Stewardship Plan to Protect and Restore the Atlantic salmon (Salmo salar) Habitat in the Bouctouche River

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Acknowledgments

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We also would like to show our appreciation to all the individuals and members that have pledged their full support during our focus group day on February 28, 2013. Thanking you all very much. All the comments and input were greatly appreciated. We will surely not forget one saying "We will help build it and they will come!!"

Last, but not least, to Donald Alexander, Michelle Maillet, Rémi Donelle and André Cormier thanks a whole lot for your time, energy and patience in realizing this report. I certainly enjoyed the challenges that came along with it. Thank you for the team effort, which made it possible to pull together this document under such limited time.

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Developing a Stewardship Plan to protect and Restore the Atlantic salmon (salmo salar) Habitat in the Bouctouche River

1.1 Background

In the last 20 years, The Southeastern Anglers Association has become stewards in protecting and enhancing the Atlantic salmon population and their habitat in some rivers of southeastern New Brunswick. Completing a stewardship program to protect and restore the Atlantic salmon habitat in the Bouctouche river is the first step before implementing important stewardship projects in the near future. It is only with great participation and interest from our members, landowners, local communities and partners that this project will become an important tool to work with.

In November 2011, the Southeastern Anglers Association was advised from Fisheries and Oceans Canada that the Bouctouche River would be eligible for funding through Environment Canada's Habitat Stewardship Program to work with the Atlantic salmon habitat. A letter of interest and a full proposal were submitted at the respected date.

In November 2012, an announcement confirmed that the project "Developing a stewardship plan to protect and restore the Atlantic salmon habitat in the Bouctouche river" was approved. The only inconvenience was that it had to be completed within 4 months (March 31st 2013). It is thanks to a team effort, devotion and knowledge from Donald Alexander (president), Michelle Maillet and Rémi Donnelle, that this project was realized under such a short time period.

The preparation of this document includes a literature review that gathers relevant information available about the Bouctouche river. We have attempted to identify all the available documentary sources and knowledge to write up this plan within such a short period of time. These sources include many publications from government, university (published and unpublished) research papers, exclusive consultants, reports from non-governmental organizations, community groups, personal communications with experts and other sources believed to be reliable and relevant (ie. SAA members and people of the community). No field work has been undertaken for this document. A list of literature review can be found in the appendices.

1.2 Purpose of the Project

In 2010, COSEWIC designated the Atlantic salmon with the status of Special Concern in the Designable Units (DU) 12 Gaspé and Gulf of St-Lawrence, which encompasses the Bouctouche River. It is mentioned in the COSEWIC assessment and status report that the lowest abundance of Atlantic salmon in the DU12 during the last 3 generations was in 1999. Based on the data from the Miramichi river and other smaller rivers in the Gulf of St-Lawrence, adult populations were higher in the late 80's and early 90's than in the past decade. We recognize that the Miramichi accounts for the majority of salmon populations in the DU but the smaller groups of rivers flowing into the Northumberland Strait (which lets in the Bouctouche river) have appeared to indicate the same decline in salmon populations. (Fisheries and Ocean and Quebec Ministère des Ressources naturelles et de la Faune 2009). The Bouctouche river salmon population has been used as an index for the groups of smaller rivers flowing into the Northumberland Strait for the last 35 years (in the SFA 16B) By Fisheries and Ocean Canada. Annual assessments of the Bouctouche River indicate that juvenile Atlantic salmon are present but don’t necessarily meet the conservation requirements every year. (Atkinson 2009)

In 1998, legislative authority under the Fisheries Act, sanctioned by Fisheries and Oceans Canada, closed all Southeastern New Brunswick (all lakes, rivers, and streams draining into the Gulf of St. Lawrence and Northumberland Strait south of Point Escuminac down to the New Brunswick/Nova Scotia border) to Atlantic salmon fisheries. Multi-annual assessment of Atlantic salmon provided supporting evidence of low spawning escapement in all of the determined rivers and led to the total closure of all Atlantic salmon fisheries.

It is well cited in various literature that the specific causes of decline of Atlantic salmon population in the Southern Gulf of St-Lawrence in the last 30 years are unknown. Because Atlantic salmon require rivers and streams that are generally clear, cool and well-oxygenated for reproduction and also for their first few years of their life, many identified threats such has recreational and aboriginal fishing, agriculture, forestry and urbanization have probably contributed to the problem.

This project will also bring importance to the strain of Atlantic salmon that migrate and rear in the smaller rivers flowing into the Southern Gulf of St-Lawrence. The Bouctouche river strain of Atlantic salmon does not account for a big percentage of the COSEWIC DU 12 if compared with bigger rivers such as the Miramichi but are of value to our communities and our heritage.

Fisheries and Oceans Canada established the calculation for conservation requirements for adult Atlantic salmon in the Bouctouche River since 1993-1995. . The number of spawners needed to meet egg deposition requirement was calculated assuming all eggs came from large salmon. The number of small salmon required was calculated assuming the one male spawner was needed for each large salmon. Fecundity was considered to be equivalent to Miramichi stocks. The conservation requirements were established to be 281 large spawners and 172 small spawners. (Atkinson and al. 1998)

1.3 Coordination's of the Project

In 1994-1995, the Southeastern Anglers Association drafted up its first plan to protect and enhance the Atlantic salmon population and their habitat in many small rivers in Southeastern New Brunswick. This was realized thanks to the Recreational Fisheries development agreement between the Province of New Brunswick and Fisheries and Oceans Canada to encourage the development of projects that would further enhance the sport fishery in the region. Studies on habitat and angling management were necessary on all rivers of our territory so that we could determine what strategies needed to be implemented to assure the long-term sustainability of the Atlantic salmon and Brook Trout. After all study results were considered, the primary focus of the association, since 1997, was monitoring, habitat restoration and promoting good stewardship of our natural resources. In 2010, the SAA prepared a strategic plan that would outline specific, measurable and time focused objectives, working towards the SAA mission and goals for the next 5 years.

In the last 20 years, a total of 1.7 million dollars was given to the SAA to accomplish a variety of tasks. It wouldn't have been possible to realize these projects without the many partnerships involved.

The Southeastern Anglers Association has become stewards in protecting and enhancing the Atlantic salmon population and their habitat in some rivers of Southeastern New Brunswick. We feel that we are in need of a new vision and looking and analyzing past activities can realize this. Completing this stewardship plan to protect and restore the Atlantic salmon habitat in the Bouctouche River is the next step before implementing important stewardship projects in the near future. It is only with interest and participation of our members, landowners, local communities and partners that this project will become an important tool which to work on stewardship efforts at a watershed and sub-watershed level.

The primary objective of this project will be to engage the Southeastern Anglers Association and other partners in developing a stewardship plan. Based the knowledge gathered, 6 sites will be identified to protect or restore the Atlantic salmon habitat in the Bouctouche river. The plan will include recommendations on high priority areas where specific actions will be identified to facilitate future habitat stewardship projects for the Atlantic salmon. Afterward, the actions will become key elements that will be elaborated on the stewardship program.

The project coordinator will involve several partners for input before writing up the stewardship plan. It will include recommendations on how the specific actions will be brought forward. Communication strategies, landowner enrollment, details on actions (ex. Permits), timeline and financial acquisitions required will be some of the key subjects developed during the creation of the plan. During the course of the project, we will assure that the good partnerships between all interested parties remain present.

2 Overview Description of the Bouctouche Watershed

2.1.1 Geography

The Bouctouche River is located in Kent County, southeastern New Brunswick. All waters flows into the Northumberland Strait drainage, which are part of the Gulf of St-Lawrence's bigger ecosystem. The Bouctouche watershed is situated in the coastal plain of the lowlands of the eastern New Brunswick, where the slope of the land towards the sea is easy and not very noticed. The Bouctouche river has weak-moderate water flow, is short and not very deep, typical of New Brunswick's east coast.

The *Bouctouche watershed* covers a surface of 613.4 km² (SEnPAq 1995) and includes 3 major water basins: Black River, Bouctouche and Little Bouctouche. The watershed limits are delineated by the Chockpish watershed in the north, the Cocagne watershed in the south, the Caanan bog in the upper reaches and separated from the Northumberland Strait by the Bouctouche dune. The Main river is divided into two main branches, North and South, which encompasses 11 identified watercourses: Millers, Norman Ridge, Rushcove, Trout, McLean, Johnson, Yanke, Richard, Albert, Noel and Mill (LeBlanc-Poirier et Gauvin 2002, Atkinson 2004). The Little Bouctouche, which is situated just south of the Bouctouche River, meander 30 Km inland (SenPAq 1995). It encompasses 3 identified watercourses: Smelt, Breau and Bastarache (Atkinson 2004). The Black river undulates 10 km inland and flows directly into the Bouctouche Bay (SenPAq 1995).

2.1.2 Geology

During the last glaciations, the Bouctouche River was mostly covered by glaciers. Over time, these glaciers melted and receded to give the landscape that we see today. The Bouctouche watersheds are all adjacent with the Northumberland Strait and present altitudes varying from approximately 0 to 60 m above sea level and can seldom be seen on more than 20 km inland (Rees et al. 1992). These areas have an orientation southwestern/north-eastern, which partly improves the drainage of the grounds and tributaries present. The water depths are relatively low in the estuaries. (SenPAq 1990).

A Report produced by Agriculture Canada in 1992 “Soil Regions Chipman, Minto and Hartcourt in New Brunswick” gives us a good overview of the soil compositions for the concerned area.

> “*The bedrock geology is simple. In almost the whole survey area, thin deposits of unconsolidated materials are underlain by horizontally bedded Pennsylvanian sandstones. The parent material of rich soils is well-sorted marine influence outwash sand, more than 1m deep. It is free of coarse fragments, but sometimes it has some gravel and cobbles of Pennsylvanian sandstone origin. ”(Rees et al. 1992)*

2.1.3 Climate and Temperature

“All Kent County communities are influenced by a modified continental climate, which is typical of the Maritime region. Our climate is influenced primarily by the east air masses, which are provided by the central zones of Canada. These atmospheric currents are modified by the frequent inflow of humid air coming from the Atlantic. The average number of degree-days are usually higher for the inland than in the coastal area. The influence of the oceanic air tends to bring short periods of milder temperature during winter and foggy periods during summer. The precipitation is typical of the climate in the Maritimes and is fairly distributed throughout the year”. (*Agriculture NB, 1976.)* January is usually the coldest month, July being the hottest; storms are unpredictable, summer like winter; and the fog is frequent especially along coasts (Arsenault and Al 1976).

2.1.4 Land Use

This region offers a diversity of habitats such as fresh water pools, run riffles, estuarial habitats including eelgrass beds, mud flats, barrier beaches and dunes at the terrestrial limit. The adjacent lands show wetlands; surrounded by low hills, which gives the region's character. Larger amounts of forested and agricultural land developments are typical for the majority of the watershed land use. These land uses are what dominate in the regional economy and are attributing significantly to the water quality of the watershed. Numerous permanent and seasonal residences compose several little communities and two municipalities. The economy of the area depend on the natural resources and the goods and services, which the area can offer for the neighbouring areas considering its proximity to the municipalities of Moncton, Dieppe, Shédiac and Richibouctou.

2.1.5 Human Impact

Previously, the rivers were composed of many characteristics such as numerous pools, undercut banks, loose gravel in spawning grounds, an abundance of food sources and good water quality. All of these characteristics provided good fish habitat for the various stages in the life cycle of fish and other stream organisms.

With the arrival of the European settlers in the mid 1600's, we started seeing changes made to the landscape to accommodate survival and even bigger changes were seen when the Industrial revolution developed in the late 1800's. The availability of nutritious food, for both local and trading purposes, contributed to the economic growth of the Maritimes coastal.

Due to evolution, cumulative impacts associated with urbanisation and poor land use have resulted in serious deterioration of the aquatic ecosystem. Removal of vegetation along the streams, improper agriculture and forestry practices, road development, barriers, improper waste management, improper uses of pollutants, over harvesting etc., are some of the actions responsible for bringing adverse physical and chemical changes to the aquatic ecosystem.

3 Threats to Atlantic salmon in the Bouctouche River

The cumulative effects of improper activities along our rivers have contributed to the lost of fish habitat and has led to a decline in fish populations in the region. It was mentioned in the SAA's first written report " fish stocks are below normal levels" (J LeBlanc et al., 1995).

3.1 Low Marine Survival

Low marine survival is well discussed and researched among Atlantic salmon populations throughout the Gulf of St-Lawrence. It has led to reduced returns to many rivers such has the Bouctouche River and has resulted in stocks well below the designated conservation limits.

Five hypotheses were described in the Conservation status report , Atlantic Salmon in Atlantic Canada and Québec: Part II Anthropogenic Considerations: “ Five hypotheses specifically related are : higher than presumed natural mortality after Greenland Fishery , predation by birds and marine mammals, altered oceanographic conditions leading to changes in immigration routes, marine survival is decreasing because cooler waters have altered the temperature mediated balance between predators and prey, and again, density dependent effects in fresh water have influenced subsequent survival at sea.” (Fisheries and oceans Canada and Québec Ministère des Ressources naturelles et de la Faune 2009). It is really important that studies and research continue to better understand the factors of these hypotheses.

