

The St. Croix Watershed: Exploring Past and Present Fisheries Related Activities along the Waterway

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Introduction

New Brunswick Power (NB Power) is exploring the potential of emerging technologies to generate renewable energy while improving fish passage at the Milltown Generating Station. Milltown is located on the banks of the Schoodic (St. Croix) River, which forms the international boundary between Canada and the United States (See Appendix A). The Schoodic River extends 185 km, from North Lake to the tide waters of the Passamaquoddy Bay, draining an area of 4,271 km² (Appleby *et al.*, 2008). The Schoodic River watershed is the central core of traditional Peskotomuhkati (Passamaquoddy) territory (Bassett, 2015) this territory also includes both the Magaguadavic and Lepreau River watersheds.

The following information was gathered in an effort to understand pre and post-dam conditions on the Schoodic River with particular focus on anadromous fish. The rationale of this report is to establish if certain fish species had the ability to ascend the Schoodic River beyond Salmon Falls. In order to answer this question, a review of available published archaeological and ethnographical reports was carried out and summarized.

Cultural Background

As evident by an archaeological site in Penfield that was excavated in 2011-2012, First Nations people have occupied southwestern NB for nearly 13,000 years (Suttie *et al.* 2012). The beauty and biological productivity of the Passamaquoddy Bay has enticed humans to live in the area for untold generations. The First Nations people of NB (Mi'kmaq, Wolastoqiyik and Peskotomuhkati) practiced rich and complex cultures, often heavily reliant on marine and aquatic resources. Most known archaeological sites are located in strategic areas chosen for their ease of access to reliable marine and terrestrial resources.

First Nations people developed a way of life that respected the natural rhythms and life cycle of nature, (Bassett, 2015), placing importance on all things in Creation. The Peskotomuhkati people practiced seasonal journeys within their territory, which extended from Passamaquoddy Bay inland along the Schoodic River (St. Croix) to the Chiputneticook Lakes (North, East Grand, and Spednic Lakes) and also encompassed both the Magaguadavic and Lepreau River watersheds. This way of life involved taking advantage of seasonally available resources. It is said that the Peskotomuhkati people made regular use of the Salmon Falls, on the St. Croix, where they would fish salmon, eel and alewives in the spring

(newbrunswick.quaker.ca). Passamaquoddy Bay was long known for its abundance of pollock. The name Passamaquoddy (Peskotomuhkati) means “*spearers of pollock*” (newbrunswick.quaker.ca), the name itself provides context as to the deep connection to the Bay and the creatures that dwell within. The word *Schoodic* is said to have been derived from the Peskotomuhkati word *skut*, which means fire (digitalcommons.library.umaine.edu). According to a member of the Peskotomuhkati Nation, the Schoodic River may have been named for the numerous fires used to smoke river herring as Schoodic can be translated to “*a place of fire*” (digitalcommons.library.umaine.edu). Elders speak of smoking river herring at Salmon Falls and that so many fires were used that the entire sky appeared to be ablaze (digitalcommons.library.umaine.edu).

The first written account of the Schoodic River was given by Champlain (1604), where he describes the great quantities of herring and bass. Champlain also depicts his understanding of how First Nations people used the watershed for transportation purposes. Through a system of short overland carries, or *portages*, one could access the Magaguadavic, Wolastoq and Penobscot River watersheds. The Chiputneticook Lake system (headwaters of the Schoodic) was an area used not only by the Peskotomuhkati, but the Wolastoqiyik and Penobscot as well. During times of conflict, the Chiputneticook Lakes were traveled heavily as warriors traversed the landscape to congregate with their Wabanaki brethren (The Wabanaki Confederacy included Mi’kmaq, Wolastoqiyik, Peskotomuhkati, Penobscot and Abanaki Nations). During peaceful times, the watershed was travelled by family units and hunting parties, as evident by the multitude of archaeological deposits along the shorelines.

In 1899, W.F. Ganong released a Monograph of the Historic Sites in the Province of New Brunswick, which outlined what he knew of First Nations land use. Concerning village sites within the Schoodic River watershed, Ganong described a location below Forest City, between Grand and Chepednek Lakes as a point known to residents as an ancient campground. The area that Ganong describes is most consistent with the site presently named Mud Lake Stream. Ganong mentioned that this area was labeled: Etienne's Eel Works, on an 1832 plan, indicating the potential importance of the American eel in the Schoodic drainage system. Ganong also stated that the passage between the lakes must have been a great fishing place. Ganong also makes mention of the town of St. Croix, a town near the outlet of Spednic Lake. A plan of St. Croix dated to 1837, marks the site as having eel works and a deserted Indian village (Ganong, 1899). Ganong relayed that the site is an ideal camping place and the falls are just above. According to Ganong, Salmon Falls, near Milltown, was the site of an ancient camping place and burial ground. In 1704, Captain Church, an English colonist in North America who fought in King Philip’s War (Church, 1772), attacked the Native inhabitants of the site at Salmon Falls and destroyed their stores of fish (Ganong, 1899). Clearly, the site at Salmon Falls was a very important location for many cultural practices including the procurement of fish.

