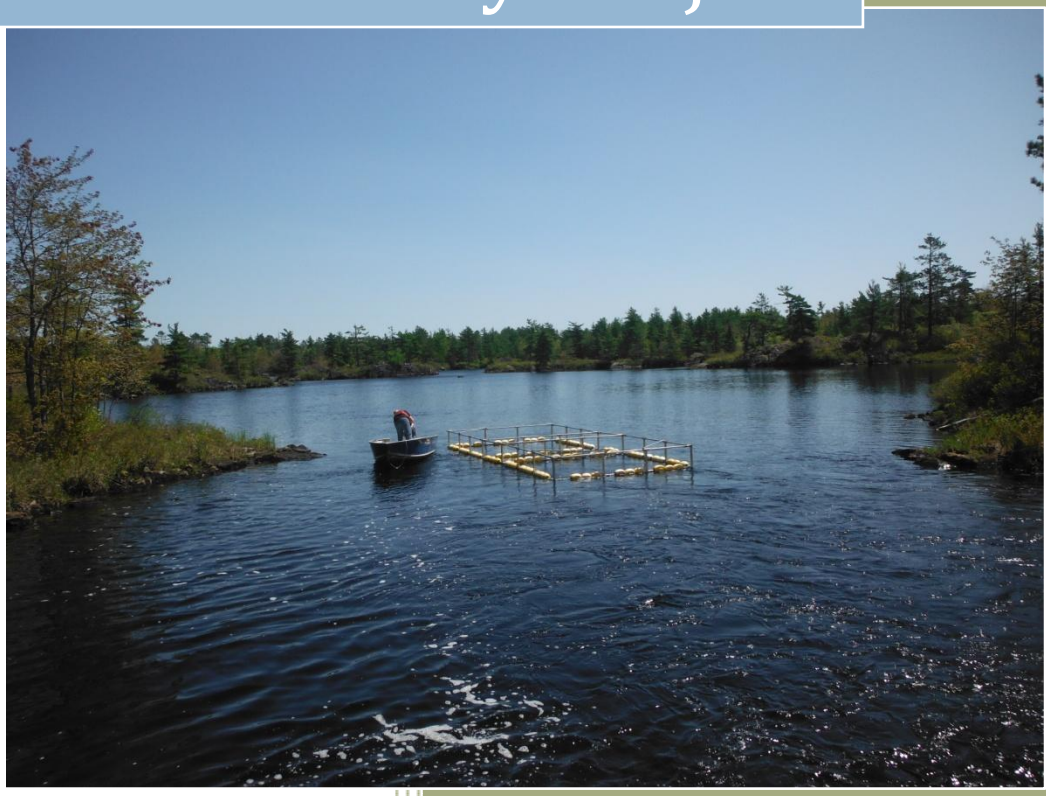
2013

# Atlantic Whitefish Recovery Project



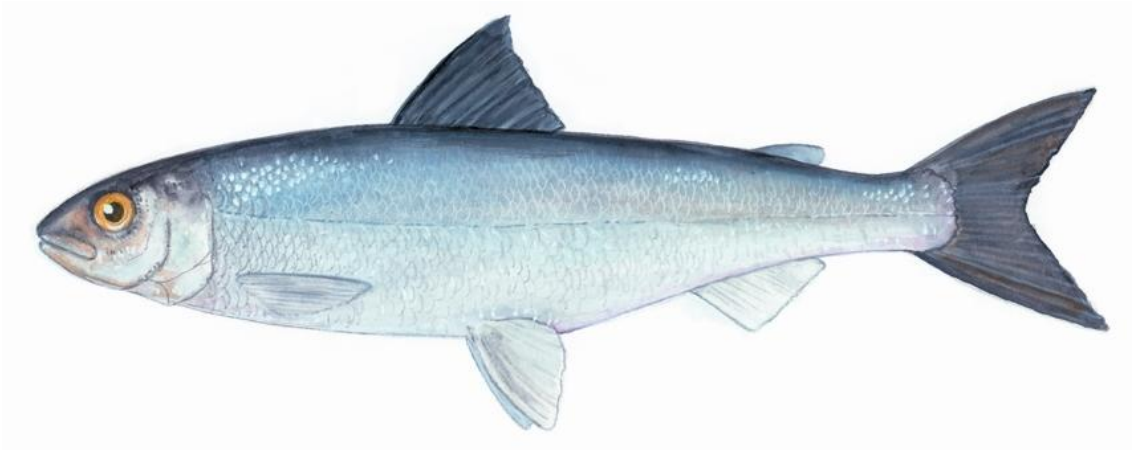
Andrew Breen

Bluenose Coastal Action Foundation

March 2014

# Atlantic Whitefish Recovery Project

## Report on 2013 Field Activities



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Coastal Action
Foundation

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- 2013 Field Crew: Phillip Longue, Tyler Peterson
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- Members of the Atlantic Whitefish Conservation and Recovery Team
- Bluenose Coastal Action Foundation summer staff
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# Introduction

## Bluenose Coastal Action Foundation

The Bluenose Coastal Action Foundation is a community based charitable organization that addresses the environmental concerns in the South Shore region of Nova Scotia; the epicentre of the foundation's work is within Lunenburg County. Bluenose Coastal Action's goal is to promote the restoration, enhancement, and conservation of our ecosystem through research, education, and action. Since the organization's establishment in December 1993, it has been an active member of the Lunenburg County community. Originally as part of the Atlantic Coastal Action Program (ACAP), Bluenose Coastal Action Foundation was created to respond to the urgent need to restore human-impacted coastal environments, so that they could continue to sustain coastal communities.

Now in its 20th year, Bluenose Coastal Action Foundation remains true to its community-based joint planning/multi-stakeholder process and is guided by a unique program specifically designed to address coastal and watershed based issues through community-driven planning and management activities. In 2013, Coastal Action was involved in the Roseate Tern Recovery Project, East River, Chester Elver Abundance Study, Gold River Catchment Liming Project, LaHave River Watershed Project, American Eel Research Study, Environmental Home Assessment Program, Environmental Education at the Morton Centre, Developing a Coastal Policy for the Municipality of the District of Lunenburg, Solid Waste Education Program, Living Shorelines Project along the banks of the LaHave River, and the Atlantic Whitefish Recovery Project.

## The Atlantic Whitefish

The Atlantic whitefish (*Coregonus huntsmani*) is a naturally anadromous, endangered fish species, which is endemic to eastern Canada. Currently, it is only found within the Petite Rivière watershed in Lunenburg County, Nova Scotia. In 1984, the Atlantic whitefish became the first Canadian fish species to be classified as "endangered" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Its "endangered" status was reconfirmed by COSEWIC in 2000, and more recently in 2010. The Atlantic whitefish was also recognized as being threatened with imminent extinction and is listed as "endangered" on Schedule 1 of the federal *Species at Risk Act (SARA)* in 2003. It is protected under the *Maritime Fishery Regulations*, the federal *Species at Risk Act*, and the *Nova Scotia Endangered Species Act*. Extinction of the Atlantic whitefish would have a significant effect on the local aquatic biodiversity (COSEWIC 2010). Therefore, with an aim to help conserve and recover the current population, Bluenose Coastal Action has been dedicated to raising public awareness and researching the Atlantic whitefish since 2004.