3.2 Estuaries- Adaptation of Marine Life and Predation

Knowledge of salmonids in the early pre-marine phase is relatively limited. The Atlantic salmon dwell period in the estuary is relatively brief, generally lasting only one or two tidal cycles. In estuaries, schools of smolts reside in and are usually displaced with the surface current and movement influenced by the tide and the direction of the water flow. During this migration from the river through to the estuary, the diet of Atlantic salmon smolts change. Feeding conditions and early marine growth have been postulated to be critical to overall marine survival and year-class strength for Atlantic salmon. Many physiological changes, which are essential for seawater entry, occur in smolts during the downstream migration, and further changes take place in response to seawater transfer. These physiological responses may be a critical part of the adaptive process to ocean conditions. Perhaps one of the greatest values of the estuary to these young salmon is the abundance of food that enables them to double or even triple in size before migrating to sea. Size is one of the best defenses against predation. So estuaries are essential to the very survival of these fish.

http://www.bio.umass.edu/biology/mccormick/pdf/JFB%20Post-smolt.pdf

As for Atlantic salmon adults, a small minority of these will feed as they enter their native river. They will mainly travel in the estuary to attain freshwater to spawn. Predators such as seals and human could influence their survival.

Four hypotheses to estuarine life survivors were identified in the Conservation status report, Atlantic Salmon in Atlantic Canada and Québec: Part II Anthropogenic Considerations: " Fish predation on smolts, bird and seal predation on smolts, density-dependent effects in fresh water influencing subsequent survival at sea and seal predation on adults returning. (Fisheries and Oceans Canada and Québec Ministère des Ressources naturelles et de la Faune 2009). It is really important that studies and research continue to better understand factors of these hypotheses.

3.3 Low Spawning Escapement for Atlantic salmon in Freshwater

Multi-annual assessments of Atlantic salmon provided supporting evidence of the low spawning escapement in the Bouctouche River. In 1998, it led to the total closure of all fisheries of Atlantic salmon in the many rivers South of the Miramichi River down to the Nova Scotia border. Fisheries and Oceans Canada have assessed relative abundance of juvenile Atlantic salmon yearly since 1974. The results show that " Juvenile density in the past three decades has been at least stable and demonstrating no significant trends. But juvenile abundance remains low. Higher densities in recent years, particularly in the Bouctouche River, may be influenced by the closure of all salmon harvesting in 1998. (G. Atkinson 2004).

The low spawning escapement is probably reflected by the lower adult returns and lower carrying capacity of the habitat. It has been shown to have been directly caused by many improper human activities throughout the years. Here are the reasons that we have identified and which should be brought forward for remediation when stewardship actions are developed in the future.

3.3.1 Impacts on freshwater habitat from human activities

3.3.1.1 Habitat alteration

Physical quality, fragmentation, erosion and runoff

Habitat alteration is a common problem on the Bouctouche river. Changing land –use patterns, particularly land development and land clearing for urbanization, agriculture and forestry operations, created a number of conditions affecting spawning and rearing habitat. Increasing development and population growth resulted in land clearings and infrastructure construction such as roads and buildings. These activities and structures have altered and disrupted the hydrology process in nearby streams, directly affecting the water and habitat quality. The succeeding paragraphs will explain how each human activity may have altered water and habitat quality.

3.3.1.1.1 Agriculture

Agricultural activities have impacted the geomorphology and the riparian zone of surrounding water courses. The extent and the character of farming could determine what type of problems we could encounter. Farmers could have realigned or piped streams along their fields to improve workability. Livestock using the streams could cause water contaminations, bank erosion and siltation in the bottom of the stream. Improper land use of crops and farm operation could contribute to an overload of sediments, which would create disruption in the natural hydrology. Sediment overload, over-widening, shallow depths and lack of resting pool all show signs of habitat fragmentation and poor habitat quality.

3.3.1.1.2 Forestry

The history of forestry activities had a long-term detrimental impact on some sections of the river. Few remaining sections of undisturbed, natural areas exist. In favor of economic growth, this industry has had an impact on the geomorphology and on the riparian zones in many sections of the river. The most important factor that has changed because of past forestry practices increases sedimentation. Clear cutting, improper road construction and log driving brought changes to the buffer zone and the morphology of the watercourse. Many streams show section without adequate temperature, depth or resting pools.

3.3.1.1.3 Urbanization

Urban development has directly impacted the entire watersheds' water flow pattern in many ways. Channel realignment, dredging, infrastructures for waste water and water supply and street and road construction have interfered with the morphology of the watercourses present on these sites and still farther downstream. Improper control of storm water runoff from new developments or even past ones can carry contaminants from developed areas into nearby streams or rivers and cause morphological changes to the streambed. In many of these cases, the soils are impervious (hardened) due to development. As more areas are covered with surfaces that don't let the precipitation percolate into the soil, the storm water amounts that flow directly into nearby waterways over a short period of time increase and can cause habitat destruction where diversions or healthy buffer zones are not well established. (Fisheries and Oceans 2006).

3.3.1.1.4 Transportation infrastructure

Issues with transportation infrastructure are most notable when dealing with watercourse crossing and the variety of choices available for proponents. For example, culvert installation needs to be properly planned so the culvert function does not impair ecosystem function. With inadequate safeguards, poor roadway maintenance, improperly installed culverts, unstable bridge abutments, improper road ditching, can increase the input of sediments into streams, exceeding the capacity of the hydraulic process to move and sort the fine particles.

Problems with culverts occur when they are improperly installed. In such a case, the culvert may erode the stream banks or streambeds downstream and lead to deposition of sediment causing imbalance in the hydrology. If the problems persist for many years the culvert becomes perched, blocking fish migration and filling out pools with sediments downstream. When causeways are placed, they can restrict the water flow and change the hydrology permanently.

3.3.1.1.5 Industrial Activities and Mines

No major industries or mines are presently active in the Bouctouche watershed.

Preventative measures should be considered before any future developments.

3.3.1.2 Water Quality

3.3.1.2.1 Sedimentation

A common problem found in the Bouctouche river is excessive input of silt and sand to nearby streams. Causes are improper installation or maintenance of transportation infrastructure, poor agriculture processes, all terrain vehicle trails and fords, poor forest harvesting practices and dredging can increase the input of sediments in to streams, exceeding the capacity of the hydraulic process to move and sort the fine particles. It is noted in many reviewed documents that the movement of the normal bed load is a natural process which sorts and migrates substrates, usually without disrupting processes in the life cycle of salmon. Thereby excessive input of silt and sand may stress, suffocate or trap alvins and disrupt and impact the macro invertebrate populations which are the juveniles food source.

3.3.1.2.2 Nutrient regime alteration

Nutrients from common activities such as fertilizing, poorly maintained septic systems or municipal lagoons can result in serious impacts to fish habitat. These cause serious endocrine-disrupting compounds that can compromise the survival of salmon at sea. (Fairchild and al 2002). No evidence of high sub-lethal contaminants and nutrients were recorded in the freshwater portions of the Bouctouche river. Sources of highly disrupted compounds and nutrients should be monitored in estuaries were more land use influence, such as municipal waste, private septic systems and agriculture practices are more present.

3.3.1.2.3 Contaminants and pathogens

Higher counts of e-coli and fecal coliform can be found in some section of the river. Sources are probably municipal lagoons, faulty septic systems or agricultural run off. A correlation with nutrients should be monitored because researches suggest that the presence of nutrients may also encourage the proliferation of aquatic pathogens. (Fisheries and Oceans 2006)

3.3.1.3 <u>Ecosystem imbalance</u>

An ecosystem that is imbalance occurs when the relative numbers of one to many components of a natural community is unstable. When the ecosystems become an imbalance competition between organisms or species, in which the strength of one is lowered by the presence of another, starts to affect their populations. Limited supply of at least one resource (such as food, water, and territory) used by both may start depleting one of the organisms.

When an imbalance occurs in an ecosystem, signs may be apparent. Abundance of one species or depletion of another, eutrophication, poor water quality are some of the signs.

The causes can be related to the introduction of new species, the sudden death of some species, natural hazards or man-made causes.

3.3.1.4 Climate change

Climate change is one of the most important environmental issues of our time and should be brought up. Climate change is defined as a long-term shift in climate measured by changes in temperature, precipitation, wind and other indicators, and should be considered in having an impact on our ecosystems. Ocean and freshwater habitats for Atlantic salmon have been affected by global scale phenomena, such as climate change. It brought changes to precipitation and temperature patterns, affecting the ocean ecosystem, migration routes of salmon as well as salmon habitat in rivers and streams.

It is stated that

> "*In Canada, many parts of the coast have been shown to have significant sensitivity to sea-level rise and associated storm impacts. Areas with the highest sensitivity include parts of the Atlantic coast, especially in the southern Gulf of St. Lawrence, including sections of the New Brunswick Gulf coast. In this region, sea level is already rising, with demonstrable impacts" (Environment Canada 2006)*

3.3.1.5 Poaching and Illegal Fishing

By catch of Atlantic salmon continues to run throughout the Bouctouche river despite existing federal regulation that prohibit the retention of any salmon caught as by catch during commercial fishing, recreational fishing or illegal poaching.

- Commercial Fishery

  Since 1984, the Department of Fisheries and Oceans states that any Atlantic salmon caught in the Maritime provinces by by-catch in fisheries directed to other species must be returned to the water. (Fisheries and Oceans Canada and Quebec Ministère des ressources naturelles et de la Faune, 2009). . Even with modified gear (prohibition of gill nets), it is evident that some fisheries still catch salmon accidentally

- Recreational Fishery

  Since 1998, legislative authority under the Fisheries Act sanctioned by Fisheries and Oceans Canada, closed all of Southeastern New Brunswick, including the Bouctouche River. Since then, no retention of Atlantic salmon has been allowed but the by-catch from other recreational fisheries such as Brook trout could have a small impact on the salmon population. Fishing gear used (barb hook) and improper handling of salmon caught could have an impact, especially during black salmon and smolts runs in spring and early summer.

- Poaching

  Poaching has the greatest potential of illegally catching adult salmon but also holds the greatest potential for disturbing the habitat with the methods used. It occurs in both marine and freshwater habitats and the intensity varies throughout the regions and years. The methods vary from gigging, gill nets for sweeping pools with nets.

4 Vision for a Stewardship Plan for the Bouctouche River

4.1 Objectives.

The main and objectives of this project will be to engage the Southeastern Anglers Association and other partners in developing a stewardship plan to protect and restore the Atlantic salmon habitat in the Bouctouche river. The plan will include recommendations on high priority areas where specific actions will be identified to facilitate future habitat stewardship projects for the Atlantic salmon. Afterwards, the actions will become key elements that will be elaborated in the stewardship plan. It will include recommendations on how the specific actions will be brought forward. Communication strategies, landowner enrolment, details on actions (ex. Permits, labor), timeline and financial acquisitions required are some of the key subjects developed.

Through years of experience, the SAA has realized that for a project to be well delivered and to move forward quickly, adequate sources of support are needed. Undertaking a watershed project takes a great deal of preparation and time to complete properly and effectively.

4.1.1 Input from Focus Group Meeting- Identifying issues of local concern

On February 28th 2013, the SAA organized an afternoon of discussion on Atlantic salmon in the Bouctouche River. 21 people participated at the event. Agenda, a list of participants and notes from discussion can be found in the Appendices.
Here is a list of reviews of comments taken from a discussion at the focus group meeting.

The water levels are very low in many of the rivers tributaries

- Sedimentation
- Shallow because some sections have become to wide
- Some sections are being ‘filled in’ (example: Little Bouctouche, above and because of the bridge/causeway)
- Lack of pools
- Improper culvert installation resulting in a blocked fish passage
- Lack of proper meandering pattern

Concerns about potential impacts from the possible sources of contamination/pollution

- Municipal lagoons
- Farm
- Shared fields for livestock
- Defective or non existing septic fields on older properties

If a fishing season for the salmon were to reopen on the Bouctouche river, proper rules should be enforced, such as:

- Barbless hooks (mandatory)
- Catch and release only **or** small limits (ex. 1 tag allowed a month) **or** set season
- More accessibility to the river
- Most anglers agreed that they are not able to go to Miramichi to fish very often because of monetary or time restrictions. They would correspond to enforce rules.

A couple anglers expressed that there were still salmon in the river and one mentioned that in the past, there wasn't more. Other anglers understood that the amount of salmon is proportionate to the river's size, in other words only so many salmon can be sustained in the Bouctouche River.

4.2 Goals

The primary goals of this project will be to engage the Southeastern Anglers Association and other partners in utilizing this stewardship plan to develop projects to protect and restore the Atlantic salmon habitat in the Bouctouche river. Based on the knowledge gathered, 6 sites have been identified and actions developed to help elaborate future stewardship projects.

