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Introduction

Shari Prowse and Suzanne Needs-Howarth

This volume is the result of a session organized by the two of us at the 36th Annual Symposium of the Ontario Archaeological Society, held in Waterloo, Ontario, on October 17, 2009. The volume presents three papers that resulted from the session (General and Warrick; Hawkins and Caley; Needs-Howarth and MacDonald) and two others (Ingleman, Perrelli, and Thomas; Lister) that are relevant to the topic at hand. We provide here a summary of the papers in this volume and have added a list of references on Great Lakes Aboriginal fisheries that we believe we will be of use to future researchers.

The point of the session was to provide a forum for research on Aboriginal fisheries within the Great Lakes region, with the ambitious goal of showcasing what fisheries research can contribute to our understanding of past lifeways. Thankfully, gone is the perception of pre-contact fishery researchers as nothing more than fish faunal analysts whose primary task is to generate lists of taxonomic identifications accompanied by counts of bone fragments. Like other archaeological disciplines, archaeological fisheries research has matured to include the inquiry of all the imaginable environmental, social, and cultural phenomena around fishing and human interactions with fish. Also like other areas of study, it is multidisciplinary, with many of its practitioners working collaboratively with others and being jacks of all trades. Zooarchaeology, archaeology, fisheries science, ethnohistory, ethnology, zoology, biology, chemistry, genetics, geology, geography, hydrology, history, and statistics all have a role to play in generating a better understanding of fishing and its influence on—and interplay with—the people of the past.

In the first paper, Ken Lister reveals the relevance and importance of fishing to Ontario Aboriginal communities in the Great Lakes region during the mid-nineteenth century through the work of the talented artist Paul Kane, pinpointing which species are being described in various ethnohistorical sources.

Paul General and Gary Warrick trace changes in the lake sturgeon fishery within the Grand River drainage through archaeological and historical documentation and oral history. It seems rather fitting that, in a session of seven papers, we had two on sturgeon (Terrance Martin also presented on the sturgeon fishery, in southwestern Michigan; see Martin 2009, 2013). Together with those of eel and Atlantic salmon, archaeological remains of sturgeon have aroused the interest of fisheries scientists because the current distributions of these fish are so reduced from their past distributions.

David Ingleman, Douglas Perrelli, and Stephen Cox Thomas provide a synopsis of recent research into the Middle Woodland period fishery on the upper Niagara River, relating fish bone and netsinker data to modern environmental impacts. They make use of osteometry; incremental structures on fish vertebrae; as well as archaeological, historical, and environmental evidence to reconstruct past fish populations and to attribute causes to their decline.

Suzanne Needs-Howarth and Robert MacDonald examine the choices made around fish resources by the past inhabitants of the Peace Bridge site, also situated along the Niagara River, in Fort Erie, Ontario, using osteometry and cumulative frequency distributions. They also examine taphonomic history through element dis-

tribution, by means of minimal animal units. Comparisons with such distributions at other sites allow them to put the data into context.

Alicia Hawkins and Erin Caley infer the nature of the Uren-period fishery in Simcoe County through osteometry and intra- and inter-site distribution. They examine the relationship between bone and body dimensions in yellow perch to determine the size of fish caught and, by extension, the fishing strategies employed at the Steven Patrick site. Because yellow perch is commonly found on Great Lakes sites and beyond, the regression equations they have generated will be of great utility to the zooarchaeological community in eastern North America.

We thank the peer reviewers for their indispensable part in getting these papers into print. When polled, our contributors listed a variety of influences and sources of inspiration. Many mentioned the zooarchaeological guidance and teachings of the late Howard Savage, who was the first to systematically conduct and teach the study of animal bones in Ontario; Max Friesen (University of Toronto); and Aubrey Cannon (McMaster University). Other influences include fellow researchers, in particular, Stephen Cox Thomas; the ethnographic work of the ROM's late Edward S. Rogers; and the anecdotal and oral histories of Aboriginal peoples, specifically those of the Six Nations. In recognition of the relevance of archaeology—and specifically the Grand River fishery—to contemporary communities, Gary Warrick offered a desire to be “reflective about the value of Ontario archaeology to living communities.” It is to these trailblazers, influencers, and inspirers that we also give thanks. Without them, this volume would not have been possible.

Selected Reference Sources

At the time of writing, about a dozen detailed academic studies examining Aboriginal fishing in the Great Lakes and adjacent waterways have been completed, in addition to a large volume of site reports and site-specific studies stemming from work in archaeological consulting. We have compiled a list of theses, dissertations, books, reports, articles, and conference presentations on the Ab-

original fisheries of the Great Lakes. We hope that this, in addition to the references provided in the papers in this volume (some of which are also included here), will be helpful for those doing research in this area of study.

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Dip Nets and Jacklights: Paul Kane's Views of Fishing the Great Lakes Region

Kenneth R. Lister

In 1845, Canadian artist Paul Kane travelled by foot, canoe, steamer, and wagon through regions of the Great Lakes taking sketches to illustrate the native peoples, their customs, and, in his words, "the scenery of an almost unknown country" (Kane 1859:viii). After returning in 1848 from a second journey that took him as far west as the Pacific Ocean, he placed 240 of his sketches on exhibition in Toronto. The display received overwhelmingly positive reviews, with the media referring to Kane's art as being "perfectly accurate." Kane sketched in graphite, watercolour, and oil on paper native encampments, transportation methods, subsistence activities and resource preparation, domestic-oriented techniques, social and economic relationships, warfare, and ceremonial and sacred events. In the Great Lakes region his sketches of dip-net fishing and seasonal camps on the St. Marys River at Sault Ste. Marie and fishing with jacklights on the Fox River in Wisconsin illustrate details that are commensurate with historical reports. Kane's art speaks to the economic value of fish to the native peoples of the Great Lakes region because it also represents first-hand graphic records of activities he directly witnessed.

"All traces of his footsteps are fast being obliterated"

On a warm July 13th morning in 2006, leaning against the railing of the Soo Lock observation platform in Sault Ste. Marie, Michigan, my view to the north, across the St. Marys River, was dominated by concrete lock walls, the truss arches of the International Bridge between the United States and Canada, and the flares and smoke of the Canadian Algoma Steel Plant. The St. Marys Falls Canal and the Soo Locks—first completed in 1855 to bypass the St. Marys River rapids and thus facilitate shipping between Lakes Superior and Huron—obliterated the scene of the rapids sketched by Paul Kane only ten years earlier. Today, the vista of the distant hills is all that can be discerned of Paul Kane's views. The rock-lined shore, wooded islands, and the white-capped rapids are all gone from sight (Figure 1). Gone also are the views of native canoeists ascending the

rapids in bark canoes for the purpose of dip-net fishing (Figures 1–3). To take in the scene from the Soo Lock observation platform is to appreciate the power of industry and commerce, but it is also to lament our loss, underscoring the significant value of Paul Kane's artistic legacy.

In June 1845, Paul Kane (1810–1871) left Toronto on the first of two major journeys to, in his words, "sketch pictures of the principal chiefs, and their original costumes, to illustrate their manners and customs, and to represent the scenery of an almost unknown country" (Kane 1859:viii). When Kane returned from his second journey in October 1848, having reached as far west as Vancouver Island, he returned with more than 600 sketches on paper in graphite, watercolour, and oil. With this volume of work he indeed accomplished his desire to record the country's native peoples and landscapes and thereby provided us with one of this country's most significant pictorial collections of landscapes;

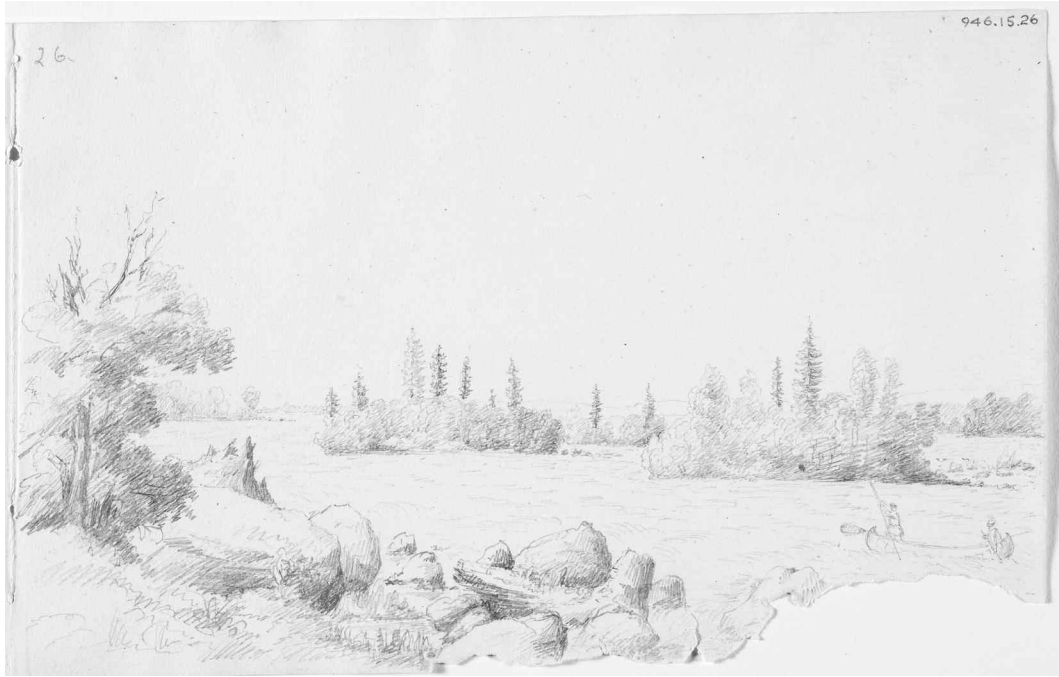


Figure 1: *Poling up the St. Marys River. Chippewa/Southeastern Ojibway. American side of the St. Marys River; early August 1845. Graphite on paper; 13.7 x 21.5 cm. ROM 946.15.26. Courtesy of the Royal Ontario Museum © ROM*

cultural scenes; and figure, material culture, and natural history studies of the mid-nineteenth century (Lister 2010).

Kane's ambition was fuelled by the belief that native peoples were disappearing. In his book *Wanderings of an Artist Among the Indians of North America*, published in 1859, he was explicit about this view and its influence on his goal:

But the face of the red man is now no longer seen. All traces of his footsteps are fast being obliterated from his favourite haunts, and those who would see the aborigines of this country in their original state, or seek to study their native manners and customs, must travel far through the pathless forest to find them [Kane 1859:vii].

The notion that native peoples both in Canada and in the United States were disappearing was a prevalent one during the nineteenth century, due in part to assimilation pressures and the

dispossession of native lands. At the beginning of the century, President Thomas Jefferson's assimilation plan, articulated in an 1803 letter to the governor of the Indian Territory, was clear in its design to draw native peoples "to agriculture, to spinning, and weaving," with the concomitant dispossession of their lands: "When they withdraw themselves to the culture of a small piece of land, they will perceive how useless to them are their extensive forests, and will be willing to pare them off from time to time in exchange for necessaries for their farms and families (quoted in French 2007:35). As well, part of Jefferson's plan was the removal to west of the Mississippi River of those who refused to "incorporate" as citizens of the United States. The American drive for expansion was further hardened with President Andrew Jackson's signing of the 1830 *Indian Removal Act*, giving the president authority to "provide for an exchange of lands with Indians residing in any of the states or territories, and for their removal west of the river Mississippi" (quoted in French

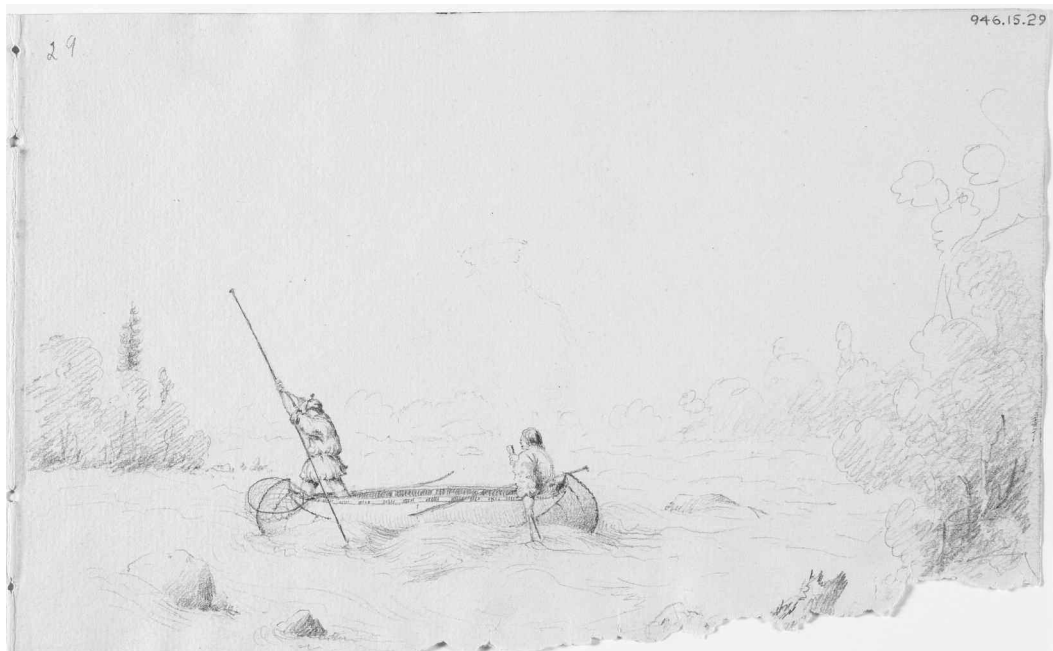


Figure 2: Dip-Net Fishing from Canoe. Chippewa/Southeastern Ojibway. American side of the St. Marys River; early August 1845. Graphite on paper; 13.7 x 21.5 cm. ROM 946.15.29
Courtesy of the Royal Ontario Museum © ROM



Figure 3: Poling the Rapids, St. Marys River. Chippewa/Southeastern Ojibway. Canadian side of the St. Marys River; early August 1845. Graphite and gouache on paper; 13.7 x 21.5 cm. ROM 946.15.38. Courtesy of the Royal Ontario Museum © ROM

2007:41). Such removals and attitudes were published in the daily newspapers so that the deteriorating situation for native peoples was part of general public understandings. For instance, the state of Wisconsin's "Resolution relative to the extinguishment of the Indian title to the lands north of the Fox River . . ." was published in the January 20th, 1845, edition of the *Milwaukee Daily Sentinel*—eight months prior to Kane's canoe journey up that very river. And four years later, a view that native peoples had to be either "exterminated" or "taught to cultivate the soil, read and write, to pursue industrious and laborious occupations" was printed in the July 4, 1849, edition of the *Marshall Statesman*, Michigan. Kane began his journeys, therefore, in the knowledge that native peoples on both sides of the border were under pressure to assimilate while being forced off of their lands by foreign immigration, land speculation, and coercive treaties.

Susanna Moodie, in her book *Life in the Clearings*, laments the loss of the "proud independence" of the native person who is "out of his element" on a farm ([1853] 1959:142–143). In 1844, Margaret Fuller Ossoli, in her book *Summer on the Lakes*, wrote that amalgamation is the "profound means of civilization," but as the native peoples are effaced from their home lands they are "fated to perish" ([1844] 1970:96). "Yet, ere they depart," continues Fuller Ossoli, "I wish there might be some masterly attempt to reproduce, in art or literature, what is proper to them,—a kind of beauty and grandeur which few of the every-day crowd have hearts to feel, yet which ought to leave in the world its monuments, to inspire the thought of genius through all ages" ([1844] 1970:96–97). Writers such as Moodie and Fuller Ossoli, as well as others—for instance, George Catlin and James Fenimore Cooper—express a melancholy acceptance for what they perceive as the inevitable demise of native cultures. And as if inspired directly by Fuller Ossoli's appeal and influenced by the philosophical views of his time, with pencil and paints Kane set off in 1845 to record "what is proper to them,—a kind of beauty and grandeur which few of the every-day crowd have hearts to feel."

"What is proper to them"

On November 9, 1848, less than one month after his return from the west, Paul Kane opened in Toronto an exhibition of 240 of his sketches. Supported by an accompanying catalogue (Kane 1848), the exhibition—the first solo exhibition to be held in Canada—received fulsome praise in the media reviews. The *British Colonist* (November 17, 1848) published, "it is difficult to speak in too high terms of the energy, enterprise and skill of our young fellow townsman." *The Globe* referred to the sketches as "perfectly accurate" (November 15, 1848), while the *Christian Guardian* praised them as being "highly valuable" (November 15, 1848). With his sketches as inspiration, Kane then pursued a grander project to develop a series of oil paintings illustrating the landscapes he traversed and the people he witnessed. He received similar reviews as he had for his sketches: his oil paintings were praised as "finely executed Indian scenes" (*The North American*, October 1, 1852), and Susanna Moodie wrote that "For correctness of design, beauty of colouring, and a faithful representation of the peculiar scenery of this continent they could scarcely be surpassed" ([1853] 1959:237).

Had Margaret Fuller Ossoli lived past her untimely death in 1850, she would likely have agreed that Paul Kane had responded well to her appeal by sketching and painting "what is proper to them." In more than 600 field sketches and a cycle of 100 oil canvases, Kane developed a record of landscapes, portraits, cultural scenes, and studies covering subjects between Toronto and Fort Victoria. The cultural scenes in both sketches and oil paintings depict "humans and evidence of human activities within cultural contexts or environmental settings" (Lister 2010:60) and include native encampments and associated undertakings, transportation methods, subsistence activities and resource preparation, domestic-oriented techniques, social and economic relationships, warfare, and ceremonial and sacred events—in addition to Canadian and American villages, Hudson's Bay Company posts, and missions. Kane offers details related to native resource exploitation depicting equipment and

use, structural elements, and seasonal parameters. Subsistence activities depicted include bison hunting south of the Red River Settlement and along the North Saskatchewan River; duck hunting in northern Ontario; pronghorn antelope hunting in the northern Plains; and a variety of fishing practices along the middle and lower Columbia River, as well as in the region of the Great Lakes.

“A mere summer campaign”

During the months of June through December 1845, Kane travelled the Great Lakes by steamboat, foot, wagon, and canoe. He initially visited the Saugeen village, following the “Indian path” between Owen Sound, at the bottom of Georgian Bay, and the village, located near the mouth of the Saugeen River, which drains into Lake Huron. After retuning to Owen Sound, Kane continued his journey by canoe, paddling along the southern shore of Georgian Bay and then veering north up through the 30,000 islands. He writes, “we continually lost ourselves in its picturesque mazes, enchanted with the beauty of the ever-varying scenery, as we glided along in our light canoe. We fished and hunted for fourteen days, almost unconscious of the lapse of time so agreeably spent” (Kane 1859:6). Kane arrived at Manitowaning on Manitoulin Island in mid-July, at the time that native peoples were gathering to receive their annual presents from the government. After a two-week stay he caught a steamboat and travelled the length of the North Channel to St. Marys River and Sault Ste. Marie.

At Sault Ste. Marie, Kane changed his plans from travelling into the interior. There he met John Ballenden, chief trader for the Hudson's Bay Company, who advised that he proceed farther west only with the support of the Hudson's Bay Company (Kane 1859:25). Wisely accepting Ballenden's advice, along with his suggestion to seek the support of Sir George Simpson, overseas governor of the Hudson's Bay Company, Kane decided to limit his current journey to the Great Lakes and to the current year: “I determined upon confining my travels for the present to a mere summer campaign” (Kane 1859:25).

Kane stayed only a few days at Sault Ste. Marie before leaving for the island of Mackinac, located in the Straits of Mackinac between Lakes Huron and Michigan. Again, he arrived at the time that annual presents were being distributed. Following a three-week stay he continued down Lake Michigan to Green Bay, Wisconsin. From there, with three companions, he canoed up the Fox River to a Menominee camp, where, he writes, they found some 3,000 native people “assembled, anxiously awaiting the arrival of the agent with their money” for lands sold to the United States government (Kane 1859:32). Following a three-week stay on the Fox River, Kane made his way by wagon and steamer to the western shore of Lake Michigan, where he caught a steamer for Buffalo, New York. On December 1, Kane's 1845 “campaign” ended when he arrived back in Toronto, carrying with him a collection of sketches illustrating landscapes, cultural scenes, and figure and material culture studies that shed light on the environment and on cultural activities, human relationships, and conditions in the mid-nineteenth century Great Lakes region.

“Great numbers of fish are killed in this manner”

Paul Kane's 1845 sketches of dip-net fishing on the St. Marys River and of Chippewa/Southeastern Ojibway encampments depict the nature of the rapids, illustrate fishing techniques, and show details of camp structures and settlement layout. Margaret Fuller Ossoli wrote that the rapids of the St. Marys River between Lake Superior and Lake Huron are “beautiful indeed,” adding, “The grace is so much more obvious than the power” ([1844] 1970:107). In *Wanderings of an Artist*, Kane writes that the water “becomes a foaming torrent” (Kane 1859:45), and this description is manifested in a sketch of the rapids from the Canadian side wherein he illustrates a sternman with paddle and a bowman handling a setting pole struggling to ascend the surging water in a birchbark canoe (Figure 3). Here Kane depicts the vigour of the “foaming torrent.” Kane expands on that by writing that “practised guides” descended the rapids with “terrific violence” (Kane 1859:45), and

his sketches of the rapids (Figures 1–3) render the scenes visible with energy. In particular, the bowman in Figure 2—shown standing in the canoe with his forearms tense as he pushes the setting pole against the river bottom—emulates the verve of the river as the canoe is slowly inched forward.

As Euro-American visitors praised the visible splendour of the St. Marys River rapids (Jameson 1923:355; Fuller Ossoli [1844] 1970:108; Dana 2004:37), native fishers exploited their capacity to bequeath copious amounts of fish. The rapids supported a rich fishery of lake whitefish (*Coregonus clupeaformis*), in Ojibway called *atikameg* (Baraga 1966:19). Early accounts noted that the fish were “large as salmon” (Bacqueville de la Potherie [1753] 1911:275), “very white” (Dablon [1669–1670] 1899:131), and furnished food “almost by itself, to the greater part of all these peoples” (Dablon [1669–1670] 1899:131). The latter point by Father Dablon was reaffirmed by John Johnston, a fur trader situated at the rapids in the late eighteenth and early nineteenth centuries, when he stated that whitefish from the river was a chief resource for both the native and non-native inhabitants of the region.

The fish are from five to ten pounds weight, and, when in season—which is from May to November—are the richest and best flavoured ever found in fresh water. They cure as well as cod, and are the chief support of both the Indians and white people here [Johnston 1890:148].

Early historical documents, such as those written by Dablon and Johnston, record the abundance of the St. Marys River rapids fishery. These statements conform with the 1669–1670 narrative of De Bréhant de Galinée, where he states that the fishery could support upwards of 10,000 people: “This river forms at this place a rapid so teeming with fish, called white fish or in Algonkin Attakameque, that the Indians could easily catch enough to feed 10,000 men” (Galinée 1903:73). Alexander Henry, a trader in the region during the latter part of the 1700s, also noted the significance of the fishery to the native population, stating that the fishery was “of great moment to the

surrounding Indians” and that the rapids there supplied “a large proportion of their winter’s provision” (Henry 1809:59). These accounts noting vast quantities of fish are significant in that they speak to the economic importance of the St. Marys River rapids and to a harvest that could support populations living beyond the immediate area of the rapids themselves (MacDonald 1978:58; Kinietz 1947:16).

Paul Kane himself did not contribute significantly to the literature addressing the economic value of the St. Marys River rapids fishery, but his sketches of native canoeists ascending the rapids are invaluable illustrations to accompany historical accounts. Bacqueville de la Potherie, for instance, describes the technique of dip-net fishing in the rapids that is commensurate with the depictions in Kane’s images (see Figures 1–4):

The savages surmount all those terrible cascades, into which they cast a net which resembles a bag . . . attached to a wooden fork about fifteen feet long. They cast their nets headlong into the boiling waters, in which they maintain their position, letting their canoes drift while sliding backward. The tumult of the waters in which they are floating seems to them only a diversion; they see in it the fish, heaped up on one another, that are endeavoring to force their way through the rapids; and when they feel their nets heavy they draw them in [Bacqueville de la Potherie (1753) 1911:275–276].

Similarly, Father Dablon describes the dip net and the netting technique as he also emphasizes the need for “dexterity and strength”:

Dexterity and strength are needed for this kind of fishing; for one must stand upright in a bark Canoe, and there, among the whirlpools, with muscles tense, thrust deep into the water a rod, at the end of which is fastened a net made in the form of a pocket, into which the fish are made to enter. One must look for them as they glide between the Rocks, pursue them

when they are seen; and, when they have been made to enter the net, raise them with a sudden strong pull into the canoe. This is repeated over and over again, six or seven large fish being taken each time, until a load of them is obtained [Dablon [1669–1670] 1899:131].

Kane has left us three graphite sketches in the category of “Cultural Scenes” that depict birchbark canoes ascending the St. Marys River rapids for the purpose of netting whitefish. In the bow of each canoe, extending over the gunwales, are dip nets (Figures 1–3). Additionally, Kane sketched a “Multiple Images Study” that shows two separate scenes of canoes ascending rapids, and one of the associated images is a material culture study of a dip net (Figure 4). This rendering of a dip net, sketched in enough detail to determine its construction, with large circular net frame and long pole-like handle, and the views of canoeists in the rapids—especially the image in Figure 2 showing the bowman straining on a setting pole as the sternman orients the canoe’s direction—are excellent images to illustrate Alexander Henry’s description of the dip-net fishing method:

The method of taking them is this: each canoe carries two men, one of whom steers with a paddle, and the other is provided with a pole, ten feet in length, and at the end of which is affixed a scoop-net. The steersman sets the canoe from the eddy of one rock to that of another; while the fisherman, in the prow, who sees, through the pellucid element, the prey of which he is in pursuit, dips his net, and sometimes brings up, at every succeeding dip, as many as it can contain. The fish are often crowded together in the water, in great numbers; and a skilful fisherman, in autumn, will take five hundred in two hours [Henry 1809:59].

It is interesting to note that Henry suggests that the bowman uses the pole-like handle of the dip net as a setting pole, whereas Kane illustrates the dip net resting over the gunwales. The bowman

in turn uses a separate setting pole to push the canoe forward. Directing the canoe into eddies where the fish congregate is a coordinated effort between the stern paddler and the bow poler. Once in position, the sternman handles the movement of the canoe as the bowman manipulates the net in a manoeuvre made explicit by Johnston:

The eddies from around the rocks are the best places for taking the white fish; this is done with scoop-nets, fixed to a pole and bent so that the circle to which the net is attached can be brought to lie flat on the bottom. The man in the bow of the canoe lets the net drop right over the fish, and the steersman gently lets the canoe descend, then the fisher gives his net a sudden turn, and hauls it up close to the canoe, and proceeds to push up against the stream to the same pool, if he sees any have escaped, or else pushes off to another [Johnston 1890:147].

The bend in the pole-like handle described above by Johnston is accurately rendered by Kane in Figures 2 and 4. In Figure 2, note the bend at the end of the pole handle that extends over the starboard gunwale of the canoe. Similarly, in the Figure 4 dip-net study, Kane shows the end of the handle to have a significant bend. Here we have excellent examples of the accuracy of Kane’s sketches and, through Johnston’s description in particular, learn that the bend at the end of the handle is an intricate part of the dip-net design. By holding the handle aft of the bend, the shape of the pole allows the fisherman to orient the circular-shaped net frame parallel to the river bottom and directly over the fish. With a twist of the handle by the bowman—as the canoe is allowed to back away—the net scoops up the catch with a haul, according to Johnston, of as many as fifteen whitefish (Johnston 1890:147).

On the shore of the St. Marys River rapids, Kane sketched scenes of encampments established by Chippewa/Southeastern Ojibway families camped there to take advantage of the fishery (Figures 5–7). Kane’s sketches are noteworthy for their detail in

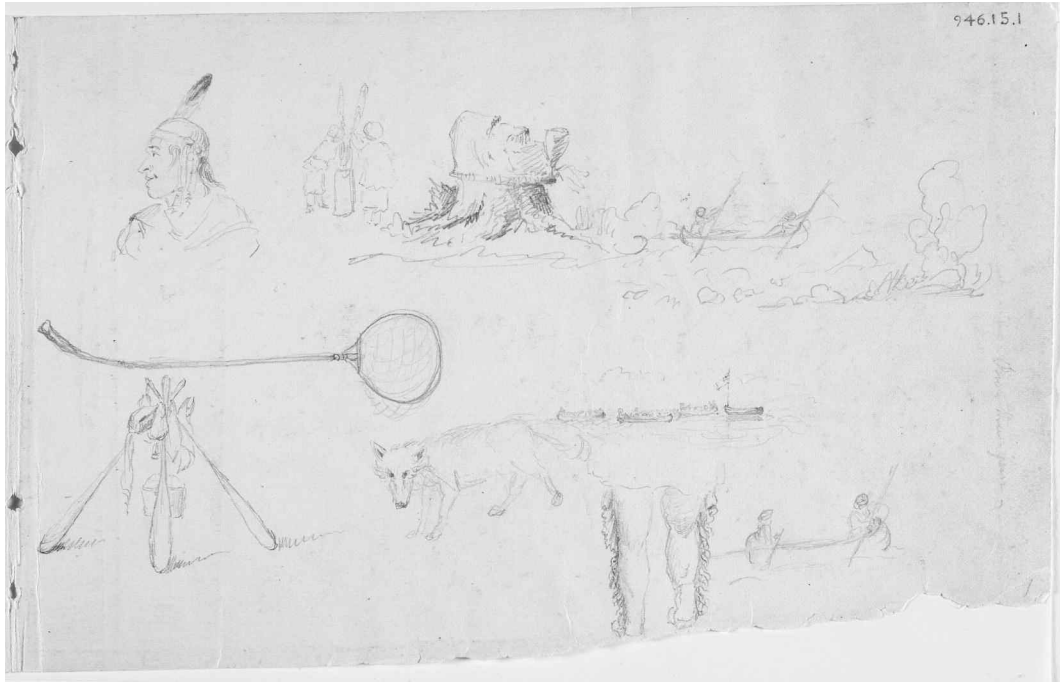


Figure 4: *Ten Cultural Studies. Southern Algonquian. St. Marys River; early August 1845. Graphite on paper; 13.7 x 21.5 cm. ROM 946.15.1. Courtesy of the Royal Ontario Museum © ROM*

rendering the layout of camps and their structural elements. Sketches of dome-shaped lodges covered with rush mats and sheets of birchbark show the manner by which the coverings are layered over the bent-pole frames. Poles leaning against the structures hold the coverings in place, and openings are shown on the roofs for the emission of smoke from central fires. Doors and openings are shown with covers of blankets and boards, and Figure 7 shows baskets, and thus evidence of domestic activities, placed in the lee of a wind break that protects that lodge's door. Figure 7 also illustrates a conical-shaped wind break layered with sheets of birchbark placed around a fire. Figures 5 and 6 show cooking tripods, with one arm of the tripod in Figure 5 represented by a canoe paddle; from that tripod a pot is suspended over the fire (see Figure 4 for a sketch of a tripod made of three paddles). Kane's settlement sketches depict the nature and layouts of seasonal and temporary fishing camps situated at the St. Marys River rapids. In particular, Figure 6 shows the placement

of a long-poled dip net leaning against a dome-shaped lodge, thus making the direct connection between these camps and the fishery.

In mid-to-late September 1845, Kane canoed up the Fox River in Wisconsin with three other companions en route to a gathering where the United States government was to distribute annual payments for lands sold. The evening previous to their arrival, Kane witnessed and sketched (Figure 8) Menominee individuals spear fishing with jacklights. He describes the scene in *Wanderings of an Artist*:

The evening previous to our arrival, we saw some Indians spearing salmon; by night, this has always a very picturesque appearance, the strong red glare of the blazing pine knots and roots in the iron frame, or light jack, at the bow of the canoe throwing the naked figures of the Indians into wild relief upon the dark water and sombre woods. Great numbers



Figure 5: *Ojibway Camp, Sault Ste. Marie. Chippewa/Southeastern Ojibway. American side of the St. Marys River; early August 1845. Graphite on paper; 13.7 x 21.5 cm. ROM 946.15.21. Courtesy of the Royal Ontario Museum © ROM*



Figure 6: *Indian Camp Scene with Dome-shaped Lodges, a Dip Net, and Tripod over Fire. Chippewa/Southeastern Ojibway. American side of the St. Marys River; early August 1845. Graphite on paper; 13.7 x 21.5 cm. ROM 946.15.24. Courtesy of the Royal Ontario Museum © ROM*

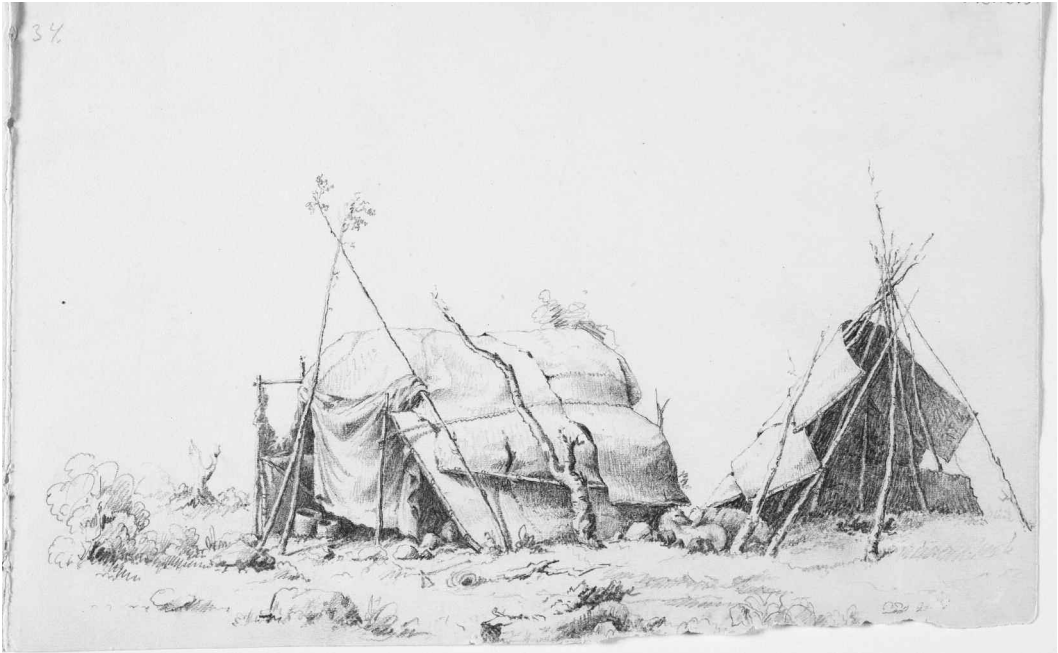


Figure 7: *Dome-shaped Lodge with Fire Wind Break. Chippewa/Southeastern Ojibway. American side of the St. Marys River; early August 1845. Graphite on paper; 13.7 x 21.5 cm. ROM 946.15.34. Courtesy of the Royal Ontario Museum © ROM*

of fish are killed in this manner. As the light is intense, and being above the head of the spearsman, it enables him to see the fish distinctly at a great depth, and at the same time it apparently either dazzles or attracts the fish [Kane 1859:31–32].

Spearing fish with the use of light had a wide distribution, with reports of this method being employed by the Menominee (Skinner 1921:210), Ojibway (Kohl 1860:326), and Mississauga (Rogers 1994:133–134), and as far east as the Innu of Labrador (Strong 1994:87). The most common torch was undoubtedly of birchbark (i.e., Strong 1994:87), and George Head—writing about the Georgian Bay area—describes the torch as pieces of folded birchbark held in the cleft of a pole that was in turn secured to the head of a canoe (Head 1829:265). Among the Menominee, Skinner describes and illustrates a torch also used for deer hunting that consisted of a blackened wood sconce that held a “resinous torch” (Skinner 1921:186–187). Following on the tradition of the

sconce, Kane’s sketch shows two canoes with jacklights of iron mounted to each bow (see Figure 8). Kane describes and shows wood poles holding aloft iron-framed jacklights (see Figure 9) with substantial blazes fuelled by pine knots and roots.

Kane identifies the fish speared by the Menominee as salmon; however, since salmon—other than the landlocked Atlantic salmon (*Salmo salar*) in Lake Ontario (Bogue 2000:19–27)—were not indigenous to the Upper Great Lakes, the identity of the fish is not entirely clear. Today, fish such as brook trout (*Salvelinus fontinalis*), northern pike (*Esox lucius*), and yellow perch (*Perca flavescens*) all inhabit the Fox River basin and are therefore possibilities (see Becker 1983). However, walleye (*Sander vitreus*), often referred to as yellow pickerel and sometimes as white salmon (Becker 1983:871), included the Fox River basin in its original range, and walleye may therefore be the fish that Kane references. In the painting reproduced in Figure 10, the fish that Kane shows impaled to the spear held by the fisherman in the bow of the background canoe



Figure 8: *Fishing by Torch Light. Menominee. Fox River, Wisconsin; mid-late September 1845. Oil on paper; 24.5 x 31.1 cm. ROM 2011.58.1. Courtesy of the Royal Ontario Museum © ROM*

suggests a fish that could be a walleye in the 30 cm to 50 cm length range.

Skinner describes the traditional spear head as being a leister made of three cedar prongs—two prongs angled outward and serrated on their inner edges, with a central spike secured between them (Skinner 1921:200). With the thrust of the spear the fish is impaled with the central spike, and the inward pressure of the two outer, serrated prongs prevents the fish from sliding off. Skinner notes that with the availability of trade goods, iron spear heads replaced the wooden leister heads that were native-made. Examination of Kane's sketch does not provide the identity of the spear head, as it seems that the terminal end of the spear is shown beneath the water's surface with the spear in thrusting position. However, with reference to the oil-on-canvas painting of the same scene that Kane later

developed in his Toronto studio (Figure 10), Kane clearly shows the spear head to be a metal trident form with socket to accept the spear handle.

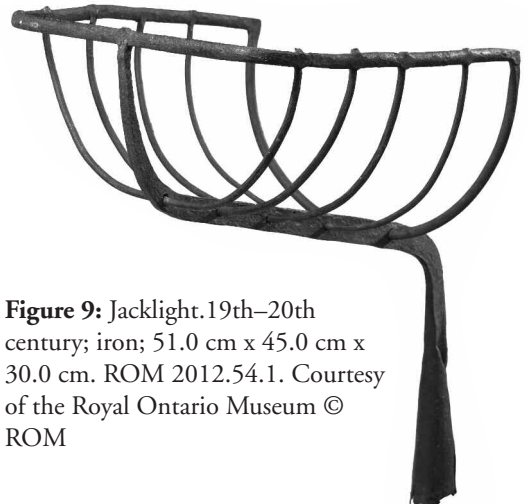


Figure 9: Jacklight. 19th–20th century; iron; 51.0 cm x 45.0 cm x 30.0 cm. ROM 2012.54.1. Courtesy of the Royal Ontario Museum © ROM



Figure 10: *Fishing by Torch Light. Menominee. Fox River, Wisconsin; 1849–1856. Oil on canvas; 45.7 x 73.6 cm. ROM 912.1.10. Courtesy of the Royal Ontario Museum © ROM*

“To inspire the thought of genius”

Paul Kane’s art, and in particular his field sketches, provide us with environmental and cultural details from an era when it was thought that native peoples were on the verge of disappearing. Certainly, native peoples were under extreme pressure to give up their lands and cultural traditions, and Kane’s sketches gift us a pictorial record of that moment in Canada’s past. Illustrations of dip nets in use on the St. Marys River rapids and iron jacklights ablaze on the Fox River speak to the economic value of fish to the native peoples of the Great Lakes region because they also provide graphic records of activities directly witnessed. Kane’s gift to us is a record of a moment in time—details of native life patterns observed, and this many years later, to refer to the thoughts of Margaret Fuller Ossoli, a record of their “monuments” that upon reflection have the potential “to inspire the thought of genius through all ages.”

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Frank and Emily Riddell Memorial Fund, Mark Schmeer, the Elizabeth Walter Endowment Fund, and Susan Witteveen. This sketch has been certified by the Canadian Cultural Property Export Review Board under the terms of The Cultural Property Export and Import Act as being of "outstanding significance and national importance" for Canada's national heritage. Figure 9 is a gift of the Estate of Patricia Harris Walwyn. Figure 10 is a gift of Sir Edmund Osler. Finally, sincere appreciation is expressed to the anonymous reviewers for their valuable comments and insights.

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En 1845, à travers certaines régions des Grands Lacs, l'artiste canadien Paul Kane s'est déplacé à pied, en canot, en bateau à vapeur et en chariot, créant des croquis illustrant les peuples autochtones et leurs coutumes, et, selon ses paroles, illustrant « le paysage d'un pays presque inconnu ». En 1848, après son retour d'un deuxième voyage qui l'a porté vers l'ouest, aussi loin que l'océan Pacifique, il a exposé 240 de ses esquisses à Toronto. Cette présentation a reçu des commentaires très positifs. Les médias ont même présenté l'art de Kane comme étant « tout à fait exact ». Sur du papier, Kane a esquissé divers scénarios en utilisant du graphite, de l'aquarelle et de l'huile. Entre autres, ses esquisses présentaient des campements autochtones, des moyens de transport, des activités de subsistance et de préparation des ressources, des activités liées aux tâches domestiques, des relations sociales et économiques, des scènes de conduite de guerre et des événements cérémoniaux et sacrés. Ses croquis de pêche à l'épuisette et des campements saisonniers de la rivière Sainte-Marie à Sault-Sainte-Marie, dans la région des Grands Lacs, et ceux de la pêche à la lanterne sur la rivière Fox dans le Wisconsin, illustrent des détails qui correspondent à des rapports historiques. L'art de Kane parle en faveur de la valeur économique du poisson pour les peuples autochtones de la région des Grands Lacs. De plus, il représente également des traces graphiques de première main d'activités qu'il a directement témoignées.