The Atlantic whitefish is a coregonid species, which is classified as a subfamily within the salmonids. Its physical resemblance to the more common lake whitefish originally delayed its identification (COSEWIC 2010). Although, previously known as the Acadian whitefish, Sault whitefish, round whitefish, and common whitefish (Edge and Gilhen 2001), anatomical comparisons and genetic analyses have confirmed the Atlantic whitefish as a separate and distinct species (Bernatchez et al. 1991; Murray 2005; COSEWIC 2010). The Atlantic whitefish

has silver sides, a white belly, and a black, dark blue, or dark green back (Figure 1). It can be further identified by its deeply forked tail and the presence of a fleshy adipose fin, which lies along its back, between its dorsal and caudal fin (Scott and Scott 1988). Land-locked individuals reach an average length of 20 to 25 cm, significantly smaller than anadromous individuals, which average 38 cm in length but can reach up to 50 cm (Bradford 2000). Anatomical comparisons conducted by Hasselman et al. (2009), showed that three species-specific characteristics consistently distinguished the Atlantic whitefish from the lake whitefish. The Atlantic whitefish was found to have shorter pectoral fin lengths, a greater number of lateral line scales (Atlantic whitefish: mean = 94; lake whitefish: mean = 77), and a more terminal mouth position.


**Figure 1**: Atlantic whitefish.

Although the remaining Atlantic whitefish population is now only found within the Petite Rivière watershed, historically, an anadromous population was also known to exist in the Tusket-Annis watersheds in Yarmouth County, Nova Scotia. However, since there have been no reported Atlantic whitefish sightings in the Tusket or Annis rivers since 1982, this population is believed to be extirpated (Bradford et al. 2010). Occasional, isolated sightings have been reported in other coastal areas, including the Sissiboo River (in 1909) (Scott and Scott 1988), Halls Harbour (in 1958) (Edge and Gilhen 2001), the Lahave Estuary (in 1995 and 1997) (Edge and Gilhen 2001), the Medway River (DFO 2011 Pers. Comm.), and the lower reaches of the Petite Rivière system, including Fancy Lake (DFO 2006). Although it is possible that the species' range had already been reduced prior to its identification in 1922 (Huntsman 1922; DFO 2004a), these individuals were likely remnant members of either the Petite or Tusket-Annis River populations (DFO 2006).

## Threats to Survival

A number of factors have been identified as threats to the survival of the Atlantic whitefish, although, it is uncertain which of the current threats played a significant role in the decline of the species in earlier years (Bradford et al. 2010). The following threats, identified by COSEWIC, are thought to have either led to the decline of the population, and/or are currently threatening the survival of the Atlantic whitefish: habitat degradation, fishery-related bycatch, the introduction of non-native invasive species, and barriers to fish passage.

### Habitat Degradation

Acidification caused by acid rain has been identified as a major cause of habitat loss and degradation. Many of the rivers in southwest Nova Scotia are naturally acidic but have become more acidic in recent years. Acidification likely played a significant role in the extirpation of the Tusket-Annis population, and has also been identified as a major factor contributing to the decline of wild Atlantic salmon throughout the region (DFO 2000). Fortunately, the Atlantic whitefish is considered to be relatively tolerant to acidic conditions (Cook et al. 2010), and due to the river's buffering capacity, the Petite tends to maintain a slightly higher pH than other rivers in the area (COSEWIC 2010).

### Fishery-Related Bycatch

Historically, unregulated fishing practices and poaching may have had a significant impact on the decline of the species (Bradford et al. 2004b). The once abundant Atlantic whitefish was targeted as a food and sport fish, and was also a common bycatch product in the Gaspereau (*Alosa pseudoharengus*) gillnet fishery (Bradford et al. 2004a). It has also been suggested that the Atlantic whitefish may have been harvested in large quantities for use as lobster bait and fertilizer (Cited in DFO 2006; Scott and Scott 1988; P. Longue, DFO 2001 Pers. Comm.). Legal harvesting of the Atlantic whitefish and harmful bycatch fisheries ceased in the Petite Rivière prior to 1980, and Section 6 of the *Maritime Provinces Fishery Regulations*, which came into effect in 1993, specifically banned the catch, retention, and possession of Atlantic whitefish (DFO 2006). Presently, incidental catch by recreational anglers may still have a small impact on the current population (COSEWIC 2010).

### Non-Native Invasive Species

The introduction of non-native invasive species into Nova Scotia's lakes and rivers with the purpose to enhance recreational angling continues to pose a threat, not only to the Atlantic whitefish, but to other native fish species as well. The effect of smallmouth bass on native fish populations in other watersheds has been well documented (COSEWIC 2010) and potential impacts include direct predation, trophic disruption, and habitat competition (Jackson 2002). In 2013, Bluenose Coastal Action staff determined that chain pickerel (*Esox niger*) had been illegally introduced into the Petite Watershed.

Smallmouth bass are a member of the sunfish family, Centrarchidae, and due to their ability to fight when hooked, they are considered to be a great angling fish. The increased popularity of smallmouth bass angling has lead to the illegal introduction of this species throughout Canada, including into the lakes and rivers of Nova Scotia. Smallmouth bass are presently found in 188 lakes and rivers in Nova Scotia (DFO 2009a). They were first introduced to Nova Scotia in 1908, and were first recorded in the lower reaches of the Petite Rivière in 1994. A Habitat Stewardship Program study conducted in 2003 confirmed the presence of a reproducing smallmouth bass population in the lakes above the Hebb Lake Dam (Bradford et al. 2004b). In recent years, smallmouth bass angling and nest surveys have shown that smallmouth bass are becoming well established in the Petite Rivière watershed, both above and below the Hebb Lake Dam.

Chain pickerel are a member of the pike family, Esocidae. They are an aggressive predator and will actively feed on invertebrates, fish, small mammals, amphibians, and even ducklings.

## Barriers to Fish Passage

Southwest Nova Scotia's rivers have had an extensive history of damming. Prior to September 2012, the Atlantic whitefish population, which is believed to be naturally anadromous, had been land-locked for over a century due to a series of dams constructed along the Petite Rivière since the late 1700s (Sodero 1994; DFO 2006). At least 48 known mills, producing lumber, flour, laths, and shingles, were operated on the Petite Rivière between 1783 and 1973 (Sodero 1994). Current potential barriers include structures at Crousetown, Conquerrall Mills, Milipsigate Lake, and Minamkeak Lake.