4.2.1 Sites to be restored and protected in the Bouctouche Watershed

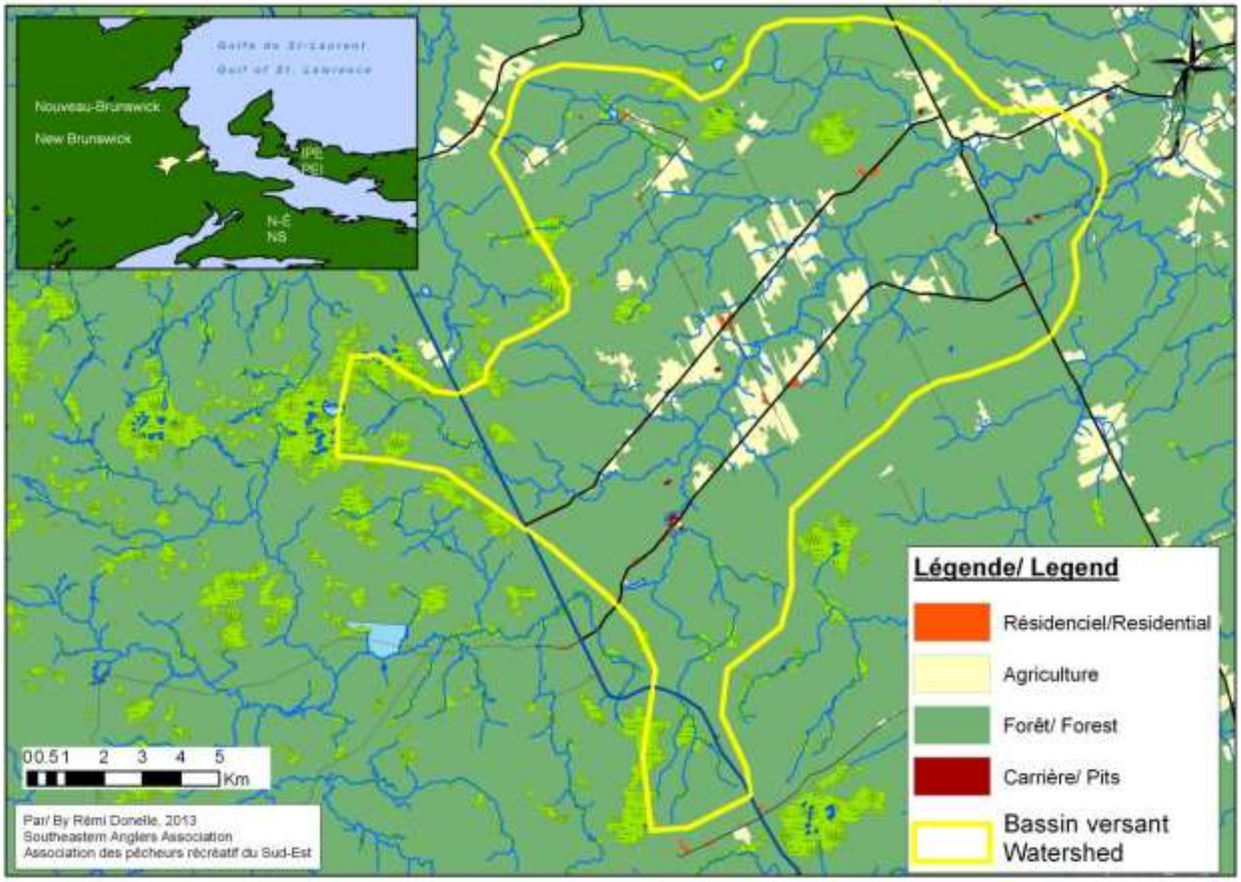
Based on the knowledge gathered, here are the 6 sites identified. Concerns and action items have been identified for each site to help protect or restore the Atlantic salmon and their habitat in the Bouctouche River. Details on specific stewardship actions identified and how progress will be evaluated will be described in the following sections of this plan.

4.2.2 North Branch Bouctouche River

4.2.2.1 Location

The North Branch River is approximately 24-30 km long and goes from the headwaters marshes just west of route 106 to the junction with the South Branch in Coates Mills.

Utilisation du territoire - Bassin versant de la rivière North Branch Bouctouche
North Branch Bouctouche River Watershed - Land use



4.2.2.2 Land use and surrounding landowners

The majority of the watershed is covered in forest areas. There are some agricultural activities as well as residential areas in the village of Saint Paul (pop 858) that is established on both sides of the North branch river. Some quarries are located near the river in the upper watershed.

4.2.2.3 Human impact

The village of Saint Paul has little infrastructure and agriculture near the river. The main risk of disturbance comes from inappropriate forestry practices near the watercourse. Some quarries are near the river in the upper watershed.

4.2.2.4 *Water quality*

There are 2 situations that are monitored for the Water Classification Program (WCP) in the North branch, one of Saint Paul and another in the upper watershed.

4.2.2.5 *Chemical parameters*

During the monitoring for the WCP, E. coli was low for both sites of the North Branch. The majority of samples are under 200MPN/100ml

4.2.2.6 *Physical parameters*

Water temperature was monitored once a month between July and October from 2000-2012 for the WCP. The water temperature was under 23^{o}C, the threshold temperature for the Atlantic salmon survival. ( ) for all except two July samples. (2008, 2001).

Dissolved oxygen was also monitored monthly. The majority of DO levels remained over 7 mg/L for the great majority of samples, which is the recommended threshold for aquatic life. Two samples in the upper reach had very low DO that could adversely affect salmon only once during the study. A beaver dam blocking water flow at the sampling site can cause this low DO.

4.2.2.7 *Sedimentation*

A study done on grain size was done on the North Branch River near the bridge on Traverse road in Saint Paul. The analysis shows a high percentage of fine sediment under 2mm in one sample (26,7%) while the other two samples had 19.9%, 17,1% of fine sediments. These amounts are high for salmon reproduction as it is recommended that fine sediment less than 2mm be under 20% of total substrate. Further study could determine the suitability of the substrate in the remainder of the watershed.

4.2.2.8 Habitat quality

Changes in water quality and habitat quality were evaluated with an invertebrate study on the North branch Bouctouche River in 2004, 2005, 2008 and 2010. The protocol used for the study is the Rapid Assessment developed by the NB Dept of Environment and Local Government and Eastern Charlotte Waterways. This study can detect changes in habitat water quality by using various indexes calculated using invertebrates.

Along the North Branch this study shows that water quality generally remains stable but was negatively affected in 2004 by a high water event.

4.2.2.9 Concerns and stewardship actions of the site

Here is a table representing the site concerns and actions.

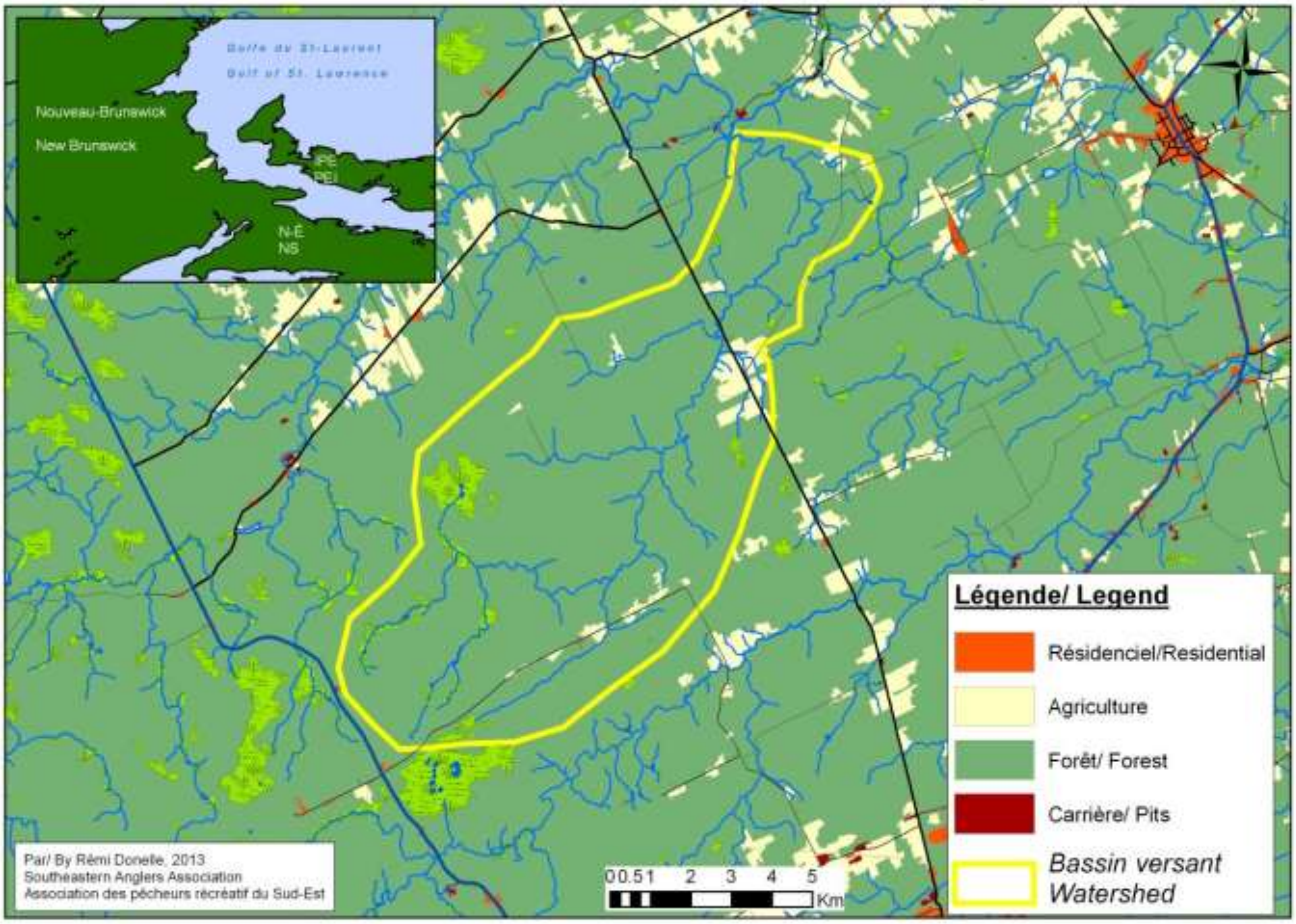
Concerns	***Actions***
Urbanization: Residential development near the river	-Promoting Best Management Practices (BMP'S): Urbanization -Habitat restoration projects: Riparian zone, tree planting, instream structures -Outreach and Education
Damages caused by mismanaged forestry practices (siltation and poor buffer zone)	-Promoting Best Management Practices (BMP'S): Forestry -Habitat restoration projects: Riparian zone, tree planting, instream structures -Outreach and Education
Influence of quarries near watercourse (siltation)	-Promoting Best Management Practices (BMP'S): - Habitat restoration projects: Riparian zone, tree planting, instream structures -Outreach and Education
Other	Protection of Pristine areas: Wetland

4.2.3 South Branch Bouctouche River

4.2.3.1 Location

The South Branch Bouctouche River is approximately 25-30 km long and goes from headwater marshes just east of route 106 to the junction with the North Branch in Coates Mills.

Utilisation du territoire - Bassin versant de la rivière South Branch Bouctouche
South Branch Bouctouche River Watershed - Land use



4.2.3.2 Land use and surrounding landowners

The South Branch Bouctouche River is almost completely in a forested area. There's a small agricultural zone with a few residences at Glade side on route 490 and a few fields in the upper watershed on New Scotland road.

4.2.3.3 Human impact

The South branch of the Bouctouche River has minimal human impact. Forestry practices have the potential to adversely impact the river.

4.2.3.4 Water quality

One site is monitored on the South Brand River for the Water Classification Program (WCP) on route 490.

4.2.3.5 Chemical parameters

Testing from the Water WCP has indicated low E. coli in the majority of samples. A few samples in 2010 and 2011 were slightly over the recommended limit of 200 MPN/ 100ml (387, 360 and 240 MPN/100 ml).

4.2.3.6 Physical parameter s

Water temperature was monitored in 2004 and 2007 on this river. The temperature has exceeded 23ºC the threshold temperature for the Atlantic salmon survival. ( )   for several days in 2007 in a manner that can be detrimental to the health of salmon. In 2004, the temperature remained low.

During the WCP monitoring the temperature only exceeded 23ºC twice.

Dissolved oxygen was also monitored once a month for the WCP in 2000-01, 2004-06 and 2008-12. The DO levels remained over 7 mg/L which is the recommended threshold for aquatic life.

pH measurements were also recorded and varied from 5 to 7,9 on this site. Most samples were in an acceptable range for Atlantic Salmon with two samples with the pH below 6,2 which is considered harmful to salmon.

4.2.3.7 Sedimentation

There was a study done for substrate grain size in the South Branch River. For salmon it is recommended that fine sediment smaller than 2mm is less than 20% of total substrate.

Three samples were taken and the percentage of fine sediment under 2mm was calculated. The results were that fine sediments took 29.89% of the first sample, 10.55%

for the second and 6.83% for the third. The sediments in this site are adequate for salmon health and reproduction but may not represent the whole watershed.

4.2.3.8 Habitat quality

Changes in water quality and habitat quality were evaluated with an invertebrate study on the South Branch River in 2004, 2005, 2008 and 2010. The protocol used for the study is the Rapid Assessment developed by the NB dept. of Environment and Local Government and Eastern Charlotte Waterways.

This study can detect changes in water quality by using various indicators. For this site the water quality seems to remain stable. However, in 2004 water quality was possibly altered because of a high water event.

4.2.3.9 Concerns and stewardship actions of the site

Here is a table representing the site concerns and actions.

