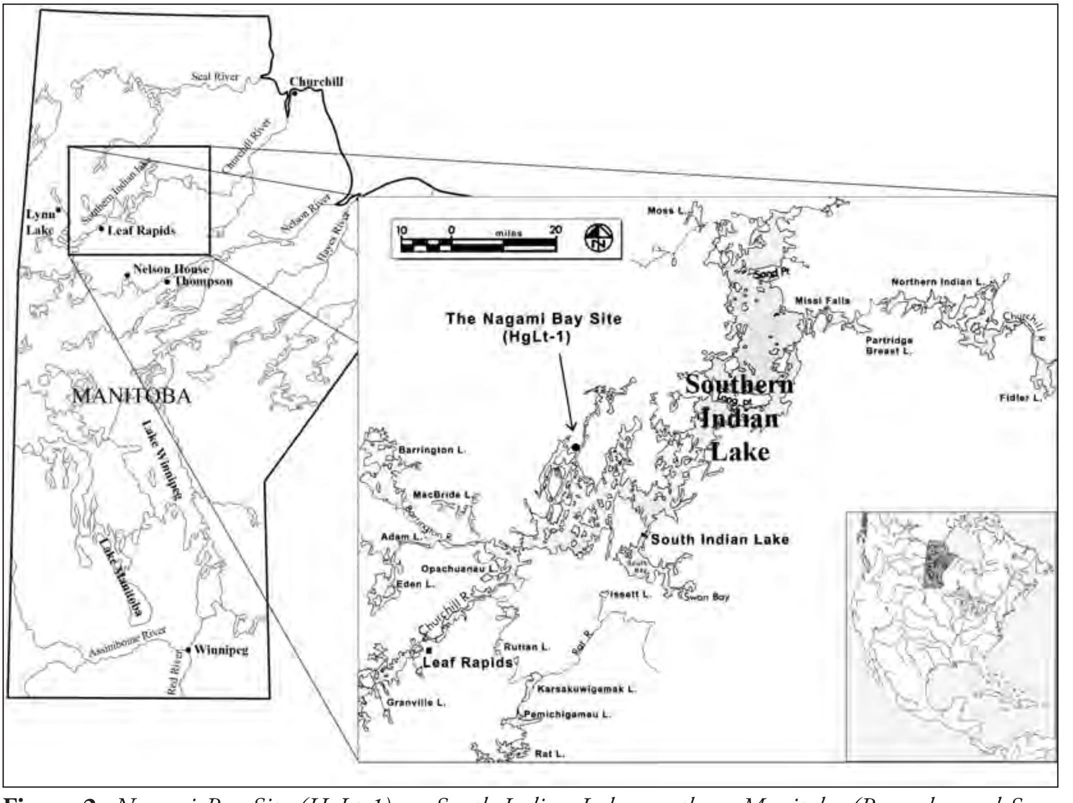

Figure 2. *Nagami Bay Site (HgLt-1) on South Indian Lake, northern Manitoba (Brownlee and Syms 1999:2).*

bone awls, a loon wing awl handle, a knife from a moose spinous process, geochemically identified catlinite beads, and 1,641 pin cherry seed beads (Figure 3). However, she also had a small sample of two European blue glass beads, a copper and an iron knife blade in split rib handles, and an iron awl point in a wing bone handle (Brownlee and Syms 1999). These European materials came from the St. Lawrence River area. For the Churchill River System, the Protocontact Period was AD 1654–1682, starting with the opening of the upper Great Lakes to traders about AD 1654, after the cessation of the Iroquois wars that had closed western trade and ended in AD 1682 when the construction of three local forts on the Hudson Bay provided a supply of European goods (see Brownlee and Syms 1999 for discussion).

Efforts to date the woman's remains initially produced anomalous results. A bone derived radiocarbon sample that was sent to the Isotrace Research laboratory was assessed at cal AD 1310–1355 (88%) and cal AD 1385–1400 (100%) at one sigma, impossibly early dates (Table 3). Assuming that a laboratory error had taken place, a second sample was submitted but this also came back with almost identical dates of cal AD 1310–1350 (62%) and AD 1390–1420 (100%) at one sigma. When questioned about the impossibly early date, Isotrace Research staff responded by saying that there must have been mixing from other occupations, but that could not have taken place because this burial clearly was a single event. A sample was sent to Beta Analytic to test for laboratory variability but it came back with a similar date of cal AD 1435–1460 at one sigma. It had to be assumed that either the iron items represented had been the unlikely influence from the last of the Vikings in Greenland or, more

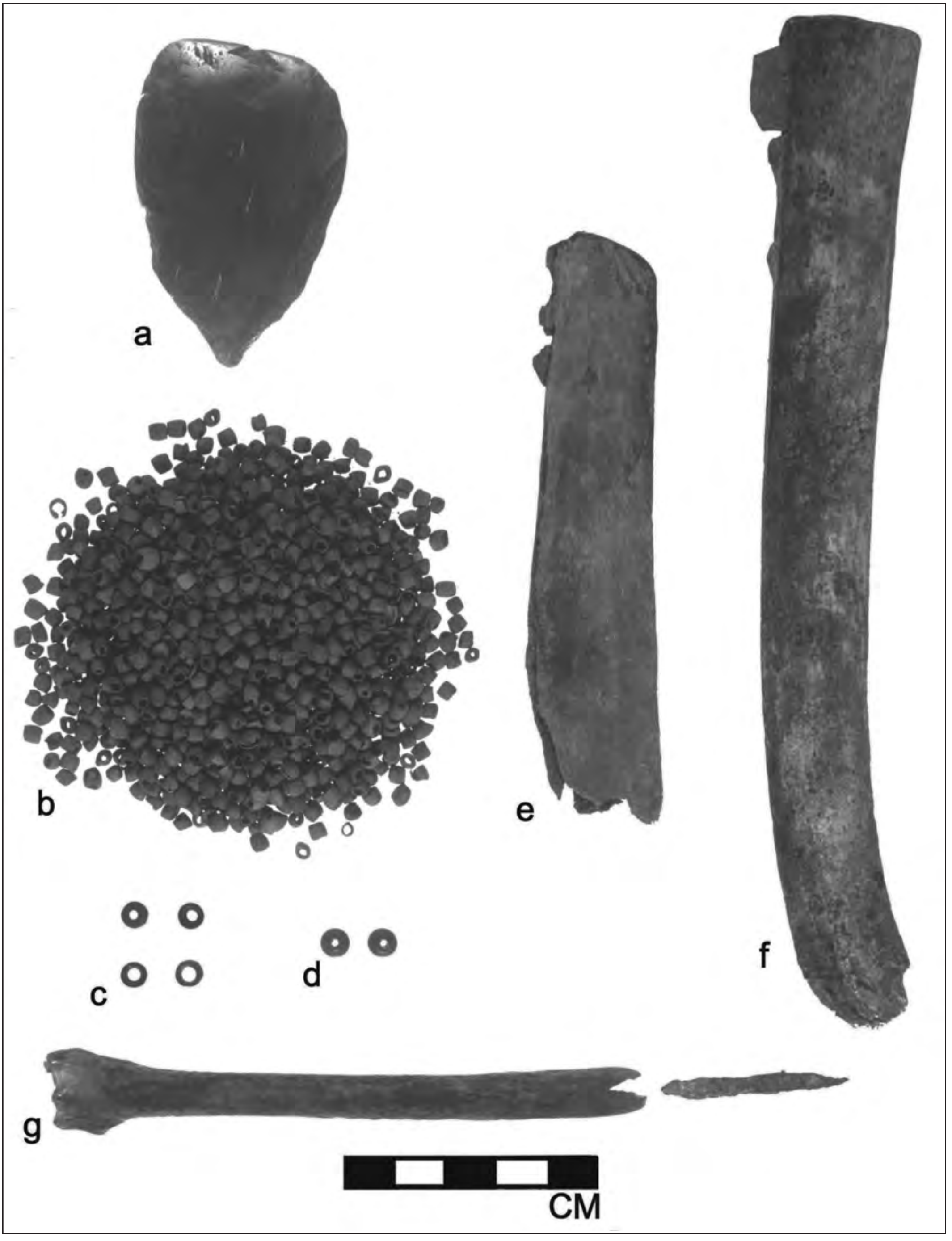

Figure 3. *Variety of artifacts associated with the Protocontact Nagami Bay woman. a): stone adze; b) sample of pin cherry seed beads; c) catlinite beads; d) glass beads; e-f): rib bone knife handles with inset iron and copper blades; g) wing bone handle with iron awl inset.*

Table 3. *Dates for the Nagami Bay cache (HgLt-1).*

A. Protocontact (Historical Documentation) - AD 1654–1682					
B. AMS Dates					
Sample #	**Material**	**C^{13}/C^{12} (‰)**	**Conventional Radiocarbon Age, BP**	**Cal age range 1 (SD) 68%**	**Cal age range 2 (SD) 95%**
TO-5228	Bone	–25.0%	590 ± 40	AD 1310–1355 (88%)	AD 1300–1430
				AD 1385–1400 (100%)	AD 1300–1430
TO-5228a	Bone	–25.0%	570 ± 40	AD 1310–1350 (62%)	AD 1300–1440
				AD 1390–1420 (100%)	AD 1300–1440
Beta- 107745	Bone	–23.3%	440 ± 30	AD 1435–1460	AD 1425–1485
					AD 1535–1545
Beta-106475	Seeds	–25.3%	220 ± 50	AD 1650–1680	*AD 1635–1700*
				AD 1755–1805	AD 1720–1820
					AD 1855–1860
				AD 1940–1950	AD 1920–1950

TO-5228a was a re-run of TO-5228 because we assumed that there had been an error in the laboratory processing because the date was too early; the italicized date is the only date range that falls in the Protocontact Period and is also consistent with the artifact cluster

Table 4. *Central date differences between terrestrial source dates versus aquatic sources and human population dates, northern Manitoba.*

Site	**Conventional Radiocarbon Dates (BP) and Materials**		**Date Differences**
Moose Rack GjLp-7	5950 ± 40 human bone	5590 ± 40 moose antler	360
Victoria Day GkLr-61 Feature 1	4370 ± 60 human bone	4050 ± 70 moose bone	320
Victoria Day GkLr-61 Feature 2	3920 ± 60 loon bone	3700 ± 60 moose antler	220
Nagami Bay HgLt-1	440 ± 30 human bone	220 ± 50 pin cherry seeds	220
	590 ± 40 human bone	220 ± 50 pin cherry seeds	370

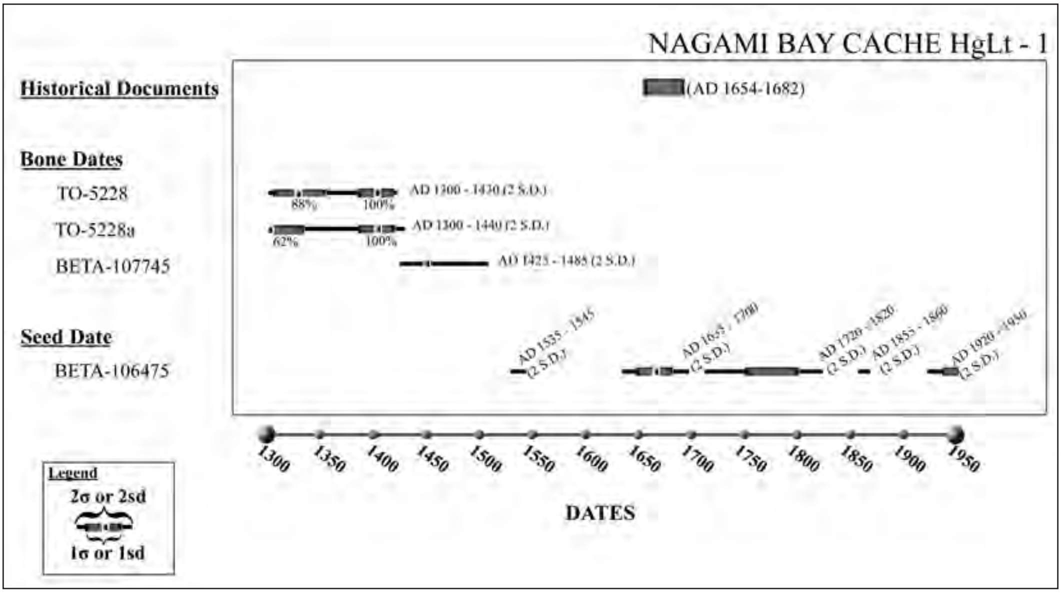

Figure 4. *Schematic of Nagami Bay Site (HgLt-1) dates, showing the difference between the bone dates affected by the freshwater reservoir effect (upper) and the correct terrestrial dates (lower).*

likely, that the dates were in error. At the suggestion of Kevin Brownlee, a sample of pin cherry seed beads was submitted for dating, and these produced a result that was about 250 years more recent and compatible with the historically derived date. Like most recent dates, it produced multiple intercepts within the calibration curve, of which one, cal AD 1650–1680 at one sigma and cal AD 1635–1700 at two sigma matched the historic date range (Figure 4). In the meantime, the trace element calibration of the blue glass beads also confirmed the historically documented date range.

The results are a few paired dates representing both terrestrial and aquatically influenced sources from single features (Table 4). We find, with one exception, that all of the dates from aquatic sources (e.g., loon and human populations consuming a fish diet) are approximately 220 to 370 years older, using age range intercepts, than the dates from terrestrial sources, such as moose and pin cherries, from the same archaeological features. These dates do not show any changing trend through time. As Kevin Brownlee (personal communication) has found, the values for ^{13}C and ^{15}N are also clustered very tightly throughout the full time period. These older dates are, we believe, due to the freshwater reservoir effect introduced through a mostly fish diet, one that we know to have been important traditionally in this area (Syms 2003a, 2003b, 2003c, 2004, 2008).

Need for Staple Isotope Analysis in Developing Consistent Radiocarbon Dates

The freshwater reservoir effect and marine reservoir effect are also part of the larger issue of dating samples from different species that "contain inherent differences as a result of isotopic fractionation in the living plant and animal" (Morlan 1999:3). For example, C_3 plants as represented in most flowering plants and temperate zone grasses yield different results than C_4 plants such as corn. These differences in isotopic fractionation are further differentiated up the food chain between the ungulates that feed on the plants and the carnivores that feed on the ungulates. Within the aquatic setting there are food chains that include both aquatic and terrestrial food sources whether it is fish that consume some non-aquatic resources or birds such as loons that consume fish, molluscs, and other aquatic resources. As Morlan (1999:4) has so eloquently stated, "Unless we take into account the inherent differences in isotopic fractionation among these dating samples and correct for them, we are not merely comparing apples and oranges…; we are building on a veritable fruit basket!"

In order to identify and correct for the freshwater reservoir effect, it is necessary to determine an isotopic fractionation baseline of local resources that includes terrestrial and aquatic resources and animals with mixed terrestrial and aquatic diets. A detailed review of the complexities of isotopic analysis is beyond the scope of this paper. Values have been commonly calculated for $\delta^{13}C$ and $\delta^{15}N$. Increasing values for these isotopes reflect increasing trophic levels in the food chain from plants to herbivores to carnivores to humans. There have been recent developments in the use of the stable hydrogen isotope, δD, which also shows increasing values in the trophic chain from herbivores to omnivores to humans to carnivores, in patterns that are analogues to the $\delta^{15}N$ developments (Arnay-de-la-Rosa et al. 2010; Reynard and Hedges 2008).

Developing a Freshwater Reservoir Calibration

When dealing with marine reservoir calibration there have been thousands of calibrations including controlled samples. As a result there is an established calibration curve (Reimer and Reimer 2001) and see Molto and colleagues (1997) for an application.

Quantification of the freshwater reservoir effect is in the developmental stage. Our initial work in northern Manitoba conducted the simple technique of subtracting the calibrated dates of human remains from terrestrial dates based on pin cherry seeds and moose and assumed that the differences represented the impact of aquatic diets (Brownlee and Syms 1999; Syms 2004, 2008). As noted in a previous section, a number of calculations using the same approach have been determined from international sites, but it cannot be assumed that these values will be universally consistent and, therefore, be transferable to local research.

We need to set up regional databases with rigorously researched samples. It is necessary to use stable isotopic values for terrestrial samples of plants such as berries and animals that have totally terrestrial diets, such as many birds, rodents, and deer. Some species such as moose may not even be ideal, since they include aquatic plants as part of their diet. For aquatic species we need to use species that have a diet of just aquatic plants or other aquatic species. Here again, those fish that include non-aquatic dietary items such as baby birds do not yield the same values as other fish (Fisher and Heinemeier 2003). The differences in stable isotopic values will provide the freshwater reservoir values. These need to be determined for modern species as well as for samples that are contemporary with the archaeological samples. These data will also be important during the calculation and analyses of diets. If it becomes necessary to use species such as bears that include mixed terrestrial and aquatic diets, there is developing research on equations that incorporate multiple dietary sources (Phillips and Gregg 2003; Phillips and Koch 2002). As a database of large numbers of freshwater reservoir effects dates is determined, distribution curves should be able to be developed.

Dates for human bone samples will have isotopic fractionation values that will reflect their usually omnivorous diet of both terrestrial and aquatic species. Their diets will, then, usually differ from terrestrial species and these differences will reflect the aquatic impact.

The calibrated dates for these samples exist as time ranges that should be small. The calculations are based on point differences within these ranges, so it is advisable to use the mean values of these ranges for consistency. The mean values should also represent the highest probability values.

Developing Consistency of Dating Results

We need to establish a consistent set of steps in documenting and reporting dates. I would suggest the following steps:

1. For non-human remains, choose dating samples that are taxonomically identifiable, preferably at the species level, so that the relationship of terrestrial versus aquatic diet sources are known

2. Use radiocarbon conventions as outlined by Stuiver and Polach (1977)
- Libby half-life of 5568 years
- Oxalic acid as a standard
- The year 1950 as the base line year for BP date
- Normalize for carbon isotope fractionation

3. Always request ^{13}C isotope ratio*
- Sometimes this comes with AMS dates, but not traditional dates
- Are done on bone collagen which provides information on protein only
- Insist that they be run and check that they are run and not just estimated

4. Request ^{13}C ratios on bone apatite as well*
- ^{13}C collagen fraction provides evidence based solely on the protein whereas the ^{13}C on the carbonate fraction of the bone apatite provides evidence based on the total diet
- More important for establishing total diet than freshwater carbon

5. Request ^{15}N ratios[1]*
- Absolutely necessary to determine diet
- It is far more positive for fish than terrestrial foods
- It can provide insights into the trophic levels of various species in the food chain, so one needs to try to use samples that are identifiable to species

6. Consider δD ratios since they are becoming more conventional and may replace δC to some degree

7. Calculate the freshwater reservoir effects by determining the differences between the mean range of values for terrestrial and aquatic sources, until such time as standardized ranges of regional differences can be developed based on multiple samples

8. Consider the necessary correction for various isotopic fractionation for various diets
- Clearly need to understand the ecology of the plants and animals that are being used for dating samples
- For humans, need to consider their even more complex ecological behaviour

9. Use calibrated dates

10. For dates that were run earlier, normalize them based on the best estimate of ecological patterns
- Cannot necessarily just use the average dates suggested recently by Morlan (1999)

Current Developments

The recognition of the importance of this effect is appearing sporadically around the world. As noted earlier, the applications of this dating correction are developing rapidly in Europe. Elsewhere, its development appears to be sporadic, and only recently is it starting to emerge as a brief review of some of the reports are indicating, such as effects on riverine shells in the Murray-Darling Basin in New South Wales, Australia (Gillespie et al. 2009), and altered dating of 340 ± 20 years on freshwater shells in the Elk Hills of California (Culleton 2006). The freshwater reservoir effect is being addressed or incorporated sporadically in the Americas (Culleton 2006; Zarrillo et al. 2008a, 2008b). Zarrillo and colleagues (2008a, 2008b) identified it as an issue in early Ecuadorian sites, but argued that it was not an important issue there, because the diet was largely plant-consuming terrestrial animals. This effect is clearly a worldwide, if somewhat sporadically developed, phenomenon.

[1] For a \$50–\$60 additional cost for these additional results, one may obtain crucial information for good, consistent dates.

Implications Arising from the Fresh Water Reservoir Effect

Since the fresh water reservoir effect exists as well as the marine reservoir effect, and since we have evidence that seems to confirm that, like Western Europe, we have the effect here in North America, what are the ramifications? I would suggest the following observations:

1. Any area where there is the likelihood of fish, mollusc, or other aquatic resource consumption (and that is in much of North America), it is necessary to take multiple dates and stable isotope measurements on terrestrial and aquatic resources and consumers of these resources to check for the freshwater reservoir effect and to establish the degree of that effect. In choosing the dating samples, it is important to have some knowledge of animal behaviour. We know that dog teams in the north were fed large quantities of fish. Migratory waterfowl may be affected by their southern environments (e.g., loons not only have a northern aquatic diet but also some marine diet in the south).

2. It is crucial to establish diet through ^{13}C values in collagen and bone apatite fractions and through ^{15}N to determine if fish or other aquatic species were part of the diet and caused the reservoir effect. δD values are also becoming important and may reduce the need for $\delta^{13}C$. It will be necessary to determine diet based on relating isotopic values and faunal resources (Katzenberg 2000; Katzenberg and Harrison 1997).