**Table 1**: Descriptions of barriers to fish passage in the Petite Rivière (DFO 2004b; DFO 2006 (adapted from Conrad 2005); Fielding 2011).

| DAM | DESCRIPTION | CONSTRUCTION DATES |
|---|---|---|
| **Crousetown** | A 2.4 m high timber dam located at a former sawmill site. The dam includes a run-around channel fishway constructed from loose stone. Considered to be inefficient for fish passage. | Current structure constructed in 1889; fishway repaired in 1945 (previous dam may have been constructed as early as 1802). |
| **Conquerrall Mills** | The dam at the former Conquerrall Mills hydroelectric site was partially dismantled, allowing a 9 m space between the remaining concrete abutments. The resulting short series of rapids constitutes a 1.2 m drop, which may present a velocity barrier to Atlantic whitefish passage upstream. | Installed in 1939; operation ceased in 1971; dam was breached in 1979. |
| **Hebb Lake** | A hydroelectric facility, which operated between 1939 and 1971. Currently serves as a storage dam at the base of Hebb Lake, for the Town of Bridgewater water supply. Consists of a concrete flow-control structure and a long rock and earth filled berm. Upgraded in 2011 to include a fish passage facility, which became operational in 2012. | Initial construction could have been as early as 1901; new dam constructed between 1971-1974; upgraded in 2011; fish passage facility opened in 2012. |
| **Milipsigate Lake** | A concrete dam structure operated by the Town of Bridgewater for flow regulation and water storage purposes. Other than the spillway, no fish passage is provided at this dam. | 1939 (approx.); upgraded in 2011. |
| **Minamkeak Lake** | The uppermost storage dam for the Town of Bridgewater for flow regulation and water storage purposes. Other than the spillway, no fish passage is provided at this dam. | 1939 (approx.); upgraded in 2011. |

Man-made barriers have had significant impacts on diadromous fish populations, which depend on upstream and downstream migrations at various life stages. The construction of dams without adequate fish passage has been responsible for a reduction in habitat access, water flow alteration, changes and delays to migratory patterns, and the decline of several fisheries. In the Petite Rivière watershed, the Hebb Lake Dam has been the main barrier blocking upstream fish passage into Hebb Lake since the early 1900's (DFO 2006). However, on September 24, 2012, a newly constructed fish passage facility including a fishway and fish trap was opened (Figure 2), allowing for monitoring and sampling activities.

**Figure 2**: Hebb Lake Dam Fish Passage Facility.
*Photo courtesy of Kim Robichaud-LeBlanc (DFO)*

## Goals and Objectives

Bluenose Coastal Action Foundation's Atlantic Whitefish Recovery Project (AWRP) had several goals and objectives at the start of the 2013 field season. However, with the discovery of chain pickerel in the watershed those objectives were amended.

Goals are start of 2013 field season:

1. To continue to address knowledge gaps surrounding the migratory behaviour of Atlantic whitefish, including upstream and downstream migration patterns.
2. To increase Atlantic whitefish awareness within the community.
3. To assess the impact of smallmouth bass (SMB) on the existing Atlantic whitefish population, to assess the spread of smallmouth bass in Hebb Lake, and to prove direct predation of Atlantic whitefish by smallmouth bass.
4. To establish catch per unit effort (CPUE) records for SMB in the vicinity of Milipsigate Dam.
5. To conduct and analyse a stomach content survey of SMB from the Upper Petite Lakes.
6. To operate and monitor the Hebb Lake Dam fishway and trap.

Goals upon the discovery of chain pickerel in Hebb Lake:

7. To determine the range, abundance, and age class of chain pickerel in the Upper Petite Watershed.

# Methodology

## Study Area

All sampling took place within the Petite Rivière watershed (Figure 3) between April 2013 and December 2013. Data were collected from three lakes; Minamkeak, Milipsigate, and Hebb, as well as the main branch of the Petite Rivière, and the upper and lower tributaries that feed into the river.

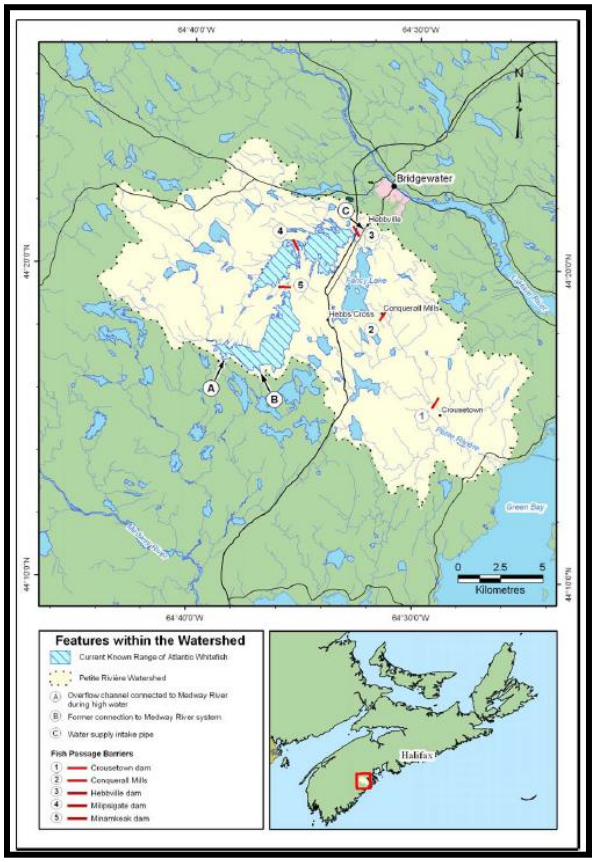


**Figure 3**: Map of the Petite Rivière watershed showing the three lakes (Minamkeak, Milipsigate, and Hebb), which contain the existing wild Atlantic whitefish population, as well as the dams that currently impede fish passage.

## Outreach and Education

An important component of the AWRP is to provide the local community with information about the plight of the Atlantic whitefish and ongoing recovery efforts. Bluenose Coastal Action staff presented and/or had a project booth available at the following community festivals and events during the 2013-14 AWRP project year.

- Nova Scotia Community College – Lunenburg Campus Sustainability Expo
- Parkview Education Centre's Knowledge Festival
- Lunenburg, Bridgewater, and Mahone Bay Farmers Markets
- RBC Blue Water Day
- World Oceans Day celebrations at Bluenose Academy
- Fisheries Museum of the Atlantic Open House
- Michelin Seniors Expo
- Michelin Health & Safety Fair
- Municipality of the District of Lunenburg's Day Camp Program
- Lunenburg County's YMCA Day Camp Program
- YMCA Healthy Kids Day
- Mahone Bay Pirate Festival and Regatta
- Bridgewater Growing Green Sustainability Festival
- Bridgewater Children's Fair
- Halifax International Boat Show
- White Point Beach March Break Programming Activities
- World Water Day Panel Discussion at Mahone Bay Centre
- Lunenburg County Fish Friends Program (9 local schools participate in this program)

## Invasive Species Monitoring

The smallmouth bass nest surveys were carried out between May 17, 2013 and June 6, 2013 on Hebb and Milipsigate Lakes as well as Milipsigate Outlet. A 14-ft Princecraft aluminium boat complete with a 4-stroke 4 HP Yamaha engine was used to navigate the lakes. To obtain the best results, nest surveys were conducted, whenever possible, on calm days in the morning and polarized glasses were used to provide enhanced visibility. Any potential nests were examined using a viewfinder which allows the user to clearly see below the waterline. All nests were counted, assessed, and marked using a handheld GPS.