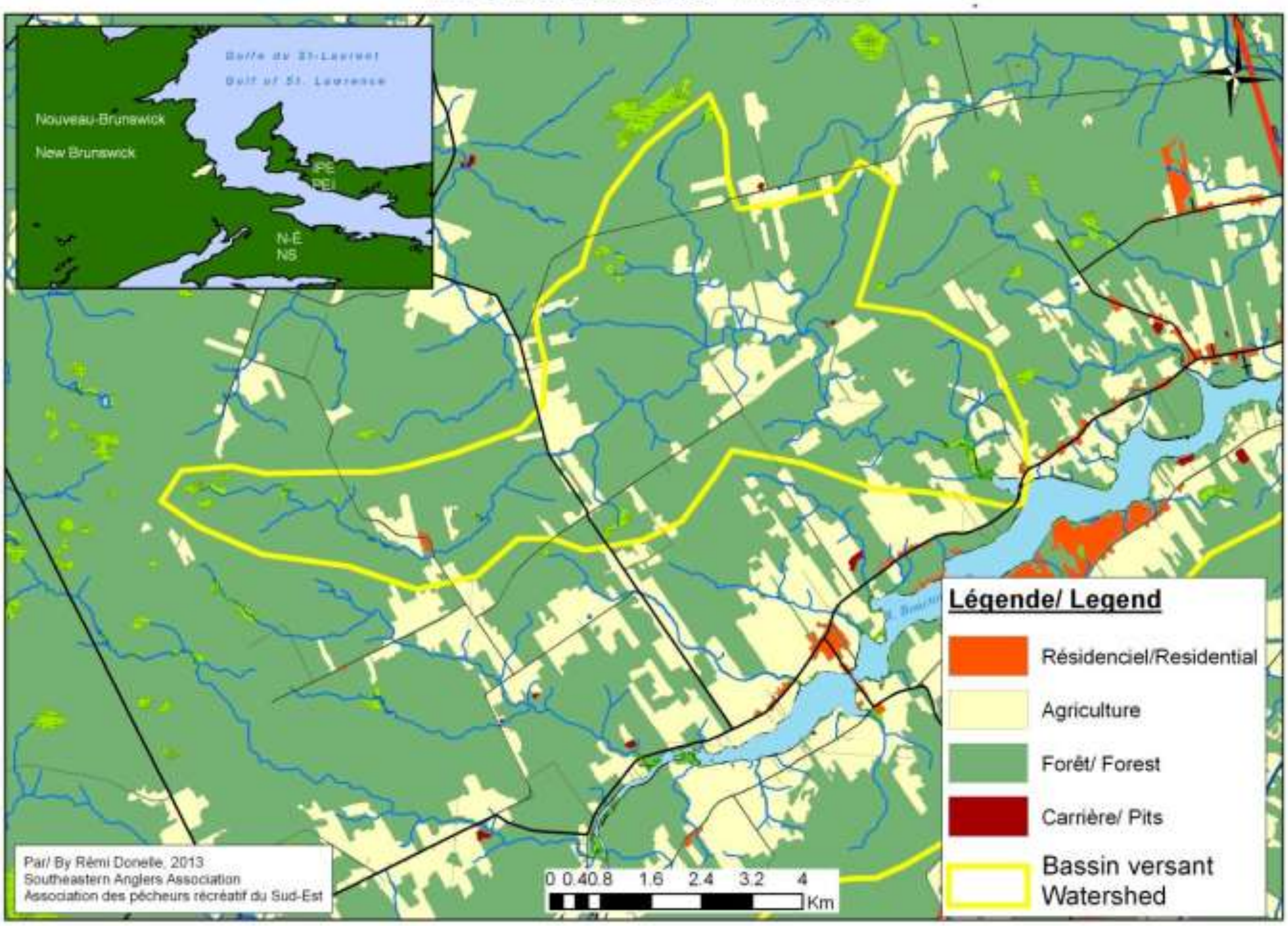
Concerns	***Actions***
Agriculture practices (Silt and contamination from crop field)	Promoting Best Management Practices (BMP'S): Agriculture -Outreach and Education
Damages caused by mismanaged forestry practices (siltation and poor buffer zone)	-Promoting Best Management Practices (BMP'S): Forestry -Habitat restoration projects: Riparian zone, tree planting, instream structures -Outreach and Education
Urbanization (Future development)	-Promoting Best Management Practices (BMP'S): Urbanization Outreach and Education
Other	Protection of Pristine areas: Important parcel of land undeveloped.

4.2.4 Mill Creek- Tributary of the Bouctouche River

4.2.4.1 Location

Mill Creek empties in the estuary of the Bouctouche River in between the town of Bouctouche and the village of Sainte-Marie. Its headwaters are in a forested area near Saint Lazare. The length of the river is approximately 16 km long with tidal waters for the first km.

Utilisation du territoire - Bassin versant de la rivière Mill Creek
Mill Creek Watershed - Land use



4.2.4.2 Land use and surrounding landowners

The Mill Creek watershed is mostly forestland with an important agricultural zone midway of the stream. These agricultural zones are active and include community pasture. A few rural residences are located in the area.

4.2.4.3 Human impact

Mill creek passes through an active agricultural area that seems to affect water quality.

4.2.4.4 Water quality

A site on Mill Creek was monitored for the Water Classification Program (WCP) in 2001 and from 2008 to 2012

4.2.4.5 Chemical parameters

The situation is immediately downstream from agricultural zones and regularly experienced excessive amounts of E. coli is exceeding the guideline for aquatic health. The amount varied from 150 MPN/ 100 ml to exceeding the upper limit of testing 2400MPN/100ml. The closeness of the sampling site to an active pasture can explain these results.

4.2.4.6 Physical parameter

Water temperature was taken once a month between June and October in 2001 and from 2008 to 2012. The temperature from the monthly monitoring was always under 23ºC.

A temperature logger was also located in the Mill Creek. From 2004-2006, the temperature exceeded 23ºC a few times in 2005 and 2006 but remained suitable for Atlantic salmon.

Dissolved oxygen was also monitored once a month in 2001, 2004-06 and 2008-12. The DO levels remained over 7 mg/L which is the recommended threshold for aquatic life.

PH was measured for the WCP in 2001, 2009 and 2012. The pH readings were between 6.4 and 9 which is adequate for Atlantic Salmon.

4.2.4.7 Sedimentation

No study on substrate and grain size has been undertaken in Mill creek. However, excessive erosion of the access trail causing silt to enter the river has been observed at the sampling site.

4.2.4.8 Habitat quality

Changes in water quality and habitat quality were evaluated with an invertebrate study on the Mill Creek in 2004, 2005, 2008 and 2010. The protocol used for the study is the Rapid Assessment developed by the NB Dept of Environment and Local Government and Eastern Charlotte Waterways.

This study can detect changes in water quality and habitat by using various indicators. For this site, water quality generally remains stable but was negatively affected in 2004 by a high water event.

4.2.4.9 Concerns and stewardship actions of the site

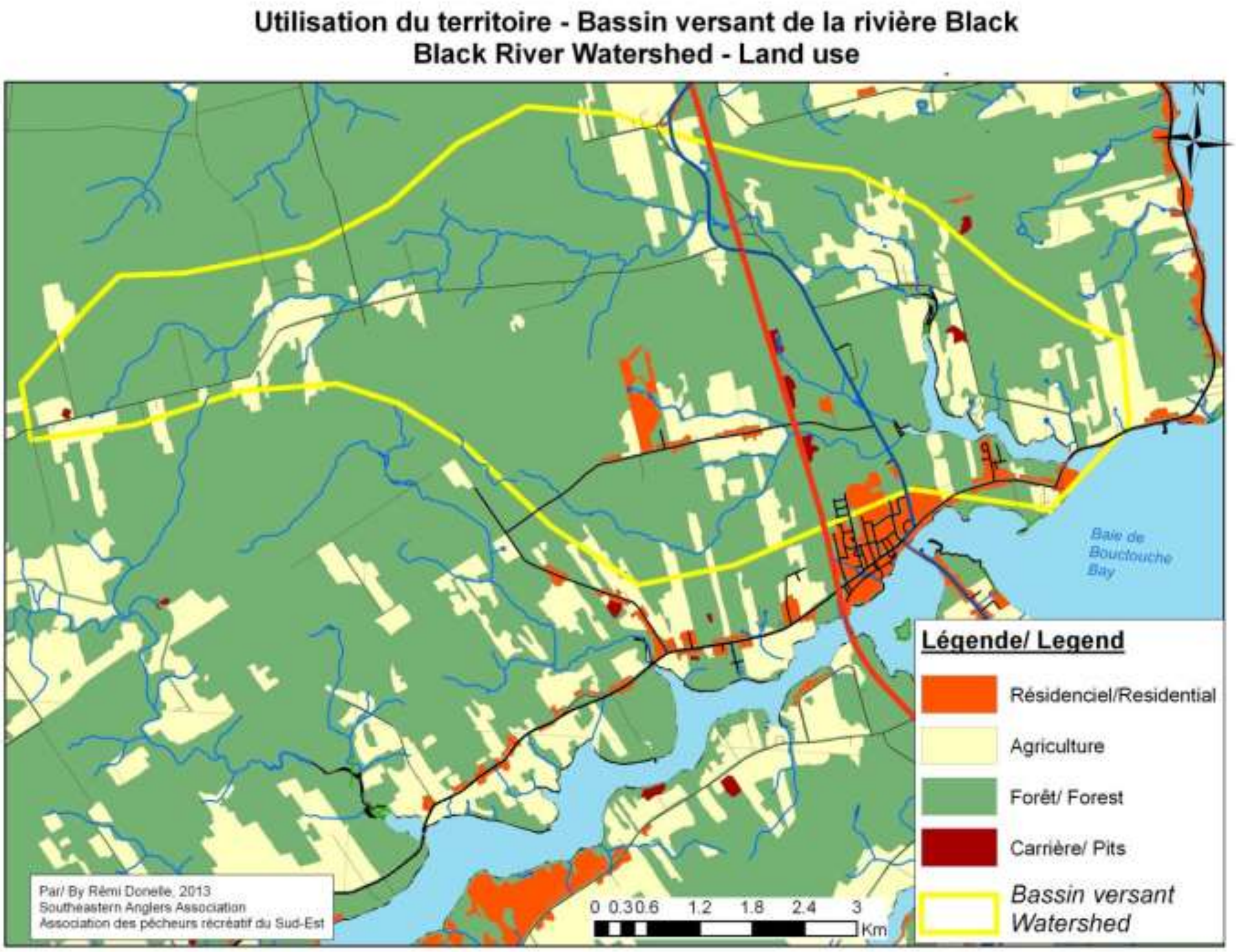
Here is a table representing the site concerns and actions.

Concerns	***Actions***
Agriculture practices (Cattle access, poor buffer zone and contamination from fields)	Promoting Best Management Practices (BMP'S): Agriculture -Outreach and Education
Damages caused by mismanaged forestry practices	-Promoting Best Management Practices (BMP'S): Forestry -Habitat restoration projects: Riparian zone, tree planting, instream structures -Outreach and Education
Roads infrastructure	Promoting Best Management Practices (BMP'S): Transportation -Habitat restoration projects: Riparian zone, Instream structures

4.2.5 Black River- major tributary of the Bouctouche Watershed

4.2.5.1 Location

Black River discharges in the Bouctouche Bay just north of the town of Bouctouche. It's approximately 10 km long and has tidal waters that cover approximately 3.5 km of the river (to Potts rd in the north and roads and route 134 in the west).



4.2.5.2 Land use and surrounding landowners

The Black River watershed has a mixed use. The majority of the land is forested. Two areas of active agricultural activity are found on Girouard road and Saint Maurice road. Likewise, some agricultural fields are present on the North side of the estuary. The main residential areas include the Town of Bouctouche as well as a golf course on Girouard road.

4.2.5.3 Human impact

This site is impacted by any human activity, which includes residential areas, agricultural fields and a golf course. The watershed is divided by highway 11 and a few quarries are found along this highway.

4.2.5.4 Water quality

Two sites were monitored for the Water Classification Program on the Black River. The first site is located at the end of the tidal waters on Potts Road. It was then moved up in the river system to route 134 to avoid influence from salt water.

4.2.5.5 Chemical parameters

During water quality monitoring for the Water Classification Program (WCP), this site has regularly experienced amounts of E. coli exceeding the guideline for aquatic health. Every year that was monitored had at least one month of high counts of E. coli. This includes 2000, 2001, 2007, 2009, 2010, 2011 and 2012. The highest counts varied from 590 MPN/100ml to 2000 MPN/100ml. The recommended limit for aquatic life is at 200 MPN/100ml. The source of the contamination may be from agricultural runoff.

4.2.5.6 Physical parameters

Water temperature was monitored monthly during the WCP. The temperature was followed as well from 2004 to 2008 with a temperature logger. The temperature was always under 23ºC which is excellent for salmon health. Dissolved oxygen was also monitored once a month in 2000-01, 2004-06 and 2009-12. The DO levels remained over 7 mg/L which is the recommended threshold for aquatic life. For the WCP, pH was also monitored. The pH of the Black river varies between 6.4 and 8 which is an acceptable level for Atlantic salmon.

4.2.5.7 Sedimentation

A study done on substrate grain size was done along the Black river near route 134. For salmon reproduction and health, it is recommended that substrate contains less than 20% of fine sediment less than 2mm. The analysis shows high percentages of fine sediment less than 2mm at the sample site (26.18 %, 33.31 %, 33.88 %). Further investigation may be necessary as the site may not be representative of the whole watershed.

4.2.5.8 Habitat quality

Changes in water quality and habitat quality were evaluated with an invertebrate study on the Black river in 2004, 2005, 2008 and 2010. The protocol used for the study is the Rapid Assessment developed by the NB Dept of Environment and Local Government and Eastern Charlotte Waterways. This study can detect changes in habitat water quality by using various indexes calculated using invertebrates. Along the Black River this study shows that water quality generally remains stable but was negatively affected in 2004 by a high water event.