3. In addition to making the existing corrections to past, present, and future dating samples to produce consistent conventional dates and calibrated dates, it will now be necessary to correct for both marine and fresh water reservoir effects in many areas. All dates must be converted to conventional dates and all must be calibrated; this must apply to related geomorphological and environmental dates.

4. Failure to identify, measure, and correct for the reservoir effects will not only continue to produce unexplainable anomalous dates, such as burials associated with villages yielding different dates than samples from the villages, but it will produce fallacious results that will lead to a great number of inevitable misinterpretations. Figure 5 illustrates only a couple of the myriad of potential misinterpretations.

(**A**) (upper image) The combining of older, uncorrected reservoir effect dates with correct terrestrial dates will incorrectly increase the definitive time span for archaeological complexes, making it impossible to develop tight temporal control, and will lead to erroneous "average" dates and temporal ranges.

(**B**) If one is trying to relate cultural activities to environmental events such as the drought of the 1300s, this will be impossible if the environmental dates are terrestrial samples, which they tend to be, and the cultural dates are erroneously older because of the reservoir effect, making them appear to be of different time periods and unrelated.

(**C**) It will be impossible to discuss relationships between coexisting precontact coastal and inland groups such as the Inuit and Dene when the coastal populations may be dated much older than their caribou-eating contemporaries due to the marine reservoir effect. Diets and dates affected by the marine reservoir effect will yield different results than inland groups affected by the freshwater reservoir effect as demonstrated in Danish sites (Fischer and Heinemeier 2003).

(**D**) There will have to be the implementation of the correction for the freshwater reservoir effect in all areas where early populations have been consuming aquatic resources or resources that have fed on aquatic resources throughout the world. Until its use becomes widespread, it can be used to solve only site-specific problems; any broader research issues will be hampered by incompatible data!

Acknowledgements. These dates are from the CDAP which consisted, until the mid-2000s, of a partnership consisting of Manitoba Hydro, who provided annual funding as part of the Northern Flood Agreement and their commitment to the northern communities; Manitoba Historic

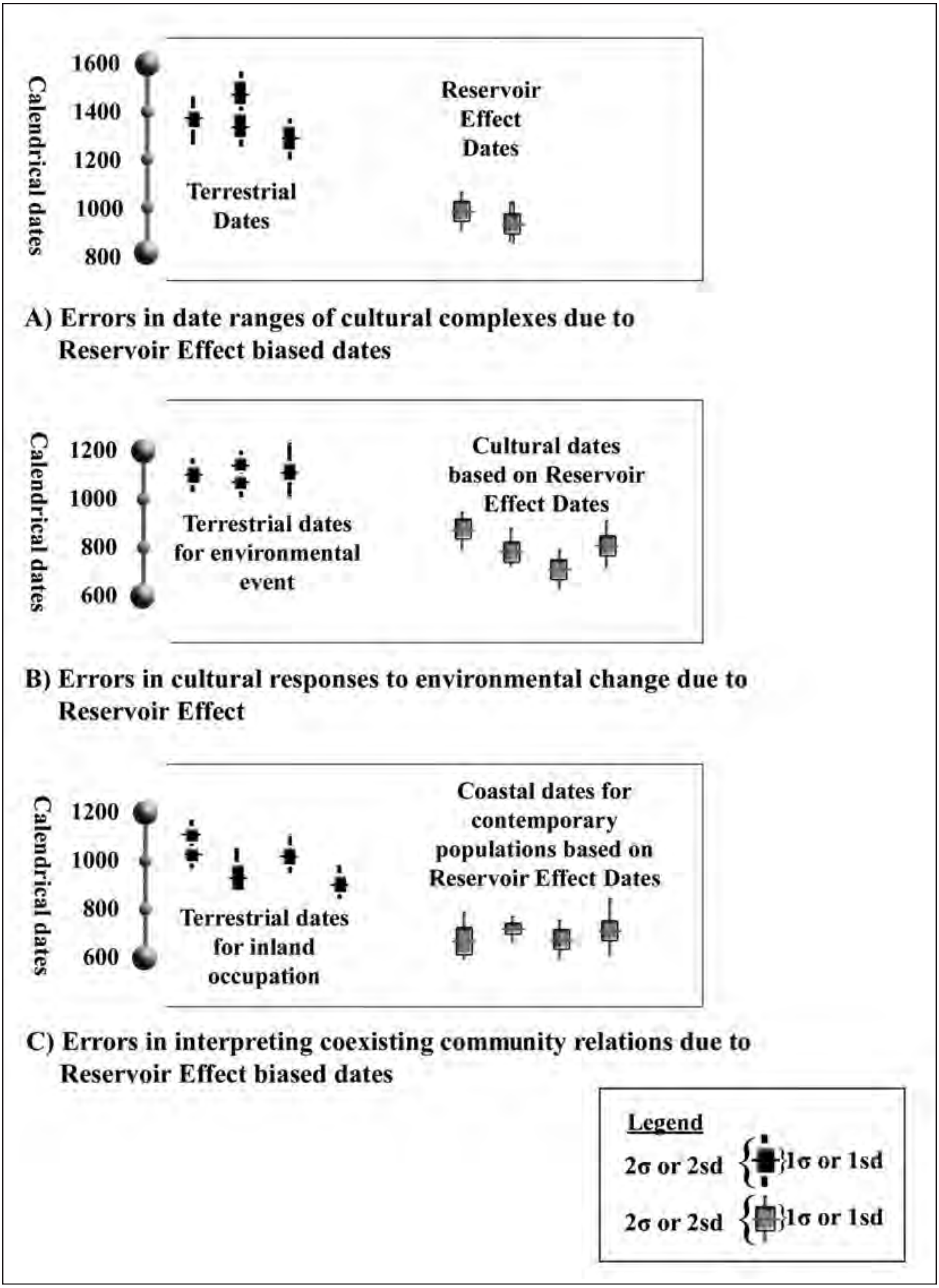

Figure 5. *Schematic presentation of problems created by comparing radiocarbon dates uncorrected for freshwater reservoir effects and correct terrestrial dates.*

Resources Branch, which administered the project and provided field crews; The Manitoba Museum, which provided artifact analysis, storage and management, research publications, educational exhibits and public programming, particularly to First Nations groups and communities; and several First Nations communities, particularly Nisichawayasihk First Nation of Nelson House, who provided advice, information, and field crews. Dr. Earle Nelson of Simon Fraser University helped to process and provide the first set of dates, the CAMS dates. I would also like to thank Kevin Brownlee for sharing his ideas and providing his summary data on dates and stable isotopes. Myra Sitchon provided a number of the interpretive figures that helped to visually clarify the arguments. The editorial input and comments of two anonymous reviewers and Jill Taylor-Hollings are much appreciated.

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Bien que l'effet du réservoir marin de la datation par le radiocarbone soit bien connu, l'effet du réservoir d'eau douce est un phénomène beaucoup plus récent en Europe et n'est reconnu que de manière intermittente en Amérique du Nord. Les divergences entre les datations par le radiocarbone de la forêt boréale du Nord du Manitoba ont démontré que la datation d'échantillons de sources aquatiques ou d'échantillons d'alimentation de poisson de la forêt boréale du Nord manitobain, associés à un même événement, était entre 220 et 370 ans plus reculée que celle d'autres échantillons de sources terrestres. Lorsqu'une méthode de datation indépendante est disponible, les sources terrestres fournissent la date exacte. Ce modèle correspond aux résultats européens. La sélection d'échantillons de datation doit comprendre plusieurs dates et, si possible, des échantillons aquatiques et terrestres. Les échantillons osseux humains doivent subir des analyses d'isotopes stables, notamment ^{15}N et ^{13}C sur les fractions d'apatite et de collagène, et doivent inclure le D. La découverte de l'effet des réservoirs d'eau douce en Europe et au nord du Manitoba a des répercussions importantes pour le choix, la correction et l'interprétation de tous les échantillons soumis à la datation qui ont subi l'effet de l'eau douce; ces datations représentent une grande partie des échantillons qu'on peut trouver au Canada, dans les Amériques et partout dans le monde.

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Problems and Potential in the Investigation and Interpretation of the Quarry of the Ancestors: Western Interior Boreal Forest Lithic Extraction Localities as Interpretive Prospect and Challenge

Elizabeth Robertson and Nancy Saxberg

Located about 50 km north of Fort McMurray, the Quarry of the Ancestors is a rare example of a relatively well-documented lithic extraction and processing locality in the Boreal Forest regions of Alberta and Saskatchewan. As a heavily exploited source of raw material, it incorporates massive quantities of tools and debris, a situation that, similar to many quarries, makes analysis and interpretation a daunting task. The location of the quarry in Canada's western interior Boreal Forest only intensifies this problem, because, like the vast majority of sites in this region, it has not experienced geomorphic processes favourable to stratification and the acidity of its Brunisolic soils destroys organic artifacts. These issues, in turn, make it difficult to vertically or horizontally define assemblages from different occupations, much less to assign absolute or relative dates to them. Nonetheless, the rich archaeological record at the quarry cannot be ignored, as it presents a rare and valuable opportunity to gain new insights about the nature of precontact activity in this part of the Boreal Forest. With the archaeological complexities and potential of this locality in mind, we suggest that effective and meaningful interpretation of the quarry benefits from a combination of technological and archaeometric research with studies that model the cultural frameworks that supported and facilitated precontact use of this important resource.

Introduction

The high density of archaeological remains typically associated with lithic quarries offers an exceptional amount of information on past technological activities and cultural practices. However, such large quantities of archaeological evidence can also pose significant challenges, demanding substantial time and effort for the analysis of the rich assemblages that quarry sites often yield. Interpretation of lithic quarries is further complicated by the intensive and repeated uses of many quarries, a phenomenon that can make it difficult, if not impossible, to identify the kind of vertical and horizontal patterning essential for archaeological differentiation of occupations and activities.

These challenges grow only more daunting in contexts such as the Boreal Forest of northern Alberta and Saskatchewan, where there is a paucity of well-established time-space frameworks of the type useful in untangling the complex archaeological deposits typical of quarry sites. The somewhat embryonic state of culture history in this region is partly due to limited previous research, but also reflects vegetation that heavily obscures the ground and impedes survey, acidic soils that usually leave only stone artifacts intact, and geomorphic conditions that do not favour formation of stratified sites (Ives 1985:1, 1993:8). These problems complicate the discovery of sites, limit the range of artifacts available for consideration, and preclude the use of chronometric dating based on radiocarbon assay or relative dating based on stratigraphic analysis. The limitations pose significant obstacles to the interpretation of relatively simple Boreal Forest sites, with even more serious implications for complex archaeological contexts, such as quarry sites. Yet the rich array of data yielded by lithic quarries suggests that they represent an extremely valuable, and possibly essential, means of addressing some of the many questions which archaeologists working in the Canada's Boreal Forest region continue to struggle with. Even so, the complexity of such sites, as well as the archaeological problems that this region presents, will require us to use levels of methodological and theoretical sophistication and innovation commensurate with these challenges.

The Quarry of the Ancestors as Interpretive Prospect and Challenge

The Quarry of the Ancestors is a rare example of a well-documented lithic quarry in northeastern Alberta (Figure 1). As such, it exemplifies the problems and potential that quarry sites present for efforts to better understand the region's archaeological record. Located about 50 km north of Fort McMurray (Figure 2), its core area is a designated provincial historical resource with boundaries that encompass just under 200 ha. The designated locality incorporates two major workshop complexes, HhOv-305 and HhOv-319, as well as a number of additional sites at which extracted stone was worked. It also includes at least two surface or near-surface exposures from which workable stone was likely extracted. However, its ground surface is currently largely obscured with boreal muskeg and forest, making it unclear if stone was once accessible in additional locations.

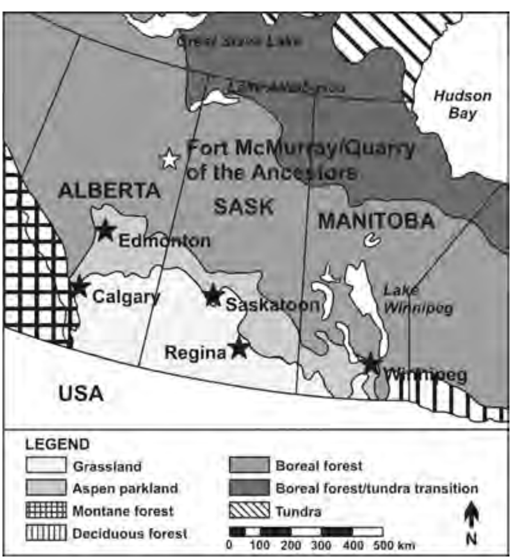

Figure 1. *Location of the Quarry of the Ancestors.*

The raw material from the quarry is known for historical reasons as Beaver River Sandstone (BRS) (Saxberg and Robertson 2017), although it is actually an orthoquartzite (Abercrombie and Feng 1997:267; De Paoli 2005; Tsang 1998:150–153). It has a variable appearance, ranging from dark gray to light tan and displaying a range of textures, the finest of which are well suited to the production of flaked stone tools. These textural differences are likely due to the processes responsible for orthoquartzite formation in this area. The processes are thought to involve hydrothermal upwelling through antecedent siltstones and sandstone, causing partial dissolution and subsequent redeposition of the silica comprising its grains (Abercrombie and Feng 1997:267; Church 1994:11, 1996:140–141; De Paoli 2005; Tsang 1998:150–153). This sequence of events leads to the attrition of these grains and the cementation of their remnants within an amorphous, siliceous matrix (Church 1996: Figure 3). Extensive dissolution and redeposition leads to an end product with considerable amorphous silica, giving it a fine-grained texture suitable for flintknapping, whereas limited dissolution and redeposition leads to retention of many original siltstone and sandstone grains, creating a less workable material, as seen in scanning electron micrographs (Figure 3).

The appeal of the less granular variants of BRS to ancient flintknappers is evident in the extremely high density of moderately to very fine-grained BRS tools and debitage in and around the quarry. Archaeological assessments conducted in association with active oil sands development have identified the aforementioned sites within its boundaries, as well as hundreds of additional sites beyond its perimeter (e.g., Saxberg 2007a, 2007b; Saxberg and Reeves 2004; Tischer 2004). In fact, the continuous nature of the culturally modified

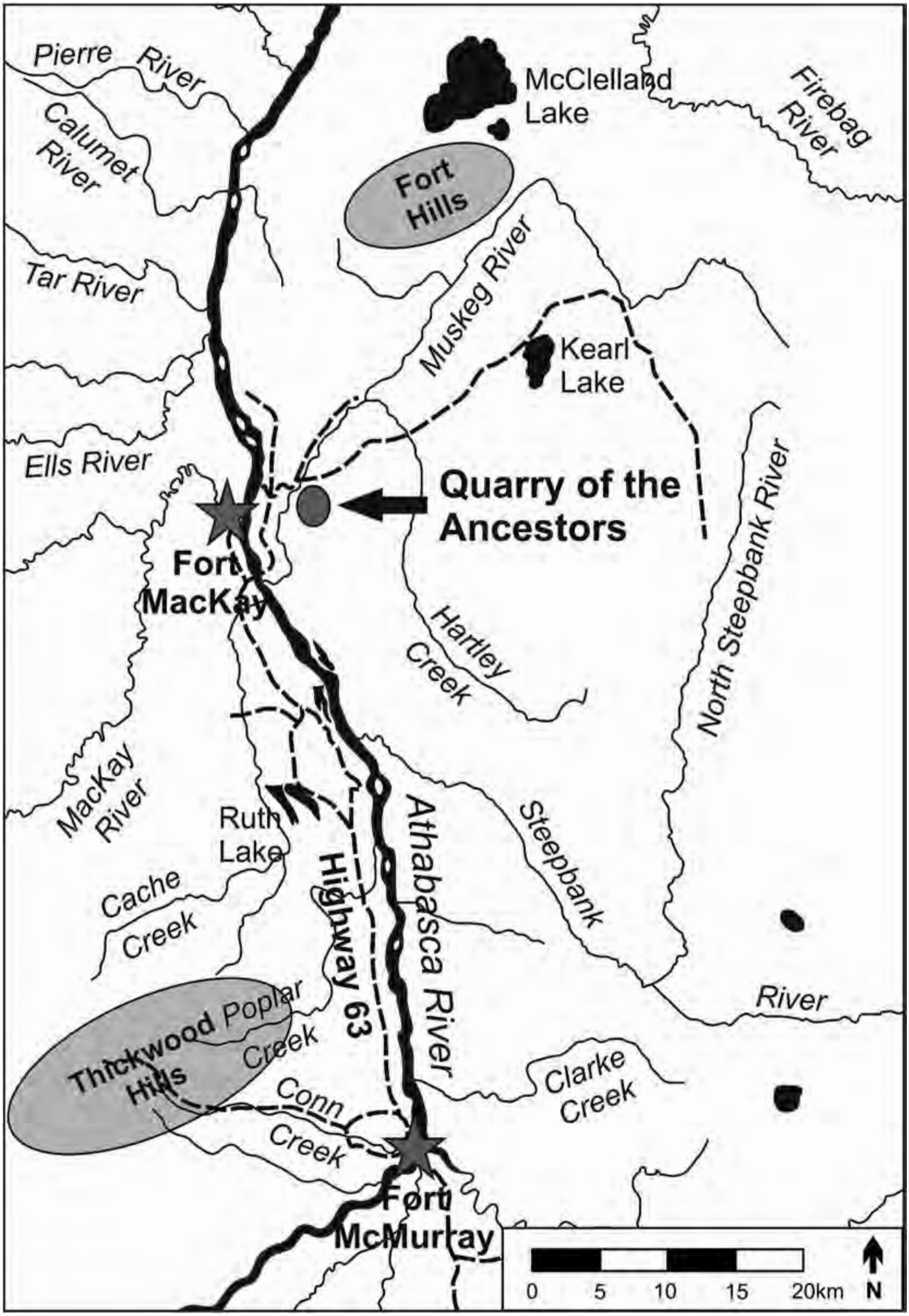

Figure 2. *Location of the Quarry of the Ancestors within northeastern Alberta.*

BRS deposits in and around the quarry suggests that, in many respects, the locality is better treated as a single site (Saxberg and Robertson 2017). Its discovery, coupled with past and present work in its vicinity by consulting, government, and academic archaeologists, has made it clear that the quarry represents an exceptional opportunity to gain important insights into the archaeology of this poorly understood region. At the same time, its investigation presents an array of challenges and complications that will continue to limit its interpretive value without continued efforts to find ways of coping with its dense and continuous cultural deposits.

The extensive oil sands development in the Quarry of the Ancestors area has meant that it has received more archaeological attention than the majority of northern Alberta. Even less is known about the ecologically and physiographically similar portions of Saskatchewan and the Northwest Territories. However, despite numerous surveys and excavations carried out in advance of oil sands extraction, the difficulties of undertaking archaeological investigations in the Boreal Forest and muskeg of the Quarry of the Ancestors area continues to restrict knowledge and characterization of surface and near-surface BRS occurrences, leaving even basic questions about the location and extent of quarrying activities unresolved. In particular, there has been continued debate about whether the BRS found at the many sites throughout the area was derived solely from the relatively fine-grained orthoquartzite occurrences found within the quarry as opposed to the outcrops of coarse-grained orthoquartzite typical of adjacent areas.

This debate has roots in the 1970s, when early interest in oil sands development triggered the initial wave of archaeological assessments north of Fort McMurray (Ives 1993:7–8). These assessments revealed large quantities of this previously unnamed lithic material in the sites and assemblages that they identified. This development encouraged considerable research, particularly on the part of Fenton and Ives (1982, 1984, 1990; Ives and Fenton 1983), who noted the presence of a similar material within the oil sands–bearing McMurray Formation. Many of the early studies of the material that came to be known as BRS concentrated on outcrops of coarse-grained material exposed in cutbanks in the Athabasca River drainage (e.g., Fenton and Ives 1984, 1990; Ives and Fenton 1983; Losey 1980; Syncrude Canada Limited 1974). However, the coarse-grained texture of the material in these outcrops is a marked contrast to the fine-grained BRS comprising many of the artifacts in the region's archaeological sites.

With renewed oil sands development in the mid-1990s, a second, larger wave of archaeological assessments was triggered, extending archaeological activity to a number of previously uninvestigated areas lying well beyond the region's relatively well-known and accessible river valleys. Of particular importance was Saxberg's (2007a, 2007b; Saxberg and Reeves 2004; Saxberg and

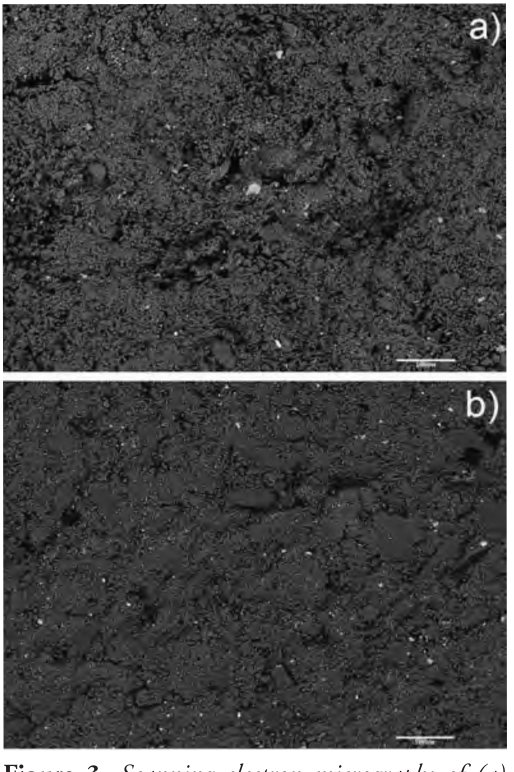

Figure 3. *Scanning electron micrographs of (a) microcrystalline and (b) cryptocrystalline BRS. Note the finer texture of the latter due to greater replacement of its original silica grains with amorphous silica.*

Robertson 2017) work a few kilometres east of the Athabasca River, in an area slated for development as a limestone quarry by Birch Mountain Resources Ltd. This work identified high numbers of sites rich in fine- to medium-grained BRS. It also identified the two previously mentioned occurrences of BRS, which, although part of the same geologic formation as the previously studied coarse orthoquartzite deposits, proved to be fine- to medium-grained variants of the material. Based on these finds, Birch Mountain Resources Ltd. made the important decision to exclude the area, subsequently named the Quarry of the Ancestors, from development and to work with the Archaeological Survey of Alberta to see it permanently protected. This endeavour, with the cooperation of the region's other resource development firms, saw the quarry designated as a provincial historical resource in 2011 (B. Ronaghan, personal communication, 2011).