SMB Nest clarification:

- A – newly excavated with no silt and no eggs present
- B – eggs present
- C – fry present but not yet dispersed into the water column
- D – fry dispersed (successful)
- F1 – abandoned after being classified as class A

- F2 – abandoned after being classified as class B or C
- N – new nest not observed on previous sampling days

The following habitat characteristics were also recorded for all nests found in the Milipsigate Outlet and Hebb Lake:

- Weather conditions
- Water temperature (°C) – Measured using an ExStick II digital thermometer
- Water depth (cm) – Measured using a metre stick
- Distance from shore (m) – Measured using a measuring tape, metre stick, or an eyeball estimate
- Nest cover:
    - B – boulder
    - L – log
    - O – overhanging vegetation
    - X – no cover
- Substrate type:
    - MS – mud or silt
    - G – gravel
    - C – cobble
    - R – rock or boulder
    - D – detritus
    - Z – other

## Smallmouth Bass and Chain Pickerel Biological and Catch per Unit Effort (CPUE) Study

A biological study and catch per unit effort (CPUE) survey were conducted in Hebb, Milipsigate, and Minamkeak Lakes, with special focus paid to the Milipsigate Outlet. All angling took place between April 25, 2013 and October 21, 2013. Using a 14-ft Princecraft aluminum boat and a four-stroke Yamaha motor, two or three anglers fished a range of habitats, but concentrated on several habitat types found in the Milipsigate Outlet. These habitats included rocky drops, vegetated areas, and areas with flowing water at the base of the Milipsigate Dam.

On May 14, 2013, the AWRP field team were advised by a community contact that chain pickerel were present in the Upper Petite Watershed and that fish had been caught in Little Lake. These statements were later confirmed on May 17, 2013, when the field team caught a 25.5 cm chain pickerel in Little Lake. Bluenose Coastal Action Foundation was then contracted by DFO to assess the general status of invasive species (i.e., chain pickerel and smallmouth bass) in all three lakes. Coastal Action staff used various methods including angling, fyke nets, eel and minnow pots, and electrofishing to determine the extent of distribution in the upper watershed.


**Figure 4**: Aerial view of the Milipsigate Outlet.

As part of the CPUE study, the following details were recorded:

- Total angling time at each site (in minutes)
- Number of anglers
- Weather conditions
- Water temperature (°C) – Measured using an ExStick II digital thermometer
- Habitat description
- Type of lure used (i.e., spinner, rapala, shad dart, artificial worm)
- Catch data: species, fork length (cm), weight (g)
- Stomach content (fish, invertebrate, or empty)
- Sex of fish

The estimated CPUE value was calculated by dividing the number of angled smallmouth bass or chain pickerel by the total amount of time spent fishing in each body of water.

All invasive species angled during the CPUE study, as well as any captured in the rotary screw trap, trap net, and fishway trap, were retained and analysed in the biological component of the study. All fish were placed on ice in a cooler and were sampled within a few hours of their capture. Several details and measurements were taken for each fish; including weight (g), fork length (cm), sex, stomach content, and scale samples. Scale samples were taken from of the left side, posterior to the pectoral fin, and below the lateral line using tweezers.

**Figure 5**: Preferred area to remove scales from smallmouth bass.

The samples were cleaned, mounted on slides, and examined using a microfiche reader. The age of each fish was determined by counting the number of bands and circuli. Feeding preferences were determined by examining stomach contents, which were extracted using a filet knife. Stomach content was recorded as being either fish, invertebrate, or empty.

A fecundity study was conducted on 40 female SMB captured between May 15, 2013 and June 4, 2013. The gonads were carefully dissected from the fish and weighed; a sample of 100 oocytes (eggs) were then separated from the ovary and weighed. The formula used was:

Total Gonad weight/Sample weight X 100 = Fecundity

The stomach contents were removed by making an incision in the fish and exposing the stomach. The stomach was carefully removed from the body cavity and its contents were inspected for the presence of fish or invertebrates. Furthermore, an inspection was carried out to check if the bass had regurgitated any of its stomach content.

**Figure 6**: Stomach content analysis – smallmouth bass.

## Rotary Screw Trap Study

A rotary screw trap (RST) (developed by EG Solutions, Inc., Corvallis, Oregon, USA) was installed in the Petite Rivière, approximately 100 m downstream from the Hebb Lake Dam (Figure 7). Rotary screw traps are most commonly used to capture downstream migrating salmon smolts in the spring to estimate the Atlantic salmon population size. In this case, the trap was operated with the intent to capture downstream migrating Atlantic whitefish as well as to better understand the fish assemblage present in the Petite Rivière. The trap was assembled in the river and towed upstream to the sampling area. The corner of each pontoon was secured to a tree along the river bank using polypropylene rope. The trap consists of a 5-ft diameter rotating conical shaped drum, which is partly submerged and suspended on two 16-ft long pontoons. Adequate depth and sufficient water flow are required to keep the drum rotating and to guide fish through the drum into a live holding box at the rear of the trap. During periods of low flow, water velocity was adjusted using the Indian Garden Farms cranberry gate dam, which was located 10 m upstream from the trap. Five wooden gates are used to divert water into the cranberry fields at certain times of year. To ensure a direct stream of water through the trap, two or three of the gates remained closed during the study to increase the chance of capturing downstream migrating fish.


**Figure 7**: Rotary Screw Trap, Petite Riviére – May 2013.

The RST operated between April 10, 2013 and June 27, 2013 and the trap was checked daily. Each fish was removed from the holding tank using a dip net and placed in a bucket for sampling. Each fish was identified, measured to fork length (cm), and released (with the exception of smallmouth bass, which were sacrificed as part of the biological study). Physical data, including water temperature ($^{o}$C), weather conditions, and drum rotations per minute (RPM), were also collected daily. Once all fish had been sampled and released, all debris was removed from the holding tank and the external surface of the drum was cleaned using a hard brush.

## Milipsigate Dam/Minamkeak Lake Trap Net

A trap net belonging to Fisheries and Oceans Canada (DFO) was installed just below Milipsigate Dam between May 30, 2013 and June 13, 2013 (Figure 8). The trap was set and fished intermittently throughout this two week period. During the fall, two trap nets (10 ft and 15 ft deep) were deployed in Minamkeak Lake and were fishing intermittently from September 30, 2013 to October 30, 2013. All fish caught in the traps were removed using a dip net and placed into a holding bucket for sampling. The following data were then recorded:

- Time trap was set
- Time trap was checked
- Water temperature (°C)
- Weather conditions
- Catch data: species, fork length (cm), origin (hatchery or wild)

**Figure 8**: Trap net at Milipsigate Outlet.

The trap nets were towed by boat to a pre-determined fishing site on Minamkeak Lake. The traps were held in this location using four anchors that were connected to mooring buoys and the corners of the trap net. A 100-ft leader net was attached at one end to the entrance and then deployed at right angles to the mouth of the trap net. The leader is used to guide fish into the trap net.

**Figure 9**: 10-ft Trap net on Minamkeak Lake, October 2013.

## Hebb Lake Dam Fish Passage Facility Health Collections

The AWRP team assisted with the fish health collections prior to the opening of the Hebb Lake Dam Fish Passage Facility. Given the severity of the potential risks associated with introducing pathogens or disease into the waters above the Hebb Lake Dam, 57 brook trout (*Salvelinus fontinalis*) were collected from the watershed and screened for bacterial and viral infections according to the Fish Health Protection Guidelines. A total of 30 brook trout were collected from above Hebb Lake Dam (Wildcat Brook, Newcombeville Lake, and Sarty Brook) on April 22, 2013 and an additional 27 brook trout were collected from below Hebb Lake Dam (Branch Lake Tributary, the RST, and Brown Branch Brook) between April 15, 2013 and April 23, 2013. All of the fish collected were stored on ice and immediately shipped by overnight courier to DFO's Gulf Fisheries Centre in Moncton, NB for analyses.