4.2.5.9 Concerns and stewardship actions of the site

Here is a table representing the site concerns and actions.

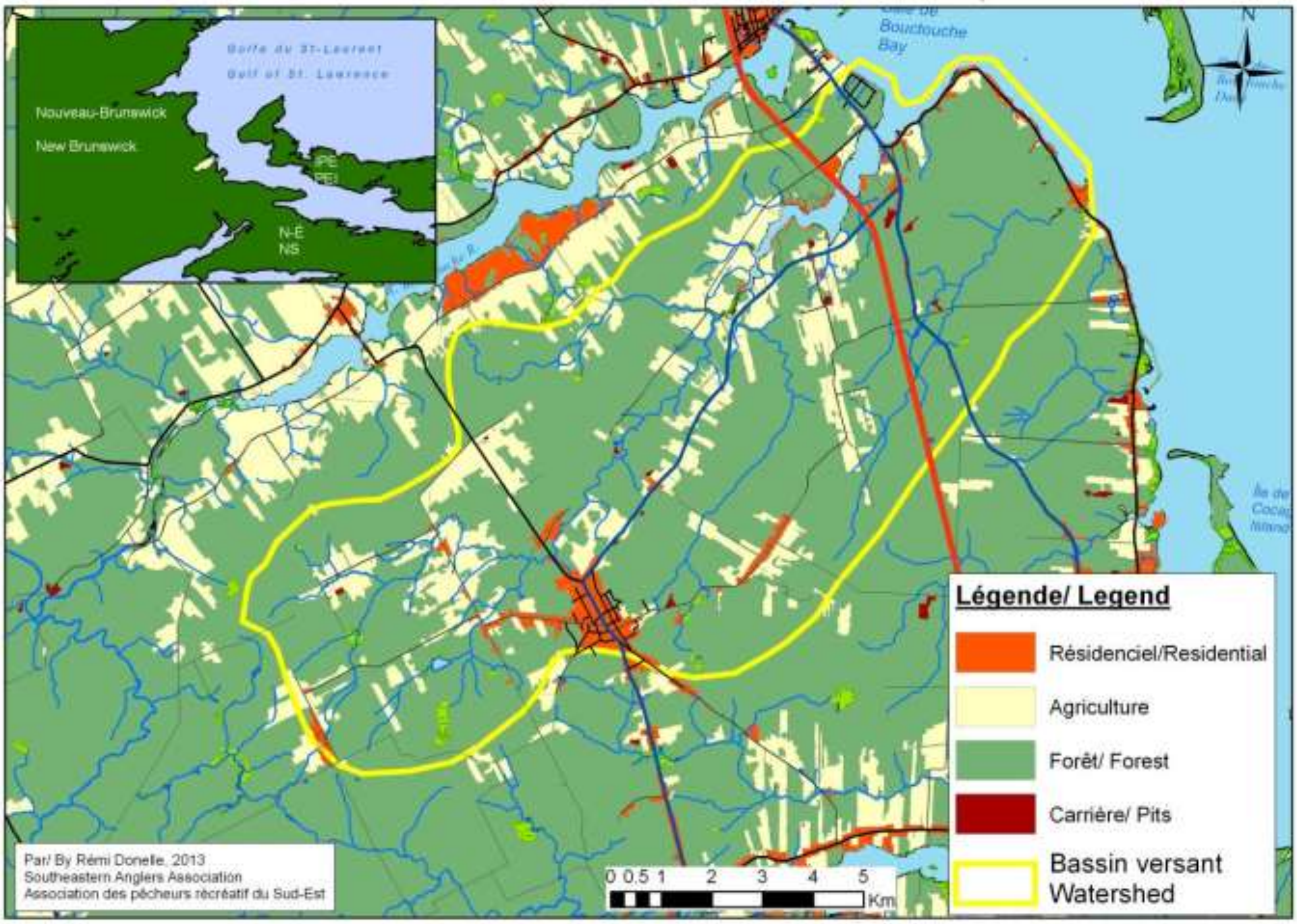
Concerns	***Actions***
Agriculture practices (Cattle access, poor buffer zone and drainage from fields)	Promoting Best Management Practices (BMP'S): Agriculture -Outreach and Education
Damages caused by mismanaged forestry practices (siltation and poor buffer zone)	-Promoting Best Management Practices (BMP'S): Forestry -Habitat restoration projects: Riparian zone, tree planting, instream structures -Outreach and Education
Urbanization (Town Bouctouche: Future development)	-Promoting Best Management Practices (BMP'S): Urbanization Outreach and Education
Roads infrastructure	Promoting Best Management Practices (BMP'S): Transportation -Habitat restoration projects: Riparian zone, Instream structures
Other: Golf course	Promoting Best Management Practices (BMP'S): golf course

4.2.6 Little Bouctouche

4.2.6.1 Location

The Little Bouctouche River discharges in the Bouctouche Bay south of the Bouctouche River. It's approximately 30 km long and the headwaters are located near the town of Saint-Antoine. The tide goes up approximately 6km to McKees Mills.

Utilisation du territoire - Bassin versant de la rivière Little Bouctouche
Little Bouctouche River Watershed - Land use



4.2.6.2 Land use and surrounding landowners

The headwaters of the Little Bouctouche River crosses agricultural land and a residential zone of the municipality of St-Antoine (pop 1770). The main branch passes through forested lands. Another agricultural area is found at McKees Mills. The Little Bouctouche estuary is a mostly residential area with some seasonal and some permanent residents. The majority of the watershed is covered by forest lands.

4.2.6.3 Human impact

The town of Saint-Antoine has residential areas and sewage treatment lagoons near the Little Bouctouche River. There's the presence of agricultural lands in the upper part of the river in Haut Saint-Antoine and also near the main branch in McKees Mills. Most of the watershed is forested land. There may be some impacts from mismanaged forestry practices.

4.2.6.4 Water quality

Two situations are monitored for the Water Classification Program on the Little Bouctouche River. The first site is situated at the end of the tidal waters in the community of McKee's Mills on Sheridan road. The next site is situated on the main branch near the town of St Antoine on route 525.

4.2.6.5 Chemical parameters

There were some high E.coli readings for both sites. The site in McKess Mills has levels ranging from 10 MPN/100ml to 1300 MPN/ 100ml. The site near St-Antoine had readings between 10 and 820 MPN/ 100ml. It is suspected that high E. coli events may be linked to sewage treatment overflow but this is not confirmed. The municipality of St Antoine has recently improved their sewage treatment center.

4.2.6.6 Physical parameters

Water temperature in the Little Bouctouche River was under 23^{o}C for most monthly sampling. A water temperature logger was installed in the river since 2004-2006 near Saint Antoine. The temperature had surpassed 23^{o}C for two separate days in 2005 and once in 2006. This is adequate for the Atlantic salmon health and passage.

Dissolved oxygen was also monitored once a month in 2000-01, 2004-06 and 2009-12. The DO levels remained over 7 mg/L for most samples which is the recommended threshold for aquatic life. In 2006 the samples in July and August both sites had low DO readings near 6 that is more of a concern. The site in Mckees Mills has a few samples with very low DO in 2004 5mg/L and 2001 (4mg/L) that can negatively affect salmon.

For the WCP, pH was also monitored. The pH of the Little Bouctouche River varies between 6.3 and 8.5 which is an acceptable level for Atlantic salmon.

4.2.6.7 Sedimentation

A study of river substrate grain size was done on the site on route525. The sampling measured the percentage of different grain size. Fine sediments less than 2mm in excess of 20 % can be detrimental to salmon health and reproduction. The samples taken from the site had low percentages of fine sediment less than 2mm (7%, 9.9%, and 12.6%). More sampling would give a better estimate of the suitability of sediment in other portions of the basin.

4.2.6.8 Habitat quality

An invertebrate study was done on the Little Bouctouche on near route 525 river in 2004, 2005, 2008 and 2010. The protocol used for the study is the Rapid Assessment developed by the NB Dept of Environment and Local Government and Eastern Charlotte Waterways. This study can detect changes in water quality by using various indicators. For this site the water quality seems to remain stable with a degradation of water quality in 2004 because of a high water event.

4.2.6.9 Concerns and stewardship actions of the site

Here is a table representing the site concerns and actions.

Concerns	***Actions***
Agriculture practices (Cattle access, poor buffer zone and contamination from fields)	Promoting Best Management Practices (BMP'S): Agriculture -Outreach and Education
Damages caused by mismanaged forestry practices (siltation and poor buffer zone)	-Promoting Best Management Practices (BMP'S): Forestry -Habitat restoration projects: Riparian zone, Instream structures, tree planting. -Outreach and Education
Urbanization (Town St-Antoine: Future development and municipal waste treatment)	-Promoting Best Management Practices (BMP'S): Urbanization -Outreach and Education
Roads infrastructure	Promoting Best Management Practices (BMP'S): Transportation -Habitat restoration projects: Riparian zone, Instream structures.

4.2.7 Entire Bouctouche Watershed

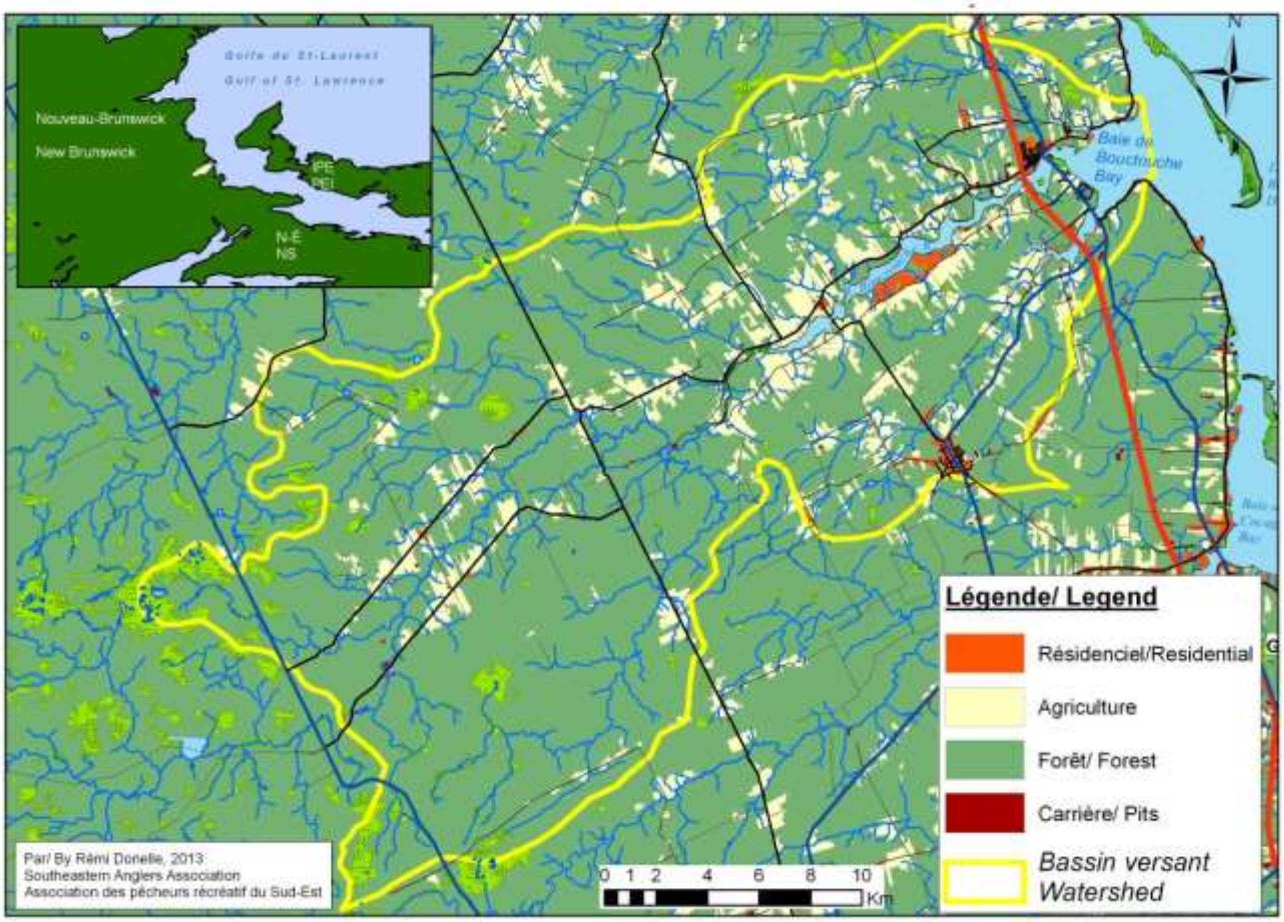
4.2.7.1 Location

The Bouctouche River is in Kent County in Southeastern New Brunswick. The Bouctouche River connects to the Northumberland Strait.

The Bouctouche Bay watershed encompasses a surface area of 613 km2. The three main rivers contributing to the bay is the Bouctouche River, the Little Bouctouche River and Black River.

The Main Bouctouche River has many tributaries including two creeks, Mill and Noel, and many brooks such as Millers, Norman Bridge, Rushcove, Trout, McLean, Johnson, Yankee, Richard and Albert. The upper Bouctouche River divides into the North Branch and South Branch.