Archaeological Background

The following table outlines the Cultural Periods associated with technological changes as seen through the archaeological record of the Maritime Peninsula.

Early Palaeo-American Period	13,000 – 10,000 Years Before Present
Late Palaeo-American Period	10,000 – 9,500 Years Before Present
Early Archaic Period	9,500 – 7,500 Years Before Present
Middle Archaic Period	7,500 – 6,000 Years Before Present
Late Archaic Period	6,000 – 3,800 Years Before Present
Terminal Archaic Period	3,800 – 3,000 Years Before Present
Early Woodland Period	3,000 – 1,500 Years Before Present
Middle Woodland Period	1,500 – 1000 Years Before Present
Late Woodland Period	1,000 – 500 Years Before Present
Proto Historic Period	500 -200 Years Before Present

(Suttie, 2002)

There is very little published information pertaining to the archaeological history of the Milltown area. The Schoodic River, being one of the earliest areas in the Province to be colonized by European settlers, has a long history of land use. Unfortunately, settler activities are often deleterious to the First Nations archaeological record and this seems to be the case for Milltown. There have been formal excavations conducted within the lakes that feed the Schoodic River, namely the Forest City Site (Site 261.31), Diggity Site, Mud Lake Stream Site and Site 95.20. There is also a record of artifacts that have been surface-collected by interested locals.

The Forest City Site (Site 261.31) is the oldest excavated site within the Chiputneticook Lake system, located on the American side of the International Border (Bienenfeld, 2003). The site is described as a single occupation Palaeo Period site dated between 11,000-10,400 years before present (Bienenfeld, 2003). The excavation footprint measured 60 m² and contained over 700 artifacts (Bienenfeld, 2003). Among the tools found were stone scrapers and flakes indicating that woodworking/hide-working and stone tool manufacture took place on-site (Bienenfeld, 2003). Few sites from the Palaeo Period have been studied in New Brunswick; perhaps additional formal archaeological surveys within the watershed may lead to the identification of other contemporaneous occupations.

According to Patricia Allen (1982), the Schoodic River and lake systems have a long history of archaeological finds, many of which have been collected along the shoreline of Spednic Lake. According to David Sanger (1975), he had analyzed archaeological collections that had been amassed by digging and surface-collecting from sites on Spednic Lake. Sanger (1975), remarked that the amount of archaeological material collected from Spednic Lake was impressive, he was able to tabulate 41 gouges (heavy wood working tools), 74 celts (axe or adze heads), 7 plummets (sinkers), 4 ulus (crescent shaped cutting tools), 5 large side-notched points (projectile points of knife blades) and fragments of ground stone rods (potentially used for sharpening gouges). Sanger also pointed out that the sites from which these artifacts were recovered are now inundated due to the presence of various dams along the river. The artifacts described by Sanger (gouges, axes, plummets and ulus) indicate a heavy Archaic Period First Nations presence in the Chiputneticook Lake system, especially Spednic Lake.

While working with local artifact collectors, Sanger (1975), pin-pointed 20 potential archaeological sites in Spednic Lake. During Pat Allen's 1982 archaeological survey of the St. Croix Waterway Recreation Area, eight pre-contact sites were recorded. An eroded site was located 1.5 km south of the Canoose River which produced one flake (a bi-product of stone tool manufacture often re-used as cutting tools) (Allen, 1982). Another site located on the Palfrey Neck which yielded a water-worn gouge, is said to have been completely washed away (Allen, 1982). Two biface thinning flakes were found along a beach opposite Star Island in Palfrey Lake (Allen, 1982). Two pecked and ground stone celts were found on what has been termed the Silas site: located 200 m south of Star Island in Palfrey Lake (Allen, 1982). The Little Beach site (located on the eastern shore of Grand Lake, between Blueberry and Spruce Points) yielded four flakes and a water-worn gouge (Allen, 1982). All of the sites mentioned above were found to be completely eroded from their original context.