Electrofishing was selected as the most efficient method for capturing the required number of fish for disease testing (Figure 10). Electrofishing involves the use of pulsed electrical current to temporarily stun the fish within an effective range. The appropriate voltage, to ensure non-lethal sampling, is selected based on the water's conductivity and the type and size of fish being targeted. The sampling team consisted of two staff members, including the individual wearing and operating the Smith Root 12A backpack electrofisher, and one dip-netter. All electrofishing took place while moving in an upstream direction and targeted areas where brook trout were most likely to be present. Once captured, each fish was transferred to a holding bin before being packaged for shipping.

**Figure 10**: Electrofishing - Brown Branch Brook.

## Weagle's Dam Fyke Net

A fyke net was deployed at the Weagle's Dam outlet of Hebb Lake from April 10, 2013 until May 9, 2013 to monitor for downstream migration of Atlantic whitefish. The trap was checked on a daily basis. All fish were removed from the holding box using a dip net and placed in a bucket for sampling. Each fish was identified, measured to fork length (cm), and released (with the exception of smallmouth bass, which were sacrificed as part of the biological study). Physical data, including water temperature ($^{o}$C), as well as weather conditions were collected daily. Once all fish had been sampled and released, all debris was removed from the holding box and the external surface of the fyke net and leaders.

**Figure 11**: Fyke net – Weagle's Dam.

## Milipsigate Lake Overflow Channel Fyke Net

A fyke net was deployed at the entrance to the Milipsigate Lake overflow channel from June 17, to June 21, 2013. The fyke net, and its associated leaders, completely blocked the channel and initially were deployed to prevent the upstream migration of chain pickerel into Milipsigate Lake. The trap was checked on a daily basis. All fish were removed from the holding box using a dip net and placed in a bucket for sampling. Each fish was identified, measured to fork length (cm), and released (with the exception of smallmouth bass and chain pickerel, which were sacrificed as part of the biological study). In addition, physical data, including water temperature ($^{o}$C), as well as weather conditions were collected and all debris was removed from the nets daily.

**Figure 12**: Fyke net – Milipsigate Overflow channel.

## Eel/Minnow Pot Deployment – Hebb Lake

To assist with determining the extent of the range of chain pickerel in the upper lakes, eel and minnow pots were deployed in Hebb Lake between June 10, and June 19, 2013. The traps were placed in three separate locations in the lake; pinch gut, Milipsigate Outlet, and a cove in Hebb Lake close to the Milipsigate Outlet (Figure 13).

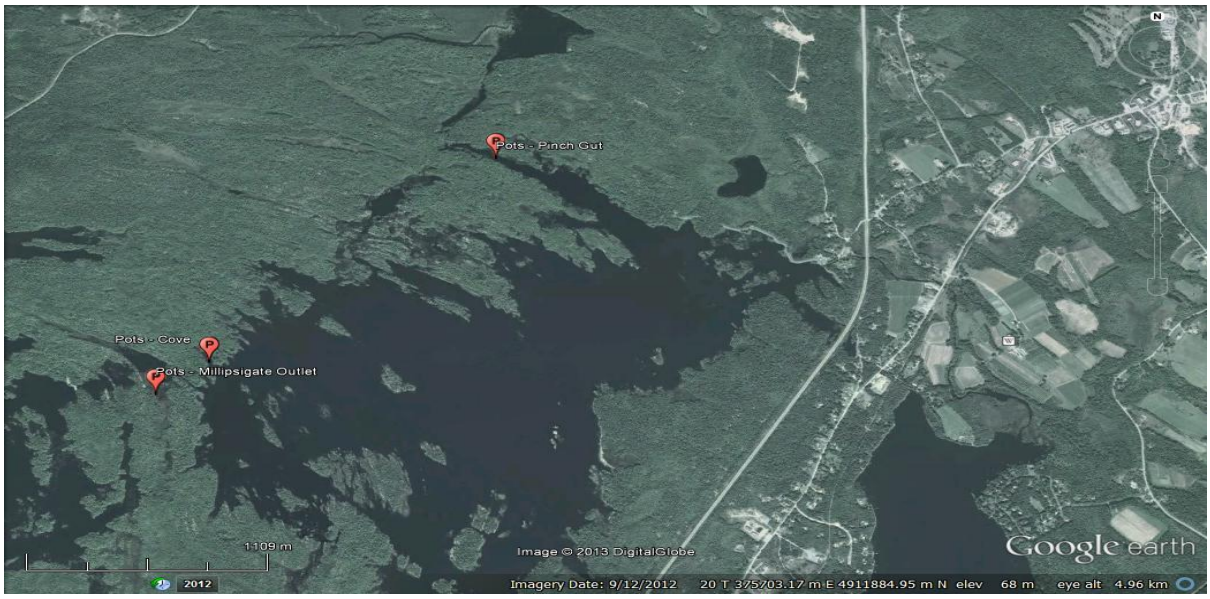


**Figure 13**: Aerial view of the Eel/Minnow pot locations.

A canoe was used to deploy the eel and minnow pots, mainly due to its versatility in shallow grassy bays (the preferred habitat of chain pickerel during the spring and summer).

**Figure 14**: Eel/Minnow pot deployment.

In total, 17 eel pots and 6 minnow traps were used for the survey. These traps were baited with smallmouth bass remnants from the smallmouth bass stomach content analysis. The traps were checked each day and were freshly baited.

## Spring and Fall Monitoring and Sampling Activities at the Hebb Lake Dam Fish Passage Facility

The Hebb Lake Dam Fish Passage Facility opened on April 16, 2013 and operated until April 19, 2013 to assist with the fish health screening collections; from May 10, 2013 until June 28, 2013 to allow for the migration of Alewife; and from October 2, 2013 to November 29, 2013 to allow for the monitoring of Atlantic whitefish. A suspended 6'0" x 6'8" x 7'8" aluminum trap was set and monitored daily during these time periods (Figure 16). The purpose of the trap was to monitor and sample any upstream migrating fish. All fish were sampled and released according to the protocols outlined in DFO's Hebb Lake Dam Fish Passage Facility Interim Monitoring Plan. The following species were permitted to pass upstream; White sucker, Alewife, Brook trout, and American eel. All other species, with the exception of smallmouth bass and chain pickerel which were sacrificed for the biological study, were released downstream. The monitoring plan protocols ensured that any fish entering the lake did not pose a risk to the engendered Atlantic whitefish population. In addition, the lake level was recorded using a gauge attached to the fishway (Figure 15) and water and air temperatures were observed on a daily basis.