Despite the discovery of sources yielding BRS with textures similar to most of the region's BRS artifacts, there are lingering questions about whether the relatively fine-grained BRS comprising these artifacts originated exclusively from within the Quarry of the Ancestors or was also derived from other outcrops or glacially transported deposits beyond its boundaries. These scenarios have different implications for past patterns of cultural activity in this area. The former suggests a need for groups to have managed and negotiated access to a valuable resource with a highly restricted distribution, while the latter suggests that BRS extraction could have taken place at many locations, leading to reduced potential for conflict and negotiation among users of this important lithic raw material. The viability of this second option is somewhat challenged by the discrepancy between the generally coarse-grained texture of BRS from outcrop sources beyond the quarry and the fine- to medium-grained texture of most BRS artifacts. Also, reported occurrences of what appears to be glacially transported BRS beyond the quarry suggests that this phenomenon may have increased its availability across the landscape. However, it is also important to note that some assemblages show zones of surface and subsurface reddening on worked BRS pieces suggesting use of deliberate heating to improve the material's workability (Crabtree and Butler 1964:1; Patterson 1996; Purdy and Brooks 1971:322). In addition to colour changes, heat treatment often generates textural changes in lithic raw material (Crabtree and Butler 1964:1; Purdy and Brooks 1971:323; Whittaker 1994:72–73), a phenomenon that has been used to argue that this process was employed by precontact groups to transform the texture and improve the workability of BRS from medium- to coarse-grained outcrops (e.g., Gryba 2001, 2017). If so, this may have significantly expanded the number of localities where usable BRS could have been extracted. On the other hand, it has also been suggested that the red coloration of observed on many BRS artifacts is not, in fact, due to deliberate heating or associated with textural change, but instead reflects the effects of natural fires or represents staining from the oxidized iron in the region's Brunisolic soils.

Thus, many basic questions about the nature and extent of BRS extraction and processing remain unanswered. With this in mind, we have undertaken research to help ascertain which BRS outcrops were and were not exploited, as well as the role that heat treatment may have played in BRS exploitation; examples from the more limited occurrences of suspected glacially transported BRS were not included in this study due to the lack of available raw material suitable for experimentation.

Clarifying the Quarry of the Ancestors through Technological and Archaeometric Studies

We initiated this research by collecting unworked samples from the two BRS occurrences located in the Quarry of the Ancestors; these occurrences yield fine- and medium-grained material, respectively. We also collected unworked material from one of the many coarse-grained exposures beyond the quarry, at an outcrop about 1 km beyond its western boundary. Initial macroscopic assessment in the field and subsequent microscopic examination in the laboratory confirmed the marked textural differences of BRS from each locality. In particular, one of the sampled areas within the quarry yielded extremely fine-grained material which macroscopically has a chert-like appearance. In contrast, the quarry's other BRS occurrence yielded material that, on a macroscopic level, resembles an indurated siltstone. For this reason, these samples were termed cryptocrystalline and microcrystalline BRS, respectively, though it is important to note that, in some cases, the microcrystalline samples appear to include small zones of cryptocrystalline texture. In contrast, the coarse-grained material from beyond the quarry macroscopically resembles a texturally uniform metaquartzite; it was termed macrocrystalline BRS.

Subsamples of each type were subjected to heating, with temperatures and durations of exposure determined based on previous studies of experimental and ethnographic heat treatment (e.g., Ahler 1983:3; Crabtree and Butler 1964:2; Griffiths et al. 1987:43–44; Joyce 1985:36–37; Luedtke 1992:91–92; Patterson 1996; Purdy and Brooks 1971; Whittaker 1994:73–74). We also attempted to replicate conditions achievable by precontact groups in northern Alberta and Saskatchewan by taking into account the fuels and the conditions in this region. In part, this involved protecting the BRS pieces from damage by rapid heating and cooling by packing them in sand similar to the glaciofluvial and glaciolacustrine sediment underlying many of the landforms in and around the quarry. Each sand-packed subsample set was then heated in a ceramics kiln, with one set of each of the three BRS types/textures exposed to 450°C for 24 hours and three sets of each BRS type/texture exposed to 250°C for 10, 24 or 48 hours, respectively. Ideally, a broader range of temperatures and durations would have been used on additional sample sets, but the limited amount of BRS sampled led us to focus this initial work on these four sets of conditions.

The heated subsamples and control sets of raw material from each sampling locality were subsequently subjected to hard hammer percussion to expose fresh surfaces for visual assessment, test for changes in working properties and remove pieces for archaeometric characterization. Although simple, this procedure demonstrated that, while heat treatment made BRS from all three sampling localities much easier to break in a controlled fashion, it failed to alter the texture or improve the flaws characteristic of material from each locality. In particular, heat-treated macrocrystalline BRS from the sampling locality beyond the quarry remained coarse grained, and, as with the unheated pieces from this locality, the tendency for this material to fracture along its grain boundaries produced blunt and somewhat rounded edges of limited practical use (Figure 4). Similarly, heat-treated microcrystalline BRS from the first of the sampling localities in the quarry retained its original texture and remained riddled with the parallel planes of weakness typical of this material in its raw form. The material's tendency to fracture along these features also largely precluded the production of useable edges (Figure 5). The heat-treated cryptocrystalline BRS from the second sampling locality in the quarry also retained its original grain size, but its tendency to fracture conchoidally, as well as its relatively infrequent flaws and the increased ease with which it fractured after heat treatment, made it easy to shape into regular forms with sharp edges (Figure 6).

Interestingly, while all three types of BRS showed similar retention of grain size and were easier to fracture following heat treatment, they showed diverse colour changes. The dark gray raw macrocrystalline BRS showed a progressive shift to light gray and white with exposures of greater duration and/or temperature; this change was evident on both the exterior and interior of heated pieces, suggesting that heat treatment causes combustion of the interstitial bitumen reported to occur in the pore spaces of coarse-grained varieties of BRS (Fenton and Ives 1990:128; Tsang 1998:17). In contrast, the light brownish gray cryptocrystalline and microcrystalline samples showed progressively brighter and deeper red rinds on their exterior surfaces with exposures of greater duration and/or temperature. As noted above, this pattern is widely considered indicative of heat treatment of lithic raw material, and its presence on artifacts in and around the quarry has fuelled debate regarding the archaeological heat treatment

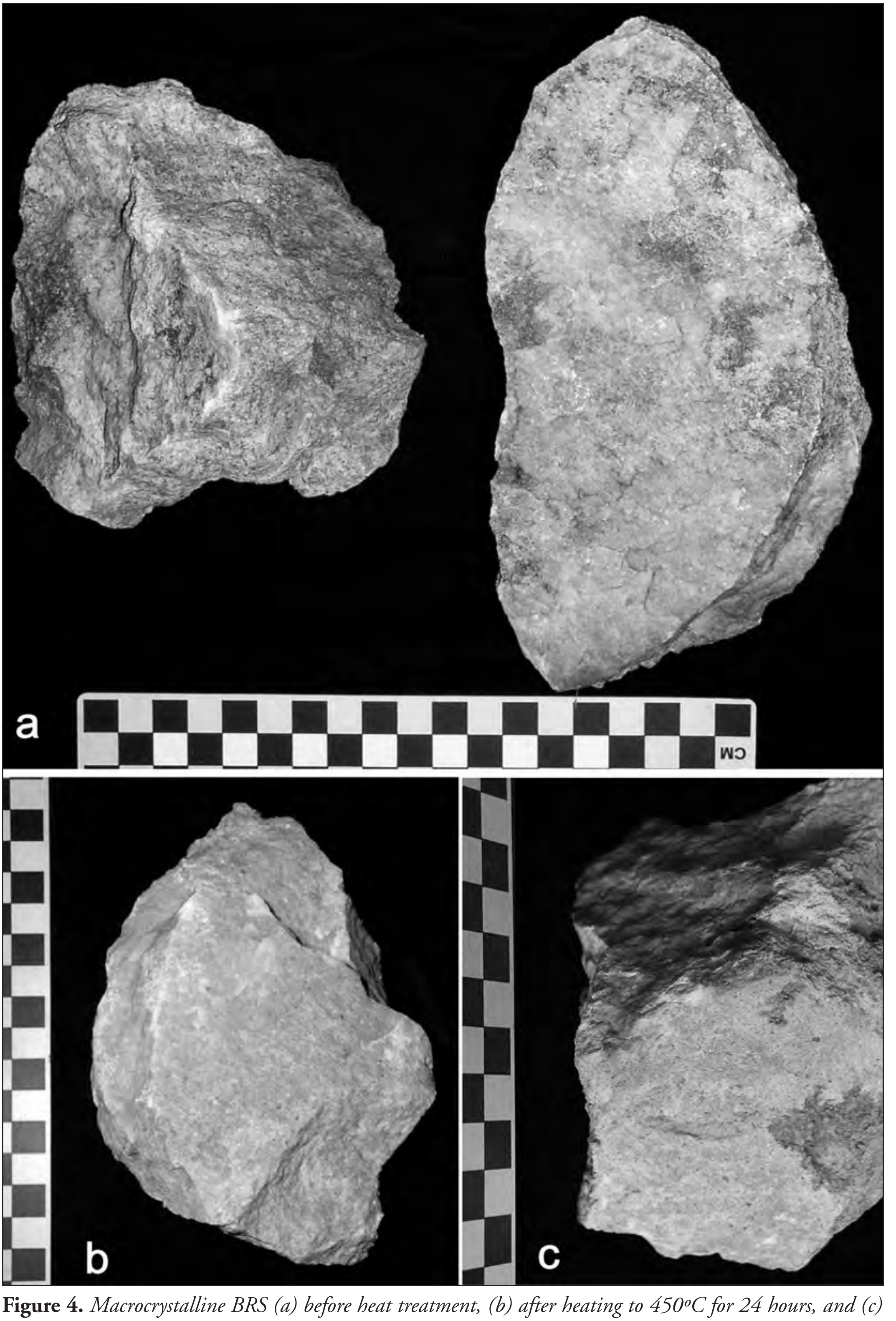

Figure 4. *Macrocrystalline BRS (a) before heat treatment, (b) after heating to 450ºC for 24 hours, and (c) close-up of unchanged grain size after heating to 450ºC for 24 hours.*

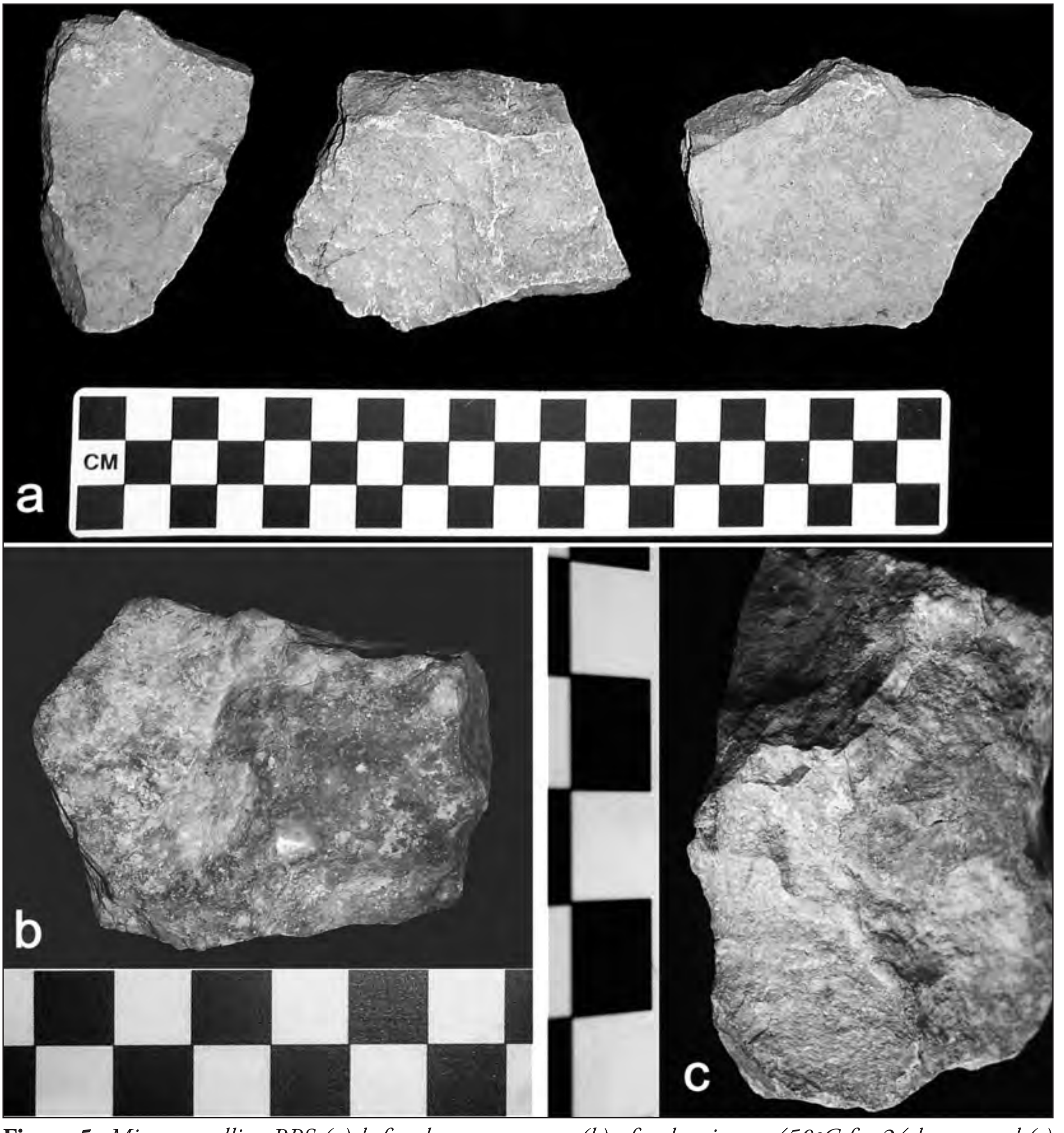

Figure 5. *Microcrystalline BRS (a) before heat treatment, (b) after heating to 450ºC for 24 hours, and (c) close-up of unchanged grain size after heating to 450ºC for 24 hours.*

of BRS. Unfortunately, we have not yet undertaken experimentation to determine if such coloration can be produced by iron staining from Brunisolic soils; however, it is worth noting that the orange coloration of the iron-rich horizons in such soils contrasts with the pinkish red coloration we generated in our heat treatment experiments; both colours are seen on the surfaces of many BRS artifacts, suggesting both soil staining and heat treatment are factors and that further research on reliable means to distinguish these causes would be valuable.

Even in the absence of such data, it is evident that, if BRS users were using heat treatment, the kinds of temperatures and durations that they could employ were not sufficient to radically transform the textural and working characteristics of material from medium- to coarse-grained sources. The prevalence of relatively fine-grained BRS in the assemblages from this region therefore

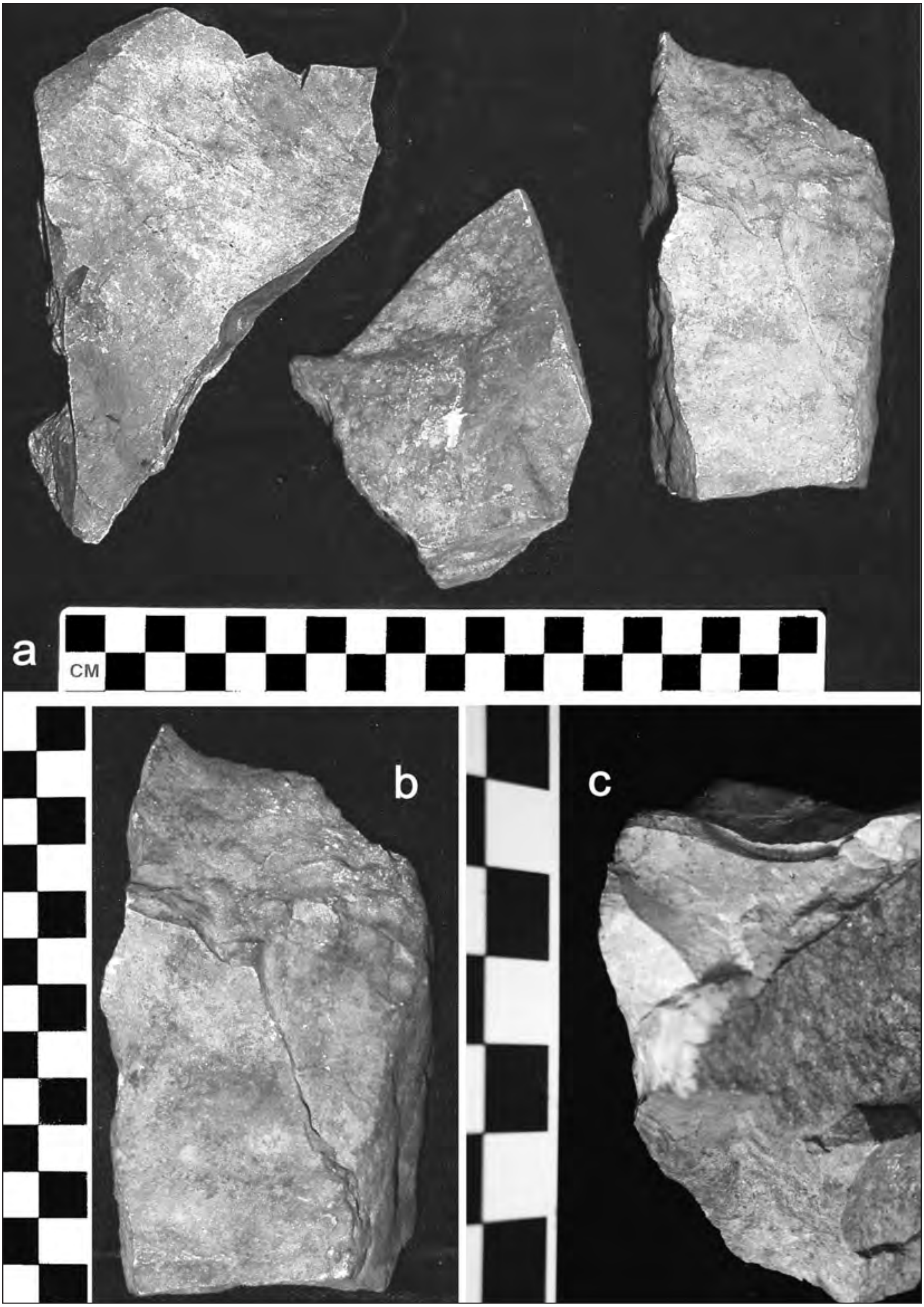

Figure 6. *Cryptocrystalline BRS (a) before heat treatment, (b) after heating to 450ºC for 24 hours, and (c) close-up of unchanged grain size after heating to 450ºC for 24 hours.*

suggests that groups who exploited BRS were somewhat restricted in terms of where they could access useable rock. In particular, it appears likely that there was considerable reliance on the abundant cryptocrystalline BRS available at one of the two sampling localities in the Quarry of the Ancestors. However, it is also possible that BRS-using groups processed large quantities of the flawed and/or less fine-grained stone at other outcrop localities to find small pieces of higher-quality, workable material. The presence of occasional cryptocrystalline zones within the microcrystalline BRS from the other sampling locality in the quarry suggests that this is feasible. Similarly, our ongoing efforts to visit BRS outcrops mentioned in previous studies have indicated that exposures dominated by macrocrystalline material may include areas of microcrystalline to cryptocrystalline BRS suitable for flintknapping.