A pre-contact archaeological site that was located near Diggity Stream on Spednic Lake was found to be partially intact and was subsequently excavated (Allen, 1982). Initial walk overs of the beach area produced biface thinning flakes, three ground stone axes, a water-worn gouge, a large oval-shaped unifacial tool and a large biface (Allen, 1982). Two excavation units were tested: one located on the exposed beach during a period of low water and the other located more inland near an established camping area (Allen, 1982). Allen's excavation units located on the beach produced hundreds of flakes, 17 unifacial steep-edged scrapers, calcined bone fragments, a biface tip (or base), an elongated abrading stone and a battered cobble (Allen 1982). The calcined bone was not described in detail and at the time of publication had not been analyzed for species. The excavation unit located inland contained 2 flakes and approximately 100 shards of a pottery vessel exhibiting a cord-wrapped stick motif. Allen attributes artifacts found along the beach to the Archaic Period for the most part and the site on the stable landform was attributed to the Woodland Period (Allen, 1982).

It would appear that many of the Archaic Period archaeological sites in the Chiputneticook Lake system are now submerged or eroding out of the shoreline; only three of the eight sites discovered proved to have portions intact (Allen, 1982). Allen suggests that this is a direct result of the presence of dams along the river and associated artificially high water levels (Allen, 1982). Due to the physical characteristics of the Chiputneticook Lake system, the water bodies are subject to a considerable degree of fetch: wind and waves can be very substantial. Wind and waves, coupled with high water levels, create conditions that are conducive to shoreline erosion and subsequent loss of archaeological sites within the Chiputneticook Lake system.

The Vanceboro Site is located on Varney Island and was excavated by the Crocker family in the 1930's (Robinson, 2001). The site is located 700 m upstream from the Vanceboro dam and was formerly connected to the eastern shoreline (Robinson, 2001). The site would have been located on a constriction in the stream and showed evidence of a major occupation site (Robinson, 2001). The Crocker family artifact assemblage consisted of over 800 artifacts collected from the Vanceboro area (Robinson, 2001). The Varney Island site contained red ochre deposits and elaborate artifacts indicative of an Archaic Period cemetery; 15 perforated pendants and 36 gouges/axes/adzes were found on-site, many of which were stained with red ochre (Robinson, 2001). (See Appendix B for map)

There are archaeological sites on the U.S. side of the border that have been reported, namely Site 95.20 in the Grand Falls Drainage (Cox, 1991). The site was brought to the attention of professional archaeologists by a private collector who had found artifacts along the shorelines of the Grand Falls Flowage (Cox, 1991). Artifacts that were surface collected on-site were indicative of an Archaic Period occupation (Cox, 1991). The private collector sought out archaeologists after realizing the implications of finding a red ochre feature eroding from the river bank: red ochre is most often associated with human burials (Cox, 1991). After the site was formally excavated, over five-hundred artifacts had been unearthed along with thousands of flakes and calcined bone (Cox, 1991). Through radio-carbon analysis, the site proved to have been created 5070 +/- 275 years before present (Cox, 1991). The site was found to have multiple occupations, from the Archaic through to the Woodland Period. Evidence for fishing activities taking place on-site consists of: ten plummets, fragments of a barbed harpoon constructed from a swordfish rostrum and twenty-six fragments of calcined fish bone (Cox, 1991). By working with a private collector, four previously unknown archaeological sites were registered within the Grand Falls Drainage; the artifacts are now held in the Maine State Museum and are known as the Eddie Brown Collection (Cox, 1991).

The site at Mud Lake Stream had been formally recorded by Allen in 1982 when initial walk-overs and excavation units were established. In the subsequent years of 1983 and 1984 a full-scale excavation was carried out by Michael Deal. During excavations at Mud Lake Stream, it was established through radiocarbon analysis that the site had been used for at least 4000 years (Deal, 1984). The oldest components of the site are associated with what archaeologists have termed: the Late Archaic Period or Susquahanna Period. This period has been well studied in Maine and Coastal New Brunswick (Deal, 1984). The people who lived during this time period were heavily marine-adapted (Deal, 1984) although excavated Archaic Period sites in the interior of the Province also indicate a heavy reliance on mammalian terrestrial resources (Cox, 1991).

During the 1982 survey of Mud Lake Stream, Allen surface-collected a plummet from the shoreline and another turned up in an excavation unit sunk by Deal in 1984. Plummets are associated with fishing activities, the most reasonable uses of the plummet are: sinkers for net systems or sinkers for jigging lines. It would appear that fishing activities were most likely taking place on-site at Mud Lake Falls.

A study conducted by Currie (2007) suggested that by 6000 years before present, fish populations became naturally dispersed across Atlantic Canada. With a radiocarbon date of 4010 +/- 180 years before present (Deal, 1984), it is possible that salmon, gaspereau, shad and eel had the ability to ascend the falls at Milltown and take advantage of the vast headwaters of the watershed.