The Grand River Sturgeon Fishery

Paul General and Gary Warrick

The Grand River fishery is an ancient one. Using archaeological data, historical documents, and oral history, this paper argues that lake sturgeon was fished in the lower Grand River by Iroquoian-speaking peoples over the past 1,000 years. Archaeological evidence suggests, however, that by A.D. 1840, sturgeon fishing on the lower Grand River had come to an end. The history of dam construction on the lower Grand River in the early nineteenth century suggests that sturgeon were prevented from swimming upriver to spawn. Nevertheless, oral history accounts from the Six Nations community suggest that sturgeon were caught and observed as recently as the 1960s and that they may still be living in the Grand River.

Introduction

In the summer of 2000, a large fish suspected to be a young lake sturgeon was reportedly caught by an angler who was fishing below the Wilkes Dam in Brantford, Ontario. Neither fisheries personnel nor biologists had an opportunity to confirm that the fish was indeed a sturgeon. The report remains anecdotal, as are most of the recent reports of sturgeon sightings or captures within the waters of the Grand River. Are there enough of these anecdotal sightings to suggest that there may be, against all odds, a very small population of lake sturgeon still residing in the Grand River? The possibility that lake sturgeon still live in the Grand River today is important to Six Nations people because the sturgeon symbolize the continuity of an Aboriginal fishery on the river that is at least 1,000 years old.

Lake sturgeon (*Acipenser fulvescens*) are considered a threatened species in the Great Lakes (Department of Fisheries and Oceans Canada 2009) and were nearly extirpated in Lake Erie (Ontario Ministry of Natural Resources [OMNR] 2009). On the Ontario side of Lake Erie, spawning tributaries for sturgeon have been eliminated over the past 200 years by dam construction (OMNR 2009:31). However, prior to the construction of dams in the early 1800s, most rivers and creeks on the north shore of Lake Erie would

have harboured spawning sturgeon. The Grand River likely had a resident population of lake sturgeon and would have offered one of the most significant sturgeon spawning habitats north of Lake Erie, as attested to by zooarchaeological evidence for sturgeon fishing from A.D. 800 to A.D. 1835. This paper will document the importance of sturgeon fishing to the Aboriginal peoples of the Grand River and trace the demise of the sturgeon fishery in the late nineteenth century through archaeological data and documentary and oral history accounts.

Lake Sturgeon Biology and Habitat

Lake sturgeon is an ancient form of fish with cartilaginous vertebrae and bony plates on the head and body. Except when spawning in creeks and rivers in the late spring, lake sturgeon live in large lakes and rivers (e.g., the Grand River), feeding along the bottom in shallower areas close to shore or around islands (OMNR 2009:12). Females can live as long as 150 years and weigh more than 140 kg. Males are smaller and typically die before 50 years of age. Sturgeon mature sexually at a relatively slow rate, and some females do not spawn before they are 25 years old. Females spawn every 4–9 years, from mid-May to late June, preferring to lay their eggs in the shallows of fast-flowing

ivers, with water temperatures of 10–15 oC, a water depth of 0.5–4.5 metres, and a rocky substrate (OMNR 2009). In Ontario, spawning males (aged 10–20 years and older) average 90 cm long and spawning females (aged 20–26 years and older) average 120 cm long (OMNR 2009:8). In Minnesota, comparable spawning ages but slightly larger size at sexual maturity (114 cm for males and 140 cm for females) are documented (Minnesota Department of Natural Resources 2009). Data on the growth rate of sturgeon in Ontario reveal geographical variation according to latitude; lake sturgeon grow quicker and attain larger sizes on average in northern Ontario than in southern Ontario (OMNR 2009:5). Sustainable harvesting of lake sturgeon should not exceed 5% because of slow maturation and low reproductive rate (OMNR 2009:25).

Iroquoians and Sturgeon

Fish were an important part of the diet of Iroquoian peoples from earliest times to the twentieth century. Until the mid-nineteenth century, Iroquoians lived on the banks and shores of major rivers and lakes, presumably because of the importance of fish protein in their diet (MacDonald 2002). Isotopic studies of pre-1650 human skeletal remains and archaeological remains from southern Ontario indicate that fish was one of the key protein sources for Iroquoians (van der Merwe et al. 2003). Freshwater eel, lake sturgeon, and salmonid species have a relatively high fat content and were important in ancient Iroquoian diets in Ontario (van der Merwe et al. 2003; Wang et al. 1990). Sturgeon yield about 110 calories per 100 grams of edible portion of fish (Rostlund 1952:4). Frederick Waugh (1916:136-138) described the various methods that Six Nations used in the early twentieth century to prepare fish for eating, explicitly mentioning eel and sturgeon. Sturgeon was normally fried and also boiled and added to corn soup.

Fishing methods used by Iroquoian peoples are documented in the seventeenth- and eighteenth-century accounts of missionaries, soldiers, and explorers in Ontario and New York State (e.g.,

Biggar 1922-1934; Sagard 1939[1632]; Thwaites 1896-1901). Net fishing appears to have been the most common method, followed by spearing and angling, often in combination with weirs. Fish spears and harpoons with line holes made of antler have been found in seventeenth-century Neutral sites such as Walker and Hamilton (Prevec and Noble 1983).

Because of their size, large sturgeon of spawning age would have torn through nets, but Gabriel Sagard, a French Recollet priest, observed the Wendat capturing sturgeon in fishing nets on Georgian Bay in the seventeenth century (Sagard 1939:185-186). Nevertheless, sturgeon fishing would have been best achieved by spearing or angling during spawning runs at river shallows, and perhaps utilizing weirs. In fact, most sturgeon remains in Ontario Aboriginal archaeological sites were likely taken in rivers or lake shallows during spring spawning because most of the year sturgeon are dispersed in deeper water in the lakes, away from the lakeshore, making them relatively difficult to catch (Needs-Howarth 1999:36). Spear fishing was recorded by Frederick Waugh (1916) in the early twentieth century at Six Nations (Figure 1), and it is still practised today. French Jesuit and explorer Pierre Charlevoix (1923[1761]:236) observed two Aboriginal men spearing sturgeon from a canoe in 1720 in the Great Lakes:

The moment he sees the sturgeon within reach of him, he lances his dart at him and endeavours, as much as possible, to hit in the place that is without scales. If the fish happens to be wounded, he flies and draws the canoe after him with extreme velocity; but after he has swam the distance of an hundred and fifty paces or thereabouts, he dies, and then, they draw up the line and take him.

The best spawning beds for sturgeon in the Grand River would have been from Cambridge down to York. Spear fishing for sturgeon would have been best accomplished in teams of two or three men. The average size of spawning sturgeon caught in North America in the eighteenth and nineteenth centuries would have been about 25 kg



Figure 1: John Jamieson Jr. fishing with a spear on Six Nations Reserve, 1912. (Photo courtesy of Canadian Museum of Civilization, photo 17406, file CD95-819-003 and published in Waugh [1916:196].)

(Holzkamm and Waisberg 2004). Spearing and landing a fish of this weight involves considerable strength, dexterity, and experience. From conversations with Six Nations spear fishers, it appears that a struggling 25 kg sturgeon would have required at least two men to catch and land it (e.g., Wayne Hill, personal communication 2009). Another fishing method that was used by Six Nations fishers in the late nineteenth and early twentieth century was angling by setting night lines, which involved baiting several large hooks and attaching them to a heavy rock on the river bottom.

Archaeological Data

Sturgeon Identification and Sampling

Lake sturgeon cranial bones and vertebrae are under-represented in zooarchaeological assemblages because some of the cranium and all of the vertebral column is cartilaginous and does not preserve archaeologically. Sturgeon has five rows of bony plates or scutes along its back; bony pectoral fins; and interlocking, ossified dermal bones on the cranium that do survive archaeologically. These ossified elements are often highly identifiable to species (by default, because there is only one species of sturgeon in the Great Lakes), even when fragmentary, unlike some of the skeletal ele-

ments of other Great Lakes fish species (Needs-Howarth 1999:10; 2001). This partly compensates for the fact that only a small portion of a sturgeon skeleton will preserve archaeologically.

Ossified sturgeon remains are relatively large and robust and can thus be relatively overrepresented in zooarchaeological assemblages collected only with standard 6.4 mm mesh.

With this caveat in mind, we note that a small number of lake sturgeon remains have been recovered consistently from archaeological sites within the lower Grand River watershed, dating as early as A.D. 700 (see Figure 2 and Table 1).

A.D. 700–1000

The earliest evidence for lake sturgeon being fished from the Grand River was found by Jim Burns in the Cayuga Bridge site, a late Princess Point settlement dating to A.D. 700–900. Only one sturgeon element was identified out of 18 recovered fish bones (no sieves were used) (Stothers 1977:302, 307). At the Porteous site in southern Brantford, dating to A.D. 900–1000, just three sturgeon bones were identified by Jim Burns in the collection of 1,480 fish remains (no sieves were used) (Stothers 1977:295). Preliminary analysis by Stephen Cox Thomas of recovered fish remains from the salvage excavation of the Holmedale site (ca. A.D. 1000), also in Brantford, revealed only one sturgeon bone from a total of 878 fish remains (recovered with flotation using 1.6 mm mesh) (Archaeological Services, Inc. [ASI] 1999:90).

A.D. 1000–1330

The Myers Road site (A.D. 1280–1330), situated in southern Cambridge on a terrace overlooking the Grand River, produced seven sturgeon bones from a total of 1,346 analyzed fish remains from features outside of houses and middens, recovered using 6 mm mesh in the field and 1.6 mm mesh for flotation samples (Thomas et al. 1998:100; analysts Charlton Carscallen, Sarah King, and Suzanne Needs-Howarth).

A.D. 1330–1600

The Middleport component (A.D. 1350–1400)

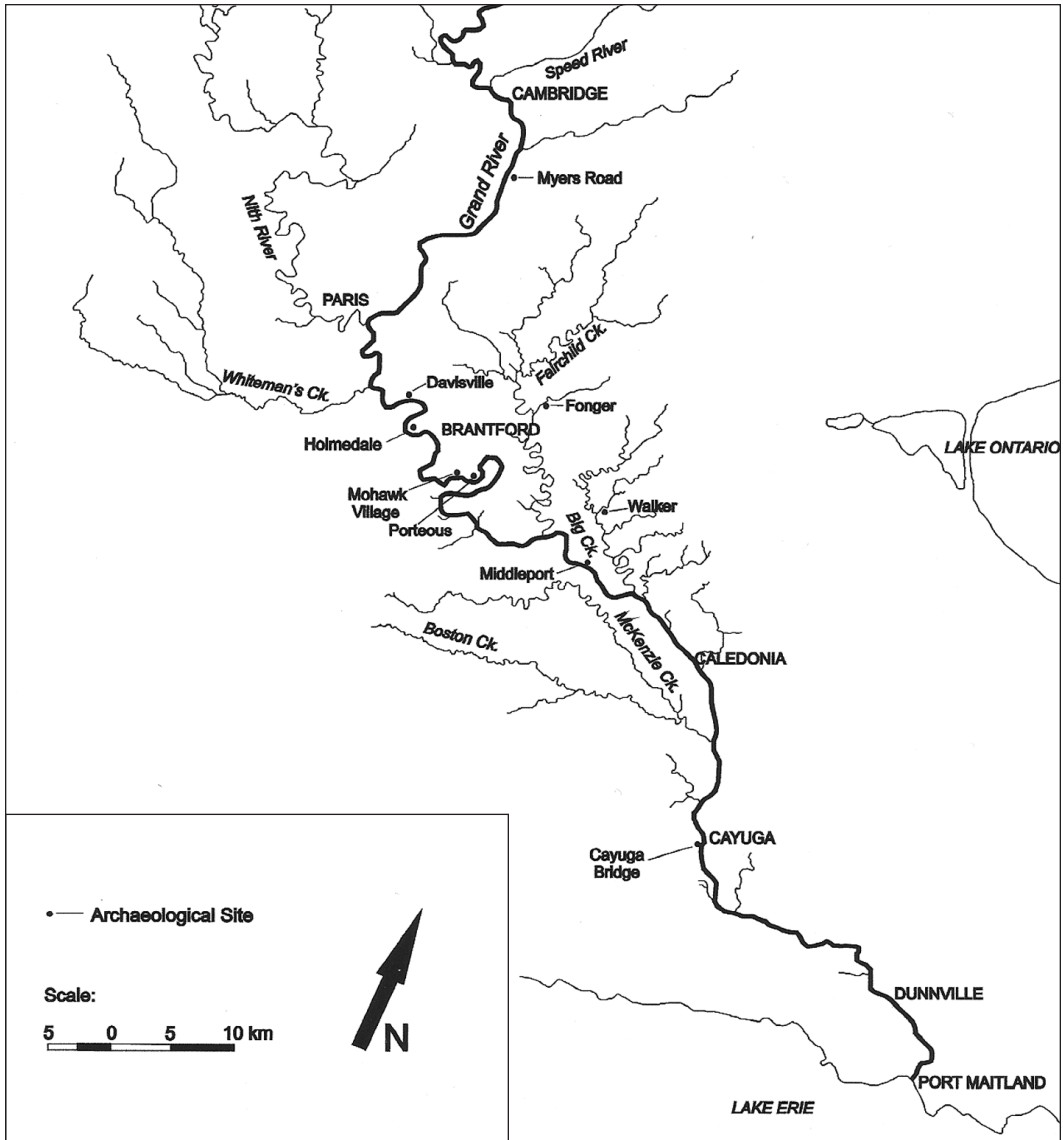


Figure 2: Location of archaeological sites on the Grand River with lake sturgeon remains.

of the Middleport site, perched on the east bank of the Grand River, was excavated using 6.4 mm mesh in the field, and flotation samples of every post mould and feature were processed through 1.6 mm mesh, resulting in the recovery of 22 sturgeon bones out of 23,867 fish remains analyzed by Rosemary Prevec (Archaeological Assessments Ltd. [AAL] 2001:9, 114). Neither the Moyer site (A.D. 1400–1450), analyzed by Paul Kohls, nor

the Coleman site (A.D. 1475–1500), analyzed by Suzanne Needs-Howarth and Rosemary Prevec, situated west of the Grand River near Alder Creek, in the Regional Municipality of Kitchener-Waterloo, revealed sturgeon remains from 378 and 2,387 fish specimens, respectively (MacDonald 1986:95; Needs-Howarth 1995; Wagner et al. 1973:90). No sieves were used in the excavation of the Moyer site, but the Coleman site deposits

were processed in the field through 6.4 mm mesh and the fill of all features was processed by flotation.

A.D. 1600–1651

Two seventeenth-century Neutral village sites have been excavated in the Grand River watershed. The Fonger site (A.D. 1580–1610) on Fairchild Creek, a main tributary to the Grand River, produced 14 sturgeon remains from a total of 700 identified fish specimens (recovered using 6.4 mm mesh; analyzed by Gabriella Prager) (Warrick 1982). The Walker site (A.D. 1635–1650), situated on Big Creek, which drains into the Grand River, yielded 39 sturgeon bones out of 1,617 analyzed fish remains (middens screened through unspecified mesh size [Wright 1981:9]; analyzed by Anne Rick, Elizabeth Siliieff, and Stephen Cumbaa). Studies of Neutral faunal assemblages indicate that fish were caught in local creeks and rivers and in Lake Ontario and Lake Erie. Based on the relatively low numbers of lake species (e.g., whitefish, lake trout) in Neutral sites within the

Grand River watershed, the Grand River Neutral appear to have fished locally in the river and its tributaries or wetlands, but not in Lake Erie (Stewart 2000). In 1651, the Neutral were attacked by the Five Nations Iroquois and abandoned their villages in the Grand River watershed. Resettlement of the Grand River by Iroquoians on a full-time basis did not resume until the arrival of Six Nations in 1784.

A.D. 1784–1840

Sturgeon remains have been identified by Deborah Berg from both Six Nations and Mississauga sites on the Grand River, occupied during the early decades of the nineteenth century. Davisville 1 and Davisville 2, Mohawk cabin sites that were occupied ca. A.D. 1810–1833, both show evidence of sturgeon fishing—eight sturgeon bones out of 553 fish specimens at Davisville 1 and seven sturgeon bones out of 891 fish specimens at Davisville 2 (Berg 2005a, 2005b). Both sites were excavated using a combination of 6.4 mm and 3.2 mm mesh in the field, and flotation with 1.6 mm

Table 1. *Archaeological Sites on the Grand River with Lake Sturgeon Remains.*

Site	Date (A.D.)	Lake Sturgeon NISP	Fish Identified Below Class	Fish NISP	Sturgeon/ Fish Identified Below Class (%)	Sturgeon/ Fish NISP (%)	Reference
Cayuga Bridge	700–900	1	7	18	14	6	Stothers 1977
Porteous	900–1000	3	369	1,480	1	<1	Stothers 1977
Holmedale	1000	1	59	878	2	<1	ASI 1999
Myers Road	1280–1330	7	1,007	1,346	1	1	Thomas et al. 1998
Middleport	1350–1400	22	5,553	23,867	<1	<1	AAL 2001
Fonger	1580–1610	14	110	700	13	2	Warrick 1982
Walker	1635–1650	39	1,617	-	2	-	Wright 1981
Davisville 1	1800–1833	8	165	553	5	1	Berg 2005a
Davisville 2	1800–1833	7	169	891	1	1	Berg 2005b
Davisville 3	1826	2	12	34	17	6	Berg 2005c
Mohawk Village (pre-1840)	1800–1840	2	127	319	2	1	Berg 2005d

mesh. The Davisville 3 site, a Mississauga camp site dating to ca. A.D. 1826, yielded two sturgeon scutes from a total of 34 fish specimens recovered (entire site screened through 1.6 mm mesh) (Berg 2005c). At the Mohawk Village site, a pre-1840 cabin was excavated using 6.4 mm mesh in the field and flotation samples processed through 1.6 mm mesh (Kenyon and Ferris 1984). The cabin cellar contained two sturgeon bones out of a total of 319 fish remains, but a later cabin (1840–1860) contained no sturgeon remains at all (Berg 2005d).

Similarly, downriver at the Dewar site (ca. A.D. 1825–1845), a former Onondaga cabin on the east bank of the Grand River, no sturgeon remains were identified by Charlton Carscallen from 1,109 fish specimens that were collected with the use of 6.4 mm mesh in the field and from the units that were processed through 1.6 mm mesh during flotation (Archaeological Assessments Ltd. 2003:25-27).

Summary

The archaeology of fishing on the Grand River demonstrates that sturgeon comprises approximately 0.5–2% of all fish remains on Iroquoian sites from A.D. 700–1840. Lake sturgeon makes up 0.5–5% of collections of fish identified to genus or species, disregarding the relative frequency of sturgeon from sites with small sample sizes (see Table 1). The incidence of lake sturgeon in Grand River sites is similar to that at Wendat sites in and around Barrie, where, except for the Barrie site, lake sturgeon remains constitute about 1% or less of fish remains identified to family (Needs-Howarth 1999:127). While not common, sturgeon has been identified from most sites in the Grand River watershed and from all sites directly on the river that pre-date 1840. The near ubiquity of sturgeon suggests that it was consistently available in the lower Grand River and part of the Iroquoian diet prior to 1840. So, why is there no evidence of sturgeon fishing on sites after 1840?

Historical Accounts of the Grand River and Lake Erie Sturgeon Fishery

In one of the first accounts of the Neutral country, including the Grand River watershed, Recollet priest Joseph de la Roche Daillon observed during his visit of 1626–1627 that “the rivers furnish much excellent fish” (LeClerq 1973, 1:269-270). Jesuits Jean de Brébeuf and Joseph Chaumonot, who stayed with the Neutral over the winter of 1640–1641, noted that the abundance of fish was comparable to the Wendat territory in Simcoe County: “the fishing likewise seems equal, as regards the abundance of fish, of which some species are found in one region, that are not in the other” (Thwaites 1896-1901, 21:195-197). Documentary history is silent for the eighteenth century on the Grand River and its fishery. On the evening of May 6, 1825, Peter Jones, a Mississauga missionary and chief, recorded that he and two other Mississauga men caught more than 120 fish (species not recorded) on the Grand River at Davisville (northwestern Brantford), by torchlight (Jones 1860:18). For the Anishnaabe (like Peter Jones and his Mississauga relatives at Davisville), fishing with spears by torchlight was the most common way of catching sturgeon during spring spawning (Holzkamm and Waisberg 2004:27). Considering the spring date of this account, it is conceivable that sturgeon were among the species caught. Clearly, the Grand River fishery was extremely productive, at least until 1825. A few short years later, however, the fishery was in trouble.

Dam construction became commonplace after 1820 on the Grand River and its tributaries, primarily for grist and saw mills. The first dam to be constructed completely across the Grand River was built at Dunnville in 1829, as part of the Welland Canal construction. The impounded water flowed into a feeder canal dug to provide water for the Welland Canal lock system. Other dams were placed across the main channel of the Grand River in the 1830s and 1840s, connected with the canals and locks of the Grand River Navigation Company (Hill 1994). In the nineteenth century, Six Nations protested repeatedly to the Government of Upper Canada about the delete-

rious impact of the dams on the Grand River on their fisheries (Hill 1994). Dams prevented spawning fish, such as sturgeon, from migrating freely upstream from Lake Erie. It is noteworthy that sturgeon are represented among the fish remains found in early nineteenth century Six Nations sites occupied prior to 1840, but are absent in the inventory of fish remains excavated from the post-1840 cabins at the Mohawk Village and Dewar sites (Berg 2005a, 2005b, 2005d). As noted previously, the lack of sturgeon bones in post-1840 Six Nations sites on the Grand River is not the result of differential excavation and recovery techniques or poor bone preservation.

Even if sturgeon could have moved freely up and down the river, their population may have been severely reduced as a result of commercial fishing in the nineteenth century. Prior to 1860, sturgeon were considered a nuisance because they tore nets. If caught, they were only eaten by the lower classes, such as servants and labourers (OMNR 2009:13). From the mid- to late nineteenth century, however, sturgeon meat, roe (caviar), and isinglass (a glue and fining agent made from air bladders) was in hot demand, fuelling a commercial sturgeon fishery throughout Canada. In 1890, the lake sturgeon harvest on Lake Erie was in excess of 263,500 kg (OMNR 2009:13). Overfishing caused lake sturgeon stocks to drop drastically by the early 1900s, and, as noted earlier, sturgeon was almost extirpated from the Lake Erie basin (OMNR 2009). Today, lake sturgeon has been declared a threatened species by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and since 2009 only Aboriginal people are permitted to fish for lake sturgeon in Ontario (Department of Fisheries and Oceans Canada 2009; OMNR 2009).

In the early twentieth century, Six Nations fishermen reported occasional catches and sightings of lake sturgeon, but sturgeon would have been rare in the Grand River because fish stocks were significantly depleted through overfishing in Lake Erie, particularly after 1903 (OMNR 2009: Appendix 8). Furthermore, the dams prevent reintroduction of lake sturgeon to the Grand River from Lake Erie.

Oral History of Sturgeon Fishing on the Grand River¹

Lake sturgeon is not considered by contemporary Six Nations people to be an important fish in the diet, and they attach no special importance to the sturgeon—unlike the Anishinaabe peoples of northern Ontario, who actually have sturgeon clan names (OMNR 2009:4). In fact, during the fur trade era some Anishinaabe groups west of Lake Superior were referred to as the “Sturgeon Indians,” and the sturgeon holds a prominent place in Anishnaabe myth (Holzkamm and Waisberg 2004:27, 29).). However, even though lake sturgeon may not have been important to Six Nations culturally in comparison with Anishnaabe groups in Ontario, archaeological evidence indicates that it was harvested for hundreds of years by Iroquoian peoples living on the Grand River. The sturgeon’s exclusion from the Grand River by the construction of dams almost 200 years ago very likely removed the species from Six Nations culture. The lead author of this paper, Paul General, who grew up at Six Nations beside the river, has childhood memories that the sturgeon has certainly always been there as a fabled presence in the river, a trophy when caught or sighted, at least for those who live along the banks of the Grand River.

Oral history traces the probable survival of the lake sturgeon in the Grand River throughout the twentieth century. A Six Nations elder with knowledge of the Mohawk Lake area in downtown Brantford (Mohawk Lake is an impoundment of a tributary stream to the Grand River and was created in the late 1840s by the construction of the canal associated with the Grand River Navigation Company [Hill 1994]) reported that a common recreational activity for residents in the 1920s was to attempt to hook a

¹The stories about possible encounters with and sightings of lake sturgeon in the Grand River from Six Nations community members are considered oral history of the community of Six Nations of the Grand River and are not attributable to a particular individual; there are, therefore, no specific reference citations in this section of the paper.

large fish described to be the size of a fence post. The student residents of the Mohawk Institute (a residential school in Brantford) would regularly fish in Mohawk Lake, and the target species was reported to be a fish the size of a fence post that when hooked would just swim away, taking line and bait with it. When the local school boys would hook the giant fish, it would just glide into deeper water, breaking off or taking all lines with it.

During the 1950s, the town of Caledonia had two mills located on either side of the river. Caledonia was the site of one of the dams originally constructed during the time of the Grand River Navigation Company in 1836 (Hill 1994). This dam, one of several between Brantford and the mouth of the Grand, was constructed to provide a navigable waterway for the Grand River. These dams also enabled hydro power for mills at the sites of the dams. As the story goes, two residents of Caledonia would regularly set nets in the mill races. On one occasion a sturgeon was reportedly caught in the net. The overwhelming size of the fish took both harvesters by surprise, causing the men to jump on the large fish in an attempt to manhandle it into submission.

In the 1960s, a resident of Six Nations would set nightlines (a heavy gauge line with several attached short lines, and each short line terminating with a hook baited with anything that smelled bad) in the hopes of catching a lake sturgeon. He was specific in his target species. What lends credence to this story is the location of his home, which was very close to one of the deeper holes in that reach of river, a possible holding area for large fish. This may have been an area where sturgeon were regularly harvested. For example, while conducting sturgeon research, the lead author of this paper, Paul General, was told by a former Grand River Conservation Authority fisheries biologist that he discovered an area between the towns of Paris and Cambridge known locally as the "Sturgie Hole," an area where sturgeon were likely harvested, although it is unknown when sturgeon was last taken at this locale.

Lastly, as referenced in the introduction to this paper, as recently as 2000, a small lake sturgeon was reportedly caught by an angler in the Brant-

ford reach of the Grand River. Other accounts exist of large fish having been caught or observed in the Grand River. There are stories from Six Nations residents of sightings of large fish swimming close to the surface, but no one made an official report or took photographs to verify these sightings. There are no other fish species in the Grand River that would approach the size of lake sturgeon, and Six Nations fishers are very familiar with pike, walleye, and other larger-bodied fish. Stories of possible encounters with lake sturgeon in the twentieth century have become part of local lore.

Conclusions

Aboriginal people have fished for lake sturgeon in the Grand River watershed probably for several thousand years. Over the past 1,000 years, as documented in archaeological sites with fish bone preservation, sturgeon is always present in small quantities in the lists of identified fish until about 1840. The ubiquity of sturgeon in Grand River archaeological sites signifies that it was likely caught during spring spawning by spearing in river shallows. Given the relatively large size of lake sturgeon, it is unlikely that whole fish were traded or transported to sites on the Grand River from Lake Erie. Lake sturgeon was not an important fish in Neutral and Six Nations culture and diet on the Grand River, but it is the largest spring spawning species and would have yielded a considerable amount of meat per fish. The archaeological record suggests that lake sturgeon was no longer being caught in the Grand River after 1840, probably as a consequence of dam construction across the Grand River, which blocked migration to and from Lake Erie.

The loss of the Aboriginal lake sturgeon fishery on the Grand River is clearly seen in the archaeological, historical, and oral history records and stands as a symbol of the dramatic destruction of fish stocks and habitats over the past 170 years in southern Ontario. The transformation of the Grand River, through the construction of dams and navigation locks by Euro-Canadians, from an Aboriginal fishing ground into a commercial transportation corridor—and the removal of Abo-

iginal people from most of the river after 1841—signalled the beginning of the end to a way of life and to a fishery that was thousands of years old. The archaeology of the lake sturgeon fishery on the Grand River reminds us that thousands of years of Aboriginal fishing had a negligible impact on the total fish stocks. On the other hand, Euro-Canadian commercial fishing in the latter half of the nineteenth century decimated fish stocks in Lake Erie and the Grand River. The near extirpation of lake sturgeon from the Grand River reminds us what the Six Nations and Mississaugas have lost and why they struggle so hard to care for the tattered remnants of the pre-European environment of the Grand River—a river that not too long ago nourished baby lake sturgeon, which in turn nourished their ancestors.

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La pêche de la rivière Grand en est une ancienne. À partir de données archéologiques, de documents historiques et d'histoires orales, cet article soutient que l'esturgeon jaune a été pêché, au cours des 1000 dernières années, dans la partie inférieure de la rivière Grand par les peuples de langue iroquoise. Par contre, des preuves archéologiques suggèrent que par l'année 1840 de notre ère, la pêche à l'esturgeon dans la partie inférieure de la rivière Grand avait cessé. L'histoire de la construction de barrages sur la partie inférieure de la rivière Grand dans le début du XIXe siècle suggère que l'esturgeon était incapable de nager en amont pour frayer. Néanmoins, des témoignages d'histoire orale de la communauté des Six-Nations suggèrent que l'esturgeon a été capturé et aperçu dans une période aussi récente que les années 1960 et qu'il pourrait encore possiblement vivre dans la rivière Grand.

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The Pre-contact Upper Niagara River Fishery: Shadows of a Changed Environment

David A. Ingleman, Stephen Cox Thomas and Douglas J. Perrelli

This article offers a synopsis of recent research into the pre-contact fishery on the upper Niagara River, with a view towards the Middle Woodland period (ca. 2,100–1,000 B.P.) and subsequent modern environmental impacts. During the Middle Woodland, fishing was a major subsistence activity, and the climate and water levels were within their historically documented range. However, many details of the pre-contact upper Niagara River fishery have hitherto remained unclear. Archaeological data suggest that during the Middle Woodland period a diverse fish community was exploited, with spawning walleye as a major focus. Anecdotal historical accounts suggest that spawning walleye were captured with nets in the upper Niagara River. Interestingly, despite the presence of some favourable habitat conditions, there is no confirmed walleye spawning ground in the upper Niagara River today. It is likely that over the past two centuries a suite of anthropogenic factors contributed to the environmental degradation of such hypothesized spawning grounds. We hope the results of this study will be germane to future palaeo-environmental reconstruction and rehabilitation efforts.

Introduction

The Niagara River courses south to north about 58 km to connect lakes Erie and Ontario (Figure 1). The river is dissected by Niagara Falls into the 31 km upper Niagara River (from Lake Erie to the falls) and the lower Niagara River (from the falls to Lake Ontario). The Niagara River also forms a political boundary separating the Canadian province of Ontario to the west and the American state of New York to the east. Most of the islands in the upper Niagara River are considered part of New York, including Grand Island (the largest) and Strawberry Island, located about 850 m southeast of Grand Island. Major population centres adjacent to the upper Niagara River include the City of Buffalo in the United States and the Town of Fort Erie, in Canada. Both Buffalo and Fort Erie are located at the head of the Niagara River (Figure 1).

Historically, the upper Niagara River supported a bountiful commercial fishery, and today recre-

ational sport fishing remains an important benefit. However, over the past two centuries, the river ecosystem has suffered a series of severe environmental stresses; as a result, fishery productivity declined. Unfortunately, river rehabilitation efforts are hampered by a dearth of knowledge about pre-industrial environmental conditions (New York State Department of Environmental Conservation [NYSDEC] 1994:4.37-4.43). This situation exists partially because a detailed history of the Niagara River fishery began to be compiled less than a century ago (Goodyear et al. 1982[10])—well after Euro-North American colonization and industrialization caused significant environmental perturbations. In contrast, evidence of the pre-contact fishery, which existed for millennia before this, is preserved in the form of abundant archaeological deposits. In this study we use a multi-disciplinary approach to model the pre-contact upper Niagara River fishery with an eye towards fisheries management.

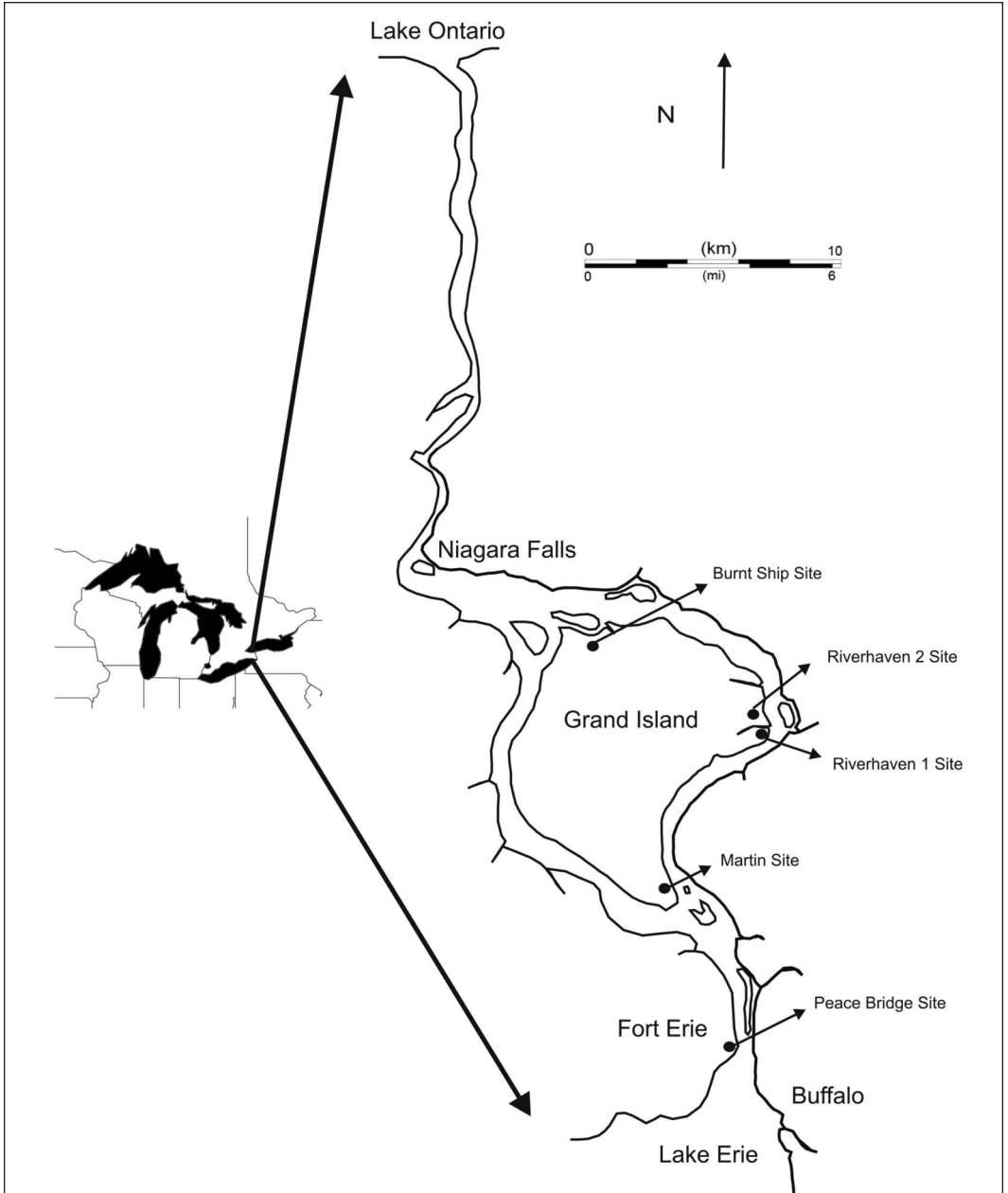


Figure 1. Map of the Niagara River showing archaeological sites mentioned in the text.

Environmental History

The upper Niagara River, which is perhaps best conceptualized as an extension of Lake Erie, achieved essentially modern climate and water levels about 2,000 years ago (Pengelly et al.

1997:398). Currently, the river ecosystem supports a diverse fish community (Carlson and Daniels 2004:115,132-139; Goodyear et al. 1982[10]) Nursery and spawning areas for several fish species, including yellow perch, muskellunge,

northern pike, largemouth bass, and smallmouth bass, are found in many upper Niagara River tributaries, backwaters, shoals, bays, and eddies (Goodyear et al. 1982[10]; New York State Department of State [NYS DOS] 1987a,b).

The upper Niagara River fishery grew in scale and intensity throughout most of the nineteenth century. In the early 1800s, the first Euro-North American settlers in the region practiced a subsistence fishery, yet by the mid-nineteenth century a commercial fishery had developed in response to increasing demand as well as improvements in infrastructure and fishing technology (Bogue 2000:37; Brown et al. 1999:308; Hodge 1922:248; cf. Regier and Hartman 1973:1249). Lyman (1844:438) aptly described the thriving nineteenth century commercial fishery when he wrote, “The waters of the Niagara yield great quantities of the finest fish...[which] find a ready market at Buffalo...employing many people and producing considerable revenue.” The readiness of the late-nineteenth century fish market is obvious when one considers that about 2,900 tonnes of fish were sold at Buffalo in 1872 alone (Bogue 2000:37).

Regrettably, increasing reliance on aquatic faunal resources also coincided with increasingly severe environmental impacts, including pollution, habitat damage, over-fishing, and invasive species introductions (i.e., Cornelius 2000:1-2; Hartman 1988:118-123; NYS DEC 1994). As a result, the composition of the upper Niagara River fish community changed as several species were introduced and others went extinct or were locally extirpated (Carlson and Daniels 2004:115, 132-139). Stocks of some fish, such as the lake sturgeon and northern pike, have clearly waned; however, other species declines are more poorly documented (Goodyear et al. 1982[10]:3; NYS DEC 1994:4.37-4.43).

Significant physical damage to upper Niagara River fish habitats commenced in the early nineteenth century and continued into the mid-twentieth century. For instance, in 1823, construction began on a pier extending from the Buffalo Harbor to the upper Niagara River. This pier was said to have “spoiled the fishing” at one of the more productive upper Niagara River shore

fishing grounds (Hodge 1922:248). Around this same time massive amounts of sediment and gravel were dredged from the upper Niagara River for navigational purposes. These activities undoubtedly destroyed some gravel shoals used for spawning. The dredged spoils were then deposited on Strawberry Island. The deposited spoils dramatically increased Strawberry Island’s size and filled in the environmentally sensitive littoral areas surrounding it (NYS DOS 1987c; Sault et al. 1997:31). Upper Niagara River dredging, primarily motivated by commercial interests, continued into the twentieth century. In the first quarter of the twentieth century more than 9,800 megalitres of material were dredged, mainly from the shallow areas just south of Grand Island (United States Army Corps of Engineers [USACE] 2009). Other significant habitat modifications, which occurred between the late 1800s and mid-twentieth century, included the erection of the International Railway Bridge, the construction of a water intake structure, and the building of the Peace Bridge. Also during this period, at various locations the shoreline was hardened as littoral areas were filled (USACE 2009). The scope and magnitude of these modifications is impressive, with negative implications for fish habitat.

Yet by the early twentieth century, pollution—not habitat damage—was deemed culpable for the upper Niagara River’s moribund fish populations. Fishery scientists reported that the upper Niagara River was “so badly polluted by sewage that anglers complain of a destruction of the fishing which is almost total” (Bean 1907:461). Lamentably, pollution of the Niagara River continued, and maybe even worsened, over the next few decades. In the mid-twentieth century, a series of fish kills linked to industrial pollution prompted the creation of additional environmental regulations (e.g., Hang and Salvo 1981; Schulte 2006:86-90; Symons and Simpson 1939). Now it is hoped that increased awareness, more stringent regulations, and targeted rehabilitation efforts may be able to reverse the Niagara’s ecological tailspin (NYS DEC 1994).

Walleye and Sauger in the Upper Niagara River
 The upper Niagara River formerly provided habitat for three members of the genus *Sander*: the sauger (*S. canadensis*), and both the larger “yellow” and smaller “blue” subspecies of walleye¹ (*S. vitreus vitreus* and *S. vitreus glaucus*). All three fishes were historically abundant in Lake Erie (Scott 1967:99; Scott and Crossman 1979:773-774; Trautman 1981:605-606, 609-610, 613). Unfortunately, the formerly prosperous Lake Erie basin *Sander* fishery declined precipitously in the mid-twentieth century as a result of environmental degradation and over-fishing (Hartman 1988:122; Regier and Hartman 1973). The once-plentiful blue walleye are now considered extinct, and sauger no longer occurs in upper Niagara River biological surveys (Carlson and Daniels 2004:115). Yellow walleye remains a key member of the Erie–Niagara fish community and is targeted for rehabilitation (Great Lakes Fishery Commission [GLFC] 2003:39; NYSDEC 1994).

Yellow walleye are currently found throughout the Niagara River system and are known to spawn in some upper Niagara tributaries (e.g., Goodyear et al. 1982[10]:15; MacLeod and Wiltshire 2004:i, 9). Additionally, there are unconfirmed reports by local fishermen of walleye spawning in the environs of Strawberry Island (Lichvar and Campbell 1997:1). However, it is possible that habitat damage in the upper Niagara River eliminated some former upper Niagara River spawning grounds altogether. Therefore, while fisheries biologists do not report that walleye were spawning in the upper Niagara River, at least from the twentieth

century onward (Goodyear et al. 1982[10]), the possibility remains that they once did so prior to the environmental destabilization associated with Euro-North American colonization.