Our continuing work on the issues surrounding the quarry also includes an effort to find an archaeometric means of definitively identifying heat treatment of BRS artifacts. As with most research questions associated with the quarry, this is a complex problem that we are now trying to address using X-ray absorption near-edge structure (XANES) spectroscopy, a synchrotron-based method that has not been previously applied to the investigation of lithic technology. The preliminary and specialized nature of our work with this method precludes discussing it at length in this paper. However, while most archaeometric applications of spectroscopy focus on determining elemental composition of archaeological materials, XANES also informs on the chemical environments or complexes in which these elements are situated. These data can only be collected because the high flux and brilliance of X-rays generated by synchrotrons allows not only detection of an element's presence but variations in its electron structure that reflect how it is bonded to neighbouring elements. As a result, it is useful for investigating processes which do not change the chemical composition of a material but instead transform it by reorganizing its constituents, even if only in subtle ways. XANES investigations of our BRS samples have clearly demonstrated that our experimental heat treatment of these samples induced patterns of migration and transformation to its trace iron, titanium, and iron content. Furthermore, these patterns vary with temperature and duration of heat treatment, as well as granularity of the BRS from different sampling localities (Robertson and Blyth 2009, 2010). XANES has also clearly shown that, although BRS is typically over 98 percent silica (Fenton and Ives 1990:128; Tsang 1998:80–81), Si and O were unaffected by the heat treatment parameters that we employed. This was an anticipated result, as geologic and materials science research has established that silica does not undergo heat-induced polymorph shifts below 573ºC (Dietrich and Skinner 1979:32). However, silica has attracted considerable attention in discussions of heat treatment (e.g., Domanski and Webb 1992:602; 2007:159; Purdy 1975:138; Purdy and Brooks 1971), as it is typically the dominant constituent of raw materials suitable for flintknapping. However, the XANES data clearly show that trace element content is important in efforts both to identify archaeological heat treatment and to understand how it causes improved working properties in lithic raw material (Robertson and Blyth 2009, 2010). These data also show that XANES represents a method well suited to ongoing exploration of these issues not only in BRS but also offers possibilities for lithic raw material studies in general.

Beyond Technological and Archaeometric Studies at the Quarry of the Ancestors

The promising preliminary data generated by these technological and archaeometric studies, coupled with the many unanswered questions about the quarry, shows both the substantial potential of and ongoing need for this kind of research on BRS. However, it is important to note that, ultimately, a central objective of these studies is to use the rich array of archaeological evidence provided by the quarry in a way that will meaningfully enhance our understanding of the precontact period in northern Alberta and Saskatchewan. This goal, in turn, will require us not merely to generate technological and archaeometric data but also to place those data into subsistence, economic, social, political, and ideational models that help us to understand the cultural frameworks that supported the lithic extraction and production activities at what was clearly an important raw material source. Working with such models may require us to use levels of inference that we do not feel can be supported by our currently basic knowledge of the culture history of the region in general and the quarry in particular. However, the challenges presented by a heavily used quarry site in western interior Boreal Forest make it very difficult to derive meaningful insights from existing data and to identify priorities for ongoing research without considering the cultural frameworks which enabled and facilitated use of this crucial resource.

For example, the spatial extent of workable BRS occurrences has important implications not only in terms of structuring where the technical processes of extraction took place, but also in terms of influencing patterns of social encounter and interaction between groups using this material. The fact that an extremely high density of archaeological remains is concentrated in and around the Quarry of the Ancestors certainly suggests this area's accessible occurrences of workable BRS were a focus for activity, implying a need for social, political, and economic relationships capable of mediating interaction between groups who relied on the quarry for lithic raw material. Acknowledgement of the social, political, and economic dimensions of this situation, in turn, offers important context to our efforts to interpret the immense amount of data provided by the sites associated with the quarry. For example, recognition of diversity among groups using this area could be extremely helpful in current debates regarding the presence or absence, as well as the significance, of certain lithic technologies, such as microblades, in different assemblages recovered in and around the quarry (e.g., LeBlanc and Ives 1986; Reeves et al. 2017; Younie et al. 2010). Differing observations on whether such technologies occur in various assemblages and what form they take may not reflect variations among the lithic analysts involved, but may instead be due to real differences in the presence and nature of these technologies in assemblages produced by different groups.

The concentration of archaeological evidence in and around the Quarry of the Ancestors also challenges us to rethink some of our basic assumptions regarding patterns of subsistence and mobility in the western interior Boreal Forest. Specifically, even though archaeological data on this region have only become abundant in the last two decades, its residents have often been loosely characterized as small bands of highly mobile hunter-gatherers who left sparse remains at ephemeral habitation and resource extraction sites (e.g., Ives 1993:8). However, the Quarry of the Ancestors and the massive quantity of lithic material that extends beyond it are potentially inconsistent with this view. It is possible that this massive concentration of artifacts simply represents a long-term accumulation of debris from repeated brief visits by small transient groups, as has been argued for the Mount Edziza obsidian source in northern British Columbia (Fladmark 1984). Studies of Mount Edziza suggested two workshop areas covering 3.2 ha and a surrounding debris sheet divided into 73 sites over 20 km^2 (Fladmark 1984:145, 151). However, the two core workshop/habitation areas at the Quarry of the Ancestors, HhOv-305 and HhOv-319, extend over approximately 33 ha and 108 ha, respectively (Saxberg 2007b:707–710, 735–738), and are surrounded by a current inventory of over 500 additional sites in the approximately 120 km^2 of the HhOv Borden block alone, with lower but still substantial site densities extending into adjacent Borden blocks. Thus, the sheer extent of the archaeological record focused around the quarry suggests that it might be wise to consider the possibility of more aggregation and less ephemerality in the subsistence and mobility practices of the groups who used this resource. A particularly explicit effort to do so has been made by Saxberg and Robertson (2017), who suggest that the quarry may actually represent a focus for semi-permanent occupation, noting that the assemblages in this area show almost no evidence of lithic raw materials other than BRS. Additionally, we note the items discarded in and around the quarry include very high numbers of lightly used expedient tools and very low numbers of heavily worn curated tools, suggesting that the quarry's users remained close enough to readily resupply their BRS stocks and did not need to use technologies geared toward raw material conservation (Saxberg and Robertson 2017). Also significant is the great diversity of the tools and the fact that they display a range of use-wear patterns, features that do not merely suggest lithic extraction and production but imply sustained on-site use in a range of activities other than acquisition and processing of BRS. For these reasons, Saxberg and Robertson (2017) argue that it is entirely possible that, contrary to traditional assumptions regarding hunter-gatherer mobility, the quarry's users did not organize the spatial distribution of their sites exclusively around key subsistence resources; instead, we suggest that they based their settlement strategy around this abundant supply of lithic raw material. This argument has precedents in archaeological and ethnographic cases, involving social strategies designed to enhance group integration and decrease individual risk by encouraging identification with and organization around an important resource locality (e.g., Carr 2005; Ellis 1989). Alternatively, extended settlement at the quarry may have been a positioning strategy to ensure access to BRS in periods of population influx to the area (Saxberg and Robertson 2017). This view directly challenges a number of suppositions about hunter-gatherers in general and Boreal Forest hunter-gatherers in particular. However, the unusual archaeological record of the quarry also challenges traditional archaeological understanding of this region and calls for new perspectives that use this record to elucidate past lifeways in the Boreal Forest and vice versa.

Another intriguing approach to understanding the quarry involves archaeological and ethnohistoric studies of rendezvous or ingathering centres among late precontact, protocontact, and postcontact Cree groups in northern Saskatchewan and Manitoba (Meyer and Hutton 1998; Meyer and Russell 2004; Meyer and Thistle 1995; Meyer at al. 1992). In contrast to the quarry, which is located well beyond the Athabasca Valley, all of the ingathering centres identified by Meyer and colleagues occur in close proximity to rivers, suggesting that they were located at least in part to maximize access to subsistence resources in seasons when the populations aggregated. However, they also note that these locations were imbued with enduring ideational significance reflecting their important role in Cree social geography (Meyer and Thistle 1995). Furthermore, they did not tend to shift location to optimize access to the important but changing network of fur trade forts that appeared during the postcontact period, despite the fact that these forts became points on the landscape from which key trade resources were accessed (Meyer and Thistle 1995). With this in mind, it seems likely that the quarry, as a spatially stable source of an essential tool making resource, became an ideationally significant point that occupied a central role in the cultural landscape of its users, commensurate with its dense archaeological record and the sustained occupational presence necessary to generate this record.

An important obstacle to looking at the quarry in terms of its social significance and meaning is our limited understanding of the culture history of northern Alberta and Saskatchewan, a situation that deprives studies of sites in this region of an element widely regarded as fundamental in archaeological interpretation. Unfortunately, efforts to overcome this issue will continue to be impeded by the region's paucity of stratified sites, the pervasive destruction of organic artifacts by its acidic soils, and the resulting lack of relative or chronometric dating opportunities. These issues make it exceptionally difficult to build time-space frameworks for this region, even though culture history is often considered an essential first step in archaeological research. In an effort to overcome these challenges, assemblages from the quarry and elsewhere in northern British Columbia, Alberta, and Saskatchewan are often related to the chronologies and typologies of adjacent but somewhat spatially removed culture areas, such as the Northern Plains and the Arctic (e.g., Ives 1993; Saxberg and Reeves 2003:306–311). For example, LeBlanc and Ives (1986) and Younie and colleagues (2010) both relate microblades and microblade cores from sites near the quarry to the Denali Complex of Alaska, the Yukon, and adjacent regions. In contrast, Reeves and colleagues (2017) relate microblade technology at nearby sites to the Arctic Small Tool Tradition of Canada's Eastern Arctic. Similarly, projectile points are often identified as Northern Plains' types like Plano or Oxbow or as varieties like Taltheilei (e.g., Reeves et al. 2017). This approach represents an important line of evidence in a region where any and all clues regarding space-time relationships are valuable. However, it makes it tempting to see its culture history not on its own terms but as a secondary development reflecting trends in the adjacent, better understood regions. Interestingly, if the archaeological record of the western interior Boreal Forest was more tractable and if, by some accident in the history of Canadian archaeological investigation, its culture history had been fully characterized before the Northern Plains and the Arctic, it is possible that we would be falling victim to the same fallacy but applying it in the opposite direction. Thus, we would be defining the adjacent Northern Plains and Arctic sequences of cultural change in relation to this portion of the Boreal Forest.

The potential problems associated with viewing the culture history of the western interior Boreal Forest through the lens of adjacent regions underlines the importance of finding ways to more fully and strategically use data from this region in this process. Working to identify and study this region's rare examples of stratified sites (e.g., Millar 1997; Stevenson 1985; Saxberg 2007a:59–63) will be essential, as will efforts to look beyond radiocarbon dating and explore alternative chronometric methods, such as optically stimulated luminescence dating, an approach that has developed an impressive track record of providing reliable dates on sand-rich landforms like those in and around the quarry (e.g., Wolfe et al. 2002).

However, this issue is also one that can be profitably addressed by using socially informed concepts of technological production to take full advantage of the exceptionally rich archaeological assemblages in and around the quarry. Traditionally, archaeological typologies focus on finished formal tools considered to be culturally and chronologically diagnostic. However, many archaeological sites yield larger quantities of debitage associated with tool production and maintenance, as well as more informal tools. As is common at and near lithic raw material sources, the sites in and around the quarry yield particularly large quantities of production debris and informal tools, with proportionally small numbers of finished formal implements. As a result, these sites offer limited resources for traditional typological analysis, but provide a very rich record of production sequences and strategies. Concepts such as the chaîne opératoire (Lemonnier 1992:25–50; Sellet 1993) and isochrestic style (Sackett 1982, 1985, 1986, 1990) have drawn attention to the fact that such sequences of tool production, not merely their end products, are valuable sources of cultural information. Thus, even if the quarry is not rich in diagnostic tools or samples suitable for radiocarbon dating, its abundant assemblages of lithic production debris suggest that analyses geared toward documenting these toolmaking sequences may be the key to identifying and understanding patterns of diversity and change among the groups who visited this area. This approach would be labour intensive, as it would require approaches like refitting studies and debitage analysis of entire assemblages, rather than morphological assessment of only formal tools. Furthermore, it would involve actively incorporating an explicitly theoretical package of concepts into the construction of culture history for this region. Those who prefer to regard the development of archaeological time-space frameworks as an atheoretical and foundational process of documenting the contents of the archaeological record might regard such an approach as putting the cart before the horse. However, it can also be argued that it explicitly and usefully draws attention to the fact that the construction of culture history is always, to some degree, founded on theoretical assumptions. Moreover, in addition to using the enormous archaeological potential of the quarry to help build culture history in this region, such an approach would simultaneously make it possible to develop a better understanding of technological variability within and between the groups that exploited BRS. This perspective would offer insights about the nature of relations between these groups, which is crucial in understanding a locality that drew such substantial attention from the region's residents.

Conclusions

The Quarry of the Ancestors exemplifies the potential and problems of undertaking archaeological interpretation at lithic quarries, while at the same time reflecting both the challenges and necessity of attempting such interpretations in Canada's western interior Boreal Forest region, where the rich potential of a quarry locality cannot be ignored in our ongoing efforts to improve our limited understanding of this region. This work will need to further integrate the kind of basic technological and archaeometric studies necessary to clarify issues such as the location and extent of the BRS occurrences from which precontact groups were able to extract useable raw material. However, the complexity and the density of past human activity in and around the quarry also require us to contextualize these types of data in terms of the social, political, and economic frameworks that supported long term use of this important toolmaking resource. Only by actively integrating an array of methodological and theoretical approaches will we be able to fully and more effectively use the exceptional data provided by the quarry in our continued efforts to better understand the culture history and past lifeways of the western Boreal Forest groups who created its rich archaeological record.

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Située à environ 50 km au nord de Fort McMurray, la Carrière des ancêtres constitue un rare exemple de site relativement bien documenté en matière d'extraction et de transformation lithique dans les régions de la forêt boréale de l'Alberta et de la Saskatchewan. Source de matière première fortement exploitée, elle contient d'énormes quantités d'outils et de débris, une situation qui, à l'instar de nombreuses carrières, rend l'analyse et l'interprétation très difficiles. L'emplacement de la carrière dans la forêt boréale intérieure de l'Ouest du Canada ne fait qu'intensifier ce problème, car (comme la grande majorité des sites de cette région) elle n'a pas connu de processus géomorphologiques favorables à la stratification, et l'acidité de ses sols Brunisoliques détruit les objets organiques. Ces éléments, à leur tour, rendent difficiles la définition verticale ou horizontale d'assemblages provenant de différentes professions et l'attribution de dates absolues ou relatives à celles-ci. Toutefois, on ne peut ignorer les richesses archéologiques de la carrière, car elle représente une occasion exceptionnelle d'acquérir de nouvelles connaissances sur la nature de l'activité pré-contact dans cette partie de la forêt boréale. Étant donné la complexité et le potentiel archéologiques de ce site, il est recommandé qu'une interprétation rigoureuse et appropriée de la carrière bénéficie d'une combinaison de recherches technologiques et archéométriques ainsi que d'études qui modélisent les cadres culturels qui ont soutenu et facilité l'utilisation de cette importante ressource durant la période pré-contact.

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Faunal Analysis of the Middle Woodland Rice Lake Serpent Mounds (BbGm-2) Midden Assemblage, Ontario

Thomas W. Dudgeon, Daniel J. Rafuse, Gary Burness, and James Conolly

This paper presents an analysis of the faunal material obtained from the 1950s Royal Ontario Museum excavation of the shell midden at the Middle Woodland Serpent Mounds on Rice Lake, Ontario (BbGm-2). The zooarchaeological and taphonomic data presented here provide significant information for understanding subsistence activities at the site, as well as site formation processes. The Serpent Mounds contains evidence of anthropogenic faunal processing in a variety of vertebrates, including white-tailed deer (Odocoileus virginianus)*, moose (*Alces alces*), beaver* (Castor canadensis)*, snapping turtle* (Chelydra serpentina)*, and painted turtle* (Chrysemys picta)*, as well as unidentified turtle* (Testudines)*, unidentified frogs and toads (Anura), and unidentified birds (Aves). There are also numerous fish remains, particularly channel catfish* (Ictalurus punctatus)*, which is the most abundant fish species by MNI. The processing activities, combined with several types of natural modifications, specifically root marks, thermal alteration, weathering, and chemical corrosion, resulted in a highly fragmented assemblage. The faunal record from the Serpent Mounds site provides additional details on the local expression of the hunting-gathering-fishing subsistence strategy that is consistent with known Middle Woodland economies in southern Ontario.*

Introduction

The Rice Lake area of southeastern Ontario hosts a substantial material record of Indigenous settlement and land use practices. The record encompasses the terminal Pleistocene to Early Holocene through European contact, and includes small Paleoindian camps, large Archaic settlements and specialized activity areas, Early and Middle Woodland habitations and ritual centres, and later Woodland villages (Sonnenburg et al. 2012). Rice Lake formed approximately 11,800 years ago when Lake Iroquois began to drain due to isostatic uplift of the area from the previously receding glaciers (Sonnenburg et al. 2012). This rebounding of the crust also caused the flooding of lowland areas in the Kawartha region, creating expansive marshes and wetlands (McAndrews, 1984). The spread of these new habitats allowed for the inundation of wild rice (*Zizania* sp.), which quickly dominated the wetland ecosystems and would likely have provided an abundant food supply for people living in the area. Pollen analysis in Kawartha lake beds show that roughly 4,000 years ago the forest assemblage began to change (McAndrews 1984). For example, hemlock (*Conium maculatum*), which was once prominent in the area quickly vanished, likely due to the introduction of a disease that infected this plant exclusively. Other trees such as birch (*Betula* sp.), beech (*Fagus* sp.), and maple (*Acer* sp.) quickly filled in the open niche, changing the ecosystem from a shaded coniferous forest to a seasonal deciduous forest (McAndrews 1984). This shift would have allowed for a large expansion of white-tailed deer (*Odocoileus virginianus*) populations, which rely heavily on deciduous forests for acorns, seeds, and other food resources associated with that ecosystem. The inferred expansion of dense and stable wetland resources, and abundant

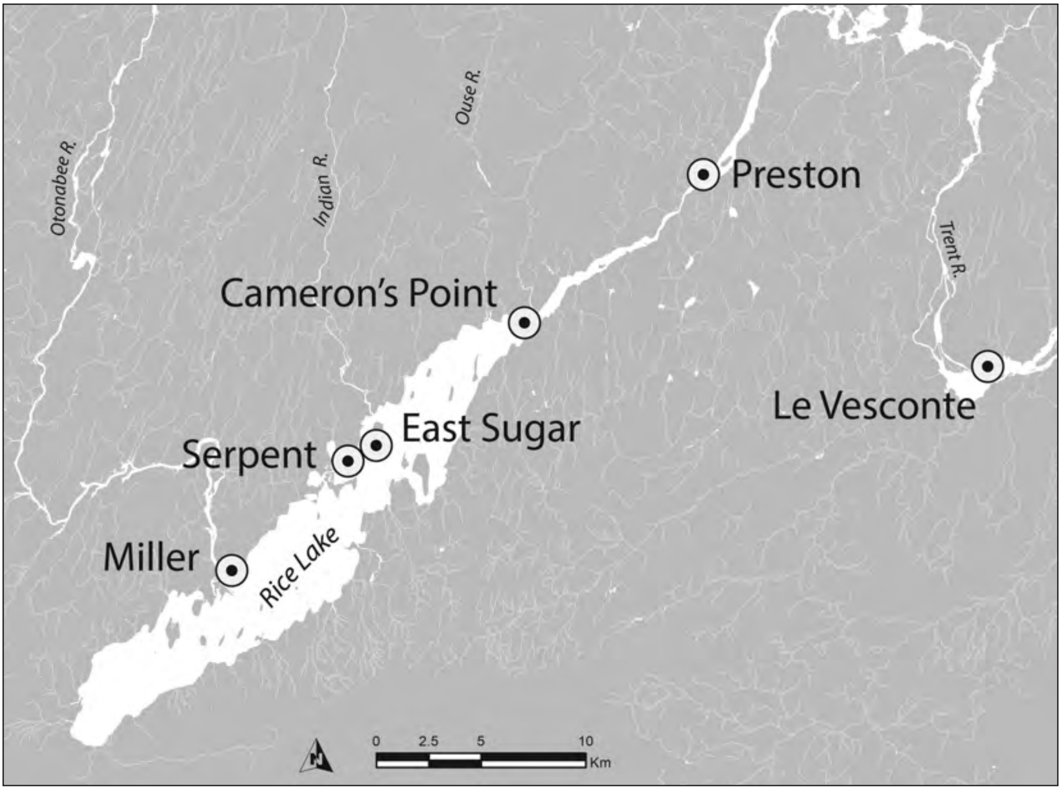

Figure 1. *A map of Rice Lake and the main sites referred to in the text.*

terrestrial game, can be reasonably correlated with an observed increase in the number of sites dating from about 4,000 years onwards (Sonnenburg et al. 2012:3565).

A highly visible component of the archaeological record of Rice Lake is the mortuary centres, consisting of clusters of earthen mounds. At least six sites from this region are known to contain earthen mounds constructed during the Middle Woodland, between approximately 2000 cal BP and 1500 cal BP (Boyle 1897; Johnston 1968a, 1968b). These include the Miller Mounds, Serpent Mounds, East Sugar Island, Cameron's Point, Preston Mounds, and Le Vesconte Mound (Figure 1). These mortuary centres were constructed episodically out of soil and rock and were likely accumulated over many punctuated periods of construction (Boyle 1897; Johnston 1968b:20; Spence 1986). The spatial organization of mounds in the Rice Lake basin is in part reflective of the density and spatial patterning of resources within the watershed (Conolly 2018).

The largest documented cluster of earthworks in the Rice Lake area is the Serpent Mounds, which is owned and managed by the Mississaugi of Hiawatha First Nation. The Serpent Mounds site is unique for its size, complexity, and centralized location within the Rice Lake cluster of mortuary locations. Although subject to considerable long-term disturbance due to grave robbing and poorly documented digging by early settlers and antiquarians, during the 1890s David Boyle (then curator of the Canadian Institute Museum) conducted the first controlled archaeological excavations of the location, and mapped the prominent topographic features of the site (Johnston 1968b:8). Boyle named the site "The Serpent Mounds" because he thought the central elongated mound resembled a snake, and the eight circular mounds around it were the

"Serpent's Eggs" (Boyle 1897). It is important to note that the mounds sit in a larger cultural landscape, which incorporate[s] other activity areas and [includes] inundated portions of what [was once] a much more extensive set of lake-wetland interfaces.