Utilisation du territoire - Bassin versant de la rivière Bouctouche
Bouctouche River Watershed - Land use



4.2.7.2 Land use and surrounding landowners

The majority of the watershed is covered in forest areas especially the upper watersheds of the South and North Branch.

Agricultural activities are mostly near the main branch of the Bouctouche in the communities of Saint Marie and Saint Paul. There are also some active agricultural zones along Mill Creek, Black River and Little Bouctouche River.

Important residential areas include the town of Bouctouche (pop 2,423) and Saint Antoine (pop. 1,770). The Town of Bouctouche is located in the estuary and the town of Saint Antoine is located in the upper Little Bouctouche river. Other important residential areas along the Bouctouche River include the villages of Sainte-Marie (pop 993) and Saint-Paul (pop 858).

4.2.7.3 Water quality

There are 9 sites that are monitored for the Water Classification Program (WCP) in the Bouctouche river watershed by the Kent Watershed Coalition (KWC). Details concerning water quality can be found in various reports from the KWC.

4.2.7.4 Chemical parameters

E. coli: During the WCP, samples were analyzed from each site for the amount of E. coli between July and October in 2000-2001, and from 2007 to 2012.The results show three sites with very high E. coli readings that surpassed 1000 MPN/100ml in Mill Creek, Black River and Little Bouctouche River.

Four sites had readings of moderate contamination (400-800 MPN/100ml). These include two sites along the main Bouctouche (Coates Mills and Route490), one site on the South branch and a site on the Little Bouctouche.

The remaining two sites along the North Branch had consistently low E. coli measurements at 200 MPN and lower.

4.2.7.5 Physical parameters

Water temperature was monitored once a month for the WCP and also there was a study on water temperature with data loggers conducted from 2004-2008 at certain sites in the Bouctouche watershed.

The water temperature was below 23^0C on most samples. July samples were the ones with the highest temperatures.

The temperature loggers provided more data and shows that water temperature can be very high (+30°C) on the main Bouctouche River at Coates Mills. There were some constant high temperatures events for many days recorded on Mill creek, South Branch and the Little Bouctouche Rivers.

Temperature remained below 23°C during the full study of 2004-2008 on the Black river

Dissolved oxygen was also monitored once a month in 2000-01, 2004-06 and 2009-12. The DO levels remained over 7 mg/L for the great majority of samples, which is the recommended threshold for aquatic life. During the full monitoring only two samples recorded very low DO that could adversely affect salmon only once in the study.

4.2.7.6 Sedimentation

A study on river substrate grain size was done on the site on five sites of the WCP in the Bouctouche River. The sampling measured the percentage of different grain size in the substrate. Fine sediments less than 2mm in excess of 20 % can be detrimental to salmon health and reproduction.

One site on Black River had high fine sediment percentage that can be detrimental to salmon health. Two sites, South and North Branch, had one sample with high percentage of fine sediments. The sites on the Little Bouctouche and Main branch had a good substrate grain size of Atlantic salmon.

4.2.7.7 Habitat quality

Changes in water quality and habitat quality were measured with an invertebrate study at 5 sites in the Bouctouche River in 2004, 2005, 2008 and 2010. The protocol used for the study is the Rapid Assessment developed by the NB Dept of Environment and

Local Government and Eastern Charlotte Waterways. This study can detect changes in habitat water quality by using various indexes calculated using invertebrates. The study shows that water quality generally remains stable but was negatively affected in 2004 by a high water event.

4.2.7.8 Human impact

There is human impact in the Bouctouche watershed from various activities. Residential development, agricultural and forestry practices must be done in a way that respects riparian zones and minimises contamination from runoff. When these activities do not follow best management practices they have a negative impact on the river.

4.2.7.9 Concerns and stewardship actions of the site

Here is a table representing the site concerns and actions.

Concerns	***Actions***
Agriculture practices **(Cattle access, poor buffer zone and contamination from fields)**	Promoting Best Management Practices (BMP'S): Agriculture -Outreach and Education
Damages caused by mismanaged forestry practices (siltation and poor buffer zone)	-Promoting Best Management Practices (BMP'S): Forestry -Habitat restoration projects: Riparian zone, Instream structures -Outreach and Education
Urbanization **(Town of Bouctouche and St-Antoine: Future development and municipal waste treatment)**	-Promoting Best Management Practices (BMP'S): Urbanization, Contact and work with municipality, planning commission and landowners -Outreach and Education
Roads infrastructure	-Promoting Best Management Practices (BMP'S): Transportation
Low abundance of adult and juvenile Atlantic salmon	-Broodstocking with Bouctouche River Strain. -Promoting best angling practices -Identify and protect important salmon habitat
Few natural areas protected	Protect Pristine areas: Important parcel of land undeveloped.

4.3 Details on Specific Stewardship Actions

Restoration and protection tools

The SAA has always practiced a holistic approach to conserve, protect and enhance any recreational fishing species such as the Atlantic salmon and their habitat with a watershed (river) approach. Aquatic habitat conservation issues are often surrounded by a complex combination of economic development and land use activities, which are not always easily answered.

In all of these actions proposed, the SAA will undertake steps to complete the preparation of a few actions yearly. Writing funding proposals, talking to landowners, enrolling volunteers, training staff appropriately for the project, gathering materials, applying for required permits, promotion, education and then actually doing the groundwork could be some of the tasks necessary. If funding is approved for the projects, the SAA has always employed a project coordinator and the appropriate staff. The projects move faster and better if coordination is in place.

At the end, our ultimate goal is to encourage actions that will protect pristine areas and support activities and projects that create healthier and more environmentally, socially and economically viable rivers for the surrounding communities. In the following paragraph we will elaborate on the actions identified.

4.3.1 Protect Pristine Areas

Protected areas have long been known as one of the most effective tools for the preservation of natural capital, its biodiversity and the complex interactions among the elements of all ecosystems.

Sufficient high-quality habitat is of utmost importance for the survival of all fish and wildlife populations, and essential for the maintenance of ecosystems on which all beings depend for their survival. As New Brunswickers and Canadians, we have a profound attachment to the wilderness, which is rooted in our collective history and heritage. This aspect has been an important driving force behind the creation of the Southeastern Anglers Association in 1993.

There are many tools and programs to protect pristine areas. These range from ownership and management of various types of formal protected areas by organisations such as Nature Conservancy of Canada to the negotiation of voluntary agreements with private landowners.

These pristine areas would primarily be created for the purpose of conservation. Management activities may include interventions such as habitat restoration and investigative research projects on species and habitat.

These types of actions will mainly require staff, volunteers and stakeholders for planning. Writing funding proposal, talking to land owners, enrolling volunteers, promotion, education and legal advice could be some of the tasks necessary before signing purchases or obtaining landowner easements. *Financial requirements will be project dependent. Coordination, legal advice and land purchasing could become cost associated with the project but will be out valued by the volunteer time, easements, agreements and areas protected.*

Here are some of the steps that could be followed:

1-Site Identification and Selection

The establishment of a pristine area begins with the identification and selection of habitat areas of importance, the protection of which would directly benefit the Atlantic salmon and other wildlife species. This process would involve coordination with other departments, governments, Aboriginal people, landowners and stakeholders that have interests in this project.

2- Feasibility Assessment

The second step would be to conduct a series of feasibility assessments. These include an ecosystem assessment and a strategic environmental assessment, to evaluate the environmental condition of the candidate site and the impact that the potential new protected area could have on the environment. In addition, public and stakeholder consultations are conducted to determine the feasibility of turning a candidate site into a protected pristine area. The results of these ecological, social and economic assessments will help set the boundaries and the various options available for protection, in accordance with the ownership and legal power of the land and aquatic area.

3- Securement and Agreement

Once a candidate site is selected, the type of protected area will determine the tools available for securing land and waters. For example, the Nature Conservancy of Canada, can secure through purchase, donation or transfer. Or individual landowners can secure by agreement, easement, or transfer. Legal advice will be an asset during this step to protect the pristine area identified.

4.3.2 **Promoting Best Management Practices (BMP'S)**

Any projects should start by encouraging and educating landowners and decision makers around the values of applying best management practices to all of their land use activities. The remedial options for a lot of the non-point sources of pollution are best management practices (BMP's). It is well researched that applying BMP's on land will have a positive impact on re-establishing the hydrology of a watercourse, its habitat and its biology.

The ultimate goal of promoting best management practices is to get together all interested parties (Stakeholders) and to work with them to apply changes to their bodily processes that are more environmentally sound within the entire drainage basin. *Great partnerships and sourcing other funding programs should be established to continue promoting BMP's and accomplish restoration projects.* *A 10 % financial requirement should be allocated for BMP's promotion in every project proposed for financial assistance, unless the total project proposed is for promoting BMP's.*

The following paragraphs will describe BMP'S for each land use activity and how actions could be taken on.

4.3.2.1 Agriculture

Agriculture is the largest land use problem contributing to habitat and water quality issues in the Bouctouche River. The SAA has worked in the past with local farmers and the Department of Fisheries, Agriculture and Aquaculture NB to promote BMP'S and accomplish extensive restoration projects. It was with great partnerships and funding opportunities that many issues have been resolved. There is still a will from local farmers to bring about positive changes but financial restrains and knowledge are still an obstacle.

We will not go into details on the BMP’s in agriculture because many documents are readily available and can be extensive. Only a list will be described:

- <u>Agricultural management practices</u>
    - Nutrient management
    - Integrated pest management guidelines
    - Proper pesticide use
    - Develop an irrigation water management plan
- <u>Vegetative and tillage practices</u>
    - Practices applied to cropland, pastureland and hay land to reduce erosion of soil due to water and wind by slowing the velocity of runoff water, increasing infiltration and establishing vegetation and tree cover.
    - Commonly used practices include conservation tillage, contour farming, strip cropping, filter strips, field borders, cover crops, crop rotation, field windbreak and pasture management.
- <u>Structural practices</u>
    - Agricultural waste management system
    - Runoff management system, wetland development
    - Terraces, water and sediment control basins or diversions
    - Livestock exclusions (fencing)
    - Grade stabilization structures
    - Grassed waterways
    - Stream bank protection

4.3.2.2 <u>Forestry</u>

Forestry is still viable economically for the area. The issues are still rising during heavy periods of rain from previous logging activities and are contributing to habitat and water quality degradation in the Bouctouche River. *<u>Great partnerships with landowners, local woodlot Marketing boards and the Department of Natural resources NB should be established.</u>* Sourcing funding programs should be looked into to continue promoting BMP’s and to accomplish restoration projects.

We will not go into details on the BMP's in forestry because many documents are readily available and can be extensive. Only a list will be described:

- <u>Road construction and Maintenance</u>
    - Erosion and sediment controls
    - Skid trails
    - Access roads
    - Erosion controls on landings
    - Stream crossing erosion control
    - Filter strip sediment control
- <u>Harvesting</u>
    - Clear cut
    - Selective
    - Riparian zone
- <u>Reforestation</u>
    - Mechanical site preparation
    - Seedling plantation

- <u>Pesticide use</u>

4.3.2.3 Urban Development

Numerous permanent and seasonal residences compose several little communities and two municipalities. In the last decades, smaller surrounding communities have felt a higher demand to expand their services, acknowledging their proximity to the Greater Moncton Area. Commuting distance is, in some areas, less than an hour to Moncton, making it easier for residents to commute to work. *Great partnerships with landowners, local service district, municipalities and the Kent planning commission should be established.* We should continue promoting BMP's and be more involved.

We will not go into details on the BMP's in urban development because many documents are readily available and can be extensive. Only a list will be described:

- Road construction and Maintenance
    - Erosion and sediment controls
    - Access roads
    - Erosion controls on landings
    - Stream crossing erosion control
    - Filter strip sediment control
    - Street and roads cleaning

- Suburb and sub-division Development
    - Minimizing directly connected impervious areas
    - Promote urban forestry
    - Detention and retention ponds
    - Porous pavement
    - Vegetative filter swales and strips
    - Address the quality and quantity of storm water runoff during heavy rainfall events.

- Waste water (septic systems and municipalities infrastructure)
    - Proper facilities
    - Promote good housekeeping practices
    - Illicit discharge detection and elimination

4.3.3 Best angling practices

The by-catch from other recreational fisheries such as Brook trout could have a small impact on the salmon population. Promotion and education strategies should be taken to support BMP's for recreational fishing. Fishing gear used (barbless hook) and improper handling if salmon caught could have an impact. Especially during black salmon and smolt run in spring and early summer.

1: Fishing regulations

It is best if you inform yourself about the regulations in the area that you will be fishing. In many cases rules can even vary within the same river. Species caught, limits, size and date are some of the items that are subject to change yearly.

2: Practice Catch and Release

Give the fish a chance to live. Promote the techniques supported by catch-and-release experts, such as using a circle hook, which is less likely to get a fish's gut and improves its chances of survival upon release.

3-Consider when fishing

What's the water temperature like? Particularly when fishing for cold-water species like trout and salmon, when the water becomes warm, fish have a decreased chance of survival after being released. Warm water contains less dissolved oxygen and fish are under more stress in a warmer water environment. When water temps are high, consider other fishing opportunities that will have less impact.