Mud Lake Stream provided an interesting picture of Late Archaic Site manifestation in the interior. Organic preservation on site was such that 2760 fish elements were preserved, of these, 17 elements had been identified by species (Deal, 1984). Three specimens were classed as salmonidae; 14 specimens came from older deposits and were part of the herring family, most likely alewives (Deal, 1984). A more recent report by Spiess & Halliwell (2012) focused on a re-examination of the fish remains from Mud Lake Stream. Based on archaeological provenience, anadromous alewives, shad and land-locked white perch were present in the Schoodic watershed for over 1000 years, possibly extending as far back as

3000 years before present (Spiess & Halliwell, 2012). White perch were not initially identified due to similarities with shad (Spiess & Halliwell, 2012). Deal mentions that Turnbaugh (1975) places considerable importance of the alewife and shad to the Susquahanna broadpoint distribution in the Northeast (broadpoints are one of the diagnostic tool types often associated with the people of the Late Archaic).

Deal's 1984 report indicates the possibility that the fish were caught near the falls at Milltown, smoked for preservation and imported to Mud Lake. It is worth noting that many archaeological sites in New Brunswick are located in areas that offer strategic access to resources. Mud Lake Stream seems to exhibit this characteristic as it is located at the base of a waterfall. Flagg (2007) suggests that the First Nations ancestors gathered food that was within a day's travel (10 miles or 16 km). The distance from Milltown to Mud Lake Stream is between 60-65 miles (96.5-105 km), making it unlikely that the fish remains found on site were imported (Flagg, 2007).

Through personal communications between Dr. Art Spiess and members of the Peskotomuhkati Nation, Spiess suggests that the fish remains from Mud Lake Stream most likely represent fish caught and processed on-site (Spiess, 2015 Personal Communication). Spiess points out that the shell midden deposits in Maine and New Brunswick exhibit excellent organic preservation, therefore provide a more accurate representative fish remains sample than the sites located closer to the interior (Spiess, 2015 Personal Communication). The coastal midden deposits often contain locally available ocean-dwelling species such as flounder, sculpin, cod and diadromous/anadromous species such as sturgeon, alewife, tomcod and salmon (Spiess, 2015 Personal Communication). Spiess (2015) suggests that if the salt-water species of fish were caught and preserved in large numbers and subsequently transported into the interior for later consumption, random samples of such species should show up in the archaeological record. Interestingly, the only fish bones that have been preserved in archaeological sites located above the head of the tide are sturgeon, striped bass, salmon, alewife and shad: fish that would have been locally available above the head of tide (Spiess, 2015 Personal Communication). Spiess (2015) pointed out that the only exception to the previous statement is the presence of swordfish rostrums in some archaeological deposits, which had been fashioned into hunting and fishing implements. The implications of Spiess' research and insight are that the fish remains present at Mud Lake Stream were caught and processed on-site. Alewives, American shad and land-locked white perch were present in the Schoodic River watershed (at least as far north as the base of Mud Lake Falls) during the Woodland Period, possibly extending back as far as the Late Archaic Period.

As further evidence of fishing related activities taking place on the site of Mud Lake Stream is the abundance of storage vessels (pottery) (Deal, 1984). Technology changed from one period to the next and by the Woodland Period, the use of pottery was well established. It is generally accepted that pottery vessels are associated with food preparation and storage (Bourgeois, 1999). During the excavations at Mud Lake Stream, 2,712 individual pottery specimens were collected, representing 102 individual pottery vessels (Deal, 1984). Deal found evidence that pottery vessel manufacture took place on-site, with this in mind, it makes sense that people were procuring, consuming and storing fish on-site. The development of pottery is thought to have been associated with population growth, increased sedentism and intensive use of resources such as seeds, nuts and anadromous fish species (Bourgeois,

1999). A study conducted by Bourgeois (1999) focused on pottery from the St. John River watershed which was reviewed for comparative purposes. Many of the archaeological sites mentioned by Bourgeois (1999) that contained an abundance of pottery vessel remains were strategically located in areas that are advantageous in terms of intercepting fish runs, namely: the Keyhole Site on Grand Lake, Fulton Island near French and Maquapit Lakes, the Jemseg Site on the outlet of Grand Lake and Ekpahak Island on the head of tide of the Wolastoq (St. John) River. A cluster of sites on the Oromocto River, which was not mentioned in the report by Bourgeois, contains a massive amount of pottery remains and a reliable run of gaspereau in the spring and fall. The cluster of archaeological sites is located above the head of the tide in the vicinity of Gaspereau Falls on the North Branch of the Oromocto River. Ice flows associated with the spring freshet gouge the river banks and distribute archaeological material along the shorelines. The largest concentrations of archaeological material are located in areas that are currently by used by local residents to dip-net gaspereau, which are exceedingly abundant. Intuitively, there seems to be a connection between pottery-bearing sites and productive fishing locations.