Ethno-historic Context

Background

Great Lakes ethno-historic sources document the ubiquity and importance of fishing as well as the diverse assortment of fishing techniques utilized at the time of European contact through the twentieth century (e.g., Flannery 1939; Kinietz 1965; Recht 1995; Rostlund 1952; Sagard 1939 [1632]; Thwaites 1896-1901). These sources provide ethnographic analogues that may be helpful in generating hypotheses about archaeologically discernible pre-contact fishing practices. Here we focus on the historically documented indigenous and Euro-North American peoples who fished the Niagara River from the early 1600s until the mid-nineteenth century. Our assumption is that because these peoples faced similar environmental conditions as did their more ancient predecessors, they may have also utilized similar fishing methods.

Analogy is frequently employed in archaeology, however incomplete data and complex cultural phenomena can make analogy-based interpretations difficult. This is especially true in cases, such as ours, where no direct cultural continuity can be demonstrated between archaeologically identified and ethnographically documented cultures. Moreover, the “quasi ritual nature of fishing” observed among many modern and historic fishing cultures (Acheson 1981:288) suggests that our task may be further complicated by unpredictable cultural variables. For example, if the pre-contact Iroquoian people who fished Niagara River conducted themselves like their historically documented kin, then they likely adhered to specific rituals and taboos to maintain a prosperous fishery (Herrick 1995:91-93; Recht 1995:20-26; Rostlund 1952:155-156; Sagard 1939:316-318 [1632]). These types of inherently esoteric, and potentially idiosyncratic, behaviours can be difficult to account for in developing models of pre-contact fish exploitation.

¹ The common name given to *Sander vitreus glaucus* by the American Fisheries Society is blue pike (Nelson et al. 2004:234). Some may find the nomenclature blue pike misleading because the fish is not a member of the pike family, but a bluish-tinged subspecies of the walleye. To avoid confusion, in this article we follow Scott (1967) and Scott and Crossman (1979) in using the term blue walleye for the extinct blue-tinged subspecies *Sander vitreus glaucus* and yellow walleye for the larger, yellow-tinged subspecies *Sander vitreus vitreus*. When referring generically to *Sander vitreus* we use the term walleye.

Niagara River Basin Fishing ca. A.D. 1626–1865

In the early contact period the Niagara River was controlled by the Neutral (Thwaites 1896-1901[21]:189, 209), an Iroquoian group whose fishing hamlets were said to “furnish much excellent fish” (Wright 1963:15, 23). Alas, little is known of Neutral fishing practices because they were displaced by a neighbouring Iroquoian group, the Seneca, in the mid-1600s (Wright 1963:50-56). However, we may assume that the Neutral fishery was similar to that of other, better documented contemporary and neighbouring Iroquoian groups, such as the Huron, who had a well-developed fishery that apparently included a variety of individual and mass capture techniques (Sagard 1939:185-186, 190, 229-231 [1632]).

Hennepin (1903:522-523 [1698]) provided the earliest written account of Seneca fishing practices on the Niagara River when he described the use of cast nets and harpoons. Regrettably, the veracity of Hennepin’s statements may be questionable (Rostlund 1952:80). However, the Seneca clearly continued to fish in the Niagara region well into the nineteenth century (Hauptman 1998:167), when they were frequently observed fishing with spears, hooks, and lines (Weston 1904:109); fish baskets (Severance 1911:230); and seine nets (Allen 1879:309; Norton 1879:98). Seneca seines were reportedly used around Grand Island to net “muskelonge [*sic*], yellow pike, sturgeon, black bass, pickerel, and mullet...in their seasons” (Allen 1879:309) and by Black Rock to catch “herring”² (Norton 1879:89).

In the early nineteenth century some Euro-North American fishing techniques in the upper Niagara River apparently differed little from indigenous techniques. For instance, fish were

reportedly speared at night by torch light from canoes (Indian Fishing in North America 1837:194), by both “settlers and Indians”³ (Blane 1824:406). Angling was another productive fishing method common to both indigenous people and Euro-North American settlers (Fishes of the Upper Lakes 1832:118; Hodge 1922:248). Seine nets were likewise used by early Euro-North American settlers to great effect. For example, the family who operated the Black Rock ferry were said to have caught “an abundance of fish in the spring with the seine...[including] pickerel and salmon trout each about four pounds [1.8 kg]” (Cooper 1915:18 [1809]).⁴

Archaeological Context and Materials

Background

Substantial, overlapping pre-contact cultural deposits line the banks of the upper Niagara River, including many sites located on islands in the river. These abundant archaeological remains were well known to early investigators such as Cyrus Thomas (1891:142), who mentioned “Indian village sites along the Niagara River on both sides for its entire length.” More recently, Granger (1976:4) described the situation as “the Niagara River Sheet Midden.” These archaeological resources offer a window into pre-contact environmental conditions and cultural adaptations along the upper Niagara River.

Fishing was apparently a major subsistence activity at some upper Niagara River archaeological sites (Granger 1976; White 1964, 1966:22; Williamson and MacDonald 1997; Williamson, Austin and Robertson 2006; Zubrow and Buerger 1994). Indeed, archaeological studies have suggested that across much of pre-contact eastern North America, and especially in the Great Lakes

² In this context, the nomenclature “herring” is somewhat ambiguous, but likely denotes the cisco (*Coregonus artedii*); however, mooneye (*Hiodon tergisus*) is also a possibility.

³ The “Indians” mentioned may have been Seneca, Tuscarora, or Mississauga. All three tribes were associated with Niagara River at this time, and torch-spear fishing was a widespread practice in the Great Lakes

region (Rostlund 1952:110-112,181-182).

⁴ Note that walleye (*Sander vitreus*) are sometimes called “pickerel” (Goodyear et al. 1982[10]:15, citing Kerr and Kerr 1860-1898). Modern yellow walleye weigh on average about 1.4 kg and spawn in the spring, when they can be caught with seine nets (Scott and Crossman 1979:767, 772).

region, fish were an abundant, predictable, and renewable resource that were harvested with a variety of techniques (e.g., Cleland 1982; Fitting 1975:65, 68; Limp and Reidhead 1979; Petersen et al. 1984). Unfortunately, our understanding of the pre-contact fishery in eastern North America in general, and in the eastern Great Lakes region in particular, remains somewhat limited.

Materials

In order to develop a preliminary model of the pre-contact upper Niagara River fishery, we examined a sample of five key sites—Riverhaven 1, Riverhaven 2, Burnt Ship, Peace Bridge, and Martin (Figure 1, Table 1). Sites were selected from the Archaeological Site Files at the SUNY at Buffalo Department of Anthropology because they contained the best evidence for fish procurement activities. All the sites are located adjacent to the upper Niagara River and are in close proximity to significant modern fish habitats (NYS DOS 1987a-d). Each of the sites in our sample also yielded ichthyofaunal assemblages and notched stones interpreted as sinkers for fishing nets.

Riverhaven 1. The Riverhaven 1 site, situated south of Spicer Creek on Grand Island, was first identified by Kochan (1961, 1962), an amateur archaeologist. Subsequently, the site was excavated by an archaeological field school in 1977 (Engelbrecht 1977). Postmoulds, midden deposits, and artifacts dating from the Late Archaic to the post-contact period were identified at the site. Fish bones were recovered but remain unanalyzed. Hence, the relative abundance and dietary importance of fish at this site is unknown (Engelbrecht 1977; Kochan 1962).

Riverhaven 2. The Riverhaven 2 site, located north of Spicer Creek, was also first identified by Kochan (1961) and was subsequently investigated by archaeologists from SUNY at Buffalo in 1967 and 1971 (Granger 1978:157-159). The Riverhaven 2 site may be best known for its Early Woodland component; however, Archaic period artifacts were also recovered (Kochan 1961:14).

The relative importance of fishing at the Riverhaven 2 site is debateable. Ritchie and Funk (1973:346) felt that “fishing was important”;

Table 1. Summary of upper Niagara River pre-contact sites studied.

Site	Field Investigator: Date(s)	Selected References
Riverhaven 1	Kochan: 1959 Engelbrecht: 1977	Kochan (1961, 1962) Granger (1978) Engelbrecht (1977)
Riverhaven 2	Kochan: 1959, 1961–1963 Granger: 1967, 1971	Kochan (1961) Grayson (1974) Granger (1978)
Burnt Ship	Kochan: 1962–1963 Miller: 1977 Hansen: 1978	Henke (1969) Hansen (1979)
Peace Bridge	White and Noble: 1964 Pengelly: 1988 Williamson: 1994–2000	White (1966) Granger (1976) Williamson and MacDonald (1997) Williamson, Austin, and Robertson (2006)
Martin	Kochan: 1962 White: 1963 Zubrow: 1978, 1979	White (1964) Ellis (1985a) Buerger (1992) Zubrow and Buerger (1994)



Figure 2. *Plan view of Martin site Feature 12. Note: sticks mark all possible postmoulds.*

however this statement was not necessarily supported by faunal data. The Riverhaven 2 faunal assemblage includes about 3,000 vertebrate elements, but just 218 fish bone specimens (Grayson 1974:23, 37). Of these, identification to species was only attempted for the 50 fish bones excavated by Kochan. However, according to Grayson (1974:37), most of the fish bones in the total site assemblage “seem to be fish of the family Ictaluridae, catfish.” The paucity of fish remains apparently led Grayson (1974:37-38) to his belief that “the inhabitants of Riverhaven No. 2 gained most of their subsistence from mammals and relatively little from birds, fish and reptiles even though...the location of the site may in large part have been determined by the accessibility of these numerically minor resources.” Granger (1978:234) concurred with Grayson and similarly surmised that, “While fishing was evidenced at the site, it does not appear to be a major activity.” Based on the recovery of some fish bones and relatively large netsinkers, Granger (1978:231-234) suggested the site contained evidence of “limited weir net fishing in the Niagara River.”

Yet, the relative importance of fishing at the Riverhaven 2 site may have been obscured by preservation bias and excavation methodology. Kochan (1961:14) apparently screened bulk sediments; however, after a review of published reports and unpublished materials curated in the SUNY at Buffalo, Department of Anthropology, we have been unable to determine what size mesh he used. In contrast, Kochan (1961:14) “troweled” features, apparently saving any observed artifacts as well as at least some soil flotation samples (Granger 1978:4). Although the field notes are oddly silent on the issue, the SUNY at Buffalo excavations likely screened bulk sediments with 6-mm mesh screens, as this was apparently a common practice at the time (cf. Granger 1978:84). Not surprisingly, it was apparently a flotation sample which produced the majority of the analyzed Riverhaven 2 fish bone. According to Granger (1978:301), “most of the fish bone [excavated by Kochan] was found in a compact mass of light gray sandy clay resembling ‘ash’. When this was broken down in the laboratory few actual fish bones remained.” Clearly fish bone preservation

was somewhat poor. In fact, the dominance of catfish in the ichthyofaunal assemblage may be due to their relative durability compared with the more ephemeral bones of many other fish species.

Burnt Ship. The Burnt Ship site, first excavated by Kochan from 1962 to 1963, is located near the north shore of Grand Island, adjacent to a large marsh and creek. Artifacts spanning the Late Archaic to the Late Woodland periods were identified, including Neutral pottery (Henke 1969). Additional excavations and analysis identified the Iroquoian occupation as extractive and non-residential. Many fish vertebrae and scales were recovered, but these remain unanalyzed (Hansen 1979).

Peace Bridge. The Peace Bridge site (AfGr 9) refers to a large area (24 ha) along the western side of the upper Niagara River near its head. The Peace Bridge site designation subsumes several locations previously identified as discrete sites, including the Fort Erie and Orchid sites (Williamson, Cooper, Robertson and Austin 2006:46-58). Archaeologists have found evidence of occupation here from the Late Archaic through Late Woodland periods (Austin and Williamson 2006:524).

Excavations at the Peace Bridge site conducted by Archaeological Services Inc. between 1994 and 2000 yielded a total of 233 complete netsinkers, 285 fragmentary netsinkers, and a large concentration of artifacts interpreted as netsinker notch spalls. The netsinker collection also contained more than 100 specimens stained with red ochre (MacDonald et al. 1997:375-376; Austin and Jenkins 2006:398).

The Peace Bridge site faunal assemblage includes several fish species. Of particular interest to our study are the contents of a collapsed Princess Point-like vessel, recovered from Feature 158, which is thought to have contained the remains of soup or stew dominated by walleye and other fish (Thomas 1997a:475, 492). An encrustation from the vessel interior was dated using Accelerated Mass Spectrometry (AMS) to a "calibrated radiocarbon date of A.D. 676, with a range of A.D. 625-862 at 2σ " (Robertson et al. 1997:502).

Martin. The Martin site, situated near the southern tip of Grand Island, was first excavated by Kochan in 1962 and then revisited by three SUNY at Buffalo field schools (White in 1963 and Zubrow in 1978 and 1979). These excavations produced a very large artifact collection spanning the Early Archaic to Late Woodland periods (White 1964; Zubrow and Buerger 1994). The majority of the Martin site pottery is diagnostic of the late Middle Woodland period (White 1966:14, citing personal communication with William Ritchie; Zubrow and Buerger 1994).

The island-dwelling Martin site inhabitants were clearly riverine-adapted people, an interpretation supported by the abundant zooarchaeological evidence. In contrast to the Burnt Ship and Riverhaven 1 sites, about half of the zooarchaeological remains from Martin were analyzed (Ellis 1985a, 1985b). This analysis identified more than 2,700 fish bone specimens, in addition to a large amount of scales, which suggested that the Martin site inhabitants relied heavily on locally available aquatic resources (Zubrow and Buerger 1994:Footnote 22, Table 9, citing Ellis 1985a). However, the Martin site sample may, in fact, underrepresent the importance of fish due to biased recovery methodology. Although we have been unable to verify what screen mesh size Marian White used while excavating the Martin site in 1963, it is believed that at this time in her career she typically used 8-mm mesh screens. This coarse-gauge mesh would tend to bias the quantity and diversity of fish remains recovered in favour of larger-bodied animals and larger elements of smaller-bodied animals. Zubrow and Buerger (1994) also do not state clearly what mesh size was used in the 1978 and 1979 excavations. However, we assume that by that time soil flotation as well 6-mm mesh was in use.

Of particular interest to our study is Martin site Feature 12, which Marian White excavated in 1963 (Figures 2, 3). This large feature, roughly circular in plan with a bowl-shaped profile, was surrounded by several postmoulds. Feature 12 measured 1.2 m long, 1.5 m wide and 40 cm deep. Its contents included a notched stone netsinker, an anvil or hammer stone, chert debitage, at least nine utilized flakes, and a biface.

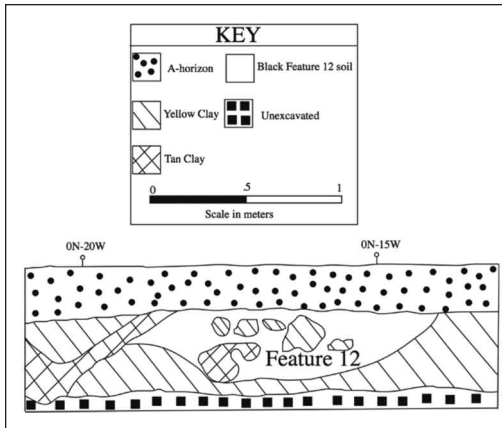


Figure 3. Profile of Martin site Feature 12, facing north. Note: chaining pins indicating the original 5 ft (1.5 m) excavation block and scale in metres. Redrawn from original field sketch (White 1963).

Middle Woodland pottery of coil manufacture with channelized interiors and cord-wrapped stick-decorated exterior dominates the assemblage of 251 potsherds. A small number of later, intrusive artifacts was also recovered from this apparently Middle Woodland period feature, including a few sherds of Late Woodland pottery, a Madison point base, and a few iron nails (Trubowitz 1970a, 1970b). Two Archaic period Brewerton-type projectile points were also found. These were probably intrusive, but may also represent reclaimed artifacts, or unintentional inclusions. The initial faunal analysis indicated the presence of abundant fish bones as well as fewer amphibian, reptile, bird, mammal, and freshwater bivalve specimens (Ellis 1985b).

Two AMS assays were recently obtained from Feature 12 and are reported here for the first time. The dates come from a Middle Woodland cooking pot encrustation, of the dominant type from the feature, and from a walleye vertebra. Artifact ages were calibrated using INTCAL98 (Stuiver et al. 1998). The potsherd encrustation yielded a return of 1900 ± 40 B.P. (Beta-190550). This calibrates to A.D. 100, with a one sigma range of cal. A.D. 70–130, and a two sigma range of cal. A.D.

30–220. The vertebra was assayed to 1890 ± 40 B.P. (Beta-190748), which calibrates to A.D. 110, with a one sigma range of cal. A.D. 70–140 and a two sigma range of cal. A.D. 40–230. These dates suggest that the faunal remains and artifacts from Feature 12 are roughly contemporaneous.

Although clay lenses were mentioned in the Feature 12 excavation field notes, they were apparent neither in excavation photographs nor in profile sketches (Figure 3). Therefore, these lenses may have been intermittent, faint, or disturbed by bioturbation. However, internal feature structure is also suggested by the excavation notes, which mentioned that the faunal material was recovered primarily from the basal area of the feature (White 1963). Thus, based on the dense accumulation of several classes of artifacts and some internal feature stratigraphy, it seems that Feature 12 represents a midden-like deposit, perhaps filled in by multiple discard events over several seasons.

Also potentially significant for our study is Martin site Feature 4, located three metres south of Feature 12. This circular feature with a bowl-shaped profile measured about 15 cm in diameter, and eight centimetres in depth. The feature was filled with charcoal and contained three netsinkers as well as “a large stone of questionable use” (White 1963). All of the stone artifacts from this feature are now missing. Given its setting, it seems possible that this feature represents a hearth, perhaps used to smoke fish. Charcoal from this feature was recently dated using the standard radiometric technique. Also reported for the first time here, this feature dated to $1680 \pm$ B.P. (Beta-190549). Using the INTCAL98 calibration curve (Stuiver et al. 1998), this calibrates to A.D. 390, with a one sigma range of cal. A.D. 330–420 and a two sigma range of cal. A.D. 240–450.

Netsinker Analysis

Background

As discussed above, ethno-historic sources indicate that seine nets were used in the upper Niagara River by both native and non-native peoples during the nineteenth century. Although a variety of

modern seine net types exist, all seine nets are similar in that they essentially act as fences, stopping all fish too large to pass through their mesh. Modern seines range in form from the simple beach seine, which is dragged through shallow water to actively net schools of fish, to the elaborate pound net, which may be set and used passively. Nets such as these are most effective when fish aggregate, such as during spawning (Cleland 1982:774).

The advent of fishnet technology in the Great Lakes region represented an important technological advancement that allowed for the efficient harvest of large quantities of fish. Therefore, the archaeological study of fishnets may provide important insights into pre-contact subsistence practices. However, the development of ancient fish netting technology in the Great Lakes region remains the subject of considerable archaeological debate (e.g., Cleland 1982, 1989; Colley 1990:231-233; Martin 1989; Petersen et al. 1984; Prowse 2003:48; Smith 2004).

Because of poor organic preservation, ancient nets are exceedingly rare archaeological finds in the Great Lakes region. Instead, archaeologists frequently infer the use of fishnets through more common proxy evidence. For example, in some cases faunal data alone might be sufficient to suggest the use of nets. However, this is not useful at sites where no fish remains were recovered. Even at sites with abundant fish bone, inferring the use of nets may be difficult if multiple fishing techniques were employed and the fish remains were commingled (Colley 1987:17-18; Prowse 2008-2009:73). Therefore, the presence of ancient seine nets often must be deduced by the occurrence of the presumably durable artifacts used to “sink” them.

In the late-nineteenth and early twentieth centuries several antiquarians and archaeologists hypothesized that a variety of notched, grooved, and perforated stones of various sizes and shapes were fishing netsinkers (e.g., Abbott 1872:225-226, 1881:237-243, 1884; Beauchamp 1897:75-79; McCall 1912; Rau 1873, 1884:156-157). Function was inferred primarily based upon the riverine and lacustrine context of the majority of their finds, their tendency to occur in caches

(possibly suggesting that they represented the remains of a single net), and ethnographic analogy. Many prominent investigators were apparently convinced that notched stones functioned as sinkers for fishing nets (e.g., Berlin 1900:210-211; Mason 1900:667; Parker 1920:58; Rostlund 1952:87-88, 167-168).

The netsinker hypothesis proved so persuasive that the presence of notched stones alone was often considered sufficient evidence to warrant a net fishing interpretation, even at sites which yielded few or no fish bones (e.g., Madrigal 2001:72; Ritchie 1980:48, 54-58, 129; Ritchie and Funk 1973:346). A dearth of fish bone in faunal assemblages may be at least partially accounted for by a variety of factors, such as differential preservation; biased recovery methods; and ancient processing and disposal activities, which tend to reduce the recovery of fish bones in archaeological contexts (Prowse 2003:70-79).

Yet, not everyone immediately accepted the netsinker hypothesis. Critics pointed to conflicting ethnographic (Babbitt 1888:529; Kent and Nelson 1976:152; cf. Skinner 1909:215; Snyder 1897), archaeological (Cadzow 1936:150-151; Skinner 1921:104; Wren 1914:84), and experimental evidence (Kahler 1956). Other researchers accepted the netsinker hypothesis in principle, but expressed concerns about the diversity of artifacts sometimes subsumed under the netsinker functional designation (e.g., Bressler 1980:45; Kinsey 1972:385; Kraft 1975:114; 1992:14-15, 17). As a result, several investigators proposed alternative functional—and multi-functional—interpretations of certain notched and grooved stones (e.g., Coe 1964:81, Figure 70, Specimen F; Ritchie 1980:185, 308, Plate 106, #16; Smith 1973:20).

For most eastern North American archaeologists, lingering uncertainty about the netsinker hypothesis was apparently “laid to rest” (Cleland 1982:769) by the unique find of a carbonized net fragment associated with “thick, ovate-shaped, natural pebble[s] with notched or grooved ends” excavated from a grave at the Early Woodland period Morrow site in western New York State (Ritchie 1980:186-188; cf. Guthe 1958; White 1957:25). This rare find was considered “even more convincing” (Weston 1978:24) than previ-

ous evidence that notched stones functioned as netsinkers (see also Petersen et al. 1984:202 and Prowse 2003:47, 2008-2009:69). However, we must question how this unique find of *ovate grooved pebbles* associated with a net of unclear function, in a mortuary context, provides conclusive evidence that the relatively common *flat notched stones* found throughout eastern North America functioned in a subsistence context as fishing netsinkers.

Nevertheless, as the netsinker hypothesis became more accepted, several archaeologists turned their attention to scrutinizing notched stone morphology and size using an essentially descriptive and classificatory approach (e.g., Brose 1970:122-126; Granger 1978:117-118, 147, 213, 247, 349, Table A.16; Kraft 1975:112-113, Prowse 2003:49-57, 2008-2009; Weston 1978). To these investigators, relative consistency in shape, size, and notch pattern indicated a netsinker “type.” Consistency and correspondence of metric attributes within types was interpreted to signify priority in selection or creation of those attributes. For example, Brose (1970:124) interpreted a correspondence between notched stone weight and distance between notches to mean that “weight was the principal desideratum in selecting beach pebbles to be used as net-sinkers.” In contrast, Prowse (2008-2009:92) identified a suite of criteria, including material, size, and shape, which formed a “mental template” that defined what constituted an acceptable netsinker.

Despite a growing body of literature describing netsinkers, few functional or experimental studies of ancient fish nets exist (see Hart et al. 2004 and Whalen et al. 2006 for exceptions). Fortunately, although net fishing technology has evolved considerably over the millennia, the physical forces acting upon fish nets—including hydrostatic forces, hydrodynamic forces, gravity, and friction—remain unchanged. Therefore, we may assume that, like modern fishing nets, ancient nets were designed to harmonize these forces (Fridman 1986:48-53, 69-70).

In the case of modern fishing equipment, netsinkers must be neither too light nor too heavy, with the proper weight range determined by the specific technology employed and the hydrologic

conditions present (Fridman 1986). Generally, heavier netsinkers are required to counterbalance relatively buoyant floats and turbulent conditions. Lighter weights are more appropriate for calmer water and less buoyant floats. However, weight is not the only consideration involved in netsinker design. Netsinker shape and material are also important; these are determined by functional, economic, and stylistic considerations (Fridman 1986:66). Designers of ancient fish nets must have faced similar limitations and goals, which may be why archaeologists are able to identify specific netsinker “types” and “mental templates.”

In sum, although the cumulative evidence furnishes “a convincing argument for classifying at least some of these [notched stone] artifacts as netsinkers” (Prowse 2008-2009:69), we still know very little about ancient net fishing. Therefore, we cannot yet definitively conclude that notched stones functioned as netsinkers. Below we will attempt to develop a method for testing the netsinker hypothesis.

Materials and Methods

Artifact collections from the Riverhaven 1, Riverhaven 2, Burnt Ship, and Martin sites examined for this study are curated at the SUNY at Buffalo, Marian White Anthropology Museum. Peace Bridge site netsinkers cited in this study are housed both at the Fort Erie Museum and at the Buffalo Museum of Science. All specimens utilized were notched on as few as one and as many as four sides, and one artifact was chipped all along its periphery. Several specimens were excluded from this study because they were either unmodified or incomplete, including two specimens each from the Riverhaven 1 and Riverhaven 2 assemblages, one from the Burnt Ship site, and 16 from the Martin site. Additionally, only a fraction of the total Peace Bridge site netsinker assemblage was considered in this study because these were the data most easily accessible to the primary author.

This study proposes to examine the relationship of artifacts identified as “netsinkers” to the context of their supposed use. All 57 netsinkers in our sample were weighed to the nearest 0.1 g, grouped by site, and then compared to stream velocities

from adjacent portions of the Niagara River. In so doing, we suggest that if these artifacts were used as netsinkers in these waters, then a correlation will exist between netsinker mass and associated stream velocity. However, we acknowledge that netsinker mass may also correlate to other variables, such as net type (e.g., seine vs. gill net) or weather conditions.

Kathryn Whalen analyzed the netsinkers from the Riverhaven 1, Riverhaven 2, and Burnt Ship sites. The senior author performed the netsinker analyses for the Martin site and for the Peace Bridge site collection at the Buffalo Museum of Science. Shari Prowse (personal communication 2006) generously provided the weights of three Peace Bridge site netsinkers curated at the Fort

Erie Museum for use in this study.

Stream velocities were taken from a model provided by the US Army Corps of Engineers (USACE 2006). The model plots high, medium, and low stream velocity for the centre channel of the upper Niagara River. Velocity corresponds to seasonal fluctuations, with the highest flows occurring in the spring as the snow melts. Using these data may be somewhat misleading, in that many fishing nets were likely deployed in shallower water along the river's edge or perhaps in an embayment or eddy, where the velocity was not as great. Further, upper Niagara River hydrology has changed considerably over the past several millennia. Still, as a proportional measure for the purposes of this study, we believe the model to be useful.

Table 2. List of complete netsinkers by ascending mass.

Catalogue #	Mass (g)	Catalogue #	Mass (g)	Catalogue #	Mass (g)
Riverhaven 1^a		Burnt Ship^a		Martin^a	
64.14/3029	93.8	64.13/233	102.0	–	25.5
64.14/3056	104.8	78.11/47618	114.0	63.7/ 6176?	34.0
64.14/3028	140.9	64.13/237	153.9	63.7/ 5990	143.3
64.14/3057	142.7	64.13/239	167.7	–	184.3
64.14/3055	162.8	64.13/236	170.0	63.7/ 6292 ^c	192.8
64.14/3049	219.3	64.13/234	183.3	63.7/ 6256	198.5
64.14/3031	219.9	64.13/240	183.8	63.7/ 6072	221.0
64.14/3050	249.3	64.13/230	227.8	63.7/ 5896	224.2
Riverhaven 2^a		64.13/228	229.4	63.7/ 6299	237.1
64.15/1201	161.3	64.13/227	234.9	63.7/ 5898	314.0
64.15/1228	191.1	64.13/238	281.4	63.7/ 6006	322.5
64.15/1227	231.5	Peace Bridge		63.7/ 6289	324.3
64.15/1223	263.3	C17961 ^b	116.7	63.7/ 5895	387.0
64.15/1211	264.0	C17962, no. 1 ^b	132.8	63.7/ 6256	453.6
64.15/1219	289.5	0.0098 ^c	150.4	63.7/ 5872	456.4
64.15/1192	312.6	C175505 ^b	179.8	63.7/ 5876	462.1
64.15/1188	385.5	C17962, no. 2 ^{b,d}	214.9	63.7/ 5892	467.8
64.15/1232	405.7	0.0012 ^c	227.9	63.7/ 6278	635.0
64.15/1218	470.8	0.0040 ^c	463.9		
64.15/1176	471.1	C4947 ^b	721.3		
64.15/1231	486.4				

^a SUNY at Buffalo, Marian White Anthropology Museum

^b Buffalo Museum of Science

^c Fort Erie Museum

^d specimen not notched, but chipped around the periphery

^e specimen recovered from Feature 12 of the Martin site

Three sites in our sample—Riverhaven 1, Riverhaven 2, and Burnt Ship—are situated adjacent to creeks with known spawning runs (NYSDOS 1987 a,b). Although there are no published velocity measurements for these creeks, they are clearly miniscule compared with the mighty Niagara. Therefore, if the netsinkers from these sites were used in the adjacent creeks, we would expect their average mass from these sites to be significantly less than the average for the upper Niagara River.

Results and Conclusions

Table 2 lists the masses of individual netsinkers grouped by site provenience and Figure 4 plots these data against the water velocities for the adjacent section of the Niagara River. Table 3 and Figure 5 illustrate the relationship between the mean and median netsinker mass from each site and associated water velocities. Generally, these figures and tables convey similar information, though the trends are less noticeable in the latter, which, as a process of averaging, smoothed out the mass profiles.

Interestingly, the Riverhaven 2 assemblage has the greatest average netsinker mass, despite the fact that the Peace Bridge and Martin sites produced the heaviest individual specimens. The netsinker mass profiles from the Peace Bridge, Martin, and Riverhaven 2 sites are very similar, and they appear to have a relationship to the stream velocity in the adjacent section of the Niagara River. These data suggest that the Peace Bridge, Martin, and Riverhaven 2 netsinkers were viable netsinkers given current conditions in the Niagara River channel. The netsinker mass profiles of Martin and Peace Bridge appear to be the most similar. The Peace Bridge and Martin sites are the only sites in our sample that produced netsinkers with masses exceeding 600 g. These data further suggest that netsinkers from both sites were used in similar, possibly turbulent conditions—perhaps to capture fish that spawn in the spring when Niagara River flows would be at their greatest.

In contrast to the other site assemblages in our sample, the Riverhaven 1 and Burnt Ship site

Table 3. Average netsinker mass and adjacent Niagara River stream velocity.

Site	Netsinker Mass (g)		Adjacent Water Velocity (m/s)		
	Mean	Median	High	Average	Low
Riverhaven 1	190.9	152.8	0.79	0.69	0.56
Riverhaven 2	327.7	301.1	0.92	0.80	0.65
Burnt Ship	186.2	183.3	0.60	0.52	0.41
Peace Bridge	276.0	197.4	2.69	2.46	2.16
Martin	293.5	275.6	0.65	0.58	0.50

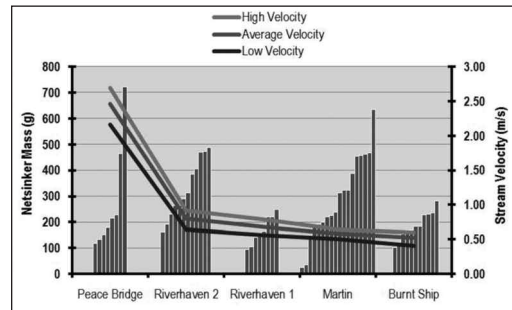


Figure 4. Niagara River netsinker mass profile vs. adjacent stream velocity.

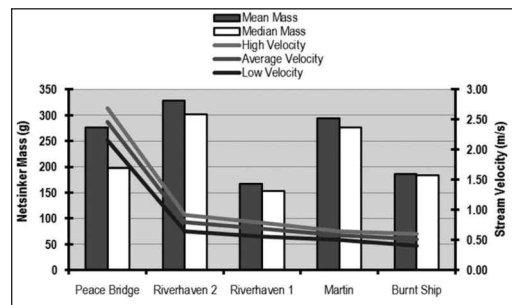


Figure 5. Niagara River netsinker average mass vs. adjacent stream velocity.

netsinkers do not correlate well with Niagara River stream velocities. They are much lighter on average, and none are more massive than 300 g. These data suggest that they may have been used in a slow-moving water setting, such as a marsh or small creek. The most likely location of use for the Riverhaven 1 netsinkers then appears to be the adjacent Spicer Creek, and the Burnt Ship site netsinkers were likely used in the neighbouring backwater of Burnt Ship Creek.

To conclude, a correlation appears to exist between netsinker mass and hypothesized location and conditions of use. However, our small sample size may be an issue. Ideally, only netsinkers found in caches—which may represent the remains of individual nets—should be compared. Because no such caches exist in our sample, we lumped together all netsinkers from the same site. However, these sites were recurrently occupied for thousands of years, during which time new fishing methods developed and hydrologic conditions fluctuated.

Chipped Stone Artifact Analysis

Background

Often in archaeology one must infer the presence of something based on indirect evidence. Such is the case with certain types of chipped stone artifacts, which, although not used directly to catch fish, may provide indirect evidence of fishing and fish processing. Here we briefly discuss a few types of chipped stone tools with possible fishing associations.

Historically, fish spears and harpoons are well documented in the upper Niagara River. Considerable antiquity is suggested for this pattern by bone and antler harpoons recovered from several pre-contact sites in the eastern Great Lakes region (e.g., Beauchamp 1901:306-308; Rostlund 1952:178)—including one specimen from the Riverhaven 2 site (Ritchie 1980:186-187, Plate 65; cf. Granger 1978:227-228). However, the simple wooden spears and harpoon shafts that were undoubtedly also present in antiquity suffer from preservation bias and are archaeologically absent. Fortunately, the lithic spoke-shaves likely used in their manufacture may provide indirect evidence of this type of fishing and should not suffer the same preservation bias (Kullen et al. 1996:184; cf. Kooyman 2000:102).

Fish cleaning generally consists of three actions: eviscerating, decapitating, and scaling. Pre-contact fish scaling in the Great Lakes region is often associated with unifacial tools (e.g., Buerger 1992:28; Fitting 1968:130; Granger 1987:122-124, 149, 218, 247, 249; Kullen et al. 1996:172-173; Purtil 2001:159; Taggart 1967:165). Evisceration and decapitation may have been accomplished with a

simple, unmodified blade (Buerger 1992:28) or flake (van Gijn 1986:15), but a formal bifacial knife is also a possibility. However, microscopic use-wear studies confirming the ancient utility of chipped stone artifacts for fish processing are rare in the Great Lakes region (for an exception see Purtil 2001:159).

Materials and Methods

For our study, Perrelli examined all available chert debitage ($n = 582$) from Martin site Feature 12. We focused on three functional types of flake tools: spoke-shaves (i.e., flakes with semi-circular concavities or deep, steep-edged notches), unifacial tools (i.e., flakes with a straight, unifacial, and steep-edged retouch or use area), and blades (i.e., long, narrow, sharp-edged flakes).

The chipped stone assemblage was first size-sorted by sifting it through different-sized wire mesh screens. Micro flakes are defined as those flakes that passed through all mesh sizes including 6-mm mesh, small flakes as those that passed through 12-mm mesh but were trapped by 6-mm mesh, large flakes as those that were trapped by 12-mm mesh, and macro flakes as those that were trapped by 25-mm mesh. The flakes were examined without magnification. Nine flakes identified by prior analyses as retouched and/or utilized were not size-sorted.

Results

Results of this cursory inspection show the nine previously identified retouched and utilized flakes to be just that—pieces that are likely flake tools with little modification, reflecting short-term use and probable discard in or near their place of manufacture and use. Size sorting resulted in the identification of 43 micro, 328 small, 178 large, and 24 macro flakes. Macro flakes includes 3 (12.5 percent) generalized retouched/utilized flakes, 1 steep-sided retouched flake (4.1 percent), and 1 spoke-shave flake (4.1 percent). Large flakes yielded 2 (1.1 percent) specimens classifiable and spoke-shaves, 1 (0.6 percent) as a steep-edged retouched flake, and 16 (9.0 percent) generalized retouched/utilized flakes. Two (1.1 percent) utilized blades were also identified. Other size classes were not examined. This preliminary study shows

no concentration of tools assumed to be associated with fishing and fish processing in this location.

In terms of lithic technology and reduction techniques, the assemblage consists primarily of amorphous core reduction flakes and likely contains many objects used as tools but bearing no outward signs of use. Very low numbers of bipolar flakes and cores, biface thinning flakes, and blades from blade-cores were noted. Cortex on flakes was common, and most flakes appear to be from locally available chert cobbles.

Zooarchaeological Analysis

Overview

All of the five pre-contact sites in our sample have produced faunal assemblages, although not all have been analyzed. In the following section, we briefly review the existing zooarchaeological data. The best studied sample comes from the Martin site, followed by the Peace Bridge site, both of which we present for comparison. Little information is available on the fish assemblage from Riverhaven 2, and faunal collections from Riverhaven 1 and Burnt Ship sites have not yet been analyzed. For comparison we summarize modern fish populations near the five sites in our sample (Table 4).

Radiocarbon-dated deposits of fish bones from the Martin and Peace Bridge sites speak to the significance of the upper Niagara River fishery, especially the walleye fishery, during the Middle Woodland period. The Martin site Feature 12 assemblage appears to reflect subsistence activities conducted during the early Middle Woodland period, whereas the Peace Bridge site Feature 158 assemblage dates to the transition from the Middle to Late Woodland. In both features, walleye is decisively the most important species, based on proportions of archaeological remains. This finding is noteworthy in light of some recent fish population studies, which indicate that walleye are not found in significant numbers in the upper Niagara River. On the contrary, species other than walleye dominate the modern recreational fishery, including largemouth bass, smallmouth bass, northern pike, yellow perch, and muskellunge (Normandeau Associates 2005:3.56-3.75; NYS-DOS 1987 a-d).

Materials and Methods

The following analysis is based on fish remains from Feature 12 (Figures 2 and 3), which was excavated in 1963 by Marian White. Feature 12 produced approximately 959 fish bone specimens. Thomas (2004, 2006) examined close to 85 percent of these, of which 662 specimens were identified to an analytically useful taxonomic level, usually genus or species. Of the 146 remaining specimens, 24 identified to skeletal element still provide information relevant to body portion representation. Preservation was fair, with bone cortex intact but noticeably weakened, and breakage the major impairment to taxonomic identification and osteometry. Some good preservation exists, with cortex fairly hard, and breakage a minor limitation. The frequency of root damage was low. Although details of excavation methodology remain unclear, excavators in 1963 likely recovered specimens from feature soils by the trowel and grab method and/or with 8-mm mesh screens. Hence, some degree of recovery bias likely limits the representation of the remains of smaller fish, small fragments, or smaller elements of larger fish.

Thomas (2004, 2006) analyzed the zooarchaeological materials by using comparative osteology collections at Bioarchaeological Research and the Royal Ontario Museum (ROM). The ROM reference collections are particularly strong on fish. The analysis includes certain postcranial serial elements, including vertebrae, spines, and pterygiophores. These are excluded from some faunal studies because they are not as distinctive and as easy to identify taxonomically as are the major cranial bones, and they are less useful for estimating the minimum number of individuals (MNI) per taxon. We include them here because the vertebrae may provide information relevant to age at death and seasonality, and because this entire set of bones may provide information about body portion representation and carcass processing.

Units of quantification include the number of identified specimens (NISP) and MNI per taxon. When broken pieces of the same bone were encountered, or when two or more bones were found articulated together, they were treated as a single specimen and allocated a single catalogue

Table 4. Upper Niagara River archaeological fish assemblage data (quantified by NISP) vs. modern fish communities.