**Figure 15**: Hebb Lake Level Gauge.

**Figure 16**: Fishway trap.
*Photo courtesy of Kim Robichaud-LeBlanc (DFO)*

Each day a minimum of two staff lifted the trap out of the water using a chain pulley system. The trap was opened, and each fish was netted and placed in a holding tank. All Atlantic whitefish and Atlantic salmon

would have been held in a plexiglass aquarium to facilitate examinations for any signs of hatchery rearing (i.e., fin clips, fin/snout erosion, tags, and general health) and to allow photos to be taken while keeping handling to a minimum. Each fish was measured to fork length (cm), weighed (g) in water using a digital hanging scale or balance scale, and examined to ensure good health. Scale samples and DNA samples would have been extracted from Atlantic whitefish and Atlantic salmon. Five to ten scales were removed from the left side of the fish just behind the dorsal fin and above the lateral line using a small clean knife. All scale samples would have then been mounted on slides using fine tweezers and examined with a microscope or microfiche reader. The protocol for wild Atlantic whitefish caught in the trap during this time period (Fall 2013) called for them to be transferred to Minankeak Lake.

## Crousetown Dam Fish Trap

A fish trap was deployed immediately upstream from the Crousetown Dam Fishway. The trap consisted of a frame 5 ft x 5 ft x 10 ft long constructed of 2”x4” spruce and a 5\8 “mesh size smelt net complete with 2 X 10 ft wing. Several ropes were attached to the bottom of the net to allow for easy operation, this allowed for the trap to be checked from the shore. The trap was checked daily and all fish were identified and sampled. The purpose of the trap was to monitor for any migration of Atlantic whitefish in the Lower Petite Watershed.

**Figure 17**: Crousetown fish trap.

# Results

## Invasive Species Monitoring

### Smallmouth Bass Nest Surveys

Smallmouth bass nest surveys were carried out in Milipsigate and Hebb Lakes as well as the Milipsigate Outlet. Due to poor weather conditions and the discovery of chain pickerel in the Petite system, the nest surveys were limited in 2013. A total of 10 nests were identified and monitored in the Milipsigate Outlet, 6 nests were recorded in Hebb Lake, and 37 were recorded in Milipsigate Lake. In the Milipsigate Outlet and Hebb Lake, any nests that were identified were not allowed to successfully disperse fry; adult males guarding the nests were actively angled and then the nests were raked.

In Milipsigate Lake, only a small percentage of the lake was surveyed due mainly to time and weather constraints.

**Table 2**: Percentage of shoreline surveyed, total number of smallmouth bass nests identified, total number of successful nests, and the calculated success rate for each of the two lakes surveyed as well as Milipsigate Outlet.

| Lake | % of shoreline surveyed | Total number of nests identified | Total number of successful nests | Success rate |
|---|---|---|---|---|
| **Hebb Lake** | >5% | 6 | 0 | 0% (2013) |
| **Milipsigate Outlet** | 85% | 10 | 0 | 0% (2013) |
| **Milipsigate Lake** | >5% | 37 | 16<br>(using NSDFA 2010 success rate) | 44% (2010) |


**Figure 18**: Shoreline surveyed – Milipsigate / Hebb Lake during smallmouth bass nest study.

## Smallmouth Bass Catch per Unit Effort (CPUE) Study

A total of 516 smallmouth bass were angled and removed from the watershed during the CPUE study. All fish were angled using a spinner, rapala, shad dart, or artificial worm; however, the majority of smallmouth bass were angled using an artificial worm lure (Figure 19).

**Figure 19**: Artificial worm lure.

**Table 3**: Number of smallmouth bass angled from the eight fishing areas, the total amount of time spent angling, the estimated catch per unit effort (CPUE), and other incidentally angled species.

| Area | Number of bass angled | Total time spend angling (Hrs) | Estimated CPUE (# bass/hour) | Other species angled |
|---|---|---|---|---|
| **Hebb Lake** | 15 | 9.75 | 1.54 | White perch; chain pickerel; |
| **Milipsigate Outlet** | 342 | 56.5 | 6.05 | White perch; chain pickerel; Brook trout |
| **Milipsigate Lake** | 74 | 21.25 | 3.48 | Chain pickerel |
| **Minamkeak Lake** | 3 | 6 | 0.5 | None |
| **Andrew Lake** | 37 | 3 | 12.33 | None |
| **Fancy Lake** | 8 | 3 | 2.67 | None |
| **Hebb Dam** | 32 | 1.25 | 25.6 | None |
| **Petite R.** | 5 | 0.75 | 6.67 | None |
| **Total** | **516** | **101.5** | **5.08** | |

Between April 25, 2013 and October 7, 2013 approximately 101.5 hours were spent angling in the Petite Watershed. Over 50% of the total angling effort was concentrated in the Milipsigate Outlet area. CPUE was assessed on a monthly basis in this area to determine the viability of angling as a control method in a sensitive habitat area. (Note: The base of Milipsigate Dam was an area that traditionally, pre-2010, would be known to support a population of Atlantic whitefish during May. They would congregate in this area to feed on White sucker eggs.)

**Table 4**: Catch per unit effort in Milipsigate Outlet.

| | CPUE Milipsigate Outlet Effort (Hrs) | SMB Angled | CPUE (Fish per hr) |
|---|---|---|---|
| **April** | **1.00** | **0** | **0.00** |
| **May** | **19.08** | **157** | **8.23** |
| **June** | **3.00** | **8** | **2.67** |
| **July** | **6.50** | **47** | **7.23** |
| **Aug** | **16.92** | **93** | **5.50** |
| **Sept** | **9.50** | **36** | **3.79** |
| **Oct** | **0.5** | **1** | **2.00** |
| **Total** | **56.5** | **342** | **6.05** |

The greatest rate of CPUE occurred on May 13, 2013; 37 SMB were caught in a 30 minute period giving a CPUE of 74 fish per hour.

**Figure 20**: The largest bass of the year. An 11 year old 48.8 cm, 1.72 kg female caught in Milipsigate Outlet on May 31, 2013.