Human-induced Impacts to the Schoodic River

In Perley's 1825 manuscript he describes the lower dam at Milltown (Union Dam) extending from bank to bank. He described the nature of the other dams present along the St. Croix River and their apparent lack of fish passage capacity. Concerning the Union Dam, there was no official fish-way, instead, water passed over the dam creating a "roll" (Perley, 1825). It was thought by Perley that salmon could ascend the dam at high water, but other species could only do so with great difficulty. The location of the dams were described as being located on bedrock ledges that created runs and channels of flowing water (Perley, 1825). According to Perley (1825), the runs of moving water were often choked with debris caused by logging activities on the river and the impacts were such that no fish could pass upstream. Through conversations with locals, Perley was told that salmon, shad and gaspereau were exceedingly abundant in the Schoodic River. The average catch of salmon, during the season, was 200 fish per day and the shad and gaspereau resources were so bountiful that it was thought that they could never be exhausted (Perley, 1825).

According to Perley, up until 1825 the dams on the Schoodic River had active fish-ways, however, with the establishment of the lowermost dam (Union Dam) and lack of fish-way, fisheries in the area dramatically declined. In 1846 the Union Dam was swept away and the fishing once again became productive until a new dam was built in the same location two years later (Perley, 1825). Perley outlined an agreement set forth during the sale of the Union Dam that required all dams on the river to incorporate adequate fish-way systems. Although it was stated that if fish-ways were not employed the contract would become void, the proprietors were non-compliant yet retained control of the dam (Perley, 1825). Perley places the responsibility for the dramatic decrease in fish stocks on the shoulders of the proprietors of the Union Dam for but also acknowledges that the other dams on the river contributed to the problem.

The construction of dams along the Schoodic River was initiated for log driving and milling purposes, but by the 1800's were they producing mechanical energy to power manufacturing facilities and towns (International St. Croix Watershed Board, 2008). Many industrial activities have had an impact on the character and quality of the watershed, these activities include: sawmills, pulp and paper mills, tanneries, fish hatcheries, ship yards and marine ports (International St. Croix Watershed Board, 2008).

A serious decline in water quality is also thought to contribute to impacts on fish stocks in the St. Croix. In 1950-1960, water quality in the river was so poor that very few fish were using the system (Anon, 1988). This was said to be caused by pulp deposition on the river bottom which has a high oxygen demand. This was further compounded by the presence of industrial effluent and barriers such as dams (Anon, 1988). According to a study conducted in 2005, 50-200 cords of pulpwood are removed at the Woodland and Grand Falls dam every year (International St. Croix Watershed Board, 2008). A study conducted in 1988 outlined potential contributors to a slight decline in water quality. Among the contributors are: sedimentation and silting associated with road construction and logging, minor pollution from small towns and summer cottages, and finally, industrial wastes associated with pulp and paper mills (Anon, 1988).

Fish Passage

The upstream migration of gaspereau (alewives and blueback herring) has been a controversial topic since the 1980's (Flagg, 2007). Small mouth bass were introduced to the Schoodic River in the 1800's and became an important sport fishery in the watershed (Anon, 1988). By the mid 1980's bass stocks were in decline, prompting a joint effort from both the Canadian and American fisheries agencies to explore potential causes of the decline (Anon, 1988). The study found that a large influx of gaspereau coupled with significant reservoir drawdowns, extirpated bass from their nurseries along the shoreline, forcing them to compete with other species for habitat and sustenance (Flagg, 2007).

In response to the findings of the previously-mentioned study, the St. Croix Steering Committee agreed to block the Vanceboro fish-way during the alewife run (Flagg, 2007). The Vanceboro fish-way has been closed since 1988. Beginning in 1995, both the Woodland and Grand Falls fish-ways have been closed during the gaspereau runs (Flagg, 2007). The efforts to protect the invasive small mouth bass led to a dramatic drop in alewife population. Counts dropped from 2,600,000 gaspereau in 1987 compared to 900 gaspereau in 2002 (Flagg, 2007). Throughout this time period, NB Power has been providing upstream passage for gaspereau above the Milltown Generating Station, and since 2001, have been trucking fish to the Woodland impoundment (the next upstream river barrier) (Flagg, 2007). (Refer to Appendix C for data tables related to fish passage at Milltown.)

In 2006, a non-profit organization carried out scientific studies on the St. Croix River (Hoffman, 2007). Two important results were drawn from the study: 1) small mouth bass and gaspereau can indeed coexist with one-another, 2) the studies substantiated the historic claims of alewives being present in the Upper St. Croix Drainage (Hoffman, 2007).