Common Name	Taxon	Riverhaven 2 ^a		Burnt Ship		Peace Bridge ^b		Martin ^c		
		Modern Habitat ^a	Whole Site ^b	Modern Habitat ^a	Whole Site ^c	Modern Habitat ^a	Whole Site ^c	Modern Habitat ^a	Whole Site ^d	Feature 12 ^d
Lake Sturgeon	<i>Acipenser fulvescens</i>	-	0	-	+	S	+	-	26	2
Cisco, or Lake Herring	<i>Coregonus artedii</i>	-	0	-	-	-	-	-	0	0
Grass Pickerel/small N. Pike	<i>Esox sp. (small)</i>	-	0	-	-	-	-	-	0	1
Northern Pike	<i>Esox lucius</i>	S	0	S	-	S	-	S?	0	0
Northern Pike/Muskellunge	<i>Esox lucius/masquinongy</i>	-	0	-	-	-	-	-	0	1
Muskellunge	<i>Esox masquinongy</i>	H	0	H	-	H	-	S	2	0
White Sucker	<i>Catostomus commersoni</i>	H	0	H	-	-	-	-	0	0
Sucker	<i>Catostomus sp.</i>	H	5	-	+	-	+	-	0	0
Bigmouth Buffalo	<i>Ictiobus cyprinellus</i>	-	0	-	-	-	-	-	0	1
Redhorse Sucker	<i>Moxostoma sp.</i>	-	0	-	+	-	+	-	0	1
Sucker or Redhorse Sucker	<i>Catostomidae sp.</i>	-	0	-	+	-	+	-	0	3
Bullhead	<i>Ameiurus sp.</i>	H	13	H	+	-	+	-	0	1
Catfish ^b	<i>Ameiurus [sic] sp.</i>	-	11	-	-	-	-	-	-	-
Channel Catfish	<i>Ictalurus punctatus</i>	-	0	-	+	-	+	-	134	25
Burbot	<i>Lota lota</i>	-	0	-	-	-	-	-	0	7
White Bass	<i>Morone chrysops</i>	-	0	-	+	H	+	-	10	22
Rock Bass	<i>Ambloplites rupestris</i>	H	0	H	-	H	-	-	0	0
Smallmouth Bass	<i>Micropterus dolomieu</i>	-	0	-	-	H	-	S	7	7
Largemouth Bass	<i>Micropterus salmoides</i>	-	0	-	-	-	-	S	7	2
Large- or Smallmouth Bass	<i>Micropterus sp.</i>	-	0	-	-	H	+	-	0	9
Black Crappie	<i>Pomoxis nigromaculatus</i>	H	0	H	-	-	-	-	0	0
Yellow Perch	<i>Perca flavescens</i>	-	0	H	-	H	-	S	0	0
Sauger	<i>Sander canadensis</i>	-	0	-	-	-	-	-	0	7
Walleye	<i>Sander vitreus/Sander sp.</i>	-	0	-	-	H	+	-	1,088	495
Freshwater Drum	<i>Aplodinotus grunniens</i>	-	7	-	+	-	+	-	231	81
Total			36					142	+	665

^a Symbols denoting modern fish communities: S = area is used for spawning; H = general habitat. Modern habitat data from NYSDOS (1987 a-d) and Goodyear et al. (1982;[10]). Recently introduced species are not included.

^b Riverhaven 2 NISP data come from Granger (1978:231;Table 5.21). Note the nomenclature “Catfish, *Ameiurus [sic] sp.*” used in Granger (1978) is ambiguous and outdated. We believe that “*Ameiurus sp.*” likely refers to channel catfish (*Ictalurus punctatus*).

^c Peace Bridge whole site presence (+) and absence (-) data only includes the sample discussed by Thomas (1997a:441-475) and excludes trace species and the assemblage from Feature 158 (Thomas 1997a:481).
^d Martin whole site NISP data (Zubrow and Bueger 1994, citing Ellis 1985a) cover about half of the entire site, including an unknown amount from Feature 12. Martin Feature 12 NISP data (Thomas 2004) include about 85 percent of the fish specimens in that feature. Thomas’ figures combine positive identifications (*Ameiurus nebulosus*) with probable identifications (*A. cf. nebulosus*) for brevity’s sake. Osteometric and morphological evidence indicates that most specimens identified as *Sander sp.* in the Martin Feature 12 and Peace Bridge Feature 158 analyses are walleye, not sauger.

number. This procedure tends to reduce NISP values slightly. MNI values were estimated taking into account element duplication and developmental traits, including size, following Bökönyi (1970) and Chaplin (1971:70-75). This procedure tends to produce results which approximate more closely the numbers of carcasses actually represented in the collection than does White's method, which uses element duplication for the most commonly occurring bone per species (1953).

Osteometry is useful both for MNI calculation (Chaplin 1971:73-75) and for estimating the sizes of animals represented in a faunal assemblage (cf. Bowdler and McGann 1996; Casteel 1974). Selected bones of the better-represented fish species and all fish vertebrae in sufficiently good condition were measured (Thomas 1994-2008).

The taxonomy used in this report generally follows Mandrak and Crossman (1992), with one exception: in 2004 the American Fisheries Society

changed the binomial designation for the genus *Stizostedion* to *Sander* (Nelson et al. 2004:234). Anatomical terminology generally follows Rojo (1991), supplemented by Rojo (2002).

Results

The analysis results are summarized in Table 5 in the form of both NISP counts and MNI estimates. Table 5 includes two columns of NISP figures. The first column excludes postcranial serial elements. It provides NISP data that are compatible with studies that omit these elements. The second column presents the complete counts, including the serial elements. NISP values are drawn from the second column in the following discussion.

Logically, the recovered fish assemblage would represent but a fraction of what was originally deposited. Faunal remains are ephemeral relative to lithic and ceramic artifacts. Because fish bones are generally more fragile than bones of mammals,

Table 5. Martin Feature 12 fish assemblage specimens identified to useful taxonomic level.

Common Name	Taxon ^a	NISP without Serial Elements	NISP with Serial Elements	% NISP with Serial Elements	MNI	% MNI
Lake Sturgeon	<i>Acipenser fulvescens</i>	2	2	0.3	1	1.4
Grass Pickerel/small N. Pike	<i>Esox</i> sp. (small)	1	1	0.2	1	1.4
Northern Pike or Muskellunge	<i>Esox lucius/masquinongy</i>	0	1	0.2	1	1.4
Bigmouth Buffalo	<i>Ictiobus cyprinellus</i>	0	1	0.2	1	1.4
Greater Redhorse	<i>Moxostoma valenciennesi</i>	1	1	0.2	1	1.4
Brown Bullhead	<i>Ameiurus nebulosus</i>	1	1	0.2	1	1.4
Channel Catfish	<i>Ictalurus punctatus</i>	22	25	3.8	3	4.3
Burbot	<i>Lota lota</i>	1	7	1.1	1	1.4
White Bass	<i>Morone chrysops</i>	8	22	3.3	3	4.3
Smallmouth Bass	<i>Micropterus dolomieu</i>	7	7	1.1	3	4.3
Largemouth Bass	<i>Micropterus salmoides</i>	2	2	0.3	1	1.4
Large or Smallmouth Bass	<i>Micropterus</i> sp.	5	9	1.2	–	–
Sauger	<i>Sander canadensis</i>	7	7	1.1	3	4.3
Walleye	<i>Sander vitreus</i>	129	131	19.8	42	60.9
Walleye or Sauger	<i>Sander</i> sp.	223	364	55.0	–	–
Freshwater Drum	<i>Aplodinotus grunniens</i>	32	81	12.2	7	10.1
Total		441	662	100.	69	100.0

^a For clarity and brevity, probable identifications (e.g., *Sander* cf. *vitreus*) have been merged with positive identifications (e.g., *Sander vitreus*).

birds, and reptiles, they are also more vulnerable to taphonomic stress. Several factors would have reduced bone preservation at the Martin site, and each would have had a greater impact on fish remains. Trampling underfoot by the site occupants would have taken a toll on faunal remains exposed on the ground surface. Scavenging animals damage, destroy, and disperse unburied faunal remains. The seasonal nature of this temporary fishing camp, possibly revisited over many decades, would have afforded carnivores and rodents unrestricted access to midden debris during the greater part of the year when Martin was unoccupied. Burrowing animals and frost action can cause mechanical damage to bone, and even slightly soil acids can cause chemical deterioration.

It follows that any one fish bone that came to rest in the essentially midden-like deposits of Feature 12 would have a low probability of surviving the various forms of taphonomic stress. Put another way, in the absence of evidence to the contrary—such as field-noted observations of articulated groups of bones—it seems safe to assume that relatively few of the recovered fish bone specimens were derived from the same carcass as other specimens (cf. Perkins 1973:367). This is not to say that the collection contains no sets of two or more fish bones derived from the same carcass. That possibility certainly exists. However, given the nature of the deposit and the fragility of the specimens, it seems likely that such cases are uncommon, and that they would involve a relatively small portion of the total assemblage.

The genus *Sander* (walleye and sauger) dominates the assemblage, accounting for 502 specimens, or ca. 76 percent of all specimens identified to a useful taxonomic level. Nearly three quarters of the specimens in this taxon ($n = 364$) were identified only as far as the genus level. This is due in part to the morphological similarity of walleye and saugers, together with problems inherent in working with partial bone specimens. Also, to simplify the process of working with postcranial serial elements, no attempt was made to identify the 143 postcranial serial elements beyond the genus level.

Potentially, there are three members of the genus *Sander* of concern here: the yellow walleye,

the blue walleye, and the sauger. Less than a third of the *Sander* specimens were identified to species, but two lines of evidence suggest that most of specimens identified only to genus level ($n = 364$) are attributable to walleye rather than sauger. First, considering specimens that are identified to species level, walleye decisively exceeds sauger. The ratio of walleye to sauger is more than 18:1 by NISP and 14:1 by MNI. Second, carcass length estimates indicate that most individuals were larger than the size range documented for modern sauger.

According to current fisheries data, the average yellow walleye ranges from 330 to 508 mm long (Scott and Crossman 1979:767). Trautman provides a wider range for mature adult yellow walleyes in Lake Erie: 279 to 760 mm (Trautman 1981:609). The blue walleye was smaller, from 305 to 356 mm (Scott and Crossman 1979:772). Like the yellow walleye, Lake Erie blue walleye used to occupy a large size range vis-à-vis the general population, from 230 to 406 mm (Trautman 1981:612). The average sauger ranges from 254 to 406 mm (Scott and Crossman 1979:762).

Body length (in this case, Total Length) estimates for Martin site Feature 12 *Sander* were calculated for the most commonly occurring measurable bone, the dentary—the bone that comprises the anterior part of the lower jaw. The body size estimation method used was summarized by Thomas and Ingleman (2010, 2011) and will be further described in a forthcoming technical publication. Briefly, the method involved comparing of measurements of disarticulated dentaries from walleye of known length to *Sander* dentaries from Feature 12. The specific measurement used was the height of the dentary at the symphysis. Seventy eight dentaries were intact enough to measure. The results are presented in Figure 6. Body lengths of most of the individuals represented in the assemblage fell into the 400 to 590 mm range, and more than 95 percent equalled or exceeded 400 mm. This line of evidence suggests that if the blue walleye has a presence in the assemblage, it is minimal. Also, these specimens appear to have been too large to represent sauger. However, because dentaries of sauger with known sizes were not also measured, it

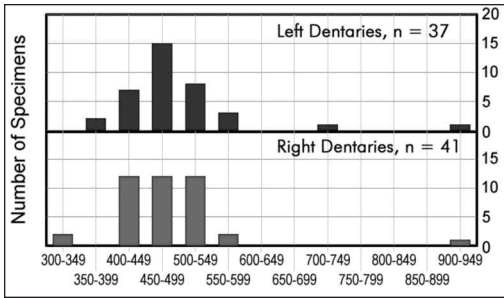


Figure 6. *Martin site Feature 12 distribution of fish Total Length estimates for Sander sp. based on height of dentary symphysis.*

is possible that sauger and walleye dentaries may correlate differently with body size.

Because the genus *Sander* dominates the assemblage, much of the human activity reflected in the assemblage was likely directed towards these fish, and behavioural aspects of the members of this genus may relate to fishing methods and season of procurement. The yellow walleye is adapted to turbid waters. Yellow walleye can also do well in clear water, although their visual adaptation to low light conditions typical of turbid water would limit feeding to dusk and dawn. In riverine contexts they are found in water sufficiently deep and turbid to provide shelter from bright sunlight, to depths of 15 m (Scott and Crossman 1979:772). They are reported to prefer slow moving streams (Stone 1948:55). Blue walleye preferred deep lacustrine habitat, and, in the same water body, they are generally found at greater depths than the yellow walleye. In Lake Erie, blue walleye were more concentrated in the deeper, eastern half (Stone 1948:54; Trautman 1981:613). The sauger is primarily a lake fish adapted to water turbid with suspended clay particles, but it also can live in large, slow flowing rivers (Scott 1976:101; Scott and Crossman 1979:765). In Lake Erie, it is more abundant in the western portion, which has siltier conditions (Trautman 1981:605).

In Lake Erie, the yellow walleye spawns at night, sometimes close to shore in less than 0.9 m of water. In riverine contexts, it spawns in rapids, reefs, and shoals over bottoms of boulder, rock, or gravel. The average spawning period for Lake Erie is from mid- through late-April (Stone 1948:54

55; Scott and Crossman 1979:771). The blue walleye spawned further offshore, in deeper water than the yellow walleye, usually at depths from 9.0–27.4 m, and generally preferred the deeper end of that range. They usually spawned two weeks after the yellow walleye, from mid-May until the beginning of June (Stone 1948:54, 136). The sauger spawns in turbid lakes and rivers at depths ranging from 0.6–3.7 m. They sometimes spawn over the same gravel and rubble shoals as walleye. They spawn after walleye, usually from late-May through early June (Scott and Crossman 1979:763).

Taxa of secondary importance in the assemblage include freshwater drum, channel catfish, and white bass, in decreasing order. Together they account for 19.3 percent of identified specimens and 18.9 percent of the MNI total. All are abundant in Lake Erie. The freshwater drum inhabits shallows of large water bodies (Scott and Crossman 1979:815). In Lake Erie they tend to live between 1.5–18 m. This may be deeper than the other secondary species, but in warm weather freshwater drum move into shallows to feed at dusk (Trautman 1981:699). In riverine contexts, the channel catfish tends towards the deeper localities with rocky to sandy bottoms (Scott and Crossman 1979:608; McAllister and Coad 1974:126). The white bass tends to occupy large lakes and rivers in areas with firm bottoms out to 6 m. They swim in schools and come inshore to feed at dusk (Werner 1980:147).

These species spawn later in the year than do walleye. Schools of white bass in Lake Erie spawn from May into June over gravel or rubble bottoms. The spawning period lasts 5 to 10 days (Scott and Crossman 1979:690–691; Werner 1980:147). Channel catfish spawn from the late-spring onward into the summer. In riverine contexts, spawning occurs over rocks or logjams, or in undercuts (Scott and Crossman 1979:607). Freshwater drum in Lake Erie spawn in July, sometimes on into September. Bottom conditions may not be a major influence in spawning location for this species because the eggs float rather than drop to the bottom (Scott and Crossman 1979:813–814).

Eight other minor taxa account for 4.8 percent of the identified specimens (n = 32). Most promi-

ment in this group is the genus *Micropterus*, accounting for 9 specimens identified as smallmouth or largemouth bass, and 9 specimens identified only to the genus level. This taxon accounts for 2.7 percent of the identified specimens and 5.8 percent of the MNI total. Seven other taxa—lake sturgeon, grass pickerel or small northern pike, northern pike or muskellunge, bigmouth buffalo,⁵ greater redhorse, brown bullhead, and burbot—account for 2.1 percent of identified specimens and 10.2 percent of the MNI total. All are native to Lake Erie, if not the upper Niagara River.

Walleye Exploitation. The walleye that dominate the Martin site Feature 12 fish assemblage have considerable potential as a subsistence resource. Even today it is one of the most economically valuable freshwater fish in northeastern North America (Scott and Crossman 1979:773-774; Trautman 1981:610).

Two aspects of the data strongly suggest that the Feature 12 walleye were taken by some mass procurement technique: (1) the taxonomic focus in the analyzed assemblage, and, considering the negative preservation bias relating to fish bone, (2) the sheer amount of walleye remains. For people lacking mass capture fishing technology adapted to offshore situations, such as large, depth-adjustable gill nets, the species' preference for relatively deep water habitat would limit access to large quantities of walleye to two seasons when they would be available close to the surface in shallow water.

Walleye migrate to inshore waters and tributary

streams in the spring to spawn (MacCrimmon and Skobe 1979:106-107, 111; Scott and Crossman 1979:771; Stone 1948:54-55). Data for Lake Erie place the spawning period between the tenth and thirtieth of April (Stone 1948:54), or the early part of mid-spring. A potential second opportunity for mass exploitation would be in fall, when they move to near-shore waters in response to cooler temperatures and food availability (MacCrimmon and Skobe 1979:106-107, 109; Trautman 1981:613).

Walleye could be taken by mass capture techniques at either time of year. Potential methods might include the seine nets drawn through the shallow water, or configured as pound nets. By Middle Woodland times people in the Great Lakes area are thought to have possessed the necessary cordage, net-making, and fishing technology (Cleland 1982:773-774). Of course walleye could also have been taken using less advanced technology, with individual capture techniques employing spears, leisters, and angling equipment, but with less efficiency in terms of fish caught per fishing day.

Of the two potential windows of opportunity, the first seems most probable on the assumption that spawning would occasion denser concentrations of fish, and that the times and locations would be more predictable. To test this hypothesis, we examined incremental structures in fish vertebrae in an attempt to learn something of the age composition of the prey population represented in the Feature 12 assemblage, and, secondarily, to learn what we could about the season of capture (Thomas 2006).

Walleye Vertebra Analysis: Age and Season of Capture. If the walleye were procured during seasonal spawning events, the fish remains should reflect a primarily mature population; if procurement occurred at another time or times of year, the subadult portion of the prey population should be well represented. We examined 122 *Sander* sp. vertebrae with a Bausch and Lomb ZS4 stereo zoom microscope, continuously adjustable from 10 to 30X, using a narrowly focused beam of light to emphasize subtle surface

⁵ Thomas (2004, 2006) identified a single anterior caudal vertebra of a bigmouth buffalo (*Ictiobus cyprinellus*) (specimen 147278). This identification must be regarded with caution because ichthyologists have not reported a natural population of bigmouth buffalo fishes in the Niagara River (Carlson and Daniels 2004:115; Smith 1985). However, bigmouth buffalo fishes may have been present in western Lake Erie (Scott and Crossman 1979:558; Trautman 1981:408, 411, 414). Pending further study, the specimen could conservatively be considered a large catostomid (Catostomidae sp., large).

contours. To achieve a better play of light on the concave articular surfaces of the vertebrae, we cast over half of the specimens, either with water soluble latex or Plasticine. Both techniques, particularly the former, made it easier to discern annual patterning in the series of annular rings.

Observer error may be reduced by rejecting specimens with attributes that are either ambiguous or that are obscured by post-depositional damage. Of the 122 vertebrae examined, a large number were rejected because of ambiguous annular patterns, particularly vertebrae in the anterior trunk and posterior caudal regions. While ambiguous annular patterning was a concern in both the seasonality and minimum age at death studies, it caused more rejections in the latter. A number of vertebrae were rejected because of damage to the rims of articular surfaces. Rim damage was a greater concern in the seasonality study because here the relative widths of the last two rings were the critical factors.

The basis for age estimation from annular rings in fish vertebrae is described by Rojo (1987:216-219). Evaluating incremental growth structures can be confusing, particularly in smaller elements such as vertebral centra, where annual increments or rings can be crowded. Ambiguity may be caused by several naturally occurring events. An episode of unusually poor growth conditions can alter the potential size of the annual ring formed during the rapid growth phase. Severely adverse conditions, physical injury, and disease during the rapid growth phase can temporarily halt growth, creating a false annulus in midseason.

To increase data reliability in the age at capture study, patterns were interpreted conservatively, in favour of the youngest secure age. Beyond this, categories were used that incorporated degrees of ambiguity, for example five, five to six, five to seven. In Figure 7, these categories were collapsed into a single group: "equal or greater than five." The use of categories with this kind of ambiguity was consistent with our objective, which was to ascertain the relative proportions of sexually mature and immature individuals in the prey population. If the task were to construct a conventional age at death profile, we would have rejected more vertebrae than we did. As it was,

only seven specimens were rejected because the annular patterning was too ambiguous or faint.

The actual age at death for a specimen in Figure 7 equates to the annual ring count plus one due to the fact no trace of a first year annual ring was observed in the assemblage. This result is not surprising. In Lake Erie, the length of a yearling yellow or blue walleye would be about 10 cm (Adamstone 1922:82). Its vertebrae would be minute. It appears that traces of the first annual ring either are resorbed or become obscured by subsequent bone formation as the fish ages.

The age range represented by the analyzed vertebrae seems to be consistent with a mature, spawning population within the context of walleye from Lake Erie and, hence, the upper Niagara River. In Canada walleye can be found in Lake Erie in the south, to above the Arctic Circle in the north. Males reach maturity at two to four years while females attain maturity at three to six years (Scott and Crossman 1979:770, 772). Since walleye populations tend to mature earlier in a warmer climate (cf. Jenkins and Burkhead 1994:769), we may expect that walleyes in the southern Great Lakes region would tend to reach maturity at the early end of the range Scott and Crossman give for Canadian walleye. Our results indicate that all of the Feature 12 walleye vertebrae that we could evaluate come from individuals that were at least four years old. Approximately 85 percent of the specimens reflect individuals aged five years and older. Roughly half reflect individuals aged at least six years.

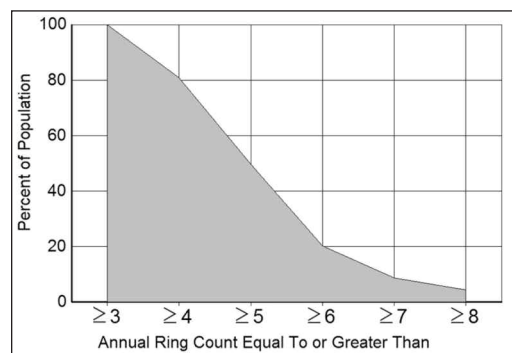


Figure 7. *Martin site Feature 12 Sander sp. central trunk vertebrae incremental age profile.*

Next, if the walleye in the Feature 12 assemblage were procured while spawning, the season of death might be reflected in the terminal rapid growth phase increment. Basically, the season in which the fish died is estimated by comparing the width of the terminal rapid growth phase ring to the width of the ring formed in the previous year. Ideally, a death early in the year should leave a narrow rapid growth phase ring, while a death later in the year should leave a wider ring (Casteel 1976:65-66). While Wheeler and Jones (1989:157) dismiss the method, the theory behind it has been tested and found to be sound (Morey 1983), and it has been accepted by ichthyologists (cf. Rojo 1987:220-221). In our case precision is limited—values were determined subjectively, not with instrumentation. Still, we ought to be able to tell whether there is or is not a trend in the data. While the results from any one specimen may be misleading, a trend shown by the majority of specimens may be inferentially useful. If there is a trend, it should be possible to tell whether it occurs towards the beginning or the end of the rapid growth phase.

The results for 73 useable *Sander* vertebrae are presented in Figure 8. There is a trend: 52 percent of the vertebrae have a terminal ring no greater than a third of the width of the previous ring (n = 38), and 90 percent of the vertebrae have a terminal ring no greater than a half of the width of the previous ring (n = 66). While these data are inconsistent with a pattern of autumn fishing, it is not quite what was expected for a spring scenario. One problem is lack of knowledge about when the rapid growth phase starts for walleye, and how the growth rate itself might vary through the warm season. The pattern shown in Figure 8 might actually fit well if growth was more rapid at the beginning of the spring, when walleye were gathering energy for spawning, and then tapered off.

Martin Site Function: Primary Capture and Processing Location. The walleye remains in the Feature 12 assemblage probably represent fish caught locally rather than at a remote location. Ethno-archaeological research indicates that when large quantities of fish are caught at a remote fish-

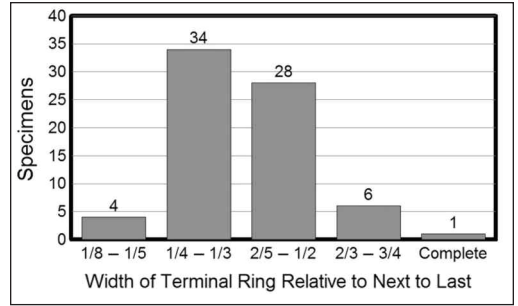


Figure 8. *Martin site Feature 12 Sander sp. seasonality, based on the outer rings of the central trunk vertebrae.*

ing camp for consumption elsewhere, they are generally prepared for transport by gutting, decapitating, and drying. This preserves the fish, making the whole operation practical, and increases the payload value relative to transportation costs. Pre-transport processing alters the patterns of body part representation in fish remains deposited at the fishing station and the recipient location. Fish processing debris at the fishing camp tends to have a larger component of cranial bone relative to vertebrae. The remains of transported fish that are deposited at the recipient site tends to have relatively fewer cranial bones, while the vertebrae, which tend to be carried along with the dried fish fillets, will be well represented (Butler and Chatters 1994:413; Sandweiss 1996:53; Stewart and Gifford-Gonzalez 1994:242; Wheeler and Jones 1989:65).

The body portion representation data suggest that primary processing was done at the Martin site, not elsewhere. Under ideal circumstances, in an assemblage of walleye remains that reflects both processing and consumption of all fish brought to the site, the ratio of cranial bones to vertebrae should be close to slightly above 1:1. This result is because a single walleye carcass appears to contain, in Thomas' experience, approximately 50 to 60 cranial bones that both tend to be recovered in archaeological contexts and can be readily identified by the analyst. The number of vertebrae in a single walleye carcass can vary between 44 and 48 (Scott and Crossman 1979:768). The ratio of cranial to vertebral specimens in the Feature 12 genus

Sander assemblage is 359 to 127, or close to 3:1.

Of course two issues obscure this picture. First, selective preservation may favour preservation of vertebrae. Second, selective recovery might act systematically to reduce recovery of fish vertebrae because the vertebral bodies tend to pass through archaeological screens more freely than larger bones of the skull.

Nevertheless, the body portion pattern seems sufficient to suggest that primary processing was done at Martin, whether or not the Martin occupants took preserved walleye fillets with them when they departed the site. If this is so, then the fish were probably caught nearby, within the immediate site catchment, because it seems unlikely that people would carry quantities of raw fish for long distances overland, or by canoe in the challenging currents of the upper Niagara River.

Exploitation of Other Species. Martin site walleye were probably taken nearby, using a mass capture technique during the species' spawning season in the early part of mid spring. The analysis provides no indication that any other species were the focus of a comparable pattern of harvest-level procurement, whether or not they were taken during their respective spawning seasons. This is true even for the three second-tier species—freshwater drum, channel catfish, and white bass.

Of the three secondary species, white bass would be the best fit for exploitation by a mass capture technique, and for exploitation as an extension of the walleye fishing pattern. Its schooling behaviour suits it to attended mass capture techniques, such as a seine net, or unattended mass capture techniques, such as a pound net. White bass spawn soon after walleye. Its preferred spawning habitat, over a bottom of gravel or rubble (Werner 1980:147), is similar to that favoured by the walleye. Potentially, these factors might have motivated the site occupants to remain a few weeks longer at Martin, ready to deploy their nets for schools of spawning white bass. Nevertheless, the data at hand do not reflect a systematic, large-scale exploitation of the white bass. This evidence suggests that by the time in May when the white bass were spawning, the Martin people had either moved to another location better suited for catch-

ing white bass, or turned their attention to different resources.

We must ask then, when and how were the remaining fish taken? A large portion of the remaining assemblage, particularly second-tier species, may well have been caught as an unintentional bycatch of the walleye harvest. Above we inferred an annual pattern of intensive subsistence activity using nets in relatively shallow water to catch spawning walleye. Given such fishing methods, other fish species would inevitably be caught. The species best represented in such a bycatch are likely to be those that would naturally occur in the inshore shoals used by the walleye to spawn. One would expect at least some representation from each of the second-tier species in the catch because they occupy the same habitat. Beyond that, some species might have been sought during their various spawning seasons, possibly using mass capture techniques but on a smaller scale, perhaps by small family groups who reoccupied the Martin site at other times of year. Finally, small amounts of fish may have been taken opportunistically, using individual capture techniques, at any time over the course of the annual subsistence round.

Although this analysis is restricted to material from a single feature, it appears that the Feature 12 fish assemblage is generally representative of the rest of the Martin site. A site wide faunal analysis was attempted two decades earlier (Ellis 1985a,b). The results are summarized in Zubrow and Buerger (1994: Table 9, citing Ellis 1985a). Ellis reports an overwhelming emphasis on walleye, followed by freshwater drum, channel catfish, and smaller amounts of other species. There are some differences between Ellis's results and our own. We suspect that a major factor underlying these differences was that Ellis may have excluded fish vertebrae from her analysis (and, presumably, other postcranial serial elements). An examination of Table 5 demonstrates that postcranial serial elements can make a difference in species representation by NISP.

Comparison of Fish Remains from the Martin and Peace Bridge Sites. The best-documented faunal assemblage along the upper Niagara River, which is culturally comparable to the Martin assemblage,

comes from the Peace Bridge site. As mentioned above, at the Peace Bridge site, archaeologists discovered a collapsed, Princess Point-like ceramic vessel that contained faunal material. Among the faunal remains, excavators noted articulated groups of fish vertebrae (MacDonald and Williamson 1997:218; Robertson et al. 1997:501-502). Meticulous excavation techniques were employed to recover virtually every surviving faunal specimen from the vessel interior (Thomas 1997:476).

There are significant differences between the faunal assemblages from Martin Feature 12 and Peace Bridge Feature 158. The former derives from many subsistence events over the course of multiple occupations, and presumably a gamut of subsistence-related activities. The latter represents a cooking event over the course of one day, or a few days at the very most. The former derives from an exposed, midden-like deposit subjected to scavenging carnivores and rodents. The seasonal pattern of occupation would have enabled scavengers to maximize damage to the assemblage. In addition, trampling by the site occupants would have damaged fragile fish remains. We have argued above that the combined effects of this taphonomic stress would result in a fish bone assemblage with a low degree of element interdependence. In contrast, the latter assemblage derives from a sealed deposit where excavators noted articulated groups of fish vertebrae. We may assume, therefore, that the degree of element interdependence in the latter assemblage is relatively high.

The analysis methods and reference collections used for the Feature 158 analysis were similar to those employed in the Martin analysis (Thomas 1997a, 1997b). Fish accounted for 142 of 152 specimens identified to a taxonomically useful level. The fish remains are summarized in Table 6. The genus *Sander* predominates. White bass is the only real second-tier species. An analysis of incremental features on 58 vertebrae found that 56 were at least 4 years old. Given the conservative bias of the study, the data appear consistent with a mature, spawning-aged population (Thomas 1997a:486-487).

The preferred spawning temperatures of fish

species were used to construct the sequence of spawning events (Thomas 1997a:492). The season of death was inferred from fish vertebrae using a method cruder than that employed in the Martin study. This indicated that almost all fish were caught during the rapid growth phase (warm weather) (Thomas 1997a:486-487). Using taphonomic attributes, specimen size, and other factors, an attempt was made to separate elements that probably comprised the original pot contents from those that would have been carried in with matrix from the surrounding sheet midden (Thomas 1997a:481-482).

Walleye, or *Sander*, would appear to be a major taxon in the multi-component Peace Bridge faunal assemblage as a whole. A unit-by-unit inventory of the faunal material excavated by Archaeological Services Inc. from 1994 to 1996 (Thomas 1997a:441-475) shows a total of 1,108

Table 6. Peace Bridge site, Feature 158 vessel contents: Fish elements identified to useful taxonomic level.

Common Name ^a	NISP without Serial Elements	NISP with Serial Elements	% NISP with Serial Elements	MNI	% MNI
Lake Sturgeon	7	7	4.9	1	7.1
Cisco or Lake Herring	1	1	0.7	1	7.1
Probable Golden Redhorse	1	1	0.7	1	7.1
Sucker or Redhorse	0	2	1.4	–	–
White Bass	7	22	15.5	3	21.4
Rock Bass	1	1	0.7	1	7.1
Smallmouth Bass	1	1	0.7	1	7.1
Walleye & <i>Sander</i> sp.	37	104	73.2	5	35.7
Freshwater Drum	1	3	2.1	1	7.1
Total	56	142	99.9	14	99.7

^a For clarity and brevity, probable identifications (e.g., *Sander* cf. *vitreus*) have been merged with positive identifications (e.g., *Sander vitreus*).

fish bone specimens found in 463 provenience units. The genus *Sander* was recognized in more units (12 percent) than any other genus of fish. The next most frequently recognized was *Micropterus*, the black basses, in 4 percent of the units. A full zooarchaeological analysis would likely find *Sander* to be at least among the major fish taxa in the assemblage. Our subjective impression is that most *Sander* remains are attributable to walleye rather than sauger, based on the size range of the specimens.

To summarize, the Martin Feature 12 deposit is characterized as midden like. As such it probably represents a number of subsistence related activities that occurred over a relatively long span of time. The Peace Bridge Feature 158 material probably represents one or a very few activities carried out over a comparatively short length of time. Despite this difference, in its focus on walleye it appears to be representative of pre-contact fish remains found at the Peace Bridge site. Both features are placed in the Middle Woodland, though at different ends of that period.

Evidence of blue walleye? The *Sander* populations from the two assemblages differ in size. Unfortunately, very few of the bones most useful for measuring were recovered from Feature 158. This was attributed to the selective removal of most of the head prior to cooking (Thomas 1997a:487-488). Still, it is possible to use available data to make a crude size comparison between the two assemblages. The anterior body width and body length of all *Sander* sp. vertebrae in both assemblages were measured. The comparison described here is limited to vertebrae from the central trunk region (the eleventh to the eighteenth trunk vertebrae). The size distributions were compared against yellow walleye vertebrae specimens of known body length from the comparative vertebrate osteology collection in the Department of Paleobiology at the ROM. The results, depicted in Figure 9, suggest that most of the Feature 12 population seems to fall between 400 and 500 mm Total Length, while the Feature 158 population seems to fall roughly into the 350 to 450 mm range.

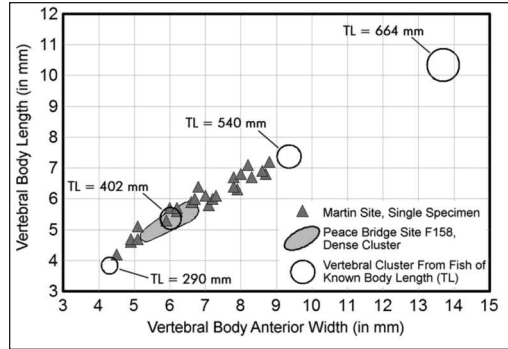


Figure 9. Martin site Feature 12 *Sander* sp. central trunk vertebrae compared with those from Peace Bridge Feature 158. For context, measurements of vertebral clusters from four yellow walleye of known body sizes are shown superimposed over the archaeological data, with Total Length indicated.

The size ranges for both sites are consistent with yellow walleye and are generally above the range for sauger. It seemed possible that the *Sander* bones in the Feature 158 vessel might be the remains of the blue walleye, given their relatively small size (Thomas 1997a:484, citing personal communication with Edwin Crossman). If they were blue walleye, the later spawning period of the blue walleye would fit into the range of other fish species in the vessel, especially white bass and lake sturgeon (Thomas 1997a:492).

The body size distribution for the Feature 158 *Sander* population depicted in Figure 9 appears large for some blue walleye average body length statistics, cited above. There is, however, some overlap, particularly for Trautman's (1981:612) Lake Erie data. To put this in perspective, the modal body size range for the *Sander* remains from Martin is slightly larger than the size range of recent walleye. If the modal size range of yellow walleye during Middle Woodland times exceeded the recent average, might not the same be true for the blue walleye? To settle the question of whether blue walleye were present in the Feature 158 pot, we need to know more about the body size distributions of various fish species in Lake Erie during pre-contact times.

Summary and Discussion

The Martin Feature 12 assemblage comprises just part of the fish remains from the entire site. However, work done on a wider range of provenience units indicates that the pattern does characterize the site as a whole, at least regarding the general taxonomic profile and the predominance of walleye (Zubrow and Buerger 1994:Table 9). The taxonomic focus of the Feature 12 assemblage in combination with the sheer number of specimens, the apparent selection of mature individuals, and the seasonality evidence are consistent with the harvest-level procurement of spawning walleye.

Indeed, the reproductive behaviour of the walleye—including its preference for shallow water spawning habitat and mass aggregation—would have made it feasible for people with Middle Woodland fishing technology to exploit this subsistence opportunity, and to do so effectively. It appears likely that the Martin people would have used a mass capture technique. We suggest that this involved fishing nets, since a weir would be difficult to construct in the swift current of the Niagara River and would be likely destroyed each year by river ice.

The assemblage contains lesser amounts of other fish species that spawned during the spring or in the summer. A portion of these, particularly fish of species that would normally occupy the habitat used by walleye to spawn, may have been taken as a bycatch of the walleye fishery. The balance of the fish in the assemblage were probably not taken by a mass capture technique, but opportunistically by smaller groups of people who reoccupied the site intermittently over the rest of the year.

Faunal assemblages from some sites in the upper Niagara area contain no walleye remains at all, the assemblage from Riverhaven 2, for example. This site may well reflect a different segment of the annual round. The assemblage of sucker, bullhead, freshwater drum, and possibly channel catfish (Granger 1978:251) suggests a pattern of accompanied or unaccompanied individual capture (e.g., spearing or angling) of fish in streams or inshore river shallows.

The pattern of large-scale, spawning walleye exploitation is not unique to Martin, but seems to

be a feature of certain other sites along the upper Niagara River, such as the Peace Bridge site. At least during the Middle Woodland period, it may well have been a key subsistence activity that groups of extended families relied on, given its timing after the winter and early spring lean season. However, the closest confirmed walleye spawning grounds in the Niagara River system are located a considerable distance from the Peace Bridge and Martin sites (Goodyear et al. 1982:[10]:15, 1982:9:170-171, 173, 182).

If our interpretation of the archaeological evidence is correct, and assuming that people who exploited a harvest-level fishing resource in near-shore shallows would tend to minimize transport costs by locating their fish processing and living area close by, then there must have been at least two additional productive walleye spawning areas in the upper Niagara River to account for the abundance of walleye remains in the Martin and Peace Bridge deposits. If so, then something caused their demise. One possible culprit could be the historic habitat modifications near these sites. Filling certain littoral zones between the 1930s and 1970s regularized the shoreline near the Peace Bridge and downstream areas of Fort Erie. Large-scale dredging projects also severely modified the habitat in the area upstream of Grand Island (USACE 2009). Island dredging may have also changed eddy patterns, leaving insufficient shelter for the fry of spawning fish.

Other factors likely contributed to the devastation of the hypothesized walleye spawning populations. For instance, siltation has a negative effect on the spawning habitat of some fish species, including walleye. Erosion and siltation were consequences of land clearance related to the introduction of European-style agriculture to the eastern Great Lakes area. Other agencies that probably took their toll on the fish of the upper Niagara include over-fishing; high-density shoreline development; and pollution from industry, sewage and agriculture. During the first half of the nineteenth century, each of these factors exerted at least some influence on fish populations in the upper Niagara. Unfortunately, many of these forces were acting on the Niagara River system before the first earnest efforts to study the river

fauna were accomplished in the late-nineteenth century (Goodyear et al. 1982[10]).

Conclusions and Discussion

Historically, large quantities of fish were taken from the upper Niagara River by a variety of techniques, including spearing, angling, and seine netting. Archeological faunal data suggest that the pre-contact fishery was also abundant. However, ancient fishing tools are rare archaeological finds. This discrepancy may be at least partially attributed to poor preservation of perishable materials, such as wood and plant fibres. Nevertheless, several classes of more durable and commonly found stone artifacts may be associated with the pre-contact fishery.

Few detailed studies of pre-contact fishing related tools exist; consequently, little can be definitively said about them. Blades, unifaces, and utilized flakes may have been used in antiquity to process upper Niagara River fish, but this remains unconfirmed by use-wear analysis. Spoke-shaves were likely used to manufacture fish spears and harpoon shafts; however, these artifacts would be difficult to differentiate from spoke-shaves used for other purposes. Therefore, simple notched stones, commonly found along the upper Niagara River, may provide the best direct evidence for ancient fishing tackle. In the past, archaeologists have somewhat uncritically assumed that notched stones found along the upper Niagara River were used to sink ancient fish nets. Our study tentatively demonstrated a relationship between notched stone masses and modern stream velocities adjacent to the sites where they were recovered, suggesting their use as seine netsinkers. This hypothesis is supported by faunal data from the Martin and Peace Bridge sites, which indicate a focus on the mass capture of spawning walleye—a task ideally suited to seine nets.

Faunal data from the Martin and Peace Bridge sites suggest that during the Middle Woodland period, fish from the genus *Sander*, probably caught during spawning, dominated the upper Niagara River fishery. *Sander* was also prominent in descriptions of nineteenth century upper Niagara River seine netting operations. These data

support our hypothesis that in pre-contact times, and potentially into the first half of the nineteenth century, walleye and possibly sauger spawned in the upper Niagara River.

Today, neither walleye nor sauger spawn in the upper Niagara River and walleye occupy a minor fraction of recreational anglers' catches. The Martin and Peace Bridge sites appear to be located too far from the closest known walleye spawning grounds for them to have served as base camps for the exploitation of these resources. It seems more likely that walleye formerly spawned in the upper Niagara River in at least two locations (i.e., adjacent to Peace Bridge and in a littoral area near Strawberry Island). The apparent destruction of walleye spawning grounds in the upper Niagara River may be attributed to any number of historic and modern environmental perturbations.

The upper Niagara fishery has changed considerably over the past two millennia, in terms of both environmental health and cultural attitudes towards fish resources. In addition to partially clearing our murky conception of the pre-contact fishery, potentially useful for fishery management purposes, this study demonstrates the research potential of archaeological assemblages that were collected using different excavation strategies and that have retained varying amounts of documentation. Despite the important contributions of this research, these efforts must be considered preliminary because the data potential of the upper Niagara River archaeological record is largely untapped.