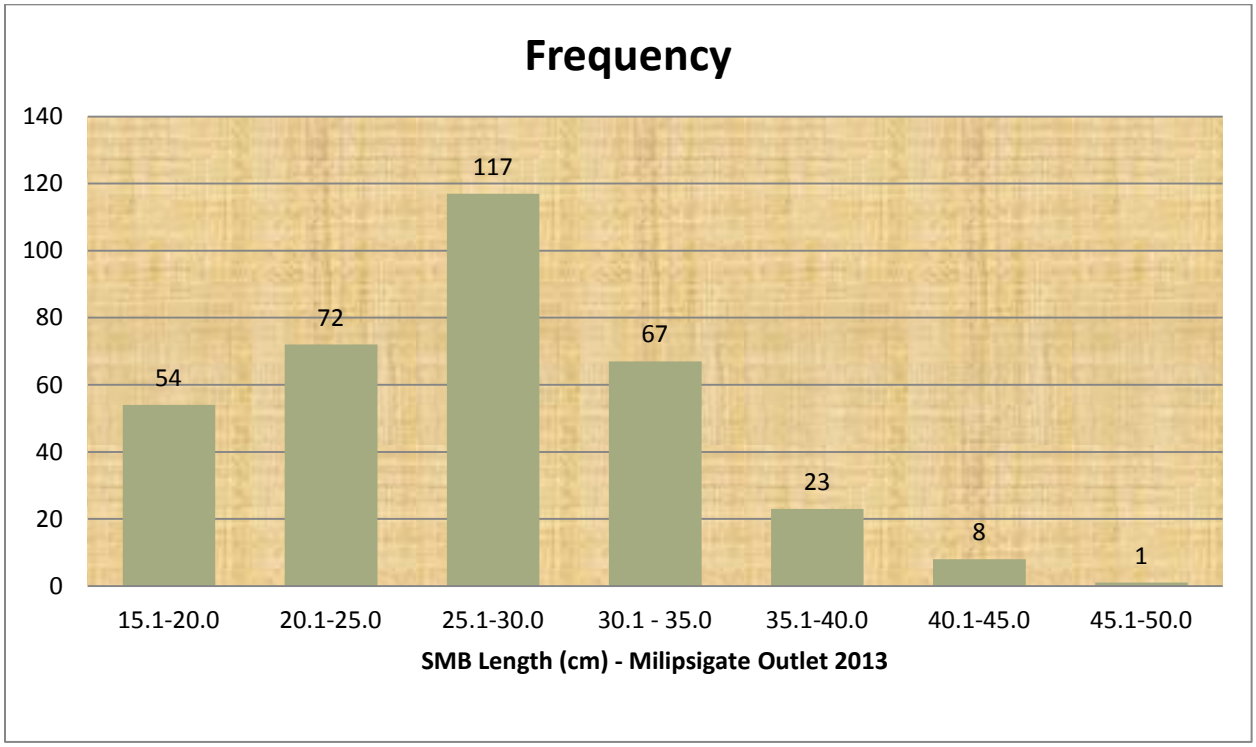


**Figure 21**: Length distribution of all SMB angled in the Milipsigate Outlet in 2013.

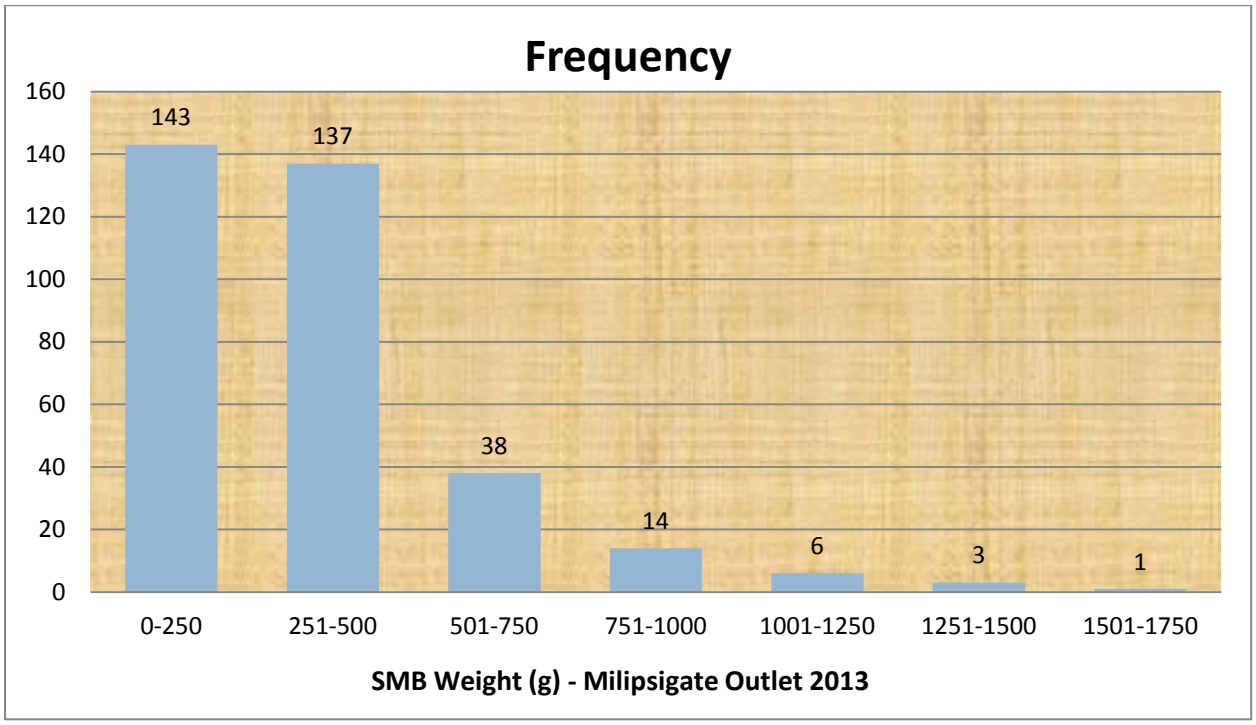


**Figure 22**: Weight distribution of all SMB angled in the Milipsigate Outlet in 2013.

## Smallmouth Bass Biological Study

A total of 552 smallmouth bass were retained for a biological stomach content analysis. This total includes 502 (of the 516) SMB angled during the CPUE survey, 18 caught in the fishway, 3 caught in fyke nets deployed in Milipsigate Lake and Weagle's Dam Outlet, 5 caught in the RST, and 24 caught in the trap net deployed at the base of Milipsigate Dam.