The population of gaspereau attempting to ascend the Schoodic River is increasing, however, the numbers do not compare to the historical accounts mentioned by Perley (1852). Flagg (2007) pointed out that if the gaspereau did not ascend the river beyond Grand Falls, then why was there such a dramatic decline after the closure of the fish-ways in 1995? It is suggested that there is not enough fish habitat below Grand Falls to account for the historic quantities of gaspereau that have been recorded above the falls in the past (Flagg 2007).

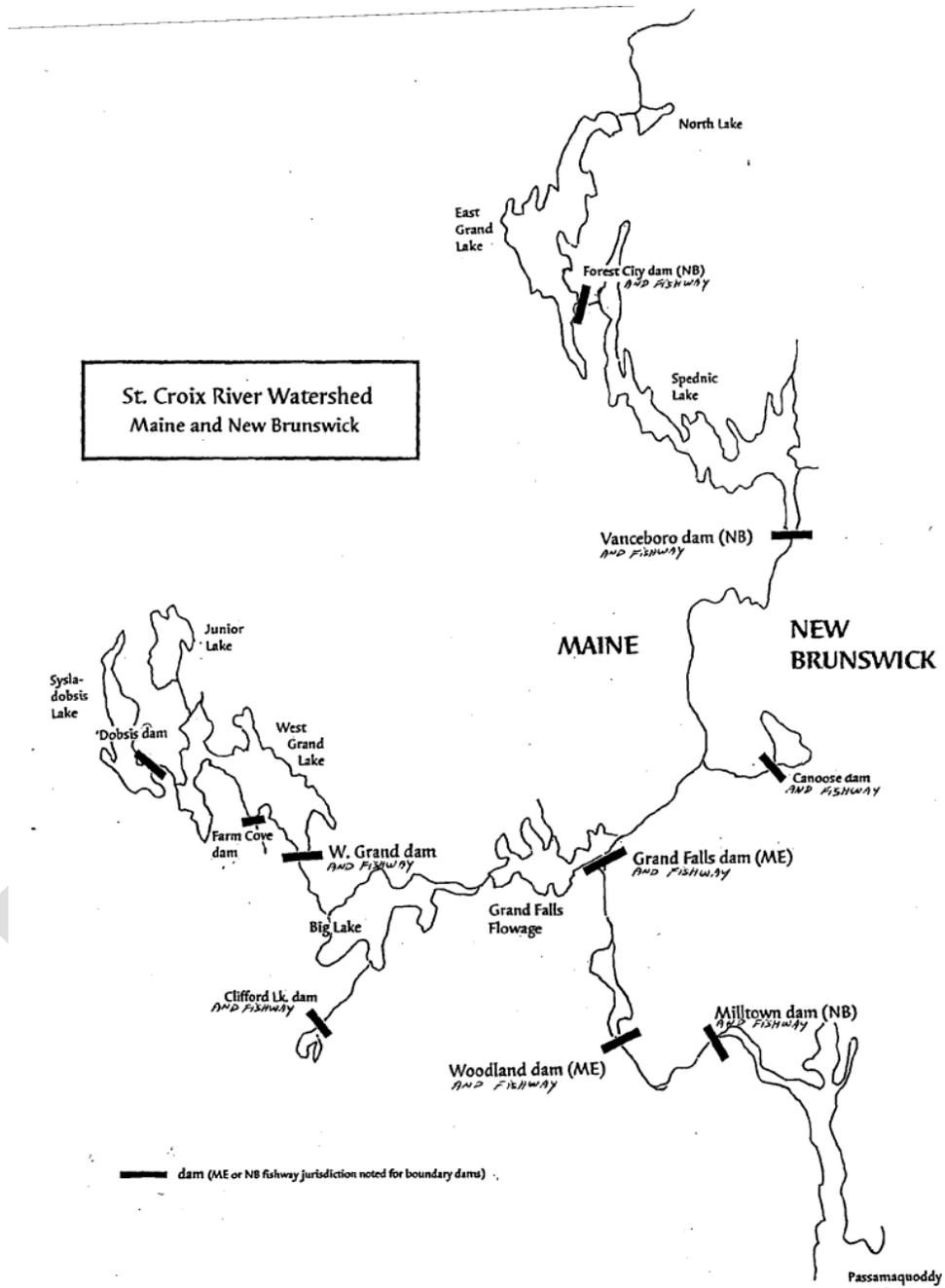
Conclusion

It would appear that there is ample anecdotal evidence (accounts from the 1800's) and physical evidence (the archaeological record) suggesting gaspereau and shad had the ability to ascend the natural river barriers present near Milltown, NB. Flagg (2007) suggests that we would not see such dramatic decreases in alewife stocks in the upper reaches of the watershed if the habitat above Grand Falls/Woodland was not historically reached by alewives. The same report also suggests that there is not enough fish habitat below Grand Falls to account for the historic quantities of gaspereau that have been recorded in the past (Flagg 2007). As the data presented above illustrates, a dramatic decrease in alewife stock coincided with the blockage of various fish-ways along the upper reaches of the river.