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Avec un regard sur la période Sylvicole moyenne (environ 2100 à 1000 B.P.) et sur les impacts environnementaux modernes qui ont suivi, cet article propose une synthèse des recherches récentes quant à la pêche avant le premier contact sur la partie supérieure de la rivière Niagara. Au cours de la période Sylvicole moyenne, la pêche était une activité de subsistance importante et le climat et les niveaux de l'eau étaient dans leur intervalle de variation normal documenté historiquement. Cependant, de nombreux détails de la pêche avant le premier contact sur la partie supérieure de la rivière Niagara sont jus-qu'ici demeurés incertains. Les objectifs de cette étude sont de décrire la pêche de la partie supérieure de la rivière Niagara avant le premier contact, y compris les méthodes de pêche probables, les espèces de poissons et les anciens habitats de poissons. Des données d'artéfacts, de radiocarbone et de zooarchéologie suggèrent que durant la période Sylvicole moyenne, la communauté de poissons exploités était diversifiée mais le doré jaune en période de frai était une préoccupation majeure. Des comptes rendus anecdotiques historiques suggèrent que, sur la partie supérieure de la rivière Niagara, le doré en frai était capturé au filet. Fait intéressant, aujourd'hui, malgré la présence de quelques conditions d'habitat favorables, il n'y a pas de frayères de dorés confirmées dans la partie supérieure de la rivière Niagara. Il est probable qu'au cours des deux derniers siècles, la succession de facteurs anthropiques a contribué à la dégradation environnementale de ces frayères. Nous espérons que les résultats de cette étude seront pertinents pour la re-construction paléo-environnementale éventuelle et pour les efforts éventuels de réhabilitation.

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The Walleye Fishery at the Peace Bridge Site, Fort Erie, Ontario

Suzanne Needs-Howarth and Robert I. MacDonald

Excavations at the Peace Bridge site (AfGr-9) over the past 20 years by Archaeological Services Inc. have produced a large faunal assemblage that spans the Woodland period. The fish remains are dominated by the genus Sander, which in Ontario comprised the three taxa commonly known as sauger, walleye, and blue walleye. The osteological element representation of the fish remains is uneven, likely largely the result of preferential survival of the robust portions of the cranium and the vertebrae. Comparison with other Woodland period fish bone collections suggests that trampling may have been a major taphonomic process at the site. Osteometrics indicate that most of the Sander sp. were sexually mature at the time of capture and somewhat restricted in their size distribution. These fish were likely obtained from the Niagara River during their spring spawning run, using techniques of mass capture, such as nets. The Peace Bridge site represents a nodal site, where people were attracted to a suite of key resources, including an outcrop of Onondaga chert, for hundreds of years. Here we argue that another of the key resources was a predictable supply of fish that allowed people to obtain food to sustain them during their occupation of the site with a minimum input of time and labour. This idea is supported by comparing the Peace Bridge site faunal assemblage with a similar faunal assemblage at the nearby Martin site, which is also dominated by Sander sp.

Introduction to the Site

The Peace Bridge site (AfGr-9) is located on the upper reach of the Niagara River in what is now the Town of Fort Erie, Ontario (Figure 1). Archaeological Services Inc. has been excavating this large (ca. 24 ha.) multi-component site (Figure 2) intermittently for the past 20 years on behalf of the Buffalo and Fort Erie Public Bridge Authority and the Public Works Department of the Town of Fort Erie. The site was first documented by Frederick Houghton in the early twentieth century. Several localities within the site were investigated as discrete sites in the mid-1960s and early 1990s, before being consolidated within the newly defined Peace Bridge site in 1997 (see Williamson et al. 1997:49-59; Williamson et al. 2008-2009 for detailed investigation histories). These localities included the Orchid site, an Iroquoian ossuary that also yielded artifacts ranging in age from the Late Archaic period (ca. 4,000 ¹⁴C B.P.) through to the contact period (White 1966;

Granger 1976); the Surma site, which yielded artifacts and burials spanning a similar time range, including a major Late Archaic Genesee Broadpoint component (Emerson and Noble 1966); and the Walnut site, which further documented this extensive multi-component deposit within the modern urban landscape (ASI 1993).

Situated below the higher bluffs of the Fort Erie moraine, the Peace Bridge site lies on a 400 m wide floodplain of the Niagara River (MacDonald and Cooper 1997:10). At the site, the river measures 600 m wide and 4 m deep, with an average current of 13 km per hour. North of the site, the constricted river forms a series of rapids where it flows over the Fort Erie–Buffalo sill, a bedrock ridge that controls the water level of Lake Erie. Further downstream, toward Niagara Falls and where the river deepens, the flow drops to 3 km per hour (MacDonald et al. 2004).

Geoarchaeological research by Douglas and others (Douglas 2003; MacDonald et al. 2004) has

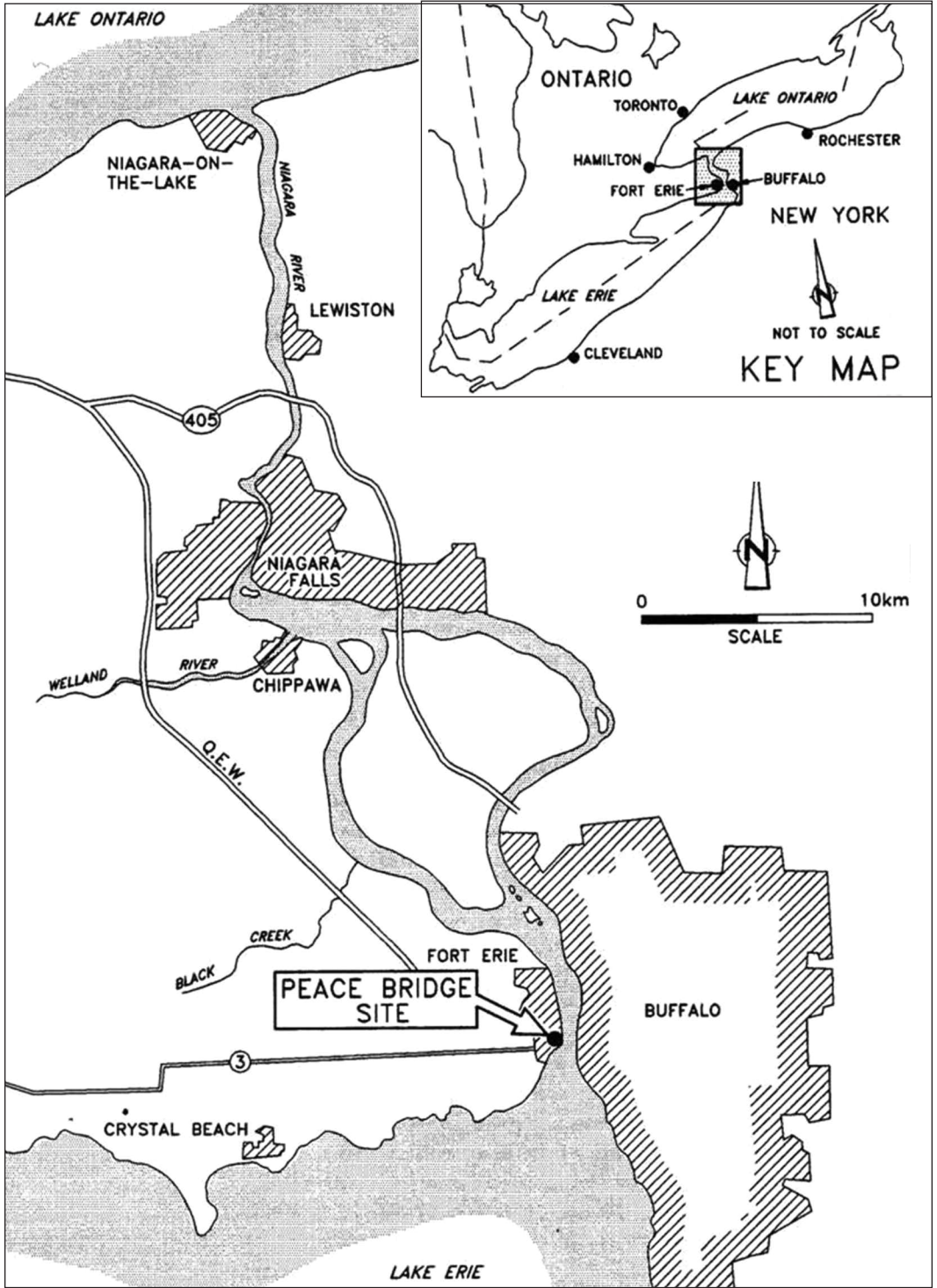


Figure 1. Location of the Peace Bridge site.

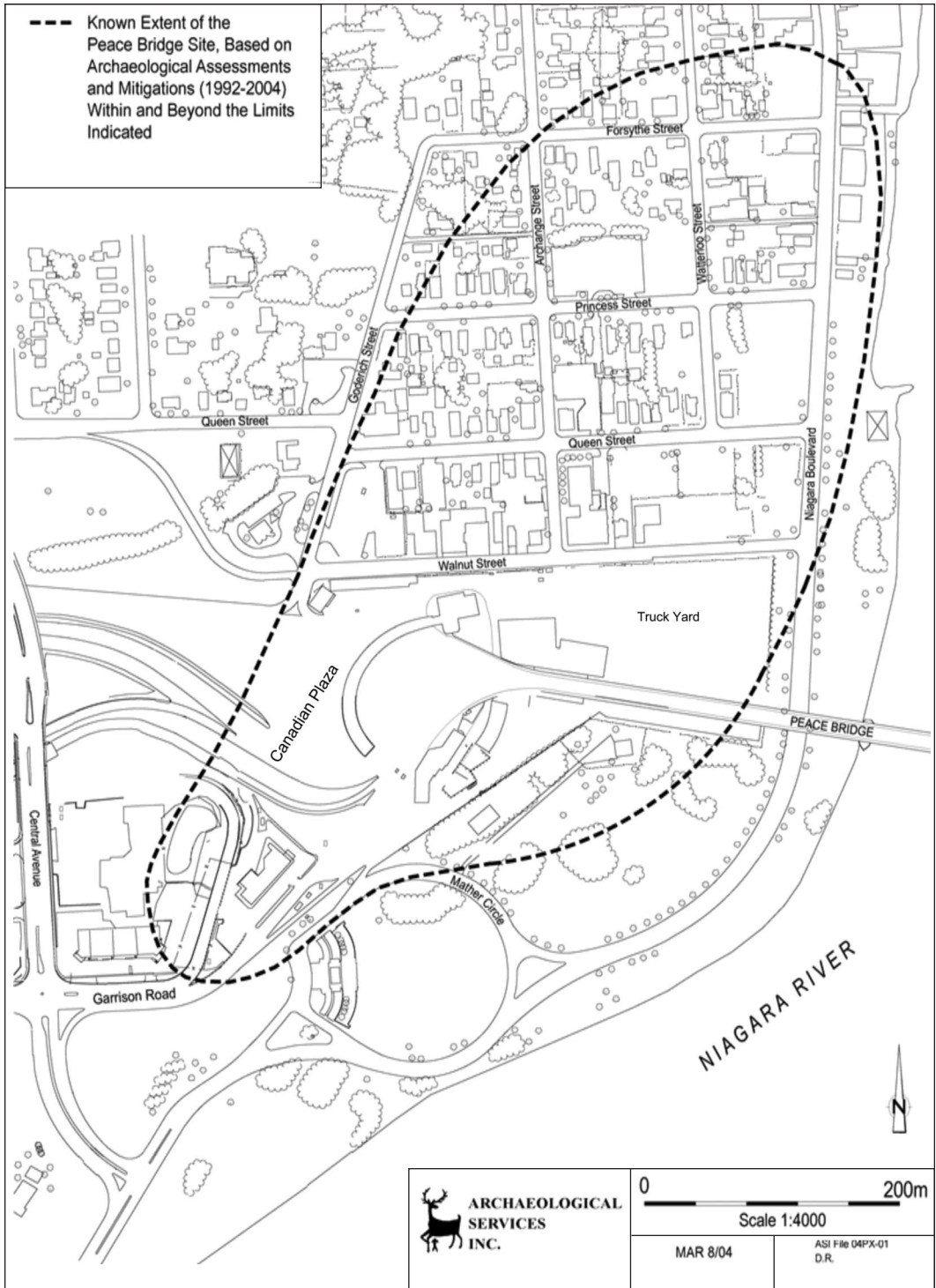


Figure 2. Spatial Extent of the Peace Bridge site.

shown that the site was first accessible ca. 3,800 ¹⁴C B.P., when the waters in the Lake Erie basin fell to near modern levels at the end of the Nipissing high-water phase. The stabilization of the lake level and the transition from lacustrine to fluvial conditions in the upper Niagara River created a broad floodplain and exposed the Onondaga chert beds along the waterfront. Nut shell fragments recovered in association with Genesee broad points from two features in the Truck Pad area of the Peace Bridge site have yielded dates of 3,470 +/- 60 B.P. and 3,580 +/- 60 B.P. (MacDonald and Williamson 1997:214-242; Robertson et al. 1997:497), suggesting occupation of this floodplain beginning in the Late Archaic period (Robertson et al. 1997:496-497).

From its earliest occupation, the site was an attractive location for human settlement because of its proximity to potable water, a variety of wild foods, and stone tool raw materials. The acquisition of high grade toolstone and manufacturing of stone tools on a large scale has long been recognized as one of the most noteworthy attributes of the Peace Bridge site (Emerson and Noble 1966; Kenyon 1981; Robertson et al. 1997; MacDonald 2000; Williamson et al. 2008-2009). Onondaga chert, which outcrops at the site, was the most widely used pre-contact Aboriginal stone tool material in southwestern Ontario (MacDonald and Cooper 1997:11-12). At the Peace Bridge site, it was apparently both quarried from bedrock outcrops and collected as cobbles from the beach (Austin 2006:75; MacDonald and Cooper 1997:12).

Although the floodplain would have been subject to occasional inundation by the Niagara River, this did not diminish the appeal of this site and environs to human groups in search of food and other resources (MacDonald et al. 2004). As recorded by early cartographers, such as British naval officer and hydrographic surveyor Henry W. Bayfield, there were once complex shorelines, reefs, and coastal wetlands between Fort Erie and Point Abino (see Figure 3) that would have supported a wide variety of aquatic plant and animal resources throughout antiquity (ASI 2003:63-96). In addition, the site is located where the Mississippi and Atlantic flyways merge (MacDonald and

Cooper 1997:31) and, as such, would have provided easy access to migratory fowl. Inland, the Carolinian-deciduous forest, which surrounds the site, was home to both large and small mammals and would have provided fuel and building materials (MacDonald and Cooper 1997:28-30). In this paper we explore archaeological evidence for Woodland period (ca. 2,900 to 335 ¹⁴C B.P.) exploitation of the abundance of fish that the site's proximity to the Niagara River and Lake Erie would have afforded its inhabitants.

Overview of the Fish Assemblage

Analyses by Thomas (1997, 2006) and Stanchly (2004) of samples of fish bone from the buried palaeosol at the Peace Bridge site, dating mostly to the Meadowood phase of the Early Woodland period (ca. 2,900–2,400 ¹⁴C B.P.), have revealed that fish in the genus *Sander* (family Percidae, order Perciformes) dominate the identified portion of the fish assemblage. This paper, incorporating additional zooarchaeological analyses by Needs-Howarth (2005, 2008, 2009, 2011), adds to and corroborates those earlier findings (Table 1).

In the Lake Erie basin, the genus *Sander* could pertain to three (sub)species (see Thomas 1997), namely, yellow walleye, *Sander vitreus* (Mitchill, 1818); the now-extinct blue walleye, initially designated as a subspecies of the yellow walleye (*Stizostedion vitreum glaucum*, Hubbs, 1926), but currently designated a junior synonym of *Sander vitreus* by the Integrated Taxonomic Information System (www.its.gov); or sauger, *Sander canadensis* (Griffith and Smith, 1834). Because of the lack of skeletal reference specimens of blue walleye and the osteological similarities between yellow walleye and sauger, taxonomic identifications are often limited to the genus level (that is, *Sander* sp.).

The consistent prevalence of *Sander* at different locations and different periods in the site prompted us to ask the following questions: Why the abundance? Is this indicative of local availability and human choice, or is it a reflection of taphonomy? Where, when, and how did people capture these fish? Can the fish bones themselves provide us with any clues to answer these ques-

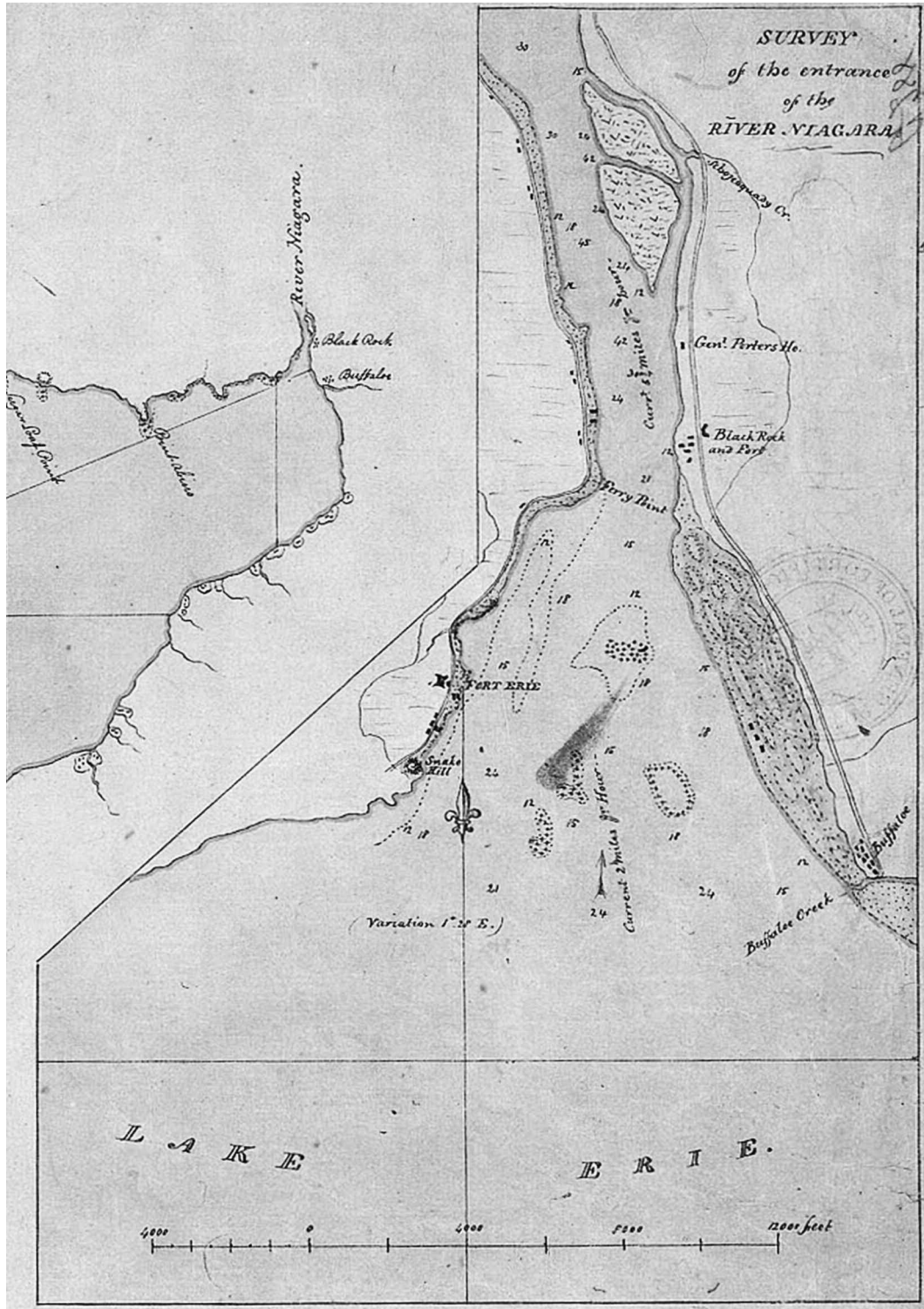


Figure 3. The Bayfield Map, 1817–1818 (Bayfield 1818).

Table 1. Fish NISP by location within the Peace Bridge site (6 mm aperture dry screening). Nomenclature follows the Integrated Taxonomic Information System, accessed at www.itis.gov. Taxonomy follows Scott and Crossman (1973). ID means identified below class Actinopterygii.

	Canadian Plaza 2004 ¹			Canadian Plaza 2005 ¹			Forsythe St. 2003 ²			Queen St. 2009 ³			Forsythe St. 2001 Early Woodland ⁴			Forsythe St. 2001 Late Woodland ⁴			Total		
	NISP	% of ID fish	%	NISP	% of ID fish	%	NISP	% of ID fish	%	NISP	% of ID fish	%	NISP	% of ID fish	%	NISP	% of ID fish	%	NISP	% of ID fish	%
Actinopterygii	12	34		19	23		329	23		164	40		155	55		685	30		685	30	
<i>Actipenser fulvescens</i>	0			0			0			0			5	2		5	0		5	0	
Salmoniformes	0			1	1	2	0			0			0			0			0		
Salmonidae	3	9	13	0			4	0	0	0			0			0			0		
<i>Coregonus artedii</i>	0			0			0			0			0			0			0		
<i>Salvelinus namaycush</i>	0			0			0			0			1	0	1	0			1	0	0
Catostomidae	3	9	13	0			0			3	1	1	1	0	1	0			7	0	0
<i>Catostomus</i> sp.	0			0			0			0			1	0	1	0			1	0	0
<i>Moxostoma erythrum</i>	0			0			0			0			0			0			0		
Ictaluridae	0			0			26	2	2	17	4	7	8	3	6	1	5	8	52	2	2
<i>Ictalurus punctatus</i>	1	3	4	0			12	1	1	0			2	1	2	0		15	1	1	
<i>Ameiurus</i> sp.	1	3	4	0			0			0			0			0		1	0	0	
<i>Lota lota</i>	0			0			0			0			1	0	1	0		1	0	0	
<i>Morone chrysops</i>	0			0			0			0			0			0		0			
Perciformes	1	3	4	6	7	10	14	1	1	2	0	1	0			0		23	1	1	
Centrarchidae	0			0			0			0			0			0		0			
<i>Ambloplites rupestris</i>	0			0			0			0			0			0		0			
<i>Micropterus</i> sp.	0			0			1	0	0	0			0			0		1	0	0	
<i>Micropterus dolomieu</i>	0			0			0			0			0			0		0			
Percidae	0			3	4	5	0			14	3	6	1	0	1	0		18	1	1	
<i>Sander</i> sp.	14	40	61	52	64	84	1052	73	95	214	52	85	107	38	83	12	63	92	100	64	49
<i>Sander vitreus</i>	0			0			0			0			0			0		0			
<i>Aplodinotus grunniens</i>	0			0			1	0	0	0			2	1	2	0		4	0	0	
Total	35			81			100			284			19			100					

Note: For clarity of presentation, uncertain (cf) identifications have been merged with positive identifications.
¹ Needs-Howarth (2008); ² Needs-Howarth (2005); ³ Needs-Howarth (2009); ⁴ Stanchly (2004); fish vertebrae identified to class only.

	Canadian Plaza 2004 ¹		Canadian Plaza 2005 ¹		Forsythe St. 2003 ²		Queen St. 2009 ³		Forsythe St. 2001 Early Woodland ⁴		Forsythe St. 2001 Late Woodland ⁴		Total palaeosol	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
articular	1	0.5	3	1.5	7	3.5	1	0.5	10	5.0	0	0	22	11.0
ceratohyal	1	0.5	2	1.0	1	0.5	0	0	27	13.5	0	0	31	15.5
cleithrum	0	0	0	0	0	0	0	0	1	0.5	0	0	1	0.5
dentary	0	0	4	2.0	61	30.5	15	7.5	31	15.5	9	4.5	120	60.0
ectopterygoid	0	0	0	0	0	0	0	0	3	1.5	0	0	3	1.5
epihyal	1	0.5	0	0	0	0	0	0	2	1.0	0	0	3	1.5
frontal	0	0	1	0.5	0	0	0	0	0	0	0	0	1	0.5
hyomandibular	0	0	1	0.5	0	0	1	0.5	0	0	0	0	2	1.0
maxilla	0	0	1	0.5	1	0.5	3	1.5	9	4.5	0	0	14	7.0
operculum	0	0	0	0	1	0.5	0	0	2	1.0	0	0	3	1.5
palatine	0	0	1	0.5	0	0	0	0	0	0	0	0	1	0.5
parasphenoid	1	0.5	1	0.5	5	2.5	0	0	9	4.5	1	0.5	17	8.5
premaxilla	0	0	3	1.5	8	4.0	7	3.5	7	3.5	0	0	25	12.5
quadrate	2	1.0	2	1.0	5	2.5	8	4.0	6	3.0	2	1.0	25	12.5
supracleithrum	0	0	1	0.5	0	0	0	0	0	0	0	0	1	0.5
vomer	0	0	1	0.5	2	1.0	0	0	0	0	0	0	3	1.5
Total cranial	6	3.0	21	10.5	91	45.5	35	17.5	107	53.5	12	6.0	272	136.0
vertebrae	8	4.0	31	15.5	961	480.5	179	89.5	--	--	--	--	--	--

Table 2. *Sander* sp. cranial bone NISP and Minimum Animal Units (MAU) by location within the Peace Bridge site. (6 mm aperture dry screening).

tions, and what do these answers suggest about life at the site? How important was fishing to the inhabitants of the site?

Taphonomic Considerations

The bone from the Peace Bridge site tends to be fragmented and abraded (Needs-Howarth 2005, 2009; Thomas 1997). The percentage of fish specimens that could not be identified below class varies across the site. A higher percentage of fish that could not be identified below class may indicate less favourable taphonomic conditions (i.e., proportionately fewer fish bones survived intact enough for a below-class identification).

Fifty-five percent of the Forsythe St. 2001 area Early Woodland period features and 46% of the Forsythe St. 2001 Late Woodland period feature fish remains were unidentifiable (Table 1). For these two samples, vertebrae were not identified below class. It is likely, based on the other samples from the site, that the unidentified component contains a large proportion of *Sander* sp. vertebrae. This factor may explain why the percentage of unidentified fish is higher in the Forsythe St. 2001 Early and Late Woodland features than in the other samples, which did include vertebrae in the below-class identifications. Among the

samples with identified vertebrae, the proportion that could not be identified below class is 40% for Queen St., 34% for Canadian Plaza 2004, and 23% for both Forsythe St. 2003 and Canadian Plaza 2005. We therefore suggest that the fish remains did not survive as well at the Queen St. location as at the Forsythe St. 2003 and Canadian Plaza locations.

The relative paucity of vertebrae (Table 2) could indicate that the heads were taken off at the site and the rest of the body was transported elsewhere as preserved/stored food. Alternatively, it could be a function of recovery, with smaller vertebrae, especially those that (no longer) had vertebral spines, falling through the 6 mm screen. People would likely only transport headless, preserved fish elsewhere in winter, because fish caught during the warmer months would not preserve. On-site butchering, cooking, and disposal practices would have influenced preservation as well. If fish cranial bones are identified at a site, a researcher may safely assume that the anterior portion of the head, containing all of the associated cranial bones, was once present. If fish are beheaded, however, this may result in the cutting or breaking of the cleithrum (Thomas 1997:488). With the exception of the dorsal portion of the cleithrum, therefore, any cranial bones that are underrepresented in an assemblage must be accounted for through a variety of taphonomic factors, including processing, cooking, and preservation, rather than through differential bone transport by humans.

Fish assemblages often demonstrate an uneven distribution of identified cranial elements even when it is likely that the entire fish was disposed of in the same location. For example, the bone of oily lake whitefish (*Coregonus clupeaformis*) may not have survived as well as that of other fish because of autolysis (Lubinski 1996). In addition, its fragile cranial bones would have been more readily destroyed by other taphonomic processes, such as trampling. For taxa with less oily bones, such as walleye, the uneven element distribution relates to, among other factors, (1) element distinctiveness, (2) element robusticity, (3) element fracture capability, and (4) element recognition following fracturing.

During lab analysis by Needs-Howarth, it was noted that the anterior portion of the dentary (the anterior-most bone of the lower jaw), seemed unusually common. In order to better understand taphonomic factors influencing the assemblage, we compared *Sander* sp. cranial element distribution across the Peace Bridge site (Table 2). And in order to compare like with like, we standardized how many times that element occurs in the intact skeleton of an individual fish using Minimum Animal Units (MAU). MAU involves determining how many individual elements are represented by the remains, known as Minimum Number of Elements (MNE), and then dividing those MNE values by the number of times that element occurs in a complete skeleton (Binford 1984:50-51). To make patterns easier to identify, we normalized the MAUs to the element with the highest MAU value.

It is clear from Table 2 that the element distribution is consistently uneven across the site, with the dentary predominating. But is this atypical? To answer this question, we contrasted the *Sander* sp. cranial element distribution in the palaeosol at the Peace Bridge site with the element distributions at a number of other pre-contact sites. Only those sites with available data on cranial bone element identifications have been included. The samples used in the cranial bone MAU comparison are Barrie (Needs-Howarth 1999), a fourteenth-century Iroquoian village near Lake Simcoe; Carson (Needs-Howarth 1999), a late fifteenth to early sixteenth century Iroquoian village near Lake Simcoe; Dunsmore (Needs-Howarth 1999, including identifications by Thomas [1996]), a fifteenth-century Iroquoian village near Lake Simcoe; King's Forest Park (Needs-Howarth 2007), an early Iroquoian site on Red Hill Creek in Hamilton; and Mantle (Needs-Howarth 2012a), an early sixteenth century Iroquoian village on a tributary of Duffins Creek in the Rouge River drainage. All of these sites were recovered using 6 mm mesh dry screening except for Carson, which was recovered using 3 mm mesh dry screening.

Most of these Iroquoian sites have very little *Sander* sp. within their assemblages; the identifications pertain mostly to the smaller, more

delicate fish in the order Perciformes (i.e., yellow perch within the family Percidae and all species except larger *Micropterus* sp. in the family Centrarchidae, or sunfishes). At Peace Bridge, *Sander* sp. makes up 97% of the Perciformes bones, whereas at the sites used for comparison the percentage is much lower (Barrie 1%; Carson 4%; Dunsmore 4%; King's Forest Park 19%; and Mantle 12%). Therefore, in order to arrive at sufficiently large sample sizes, Perciformes other than *Sander* have been included. The bones of *Sander* are more robust than those of any of the other Perciformes. All else being equal, we would therefore expect a more even representation of cranial bones in Perciformes samples with a high proportion of *Sander*. At each of these comparator sites, the cleithrum and operculum are the two most commonly identified elements, presenting a completely different picture of element survivorship than at Peace Bridge (see Figure 4).

Trampling is one possible taphonomic agent at the site, as was first suggested by Thomas (1997:442; 2006:475). Trampling by humans moving about on top of the ground surface when the palaeosol was in the process of being formed could have resulted in breakage of fish bones. This factor in turn would result in fewer fish bones being collected in the screen (as some of the bone, including the most robust, anterior part of the dentary, would become so small that it would fall through the 6 mm screen) and fewer (recognizable

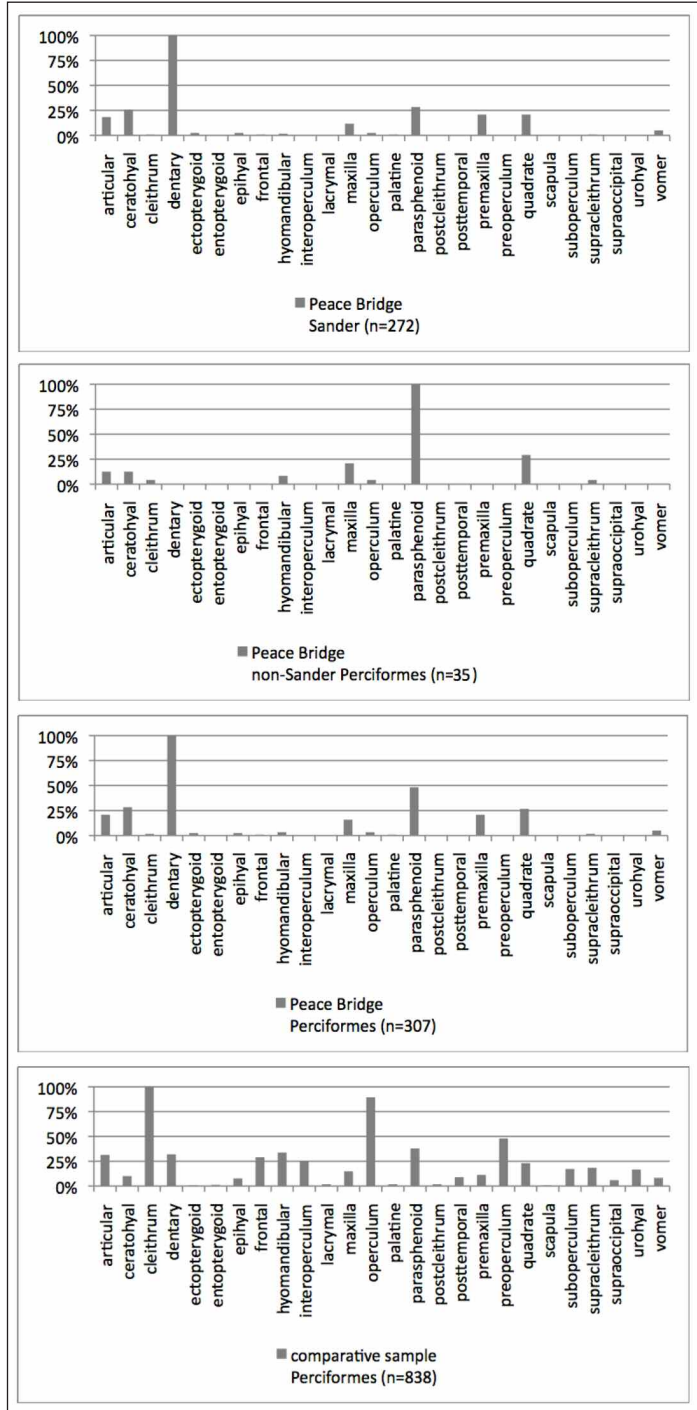


Figure 4. MAU normalization of Perciformes cranial bones, the Peace Bridge site and selected Late Woodland sites (6 mm aperture dry screening). See text for site descriptions and sources.

Table 3. Top 10 commercial catches from the Ontario portion of Lake Erie (excluding introduced/invasive species). Based on Baldwin et al. (2009).

Taxon	Common name	Largest catch in lbs. (000s) 1867/1915-2000	Year
<i>Perca flavescens</i>	yellow perch	29,802	1969
<i>Coregonus artedii</i>	cisco	14,170	1917
<i>Sander vitreus</i> ¹	blue walleye	12,037	1955
<i>Sander vitreus</i> ¹	walleye	10,937	1996
<i>Morone chrysops</i>	white bass	6,153	2002
<i>Coregonus clupeaformis</i>	lake whitefish	3,800	1948
<i>Esox lucius</i>	northern pike	2,927	1914
<i>Aplodinotus grunniens</i>	freshwater drum	1,727	1958
<i>Acipenser fulvescens</i>	lake sturgeon	610	1887
<i>Catostomus</i> sp., <i>Moxostoma</i> sp.	suckers	334	1952

¹ Blue walleye and walleye were not recorded separately until 1915, so figures for these two taxa are post-1915; the last commercial catch of blue walleye was in 1960.

parts of) fragile bones (Needs-Howarth and MacDonald 2009).

Dog scavenging is another possible taphonomic agent. The destruction that dogs cause to bones has been amply documented (Jones 1986; Payne and Munson 1985; Walters 1984). At the Peace Bridge site, dog scavenging activity would have resulted in both fewer fish bones and fewer fragile fish bones. In this scenario, the most robust parts of the most robust elements of the *Sander* skeleton either survived dog gnawing, or, in the case of the dentary and premaxilla (the anterior portion of the upper jaw), were avoided because of their robust and sharp teeth (Needs-Howarth and MacDonald 2009).

Both of these possible taphonomic agents would favour bigger, more robust fish and more robust, especially toothed, elements of those fish. This means that *Sander*, in general, would have survived a lot better than, for example, the morphologically similar but less robust (and less prominently toothed) yellow perch or any of the sunfishes.

However, these same taphonomic agents would also favour a lot of other taxa with relatively robust bones that would likely have been available near the site but that were not identified in any great numbers in the assemblage, namely, catfish,

sturgeon, suckers, and drum. This reasoning, then, would suggest that the high percentage of *Sander* is to some extent “real” and therefore a function of human choice. The bones of taxa with more fragile osteology and smaller bones, such as non-*Sander* Perciformes, may not have survived or may not have been recovered; we cannot know whether their absence is real or not.

The MAU data seem to confirm that the *Sander* assemblage at Peace Bridge has suffered from additional or different attrition, resulting in a skewed distribution of identified elements, namely, one dominated by the most robust, toothed portions of the fish skull.

Availability

In the nineteenth and twentieth centuries, yellow and blue walleye were one of the most important commercial fishes in Lake Erie, whereas sauger was not, as indicated by catch statistics compiled by Baldwin et al. (2009). To give an indication of the top biomass producers over time, Table 3 lists the top 10 commercial catches from the Ontario portion of Lake Erie since record keeping began in 1867. Table 4 provides a snapshot of average catches of all species for the last five years of the nineteenth century (which is the earliest window

Table 4. Commercial catches from the Ontario portion of Lake Erie, late nineteenth century (excluding introduced/invasive species). Based on Baldwin et al. (2009).

Taxon	Common name	Avg. yearly catch 1895/1896-1899 in lbs. (000s)
<i>Coregonus artedii</i>	lake herring	5,218
<i>Sander vitreus</i>	walleye or blue walleye ¹	1,152
<i>Perca flavescens</i>	yellow perch	428
<i>Coregonus clupeaformis</i>	lake whitefish	244
<i>Acipenser fulvescens</i>	lake sturgeon	243
<i>Esox lucius</i>	northern pike	276
<i>Ictaluridae</i>	channel catfish and bullheads ²	26

¹ Blue walleye and walleye were not recorded separately until 1915.

² First record is 1896; the average is for 1896–1899.

Table 5. Spawning temperature range of the water for spring-spawning fish that were abundant in early commercial catches. Based on Ontario Freshwater Fishes Life History Database (Eakins 2012).

Taxon	Common name	Spawning temperature (°C)
<i>Acipenser fulvescens</i>	lake sturgeon	11–18
<i>Esox lucius</i>	northern pike	4–11
<i>Perca flavescens</i>	yellow perch	6–12
<i>Sander canadensis</i>	sauger	6–12
<i>Sander vitreus</i>	walleye	4–11
<i>Sander vitreus</i>	blue walleye	3–9

for which full records exist and before lake sturgeon started to decline).

Using commercial catch data to extrapolate absolute species availability in the past is problematic. First, the commercial catch is not a direct reflection of species availability within the lake; second, the catch varies by year in terms of total weight and proportions; and, third, the proportions of different taxa within the fish population may have changed from the pre-contact Aboriginal occupation of the site to when the catch data were collected by fisheries scientists. However,

commercial catch figures do indicate what species were in the lake in large enough quantities to make commercial fishing feasible. The relatively small commercial catches of sauger (Baldwin et al. 2009) suggest that sauger were simply not that abundant in Lake Erie in the nineteenth century. Today, the Niagara River is not ideal habitat for sauger in terms of turbidity, and there have been no confirmed sauger catches in the upper Niagara River over the past 30 years of monitoring (Donald Einhouse, New York State Department of Environmental Conservation, personal communication 2013). If this relative abundance held true during the Woodland period, it seems that the *Sander* sp. identifications in the archaeological assemblage (whether deriving from Lake Erie or the Niagara River) are more likely to be walleye or blue walleye rather than sauger.

The Ontario side of Lake Erie had even larger catches of yellow perch and lake herring, as well as substantial catches of other taxa (Tables 3 and 4), but these abundances are not reflected in the Peace Bridge site zooarchaeological assemblage (Table 1). The explanation may lie in a combination of three factors: taphonomy; timing of exploitation (lake sturgeon and perch spawn at higher water temperatures, that is, later in spring, and lake herring spawn in late fall) (Scott and Crossman 1973:84, 239, 757; see also Table 5); and/or location of exploitation.

Richness and Evenness

For such a large assemblage of fish bones (combined 6 mm dry screening NISP 2273), the taxonomic diversity is in fact rather low. Only 10 unique fish taxa (that is, taxa that cannot be subsumed under a higher-level taxonomic identification) were identified at the Peace Bridge site, whereas the assemblages from some Iroquoian sites have up to 20 unique taxa (species, genus, family, or order) of fish (e.g., Mantle [Needs-Howarth 2012a]).