The more narrowly defined archaeological site (designated as BbGm-2) comprises nine earth mounds constructed on an elevated promontory on the north shore of Rice Lake, at the eastern mouth of the Indian River. A large elongated central mound ("Mound E") measures around 70 m in length, 7.5 m in width and up to 1.8 m in depth (Johnston 1968b:19). South and east of the central mound are four smaller mounds, some measuring 11 to 14 m in length at their base. Three further ovoid mounds lie to the northeast of the Mound E, and a single ovoid mound about 40 m north of the west end of the main mound (Figure 2).

Modern excavations were first conducted under the auspices of the Royal Ontario Museum (ROM) between 1955 and 1960. Initially directed by William Adams, from 1957 the project came under the direction of Richard B. Johnston (later Professor at Trent University). He and his team investigated four of the mounds (most extensively in Mound E), and in the process recovered a large sample of human remains. His team investigated a habitation site about 70 m southwest of the mound cluster and excavated shell middens along the point's eastern shoreline. The excavations are reported on in considerable detail in the resulting 1968 ROM publication (Johnston 1968b). It is from Johnston's meticulous work and records that a detailed understanding of the mounds' history

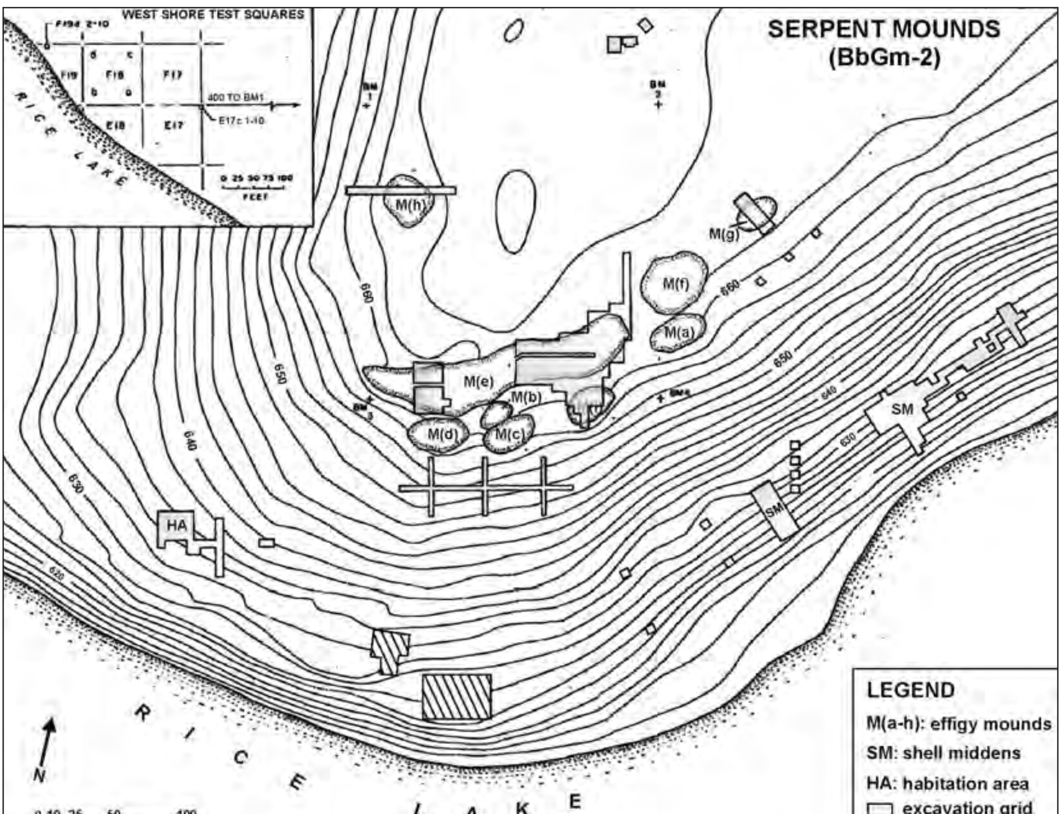

Figure 2. *A topographical map of Roach's Point showing the central effigy mounds, shell middens, habitation area, and west shore test squares. Modified from Johnston (1968b:Figure 2).*

was first obtained, including its absolute age. However, given that the estimated age was obtained during the developmental phase of radiocarbon dating and required large samples of carbon, which is also potentially subject to old wood effects, the precision is poor by modern standards. Based on two dates from within the mounds (1830 ± 200 ^{14}C years BP and 1160 ± 150 ^{14}C years BP) and one from the shell midden (2020 ± 150 ^{14}C years BP), the activities documented from the excavations may span as much as 700 years either side of 1800 cal BP (Johnston 1968b:70–72). The uncertainty around the chronology of use of the mounds, and their temporal relationship to other activity areas in the wider region, is a topic being addressed by a new dating program on ongoing comparative work (Conolly et al. 2017).

The focus of this paper is Johnston's shell midden excavation. The midden is approximately 120 m long and 20 to 30 m wide and sits roughly 50 to 100 m to the east of the mounds on the steep banks of the modern shore of Rice Lake. Portions of the midden are currently under water due to the 1830s-era dam that elevated the water level by approximately two metres (Sonnenburg et al. 2012). Johnston sampled 270 m^2 of the non-inundated portion of the midden, mainly along the central and northern portions. The midden excavations produced the bulk of the non-burial archaeological materials from the ROM's excavation.

The midden is composed of a thin (up to 30 cm, but often much shallower in depth: Johnston 1968b:41) but clearly stratified layer of mollusc shells and animal bones, broken fragments of pottery, and discarded stone tools (Johnston 1968b:40–48). The shell layer is comprised primarily of Eastern elliptio (*Elliptio complanata*) and fatmucket clam (*Lampsilis siliquoidea*) in a ratio estimated to be 3:1 (Johnston 1968b:42). The shell identifications were made by Henry van der Shalie (Curator of Mollusks, Museum of Zoology, University of Michigan) and are presumed correct (Johnston 1968b:26). Johnston also reported 3,412 ceramic sherds from the midden (compared to approximately 250 recovered sherds from the mound excavations), of which the bulk of the diagnostic varieties are Vinette II class, consistent with the general Middle Woodland date of the mounds. Some of the stone tools include adze and axe fragments, projectile points (grey-flint and fine-grained green quartzite), blades, scrapers and drills, and drill fragments. Bone tools were also recovered, including barbed harpoons, bird bone pins, and various antler artifacts (drifters, projectile points, combs, etc.); however, none was described in this analysis. Johnston (1968b) characterized the midden as predominantly shell, but a large volume of bone remains were recovered that have not been subsequently examined. This bone material provides an important set of data about non-shellfish related subsistence activities at the site. The purpose of this study is to document and describe previously unreported characteristics of the bone material incorporated into the shell midden deposits of the Serpent Mounds (BbGm-2).

As far as we are aware, this is the first published faunal analysis of material associated with a Middle Woodland burial mound in the Rice Lake region. Accordingly, our goals in this paper are primarily to document the material and its depositional character and to build understanding of the foraging pattern at this location. Future work will address the characteristics of the foraging pattern at the Serpent Mounds from a comparative perspective.

Sample Section and Methods

The sample examined in this analysis derives entirely from the 1950s shell midden excavation, which comprises approximately 55 thousand artifacts collected within 114 five-foot-square (152.4 cm^2) excavation units, subdivided by an arbitrary or natural stratigraphic layer. Soil from the midden was not screened, but photographs and description by Johnston (1986b) of trowelling suggests that it was carefully hand excavated rather than shovelled, somewhat mitigating the considerable biases that non-screened faunal assemblages possess (Struever 1968). Despite this, we still believe that the faunal assemblage is likely biased against smaller taxa due to the method of excavation. It has been shown that material screened with a large mesh aperture will not preserve all diagnostic material of small sized animals such as fish, creating inherent biases in an assemblage which has been screened with a large aperture, or in assemblages excavated with a method other than screening (James 1997; Quitmyer 2004; Schaffer 1992; Wing and Quitmyer 1985). As a result, the proportion of small taxa such as fish and small mammals recovered from the assemblage is not likely to accurately represent the proportion of these taxa at deposition.

Most of the midden sample forms part of the Royal Ontario Museum's collection, which was kindly made available for study. The ROM sample was integrated with the smaller sample of faunal material curated by Trent University. Approximately 35 percent of the total midden sample is animal bone (over 19,000 specimens), and a further 2,400 specimens are shell. As it is not clear whether all the shell was retained during excavation, direct comparisons on the relative dietary importance of shellfish versus other animals are difficult.

Of the total bone assemblage, a sample of 2,744 (about 7% of the total bone assemblage) was selected from 28 randomly selected excavations units. Using the Trent University Zooarchaeology Laboratory reference collection, which contains a large collection of animals from Ontario (Nash 1908; Dobbyn 1966) and abroad, each bone element was identified to the highest taxonomic level possible, with class as the broadest classification. It should be noted that Sauropsida was divided into two clades for ease of description, where avian sauropsids were described as "Aves" and non-avian sauropsids were described as "Reptilia." If a fragment did not contain identifiable features, it was categorized as "undetermined." For this initial study of the faunal material, tallies are based on the entire sample, regardless of stratigraphic or excavation units.

Taxonomic abundance was quantified using the standard measurements NISP (number of identified specimens: Payne 1975) and MNI (minimum numbers of individuals: White 1953). NISP was tallied for all specimens, while MNI, which is a function of NISP and is defined as the most abundant skeletal part of a species (Lyman 2008), was derived only for the taxa identified to species. Strengths and weaknesses of these counts have been discussed in detail elsewhere (Grayson 1979, 1984; Lyman 2008, 2018a, 2018b). For the purpose of understanding butchering and transport strategies in white-tailed deer (the most abundant large vertebrate identified in this study), anatomical representation was quantified using MNE (minimum number of elements: Binford 1978, 1984; Lyman, 1994a, 1994b) and MAU (minimum animal units: Binford 1978, 1981, 1984), and the latter standardized value (%MAU: Binford 1984; Lyman 1994a). Anatomical representation of other species from the site is described in the results, however incompleteness and under-representation of skeletal parts makes quantification of these latter variables problematic. Note that although the pelvis is properly defined as an appendicular element, it is considered here as part of the axial skeleton because it is difficult to remove from a carcass through butchering (Soulier and Costamagno 2017). For the determination of the age classes in white-tailed deer, the anatomical representation was calculated separately by considering fused, unfused, semi-fused, and undetermined fusion (Purdue 1983).

The bones from Serpent Mounds were separated into three body size categories: small (< 5kg), medium (between 5kg and 50kg), and large (> 50kg). These size categories were determined by the estimated mass according to the local and current vertebrate populations (Nash 1908; Dobbyn 1966). If the fragment could not be identified to species, then the size category was estimated by the size of the fragment, and the thickness of the cortical wall.

In order to describe the preservation of material at Serpent Mounds and evaluate human modifications to the bones, the following taphonomic variables were identified: weathering stages (Behrensmeyer 1978); geologic abrasion (Fernández-Jalvo and Andrews 2003); carnivore marks (punctures, pitting, scoring, furrowing, crenulated edge, and scooping out: Binford 1981; Haynes 1980); presence/absence of trampling (see Domínguez-Rodrigo et al. 2009 for diagnostic features); burning stage of thermal alteration (scorched, carbonized, and calcined: White 1992); root etching (Andrews 1990); and chemical corrosion (Fernández-Jalvo et al. 2010). Other modifications identified include dark lines and black staining on the bone surface of unknown origins, but natural staining is a possibility. The identification of anthropic modifications included cut marks (Fisher 1995), thermal alteration, and bone fractures (Blumenschine et al. 1996; Galán et al. 2009; Johnston 1985; Olsen and Shipman 1988). Cut marks were allocated into four categories describing the activity that likely caused it (Binford 1981). These categories are based on the type of mark and its location on the bone: marrow procurement (c.f. Karr et al. 2015),

Table 1. *The NISP and MNI of vertebrate taxa observed at Serpent Mounds.*

Small Vertebrate	**Taxa**	**NISP**	**MNI**
Mammalia	*Marmota monax* (marmot)	3	1
	Ondatra zibethicus (muskrat)	6	2
	Tamias striatus (eastern chipmunk)	1	1
	Undetermined	71	–
Reptilia	*Chrysemys picta* (painted turtle)	47 (47)	8
	Testudines	263 (253)	–
Amphibia	Anura	17	–
Actinopterygii	*Ictalurus punctatus* (channel catfish)	148	19
	Undetermined	112	–
Aves	*Ectopistes migratorius* (passenger pigeon)	1	1
	Anatidae	1	–
	Undetermined	9	–
Undetermined		371	–
Medium Vertebrate			
Mammalia	*Canis* sp. (dog/wolf/coyote)	2	1
	Castor canadensis (beaver)	5	1
	Erethizon dorsatum (porcupine)	1	1
	Vulpes vulpes (red fox)	2	1
	Cervidae	20	–
	Carnivora	2	–
	Rodentia	1	–
	Undetermined	1,131	–
Reptilia	*Chelydra serpentina* (snapping turtle)	85 (46)	4
Actinopterygii	*Esox lucius* (northern pike)	10	3
	Sander vitreus (walleye)	2	2
Undetermined		77	–
Large Vertebrate			
Mammalia	*Alces alces* (moose)	5	1
	Odocoileus virginianus (white-tailed deer)	288	7
	Ursus americanus (black bear)	4	1
	Cervidae	1	–
	Undetermined	58	–

NISP Totals in brackets ( ) = number of turtle shell fragments.

Table 2. *White-tailed deer anatomical part representation.*

	Unfused			Fused		
	MNE	MAU	%MAU	MNE	MAU	%MAU
Mandible	0	0.0	0.0	0	0.0	0.0
Occipital Bone	0	0.0	0.0	1	1.0	22.2
Pelvis	1	1.0	66.7	1	1.0	22.2
Rib	0	0.0	0.0	1	0.0	0.9
Temporal Bone	0	0.0	0.0	1	0.5	11.1
Tooth	0	0.0	0.0	0	0.0	0.0
Vertebra (lumbar)	0	0.0	0.0	1	0.2	3.7
Vertebra (thoracic)	0	0.0	0.0	0	0.0	0.0
Vertebra (undet.)	5	0.2	12.8	2	0.1	1.7
Astragalus	0	0.0	0.0	0	0.0	0.0
Calcaneus	0	0.0	0.0	3	1.5	33.3
Cubonavicular	0	0.0	0.0	6	3.0	66.7
Cuneiform	0	0.0	0.0	0	0.0	0.0
Femur (prox.)	2	1.0	66.7	0	0.0	0.0
Femur (diaph.)	1	0.5	33.3	0	0.0	0.0
Femur (dist.)	1	0.5	33.3	1	0.5	11.1
Fused 2nd and 3rd tarsals	0	0.0	0.0	2	1.0	22.2
Humerus (prox.)	3	1.5	100.0	1	0.5	11.1
Humerus (diaph.)	0	0.0	0.0	0	0.0	0.0
Humerus (dist.)	0	0.0	0.0	4	2.0	44.4
Lunate	0	0.0	0.0	0	0.0	0.0
Metacarpal (prox.)	0	0.0	0.0	6	3.0	66.7
Metapodial (prox.)	0	0.0	0.0	1	0.3	5.6
Metapodial (dist.)	3	0.8	50.0	2	0.5	11.1
Metatarsal (prox.)	0	0.0	0.0	9	4.5	100.0
Metatarsal (diaph.)	0	0.0	0.0	0	0.0	0.0
Navicular	0	0.0	0.0	0	0.0	0.0
Patella	0	0.0	0.0	0	0.0	0.0
Phalanx (prox.)	4	0.5	33.3	7	0.9	19.4
Phalanx (inter.)	5	0.6	41.7	5	0.6	13.9
Phalanx (dist.)	0	0.0	0.0	3	0.4	8.3
Phalanx (undet.)	0	0.0	0.0	1	0.0	0.9
Radius (prox.)	1	0.5	33.3	0	0.0	0.0
Radius (diaph.)	0	0.0	0.0	0	0.0	0.0
Radius (dist.)	3	1.5	100.0	9	4.5	100.0
Sesamoid	0	0.0	0.0	0	0.0	0.0
Scaphoid	0	0.0	0.0	0	0.0	0.0
Scapula	0	0.0	0.0	4	2.0	44.4
Tibia (prox.)	4	2.0	33.3	2	1.0	22.2
Tibia (diaph.)	0	0.0	0.0	0	0.0	0.0
Tibia (dist.)	2	1.0	66.7	5	2.5	55.6
Ulna (prox.)	2	1.0	66.7	0	0.0	0.0
Ulna (dist.)	0	0.0	0.0	0	0.0	0.0
Unciform	0	0.0	0.0	1	0.5	11.1
Vestigial Toe	0	0.0	0.0	3	0.4	8.3

Undetermined Fusion			Total		
MNE	MAU	%MAU	MNE	MAU	%MAU
6	3.0	100.0	6	3.0	46.2
1	1.0	33.3	2	2.0	30.8
2	2.0	66.7	4	4.0	61.5
2	0.1	2.6	3	0.1	1.8
1	0.5	16.7	2	1.0	15.4
3	0.1	3.1	3	0.1	1.4
3	0.5	16.7	4	0.7	10.3
2	0.2	5.1	2	0.2	2.4
11	0.4	14.1	18	0.7	10.7
4	2.0	66.7	4	2.0	30.8
3	1.5	50.0	6	3.0	46.2
0	0.0	0.0	6	3.0	46.2
5	2.5	83.3	5	2.5	38.5
1	0.5	16.7	3	1.5	23.1
2	1.0	33.3	3	1.5	23.1
4	2.0	66.7	6	3.0	46.2
2	1.0	33.3	4	2.0	30.8
1	0.5	16.7	5	2.5	38.5
1	0.5	16.7	1	0.5	7.7
2	1.0	33.3	6	3.0	46.2
2	1.0	33.3	2	1.0	15.4
0	0.0	0.0	6	3.0	46.2
0	0.0	0.0	1	0.3	3.9
5	1.3	41.7	10	2.5	38.5
1	0.5	16.7	10	5.0	76.9
3	1.5	50.0	3	1.5	23.1
1	0.5	16.7	1	0.5	7.7
1	0.5	16.7	1	0.5	7.7
3	0.4	12.5	14	1.8	26.9
3	0.4	12.5	13	1.6	25.0
1	0.1	4.2	4	0.5	7.7
0	0.0	0.0	1	0.0	0.6
0	0.0	0.0	1	0.5	7.7
2	1.0	33.3	2	1.0	15.4
1	0.5	16.7	13	6.5	100.0
1	0.5	16.7	1	0.5	7.7
5	2.5	83.3	5	2.5	38.5
1	0.5	16.7	5	2.5	38.5
0	0.0	0.0	6	3.0	46.2
2	1.0	33.3	2	1.0	15.4
2	1.0	33.3	9	4.5	69.2
3	1.5	50.0	5	2.5	38.5
1	0.5	16.7	1	0.5	7.7
2	1.0	33.3	3	1.5	23.1
5	0.6	20.8	8	1.0	15.4

skinning, disarticulation, and filleting. Bone fractures were classified as dry or fresh (Johnston 1985). Fresh fractures were considered bones that were broken while green but lack technological features such as impact marks (Blumenschine and Selvaggio 1988). All observations were taken using an Olympus SZ61 microscope, at 0.67x–4.5x magnification.

Results

Species Representation

A total of 2,744 fragments were analyzed. Of these, 2,296 (84%) were identified to the rank of class or higher (Table 1). All three body size categories were identified at the site. The higher frequency of faunal remains corresponds to the medium size vertebrates (NISP=1,338; 49%), followed by small size vertebrates (NISP=1,050; 38%), and large size vertebrates (NISP=356; 13%). Mammalia constitutes most of the assemblage at 58 percent (NISP=1,601), followed by Reptilia (14%; NISP=395) and Actinopterygii (10%, NISP=272). Amphibia (NISP=17) and Aves (NISP=11) each represent less than 1 percent of the total assemblage. Just over 16 percent of the total bone assemblage (NISP=448) were specimens in which the taxonomic status was undetermined.

In terms of identified species, white-tailed deer (*Odocoileus virginianus*: NISP=288; MNI=7; see age class tallies in *Representation of Parts* section below for MNI calculation) represent 84 percent of determined Mammalia (NISP=341), and 10 percent of the total assemblage based on NISP data. Channel catfish (*Ictalurus punctatus*: NISP=148; MNI=19) was the most common fish, representing 92.5 percent of Actinopterygii identified below class (NISP=160), and 5 percent of the total assemblage. Snapping turtle (*Chelydra serpentina*: NISP=85; MNI=4) and painted turtle (*Chrysemys picta*: NISP=47; MNI=8) were the only reptiles that were identified to species, however unidentified Testudines (NISP=263) was the most common and represented 66 percent of Reptilia and 9.5 percent of the total assemblage. No Amphibia fragments could be identified to the level of genus, however all belonged to Anura (NISP=17). Only one Aves fragment was identified to species, passenger pigeon (*Ectopistes migratorius*: NISP=1); all other specimens belonged to unidentified Anatidae (ducks). Carnivore species were identified in all three body size categories, including American black bear (*Ursus americanus*: NISP=4; MNI=1) and red fox (Vulpes vulpes: NISP=2; MNI =1). Muskrat (*Ondatra zibethicus*: NISP=6; MNI=2) was also identified.