The archaeological record supports the idea that gaspereau and shad were able to reach the base of Mud Lake Stream Falls, which was an important First Nations land-use site for the last 4000 years. It seems intuitive that salmon could also ascend the river if shad and alewife had the ability. Historical evidence paints a picture of abundant aquatic resources in the Schoodic River prior to industrialization. The evidence presented through the analysis of many reports suggests that inadequate fish passage has been the predominant factor contributing to fish stock decline in the watershed.

Through scientific study and collaboration on both sides of the international border, efforts have been made to decrease the loss of gaspereau populations. Species of fish that currently attempt the ascent of the Schoodic River include: alewife, blueback herring, Atlantic salmon, landlocked salmon, American shad, white sucker, small mouth bass, golden shiner, common shiner, brook trout, sunfish, American eel and sea lamprey. Understanding the key species needs and preferences in terms of fish passage is essential to ensuring that Native fish species always have niche within our ecosystem.

Appendix A



(Map sourced from Flagg, 2007)

Appendix B



Map depicting the Vanceboro Site on Varney Island, St. Croix, NB. Yellow dots indicate artifact finds, the red dots represent red ochre features and the blue dot represents a human calcaneus or heel bone (Robinson, 2001).

Appendix C

Gaspereau returns at the Milltown fish-way, 1981 - 2017.

Year	Returns at Milltown	Significant events
1981	169,620	New pool and weir fish-way
1982	233,102	
1983	151,952	
1984	152,900	
1985	368,900	
1986	1,984,720	
1987	2,624,700	
1988	2,590,750	Spednic fish-way closed
1989	1,164,860	
1990	1,531,250	Grand Falls fish-way closed
1991	586,910	Limited alewife escape into

		Spednic Lake
1992	203,750	Limited escapes above Grand Falls
1993	297,720	Grand Falls fish-way blocked
1994	350,154	Grand Falls fish-way blocked
1995	274,079	Woodland and Grand Falls fish-way blocked
1996	645,978	
1997	225,521	
1998	177,317	
1999	25,327	
2000	8,569	
2001	5,202	Woodland headpond stocked
2002	900	Woodland headpond stocked
2003	7,901	Woodland headpond stocked
2004	1,299	Woodland headpond stocked
2005	11,632	Woodland headpond stocked
2006	11,829	Woodland headpond stocked
2007	1,294	
2008	12,261	
2009	10,450	
2010	59,145	
2011	25,142	
2013	16,677	
2014	27,312	
2015	93,503	
2016	33,016	
2017	157,750	

(Flagg, 2007 and the Department of Fisheries and Oceans, 2017.)

Current data from the Milltown fish-way (2012-2017) organized by species.

Species	2012 Trap Count
Alewife/Gaspereau	36,168
White Sucker	30
Small Mouth Bass	11
Golden Shiner	2
Brook Trout	1
Landlocked Salmon	1
American Eel (partial count)	1
Sea Lamprey (partial count)	1
Atlantic Salmon	0

(Sochasky, 2012)

Species	2014 Trap Count
Alewife/Gaspereau	27,312

White Sucker	40
Small Mouth Bass	8
Brook Trout	2
Sea Lamprey	2

(Atlantic Salmon Federation, 2014)

Species	2015 Trap Count
River Herring: Alewife and Blueback Herring	93,503
Small Mouth Bass	29
White Sucker	27
American Shad	11
Brook Trout	9
American Eel	2
Common Shiner	2
Sea Lamprey	1

(Sochasky & Goreham, 2015 and the Department of Fisheries and Oceans, 2017)

Species	2016 Trap Count
River Herring: Alewife and Blueback Herring	33,016
Small Mouth Bass	24
White Sucker	14
Brook Trout	13
Common Shiner	3

(Goreham & Almeda, 2016)

Species	2017 Trap Count
River Herring: Alewife and Blueback Herring	157,750
White Sucker	94
American Shad	56
Small Mouth Bass	45
Lamprey	8
American Eel	5
Golden Shiner	3
Common Shiner	2
Brook Trout	2
Rainbow Smelt	1
Sunfish	1

(Goreham & Almeda, 2017)

References

Allen, P. 1982. The St. Croix Waterway Recreation Area 1982 Archaeological Survey. Manuscripts in Archaeology. New Brunswick Historical and Cultural Resources.

Almeda, H & Goreham, R. 2017. Milltown Fishway Research Trap Report St. Croix River, New Brunswick and Maine. St. Croix International Waterway Commission.