To verify whether the taxonomic distribution at the Peace Bridge site is, indeed, uneven and lacking in richness, we compared the fish cranial bone cumulative frequencies with those of Barrie, Carson, Dunsmore, King's Forest Park, and Mantle

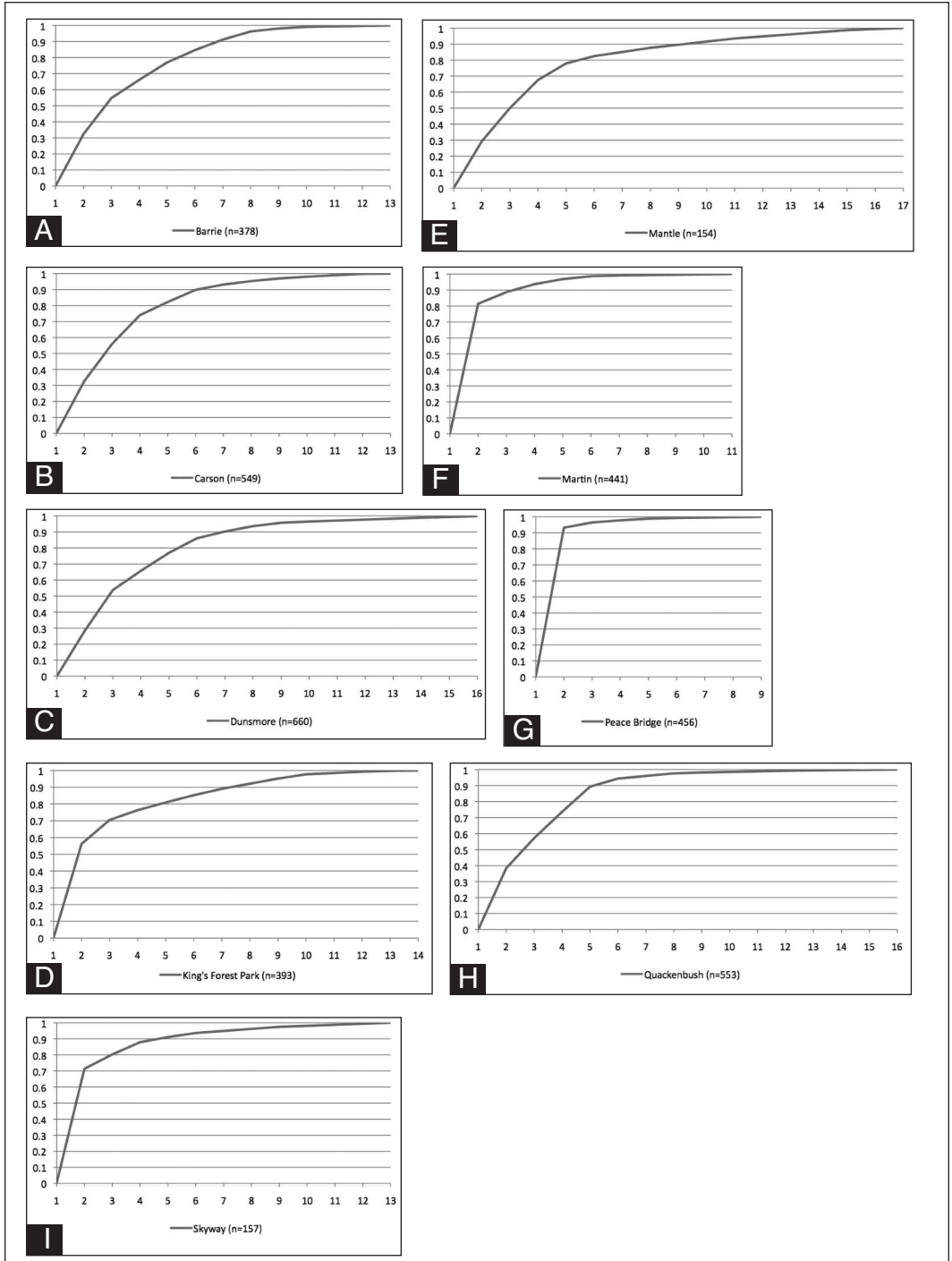


Figure 5. Cumulative frequencies of fish cranial bone, Peace Bridge site and selected Late Woodland sites (6 mm aperture dry screening). The vertical axis represents the cumulative percentage contribution to the total (in this case, fish cranial bones identified to genus or species level, aggregated at the genus level). The horizontal axis represents the number of unique genera. The sites are organized alphabetically. See text for site descriptions and sources.

(described above), as well as Martin (Thomas 2004; Thomas and Ingleman 2010, 2011), a Middle Woodland site on the Niagara River (see this volume); Quackenbush (Needs-Howarth et al. n.d.), a Late Woodland site near Stoney Lake; and Skyway (Needs-Howarth 2012b), a Late Woodland site on a sandbar in Hamilton harbour (Figure 5). Cumulative frequency is essentially a running total of the assemblage sorted by NISP, forced through zero. Because analysts differ in their treatment of post-cranial serial elements, such as vertebrae, the comparisons are restricted to assemblages where the number of cranial bones was readily available. We acknowledge that some of the variation among these sites may be a result of differential processing, which might become visible if vertebral counts were included.

Diversity measures such as cumulative frequency require working with a single taxonomic level (Lyman, 2008). Many researchers calculate diversity measures at the level of family. In order to capture the diversity of fish behaviours while optimizing the available NISP counts, we decided to compare the assemblages at the genus level (subsuming all species-level identifications to the genus level and excluding identifications above the genus level). Figure 5 indicates that at the Peace Bridge site, *Sander* (which is in position 1 in the graph) is much more prevalent than other fish and that there are relatively few genera compared with the other sites (except for Martin, which resembles Peace Bridge in this respect).

Season, Method, and Location of Capture

What do the fish bones tell us about timing, technique, and place of capture? To answer that, we need to examine fish behaviour and habitat.

The preference of saugers “seems to be for large, shallow lakes which are turbid ... or for large, turbid, slow-flowing rivers” (Scott and Crossman 1973:765). They “often feed on the same shoals as do walleye” (Scott and Crossman 1973:765) and may spawn in similar gravel to rubble environments in large, turbid lakes or turbid rivers (Scott and Crossman 1973:763).

Walleye “appear to reach greatest abundance in large, shallow, turbid lakes”; suitable habitat is also

found in “large streams or rivers, providing they are deep or turbid enough to provide shelter in daylight” (Scott and Crossman 1973:772). In more turbid water, they can be active during the day (Scott and Crossman 1973:772). In winter they can be caught through the ice (Scott and Crossman 1973:772). Walleye spawn at night “in rocky areas in white water below impassable falls and dams in rivers, or boulder, to course-gravel shoals of lakes” (Scott and Crossman 1973:771). Walleye usually spawn just after ice break-up, when the water temperature reaches 6.7 to 8.9°C (Scott and Crossman 1973:771), with a range of between 4 and 11°C (Eakins 2012), which in southwestern Ontario is early in April.

Blue walleye started and ended their spawning run at slightly lower temperatures (i.e., earlier) than either yellow walleye or sauger (see Table 5), and in a study cited by Scott and Crossman (1973:772), blue walleye were found at greater depths than yellow walleye.

Because walleye are piscivorous and active throughout the winter (Scott and Crossman 1973:772), they can be caught individually using hook and line, on open water or through the ice. Another technique that may have been used is spearing. It likely would be size-selective, as it is harder to spear small (read, narrow-bodied) walleye or sauger than it is to spear large individuals. Sauger can also be caught with gillnets in winter (Scott and Crossman 1973:766). However, all three *Sander* taxa would be most efficiently caught with nets during their spawning run, as part of a targeted spring spawning run fishery, one of the three fisheries posited by Needs-Howarth and Thomas (1998).

Intergrades of yellow and blue walleye were common in Lake Erie in the past (Scott and Crossman 1973:773), suggesting that at times yellow and blue walleye occurred in the same locations during spawning. Similarly, saugers hybridize with yellow walleye (Scott and Crossman 1973:773). Therefore, we would argue that all three of these (sub)species may have been caught together at times as part of the same spring spawning run fishery. Given the overlaps in habitat preference and spawning period (Table 5), their similar behaviour, and the likelihood that

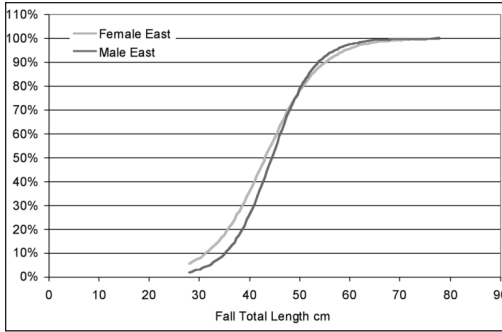


Figure 6. Percentage of male and female *Sander vitreus* mature by length, Lake Erie east basin. Source: Courtesy of Lake Erie Management Unit, Ontario Ministry of Natural Resources (2009).

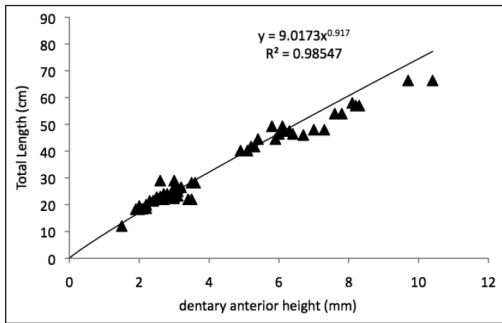


Figure 7. *Sander vitreus* dentary anterior height (dn.a.h.) to nearest 0.1 mm taken on modern Great Lakes region specimens housed at the Royal Ontario Museum, Department of Vertebrate Paleontology; Ostéothèque de Montréal; Laurentian University, Anthropology Department; and the Illinois State Museum, plotted against Total Length. Note that the best-fit regression line has been forced through zero.

sauger were not very prevalent locally, our inability to consistently distinguish between these three (sub)species based on osteology is not an insurmountable problem in addressing the research questions posed here.

Two types of nets were in use in the early contact period: seine nets and gillnets. Prowse (2008-09:76) has argued that the walleye from area K3 of the Bluewater Bridge South site (140–660 C.E.) were caught with seine nets. Walleye are caught with gillnets in today's commercial fishery. Seine nets function like a wall, capturing fish

above a certain size as the net is pulled. Gillnets, which are suspended or set touching the bottom and then left in place for a period of time, target a desired body shape/girth through mesh aperture and mesh shape (McCombie and Berst 1969). Essentially, smaller fish swim through the net, fish of the target body shape/girth (and hence length) are entangled by their gills or wedged, and larger fish do not get caught because they are unable to advance far enough into the net; they then bypass the obstacle of the net. However, in modern nylon gillnets, large fish can be tangled in small mesh sizes and small fish can occasionally be caught in large mesh sizes by tangling (teeth, preoperculum, etc.). A modern gillnet mesh size restriction exerts a strong influence on the size distribution of fish caught, but incidental harvest in nets targeting smaller fish or species does occur (Andy Cook, Ontario Ministry of Natural Resources, personal communication, 2013). Gillnets made from cotton are less efficient than nylon nets (Berst 1961). It seems likely to us that nets made from other natural fibres, such as hemp, would also be less efficient.

How do we tell whether the bones at the site are a result of mass spawning run catches rather than individual or incidental catches? Only fish that are above the minimum size for sexual maturity could have been part of spawning run catches. We can use osteometrics to estimate live fish size and relate it to known size at maturity data (Needs-Howarth and Thomas 1998). Given that walleye is a valued commercial species, detailed modern data are available (Ontario Ministry of Natural Resources 2009). Walleye in the east basin of Lake Erie start becoming mature during fall at a Total Length of just under 30 cm, 50% are mature at around 45 cm, and all are mature at 65 cm (Figure 6).

How big—and hence how old—were the *Sander* captured by the inhabitants of the Peace Bridge site? Were they old enough to have been part of a spawning population? We obtained metrics from a number of modern reference specimens in an attempt to generate a regression curve relating the anterior height of the dentary (dn.a.h.) (Morales and Rosenlund 1979) of walleye to the fish Total Length (Figure 7). This approach was meant to enable us to calculate the

length of the archaeological fish, from which their sexual maturity could be extrapolated.

A power equation gives the best fit, but not all of the data points fit the regression curve. There are four possible reasons for the outliers: (1) upon accession of the specimen, the Total Length may have been measured in slightly different ways (holding the tail flat vs. compressing it); (2) the absolute measurement dimension is relatively small, causing any measurement errors to have a proportionately greater impact; (3) the anterior height of the dentary is not the most easily replicable measurement because the height varies over the size of the calliper blade, partly because of the irregular margins of the tooth socket; and (4) the fish from the reference collections were caught in different bodies of water, resulting in different growth patterns.

Because of the outliers, we decided not to use the equation to directly calculate total length. Instead, we approximately fitted the osteometrics to the graph, to gain a general idea of fish size (i.e., whether the fish are large enough to have been part of a spawning run catch).

The osteometrics on our archaeological fish (Figure 8), assuming they are, indeed, walleye, and not blue walleye, sauger, or a hybrid, translate to an approximate Total Length of between 32 and 52 cm and thus some at least are likely of spawning size. Thomas (1997) examined trunk and caudal vertebrae recovered through floatation from Feature 158 from the Peace Bridge site for growth increments and found that they ranged

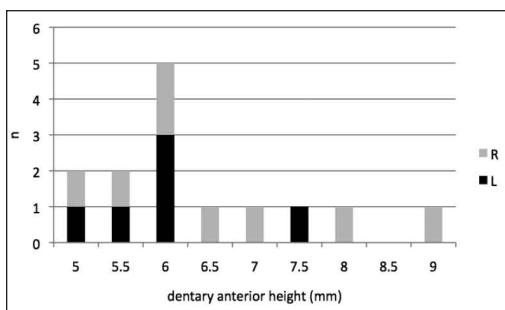


Figure 8. *Sander sp.* dentary anterior height (dn.a.h.) from the Peace Bridge site, Queen St. location, recorded to the nearest 0.5 mm.

from a minimum of three years to a minimum of six years. The dentary osteometrics from the Queen St. location indicate similar ages. Any interpretations again have to take into account taphonomy: the anterior portions of the dentary of much smaller *Sander* would likely have fallen through the 6 mm screen. We therefore cannot know whether the absence of smaller individuals is “real.”

Most yellow walleye reach maturity at age 3–4 for males and 4–5 for females, blue walleye at age 3 for males and age 4 for females (Eakins 2012). Because the blue walleye subspecies grew more slowly and reached a smaller maximum length and weight than the yellow walleye (Adamstone 1922), it would have been sexually mature at a shorter length. So their age at mature would be shifted left on the graph in Figure 6. If some of the fish from the Peace Bridge site are blue walleye, then a larger proportion of them would be sexually mature than if they were yellow walleye, based on the dentary osteometrics. Unfortunately, the fact that we cannot tell the two subspecies apart based on osteology alone means we can’t access this extra detail for assessing method and timing of capture.

Discussion

Despite the availability of other fish, as well as other prey in the nearby marshes, the occupants of the Peace Bridge site seem to have emphasized the procurement of walleye, likely because it is a time- and labour-efficient fish to catch during its spring spawning run. A dearth of taxa that would be incidental or opportunistic catches for people exploiting the water’s edge (turtle, frog, muskrat, beaver, ducks) (Needs-Howarth 2005, 2009) suggests most fishing was carried out in open water, using a canoe. If the inhabitants were at the site during the early spring only for the spawning fish, some of these other animals would not have been readily available. Open-water fishing in a canoe would most likely have involved spearing or netting (see also Thomas 1997:445). Use of the latter method is evidenced by the hundreds of net sinkers recovered from the site (MacDonald et al. 1997:375-376; Austin and Jenkins 2006:398;

Williamson et al. 2008-2009:50-51; see also Prowse 2008-2009). If people were canoe fishing on the river rather than on the lake, we would suggest an intensive rather than incidental fishing effort, because it would have been quite dangerous. By necessity, the fishers would have selected a part of the river or lake that was wide and deep to stabilize their canoe and to ensure that they did not tip the canoe when bringing in the catch. The fishery on the St. Mary's River at Sault Ste. Marie, recorded by the Jesuit missionary Claude Dablon in the seventeenth century, may provide a useful analogue:

It is at the foot of these rapids, and even amid these boiling waters that extensive fishing is carried on, from Spring until Winter, of a kind of fish found usually only in Lake Superior and Lake Huron. It is called in the native language Atticameg, and in ours "whitefish," because in truth it is very white; and it is most excellent, so that it furnishes food, almost by itself, to the greater part of all these peoples. Dexterity and strength are needed for this kind of fishing; for one must stand upright in a bark Canoe, and there, among the whirlpools, with muscles tense, thrust deep into the water a rod, at the end of which is fastened a net made in the form of a pocket, into which the fish are made to enter. One must look for them as they glide between the Rocks, pursue them when they are seen; and, when they have been made to enter the net, raise them with a sudden strong pull into the canoe. This is repeated over and over again, six or seven large fish being taken each time, until a load of them is obtained. (Thwaites 1899:54:128-130)

In Cleland's (1982) model of the inland shore fishery in the Upper Great Lakes, gillnets appear in the Late Woodland. The logic of this model is applicable to the Lower Great Lakes. One of Cleland's hallmarks of gillnetting is the mass capture of spawning fish of select taxa within a restrictive size range, like we see in the Peace Bridge assemblage. The somewhat limited size range may

suggest some kind of size-selective netting gear, but we would need a bigger sample and more comparative data to say with any degree of certainty that gillnet technology was present in the Lower Great Lakes prior to the Late Woodland period. The absolute sizes of the majority of the bones measured suggest spring spawning run exploitation. This evidence fits with some of the other fish finds as well. As noted by Stanchly (2004), burbot move into tributary rivers in early spring (Scott and Crossman 1973:643), and may represent a chance inclusion in a catch consisting mainly of walleye. Sturgeon and suckers could also be chance spring catches. Following the three fisheries posited by Needs-Howarth and Thomas (1998), Centrarchidae and Ictaluridae (bullhead catfishes) are more likely to be incidental catches throughout the warm weather. Very few of these species were identified in the Peace Bridge site faunal assemblage (Table 1). Overall, the assemblage seems to conform to the targeted spring spawning run fishery posited by Needs-Howarth and Thomas (1998).

The richness and evenness of the fish assemblage, as well as the size distribution of the *Sander* sp. bones suggest people were present at the site just after the breakup of the ice—although the faunal assemblage as a whole does not rule out the possibility that the site was occupied at other times as well, including the winter, when walleye could be obtained by ice fishing. Regardless, the evidence suggests a relatively intensive harvest of this fish resource.

What, then, was the role of the fish harvest in the overall occupational regime of the site? Were the occupants of the site taking advantage of their time at the Onondaga chert outcrop to fish, or were they taking advantage of their time fishing to collect and process chert?

A comparison with the Martin site, located on Grand Island in the upper Niagara River, is instructive. Animal bone from the site was analyzed by Howard Savage and Patricia Ellis in the 1980s (Ellis 1985; Zubrow and Buerger 1994) and more recently by Stephen Cox Thomas (2004; Ingleman and Perrelli 2006; Ingleman et al. this volume). The Martin site yielded plenty of *Sander* and evidence of a fairly substantial occu-

pation, but there is no chert outcrop at this location. This evidence suggests that the availability of walleye was not unique within the upper Niagara River. As such, the massive size and longevity of the Peace Bridge site pre-contact Aboriginal occupation must be accounted for by more than this one resource.

Clearly, then, both intensive fishing and chert quarrying were important activities at the Peace Bridge site, as has been discussed in detail by Williamson et al. (2008-2009:60-63). Moreover, as these authors point out, the archaeological evidence documents not only exploitation of these and other resources, such as ground stone, mammals, birds, reptiles, and various nuts, but also sustained occupation in the form of extensive burial ceremonialism (Williamson et al. 2008-2009). This supports the idea that the Peace Bridge site was a major interconnection point, or “node,” in a pre-contact Aboriginal land-use network that was strategically situated in order to optimize access to the widest variety of important natural resources (MacDonald 2000). This network likely operated via transportation routes connecting the Lake Erie shore with significant inland waterways, such as the Niagara River. The key resources of this particular node include the following: Onondaga chert; a rich fishery; potable water; nearby access to lacustrine, riparian, and inland ecosystems rich in plant and animal food resources; and proximity to a relatively safe canoe crossing to the east side of the river via Lake Erie that would have avoided the treacherous currents. Among all of the available food resources, walleye was significant both for its reliability (walleye would occur every spring at that location) and for its ability to sustain an intensive level of harvest during the spring spawning run. It is therefore considered to be one of the primary attributes that attracted Aboriginal people to this location for thousands of years.

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Les fouilles accomplies par Archaeological Services Inc. sur le site du Peace Bridge (AfGr-9) au cours des 20 dernières années ont produit une collection de spécimens recueillis à l'occasion d'un relevé faunique. Cette dernière couvre la période Sylvicole. Les vestiges de poissons sont dominés par le genre Sander, qui, en Ontario, comportent les trois taxons communément connus sous les noms de doré noir, doré jaune et doré bleu. La représentation du caractère ostéologique des vestiges de poissons est irrégulière, probablement en grande partie liée au résultat de la survie préférentielle des parties solides du crâne et des vertèbres. Des comparaisons avec d'autres collections d'os de poissons de la période Sylvicole suggèrent que des dommages dus au piétinement auraient grandement contribué au processus de taphonomie sur ce site. L'ostéométrie indique que la plupart des espèces du genre Sander étaient sexuellement matures lors de la saisie et quelque peu limitées dans leur taille. Ces poissons ont probablement été obtenus de la rivière Niagara lors de leur migration du frai printanier en utilisant des techniques de saisie de masse telles que les filets. Le site du Peace Bridge représente un site nodal où les gens ont été attirés, pendant de centaines d'années, par un ensemble de ressources clés, y compris un affleurement de silex onondaga. De plus, il est soutenu qu'une autre ressource principale était l'approvisionnement prévisible de poissons. Ceci permettait aux gens de s'alimenter rapidement et sans trop d'effort de labeur, pendant la période qu'ils occupaient le site. Cette idée est soutenue en comparant la collection de spécimens recueillis à l'occasion d'un relevé faunique du site du Peace Bridge à celle du site Martin à proximité, qui est également dominé par l'espèce du genre Sander.

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Seasonality, Mass Capture, and Exploitation of Fish at the Steven Patrick Site, a Uren Period Village near Kempenfelt Bay

Alicia L. Hawkins and Erin Caley

This paper considers the three fisheries model for fish exploitation during the Uren substage of the Middle Ontario Iroquoian (MOI) period north of Lake Ontario. Data from the Steven Patrick site, a village near Kempenfelt Bay of Lake Simcoe, are compared with existing information from other Uren sites in the area. A study of the relationship between bone and body dimensions in yellow perch provides a baseline for estimation of the size of these fish caught by Uren fishers. This line of evidence in turn allows zooarchaeologists to consider whether or not perch were obtained in mass capture events during spawning. Size also serves as a rough proxy for age, which provides further information on the nature of the Uren fishery in Simcoe County. The three fisheries model is generally supported, and data from Steven Patrick suggests that the spring spawning fishery was particularly important. Yellow perch were caught when large in size and sexually mature. Faunal remains from one feature provide strong evidence of a connection between the Steven Patrick people and the north shore of Lake Ontario.

Introduction

Steven Patrick, an early Middle Ontario Iroquoian (MOI) site in Simcoe County, lies near a suggested pioneer Uren site—the Barrie site—and in a similar environmental setting. Faunal data from Barrie (Needs-Howarth 1999) form part of the basis for a three fisheries model hypothesized for Iroquoians in Simcoe County (Needs-Howarth and Thomas 1998). Our goals in this paper are to present the Steven Patrick faunal data in conjunction with settlement pattern information; to compare our findings with those from other Uren sites in Simcoe County, particularly as they pertain to the three fisheries model; and to introduce osteometric data and regression equations for one of the important taxa present. The nature of the use of fish and other fauna at early Middle Iroquoian sites such as the Steven Patrick site may help us to understand the relationship between the first Iroquoian settlers and the landscape and resources they made use of. We may in turn consider how Middle Ontario Iroquoians balanced

the demands of specific fisheries with other seasonal activities, including those related to horticulture, and why certain locations and species may have been considered attractive.

The Three Fisheries Model

Needs-Howarth and Thomas (Needs-Howarth 1999; Needs-Howarth and Thomas 1998; MacDonald and Williamson 2001) have investigated fishing in Iroquoian groups, particularly in the Lake Simcoe area. They proposed that Iroquoian fishers targeted particular fish species in different seasons, using slightly different technologies. Examination of the preferred habitat of different species (Pihl and Thomas 1997) served as a starting point for their research. Fish, however, utilize different habitats seasonally, and to understand human fishing preferences it is necessary to examine seasons of exploitation (Needs-Howarth and Thomas 1998:111). Some fish taxa are more easily caught during spawning because they aggregate

Table 1. *The three fisheries model, after Needs-Howarth and Thomas (1998).*

Fishery Type	Taxa Involved	Water Bodies Exploited	Technology Possibly Employed
Spring spawning run fishery	lake sturgeon, longnose sucker, yellow perch, walleye	inland	“harvest-level,” mass capture methods such as seine nets
Generalized warm weather fishery	piques, white sucker, bullheads, centrarchids (sunfish and bass), and non-spawning or immature perch	inland water bodies and bays	traps or weirs
Fall lake fishery	fall-spawning salmonid taxa: lake trout, lake herring, and lake whitefish	near-shore locations in large lakes	nets

and/or because they move out of deep waters. Through consideration of the different habitats used by fish seasonally, the co-occurrence in features of fish taxa that spawn at the same time and in the same locations, and the size of fish bones,¹ Needs-Howarth and Thomas (1998) proposed and refined a model they refer to as the three fisheries model (Table 1). This model includes the major species found in the Lake Simcoe area, but it does not include one of the taxa found in the Steven Patrick assemblage (Atlantic salmon) because this species would have been present in Lake Ontario and its connected waterways, and not in Lake Huron or its connected waterways.²

A modification of the model is proposed for occupants of the north shore of Lake Ontario, the likely homeland of incoming Uren migrants (van der Merwe et al. 2003). Researchers still posit three fisheries, but suggest that perch were mainly caught during the generalized warm season fishery, and walleye were more important as a spring spawning taxon. Atlantic salmon would have been

part of the fall fishery, but they would have been caught, together with eel, in riverine environments (van der Merwe et al. 2003).

Needs-Howarth and Thomas (1998) advocate a fine-grained approach to the analysis of faunal remains. They argue that it is through the co-occurrence of fish taxa in deposits such as features, which are inferred to reflect short-duration events, that analysts will come to understand the nature of Iroquoian fishing in Simcoe County. While not all features may reflect activities carried out in a space of a few weeks or a month, it is possible to compare feature contents with “site background.” Faunal remains found in ploughzone contexts, middens, and large refuse pits probably pertain to activities that occurred over a significant time frame. By contrast, features that are densely packed with bone likely reflect specific disposal events.

The Steven Patrick site provides an excellent opportunity to test this model. A large sample of faunal remains was available for analysis. Many of the elements showed excellent preservation and could be measured as well as identified. Some remains derived from features that may have been formed quickly. Other remains derive from a midden, which within it appears to have several, fairly discrete, high-density areas. These concentrations can be treated as individual proveniences, and their contents can be compared.

¹ Spawning fish are older, and hence larger, sexually mature individuals.

² This species is not represented in the samples that were used to test the three fisheries model in Simcoe County (Barrie, Dunsmore, and Carson [Needs-Howarth 1999]).

Middle Ontario Iroquoian Uren Settlement in Simcoe³

Ontario archaeologists generally agree that the Uren migration into Simcoe County in the late thirteenth century is a clear case of pre-contact colonization (Sutton 1996, 1999; Warrick 2008). As outlined by Sutton (1999), there are only a handful of known Early Ontario Iroquoian (EOI) archaeological sites in Simcoe County, and these

sites share common features. They are multi-component; lie near major bodies of water; and are interpreted as seasonal locations used for exploitation of fish or other fauna, or for trading. By contrast, several Uren sites are either single component or do not appear to have evidence for short-term seasonal revisits. Longhouses and extensive middens at Uren sites such as Barrie (Sutton 1999), Wellington (Archaeological Services Inc. 2005), and Steven Patrick (AMICK Consultants Limited 2003) indicate that these sites were occupied for reasonably long periods of time. One point of continuity between earlier seasonal EIO sites and Uren sites is the evidence for intensive use of fish.

Excavations of several sites in the Barrie area in the past twenty years have contributed to our understanding of the Uren colonization and subsequent Middleport occupation of Simcoe. Known Uren sites include villages such as the Barrie site (Sutton 1999), which lies north of Bear Creek, and the earliest two sites in the Wellington-Holly-Dykstra sequence, which are found on a promontory on the south side of Bear

Creek (Archaeological Services Inc. 2000, 2005, 2009) (Figure 1). Two sites are found beside Kempenfelt Bay, namely, Allandale (Carscallen 2001) and Ladywood (D.R. Poulton & Associates Inc. 1999). Steven Patrick lies slightly north of the Wellington-Holly-Dykstra sites and is identified as Uren based on pottery and pipe characteristics (AMICK Consultants Limited 2003).

Ladywood and Allandale are interpreted as short-term use locations for exploitation of local

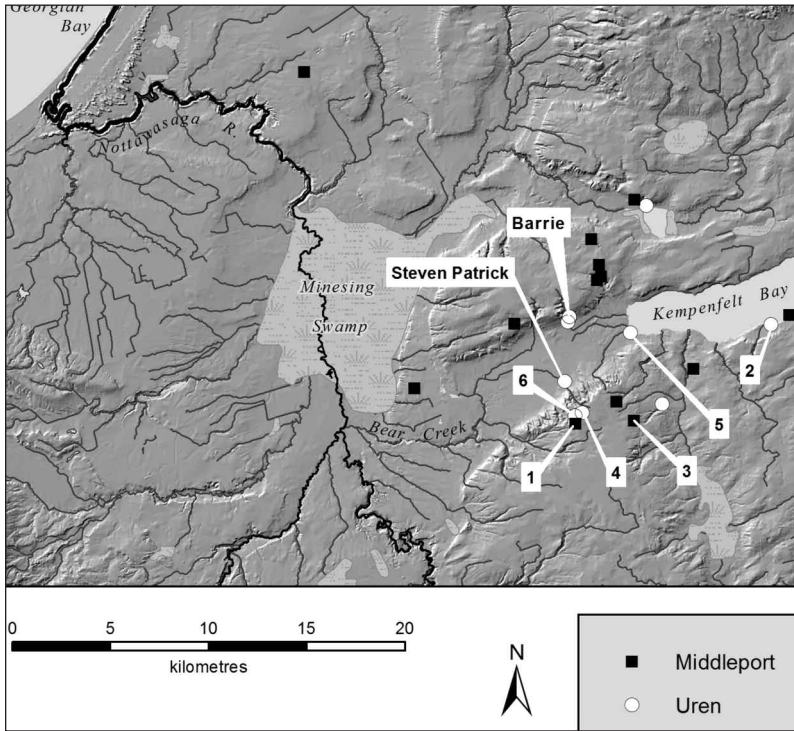


Figure 1. Map of the location of the Steven Patrick site and other Middle Ontario Iroquoian sites in Simcoe County. Sites that appear on the map are Dykstra (1), Ladywood (2), Waicek (3), Wellington (4), Allandale (5), and Holly (6).

³ The chronology of the Middle Ontario Iroquoian remains open to discussion. In this paper we follow Dodd et al. (1990) and place the Uren at A.D. 1280–1330 and Middleport at A.D. 1330–1400. However, few of the sites discussed have been dated using radiocarbon dating; age estimates are instead based on pottery seriation. The Middleport substage (1330–1400 A.D.) is characterized by a much more extensive Iroquoian occupation of Simcoe County.

fish resources. Poulton et al. (1999) did not recover any fish remains from Ladywood, but consider faunal preservation conditions to have been poor. The excavators recovered large quantities of fish remains from the midden at Allandale (Carscallen 2001). Wellington, Dykstra, Holly, all located in upland areas, vary in terms of site size and complexity. Wellington is considered to be the earliest among these sites; it is radiocarbon dated to A.D. 1256 ± 50 (Archaeological Services Inc. 2005). The settlement pattern includes two distinct houses separated by a large open space (Archaeological Services Inc. 2005). The houses differ in that one appears to have been subject to a number of rebuilding events, while the other was not. There are two middens, each associated with one of the houses. The excavators argue that this site may be a pioneering site in Simcoe. Holly is the largest in this site series, with four large houses and a number of smaller houses or special purpose structures (Archaeological Services Inc. 2009). There is one clear house at Dykstra and a number of structures, some of which may be windbreaks (Archaeological Services Inc. 2000). Overlapping houses are not evident at any of these sites, indicating single occupations without major rebuilding episodes. The Barrie site is found on what Sutton (1999:42) describes as the “margin of an upland area,” and examination of the location of Barrie in comparison with later MOI sites shows that at 245 metres asl it is at a lower elevation than later sites. Barrie lacks a palisade and has two houses of different orientations. One house has been extended, suggesting an occupation of some duration (Sutton 1999). Sutton (1999) also points out that the high density of features at the end of House 1 may pertain to an earlier house with a different orientation.

The Steven Patrick site would appear to most closely resemble the Barrie site, both in terms of physical location and in terms of site structure. Like Barrie, Steven Patrick lies at a relatively low elevation (240 metres asl). Located as they are on opposite sides of the wide, low-gradient valley that leads into Kempenfelt Bay, both are in a location that would provide access to wetland resources associated with the Minesing swamp a few kilometres to the west, and to resources associated

with Lake Simcoe and tributary streams and rivers. Soils in proximity to both these sites are classified as the Tioga series and are considered to be fair to poor productivity for crops, specifically maize (Hoffman et al. 1962:84). Soils near the upland sites have greater potential for crops. Today, the low-lying valley between Barrie and Steven Patrick has poor drainage; without substantial modification it is not useful for horticulture (Hoffman et al. 1962:68). MacDonald (2002) points out that the grain-size in the Minesing Basin is variable and that towards the edges of the basin deposited sediments would have been sandier. For this reason, locations close to the edges of uplands may have been better drained and better for horticulture. Additionally, the Minesing wetlands likely attracted a variety of wetland and other species. Recent work shows that today the wetlands provide a deer-yarding area, a waterfowl migration staging area, and a migratory corridor for fish taxa such as lake sturgeon (Bowles et al. 2007). In addition to similarities in site location, both Barrie and Steven Patrick show evidence of longhouses (unlike Allandale and Ladywood). There appears to have been more than one building event at both of these sites. The evidence for overlapping houses is not as strong at Barrie as it is at Steven Patrick, but the excavations at Barrie were not as extensive. In both cases, some houses have dense clusters of postmoulds in central locations, near hearths.

The excavators of Wellington suggest that the communities on the north and south side of the Bear Creek drainage were “distinct” (Archaeological Services Inc. 2005). If this was the case, the occupants of the Steven Patrick site might be expected to have some affiliation with the sequence of sites on the south side of Bear Creek (Wellington, Holly, and Dykstra).

Archaeologists have suggested a number of explanations for the Uren colonization of Simcoe County. Warrick (2008) enumerates these as follows: warfare (Finlayson 1998), climate change (Warrick 1984), trade (Hayden 1978), access to deer herds (Warrick 1990), and population pressure (Sutton 1996). As Warrick discusses, many of these explanations have weaknesses, and today population pressure appears to be one of the more

plausible ones. Two triggers that may have acted to push people out of the north shore of Lake Ontario region include increasing social tensions arising from conflicts in ever-growing communities, and a decline in the population of deer, a fundamental resource for both food and clothing. It is unlikely that Uren people would have been attracted to Simcoe County because of the presence of deer populations there; faunal samples from sites in Simcoe are dominated by fish remains and differ fundamentally from samples from the north shore of Lake Ontario (e.g., Stewart 1999). However, settlement in Simcoe County would place people in closer contact with their Algonquian trading partners, who would have been able to provide deer hides (Warrick 2008). Whatever the reason for the colonization of Simcoe County, the fact that EOI components—possibly sites utilized by the ancestors of the MOI colonists—exist beside major bodies of water and are interpreted as seasonally occupied fishing camps (Sutton 1996)⁴ suggests that migrants to the area were aware of the existence of rich aquatic resources.

The Steven Patrick Site

The Steven Patrick (BcGw-70) archaeological site was identified by AMICK Consultants Limited during the course of an archaeological assessment in advance of development of a property located in Barrie (AMICK Consultants Limited 2003). The site is located at the base of the Ardagh Bluffs, on the south side of a lowland area that extends west from Kempenfelt Bay, at an elevation of approximately 240 m asl. To the east of the site is Bear Creek, a tributary of the Nottawasaga River. The Nottawasaga River flows through the Minesing swamp before draining into Georgian

Bay. This location put the site in proximity to two large lakes: Lake Simcoe, which lies 4.3 km to the east as the crow flies, and Lake Huron, which lies 30 km to the west. Additionally, both a small tributary watercourse (Bear Creek) and a larger river (the Nottawasaga River) are found nearby. The Minesing swamp represents a fourth type of aquatic environment near the site.

AMICK Consultants Limited (2003) consider the location of the site unusual and point out that the site holds potential for insight into the range of environments used by Uren peoples. It differs from the location of some early sites (Wellington, Holly) and the preferred Middleport and later settlement locations in upland areas near Kempenfelt Bay (e.g., Dykstra, Hubbert, Wiacek, and others, see Robertson et al. [1995]).

The identification of the site as Uren is based on attributes of the recovered pottery and pipes. Specifically, these are (1) a significant number of body sherds that show ribbed paddling or smoothed over ribbed paddling; (2) the presence of sherds of the Iroquois Linear type; and (3) a lack of bossed pottery (AMICK Consultants Limited 2003). The two recovered pipe fragments are “of primitive form” (AMICK Consultants Limited 2003). The site excavators are confident that there is no evidence for anything except a Uren occupation of this site (AMICK Consultants Limited 2003).

The excavation of the site indicated that it is greater than 0.5 ha in size and consists of at least five houses representing two periods of house construction based on house orientation (Figure 2).⁵ Houses 2 and 4 are oriented north-west to south-east, while Houses 1, 3, and 5 are approximately east-west in orientation (AMICK Consultants Limited 2003). It is likely that houses of the same orientation relate to the same building and occu-

⁴ Sutton (1996) points out that the archaeology of Simcoe County is well known. More than 100 years of archaeology in this region has not produced any evidence of EOI villages. We may also assume that the distribution of known EOI components does reflect their actual distribution: many of the known archaeological sites in Simcoe County were discovered by farmers at inland locations.

⁵ The portion of the Steven Patrick site to be impacted by development was completely excavated; however, it is not clear that this is a complete excavation of the site because it may have extended north where Ardagh Road now lies, or east into an area protected for environmental reasons.

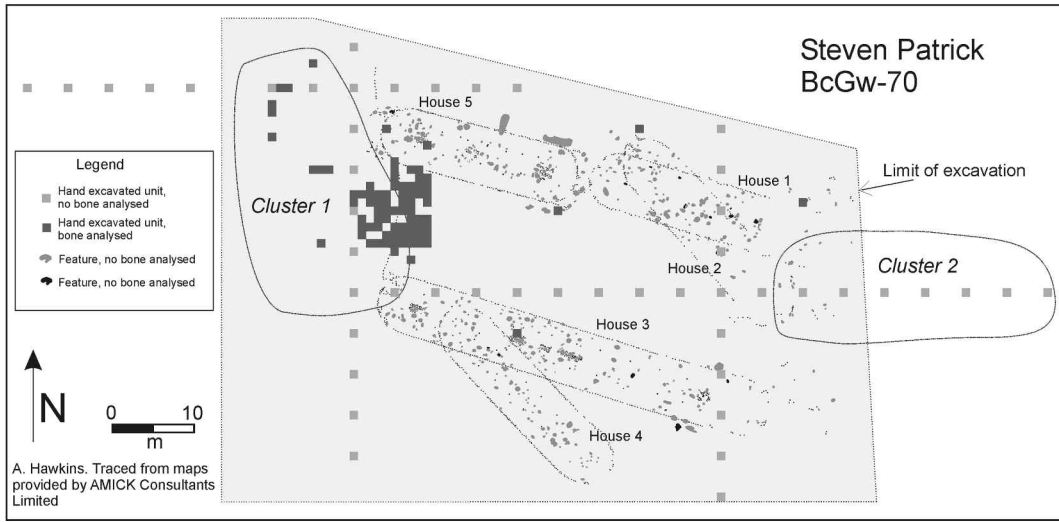


Figure 2. Settlement pattern at the Steven Patrick site, showing the location of analyzed and unanalyzed features and units.

pation episode. Indeed, Houses 3 and 5 are connected by a series of posts that may indicate a fence or windbreak. Together with the overlapping of House 1 by House 2 and of House 3 by House 4, this suggests that one period of occupation saw Houses 2 and 4 occupied, while the other saw Houses 1, 3, and 5 occupied. The grouping of Houses 2 and 4 will be referred to as Occupation A; that of Houses 1, 3, and 5 as Occupation B. While it may be possible to infer their order, at this time none is suggested. It should be noted that there is no overlap between House 5 and any

other house. Its association with House 3 is clear both from the fence and from the concentration of interior posts associated with hearths that exist in these two houses but no others. House 5 has the potential to have been occupied during both of the occupations, although it clearly has a stronger association with Occupation B.

At Iroquoian sites with archaeological evidence of longhouses in southern Ontario, the duration of longhouse use has been estimated based on the number of posts per metre of wall because over time the walls will require repair and new posts

Table 2. Summary of characteristics of houses from the Steven Patrick site. Based on diagrams provided by AMICK Consultants Limited.

	House Wall Length (m)	No. of Wall Posts	No. of Wall Posts/m	No. of Features	No. of Features/m of Wall	Average Hearth Spacing (m)
House 1	50	157	3.1	—*	—*	4.5
House 3	92	320	3.5	152	1.7	5.9
House 5	55	284	5.2	90	1.6	7.8
Occupation B total			3.9			6.1
House 2	46	132	2.9	—*	—*	6.5
House 4	60	201	3.4	78	1.3	8.0
Occupation A total			3.1			7.3

* The overlap between Houses 1 and 2 makes determination of the number of features per house impossible.

will be inserted (Timmins 1997; Finlayson 1985; Dodd 1984; Warrick 1988). Table 2 summarizes this information for Steven Patrick. For both inferred occupations, the number of posts per metre is low. This low frequency suggests that the houses were not subject to long-term use and repair during either occupation. Wall post density at the Glen Meyer Calvert site is slightly higher than that estimated for Steven Patrick (Timmins 1997:79-80) and the estimated duration of occupation for each of the three Calvert phases is approximately 20 years. Notwithstanding differences in climate, soils, and timber employed, if each occupation of Steven Patrick represented less than 20 years, it is entirely possible that both occupations occurred during the Uren substage. The recovered artifact assemblage supports the idea that both periods of construction and occupation occurred during the Uren substage.