Finally, it is important to mention that some bone specimens had previously been reported by Johnston (1968b), but were not present in the sample analyzed here and remain in the ROM's collections. This includes the beak elements of a common loon (*Gavia immer*), talons and a mandibular fragment of a bald eagle (*Aquila chrysaetos*), mandibles and maxillae of a timber wolf (*Canis lupus lycaon*), and skull and mandible of a mink (*Neovison vison*). These items formed part of a burial bundle and were not related to subsistence activities (Johnston 1968b).

Representation of Parts

As shown in Table 2 and Figure 3a, a wide spectrum of white-tailed deer anatomical units was recovered at the site. The appendicular elements (MNE=176; 80%) represented a larger portion of the deer fragments then do the axial elements (MNE=44; 20%). According to the total %MAU, the most frequent element is the radius, which is well represented by its distal portion (MNE=13). The proximal portion of the metatarsal (MNE=10) and the distal portion of the tibia (MNE=9) are also abundant. An MNI equal to 7 was calculated using the metatarsal bone (7 right, 3 left, 10 total). Excluding the indeterminate metapodials and phalanx, hind limb elements (MNE=48; 55% of limb bones) occur slightly more than the forelimb elements (MNE=40; 45% of limb bones). There is a low frequency of diaphysis portions in all the long bones, including a complete absence of the metacarpal and ulna shafts. Articulating elements (carpal/tarsal bones) were identified in average frequency, such as the calcaneus and cubonavicular (%MAU=46.15 in the case of each

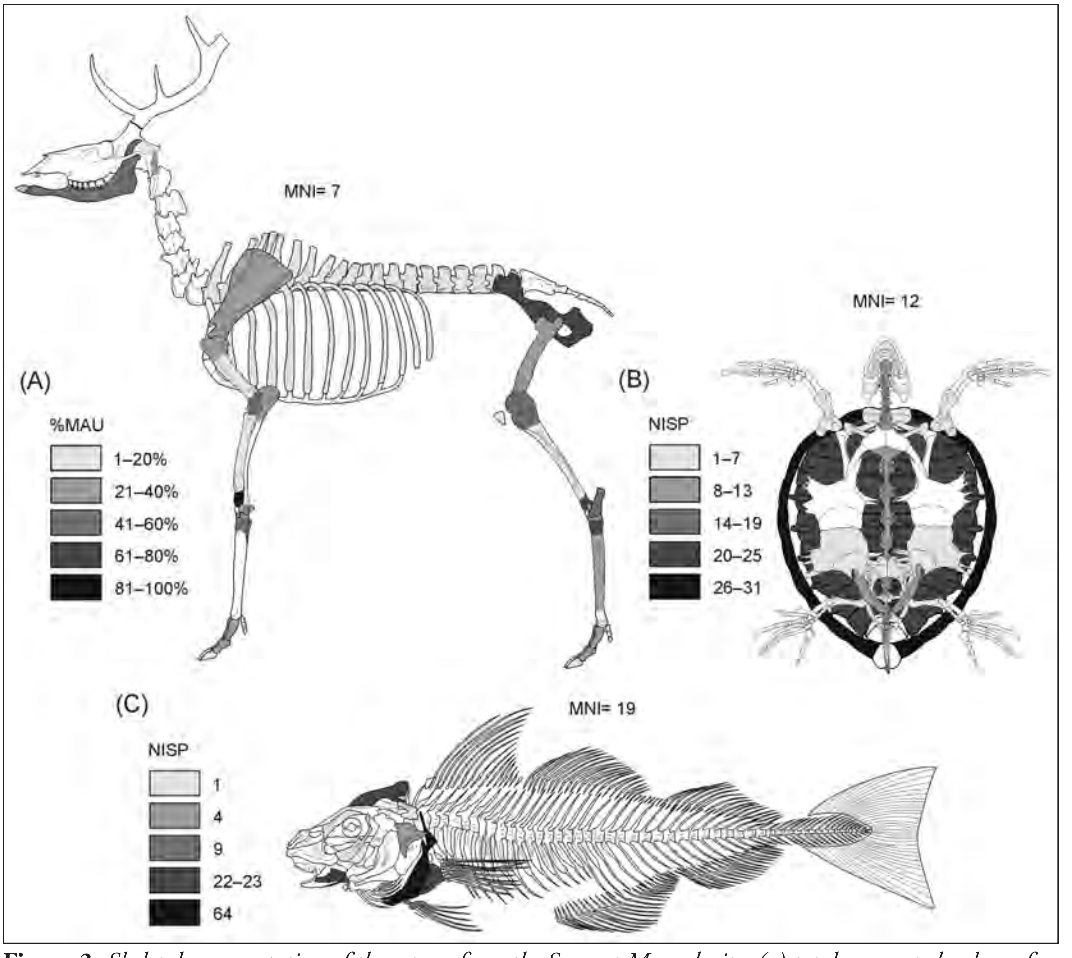

Figure 3. *Skeletal representation of three taxa from the Serpent Mounds site: (a) total segmented values of standardized minimum animal units (%MAU) of* Odocoileus virginianus*, (b) combined number of identified specimens (NISP) of* Chrysemys picta *and* Chelydra serpentina*, and (c) the number of identified specimens (NISP) of* Ictalurus punctatus*. Skeletal outlines from ArcheoZoo.org (https://www.archeozoo.org/archeozootheque/).*

element). In reference to the axial skeleton, the pelvis is the most frequent (%MAU=61.54), followed by the mandible (%MAU=46.15) and the skull, which is represented by the occipital (%MAU=30.77) and temporal bone (%MAU=15.38). There is a complete absence of maxilla and antler. The under-representation of axial bones is further supported by the limited presence of deer teeth in the assemblage (MNE=3; %MAU=1.44). Ribs are almost absent (%MAU=1.78), and only thoracic and lumbar vertebrae were identified in the site, both in low frequency. Taking into consideration skeletal elements which could be classified as unfused or fused, 71 percent correspond to fused bones (MNE=69). The identified unfused elements (MNE=28) are represented almost entirely by the appendicular skeleton. According to the initial fusion ages in white-tailed deer (Purdue 1983), the unfused bone assemblage is represented by juvenile individuals between four months (unfused proximal radius; MNE=1) and three years in age (unfused proximal humerus; MNE=3). No semi-fused deer elements were identified in the sample.

The second most abundant large vertebrate is *Alces alces* (moose). Skeletal parts include the left squamosal (NISP=1), the diaphysis of a metapodial (NISP=1), two distal epiphyses of a metapodial (NISP=2), and a molar (NISP=1). The *Ursus americanus* (American black bear) was represented by the left zygomatic arch (NISP=1), the posterior articular surface of a vertebra (NISP=1), the patellar groove of the distal epiphysis of the right femur (NISP=1), and the shaft of a baculum (NISP=1).

The most abundant species in the site in terms of MNI, is the *Ictalurus punctatus* (channel catfish: NISP=148; MNI=19: Figure 3c). The skeletal elements corresponded to the mandible (NISP=23), metapterygoid (NISP=22), operculum (NISP=4), parasphenoid (NISP=1), pectoral spine (NISP=9), cleithrum (NISP=64), frontal (NISP=22), prefrontal (NISP=1), quadrate (NISP=1), and the articular surface of the cranium with the spinal column (NISP=1).

With a combined NISP=395, turtle bones (*Chrysemys picta, Chelydra serpentina,* and undetermined Testudines) were an important component of the site (Figure 3b). *Chrysemys picta* is entirely represented by plastron and carapace (NISP=47). Plastron elements include the entoplastron (NISP=3), epiplastron (NISP=11), and hypoplastron (NISP=2). One fragment was composed of a still-fused epiplastron and entoplastron, and two fragments were composed of still-fused epiplastron and hyoplastron. Another fragment was identified as plastron based on the shape, but the element could not be identified. Carapace elements were the second marginal (NISP=1), third marginal (NISP=1), fourth marginal (NISP=2), eighth marginal (NISP=2), unidentified marginals (NISP=5), neural (NISP=4), nuchal (NISP=2), and pleural elements (NISP=7). Also, two neural, two left pleural, and three right pleural elements were reassembled and belonged to the same individual. Two fragments were identified as shell elements, but it could not be determined if they came from the plastron or carapace. *Chelydra serpentina* was represented by shell and skeletal elements. The skeletal elements were clavicle (NISP=2), maxilla (NISP=1), squamosal (NISP=1), femur (NISP=3), humerus (NISP=4), hyobranchial apparatus (NISP=1), unidentified long bone (NISP=2), mandible (NISP=4), pelvis (NISP=4), scapula (NISP=2), tibia (NISP=2), unidentified vertebra (NISP=13), and shell (NISP=46). Of those shell elements, one belonged to the plastron (hypoplastron), while the other 45 belonged to the carapace. These elements are the marginals (NISP=26), neural (NISP=4), and pleurals (NISP=15).

Taphonomy

The faunal assemblage at the Serpent Mounds site shows evidence of several types of modifications (Table 3; Figure 4). The most frequent modification is bone fractures, occurring in 99 percent (NISP=2,724) of the assemblage. Dry fractures occurred more frequently than fresh fractures across all size classes, with dry fractures ranging from 97.77 percent (NISP=1,026) in the small vertebrate category to 83.42 percent (NISP=297) in the large category. Of all fracture shapes observed, the irregular shape was most common, ranging from 92.19 percent (NISP=969) in the small category to 75.84 percent (NISP=270) in the large category. Spiral fractures (Figure 4b) were the second most common shape (14.20%, NISP=190, and 14.89%, NISP=53, in medium and large respectively) but were less frequent in the small size category (1.33%, NISP=14). Longitudinal fracture shapes were slightly less common, ranging from 7.02 percent (NISP=94) in the medium category to 3.42 percent (NISP=36) in the small category. The remaining fracture shapes occurred at a frequency less than 2 percent. The presence of fresh fractures, in particular those with evidence of spiral fracture shapes, implies that part of the bone assemblage may have been intentionally fractured by humans, at, or shortly after the time of death, although other processes may be involved (see Karr and Outram 2012).

Nine percent of the assemblage (n=248) had some form of root etching. While very few bones had root marks covering the entire surface (0.14%, n=4), many bones had root marks covering less

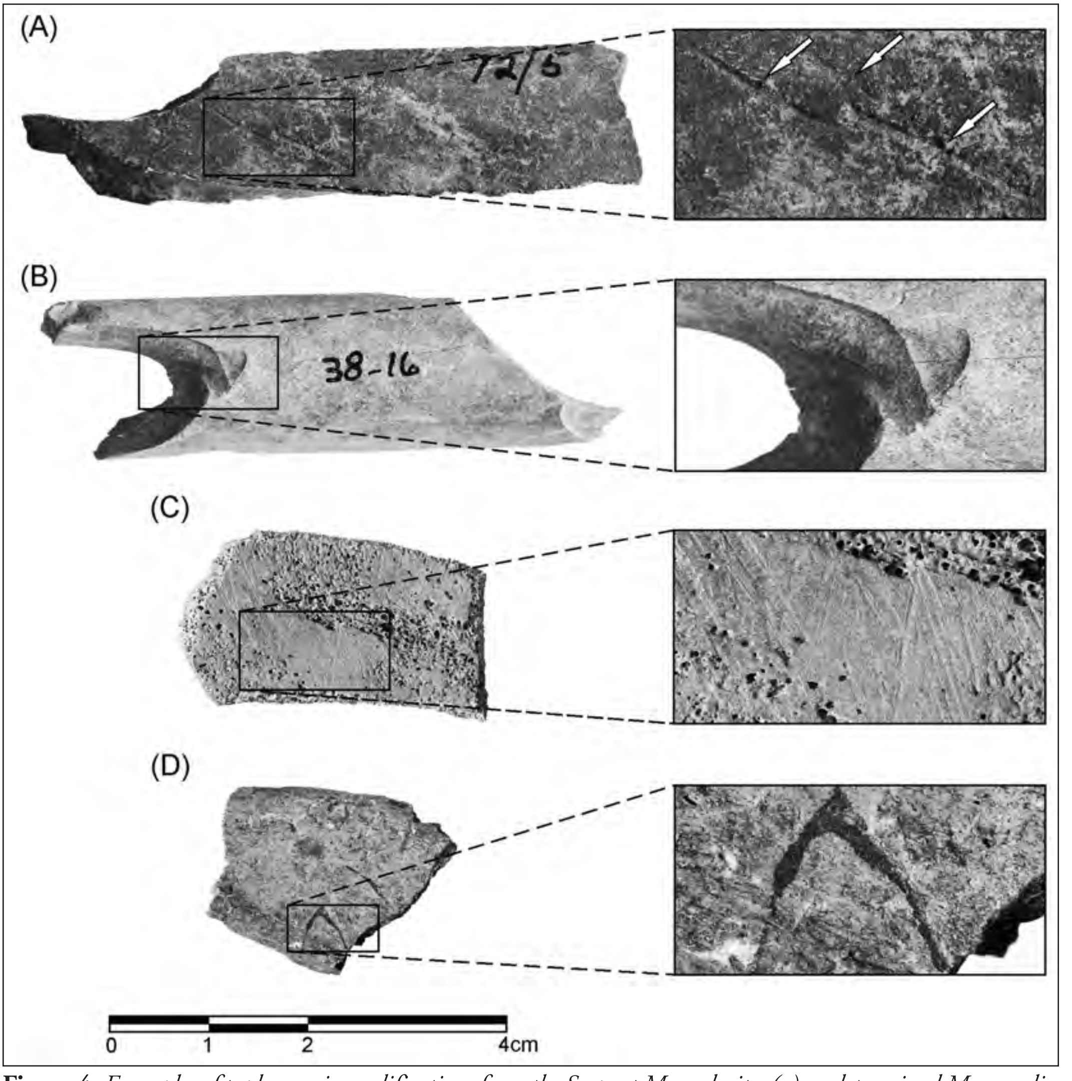

Figure 4. *Examples of taphonomic modifications from the Serpent Mounds site: (a) undetermined Mammalia bone fragment with cut marks, (b) undetermined Mammalia long bone shaft with fresh fracture and exterior flake, (c) undetermined turtle shell carapace fragment with the interior cortical surface removed, (d) undetermined bone fragment with dark staining.*

than 25 percent of the bone surface (6.85%, n=188). This implies that root etching was continuous but did not have destructive effects on the surface of the bone. Thermal alteration was another frequent type of modification in all size categories. The highest percent of burned bones was found in medium sized animal bones (8.22% of medium; n=110), followed by small sized bones (6.28% of small; n=66) and large sized bones (3.93% of large; n=14). There are significantly more carbonized burns (between 7.77% and 3.65%) than there are calcined (<1%) in all size categories, where the highest proportion of calcined fragments is on the medium bones (0.45%; n=6). The extent of burning was therefore minimal, and higher burn temperatures (see Shipman et al. 1984) only affected a small

Table 3: *The taphonomic processes observed on the small, medium, and large body size bones.*

Taphonomic Variable	Small		Medium		Large		Total	
	N	%	N	%	N	%	N	%
Weathering								
Stage 0	1,014	96.6	1,271	95.0	337	94.7	2,622	95.6
Stage 1	31	3.0	56	4.2	15	4.2	102	3.7
Stage 2	5	0.5	11	0.8	4	1.1	20	0.7
Carnivore Marks								
Pitting	4	0.4	13	1.0	4	1.1	21	0.8
Puncture	1	0.1	0	0.0	2	0.6	3	0.1
Scoring	0	0.0	5	0.4	1	0.3	6	0.2
Thermal Alterations								
Carbonized	64	6.1	104	7.8	13	3.7	181	6.6
Calcined	2	0.2	6	0.5	1	0.3	9	0.3
Root Marks								
0–25%	39	3.7	119	8.9	30	8.4	188	6.9
25–50%	4	0.4	32	2.4	8	2.3	44	1.6
50–75%	1	0.1	9	0.7	2	0.6	12	0.4
75–100%	1	0.1	2	0.2	1	0.3	4	0.1
Trampling Marks								
0–25%	0	0.0	13	1.0	2	0.6	15	0.6
25–50%	0	0.0	1	0.1	1	0.3	2	0.1
50–75%	0	0.0	1	0.1	0	0.0	1	0.0
Chemical Corrosion								
25–50%	1	0.1	0	0.0	0	0.0	1	0.0
50–75%	1	0.1	1	0.1	0	0.0	2	0.1
75–100%	1	0.1	1	0.1	0	0.0	2	0.1
Geologic Abrasion								
0–25%	0	0.0	1	0.1	0	0.0	1	0.0
50–75%	0	0.0	1	0.1	0	0.0	1	0.0
Cut Marks	66	6.3	68	5.1	31	8.7	165	6.0
Percussion Notch	0	0.0	8	0.6	8	2.3	16	0.6
Dark Lines and Staining	1	0.1	4	0.3	3	0.8	8	0.3
Fracture Type								
Fresh Fracture	18	1.7	128	9.6	43	12.1	189	6.9
Dry Fracture	1,026	97.6	1,208	90.3	297	83.4	2531	92.2
Undetermined	0	0.0	0	0.0	4	1.1	4	0.1
Fracture Shape								
Stepped/Columnar	3	0.3	5	0.4	0	0.0	8	0.3
Sawtoothed	1	0.1	0	0.0	0	0.0	1	0.0
V-shaped	0	0.0	2	0.2	0	0.0	2	0.1
Flaking	1	0.1	1	0.1	2	0.6	4	0.1
Irregular	969	92.2	1,030	77.0	270	75.8	2,269	82.7
Irregular Perpendicular	20	1.9	14	1.1	1	0.3	35	1.3
Smooth Perpendicular	0	0.0	1	0.1	0	0.0	1	0.0
Spiral	14	1.3	190	14.2	53	14.9	257	9.4
Longitudinal	36	3.4	94	7.0	21	5.9	151	5.5
Unbroken	7	0.7	2	0.2	12	3.4	21	0.8
Total # of bones in size category	1050		1338		356			

portion of the bone assemblage.

The remaining natural modifications at the site presented low frequencies (<5%). Only 4 percent of the bone assemblage shows signs of weathering, and no specimen is weathered beyond stage two. This implies that bone specimens were buried or covered by local vegetation relatively quickly. There is a low percentage of carnivore marks (<2%) in all size categories. The most common carnivore marks present are pitting, which are found on bones of all sizes. The small and large bones also show punctures, whereas the medium and large bones show more scoring. Less than 1 percent of the fragments in medium and large sized bones showed some trampling marks, and small sized bones had no trampling marks. Chemical corrosion was only found on the small and medium sized bones. When this modification was present it tended to cover most of the bone surface (50–100% coverage), where only a few fragments showed partial coverage (0–25%). Geologic abrasion was only seen on two of the medium size bones, but ranged from covering a small portion up to the whole surface.

Cut marks were present on all bone sizes, including on *Alces alces* (NISP=1), *Castor canadensis* (NISP=1), *Chelydra serpentina* (NISP=5), *Chrysemys picta* (NISP=5), *Odocoileus virginianus* (NISP=22), undetermined Anura (NISP=3), undetermined Cervidae (NISP=5), undetermined Testudines (NISP=45), undetermined Aves (NISP=1), undetermined mammal (NISP=67) (Figure 4a), and undetermined vertebrate (NISP=10). Percussion notches were only seen on *Odocoileus virginianus* (NISP=8) and undetermined mammal (NISP=8). Considering the abundance of cut marks and percussions notches on white-tailed deer, these modifications are described in Table 4 and illustrated in Figure 5. All processing marks were identified on the appendicular skeleton. Both the hind limbs and forelimbs presented similar frequencies of modifications. All four types of butchering strategies were identified, with a slightly higher frequency in disarticulation (NISP=12), compared to skinning (NISP=7) and filleting (NISP=3). Percussion notches were identified in eight specimens, along both the mid-shaft and diaphysis near the epiphysis of the long bones. This modification helps support the case that humans were one of the agents responsible for freshly fractured bone.

It is important to mention here that 43 of the 346 turtle shell fragments had extensive abrasion on one surface (Figure 4c). On many of these fragments the modification was so extensive that the entire cortical surface was removed. Given the location of these marks in the interior shell, this activity may be related with anthropic activity (see discussion below). Finally, six mammal fragments (including white-tailed deer tarsal and a moose metapodial) and two turtle fragments (a painted turtle epiplastron and a pleural element of a snapping turtle carapace) possessed dark lines and black staining on the bone surface of unknown origins (Figure 4d). The marks may be the result of natural irons in the soil staining the bone.

Discussion

The faunal material studied from a sample of the shell midden excavations provides a detailed body of information on the diversity of resources and type of human subsistence activities that occurred at this important Middle Woodland site. The examined randomly selected sample of material represents 7 percent of the total faunal assemblage recovered from the Serpent Mounds midden, and is presumed to be representative of the types of animals that were processed and recovered in the midden, and the natural formation processes that occurred during and after these activities.