4: Choose tackle wisely

The right size hooks and line strength for the fish you are going to target is a good place to start. If you intend to release your fish, remember that fish caught on flies or lures with single hooks have the best chance of surviving. If possible to do so, replace treble hooks with single hooks. If you're fishing with bait, get rid of your conventional hooks and start using circle hooks. Circle hooks have been around since the turn of the century, but they're getting a recent revival in the recreational angling community. It's rare to gut-hook a fish using one, they virtually always hook the fish in the corner of the mouth - and they're super effective. If you decide to fish with bait and conventional hooks, set the hook quickly to avoid deep hooking fish. Deeply hooked fish have a good chance of fatality tearing internal organs while you are landing them.

5: Pack Out Everything You Pack In

The point is, be particular about bagging all your detritus and bringing it home with you for recycling and composting, if possible. If you're really committed to protecting the environment, pick up somebody else's trash as well.

4.3.4 Habitat Restoration Projects

Poor physical habitat quality has been caused by multiple factors that were discussed in the paragraphs above. Numerous detrimental impacts to the watercourse at several locations can be found in a section of the Bouctouche River. Past habitat assessments revealed numerous issues in the watershed that can often be attributed to poor land use and riparian zone degradation. The SAA could employ multiple restoration techniques or a combination of techniques to deal with riparian and aquatic habitat issues. The first step would be to address land use problems by using best management practices. The second would be to design habitat restoration structures to help speed up the natural process, thus improving the ecological recovery while helping improve the habitat for all life stages of the Atlantic salmon.

More extensive planning will be involved if habitat restoration projects are undertaken by the SAA. Writing funding proposals, talking to landowners, enrolling volunteers, training staff appropriately for the project, gathering materials, applying for required permits, promotion, education and then actually doing the groundwork could be some of the tasks necessary. *Financial requirements will be project dependent*. Some could require thousands to hundreds of thousands of dollars depending on staff, materials and heavy machinery requirements.

Here are some of the proposed projects that the SAA could undertake in the future to regain a healthier Atlantic salmon habitat in the Bouctouche River.

4.3.4.1 Livestock Fencing

Restoration requires exclusion of livestock from the riparian zone. The SAA has worked on projects that teach and demonstrate the importance of the riparian area when it comes to water quality and fish habitat. Thanks to several financial sources, 11 farmers and with the help of volunteers, we have been able to restore over 20 Km of riparian zone along the rivers of the region. Today we can be proud in demonstrating the restored sites and discover an all-different biodiversity. The SAA should continue promoting the fencing off of livestock from nearby streams, before planting native trees and shrubs in the riparian zone.

Benefits:

1. *Increased bank and stream channel stability*
2. *Improved water quality*
3. *Improved herd health*
4. *Reduction of e.coli and nutrient flow into streams*

4.3.4.2 *Stabilized Fording Sites*

Since crop and pastureland often straddle watercourses, providing safe crossings for livestock and equipment with reduced potential for negative water quality effects is critical. Additionally, watering livestock at rivers is often the only practical option for agricultural producers. The SAA has used stable fording sites as both watering locations for livestock as well as crossings for farm equipment. The approaches are properly aligned and hardened, and the stream bottom is stabilized with hard rock to prevent erosion and rutting. The SAA could continue using stabilized fording sites if no other options can be found.

Benefits:

1. *Reduction in stream bank erosion*
2. *Improved herd health*
3. *Improved aquatic habitat availability*
4. *Reduced risk of stream contamination from faulty equipment or of equipment becoming stuck in a stream*

4.3.4.3 *Bank Stabilization*

Bank stabilization is used to raise a severely or moderately eroding stream bank that is lacking riparian zone vegetation. Several techniques can be used to stabilize banks, to reduce erosion and prevent sediment and nutrients from being introduced to a watercourse. Techniques such as: Back sloping, Rock armoring and Crib walls are some successful techniques used by other groups in the Province of New-Brunswick. More recently, Bioengineering has become an acceptable and successful technique for river restoration. Bioengineering is the use of living materials and ecologically designed concepts to restore or enhance a degraded section of a stream or a riparian zone.

Willow is a key tree species used in bioengineering efforts by the other groups. This pliable tree grows rapidly and can be propagated from cuttings. Its root growth is thick and readily holds soil materials in place and can act as a filter, keeping fine sediments from entering into the streams. Techniques such as willow, fascine and wattle are some examples. The mature trees will provide shade to the stream and offer terrestrial habitats to other riparian dependent species. These techniques and more can be studied in the "Ecological restoration of degraded aquatic habitats: A watershed approach" published by Fisheries and Oceans.

Benefits:

1. *Reduces sediment being introduced to watercourse*
2. *Enhances fish habitat*
3. *Maintains the riparian habitat*
4. *Preserves topsoil*
5. *Reduces greenhouse gas emissions by reducing CO2 output from bared soils*

4.3.4.4 Tree Planting

Clearly the end goal of all bank stabilization efforts is the reestablishment of the natural riparian vegetative community. Not only does the riparian zone have innumerable biological roles in the aquatic community, it is nature's way of permanently stabilizing stream banks. Whenever possible, the first thing we do is plant native trees in the riparian zone. Most times, however, erosion is proceeding at such a rate that our young trees don't have a chance. Methods of bank stabilization should be used before to allow planted trees the opportunity to thrive enough to be able to take over the job of naturally stabilizing the bank.

Benefits

1. *Increased site biodiversity*
2. *Stabilization of eroding stream banks through increased root mass*
3. *Decrease in sediment and nutrient transfer to streams by root absorption*
4. *Reduced run-off rate through increased site surface water retention*
5. *Moderated stream temperatures provided by increased shade cover*
6. *Increased fish cover and habitat*

7. *Increased aquatic food source through falling organic debris*
8. *Reduced carbon emissions as a result of reduction in bare topsoil and through uptake from vegetation*

4.3.4.5 Instream Techniques: Digger Logs, Rock Sills and Tree Deflectors

The SAA started using instream techniques such as Digger Logs, Rock Sills and Tree Deflectors in the summer of 1997. Digger logs and tree deflectors work best in small watercourses with either a sandy or silt substrate and in conjunction with a fencing/planting program to rehabilitate the riparian zone at the same time. We can now see restored sites meander and reflect all-important habitats for all life stages of the Atlantic salmon and other fish species. The SAA is still interested in continuing to apply these techniques were needed. These techniques and more can be read in the "Ecological restoration of degraded aquatic habitats: A watershed approach" published by Fisheries and Oceans. Before any of the work begins proper permits and training should be approved.

Benefits:

1. *Increased fish habitat availability*
2. *Increased stream channel stability*
3. *Improved substrate and water conditions for fish including increased dissolved oxygen and temperature*
4. *Reduces the risk of the formation of ice jams*

4.3.5 Broodstocking with Bouctouche River Strain.

Once habitat is restored or protected, stocking with Atlantic salmon broodstock could be used to help enhance the population. Brood stock management involves manipulating environmental factors to increase survival and development. Such conditioning can ensure the sustainability of a particular fish stock. This would be to sustain optimum juvenile salmon stocks and work towards meeting conservation requirements.

The biggest challenge with this action will be catching mature adult fish from the Bouctouche River. Methodologies frequently used are: Trap nets, anglers' by-catch or pool seining. Permits will be required to manipulate fish. Depending on the methodology used, it could be a time consuming and costly undertaking. *Financial requirements could range from $ 10,000 (trap net operations) to $ 2,000 (coordination of anglers by-catch or pool seining). Good partnerships and volunteer time could lower costs significantly*.

Fish Hatchery

The SAA has used the Miramichi fish hatchery facilities in the past, for hatching and rearing Atlantic salmon broodstock, for the early life stages in particular. This program was active from 1996 to 1999 until the hatchery became privatized. This methodology has proven to be successful in the South and Main Branch of Bouctouche River. For subsequent years, electrofishing data showed that the survival of stocking juvenile (adipose clip) was successful. *Financial requirements could range from $5,000 to $10,000 dollars, depending on life stage rearing at the hatchery.*

Salmon Instream or Streamside Incubators

This methodology consists of baskets (various material is presently used) that are usually buried in spawning gravel at selected sites in early fall. Once fertilized eggs are made available from recent adult spawners, baskets previously buried are filled with eggs immediately after fertilization and water hardening. In springtime, the fingerlings can flow out of the baskets and find suitable habitat nearby.

This methodology is presently being tested by The Friends of the Kouchibouquacis and Fundy National park in New Brunswick. If hatching success is consistently high from these methods, the minimum time expended and low cost could make them a viable alternative to stocking approaches. *Financial requirements could range from $1,000 to $3,000 dollars depending on the number of sites and trained staff needed to spawn adult fish.*

4.3.6 **Community Outreach**

Community outreach should become an important activity of every action/ project that will be undertaken. A key component of outreach is to provide resourceful information to all age classes of the community. We should have resourceful information in-house and on the Internet as well as face to face outreach to landowners and groups of interest. In addition to delivering services, outreach should be used as an educational tool to promote awareness of existing services and data. The Community Outreach Programs should be evaluated yearly, depending on ongoing projects, community development or environmental concerns. The outreach program could source individual tools or be a combination of several ones. The SAA could source volunteers, staff or communication firms to help us deliver outreach programs. *A 10 % financial requirement should be allocated for outreach in every project proposed for financial assistance, unless the total project proposed is for outreach.*

Here is a list of outreach tools that we used or researched:

- Annual meeting
- Increase our membership
- Focus group discussions
- Educational and/or hands-on workshops
- Informative placements on BMP's or related information
- Informative pamphlets (previously published and new design)
- Fish friend programs in schools
- Presentations (schools, anglers, nature clubs, surrounding residents…)
- Informational kiosks (local events, farmer's markets, fishing/hunting 'shows')
- SAA Website (links to other partners)
- Facebook group or Facebook page
- Newsletters
- Interpretation signs/signage placed near restoration sites
- Day camp and/or fishing derby for children
- Educational games for children (done during presentations, camps, kiosks)
- Promotional tools for anglers and possibly for children (ex. Barbless hooks, thermometers etc. With descriptive cards explaining why and how to apply)
- Mail-outs (surveys, educational references etc. Could be given/mailed with the newsletter)

4.4 Program evaluation

Program evaluation will benefits the species and habitat that we are trying to conserve by improving our ability to monitor changes and achieve the objectives. It will also benefit stakeholders and partners, by providing information or assist with decision-making.

Here is a list of monitoring/evaluation programs that should be considered when assessing the long term objectives for the actions engage. *Relative financial requirements for each program can be found in the appendix.*

4.4.1 CAMP (Community Aquatic Monitoring Program)

The Community Aquatic Monitoring Program (CAMP) offers guidance for community-based groups monitoring the health and marine productivity of their local water ecosystem. Through monitoring protocols with DFO, we are maintaining a science-based approach program for health of our watersheds.

Scientific procedures require that the program replicate the sampling regime at each site and estuary location each year. From May through September, community group members and staff sample 6 stations monthly in their designated estuary. Biological data are collected with beach seines that capture and later release live, small fish and crustaceans. The biological data collected, which helps to monitor the present health status of the Bouctouche estuary, are:

- Fish and crustacean species identification,
- Total numbers of fish and crustaceans
- General aquatic vegetation profiles,
- Water and sediment samples,
- Temperature, salinity and dissolved oxygen.

With this information, scientists working with government agencies and universities can undertake nutrient analyses, organic loading assessments, and changes in of the aquatic community structure. With this in hand, identification of the cause may be determined and actions put into place to mitigate potential negative impacts.

http://www.glf.dfo-mpo.gc.ca/e0006182

4.4.2 CABIN Invertebrate sampling

(Canadian Aquatic Biomonitoring Network)
Biomonitoring methods are used to enhance or compliment chemical and physical water quality monitoring by using the presence or health or organisms (invertebrates) living at the site as an indication of the ecosystems condition. Biomonitoring does not identify the cause of impairment but rather provides an assessment of ecosystem health.

http://www.unb.ca/research/institutes/cri/

4.4.3 Electro fishing

Electrofishing devices use electricity to stun the fish so that they can be caught to determine abundance, density, and species composition. When done correctly, electrofishing results in no permanent harm to fish, which return to their natural state in as little as two minutes after being stunned.
There are two methods that can be used.
1st method: Diminishing Return with open sites, which allows to calculate different fish species densities and percent habitat saturation. All fish captured can be counted, identified and measured depending on the intent of the survey.
The 2nd method: Spot check, which determines the presence or absence of fish in a particular area. All fish captured can be counted, identified and measured depending on the intent of the survey

4.4.4 Water Quality

Since the year 2000, water quality has been measured every year in the Bouctouche River. The same 6 sites are visited every month, between May/June to October/November to measure physical, chemical and bacteriological parameters.

Physical parameters: temperature, dissolved oxygen, salinity, conductivity and pH

Chemical parameter: nitrates

Bacteriological parameters: e-coli and total coliforms

This is a cost-effective long-term water quality-monitoring program that we are now able to apply to determine changes, positively or negatively affecting our watershed.

4.4.5 Stream Surveys

Stream surveys are conducted to determine possible contamination sources that may have potential impacts on the overall water quality. All man-made objects or alterations that are visible from the stream bank are described/noted, inspected, photographed and marked with a GPS coordinates and are considered as potential pollution sources. Examples of potential contamination sources: culverts, pipes, agricultural soils, forestry clear cuttings, septic tanks, treatment plants, garbage, dumps, any manure leaching etc. Incoming streams, freshwater sources, sedimentation hot spots, log jams and active or inactive beaver dams are also recorded.

Through this visual survey, we are able to better understand possible factors affecting fish habitat quality and overall stream health.