Overlapping houses are uncommon on Uren sites (Warrick 2008:174). At EOI sites, the presence of multiple overlapping houses has been interpreted as indicative of episodic and possibly seasonal use of sites over a long period of time (Williamson 1990). In the case of these sites, winter season occupation is inferred. The Steven Patrick site shows unequivocal evidence for multiple building episodes, but it may not be alone (cf. Barrie, Sutton 1999:45).

There are some observable differences in the houses from the two periods at Steven Patrick. Overall, Occupation B houses have slightly higher numbers of posts per metre of wall, slightly higher density of features, and slightly lower spacing of hearths. Concentrations of posts around hearth features are found only in Houses 3 and 5. With the exception of the last point, some of the observed differences may arise from variation in preservation conditions. Examination of Figure 2 suggests that in some locations posts must have existed, but their traces were not observable at the time of excavation. The same may be true of hearths. Notwithstanding this, it would appear that the occupation of Occupation B houses was slightly longer or involved more people, or both. Because the excavated area does not encompass the entire site, and because the total lengths of several houses are unknown, it is impossible to assert

with certainty that the group occupying the site during Occupation B was larger, but this is the impression one is left with.

Houses 3 and 5 have dense clusters of post-moulds in the centres of longhouses, suggestive of use of these areas as sweatlodges (Tyyska 1972) or as areas where people carried out food preparation or preservation activities. In contrast with some sites discussed by Tyyska (MacDonald 1988), where clusters of posts are not associated with hearths, at the Steven Patrick site, each cluster surrounds a feature identified as a hearth. For this reason we believe it more likely that these pertain to food preparation or preservation activities.

In sum, the settlement pattern from Steven Patrick shows clear evidence for two occupations, possibly involving different population sizes, or different times of the year. Because of the overlapping nature of the settlements, in most cases it is impossible to associate features or deposits with either Occupation A or Occupation B.

Faunal Sample

The excavation of the Steven Patrick site resulted in the recovery of more than 7,078 faunal specimens. Although survey and assessment of the site recovered some faunal remains, those examined in this paper derive exclusively from the final mitigative excavations. The excavation methodology employed included hand excavation of one by one metre units in two areas previously identified as having high artifact density (AMICK Consultants Limited 2003). Figure 3 shows the locations of units and features from which the bone samples derived.

At this time, it is not possible to definitively associate the faunal remains with one occupation specifically. The units with the highest concentration of faunal remains occur on both sides of the fence or windbreak connecting Houses 3 and 5. If all high-density units lay outside the fence, it might be tempting to suggest that the deposits pertained to Occupation B; however, this is not the case, and at this time our hypothesis is that the western part of the site was a disposal area in use during both occupations.

The area designated Cluster 1 was particularly

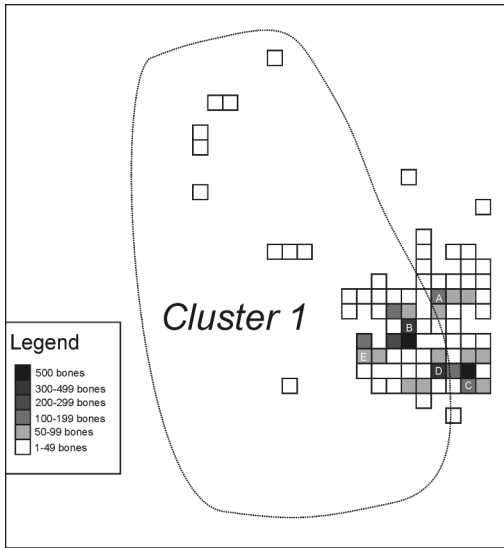


Figure 3. *Density of bone per unit at the Steven Patrick site.*

rich in faunal remains, while only a few bone fragments derive from units in Cluster 2. Subsequent to hand excavation of midden areas, AMICK Consultants Limited undertook mechanical stripping of the site, shovel shining, documentation of settlement patterns, and excavation of features. Fieldworkers retained sediment samples from features for flotation; therefore, the faunal samples from features discussed here represent only a portion of the faunal material recovered from each individual feature. Fieldworkers followed the standard screening procedures in use in Ontario at each stage of excavation: sediment was passed through 6 mm screen mesh, and sorting occurred in the field.

Figure 3 shows the locations of units and features from which the bone samples derived. Clearly, few features contained analyzed faunal bone. In many of the analyzed features it was not possible to identify the specimens to a taxonomic level below class. Most of the features for which bone exists cannot be assigned to either Occupation A or Occupation B with any certainty. The vast majority of identifications come from the area referred to as Cluster 1.

Faunal Analysis

Methods

A total of 7,078 faunal specimens were examined and identified to as low a taxonomic category as possible. Analysts⁶ undertook identification of the sample using the comparative collection at Laurentian University in Sudbury. This collection is relatively complete for mammals found in Ontario, but lacks some species of birds, reptiles, and fish. Clearly identifiable elements for which we could find no match were re-examined using the Howard Savage Faunal Archaeo-Osteology Collection at the University of Toronto. In addition, we were able to use collections at the Royal Ontario Museum (Vertebrate Palaeontology) for comparison of the bones identified as salmonids. In some cases identification was possible only to the level of class or order. Some categories of material are difficult to identify below family; in particular, fish vertebrae are frequently only identified to this level. In addition to identifying the element and taxon, analysts examined each bone or fragment for evidence of cultural or natural modifications, such as burning, working, or gnawing.

Taphonomy

The sample of 7,078 faunal specimens comprises all of the bone we were provided with from one by one metre squares and features; we did not examine materials from proveniences described as roots. We were able to tentatively assign most fragments to class (Table 3).⁷ Overall the faunal specimens showed good preservation, and this led to a high rate of identification at the below-class level as well. We were able to identify 4,298 specimens (Table 4), or about 60% of the sample, to a

⁶ Erin Caley, Elaine Cheng, and Andrew Meehan made the initial identifications in the context of an undergraduate course. Subsequently, E. Caley (2008) used this material as the basis for her undergraduate thesis, and she verified the earlier identifications. Approximately one-third of the sample remained unidentified, and Alicia Hawkins completed the analysis.

⁷ Some small bird and mammal fragments may have been misidentified, but these classes of fauna are relatively small contributors to the sample.

Table 3. *Distribution of zooarchaeological remains by vertebrate class at the Steven Patrick site.*

	n	%
Bivalves	144	2.0
Fish	6144	86.8
Amphibians	16	0.2
Reptiles	21	0.3
Birds	25	0.4
Mammals	715	10.1
Total	7065	99.8

taxonomic category of order or lower.

Other taphonomic factors contribute to this high rate of identification. As discussed below, the assemblage is dominated by fish bone. Fish bone does not appear to have been systematically subjected to heating, with only 0.4% of the bones

mammalian bone and only on a very small proportion of the specimens. It is possible that if fish elements were subject to carnivore ravaging they would be nearly or completely destroyed.

The analyzed remains derive from two types of proveniences, namely, middens and features, and the taphonomic processes applicable to each differ. The midden deposit included an area of intact deposits of about 10 metres by 10 metres (AMICK Consultants Limited 2003). However, because these deposits are overlain by plough-disturbed sediments, some of bone from the midden would have been subject to breakage because of ploughing. Bone recovered from features was exclusively recovered from below the ploughzone. We did not estimate breakage in our analysis, but examination of the proportion of unidentifiable fragments may provide insight into the variability between midden and feature contexts. Surpris-

Table 4. *Number of specimens of vertebrate taxa identified below the level of class at the Steven Patrick site. Number in parentheses represents the proportion of the total by provenience.*

	1 m ² Units				Features	Total
	Settlement Exterior	Cluster 1	Cluster 2	House Interior		
Fish	12 (0.75)	2365 (0.89)	4 (0.67)	1 (1)	1597 (0.98)	3979
Amphibians	0	1 (0.00)	0	0	0	1
Reptiles	0	19 (0.01)	0	0	2 (0.00)	21
Birds	0	16 (0.01)	0	0	4 (0.00)	20
Mammals	4 (0.25)	246 (0.09)	2 (0.33)	0	25 (0.01)	277
Total	16	2647	6	1	1628	4298

showing evidence of burning. The possibility that some fish bone was heated to the point of complete disintegration appears unlikely because denser bones such as vertebrae also do not show evidence of heating. In general, heating of mammalian bone reduces identification rates because bone breaks into small, undiagnostic fragments. Nearly 36% of mammalian fragments show evidence of burning, but the biasing effect of this burning is proportionately small because mammal bones contribute comparatively little to the assemblage. Reptile and bird bones also show some degree of burning, but they are even less important components of the assemblage. Carnivore and rodent gnaw marks were observed only on

ingly, there is little difference in the proportion of unidentifiable mammal fragments from the midden (62%) and Feature 1406 (64%).⁸ The same is true for fish bone—27% are unidentifiable in the midden and 21% in Feature 1406.⁹

We may also compare midden and feature contexts in terms of proportions of evidence for

⁸ Feature 1406 is selected as an example of the nature of bone in features because there are many bones in this feature and they are similar in nature to those recovered from the midden.

⁹ The proportions are different for Feature 1250, but, as is discussed below, the fauna represented in this feature differs from that elsewhere on the site.

carnivore gnawing, rodent gnawing, and digestion. If bone was exposed on the surface of a midden, we might expect a higher degree of interference by carnivores and other animals compared with contexts where bone was buried quickly. Gnaw marks and evidence of digestion are very rare in the assemblage, but occur exclusively in the material from the midden. A partial explanation for this dichotomy is that these types of modifications are usually found on mammal or bird bone, and there is a higher proportion of such bone in the midden.

Burning of bone also varies between midden and feature contexts. Approximately 5% of bone from the midden is burnt, while only 0.5% of bone from Feature 1406 is burnt. A similar explanation may pertain here: burning occurs more frequently on mammal bone, and mammal bone is represented in higher proportion in the midden. Examination of degree of burning and location of burning can provide important insights on taphonomy (Asmussen 2009), but such a study is beyond the scope of this paper.

Taphonomic factors that may explain the high rate of identification include those which relate to recovery and identification. The use of 6 mm mesh for screening likely resulted in the retention of many highly identifiable fish bones and the loss of others, including undiagnostic bones such as fish ribs and spines (Gordon 1993; James 1997). In terms of identification, yellow perch are an important species in the assemblage, and many of the cranial bones of this fish are distinctive and can be identified when only partially represented.

Spatial Distribution of Faunal Remains

A total of 25 features contained faunal material. The average number of specimens per feature is quite low. If two outliers are excluded, the mean number of bones per feature (for those features that contained bone) is less than 10. With the exception of a single very rich feature, only mammal, fish, and bivalve remains are known from features. The taxa represented in features appear to be generally similar to those recovered from elsewhere on the site, in terms of both the species present and the proportional distribution. In particular, perch remains appear to be present in

features in nearly the same proportion as they are present in the overall sample. A number of taxa are not found in features, but, with the exception of canids, those not found in features are represented by less than 20 identifications overall, or less than 0.5% of the total NISP. In light of this, we argue that, with two exceptions, the faunal remains in the features probably represent site background rather than specific behavioural events.¹⁰

Two features at Steven Patrick do have dense concentrations of bone. Feature 1250 contained 864 faunal specimens, and all except two are identified as fish. This feature is a small one that may be associated with either House 3 or House 4. Feature 1406 contained 1466 faunal specimens, most of which were also fish. A small number of bones are attributed to mammals (NISP 28), birds (NISP 4), and reptiles (NISP 2). This feature is interpreted as an exterior feature.

The remainder of the identified specimens derive from 82 one-metre-square units from across the site. Most of these are located on the western part of the settlement (Cluster 1, see Figure 3), and two or three particularly dense concentrations occur within this area. Fish remains account for about 80% of the bones recovered from one by one metre units. In the few instances in which mammal bones account for a large proportion of the faunal remains from the unit, the total number of identifications for the specific unit is quite low.

General Characteristics of the Faunal Assemblage

The breakdown of the identified sample shows

¹⁰ We found no evidence, for example, for possible behaviour suggested for the Wellington site (est. date A.D. 1275) and Holly site (estimated date A.D. 1280–1330), where a number of mammals were interred together in pits (Archaeological Services Inc. 2005, 2009). Archaeological Services Inc. (2005) argues that these features represent animal ossuaries. The taxa represented in the features include primarily fur-bearers, such as beaver, muskrat, and mustelids. While such taxa are present at Steven Patrick, they do not appear to occur together interred in pits, and therefore the behaviour seen in the upland group of sites appears, so far, to be unique to that location.

that fish taxa are clearly the most significant (Table 4) in terms of relative abundance as measured by NISP. Mammals make a small contribution, and other classes are negligible in terms of the propor-

tion of the overall NISP of the sample. Table 5 shows the identifications of non-fish vertebrates. Mammalian taxa include a reasonable number of both rodent and carnivore identifications, with

Table 5. Amphibians, reptiles, birds, and mammals identified at the Steven Patrick site. Nomenclature follows the Integrated Taxonomic Information System, accessed at www.ITIS.gov. Taxonomy follows Conant (1958), Hughes (2001), and Banfield (1981)

Order	Taxon Identified	Common Name	NISP	Total by Order
Anura	Anura	Frogs and toads	5	6
	Ranidae	Frogs	1	
Testudines	Testudines	Turtles	1	21
	<i>Chelydra serpentina</i>	Snapping turtle	4	
	Emydidae	Box and wood turtles	9	
Gaviiformes	<i>Chrysemys picta</i>	Painted turtle	7	7
	Gaviidae	Loons	6	
Anseriformes	<i>Gavia immer</i>	Common loon	1	1
	<i>Branta canadensis</i>	Canada goose	1	
Galliformes	<i>Bonasa sp.</i>	Grouse	1	7
	<i>Bonasa umbellus</i>	Ruffed grouse	5	
	<i>Meleagris gallopavo</i>	Wild turkey	1	
Columbiformes	<i>Ectopistes migratorius</i>	Passenger pigeon	4	4
Lagomorpha	Leporidae	Rabbits and hares	11	11
Rodentia	Sciuridae	Chipmunks, marmots, squirrels	3	109
	<i>Tamias striatus</i>	Eastern chipmunk	1	
	<i>Marmota monax</i>	Woodchuck	8	
	<i>Sciurus carolinensis</i>	Gray squirrel	4	
	<i>Tamiasciurus hudsonicus</i>	Red squirrel	10	
	<i>Castor canadensis</i>	American beaver	70	
	Cricetidae	Mice and voles	5	
	<i>Peromyscus sp.</i>	Deer mice	1	
	<i>Ondatra zibethicus</i>	Muskrat	5	
	<i>Erethizon dorsatum</i>	Porcupine	2	
	Carnivora	Canidae	Dogs, foxes and wolves	
<i>Canis lupus cf. familiaris</i>		Dog (probable)	35	
<i>Canis lupus</i>		Gray wolf	12	
<i>Vulpes vulpes</i>		Red fox	2	
<i>Ursus americanus</i>		Black bear	17	
<i>Procyon lotor</i>		Raccoon	15	
Mustelidae		Mustelids	11	
<i>Martes penanti</i>		Fisher	4	
<i>Martes americana</i>		Marten	5	
Artiodactyla		Cervidae		10
	<i>Odocoileus virginianus</i>		4	

beaver being important among the rodents. Dog and dog family species are clearly the most important carnivores. Deer are a possibly surprisingly small contributor. No particular group among the birds, reptiles, and amphibians stands out as particularly important.

It is perhaps more informative to examine taxa not by taxonomic category but rather in terms of the habitat that those taxa prefer. This procedure may allow for inference about human niche exploitation. Ontario archaeologists have used a range of methods in this regard (Berg 1986; Stew-

Table 6. *Percent of NISP of non-fish taxa by habitat preference at three Uren period sites in Simcoe County. Note that some categories are not exclusive, and totals do not add to 100%. Data from Barrie are from Needs-Howarth (1999) and exclude a possibly intrusive woodchuck; data from Allandale are compiled from Carscallen (2001).*

	Steven Patrick	%
Marsh	52	42
Water's edge	0	1
Water	2	1
Forest edge	10	38
Forest	23	26
Village	23	10
Village/fields	14	49

Table 7. *Percent of NISP of non-fish taxa used for various purposes at three Uren period sites in Simcoe County. Note that categories are non-exclusive, and totals do not add to 100%. Data for Barrie and Allandale are compiled from Needs-Howarth (1999) and Carscallen (2001), respectively.*

	Steve Patrick (n=318)	Barrie (n=387)	Allandale (n=46)
Meat	52	42	15
Fur/hides	0	1	2
Plumage	2	1	0
Companion	10	38	2
Pests	23	26	39
Accidental/ intrusive	23	10	41
Ritual	14	49	37

art 1999; Needs-Howarth 1999). In this case, we have used the categories established by Needs-Howarth (1999:103) for her analysis of the Barrie site material. Table 6 shows the percent of total NISP of non-fish identifications for three Uren sites in Simcoe County. Steven Patrick shows some interesting differences when compared with the other two sites. The proportion of taxa that prefer marshes is high compared with the other two sites, and the proportion of taxa that prefer forest-edge habitats and village/fields is low compared with the Barrie site. It is not low compared with Allandale, but this site is interpreted as a fishing station and is located in a different type of environment than Steven Patrick and Barrie. While Steven Patrick may not represent the earliest Uren site in Simcoe, the lack of species preferring forest-edge and village/fields habitats may suggest that there were relatively few field habitats near the settlement to attract such species. Alternatively, if the site was not occupied year-round, faunal exploitation may have been focussed on obtaining taxa from other niches. The relatively high proportion of species that use marsh habitats is not surprising given the location of Steven Patrick.

We may also consider the non-fish taxa in terms of their potential uses. Table 7 shows the proportion of NISP of such species broken down by possible uses. Clearly this reduces the data considerably, and involves making assumptions about how people interacted with species. Most animals could be used in multiple ways; for this reason, percentages do not add to 100%. These data show that in all of the three Uren sites examined, the non-fish taxa are mainly those that could be used for meat and/or hides/furs and plumage. The proportion of companion species (dogs) varies considerably, and the number of bones attributed to accidental catches (i.e., of diving birds in nets) or intrusive species (i.e., skeletally intact woodchuck) is lower at Steven Patrick than at Barrie or Allandale.

Seasonality

Determining the season of use of archaeological

Table 8. *Estimated periods of availability of bird species represented at the Steven Patrick site. After Stewart (1999) and Godfrey (1986)*

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Common loon	-----	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	-----
Canada goose	-----	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	-----
Grouse	+-+-+	+-+-+	+-+-+	+-+-+	+-+-+	+-+-+	+-+-+	+-+-+	+-+-+	+-+-+	+-+-+	+-+-+
Wild turkey	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++
Passenger pigeon	-----	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	+++++	-----

sites based on faunal remains is not straightforward. A lack of species does not mean that there was no habitation during this season, but rather that people may have relied on stored foods. Furthermore, determining season of death of most species is difficult. Migratory birds provide one method of determining when species were taken; however, curation of bird bone in the form of wings or bird bone tools complicates this assessment of seasonality. Table 8 shows the avian taxa identified and the seasons during which they are most active using the framework established by Stewart (1999:175,183). Grouse and wild turkey are non-migratory, and therefore could have been caught at any time of the year. The other three species represented are not present in the area during the winter and are therefore suggestive of a spring through fall catch.

Reptiles and amphibians may also be seasonal indicators. While toads are inactive in the winter, they are also fossorial and may be intrusive. By contrast, turtles are more clearly associated with human activity. Two turtle species were identified, although others may be represented in the collection too. Snapping turtles and painted turtles both hibernate in water, and therefore these provide further support for a spring through fall occupation.

All of the mammalian taxa represented are present in the area throughout the year, although some species are less active during the winter.

In sum, an occupation during the spring, summer, and/or fall is clearly indicated. Nothing exists to exclude the possibility of a winter occupation as well, because people may have relied on stored foods or on taxa, such as non-hibernating mammals, that are available year-round.

Diversity and Richness

A final comparison with other sites may also reflect the nature of the habitats exploited and the seasons of use. Richness refers to the number of taxa represented. In ecological studies, this refers to the number of taxa within a community or region; in zooarchaeology this refers to the number within an assemblage. As the sample size increases, the chance of encountering a rare species also increases; measures of diversity attempt to account for variation in sample size (Reitz and Wing 1999). Evenness refers to the proportional representation of taxa within an assemblage. Where many taxa are represented by only a few specimens and one or two taxa are represented by many specimens, there is low evenness (Banning 2000). We would expect to find relatively low richness and diversity and high evenness at sites that were used for a restricted period during which people focussed on food-getting within a narrow time frame and/or niche. Alternatively, exploitation of a particularly rich niche would result in higher measures of richness and diversity and possibly lower evenness.

Table 9 shows estimates of richness (s) and diversity. Evenness has not been calculated because it is clear from examination of the breakdown of identifications by class that none of the assemblages are particularly even. Richness and diversity measures were calculated by using only non-overlapping taxonomic categories. For example, the sample from Steven Patrick contained a number of identifications to the family Catostomidae, but none to the genus *Catostomus* or *Moxostoma*. In this case, Catostomidae identifications were included in the calculations. The same sample

Table 9. *Estimators of richness and diversity for three Uren sites in Simcoe County. Data for Barrie and Allandale are compiled from Needs-Howarth (1999) and Carscallen (2001), respectively.*

	Steven Patrick	Barrie	Allandale
n (includes only the identifications used in calculations)	3098	673	260
s (number of taxa)	38	43	21
Total diversity $dI=s-1/LN(n)$	4.60	6.45	3.60

included identifications to the order Perciformes, the family Percidae, and the genera *Perca* and *Sander*. Only identifications of *Perca* and *Sander* were included because the Percidae and Perciformes could be representatives of *Perca* or *Sander*. Cruz-Urbe (1988) and others use MNI as the basis for estimating diversity and richness. As Stewart (1999:73) points out, very few Iroquoian assemblages have MNIs that are sufficiently high for “valid richness and diversity calculations,” and in this case we use NISP instead of MNI. While NISP is sensitive to fragmentation, the variable number of elements in the body, and differential identifiability of elements (Reitz and Wing 1999), it can be considered a general estimator of the distribution of species within an assemblage. It should also be noted that the number of taxa identified is sensitive to inter-observer variation and the nature of comparative collections used. Those analysts with access to very complete reference collections are likely to be able to make more detailed identifications, and thus will have a higher number of taxa.

With the above caveats noted, it is interesting to observe that the Steven Patrick site, with a significantly higher number of identifications compared with the Barrie site, has a much lower diversity index. The number of taxa represented at each site is similar, but the number of identifications for Steven Patrick is over four times that from Barrie. That more taxa are identified at Barrie, even with a lower number of total identifications, indicates a greater diversity of taxa. Allandale, identified by the excavators as a fishing locality (Carscallen 2001:70), has the lowest diversity index of the three sites. It is likely that some of this difference may be attributed to variation in the nature of reference collections and experience of analysts. However, if we accept that at least

some of the difference relates to real variation between the two sites, this suggests that the Barrie occupants were using a wider range of habitats. A number of explanations are possible. One is that the Barrie residents were more permanently settled, while the Steven Patrick residents used the village on a more seasonal basis. A more equal dependence on the three different types of fishery would increase diversity, so there may be some difference in the reliance on different fisheries. Finally, as discussed above, if Steven Patrick was an earlier site, the number of forest edge taxa available for exploitation may have been lower.

Fish Exploited

As indicated above, fish remains dominate the overall sample. Table 10 shows the distribution of taxa within the Steven Patrick sample compared with the distribution at Barrie and Allandale. At Steven Patrick, half of the remains identified to a taxonomic level of family or lower are yellow perch. An additional 17% are identified as perch family; given the low proportion of walleye (the other species in the family present), it is likely that many of these are also yellow perch. While a number of other fish taxa are present, only a few other groups make a significant contribution. Salmon family species account for 12% of the identifications, suckers for another 12%, and bullheads and walleye for 3% each. All other taxa represent 1% or less of the total identified fish assemblage. Perch are also significant contributors at Barrie and Allandale, but at Barrie they account for only 32% of the fish identifications and at Allandale for 10%.

This breakdown can also be examined by provenience; taxa are not distributed evenly across the site at Steven Patrick. Table 11 shows the percentage distribution of fish families by feature, and

Table 10. Identification of fish from the Steven Patrick, Allandale and Barrie sites. Data for Barrie and Allandale compiled from Needs-Howarth (1999) and Carscallen (2001), respectively.

Taxon	Common Name	Steven Patrick		Barrie		Allandale	
		n	p	n	p	n	p
<i>Acipenser fulvescens</i>	Lake sturgeon	21	0.01	85	0.22		
Salmonidae	Salmon family	330	0.08				
<i>Salmo salar</i>	Atlantic salmon	35	0.01				
<i>Salvelinus namaycush</i>	Lake trout	74	0.02	7	0.02	4	0.01
<i>Coregonus clupeaformis</i>	Common whitefish	52	0.01				
<i>Coregonus</i> sp.	Whitefish sp.			1	0.00		
Esocidae	Pike family	54	0.01	10	0.03		
<i>Esox masquinongy</i>	Muskellunge			4	0.01		
<i>Esox lucius</i>	Northern pike	18	0.00	29	0.08	5	0.01
Catostomidae	Sucker family	469	0.12				
<i>Catostomus commersoni</i>	White sucker			13	0.03	110	0.31
<i>Catostomus catostomus</i>	Longnose sucker			3	0.01	24	0.07
<i>Catostomus</i> sp.	Sucker sp.			25	0.07	103	0.29
<i>Moxostoma</i> sp.	Redhorse sp.					2	0.01
Ictaluridae	Catfish family	126	0.03	2	0.01	12	0.03
<i>Ictalurus punctatus</i>	Channel catfish			1	0.00		
<i>Ameiurus nebulosus</i>	Brown bullhead			25	0.07	1	0.00
<i>Lota lota</i>	Burbot	4	0.00				0.00
Centrarchidae	Sunfish family	8	0.00			5	0.01
<i>Ambloplites rupestris</i>	Rock bass			4	0.01		
<i>Lepomis gibbosus</i>	Pumpkinseed	1	0.00	19	0.05		0.00
<i>Micropterus dolomieu</i>	Smallmouth bass	2	0.00	7	0.02	4	0.01
<i>Micropterus salmoides</i>	Largemouth bass			12	0.03	14	0.04
<i>Micropterus</i> sp.	Bass			10	0.03		
Percidae	Perch family	650	0.17			36	0.10
<i>Perca flavescens</i>	Yellow perch	1947	0.50	122	0.32	35	0.10
<i>Sander</i> sp.	Walleye or Sauger	16	0.00	1	0.00		
<i>Sander vitreus</i>	Walleye	110	0.03			1	0.00
<i>Aplodinotus grunniens</i>	Freshwater drum	2	0.00				
<i>Total fish identifications</i>		3919		380		356	

Table 12 shows the breakdown for groups of high-density one-metre-square units. Mapping of the units by number of faunal remains recovered shows that there are areas of greater and lower density within Cluster 1. Units with greater than 25 identified fish elements were grouped with other nearby high-density units to determine if any variation in the nature of deposited items

occurred among these higher-density areas or concentrations. The fence or windbreak also served to separate groups: units in groups A and B are adjacent, but A lies inside the fence; the same is true of C and D, with C lying inside. The possible concentrations are shown in Figure 3.

Percidae are represented in every feature where fish were recovered. In most cases, perch family

Table 11. *Percentage breakdown of fish remains by family and provenience at the Steven Patrick site.*

Feature Number	1015	1026	1048	1105	1110	1142	1143	1146	1159	1170	1250	1404	1406
NISP	2	5	4	15	2	1	3	18	14	5	379	13	1112
Acipenseridae (Sturgeons)	0	0	0	0	0	0	0	0	7.1	0	0	0	0.1
Salmonidae (Salmons)	0	0	0	0	0	0	0	0	0	0	86.8	0	1.3
Esocidae (Pikes)	0	0	0	6.7	50.0	0	0	16.7	0	0	0	7.7	1.1
Catostomidae (Suckers)	0	60.0	0	13.3	0	0	0	44.4	28.6	40.0	10.6	0	1.3
Ictaluridae (Bullhead catfishes)	0	0	0	0	0	0	0	0	35.7	0	0.3	0	1.3
Centrarchidae (Sunfishes)	0	0	0	0	0	0	0	5.6	0	0	0	0	0.3
Percidae (Perches)	100.0	40.0	100.0	80.0	50.0	100.0	100.0	33.3	28.6	60.0	2.4	92.3	94.6

remains account for more than half of the identified fish remains, although there are several examples of features with only a few recovered remains in which suckers also comprise a significant proportion of the identifications. One feature is significantly different from the others. Over 86% of the identified fish from Feature 1250 are salmonid family, and only 2.4% are assigned to perch family. Salmonids are rarely identified from other proveniences: they are found in only one other feature (1406), where they account for 1.3% of the fish identifications. Salmonids make up 6.3% of the fish identifications from one by one metre units.

There are also a few differences among the different possible concentrations of fish bones from the western part of the site. Suckers range from 7.5% to 33% of the fish identifications, bullheads make up between 1% and 13%, and perch family varies from 30% to nearly 83%. Groups A and E resemble one another in having relatively high amounts of suckers, bullheads, and salmonids and lower amounts of perch. Groups B and C have moderate amounts of suckers, few bullheads, and high amounts of perch. Group D has the highest proportion of perch and lowest proportion of suckers.

The Simpson's index is a measure of evenness; values close to zero indicate that the sample is divided over many classes and that each member has nearly equal representation. Values close to one have few classes and great variability in the amounts assigned to each class. Groups A and E have relatively low values for the Simpson's index. One interpretation is that these areas were places

where fish remains were disposed of after fishing events that were not focussed on particular taxa. Alternatively, these may be older deposits that reflect a mix of materials from a number of fishing episodes. Groups C and D both have high values for the Simpson's index, and these locations within the designated high-density area may reflect disposal after fishing events focussed on specific taxa.¹¹

In her analysis of the material from Barrie, Needs-Howarth (Needs-Howarth and Thomas 1998, Needs-Howarth 1999) examined the co-occurrence of taxa in features. The three fisheries model predicts the co-occurrence of various groups of species, as outlined in Table 1.

Feature 1250 at Steven Patrick may be an indicator of the third type of fishery because it contains lake trout and whitefish, but it is noteworthy that a number of elements have been identified as Atlantic salmon, which also spawns in fall. This species does not spawn in lakes, but rather in streams or rivers. Further, it would not be found in Nottawasaga Bay, Lake Simcoe, or their tributaries, having been restricted to the Lake Ontario drainage. Feature 1250 is also unusual in that many examples of cranial salmonid elements are present. The lack of cranial elements and the

¹¹ These data were also examined unit by unit, with a Simpson's index being calculated for each unit separately. All units within Groups A and E had relatively low values, indicating greater evenness. Group C was dominated by units with high values, indicating low evenness. Groups B and D contained some units with high values and some with lower values.

Table 12. Percentage distribution of fish families represented in high-density units (greater than 25 fish identifications) at the Steven Patrick site. Units are grouped with other nearby units with high densities of fish bones.

n	Group A	Group B	Group C	Group D	Group E
Acipenseridae (Sturgeons)	97	583	673	493	191
Salmonidae (Salmons)	1.0	1.7	0.9	0.4	–
Esocidae (Pikes)	13.4	7.2	3.7	4.1	8.4
Gadidae (Codfishes)	5.2	1.5	2.4	1.6	1.6
Catostomidae (Suckers)	0	0.3	0	0	0
Ictaluridae (Bullhead catfishes)	33.0	17.3	15.9	7.5	27.7
Centrarchidae (Sunfishes)	13.4	2.9	1.0	3.4	13.1
Percidae (Perches)	2.1	0.7	0	0	0
Sciaenidae (Drums and croakers)	30.9	68.3	76.1	82.8	49.2
Simpson's Index	1.0	0	0	0.2	0

presence of vertebrae at other sites has been explained by off-site processing (Needs-Howarth 1998) and by poor preservation of salmonid cranial elements (Butler and Chatters 1994; Lubinski 1996). In the case of Steven Patrick, Atlantic salmon was clearly transported to the site with the head attached, from a location in the Lake Ontario drainage basin. If this taxon was caught during spawning, which is likely, then it is probable that it was found in relatively fast-moving, deep waters (Louhi et al. 2008), such as one would find closer to Lake Ontario. The intermingling of other salmonid bones (lake trout and whitefish) in the feature is interesting. These other salmonid species also spawn in the fall, but in lakes (Scott and Crossman 1973). They could have been caught in waterways near Steven Patrick, or, equally, in lakes within the Lake Ontario drainage basin. The remains found in this feature are strongly suggestive of a fall lake fishery, but it may not have been restricted to the waterways adjacent to Steven Patrick. At least two interpretations may be put forward to explain these remains. Either the occupants of Steven Patrick travelled south to engage in fishing, or the remains were carried to the site by visitors, probably from the north shore of Lake Ontario.

Feature 1406 is the other feature that contains a large number of fish bones. It is dominated by perch, with small contributions from both species that could be taken in a spring spawning run fish-

ery (sturgeon, suckers) and those which could be taken in a generalized warm water fishery (pike, suckers, bullheads, and bass). A small number of salmonid elements were also identified. These totals suggest that, if the three fisheries model holds, Feature 1406 does not reflect a single fishing event. However, the fact that a very high proportion of the fish remains are from a single species is suggestive of mass capture, which in the case of perch is most likely to have been carried out in the spring.

Other features have low numbers of identifications and cannot be considered to reliably reflect short-term behavioural events.

The proposed groups in the midden may provide supporting evidence for the proposed fisheries, although in no case is the evidence clear-cut. Units within Groups C and D, with high amounts of perch and low numbers of pike and bullheads, are likely to reflect a fishery focussed on spring spawners, while groups A and E are more likely reflective of the generalized warm water fishery.

Estimating the Dimensions of Yellow Perch

To further examine the possibility that the yellow perch at Steven Patrick were caught in mass capture events, we undertook an osteometric study. Our hypothesis was that the perch caught in mass capture events should have greater similarity in size than fish caught during a generalized warm

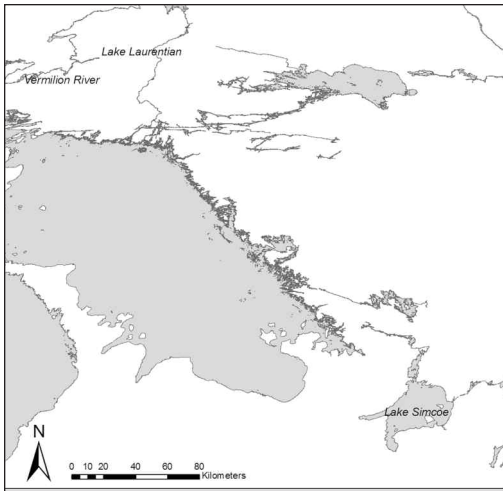


Figure 4. Map of the locations of water bodies where sample fish were obtained.

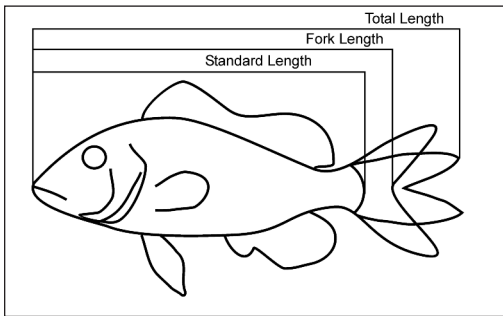


Figure 5. Length measurements of sample fish.

weather fishery. Because yellow perch are a species that schools with similar-sized individuals, it is possible that netting during the summer would result in a similar-sized catch. Support for the idea that perch were caught while spawning may also come from the size of the individuals; that is, by answering the question: Are they large enough to be of reproductive age? The strongest support for mass capture would come from features bearing elements of fish of the same size, possibly intermingled with species that may be caught accidentally during the same events.

Overall body size and the dimensions of skeletal elements are correlated (Reitz and Wing 1999). The relationship between dimension of the live organism and those of a bone may be linear or

scaled (allometric). In the latter circumstance, it is recognized that portions of the body do not grow in equal proportion to one another (Reitz and Wing 1999; Reitz et al. 1987).

In order to estimate the size of the yellow perch caught by inhabitants of the Steven Patrick site, we needed to establish a relationship between element size and overall body dimensions. We carried this out in two steps. The initial study used a series of 43 perch obtained from lakes in the Sudbury region. Because perch size is limited by a number of factors, including climate, lake size, and fish density (Headley and Lauer 2008), we chose to follow up our initial study with a comparison to 31 individuals caught in Lake Simcoe, a much larger body of water, and potentially one used by the Steven Patrick fisher people (Figure 4).

We took several measurements of the fish before gutting, including mass, girth, and length. Girth is perhaps the most relevant to archaeological samples because it can provide information on the dimensions of apertures of nets, but girth and bone dimensions are not closely related. Both mass and girth vary depending on reproductive state. For this reason, we examined the relationships between bone dimensions and fish length. There are three relevant measurements: standard length, total length, and fork length (Figure 5). In some cases the caudal fin was damaged, so the reported measurements are limited to fork length and standard length.

We selected six cranial elements for measurement and analysis. Other researchers (e.g., Leach et al. 1996, 1997) have found that these elements reliably reflect body size. Further, they can be readily identified and they are present in archaeological collections (Needs-Howarth 2001). The elements are the angular (or articular), dentary, frontal, maxilla, operculum, and quadrate. We retained other elements that may be of use in further studies, such as the cleithrum, hyomandibular, ceratohyal, and epihyal.

As much as possible we followed osteometric standards established by Morales and Rosenlund (1979), but in a number of cases it was difficult to establish landmarks that would allow for replicable measurements. In these cases, we established

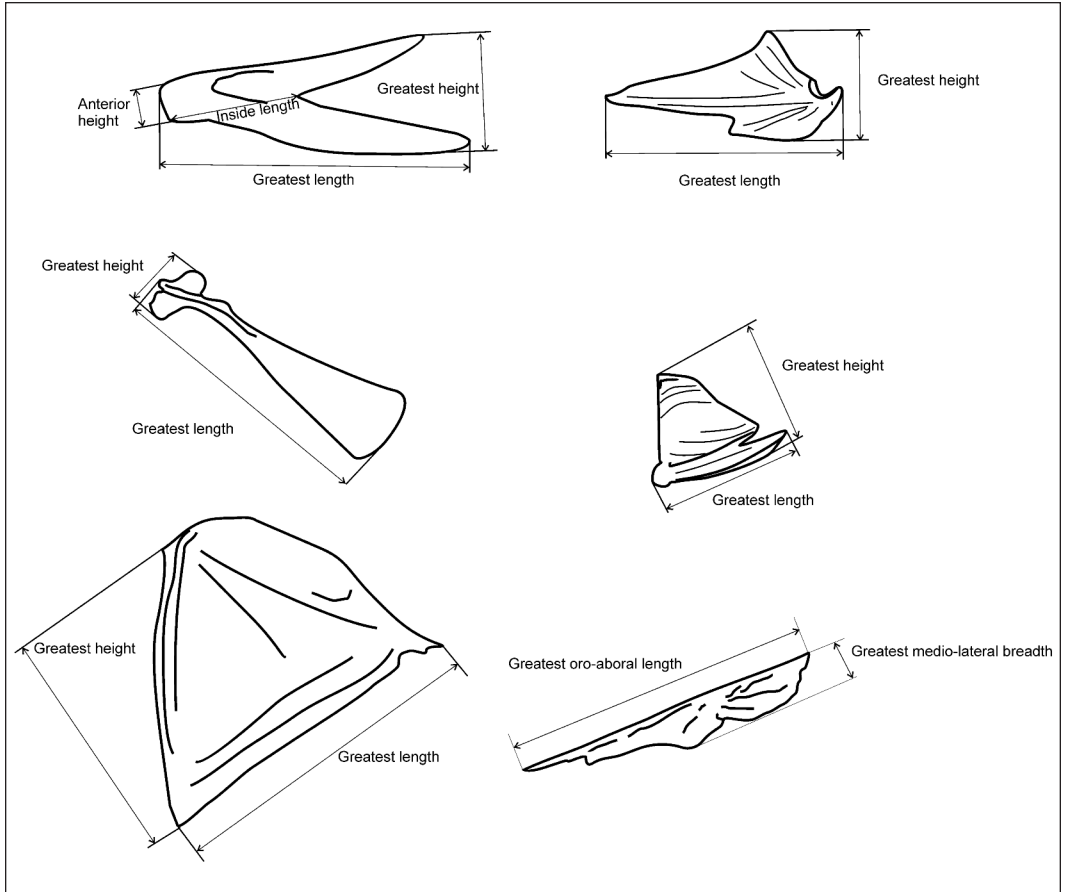


Figure 6. Dimensions measured on fish elements from the Steven Patrick site (clockwise from top left: dentary, angular [articular], quadrate, frontal, operculum, maxilla).

our own measurements. Our measurements are illustrated in Figure 6.

For each measure, we plotted the dimensions against both the total length and the fork length, and we undertook regressions using both a linear model ($y = ax + b$, where y is the dimension of the body, x is the bone dimension, a is the slope and b is the y -intercept) and a power curve model ($y = ax^b$, where a is the y -intercept and b is the slope). In both cases, the regressions were forced through a near-zero point, based on the assumption that an infinitesimally small perch would also have an infinitesimally small bone. We calculated these equations three times: once using the fish obtained from the Sudbury area, once using those from Lake Simcoe, and finally using those from the two groups combined. Because there did not

appear to be great differences between the Lake Simcoe and Sudbury equations, in this paper we use equations based on the two samples combined (Table 13). In this way, the largest range of fish sizes is included in the calculations.