An important insight from this study is that the shell midden is comprised of a wide range of other taxa beyond shellfish. The Serpent Mounds faunal assemblage presents a variety of taxa, including mammals, birds, reptiles, amphibians, and fish. It provides us with significant insight not only about Middle Woodland hunter-gatherer foraging practices, but also the local environmental conditions and vertebrate populations. Although the most abundant remains correspond to medium sized mammals, there are numerous small size reptiles and fish and at least three different large-sized mammals (moose, bear, and white-tailed deer). Deer represents a major prey type,

Table 4: *The locations of cut marks and percussion notches on white-tailed deer bones and the associated processing activity.*

Laboratory ID #	Mark	Location
960.292.869.23	Percussion Notch	proximal epiphysis of left metacarpal
960.292.866.17	Percussion Notch	diaphysis of right femur
960.292.923.46	Percussion Notch	diaphysis of metapodial
960.292.924.122	Percussion Notch	anterior surface of diaphysis of metapodial
960.292.1073.73	Percussion Notch	proximal epiphysis of proximal phalanx
960.292.1122.36	Percussion Notch	distal epiphysis of right humerus
960.292.1122.53	Percussion Notch	diaphysis near distal epiphysis of right humerus
960.292.1144.5	Percussion Notch	ulnar groove of radius
960.292.1205.56	Cut Mark	diaphysis of left metatarsal
960.292.1205.57	Cut Mark	distal epiphysis of proximal phalanx
960.292.1205.63	Cut Mark	articular surface of the distal phalanx of a vestigial toe
960.292.1206.1	Cut Mark	proximal epiphysis of left metacarpal
960.292.1219.73	Cut Mark	distal epiphysis of proximal phalanx
960.292.1205.181	Cut Mark	proximal epiphysis of intermediate phalanx
960.292.1205.183	Cut Mark	diaphysis of femur
960.292.866.39	Cut Mark	proximal epiphysis of right radius
960.292.899.27	Cut Mark	inferior edge of glenoid fossa of the right scapula
960.292.863.64	Cut Mark	diaphysis of metapodial
960.292.863.65	Cut Mark	blade of left scapula
960.292.920.67	Cut Mark	head of femur
960.292.922.44	Cut Mark	distal epiphysis of right ulna
960.292.922.45	Cut Mark	proximal epiphysis of left metatarsal
960.292.1122.36	Cut Mark	lateral epicondyle of right humerus
960.292.1122.57	Cut Mark	proximal articular surface of left tibia
960.292.1122.58	Cut Mark	distal epiphysis of left tibia
960.292.1124.50	Cut Mark	distal epiphysis of ulna
960.292.1131.27	Cut Mark	diaphysis of right tibia
960.292.1131.130	Cut Mark	lateral malleolus of right tibia
960.292.1131.131	Cut Mark	distal articular surface of metapodial
960.292.1131.125	Cut Mark	olecranon process of right ulna

Activity	Figure 5 Map ID #
marrow procurement	1
marrow procurement	2
marrow procurement	3
marrow procurement	4
marrow procurement	5
marrow procurement	6
marrow procurement	7
marrow procurement	8
skinning	9
skinning	10
skinning	11
disarticulation	12
skinning	13
skinning	14
filleting	15
disarticulation	16
disarticulation	17
skinning	18
filleting	19
disarticulation	20
disarticulation	21
disarticulation	22
disarticulation	23
disarticulation	24
disarticulation	25
disarticulation	26
filleting	27
disarticulation	28
skinning	29
disarticulation	30

and as discussed below, presents the most significant evidence of bone processing activities. Despite shellfish being identified as the predominant species by Johnston (1968b), the faunal analysis highlights the contribution of other lacustrine and wetland animal resources to the diet, particularly that of turtles and catfish.

Taphonomic History of the Serpent Mounds Faunal Assemblage

A second insight from this study is in the formation of the bone assemblage, particularly that the bones are found extensively fragmented. Almost all vertebrates from the three body size categories were entirely fractured bone. While an extensive chronological period of human activity, including burials, middens, and habitation areas, may be the direct cause for the extensive bone fragmentation, natural formation processes must also be considered. The results from the taphonomic analysis provided clues into the possible natural processes which acted on the bones and may be responsible in part for the highly fragmented sample.

The presence of weathering characteristics on only a limited proportion (4%) of the faunal assemblage suggests that very few specimens were exposed prior to being buried. Prolonged exposure can contribute to the decay of the cortical surface and in advanced stages lead to bone fragmentation. However, the low percentage of weathered remains and the prevalence of lower stages show that this process did not significantly affect the overall preservation of the assemblage. The presence of root marks in all vertebrate size categories supports the idea that plants growing over top of the bone fragments would protect the bones from weathering due to solar radiation. Root marks were identified in many specimens; although the percentage of the bone surface affected by this process was minimal (0–25%). Combined with local chemicals in the soil, root action can cause bone corrosion (Fernández-Jalvo and Andrews 2016). This natural process results in significant surface damage which can weaken the bone structure and in smaller specimens eventually lead to fragmentation. Bone corrosion at the site was identified in low frequency in small

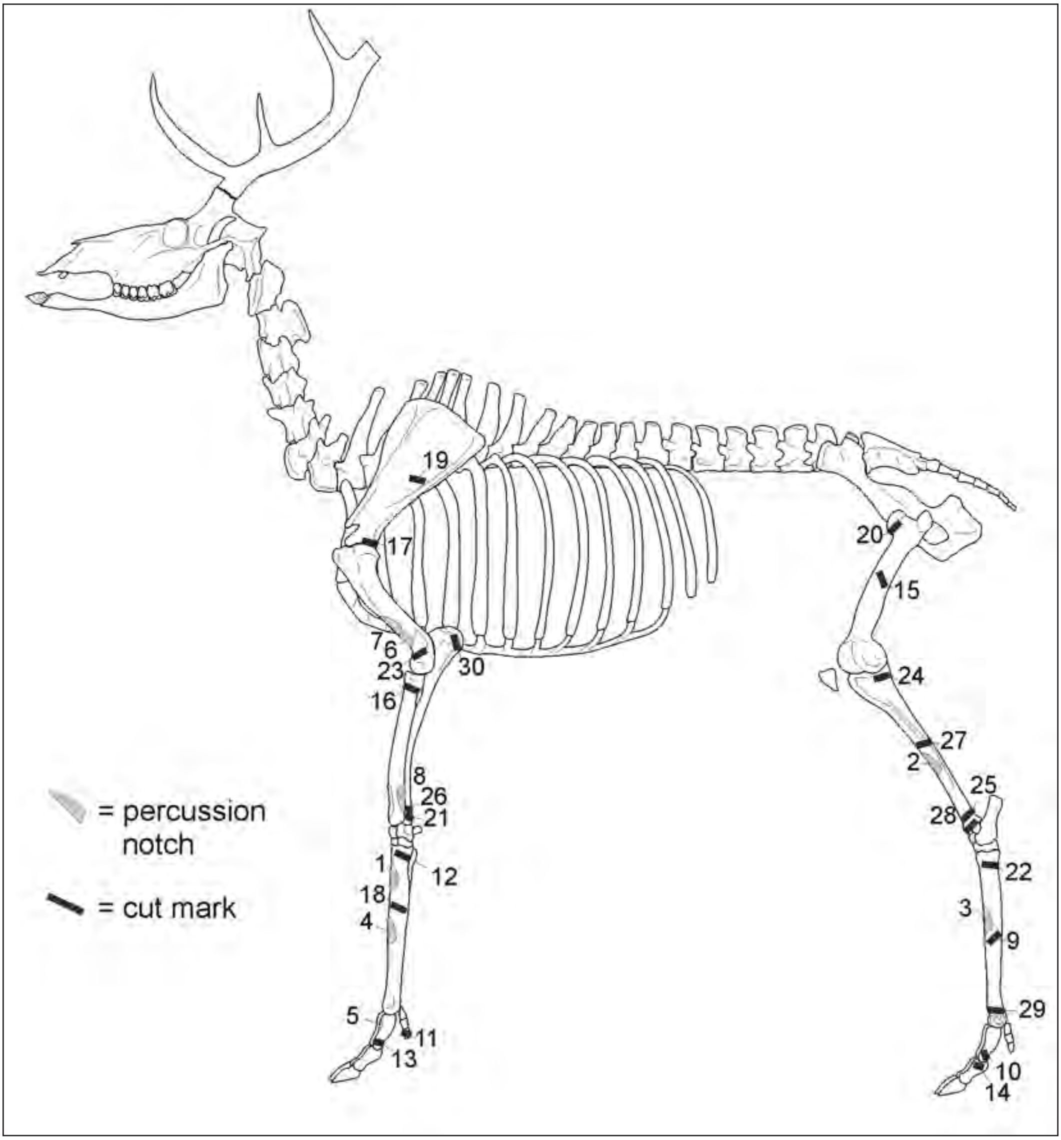

Figure 5. *The locations of cut marks and percussion notches on the white-tailed deer skeleton. See Table 4 for number references. Skeletal outline from ArcheoZoo.org (https://www.archeozoo.org/archeo zootheque/).*

and medium sized vertebrates. While present, the damage was minimal, and therefore it is not considered a significant factor in the overall preservation of the bone at this site.

Thermal alteration can be the result of natural and cultural burning. Extensive burning results in fragile bone and reduces the likelihood of preservation (Lyman 1995, 2008; Reitz and Wing 1999). Features indicating burning activities (i.e., hearths) were recorded by Johnston (1986b) in the habitation area, but not within the midden itself. Johnston (1968b) specifically identified burning in human remains and deer bone fragments. In the midden sample, the majority of the burned fragments were carbonized, which suggests lower burn temperatures (Shipman et al. 1984). While the exact source of heat (i.e., natural or cultural) of these burned fragments cannot be determined, the low frequency of thermal alteration suggests minimal damage to the bone assemblage.

Carnivores can accumulate and fracture bones during and after human occupations (Binford 1981; Blumenschine and Marean 1993; Bertino et al. 1994; Camarós et al., 2013; Haynes 1980; Lyman 1994a). Large carnivores such as American black bears, wolves, and dogs are capable of significant bone surface damage (Saladié et al. 2013). While different carnivore marks were identified in the Serpent Mounds bone assemblage, the proportion of specimens with marks is low (1%). Carnivore activity does not appear to have played a role in the fragmentation of the bone assemblage; however, scavenging and transport cannot be ruled out and may help explain the absence of some skeletal elements.

To summarize, the bones at the Serpent Mounds site were affected by multiple natural processes, in particular: root action, thermal alteration, weathering, and chemical corrosion. Other natural modifications identified at the site, such as geologic abrasion, carnivore marks, and trampling, had minimal effect on the bone assemblage. While these modifications would be in part responsible for bone fragmentation, in general, the frequency of natural modification was minimal (<10%), suggesting that other processes were acting at the site to generate extensive fragmentation, specifically, cultural modifications.

Faunal Resource Utilization

The faunal analysis presented above allows us, for the first time, to obtain insight into the types of subsistence activities that occurred at the Serpent Mounds. Despite the extensive fragmentation of the bone assemblage, different sized vertebrates were identified with cut marks, including moose, white-tailed deer, beaver, turtles, amphibians, and birds. This diversity of vertebrates with evidence of human processing suggests that the occupants at the Serpent Mounds where hunting a broad range of animals. While no processing evidence was identified in fish, the number of specimens (NISP=272; 10%) and minimum number of individuals (19 channel fish, 3 northern pike, and 2 walleye), along with the current understanding of environmental conditions at the Serpent Mounds site during the Middle Woodland period, suggests fish were a significant dietary staple. Other smaller vertebrates such as birds, turtles, and amphibians were also significant. The presence of cut marks on beaver and moose suggests hunting of larger sized mammals. Turtles not only presented cut marks, but many of the turtle shell fragments found at the Serpent Mounds site had the interior cortical surface removed, exposing the spongy cancellous bone underneath. Given that it was always the interior cortical surface that had this abrasion; it is possible that these shells were used for a secondary purpose that caused this abrasion. It has been noted before that turtle shells have been used by ancient humans across the planet as bowls and rattles (Granger 1976; Holt 1996; Sidera and Scheinsohn 2010), and it is therefore possible that turtle shells were used in a similar manner at Serpent Mounds.

White-tailed deer present the most frequent evidence of human modifications, including abundant cut marks and intentional bone fractures. The cut mark evidence suggests that at least three types of deer processing activities were taking place (disarticulation, skinning, and filleting). After the meat was removed, the deer bone was fractured for marrow extraction or processed into bone tools (Johnston 1968b). The abundant evidence of the percussion marks and fresh fractures on the long bone shafts, as well as the low frequency of diaphyses, support this claim, indicating that the deer long bones were being extensively fragmented by humans. However, the greater abundance of the denser segments of the long bones, such as the distal radius and tibia, and the proximal metapodials, suggests that the deer sample is also mediated in part by natural processes (Lam et al. 1999). The patterning can be explained by a combination of density mediated attrition and humans using bone for raw material (Lyman 1984; Needs-Howarth and Hawkins 2017; Stiner 2004).

The relatively high frequency of appendicular elements is consistent with the deer being hunted at a distance and only higher value elements being selected for transport to the site for further processing. The lack of teeth at the Serpent Mounds site also suggests that the deer were hunted at a distance and only the high yield portions of the animals were returned to the site. Teeth are made of dense enamel and dentin, which typically preserve well, and in mature individuals can remain intact even when the bone is destroyed (Hollund et al. 2013). Notwithstanding this factor, other axial parts and segments such as ribs and vertebrae are low density elements (Lam et al. 1999), which suggest part of the skeletal representation of white-tailed deer at the Serpent Mounds site is likely due to density mediated survival. Finally, the analysis of bone fusion suggests that hunters were practicing non-selective prey choice, targeting both juvenile and adult white-tailed deer.

Middle Woodland Subsistence Strategies

The archaeologically identified settlement pattern generated by the communities of the Middle Woodland period have been interpreted as reflecting a winter/summer seasonal pattern of site use (Spence et al. 1984). Larger microband groups would gather at resource rich locations during the spring and summer months, such as the mouths of rivers (Creese 2011; Johnston 1968b). These people would then disband into smaller family hunting camps as winter set in and resources became more distributed (Chapdelaine 1993; Creese 2013; Leveille et al. 2006). These yearly aggregations of people could have allowed for the exchange of tools, information, and family members through marriage between the family units. However, the relationship between aggregation sites and mortuary complexes is less clear, as these locations do not present evidence of long-term habitation but instead are likely to represent special purpose locations in which communities gathered at appropriate times. Furthermore, the relationship between food practices and these special purpose areas has until now been unclear because of a lack of any detailed analysis of faunal materials associated with a mortuary context.

Zooarchaeology and taphonomic data from the Serpent Mounds site suggests a subsistence strategy based on hunting, fishing, and gathering; primarily white-tailed deer, catfish, and shellfish. In terms of seasonality, these primary resources and the waterfront location of the site are both indicators of warm weather, with fish being exploited during the spring to summer occupation, and deer during the late summer to late fall occupation (Ellis et al. 2009; Johnston 1968b; Naylor and Savage 1984). While the proportion of shellfish to mammals and Actinopterygii is difficult to evaluate without quantitative measures of the amount of shellfish recovered from the site, the shellfish described by Johnston (1968b) suggests that this was an important resource for occupants. Consequently, the data point to a broad subsistence strategy, including complementary/secondary resources like birds, and turtles. Collecting plants, fruits, and nuts was also likely to be a complementary aspect of the diet. In general, this hunter-gatherer-fishing lifestyle maximizes the diversity of seasonally varied food resources available in the environment and is consistent with Middle Woodland subsistence economies in southern Ontario (Spence et al. 1984). For example, other Middle Woodland activity locations such as the East Sugar Island, which is roughly analogous to the Serpent Mounds, also contains middens with deer, beaver, porcupine, turkey, fish, and turtle (Ritchie 1949). Non-mortuary sites such as Dawson Creek site (2940–300 years BP) contain hearths and middens with many different animals including deer, catfish, and charred nut remains (Jackson 1988). Spillsbury Bay (1300–1100 years BP) is a Middle Woodland site located on the north shore of Rice Lake. The identified species from this site included mostly fish, as well as deer and muskrat skeletal elements (Harrington 2002). At the nearby Late Archaic site of McIntyre (4715–3650 years BP), faunal analysis found that the people mostly relied on large mammals such as white-tailed deer as a food source, but also utilized fish, turtles, and birds (Naylor and Savage 1984; Johnston 1985).

Finally, the most significant aspect of the Serpent Mounds location is its substantial mortuary context. How do the activities recorded in the midden relate to the burial mounds? From a wider understanding of the social role of food in ritual, and in particular the importance of mortuary feasting (e.g., Russell 2012:381, and references therein), a reasonable question to ask is whether the types of food activities represented in the Serpent Mounds midden are unusual and relate in some way to ceremonial practices. While the Serpent Mounds site is one of the most elaborate burial sites in southern Ontario, and the thick middens are an important part of the associated record of use, the faunal remains have no clear evidence of special activities or biases related to ritual use of food or animal parts. Rather, the food practices contained in the midden appear instead to derive from normal broad-spectrum foraging activities. The physical separation of the mounds from the midden, and the paucity of subsistence (and also lithic and ceramic) material in the mounds themselves are both suggestive of a clear separation between daily foraging practices and presumably more punctuated participation in mortuary rituals. This conforms to Sassaman's (2010:90–91) hypothesized Northeastern "Ancestor II" use of mortuary space, as distinctive from Southeastern "Ancestor I" traditions. Whereas the latter generally integrate the dead within the accumulated remains of subsistence practices, Ancestor II regions, which encompass the Great Lakes, maintain a clear separation of the two. The results from the Serpent Mounds site investigation of food practices associated with a burial context helps reinforce a wider understanding of how space is commonly structured by shared practices across a much broader region of interaction across and beyond the Great Lakes.

Conclusions

This study has provided insight into the subsistence strategies of the Serpent Mounds people during the Middle Woodland period. The results presented in this paper suggest humans as the main but not the only process responsible for the deposition of faunal remains at the site. The extensive fragmentation of the faunal assemblage is due in part to a combination of various natural formation processes acting on the taxa and on the other hand to faunal processing activities by occupations at the site, specifically for extracting marrow and the manufacture of bone tools. The faunal material recovered from the Serpent Mounds site and the direct evidence of processing of distinct taxa suggests a broad hunting-gathering-fishing subsistence strategy. This evidence is consistent with known Middle Woodland economies in southern Ontario and precontact groups in the greater part of central northeastern North America. However, the exact proportion of fish and other small animals in the Serpent Mounds assemblage is ultimately unknowable due to the inherent bias against small sized taxa in hand collecting. While the site contains a substantial mortuary context, there is currently no evidence to suggest ritual food practices, or in what season mound construction and burial took place.

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Cet article présente une analyse du matériel faunique obtenu lors de fouilles d'amas coquillier du Musée royal de l'Ontario dans les années 1950 sur le site Serpent Mounds, lac Rice, Ontario (BbGm-2). Les données zooarchéologiques et taphonomiques présentées ici fournissent des informations importantes pour comprendre les activités de subsistance sur le site ainsi que les processus de formation du site. Il contient des preuves de transformation de la faune anthropique chez divers vertébrés, dont le cerf de Virginie (Odocoileus virginianus)*, l'orignal* (Alces alces)*, le castor du Canada* (Castor canadensis)*, la tortue serpentine* (Chelydra serpentina)*, la tortue peinte* (Chrysemys picta)*, une tortue non identifiée (Testudines), des grenouilles et des crapauds non identifiés (Anura) ainsi que des oiseaux non identifiés (Aves). Il y a aussi de nombreux restes de poissons, en particulier ceux de la barbue de rivière* (Ictalurus punctatus)*, qui est l'espèce de poisson la plus abondante selon le NMI. Les activités de transformation, combinées à plusieurs types de modifications naturelles, notamment les traces de racine, l'altération thermique, les intempéries et la corrosion chimique, ont donné lieu à un assemblage très fragmenté. Le registre faunique du site Serpent Mounds fournit des détails supplémentaires sur l'expression locale de la stratégie de chasse, de cueillette et de pêche de subsistance qui correspond aux économies connues de la période du Sylvicole moyen du Sud de l'Ontario.*

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Book Review

The Abenakis of Odanak, An Archaeological Journey

(by Geneviève Treyvaud, Michel Plourde, and Nathalie Lampron)

The Abenakis of Odanak, an Archaeological Journey, by Geneviève Treyvaud, Michel Plourde and Nathalie Lampron, Musée des Abénakis. Odanak, Quebec, 2017, v + 115 pages, 118 Figures, 1 Table, bibliographic references. ISBN: 978-2-9812365-3-1 (softcover), price unknown. Available in French: *Les Abénakis d'Odanak, un Voyage Archéologique*, ISBN 9782981236531.

In recent years, more effort has been made to incorporate First Nations' views of the past, oral histories, and their visions for the future into archaeological work. This volume came out of fieldwork spearheaded by the Musée des Abénakis, in Odanak, Quebec, which led to the collaboration between archaeologists and young people from Odanak who were interested in learning more about their ancestors' ways of life.

Rather than being driven by development, or regulations, this research project was spearheaded and organized as a way to unify generations based on community history. It was an opportunity for researchers to study a portion of Abenaki history, which until now had been poorly documented in both the historical and archaeological record. The research project had several objectives: to understand the Abenakis' use of the territory along the Saint-François River in Quebec; to find the remains of the palisaded Saint-François-de-Sales mission; to establish occupations of the mission from the late seventeenth century onward; and to compile a chronology of construction at the mission site in Odanak up to the present day.