Almeda, H & Goreham, R. 2016. Milltown Fishway Research Trap Report St. Croix River, New Brunswick and Maine. St. Croix International Waterway Commission.

Anon. 1988. Long-term Management Plan for the Diadromous Fisheries of the St. Croix River. Canadian Manuscript Report of Fisheries and Aquatic Sciences No. 1969.

Appleby *et al.* 2008. St. Croix River: State of the Watershed Report, Maine and New Brunswick. International St. Croix River Watershed Board, International Joint Commission, Canada and the United States.

Atlantic Salmon Federation. 2014. Milltown Dam Trap Report St. Croix River, New Brunswick and Maine. Atlantic Salmon Federation.

Bassett, E. 2015. Cultural Importance of River Herring to the Passamaquoddy People. Sipayik Environmental Department.

Bienenfeld, P. 2013. Completing Mitigation at U.S. Customs and Land Ports of Entry. Paper Presented at the 33rd Annual Conference of the International Association for Impact Assessment. Calgary, Canada.

Bourgeois, V. 1999. A Regional Pre-Contact Ceramic Sequence for the St. John River Valley. A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Arts in the Graduate Academic Unit of the Department of Anthropology, University of New Brunswick.

Champlain, S. 1604. The Voyages of 1604-1607:41. Archive.org.

Church, T. 1772. The Entertaining History of King Philip's War. Second Edition, Newport, Rhode Island: Re-printed and Sold by Solomon Southwick, Queen Street.

Cox, S. 1991. Site 95.20 and the Vergennes Phase in Maine. *Archaeology of Eastern North America* Vol. 19. pp. 135-161

Deal, M. 1984. Final Report on the 1983-1984 Excavations at the Mud Lake Stream Site (BkDw 5), Southwestern New Brunswick. No. 15 Manuscripts in Archaeology. New Brunswick Historical and Cultural Resources.

Department of Fisheries and Oceans *et al.*, 2017. Table 2. St. Croix River ME/NB Alewife/Gaspereau/Blueback Herring Spawning Runs, 1981- Present.

digitalcommons.library.umaine.edu/cgi/viewcontent.cgi?article=1069&context=seagrant_pub

Eagles, J. 1966. A Survey of Eel Fishing in the Maritime Provinces. Industrial Development Services, Department of Fisheries and Oceans Canada, Ottawa.

Flagg, L. 2007. Historical and Current Distribution and Abundance of the Anadromous Alewife (*Alosa pseudoharengus*) in the St. Croix River. A Report to the State of Maine Atlantic Salmon Commission.

Ganong, W. 1899. A Monograph of the Historic Sites in the Province of New Brunswick.

Hoffman, K. 2007. The Maine Legislature's Bill: An Act to Stop the Alewives Restoration Program in the St. Croix River- Have the Canadians and the Biologists Gone Berserk? *Ocean and Coastal Law Journal*. Vol. 13, Number 2, Article 5.

Newbrunswick.quaker.ca/passamaquoddy-minute/passamaquoddy-recognition-background-information/.

Perley, M. 1852. Reports on the sea and River fisheries of New Brunswick. J. Simpson Printer to the Queen's Most Excellent Majesty, Fredericton, NB.

Robinson, B. 2001. Burial Ritual, Groups and Boundaries on the Gulf of Maine: 8600-3800 B.P. A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy in the Department of Anthropology at Brown University, Providence Rhode Island.

Sanger, D. 1975. Culture Change as an Adaptive Process in the Maine-Maritimes Region. *Arctic Anthropology* Vol. 12, No. 2, Papers from a Symposium on Moorehead and Maritime Archaic Problems in Northeastern North America (1975), pp. 60-75

Sochasky, L. 2012. Milltown Dam Trap Report St. Croix River, New Brunswick and Maine. Atlantic Salmon Federation.

Sochasky, L. & Goreham, R. 2015. Milltown Fishway Research Trap Report St. Croix River, New Brunswick and Maine. St. Croix International Waterway Commission.

Spiess, A. & Halliwell, D. 2012. Mud Lake Stream Site at Spednic Lake (BkDw-5), New Brunswick, Canada. Calcined Fish Bone Identification and Re-examination. Maine Historic Preservation Commission, Maine Department of Environmental Protection.

Spiess, A. 2015. Personal Communications with Members of the Peskotomuhkati Nation. Email Exchange Provided by Ed Basset to Austin Paul: January 22nd, 2018.

Suttie, B. (2002). Archaic period archaeological research in the interior of southwestern New Brunswick. University of New Brunswick, Fredericton, NB Canada.

Suttie *et al.* (2012). Recent Research on Four Sites Spanning 13,000 Years from South Western New Brunswick, Canada. Archaeological Services, Heritage Branch, Department of Tourism, Heritage and Culture NB, Canada.