We examined the R^2 values for each equation and found that some dimensions are more reliably estimated than others. In particular, we note that power equations produced using smaller dimensions—for example, anterior height of the dentary—are not particularly reliable. The linear and exponential equations produce similar results in the size range we are concerned with. Indeed, in many cases the exponent in most of the power equations is very close to 1, indicating a nearly straight line. Tables 14 and 15 list the dimensions measured, the linear and power equations, and the

Table 13. *The calculated relationship between dimensions of dentaries and fork length of yellow perch from Lake Simcoe (n=60) and from lakes near Sudbury (n=84).*

Dimension		Linear	R-squared Value	Power	R-squared Value
Greatest Length	Sudbury area	$y = 1.2178x$	0.9385	$y = 1.2495x^{0.9944}$	0.9968
	Lake Simcoe	$y = 1.1873x$	0.9371	$y = 1.1972x^{0.9979}$	0.9982
	All	$y = 1.201x$	0.9593	$y = 1.2365x^{0.9934}$	0.9972
Greatest Height	Sudbury area	$y = 2.2892x$	0.8798	$y = 2.3383x^{0.9968}$	0.9943
	Lake Simcoe	$y = 2.0751x$	0.9039	$y = 2.1122x^{0.9934}$	0.9975
	All	$y = 2.1638x$	0.8728	$y = 2.3798x^{0.9673}$	0.9868
Inside Length	Sudbury area	$y = 2.4069x$	0.9595	$y = 2.4092x^{1.0008}$	0.9978
	Lake Simcoe	$y = 2.3457x$	0.889	$y = 2.3655x^{0.9976}$	0.9966
	All	$y = 2.3731x$	0.944	$y = 2.4242x^{0.9926}$	0.9945
Anterior Height	Sudbury area	$y = 8.7169x$	0.8127	$y = 8.9162x^{0.9916}$	0.9901
	Lake Simcoe	$y = 8.0459x$	0.776	$y = 8.1792x^{0.9911}$	0.9936
	All	$y = 8.3276x$	0.8222	$y = 8.7783x^{0.9652}$	0.9817

Table 14. *Regression equations describing the relationships between element dimensions and fork length of yellow perch.*

Element	Measurement	Linear	R-squared Value	Power	R-squared Value
Angular	Greatest length	$y = 1.1307x$	0.9718	$y = 1.1461x^{0.9971}$	0.9981
	Greatest height	$y = 2.4753x$	0.9101	$y = 2.5701x^{0.9898}$	0.9946
Dentary	Greatest length	$y = 1.201x$	0.9593	$y = 1.2365x^{0.9934}$	0.9972
	Greatest height	$y = 2.1638x$	0.8728	$y = 2.3798x^{0.9673}$	0.9868
	Inside length	$y = 2.3731x$	0.944	$y = 2.4242x^{0.9926}$	0.9945
	Anterior height	$y = 8.3276x$	0.8222	$y = 8.7783x^{0.9652}$	0.9817
Operculum	Greatest length	$y = 1.1338x$	0.9246	$y = 1.1908x^{0.9896}$	0.9915
	Greatest height	$y = 1.1627x$	0.9572	$y = 1.1297x^{1.0117}$	0.9954
Quadrate	Greatest length	$y = 2.0534x$	0.9434	$y = 2.1656x^{0.9816}$	0.9934
	Greatest height	$y = 2.6198x$	0.9183	$y = 2.7988x^{0.9752}$	0.9905
Frontal	Greatest oro-aboral length	$y = 0.9044x$	0.9316	$y = 0.9431x^{0.9889}$	0.9935
	Greatest medio-lateral breadth	$y = 2.2778x$	0.8604	$y = 2.4613x^{0.9733}$	0.9871
Maxilla	Greatest length	$y = 1.1342x$	0.9584	$y = 1.1734x^{0.9902}$	0.9955
	Greatest height	$y = 3.7663x$	0.8965	$y = 3.8558x^{0.9896}$	0.9995

R² values. We calculated equations for both standard and fork length, and in subsequent estimations of the size of perch we relied on the linear measurement. The R² values of the linear equations based on fork length are slightly higher than those for the standard length. The reverse is true of the power equations.

Application of the Osteometric

Study to the Archaeological Sample

Our working hypothesis was that proveniences with high proportions of yellow perch, combined with spring spawners such as sturgeon and suckers, would represent places where the Steven Patrick inhabitants disposed of refuse from mass capture events, if the three fisheries model is applicable to the Steven Patrick inhabitants. The fish from these locations, if they were caught during spawning, would have been sexually mature and therefore relatively large. Further, Needs-Howarth

Table 15. Regression equations describing the relationships between element dimensions and standard length of yellow perch.

Element	Measurement	Linear	R-squared Value	Power	R-squared Value
Angular	Greatest length	$y = 1.0249x$	0.9713	$y = 0.9495x^{1.0271}$	0.9978
	Greatest height	$y = 2.244x$	0.9345	$y = 2.3061x^{0.9916}$	0.9953
Dentary	Greatest length	$y = 1.0891x$	0.9652	$y = 1.0189x^{1.0263}$	0.9969
	Greatest height	$y = 1.9559x$	0.9334	$y = 2.0586x^{0.9854}$	0.9948
	Inside length	$y = 2.1459x$	0.9553	$y = 2.1557x^{0.9984}$	0.9969
	Anterior height	$y = 7.5166x$	0.8808	$y = 7.778x^{0.9833}$	0.9907
Operculum	Greatest length	$y = 1.0261x$	0.9602	$y = 1.0031x^{1.0133}$	0.9965
	Greatest height	$y = 1.0543x$	0.966	$y = 1.2905x^{0.9258}$	0.9971
Quadrate	Greatest length	$y = 1.857x$	0.9549	$y = 1.8545x^{1.0042}$	0.9936
	Greatest height	$y = 2.372x$	0.9473	$y = 2.4656x^{0.9862}$	0.9923
Frontal	Greatest oro-aboral length	$y = 0.8196x$	0.9509	$y = 0.8339x^{0.9951}$	0.9944
	Greatest medio-lateral breadth	$y = 2.0603x$	0.9023	$y = 2.1896x^{0.9786}$	0.9895
Maxilla	Greatest length	$y = 1.0299x$	0.9638	$y = 0.963x^{1.0244}$	0.9949
	Greatest height	$y = 3.4112x$	0.8848	$y = 3.1349x^{1.0553}$	0.9849

and Thomas (1998:114) anticipate that methods of fishing used in mass capture results in “a broader size range...if the site inhabitants used techniques of mass capture such as seine netting or fish trapping.”¹² Specifically, we anticipated that Feature 1406 and groups C and D in the midden would show these characteristics. If the bones recovered from units in groups A and E reflect a warm weather fishery, we would anticipate smaller perch and a greater size range because these fish would not necessarily be sexually mature at the time of the catch. The nature of group B is unclear, but the bones from at least one unit (153N84E) with this area may derive from a spring spawning fishery similar to material from

groups C and D.

We measured archaeological specimens from all of these proveniences and from Feature 1406, the single feature with a large proportion of perch bones. In a number of cases where the elements were fragmentary, only one measurement could be obtained. We calculated the fork length using all the available measurements. If there were multiple measurements for a bone, we compared these. If the difference in the calculated fork length using two or more measurements was less than 5% of the fork length, we averaged the result, because we assume that small differences arise from both biological variation and from differences in how the bone is oriented in measurement. If the difference between measurements was greater than 5%, we discarded the smaller measurement under the assumption that the bone had been broken. The single exception to this treatment was in the dentary. In this case, frequently the only two measurements that could be obtained were the anterior height and the inside length. The value of variable *a* in the equation based on anterior height is 8.34; as a result, small variation in measurement appears to result in over-estimation of fork length. In the case of dentaries that showed variation between the estimations based on two

¹² Gill nets select for fish of a narrow size range because small fish swim through apertures and large fish swim around the nets. Angling would result in catching fish of a range of sizes, and any trends would likely relate to selection of individuals of particular sizes. If no selection factors were used, then small individuals would likely also be caught through angling. Weirs and nets were important fishing methods used some three hundred years later, when Champlain visited the north end of Lake Simcoe at the location of the fish fence at Mnjikaning.

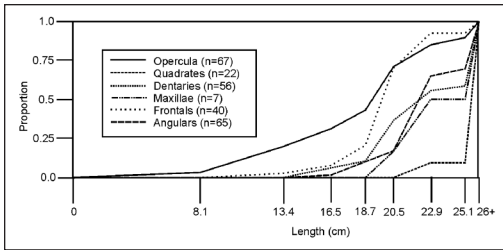


Figure 7. Cumulative frequency diagram of estimated fork length of yellow perch based on elements measured from all clusters within the midden area at the Steven Patrick site. Intervals selected based on average lengths of perch at different mean ages, after Thayer et al. (2007).

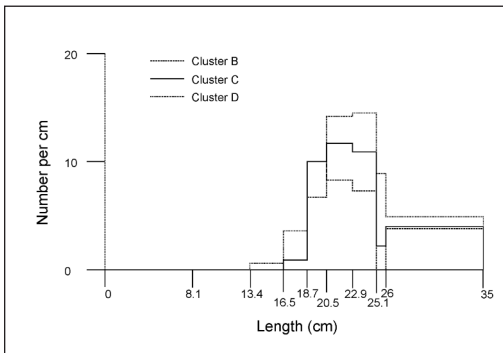


Figure 8. Histograms of proportions of yellow perch of different estimated lengths from three clusters within the midden at the Steven Patrick site.

measurements, we took the smaller of the two. Cumulative frequency graphs of all of the measurements from different concentrations within the midden are shown in Figure 7. Very few elements from groups A and E were complete enough to allow for measurement. Figure 7 shows that the distribution is similar for most elements; opercula and quadrates have somewhat different distributions. In the case of quadrates, most of the measurements suggest fish larger than 26 cm in length, whereas for all other elements measured at least half of the fish were estimated to be less than 26 cm. One explanation for this is that quadrates are the smallest among the elements measured, and those representing smaller fish may have been lost during screening. Opercula show the greatest range in estimated fish sizes. Although delicate,

this element has a greater surface area than other elements, and small examples may not have been lost. A second probable contributor to the nature of the distribution is that some breakage on these elements may not have been easily discerned. Because measurements of quadrates and opercula varied from those of other elements and there are likely several factors contributing to this variation, and because it can be assumed that all elements derive from the same population, we excluded these elements from subsequent steps in the analysis. Despite this, it is unlikely that inclusion of the opercula, for example, would substantially change our interpretations.

Figure 8 shows histograms of proportions of fish of different estimated sizes from three concentrations in the midden (B, C, and D). The bins for these histograms were selected based on mean lengths of yellow perch from Saginaw Bay on the west side of Lake Huron (Thayer et al. 2007).¹³ This study correlates mean lengths with age of fish, percent maturity, and fecundity. While fish growth rates vary with the size of the body of water in which the fish reside, in this case we assume that the perch were obtained from large bodies of water such as Georgian Bay or Lake Simcoe and that growth rates would be comparable to those of fish in Saginaw Bay.

Measurements of angulars, dentaries, maxillae, and frontals from Steven Patrick are combined to increase sample size, despite the fact that this certainly results in some individuals being counted twice. The pattern is the same in all three groups. Almost no fish are estimated to have a fork length of less than 16.5 cm, which in the Saginaw Bay study would be fish three years or less in age. The modal size in the Steven Patrick case is 20.5 to 22.8 cm (mean age 5–6 years). The data from

¹³ Estimated length measurements from the Steven Patrick site are based on fork length, while the length measurement employed in the Saginaw Bay study is unclear. Fork length is the shortest possible length measure, so trends described would be exaggerated if the Lake Huron study used total length or standard length.

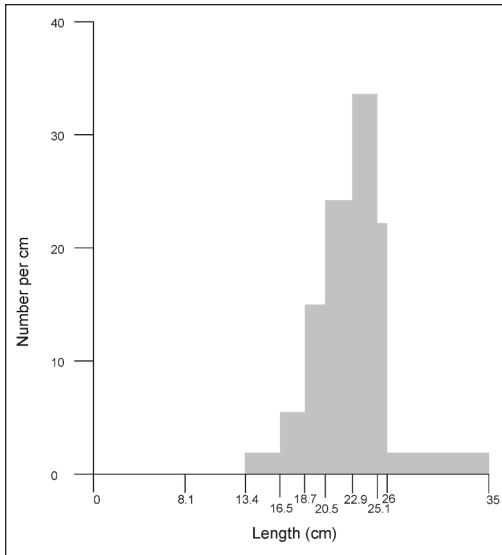


Figure 9. *Estimated fork lengths of yellow perch identified from Feature 1406 at the Steven Patrick site*

Saginaw Bay indicate that fish are 100% mature at age 6 (Thayer et al. 2007), when they have a mean length of 22.9 mm. Fish under two years of age are only 38% mature. The mean length at age 3 is 16.5 cm (Thayer et al. 2007). In all three clusters of the midden over one-third of the fish are estimated to be longer than 26 cm, which would relate to fish age 8 or older.¹⁴ Figure 9 shows the distribution of estimated sizes of fish disposed of in Feature 1406. This is not substantially different from the distributions for the different midden clusters, although the proportion of fish over 26 cm is slightly lower.

The osteometric study indicates that the fish

were sexually mature at the time of the catch, and that a range of sizes of fish are represented. Both of these findings are consistent with a focus on a spring spawning fishery for exploitation of perch. Perch in Lake Simcoe spawn in mid-April through May (MacCrimmon and Skobe 1970) in rivers and rocky shoals of the lake. In recent times, people are recorded to have caught perch in the late summer and autumn, but only the spring fishery was considered important. While the data supports the spring spawning fishery, it should be noted that the large proportion of large-sized fish can be explained in several other ways. First, it is possible that small fish are not represented because of taphonomic reasons: as Gordon (1993) has shown, mesh size of one-quarter inch will result in loss of bones from small-sized taxa.¹⁵ This factor probably contributes in part to the size distribution of perch from Steven Patrick. A second possible contributing factor is the nature of the method of the catch. As noted by Needs-Howarth and Thomas (1998), seine nets and traps used in mass capture events would select for larger fish and is clearly dependent on the size of the apertures of the net. Finally, larger elements tend to be more robust and may survive a multitude of taphonomic factors better.

Conclusion

The analysis of faunal remains from the Steven Patrick site allows us to consider the applicability of the three fisheries model to the Uren occupation of Simcoe County. In general, we argue that the faunal material from Steven Patrick supports the model, but that the fisheries are not of equal

¹⁴ The Saginaw Bay sample has a survival rate of 0 for fish over 8 years (Thayer et al. 2007). In Lake Simcoe it appears that fish do not survive past 9 years of age. A significant portion of the fish from Steven Patrick is quite large. There are several possible explanations for this unexpected finding. It is possible that the allometric equations overestimate the size of fish. This is considered unlikely because all of the elements measured show a large portion of the population made up of large individuals. A second possibility is that there were different limiting factors on the growth rates of

perch in pre-contact Ontario. A third possibility is that there were different factors limiting mortality, and that more old fish survived in pre-contact Ontario. Counting of growth rings on scales may be an avenue that can be pursued to research this further.

¹⁵ It is possible that other taphonomic factors, such as pot stewing, differentially affect smaller-sized individuals. However, recent research on a multi-component Iroquoian site in Huronia has shown that with use of water-screening through 3 mm mesh screen, recovery of small fish remains is excellent.

importance in terms of the amount of fish that they supplied. We agree that fine-grained contextual analysis is necessary for this type of examination. If we had not considered the co-occurrence of taxa feature by feature, our evidence for a fall lake fishery would have been weaker.

The fall fishery for spawning salmonids is suggested by the material from Feature 1250. The different nature of this feature is remarkable, but it is important to note that only a single location is indicative of the fall fishery. Salmonid vertebrae in the midden may pertain to other fall fishing activities, but these are relatively few in number. The presence of Atlantic salmon indicates that the water bodies used for this fishery include not only lakes, but also rivers. Furthermore, southern rivers connected with Lake Ontario were used. The fish caught during this fishery were transported to Steven Patrick with their heads attached, although they may have been gutted. It is noteworthy that the Wellington faunal remains include examples of eel bone, another species that must have been caught in waterways connected with Lake Ontario.

A spring spawning fishery focussed on yellow perch appears to have been the most important fishery represented at Steven Patrick. There are some taxa that may have been caught at the same time—lake sturgeon and suckers—but it appears that perch were by far the most important species. The osteometric study indicates that perch were sexually mature and generally quite large. While it is possible that smaller fish—perch and other taxa—are not represented in the analyzed sample for taphonomic reasons, it is clear that many of the perch were quite large. This evidence suggests that the age distribution of perch in Lake Simcoe was relatively unaffected by aboriginal fisheries at the time of the occupation of Lake Simcoe.¹⁶

The large amount of cranial material of perch and other species indicates on-site processing of fish. This includes both perch and salmonids but there is relatively little evidence for carnivore

gnawing on any portion of the assemblage. While the effect of dogs on faunal assemblages dominated by fish is unclear, it is noteworthy that many Iroquoian assemblages show reasonably extensive evidence of modification by carnivores. The low amount of carnivore gnawing could be indicative of a relative lack of dogs at this site, or, alternatively, a short-term use of the location.

The Steven Patrick settlement pattern indicates complete rebuilding of the site at some point, and a relatively low amount of repair during each occupation. As noted above, the overlapping houses are reminiscent of the EOI settlement pattern. These characteristics, together with the location of the site in a low-lying region, suggests that MOI people may have practiced a greater degree of seasonal mobility than usually described. Could Steven Patrick have served as a base for some or all community members while they focussed on mass capture of fish during the late spring? Is it possible that the same people also used upland site locations, such as Wellington, for planting and harvesting crops?

At this time, we are only able to present hypotheses about how Steven Patrick fits into regional settlement. Future analyses of faunal and floral material from flotation samples would be beneficial. Analysis of faunal specimens from flotation would help to test the interpretations we have outlined by confirming or rejecting the hypothesis that the majority of perch harvested were particularly large. Floral analysis, such as that carried out for the Wellington site (Archaeological Services Inc. 2005), would provide context for interpretation of the faunal remains. Are cultigens present? Does the charcoal indicate use of secondary or climax forests? The remains from Feature 1250 provide good evidence for a connection between the north shore of Lake Ontario and the Simcoe County area. At this point the nature of that connection is a matter of speculation: were Atlantic salmon obtained through trade, were they brought to Steven Patrick by visitors from the south, or did the Steven Patrick residents travel south to obtain resources that were scarce in Simcoe County (e.g., chert)? Analysis of other classes of artifacts, particularly lithics, would certainly inform on this question. Through these types of

¹⁶ Comparison with the size of perch caught at later dates would indicate whether the aboriginal fishery had any effect on age structure of fish populations.

analysis, analysis of faunal remains from special-purpose sites such as Allandale, and a program of radiocarbon dating, we will be in a better position to understand the challenges and opportunities faced by the Uren pioneers in Simcoe County. This may, in turn, allow us to begin to consider the social and political context for thirteenth-century migration into Simcoe County.

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Cet article considère le modèle de pêche à trois temps d'exploitation du poisson utilisé au cours de la période de la Tradition Iroquoienne de l'Ontario, lors de la subdivision Moyenne 1: Uren, au nord du lac Ontario. Des données provenant du site Steven Patrick, un village près de la baie Kempenfelt du lac Simcoe, sont comparées à des données provenant d'autres sites de la subdivision Uren de cette région. Une étude de la relation entre les os et les dimensions du corps chez la perchaude, fournit un point de comparaison afin d'estimer la taille de ces poissons capturés par les pêcheurs de la subdivision Uren. Cet aspect permet aux zooarchéologues de considérer si la perchaude était obtenue, ou non, par pêche massive lors du frai. La taille permet également de fournir une approximation de l'âge, ce qui offre des informations complémentaires quant à la nature de la pêche de la subdivision Uren dans le comté de Simcoe. Le modèle de pêche à trois temps est généralement soutenu et les données du site Steven Patrick suggèrent que la pêche lors du frai printanier était particulièrement importante. Les perchaudes étaient capturées lorsqu'elles étaient assez grandes et matures sexuellement. Des débris de faunes d'un des aménagements fournissent des preuves solides d'un lien entre le peuplement Steven Patrick et celui de la rive nord du lac Ontario.

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Book Review

*Ta'n Wetapeksi'k: Understanding From Where We Come:
Proceedings of the 2005 Debert Research Workshop,
Debert, Nova Scotia, Canada*

(edited by Tim Bernard, Leah Morine Rosenmeier, and Sharon L. Farrell)

Ta'n Wetapeksi'k: Understanding From Where We Come: Proceedings of the 2005 Debert Research Workshop, Debert, Nova Scotia, Canada, edited by Tim Bernard, Leah Morine Rosenmeier, and Sharon L. Farrell. 232 pages, about 100 figures, chapter bibliographic references, volume index. 2011. Eastern Woodland Print Communications, The Confederacy of Mainland Mi'kmaq, Truro, Nova Scotia. \$34.95 ISBN 978-0-9811967-0-1.

The Debert site in Nova Scotia is an iconic Eastern Palaeo-Indian site, significant in both the history of Palaeo-Indian archaeology and current research into Palaeo-Indian settlement patterns and fluted point chronology. One of the larger Palaeo-Indian sites in North America, Debert is also the northeastern-most substantial fluted point site, a large outpost, as it were, near glacial ice and snowfields.

Excavated 50 years ago (1962-1967), the Debert project and publication (MacDonald 1968) are models of interdisciplinary, palaeo-environmental research, radiocarbon dating, and archaeological lithic assemblage description and interpretation, which are absolutely useful as a comparative data source today. Little had been published on "Debert" in the intervening decades, until this volume. In fact, Debert is now the centrepiece of a concentration of at least eight sites (variously counted), called the Debert-Belmont sites, within a five-kilometre radius (p.3, Figure 3). The amount of quaternary (late glacial) geology and palaeo-environmental research in the region

has exploded as well, summarized in multiple papers in the volume reviewed here. As is made clear in several of the papers, there are still questions about the details of the local environment at the time of Palaeo-Indian occupation; and also about the exact age of the occupations.

The Debert-area sites may be early in a sequence of fluted-point occupations in the New England-Maritimes-Québec region (Bradley et al. 2008). It was occupied perhaps just before, or at the beginning of, the onset of the Younger Dryas cold episode, a climatic reversal that greatly affected surficial soils, geology, flora and fauna of the region. What does it say about large-scale Palaeo-Indian movement patterns, and indeed the behaviour behind the peopling of the Americas, that such a large concentration of activity occurred in the remote, northeast corner of the habitable American world of the time?

Ta'n Wetapeksi'k is the publication of papers and oral discussions from a remarkable 2005 invited conference at Debert. The broader Debert archaeological sites area is now managed by The Confederacy of Mainland Mi'kmaq, Truro, Nova Scotia, with 1200 acres owned by The Confederacy as part of the Mi'kmawey Debert Cultural Centre. As a result of treaty consultations, provincial legislation was changed after the 2005 conference to require archaeological survey prior to any soils disturbance projects. They take their management responsibilities very seriously, as a matter of cultural heritage. The *Ta'n Wetapeksi'k* conference was called, as articulated by Dr. Don-

ald Julien (Chapter 1: Welcome), “to bridge the research of the past with the research of the future...We are all committed deeply to the preservation of the sites and to the education of all people about the life and history of Debert.”

Many of the attendees were Mi'kmaq elders and included two members of the original Debert project, George F. MacDonald and Harold W. Borns. The Conference presenters included scientists and First Nations heritage experts. This reviewer was one of those honoured to attend. We were there to listen to and learn from each other's viewpoints and knowledge, now conveyed to the reader of this volume of 20 chapters, including some transcripts of conference dialogue. The conference, the *Ta'n Wetapeksi'k* volume, and the follow-on Mi'kma'wey Debert project exemplify Indigenous archaeology consciously done to be inclusive.

Aside from the introductory and closing chapters, *Ta'n Wetapeksi'k* is divided into five sections. Chapters 2 through 5 are a look at past and present. George MacDonald and Stephen Davis each provide overviews of Debert and Belmont past research and new understandings from the 2005 conference. (Their papers were revised after the conference, as were many others.) Gordon Brewster's pedo-archaeology chapter is a review of podzolic soil formation processes and bioturbation with 1,000-year formation times operating on 10,000+ year-old archaeological sites, a worthwhile exercise in raising research questions about site formation. Tim Bernard, of the Confederacy, speaks to the heritage value of Debert to the Mi'kmaq as articulated by Elders, who “look to the past for healing and spirituality, not only knowledge and information.” Advocating for archaeological site conservation and research design with Mi'kmaq input, “We are interested in researching the supposed gap between those who lived at Debert and later occupations in Mi'kma'ki.”

Chapters 6 through 9 present a summary quaternary geology (Harold Borns, Jr.), detailed reviews of palynology (R. J. Mott), surficial geology and palaeo-environment (Ralph Stea), and palaeontology, including insects (Randall Miller). As a group, these articles (and especially Stea) raise

this question: were archaeological occupations associated, in fact, with warmer, pre-Younger Dryas (pre-10,800 radiocarbon) environmental conditions, with glacier remnants in upland areas and herbaceous tundra and some spruce trees occurring locally? Or were they, as is more conventionally understood, associated with the Younger Dryas (post-10,800) climate, which returned this land to “near-glacial” conditions? The issue of temporal association of the archaeological material and the circa-10,600-year radiocarbon dates reported by the original Debert project is, therefore, still open.

Chapters 10 through 12 focus on Debert Palaeo-Indian lithic technology (Christopher Ellis), and regional and local lithic sourcing (David Black; Adrian Burke). Chapters 13 through 15 provide some archaeological context, including a consideration of Bull Brook (representing the other very large Palaeo-Indian site in the region; Brian Robinson) in comparison to Debert; and a consideration of post-Debert archaeological chronology (David Keenlyside). Trudy Sable (Chapter 15: Legends as Maps) looks at the distribution of archaeological sites around the Minas Basin and their spatial correlation with glacial surficial geology landscape features explained in Glooscap Mi'kmaq origin stories.

Section 5 (Chapters 16 through 19) is about Theories of Place: Indigenous Context for Archaeology. L'Nuitasi: Mi'kmaq Tribal Consciousness (Murdena Marshall) and Integrative Science (Cheryl Bartlett) explain the contributions that traditional knowledge can make to cultural survival and to bringing “together scientific knowledges from Indigenous and Western worldviews.” People, Caribou, and Ice in the Dän History and Culture (Sheila Greer, Diane Strand, and Pauly Sias, from the Champagne and Aishikik First Nations and Kluane First Nation, Yukon Territory) provides a provocative “real-world model” based on traditional knowledge of caribou hunting on summer ice patches as an example of what could have attracted Palaeo-Indians to the Debert area. Chapter 19 (George P. Nicholas) is a review of Indigenous archaeology in broader context. Catherine Cottreau-Robins (Chapter 20) provides a summary, looking toward a future at

Debert that includes science, indigenous archaeology, and education.

Finally, this book is well illustrated and referenced – most of the figures, which include maps and photographs, are in colour. There are some spectacular colour photographs of artifacts and raw materials. Each chapter has its own bibliography but there is also a comprehensive volume index.

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Book Review

The Huron-Wendat Feast of the Dead: Indian-European Encounters in Early North America

(by Erik R. Seeman)

The Huron-Wendat Feast of the Dead: Indian-European Encounters in Early North America, by Erik R. Seeman. 144 pp including prologue and epilogue, 10 figures. 2011. The Johns Hopkins University Press, Baltimore. \$19.95 US ISBN-13: 978-0-8018-9855-6.

Eric R. Seeman's *The Huron Wendat Feast of the Dead: Indian-European Encounters in Early North America* is a welcome addition to the body of interpretive texts examining the contact experience in southern Ontario and, to a lesser extent, upper New York State. The brevity of the text and Seeman's clear, accessible writing style make it an ideal introductory text for those wishing to learn more about the period, and it would serve well as a supplementary text for courses in Ontario archaeology, historiography, and ethnohistory.

The prologue orients the reader to the purpose of the text: to attempt to understand interactions between Wendat peoples (formerly known as Huron) and Europeans (largely Jesuits) through a spiritual lens. In particular, Seeman seeks to explore the connection between actions and worldview, especially in light of beliefs about death, burial, and the afterlife. In this way, Seeman's work is fundamentally anthropological. He highlights their shared spiritual principles in order to understand how the contact encounter unfolded. He argues that there are many points of similarity in mortuary beliefs and activities, specifically, between Wendat and French worldviews that help to explain the way in which events unfolded in the early seventeenth century. This

approach contrasts with that taken by Trigger (1976), whose formative work on the period employed a materialist approach, and Seeman openly recognizes this and embraces this contrast. Despite the difference in approach, it seems to me that both Trigger and Seeman arrive at the same theoretical place. Whether using pragmatism to explain behavior (as Trigger did), or spirituality (as Seeman did), both authors argue that Wendat and European actions are understandable by examining the context from which they arise. That is, actions in the past are knowable by carefully examining textual and archaeological evidence, and this exercise reveals the internal logic of cultural systems. Both European and Wendat actions can be studied by applying a critical, anthropological lens that treats actors as rational beings making decisions that make sense in a given cultural context.

In my opinion, this is the most important contribution of this text to a nuanced understanding of the early historic period, but it is not without its pitfalls. Seeman is quick to recognize a major problem, which is that the main source of information about Wendat beliefs is the writings of European missionaries. Clearly this introduces a significant measure of bias. The portrayal of Wendat beliefs as being similar to those of the Jesuits helped to justify the colonial project of the missionaries, in that the Wendat are deemed to be "worthy" of conversion. Seeman notes that the Jesuits would certainly have had to convince their superiors of the need for their presence in the New World, and of the likelihood of their success. On

the other hand, he argues that they also would have had to balance their reports in order to be more convincing: the situation should seem neither too easy nor entirely hopeless.

This rationale allows for the use of these texts in the interpretation of Wendat beliefs, attitudes, and actions. The larger problem seems to be that an additional layer of interpretive error is added when European writings are used to identify similarities between the two worldviews. In this case, identified similarities between the two ways of knowing may simply be artifacts of one-sided reporting. Clearly, the Jesuits would have recorded and interpreted Wendat beliefs and actions through the lens of their own particular French experiences, and the impact of this bias makes it difficult to disentangle the reality of the similarities from what was reported. While Seeman does discuss this difficulty, I think that the prospect of this type of bias is more problematic than the more overt type aimed specifically at convincing the reader of the utility of the colonial project.

In Chapter 1, "Origins of Wendake," Seeman provides a basic summary of Wendat origin myths, subsistence strategy, beliefs regarding the spirit world, and burial practices. This chapter is a wide-ranging one that covers a great deal of material in a clear and concise fashion. In particular, Seeman focuses on the primacy of the permeable boundary between the real world and the world of the spirits in Wendat belief systems. The identification of this connection between the tangible and intangible, the spirit and natural world, makes it easier for the reader to understand such cultural practices as stoicism in the face of death, the careful management and curation of bodies after death, and the link between illness, healing, and desires. Seeman's approach is not radical: he carefully documents the religious context for actions and the ways in which worldview influences behaviours and makes them seem sensible.

While Seeman's summary here is very well done, his analysis of health and illness could have benefitted from a more critical reading of the bioarchaeological literature concerning Iroquoian community health. It is certainly true that European observers commented on the robust health of Iroquoians, but this measure was clearly rela-

tive, and there are many indications from the skeletal record that Iroquoians suffered from maladies associated with increasing population aggregation and lack of adequate nutrition and sanitation (see for example various chapters in Williamson and Pfeiffer 2003; Forrest 2010; Birch and Williamson 2012). More specifically, the deadly synergy of infectious disease and malnutrition in these communities would have negatively affected those most vulnerable (infants, young children, and the elderly), who are also those least likely to be the focus of ethnohistoric writings.

Chapter 2, "Catholicism and Colonization," makes an additional attempt to contextualize French perceptions of Wendat health through the examination of Catholic religious beliefs and customs of the time. The focus here is especially on those practices relating to illness, death, and burial, and this excellent summary serves as a much-needed counterpart to the previous chapter's material. Seeman begins by summarizing Catholic doctrine and beliefs beginning in AD 1450, and draws parallels between Catholic and Wendat deathways, especially the practice of feasting, the veneration of the physical remains of the dead, and the omnipresence of the dead (and ghosts) in the lives of the living. One of the things that Seeman does well throughout the book is to cast a critical eye to the attitudes, decisions, and actions of both the French and the Wendat. This chapter in particular helps to remind the reader that Catholicism and Catholic deathways have not remained static over time. Rather, the dynamism of these practices makes them worthy of study as aspects of an actively negotiated cultural system. I think this reminder would be particularly helpful for students, who may find it easier to identify with the actions of the Jesuits, and who may assume that the Jesuits felt the same way as modern North Americans about the practices of the Wendat.

In Chapter 3, "First Encounters," Seeman provides what is more or less a conventional historical recounting of early encounters between explorers (Samuel de Champlain), missionaries (Recollets Joseph Le Caron, Nicolas Viel, and Gabriel Sagard, as well as the Jesuit Jean de Brébeuf) and the Wendat between 1609 and 1636 AD. He

strikes a good balance here between a factual recounting of the historical documents and a critical interpretation of them. Most notable here are some interesting attempts to interpret how the Wendat would have received French efforts to convert them, couched in the terms of “friendship.” From an anthropological perspective, the most interesting aspects of this encounter are the misunderstandings that happen along the way. For example the French mistook Wendat courteous silence in the face of disagreement as a sign of acceptance rather than an indication of polite dissent. Seeman’s discussion of the first outbreaks of epidemic disease is thoughtfully presented, though it seems at times that the primacy of the dead in Wendat and French culture of the time is overstated. After all, the documents on which we rely for the interpretation of these encounters are prepared by highly religious interlocutors, and this measure of bias is at times troubling.

Chapter 4, “Feast of the Dead,” recounts Brébeuf’s observations of the Feast of the Dead at Ossossané in 1636 while he was staying within Bear clan territory at the village of Ihonatriia. The strength of this chapter rests on Seeman’s ability to interpret the activities of the Wendat through the lens of traditional Wendat beliefs and French beliefs simultaneously. This again reminds the reader of the essentially cultural relativist endeavor here. Seeman discusses the importance of grave goods, offerings, and gifts as part of the symbolic ritual of the Feast of the Dead, which culminated in ossuary burial. He argues for the importance of these items as a key part of the burial ritual, and attempts to link this historic period ceremonialism to earlier practices. While the direct historic approach is usually appropriate in situations in which the behaviours to be compared are temporally and spatially similar, in the case of Wendat and ancestral Wendat burial practices, care must be taken in making assumptions. Most precontact ossuaries contain few if any grave goods, though some of these goods may have been ephemeral. Seeman suggests that much of the Wendat impetus for trade with Europeans can be attributed to the desire for grave goods, but this seems anachronistic given the lack of grave goods in the precontact period. He also suggests that the intro-

duction of European goods prior to the arrival of Europeans themselves in Ontario may have been part of a larger “cultural florescence,” in which the presence of European tools makes the creation of ceremonial objects easier. I am somewhat skeptical about this suggestion, especially the contention that the origins of this florescence can be traced back some five hundred years (Seeman 2011:62). It is certainly the case that communities were rapidly changing in the century leading up to the introduction of European goods, ideas, and peoples in Ontario, but I would be hesitant to project these changes further back in time.

This chapter also discusses skeletal biological evidence from remains from Ossossané and other ossuaries that can provide information on the effects of the epidemics that raged throughout Wendat communities in the historic period. While this is an interesting area of study, it is full of complexities and pitfalls, and these are not communicated to the reader. The studies that Seeman relies upon generated life expectancy data based on paleodemographic studies completed in the 1970s and 1980s, which employed methods of age estimation and demographic projection that we now know to be highly problematic. For instance, these early studies often did not take into account taphonomic variables that lead to the preferential preservation of the remains of younger individuals, which acts to depress the calculated life expectancy. They also fail to discriminate between the effects of fertility and mortality on population dynamics; do not account for the difference between populations of living versus dead people; and rely on methods for age estimation that are less accurate and precise than current methods. That being said, it is certainly reasonable to suggest that the demographic characteristics of pre-epidemic and post-epidemic ossuaries would be different, but the character of that difference is not knowable.

Chapter 5, “Epidemic Tensions” deals more specifically with the historical record of epidemic disease in Wendake, most specifically with the outbreak of what may have been a streptococcal infection that affected both the Jesuits and the Wendat in the fall of 1636. The chapter focuses mainly on the Jesuits as the protagonists, with

important Wendat characters (shamans; converts to Christianity) also appearing. This clearly reflects the bias of the historical interlocutors. Seeman's discussion of the reasons that the Wendat allowed the Jesuits to stay in Wendake, despite the cyclical barrage of epidemic diseases that followed their initial arrival in Wendake, is noteworthy. He argues that rather than having an entirely economic motivation for maintaining strong ties to the French, the Wendat may have been motivated by religious fervor centred around trade goods that could be used for religious purposes. These trade goods could be used as grave goods or offerings to appease the spirits, who were clearly angry with the Wendat (as evinced by the constant epidemics and hardships). Ousting the Jesuits (and thereby upsetting the French) would mean risking this source of goods, which seem to have become more and more important as a strategy for maintaining order between the human and spirit worlds. While most of this chapter is straight historical narrative, this interpretive stance seems to make sense given the historic and archaeological evidence.

Chapter 6, "Conversion and Conflict," uses both anecdotal historical evidence and archaeological evidence to document the rising tensions between Christian Wendat and traditionalist Wendat in the wake of the smallpox epidemic of 1639-1640 and the intensification of New York Iroquois (Mohawk and allied Seneca) attacks on Wendake. This is also the time in which the number of Christian converts in Wendake reaches a critical mass, resulting in the creation of the Ste. Marie mission following the departure of Brébeuf from Wendake due to increasing hostility toward him. There is an excellent narrative here, as Seeman weaves individual stories of notable characters in the Jesuit Relations with the larger narrative of the contact experience. Also notable is his discussion of "good deaths" -- those Christian Wendat deaths that most closely resemble traditional French stories of the proper way to die. Seeman rightly cautions here that these Wendat "good deaths" probably say more about the beliefs and opinions of the French than the Wendat.

The final two chapters, "Destruction" (Chapter 7) and "Epilogue: Bones of Contention, Bones of

Consolation" narrate the events of the final decade of Wendat occupation of Ontario and their eventual dispersal. Chapter 7 recounts the return of Brébeuf to Wendake, and the subsequent systematic destruction of Wendake by the Seneca, including the murder and torture of Brébeuf. Seeman provides a nuanced reading of the tense, divisive political situation within Wendake in the late 1640s, which culminated in the traditionalist Wendat seeking shelter among the Algonquin and the neighbouring Tionnontaté; and the Christians fleeing to Ste. Marie and eventually to Christian Island in 1649. Every history text is selective in terms of what is presented, and Seeman is upfront about his interpretive approach with this material. He focuses on the contact experience through the lens of deathways as this experience, he argues, is the locus of understanding between the Wendat and the French missionaries. For example, he highlights Wendat use of the language and symbolism of bones in attempts to make reparations to the French for the murder of a French servant by a group of frustrated, hostile, traditionalist Wendat in 1648. This symbolism is striking in its resemblance to the Wendat mortuary tradition, and provides a glimpse into the definition of "good death" as defined by the Wendat. This is an interesting interpretive link to Seeman's earlier discussion of "good death" according to the French.

The epilogue picks up the Wendat story following the suffering and hardships endured on Christian Island. It includes the formation of the Wendat diaspora through the adoption of some Wendat individuals in Iroquois communities; the dispersal of others to neighbouring Wisconsin and eventually Michigan, Ohio, Kansas and Oklahoma; and the movement of a small number of Wendat survivors from Christian Island east to Lorette, Jeune Lorette, and Dame de Foy, Québec. Seeman makes the statement that Wendat who had been assimilated by the Iroquois were not permitted to continue practicing the Feast of the Dead. While this may be true in many communities, there is some evidence from western New York state (at sites such as Hiller Road, Sugg/Keller, Sawmill Road, and Orangeport sites) that the situation may not have been so cut and dry. For example, at the Orangeport 1 and 2 sites,

multiple burial features containing the commingled remains of 78 and 135 individuals, respectively, were encountered (Rayner-Herter 2001). There is also evidence at the Alhart (Niemczyk 1995) and Adams (Engelbrecht 2005) sites of the incorporation of foreign women into enemy communities. This practice may have led to the creation of ossuaries associated with Seneca communities as a result of the influence of Wendat or Attiwandaron women on local social ideology (Williamson and Steiss 2003). Beyond this point, the epilogue offers a thoughtful treatment of sensitive subject matter, including the reunion of members of the Wendat diaspora at the site of reburial of the remains from Ossossané in 1999.

Overall, Seeman's book is characterized by an excellent narrative style that is easy to read, which means that this would be a good introductory text for students new to the subject area. While this book is primarily a historical volume, it would have benefitted from some additional references from the body of anthropological writings on contact encounters, or on anthropological encounters in general, and from greater scrutiny of the archaeological and bioarchaeological literature in some instances. Nevertheless, Seeman provides an interesting mix of straight history, historical interpretation, and anthropological commentary, and it is this variety that contributes to the utility of the volume for those interested in Ontario's rich history.

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