4.4.6 Redd Counts

Female salmon excavate a nest in gravel substrate to deposit their eggs. Once one or more males externally fertilize them, she covers these with gravel. These nests are called redds.

A redd count is done by counting all visible redds observed during a spawning season in an area known to contain salmon. These numbers can then be used as an indicator of the abundance of salmon spawning in a given stream.

4.4.7 Sedi-bacs: Measuring Sedimentation

This method is used to determine the amount of sediment deposited into a stream. The sediments accumulated over a period of time are then dried, sieved and weighed to determine the quantity of sediments and grain sizes.

This type of survey can be used to compare the normal amount of sediment deposition along a streambed compared to the amount of sediments deposited during major weather (rain) events.

Large amounts of sediment deposited onto a streambed in a short period of time can indicate problematic hot spots. These hot spots can be created from improper drainage ditch construction and lack of stream bank vegetation, among others. Areas with loads of fine sediment, covering larger substrate, limits the locations where salmon can spawn and results in a degraded fish habitat.

5 Conclusion

Completing this stewardship plan to protect and restore the Atlantic salmon habitat in the Bouctouche River is the first step towards stewardship projects in the near future. This document will be an important tool to work with our members, landowners, local communities and partners.

The preparation of this document includes a literature review that gathers relevant information available about the Bouctouche River. We have attempted to identify all the available documentary sources and knowledge to write up this plan within such a short period of time. No field verification was attempted for this document.

This will be an on-going working document. Actions will be re-appraised every 1-3 years to monitor progress and adjust according to the results. Priorities could modify depending on ethics, financial resources and partnership yearly.

The SAA will progress with the following values and goals in mind.

Guiding values will be has followed:

- *Landowner's involvement and partnership will be the key to achieve successful outcomes.*

- *The SAA will ensure that good communication with stakeholders involve is included at all levels when ongoing enhancement efforts will be developed.*

- *The SAA will strive to uphold the highest level of ongoing communication, Education, and awareness within the local communities to ensure that people are involved and informed of activities and successes.*

- *The SAA will encourage good stewardship and ensure that it is recognized and promoted to all local communities and partners. So that stakeholders can learn from each other.*

And goals will be:

- *Implement and support ongoing communication, education, and awareness activities towards good stewardship to protect and enhance Atlantic salmon habitat in the Bouctouche River.*
- *Restore and protect fish habitat and surrounding ecosystems.*
- *Manage and maintain a viable Atlantic salmon population in the Bouctouche River through strong stakeholders' collaboration and devotion.*

The next step will be to review actions identified in this document and elaborate on setting more profound *goals, objectives and strategies* has we move along in future years. Communications strategies, landowner's enrolment, details on actions (ex. Permits, labor, materials), timeline and financial acquisition required would be some of the key subjects to be developed.

We are grateful that this project was realized. Focus group participant pointed out that it is important to acknowledge the strain of Atlantic salmon that migrate and rear in the smaller rivers flowing in the Southern Gulf of St-Lawrence. The Bouctouche river strain of Atlantic salmon does not account for a big percentage of the COSEWIC DU 12 if compare with bigger rivers such as the Miramichi but are of value to our communities and our heritage.

6 Stocking Plan

Atlantic salmon population survey and recommendation summary:

SAA, with the help of DFO staff, surveyed Atlantic salmon populations in Bouctouche and Cocagne. The group consisted of three people performing the survey. Three sites were surveyed in the Cocagne watershed in early October and seven sites were surveyed in the Bouctouche watershed in mid-August. The electro-fishing survey was performed in 2016 and 2017 with the help of DFO in order to have comparable data. SAA has also received, from them, past data to compare with from the years 1974 through 2011, with a few gaps in between. Data revealed a slightly higher number of salmon parr present in Cocagne and Bouctouche compared to last year, but lower than ten years ago. Salmon fry seem stable in Cocagne compared to last year and higher in Bouctouche compared to last year, but a lot lower than ten years ago. In general, Atlantic salmon populations have greatly decreased in freshwater populations. The parrs seem to be at a low point of their usual fluctuation when looking at the Bouctouche results which have less data year gaps. The results seem to show an obvious need to help sustain the salmon population.
Bouctouche First Nation data from 2015-2017 was the following: 1 salmon tagged in 2015, 0 salmon tagged in 2016, 7 salmon tagged in 2017 (8 were counted, 1 escaped).

One plan recommended for future years to stock the watershed is introducing salmon eggs from the watershed back into the same watershed via use of incubators. This proposed method allows the eggs to develop in their natural habitat instead of in an artificially created environment. We hope it will eliminate certain threats such as predation or sedimentation, if sites iare well chosen, to increase egg survival rates.

2017 Electrofishing Survey Information for Bouctouche and Cocagne Watersheds

Except for 2003 and 2004, backpack electrofishing surveys have been conducted on the Bouctouche River since 1996, and since 1998 on the Cocagne River, excluding 2012-2015 (see table below for a summary of sites electrofished, and for location of sites). The electrofishing surveys provide an index for juvenile salmon in the area.

Watershed Site Electrofished											
	Cocagne			Bouctouche							
Year	C1	C2	C3	B1	B2	B3	B4	B5	B6	B7	B8
1996				x	x	x	x	x	x	x	x
1997				x	x	x	x	x	x	x	x
1998				x		x	x	x	x	x	x
1999	x	x		x	x	x	x	x	x	x	x
2000	x	x		x	x	x	x	x	x	x	x
2001	x	x	x	x	x	x	x	x	x	x	x
2002	x	x	x	x	x	x	x	x	x	x	x
2003											
2004											
2005	x	x	x	x	x	x	x		x	x	x
2006	x	x	x	x	x	x	x		x	x	x
2007	x	x	x	x	x	x			x	x	x
2008	x	x	x	x	x	x			x	x	x
2009	x	x	x	x	x	x	x			x	x
2010	x	x			x	x				x	
2011	x	x			x	x				x	
2012				x	x	x	x	x			x
2013				x	x	x			x	x	x
2014				x	x	x			x	x	
2015				x	x	x			x	x	x
2016	x	x	x	x	x	x			x	x	x
2017	x	x	x	x	x	x		x	x	x	x

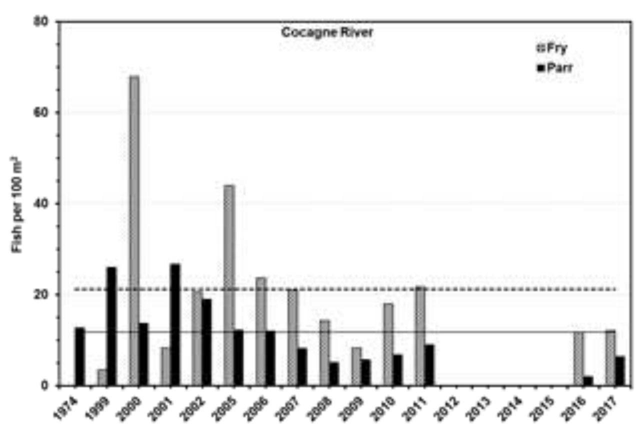
River	Site	Location	Lat	Lon
Bouctouche	B1	Near crossing upstream from the mouth of the South Branch	46 21 29.0624	64 54 1.4026
Bouctouche	B2	100 meters downstream from Route 490 (McLaughlin Rd)	46 22 15.692	64 56 35.836
Bouctouche	B3	South Branch downstream of Route 490 (McLaughlin Rd)	46 19 0.6563	64 53 51.2078
Bouctouche	B5	Upper N. Branch below Rte. 515	46 16.977	65 03.831
Bouctouche	B6	300 meters downstream from Johnson (Luke) Brook (Sweeneyville crossroad)	46 21 0.3522	64 58 48.2288
Bouctouche	B7	500 meters upstream from Coates Mill bridge	46 22 5.8245	64 52 56.8477
Bouctouche	B8	South Branch near crossing 200 meters upstream of the main stem	46 21 25.4938	64 53 51.6163
Cocagne	C1	Downstream from bridge on Poirier Rd. (*moved site upstream from illegal dumpsite)	46 16 7.4503	64 47 51.9948
Cocagne	C2	200 meters downstream from Victoria Rd. (New Scotland to O'Neil)	46 14.36837	64 53.108314
Cocagne	C3	Northwest Branch downstream of St Damien crossroad at Alexandria	46 18 41.8345	64 47 55.0171

The catch-per-unit (CPUE) index is collected from open sites with a single sweep following standardized protocols for gear and fishing technique. The CPUE method involves sampling with a single upstream pass without the use of barrier nets (open sampling). The sweeps are continued in a zig-zag pattern along the stream until at least 500 seconds have elapsed on the electrofisher. CPUE calculations are standardized so all densities reflect a 500 second sampling time and 100 m^2 area to allow for comparisons. The crew then identifies, measures the fork length (to the nearest mm) and weighs (g) all the fish sampled. For Atlantic salmon, all fry (young of the year) and parr (age 1 year and older) are distinguished on the basis of length. After sampling, fish are released downstream of the site.

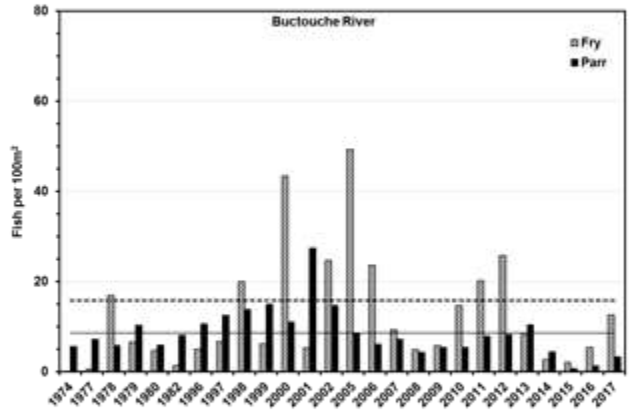
Electrofishing crews consist of three members: one operating the backpack electrofisher, a second holding the collection seine, and a third collecting fish with a dip net and bucket. If a fourth person is available, they carry the collecting bucket. The shocked fish generally drift downstream into the collection seine where they are removed with the dip net and transferred to a collecting bucket.

Electro-fishing survey results was the following for 2017: Cocagne, 3 sites were surveyed resulting at 13 fry (±13 salmon/100m^3) and 21 parr (±6 salmon/100m^3); Bouctouche, 7 sites were surveyed resulting at 56 fry (±13 salmon/100m^3) and 19 parr (±4 salmon/100m^3). Bouctouche First Nation's data from 2015-2017 was the following: 1 salmon tagged in 2015, 0 salmon tagged in 2016, 7 salmon tagged in 2017 (8 were counted, 1 escaped).

If we take a look at the past electrofishing results from both the Cocagne and Bouctouche rivers (see graphs on the right), it's easy to notice that Atlantic salmon populations have greatly decreased. They have been particularly low in the last few years. Even though they seem to be rising again (looking at Bouctouche), they are still below the desired level (dashed line for fry and full line for parr). This is why we want



to try to increase their numbers in our local rivers. The method we selected has been used by other watershed groups and has had promising results. It also provides a more natural, less stressful way of introducing young salmon to their natural habitat than typical stocking.



We plan on restoring salmon populations in the Bouctouche and Cocagne rivers via use of Jordan-Scotty Salmonid Egg Incubators. The process consists of capturing adult salmon from a river, extracting and fertilizing eggs, and putting the eggs in incubators at various sites during fall. The eggs would stay in the incubators (in their river of origin), throughout winter, until they hatch in spring.

SAA has a great partnership with Bouctouche First Nation (BFN). They have shown great interest in supporting this project. They have collaborated with us in the past and will likely do so for the foreseeable future. Their group would help, with use of their trap net, by catching adult salmon (at least one of each gender) in September/October. SAA would then transport the fish to the Miramichi Salmon Conservation Centre (MSCC) where salmon eggs would be extracted and fertilized. The adult salmon would then be brought back and released in their river of origin. As soon as the fertilized eggs are acquired, they would be brought to preselected sites where incubators would be installed. SAA would scout out for potential sites throughout the summer. Three probable sites would be a little upstream from a bridge on route 490, one near the “rue de la Traverse” in St-Paul, and the other in Coates Mill, near where the river splits into the two main branches.

After being filled with eggs, each incubator (1000 eggs capacity) would then be installed on the riverbed in an area deep enough to ensure that they stay submerged at all times. The incubators need to be secured in place with rebar and rope to ensure they don’t tip over or get carried away by the current. The incubators would then remain in place and unsupervised throughout winter (since accessing the site would be difficult due to snow and ice) and until the eggs start hatching in the spring (usually in early June).

The use of incubators allows the eggs to develop in their natural habitat instead of in an artificially created environment. This also eliminates the stress caused by a sudden change of environment when the fish are released in the rivers. This is a clear advantage over conventional stocking methods. Incubators also add the benefit of practically eliminating certain hazards (such as predation, being stepped on or being buried by sediments), greatly increasing egg survival rates.

Throughout the whole process, SAA would be following a guide document developed in 2016 by Friends of the Kouchibouguacis: *Experience gained using Jordan-Scotty Salmonid Egg Incubators*. This step by step guide includes: project preparation, disinfecting the incubators and eggs, and fish and egg transportation.

Project success would be evaluated from the percentage of eggs hatched from incubators. Success would also be evaluated during subsequent years from electro-fishing survey results. Successful results from this project would help increase wild Atlantic salmon populations.

Appendix

Literature Review and Biography

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