The book begins with a chronology of archaeological layers uncovered at the site of Odanak, followed by a foreword from the general manager of the Abenakis of Odanak Council, and a preface by one of the archaeologists who led the excavation. The book then opens with an introduction to the village of Odanak, the project, the archaeological approach, and the people involved. Chapter 1 discusses the Alsig8ntekw, or the Saint-François River, and how it has shaped the life and history of the Abenaki people. This chapter briefly reviews the chronology of First Nations occupation along the Saint-François River, the arrival of European settlers, and how this changed the relationships between First Nations peoples. It concludes with a presentation of the results of the archaeological survey and test-pitting along the Saint-François River which occurred from 2013 to 2014. Chapter 2 presents the results of historical research regarding the location and founding of the Saint-François-de-Sales mission. The challenges of locating an historical site with few written records and the survey methods employed are also presented in this chapter. Chapter 3 is focused on a discussion of the archeological discoveries and results of excavation that took place at the heart of Odanak Village, between the Saint-François-de-Sales heritage church and the Musée des Abénakis. The chapter is mainly organized by time period, beginning with the more recent nineteenth century village and moving backwards in time to the sixteenth century. Following a discussion of occupation by time period, the latter half of Chapter 3 focuses specifically on the artifacts recovered and what they can tell the reader about the daily life of Abenaki people at the time of the site's occupation—from diet to crafts to leather work, rituals, sharing, and trade with European settlers. The final chapter of the text is a brief conclusion, which sums up what daily life in Odanak was like over a period of up to 300 years. The conclusion also presents how the project links to the present-day community of Abenaki.

The book reveals history that will be stimulating for archaeologists and that can be of interest to the general reader. Topics such as settlement, metalwork, diet, and culture are discussed, and the combination of text and photos that describe these topics could potentially stimulate an interest in archaeology for those who had not thought of it in the past. Hopefully after reading this book, the reader will understand how archaeological research and evidence can be used to confirm, refute, or clarify information presented in historical texts, as well as tell us about lifestyles of people in the past. The text is organized in a way that is easy to understand for anyone who has no prior archaeological knowledge.

As mentioned earlier, the research project had several objectives: to understand the Abenakis' use of the territory along the Saint-François River; to find the remains of the palisaded Saint-François-de-Sales mission; to establish occupations of the mission from the late seventeenth century onward; and to compile a chronology of construction at the mission site in Odanak up to the present day. The first research objective was addressed toward the end of Chapter 1. By analyzing historical texts, studying Abenaki toponyms, and analyzing the landscape, the archaeological team narrowed their survey focus to areas that were likely to have been settled by Abenaki ancestors. A very basic description of test-pitting results along the Saint-François River in the locations identified by background research is presented; however, a detailed description of *how* the Abenakis used land along the Saint-François River was not discussed.

The second objective of finding the remains of the palisaded mission was addressed in Chapter 2. I found this chapter to be better organized than the preceding chapter. Before presenting the methods and results of the test-pitting and excavations in Odanak, there is a significant description and explanation of alliances and allegiances that would have occurred between various First Nations and European settlers at the time of the founding of the Saint-François-de-Sales mission. There is strong discussion of the challenges of looking for a fortified mission through archaeology when the written historical record is not very detailed, or perhaps inaccurate. The description of where and how the shovel-testing took place was brief, but the reason behind the selection of these areas for archaeological testing were well explained.

The third and fourth objectives, to establish occupations of the mission from the late seventeenth century onward and to compile a chronology of construction at the mission site in Odanak up to the present day, are addressed in Chapter 3. It is in this chapter that the real meat of the archaeological project is presented. The excavation is discussed in detail in this chapter, although spatial analysis of the features found during excavation has not yet been completed, which means that the fourth objective has not truly been met. The radiocarbon dates and stratigraphy presented in this chapter allow the reader to imagine how and when the site would have been occupied over time, and how different areas within the site could have been used by its occupants.

Although this publication presents information in a manner that spurs the imagination, the book has shortcomings. While much of the English translation reads quite smoothly, there are a few awkward phrasings that would not be used by a native English speaker; this makes the interpretation of meanings less clear than in the French publication. There are also a few instances in the book where the figures are mislabelled as right and left, where they should be the opposite. While many of the images are high resolution, and show detail very well, especially the photos of artifacts, some of the 'work in progress' images appear a bit blurry and lack the sharpness of the artifact photos. This makes it more difficult in some cases to accurately see the features that are being presented. In addition, while the bibliography is organized by chapter, there is no reference to the page in the chapter where the reference was cited.

Although this book feels geared towards the general public, I would have liked to have seen references cited in the body of the text, or as a footnote when direct quotations were used by the authors. This citation method would have provided a more concrete link between past and present, and allowed the reader to better understand the context that the quotation was taken from.

While the book describes the archaeological excavation as a '*unifying community project that looks to the future*' (p. 114), I find the text to be less successful in this aspect. Although there are forewords and a statement from a community participant in the book, the majority of the text did not feel like it incorporated Abenaki knowledge or interpretations of the archaeological work. The text would have greatly benefitted from greater discussion of Abenaki oral history—or perhaps a conclusion written from an aboriginal perspective.

The strengths of this publication are in presenting archaeological information to the public in a way that is easy to understand and easy to relate to. Images of not only the artifacts recovered but also fieldwork in progress and features found allow the reader to imagine how an archaeological dig proceeds and also what the remains of past structures look like after years of resting in the ground. The fact that the archaeological team used the process approach (and explained the approach on page 20), was a welcome touch to this reviewer. It allows the reader to see the artifacts recovered as more than one-dimensional objects, examining how these objects can reveal information about individuals, social changes, and attitudes over time.

Overall, this book will appeal to readers who are interested in learning more about Abenaki history and how present-day archaeology can inform people about the past. The book presents an interesting subject in a way that is easy to understand and explains various aspects of an archaeological project, from survey to artifact analysis and beyond. As an archaeologist, I would have liked to have seen more details, analysis, and results presented in the book, perhaps as an addendum; however, I thoroughly enjoyed learning about Abenaki history and how this archaeological dig is truly linking the past with the present.

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Book Review

Process and Meaning in Spatial Archaeology: Investigations into Pre-Columbian Iroquoian Space and Place

(edited by Eric E. Jones and John L. Creese)

Process and Meaning in Spatial Archaeology: Investigations into Pre-Columbian Iroquoian Space and Place, edited by Eric E. Jones and John L. Creese, University Press of Colorado, Boulder, 2017, vi + 240 pages, 34 figures, 24 tables. ISBN: 978-1-60732-509-3. $48.00 US (hardcover). Available as ebook: EISBN: 978-1-60732-510-9, $26.00 US.

The eight papers assembled in this volume were originally presented in 2011 in a session held during the 76th Society for American Archaeology annual meetings in Sacramento, California. Although many of the papers presented during that session could not be included in the final publication, as is often the case with conference proceedings, the contributions gathered in this volume make a coherent and self-contained set of essays. The initial goal of the organizers was to bridge the gap between archaeologists conducting research on Northern Iroquoian Peoples on each side of the US-Canadian border, by focusing on spatial analyses. As such, it is in direct continuity with a similar volume edited a few years earlier by Miroff and Knapp (2009), both illustrating the current interest in studying Iroquoian sites and collections through various scales of analysis.

In their introductory chapter, the volume editors present a brief overview of Northern Iroquoian societies, followed by a short history of spatial archaeology in Northern Iroquoian archaeology. It is mostly focused on research conducted in New York State and Ontario, while studies from Quebec are nearly absent. The next chapters are presented in increasing order of scale of analysis. Thus, Erin C. Rodriguez and Kathleen M.S. Allen use the concepts of taskscapes and domestic spaces in Chapter 1 to study the daily life and power relations visible through the spatial patterning of lithic, ceramic, and bone artifacts inside a section of a longhouse from the Parker site, located in central New York State. This is a rare and very interesting example of an intra-longhouse level of analysis. It is actually quite surprising to find so few analyses of this kind in Iroquoian archaeology, considering the fact that longhouses are at the core of any and all Iroquoian village sites (but see Chapdelaine et al. 2016 for recent examples). Although women were clearly in charge of the majority of the daily activities to occur inside Iroquoian longhouses, men were not absent from longhouses, which were places where relations of power between genders were also experienced. Thus, the interpretation of the distributional pattern observed at the Parker site through the sole prism of peer relationship established among women may be novel and worth considering, but can also be questioned.

This approach is to be contrasted with

Kathleen M.S. Allen and Sandra Katz's Chapter 3, where they assert that "Activities more strongly associated with men, such as lithic reduction," were clearly performed inside the habitation structures at both the Parker and Carman sites (p. 100–101). In this chapter, the authors look at the spatial distribution of artifacts on two nearby sixteenth-century Cayuga sites, in order to see if both can be interpreted as village sites used for similar purposes. It appears that there was a greater intensity of activities carried inside the habitation structures at Parker Farm than at Carman. More importantly, the spatial patterning of lithic, ceramic, and faunal materials reveals different intensities of occupation and economic activities at the two sites, despite their similar size and their proximity in time and space. After examining various explanations for this pattern, the authors fall back on gender to conclude that male economic activities were more intensive at the Carman site, while female economic activities were dominant at Parker Farm. Although the study does not identify precisely which factor could be responsible for this gendered difference, it clearly illustrates the variability that exists within and between Cayuga settlements.

Stuck between the latter two is Chapter 2, by John Creese, which explores the long-term trends in Iroquoian village scale, density, and layout from a sample of 25 sites in southern Ontario, representing 43 occupation phases in total. The results, which are based on a solid set of quantitative data, indicate a nearly constant growth in terms of house number, house dimension, and settlement (village) area, resulting in larger communities that are more often nucleated. This growth would have produced higher levels of social stress, the author claims, and the solution to maintain socioeconomic egalitarianism in this new context was to develop sequential heterarchies, where power is diluted among a diversity of social units and proceeds bottom-up, from the lowest units (households) to the highest ones (confederation), contrary to complex societies.

Moving to a much larger scale of analysis, in Chapter 4 Jennifer Birch, Robert B. Wojtowicz, Aleksandra Pradzynski, and Robert H. Pihl use changes in ceramic type frequencies to explore ancestral Huron-Wendat settlement coalescence and interregional interactions. The authors were thus able to reconstruct periods of increasing or declining interregional contacts and conflicts, reflecting changes in geopolitics through time. I concur with the authors when they conclude that their study offers a demonstration of the upheld relevance and utility of 'traditional' brands of ceramic analyses using types (or attributes, for that matter) even within contemporary interpretative frameworks, as they remain complementary to more recent methods. On the other hand, I regret that this chapter does not include a short summary of the data and methods that were used before to establish the historical sequences of village relocations and aggregations, as it is central to the discussion. It would have been especially useful for readers unfamiliar with Huron-Wendat archaeology, although that information can be found elsewhere (see Birch 2012, for example).

In Chapter 5, Eric E. Jones investigates the factors preferred by sixteenth- and seventeenth-century Haudenosaunee when choosing locations for their village settlements. Using a discriminant function analysis, the author ranks a dozen factors as having either a low, medium, or high importance in the selection process. The latter include distance to trade routes, average solar radiation (as a measure of the growing season for agriculture), percentage of well-drained soil, percentage of soil with good conifer and hardwood growth potential (measuring wood resource availability), and flat terrain. As the author admits, other studies had reached similar conclusions before, but in this case they have the advantage of being quantified. Also, this study refutes earlier interpretations regarding the importance of factors such as the availability of wetland resources and frost action. And finally, it neatly underlines the variability that existed in settlement location choices made by the various Haudenosaunee nations, a point to which I shall return.

Emphasizing that Iroquoian human remains from Ontario and New York State (and from Quebec, I would add) are never analyzed together in a same project, Crystal Forrest adopts a cross-border perspective to examine intergroup relations and identity as recorded in human remains, in Chapter 6. After a short but quite instructive overview of the legal and historical context of research in the two adjacent areas, the author focuses on the results of her analysis of child remains from both regions. The absence of differences in growth between children's remains from Ontario and New York, as well as between precontact and postcontact individuals, indicates that growth patterns remained the same after the arrival of the first Europeans in both areas. Such results are surprising given the deep impact of European contact on Iroquoian populations in many other respects. The author suggests that similar childcare practices occurred across tribal boundaries, such as prenatal care, prolonged breastfeeding, and childcare responsibilities shared with older children and the elderly.

Chapter 7, written by John P. Hart and William E. Engelbrecht, explores the changing relations between the Onondagas and their neighbours from 1350 to 1590 AD. Using social network analysis combined with signalling theory, the authors identify a series of changes in signalling strategies through time, from a focus on the Seneca to the West, shifting to a focus on the Oneida and Jefferson County Iroquoians to the East, finally ending with a more 'cosmopolitan' signalling strategy toward different groups in both directions. The authors conclude that the evolution of Onondaga society may not have been as continuous and straightforward as was suggested by James Tuck in his seminal work (Tuck 1971). It is unfortunate, however, that the figures in this chapter could not be printed in colour, since the actual shades of grey do not allow an easy reading of the networks illustrated in these figures.

Finally, in the concluding chapter, Ronald F. Williamson and Dean Snow delve into the history of archaeology to explain why and how Iroquoian research in Canada and the United States have long diverged, before finding some common ground and bridging gaps during the last few decades. They also wonder, as we all do, at the remarkable way Iroquoian societies remained fundamentally egalitarian despite having developed elaborated, rather 'complex' sociopolitical organizations. They underline, among many other stimulating remarks, the importance of trails, which they correctly view as the "symbolic backbone of landscapes" (p. 225), but which are difficult to track archaeologically.

I deeply enjoyed my reading of this volume, despite the uneven treatment of key methodological or conceptual issues, which varies significantly from one chapter to another. In my opinion some papers also suffer from small sample sizes or from interpretations that go far beyond the limits of the data and results presented. But more importantly, and on a different note, an interesting observation that permeates most of the papers in this volume is that variability is everywhere: inside and between longhouses, between villages or aggregated communities, across cultural (tribal) boundaries, etc. In other words, households, villages, and communities are rarely homogeneous and static, and this is illustrative of the intricate, evolving, and complex nature of ancient Iroquoian sociopolitical organizations. Moreover, the various papers in this volume move quite elegantly from one scale of analysis to another, and the strongest overall conclusion that I retain from this book is the complementarity of the diverse scales of analysis. Now, the real challenge will be to integrate them in single, multi-scale studies, instead of separate ones. Perhaps this shift will necessitate more lengthy contributions within integrative approaches that can be more properly rolled out in site reports or monographs. I look forward to such attempts in the near future, as they will certainly provide new understandings of ancient Iroquoian societies.

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Book Review

The Ward Uncovered: The Archaeology of Everyday Life

(edited by Holly Martelle, Michael McClelland, Tatum Taylor, and John Lorinc)

The Ward Uncovered: The Archaeology of Everyday Life, edited by Holly Martelle, Michael McClelland, Tatum Taylor and John Lorinc, Coach House Books, Toronto, 2018, 250 pages, 91 figures. ISBN 978-1-55245-369-8 (softcover), $27.95. Available as ebook; PDF: 9781770565609, $19.99 and EPUB: 9781770565593, $19.95.

Through the lens of chapters written by 25 authors, *The Ward Uncovered* outlines the archaeological processes and research undertaken in 2015 by Timmins Martelle Heritage Consultants and the resulting understandings about life in St. John's Ward, dating from the nineteenth century. The site itself covered about 1.6 acres in the heart of Toronto, under a parking lot that was to be replaced by a government of Ontario courthouse. The book follows in the tradition of Deetz's (1977) classic work *In Small Things Forgotten* in its contribution to historical archaeology and in bringing that archaeology to life through the stories of everyday objects uncovered and the lives they touched.

The organization of the book into six sections is intended (Lorinc and Taylor, page 24) to reflect the process of archaeology itself. The sections are The Lay of the Land, Daily Life, Work Life, Social Life, Individual Lives, and The Archaeological Life. Indeed, the book begins by introducing the who/what/where/when/why of the site in a brief chronology of its occupation. The other chapters go on to outline the processes of deposition, excavation and interpretation and include the research that informed and was directed by the archaeological project.

What makes this book an outstanding contribution to archaeological writing is that it goes beyond being another excavation report—doomed to a life as gray literature—to engaging the reader with what Martelle (page 178) refers to as "a combination of science and storytelling." The style and language of the book are approachable for professional archaeologists, for students, and also—and especially—for the general public. This inclusive style also features contributions from descendants of those who lived in "The Ward" and whose lives were touched by the site and by the objects found during the excavations. The recollections and reminiscences—such as those of MPP, the Hon. Jean Augustine, in the preface—set the tone. They add a layer of meaning for present-day readers to the "biographies" (Lorinc and Taylor, page 23) of the objects described.

These "biographies" of objects provide a social context for the artifacts. For example, the discussion of the unearthed oyster shells, chestnuts, and coconut featured in Chapter 4 provides an introduction to the topic of paleozoology, to the particular history of these foodstuffs in The Ward, to the foodways of the mid-nineteenth century, and to the excavation of the remains of the nearby North Market site. Other such 'biographies' include discussions of privies, a mended earthenware jug and other ceramics, children's marbles and dolls, shoes, hat forms, glass bottles, a metal cross, and munitions. More than a catalogue of finds, the research-based discussions again link archaeological method to the stories of the people who lived in St. John's Ward and the social history of their times.

The layers of archaeological stories uncovered are important for highlighting the diversity of the inhabitants of The Ward, with particular attention to the Black community. The layers of stories both broaden the understanding of Toronto's past and include modern residents in their city's history. Stories are those of First Nations inhabitants, settlers and other waves of immigrants, such as of those seeking freedom from slavery in the USA, Jewish, Chinese, German, Caribbean, and Irish residents. They include those of the freedom-seeker, Cecelia Jane Reynolds; the shoemaker, Francis Griffin Simpson; and bootlegger, Annie Whalen. By weaving these personal biographies with those of the objects uncovered and the history of the times, the book serves as a template for community-building through archaeology.

In terms of archaeological theory, *The Ward Uncovered* can be seen to embrace the multi-vocal and inclusive approaches of interpretive archaeology (Hodder 1991, 2001). As in the public archaeology of McManomon (1991), it addresses itself to multiple publics, and it follows in the footsteps of Leone and Potter (Leone 1981) and their use of critical theory, especially in their excavations of the everyday residents' neighbourhoods, in Annapolis.

In practice, the book builds on a foundation of classic studies in historical archaeology such as those of Deetz (as noted previously), Glassie (1975), and Orser (1995). It is a valuable addition to the historical archaeology of North American cities, in company with the work of Moss in Quebec or Cressey in Alexandria, Virginia. That the book can be listed within that sphere is not hyperbole; its contribution to the disciplines of historical and public archaeology both internationally, and particularly in Canada, are significant. In public archaeology, it provides a Canadian study similar to Merriman's (1997) *The Peopling of London* exhibit, which introduced a focus on diversity in a city's archaeological history to inform public opinion on immigration. In Toronto itself, the public archaeology work of Smardz Frost (see Smardz 1990, 2000) and Williamson (see 2008) are acknowledged as foundational to this book by including both as contributing authors, notably with respect to the city's First Nations, Black, and Irish communities' heritages. By intentionally including the diversity of stories in the book, *The Ward Uncovered* also works toward reconciliation with all the city's residents, past and present.

Public Archaeology has been seen as a less scholarly approach to archaeology, in Canada (Smardz 2000: 236). By using a narrative style and vocabulary as well as numerous illustrations (12 maps or plans, 18 copies of documents or photographs, 38 images of the artifacts, 19 of historical places, and 4 illustrations of archaeological work), rather than technical drawings, *The Ward Uncovered* could be open to such criticism. However, the copious notes and references in the book (pages 283–294) attest to the degree of research that informed the writing and provide academic and scholarly credentials to address any such criticism.

Indeed, it is an important point that writing that is firmly based in research and scholarship was deliberately presented in a way to make the results of that research accessible to a wide audience, and so, more likely to be read and incorporated into classrooms, exhibits, and other media. The artifacts have already been the basis of exhibits at Toronto City Hall and George Brown College. *The Ward Uncovered* would be popular reading from neighbourhood (or online) book stores, and should be lauded for putting archaeology itself into the category of 'popular reading.' It would equally serve educators from elementary schools to graduate studies programs, and should be included in required reading for undergraduate archaeology courses. It can especially illustrate how archaeological research and scholarship can be communicated effectively. It doesn't have to be full of jargon, 'dumbed down,' sensational, or boring.

As well, the book stands as a beacon of how consulting archaeology in Canada is not limited to producing only impact assessment reports. Done well, it can contribute to archaeological scholarship, to public archaeology, and to sharing our archaeological heritage with the community.

One matter that the book could have addressed better was in being Toronto-centric with its wording. That the book could serve well at an international level as a model for writing about the [historic] archaeology of a place, underscores the need for future such writing not to be so familiar with the place for 'insiders.' Those who don't know what Osgoode Hall or other Toronto landmarks are, and who aren't provided with explanations, are kept unnecessarily at a distance. Canadian archaeology should embrace its place within global archaeological scholarship.

The Ward Uncovered ends with a look to the future for archaeology, for the artifacts and the stories that were uncovered through the excavations. Williamson and Robertson comment on the need for attention to archaeological conservation and for adequate storage for archaeological artifacts in Toronto (pages 252–257). The book's authors questions how best—perhaps in a museum—to share the heritage the collection represents with those whose 'inheritance' it is since, "The objects may not belong to all of us, but their stories do" (Taylor, page 282). *The Ward Uncovered* has taken significant steps in sharing those stories and showing all of us their importance.

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