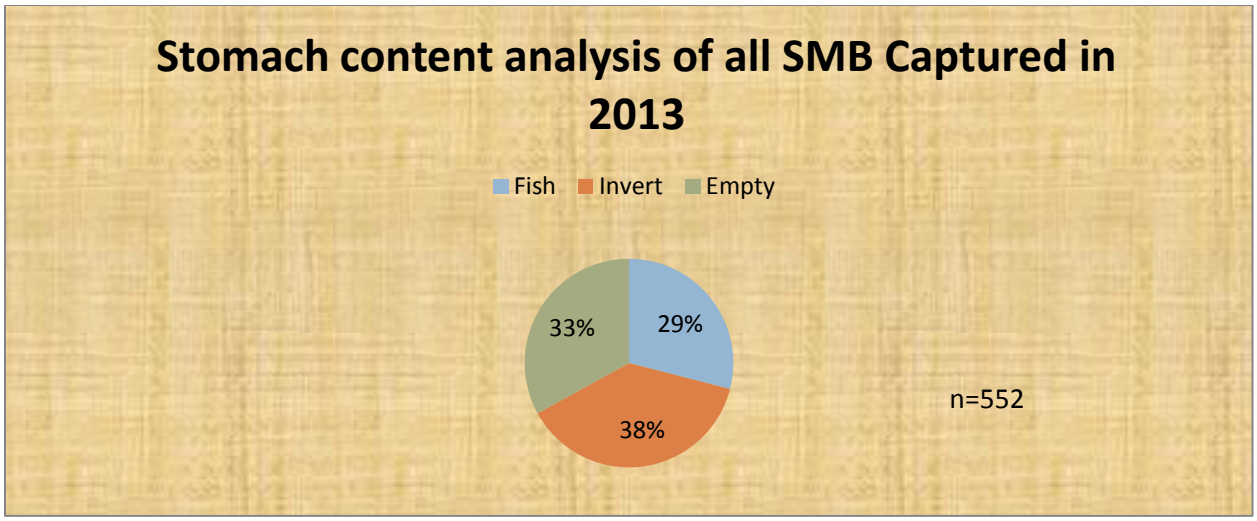


**Figure 23**: Stomach content analysis of 552 SMB captured in 2013 from all locations.

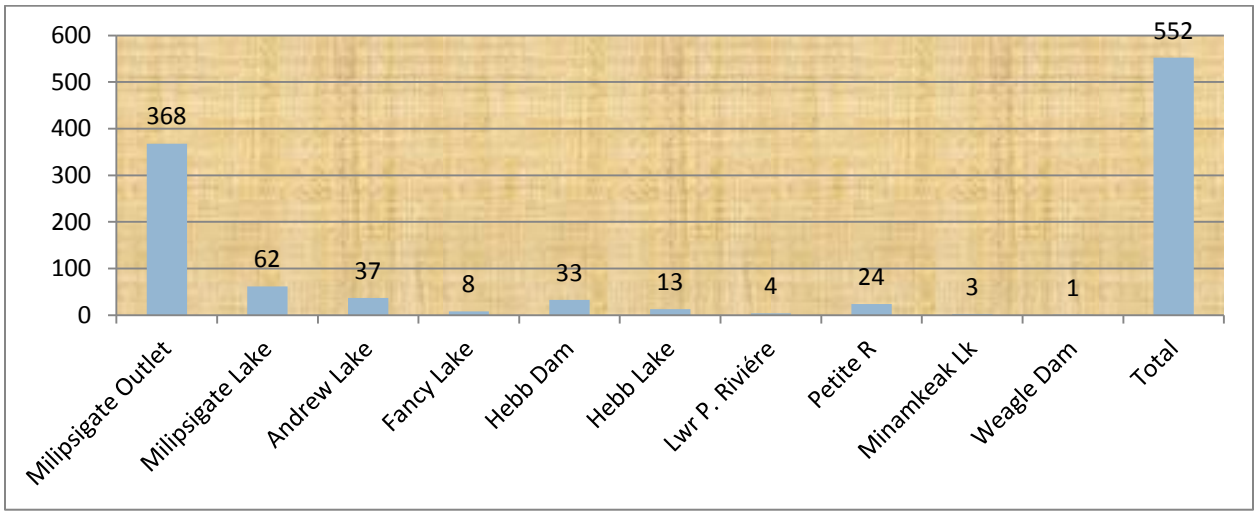


**Figure 24**: Indicates the location and total number of SMB captured in 2013.

This stomach content report concentrates on the analysis at Milipsigate Outlet between May and September 2013. This includes all fish that were angled as well as those caught in the trap net located at the base of Milipsigate Dam.

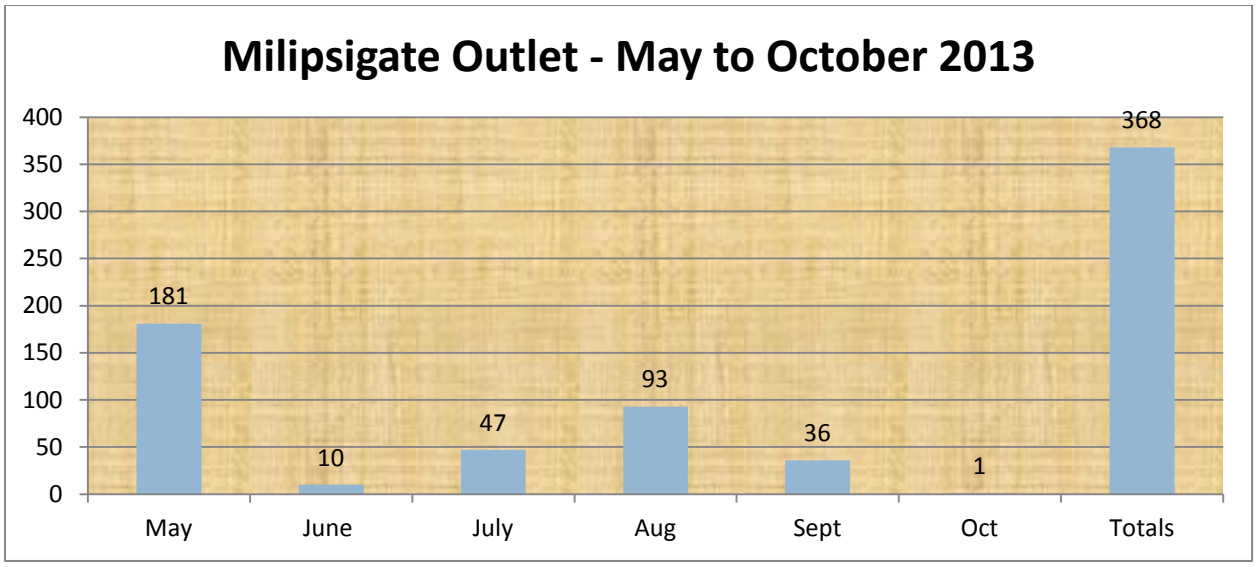


**Figure 25**: The total numbers of fish analysed in the stomach content survey caught in the Milipsigate Outlet.

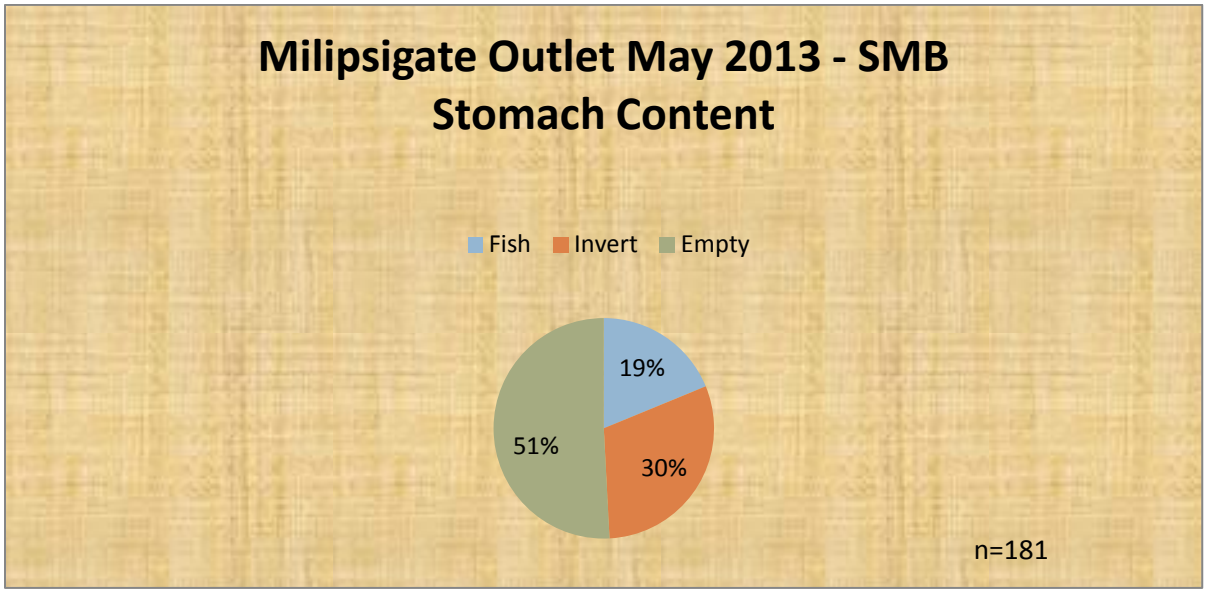


**Figure 26**: Stomach content of 181 SMB captured in May 2013 in the Milipsigate Outlet.

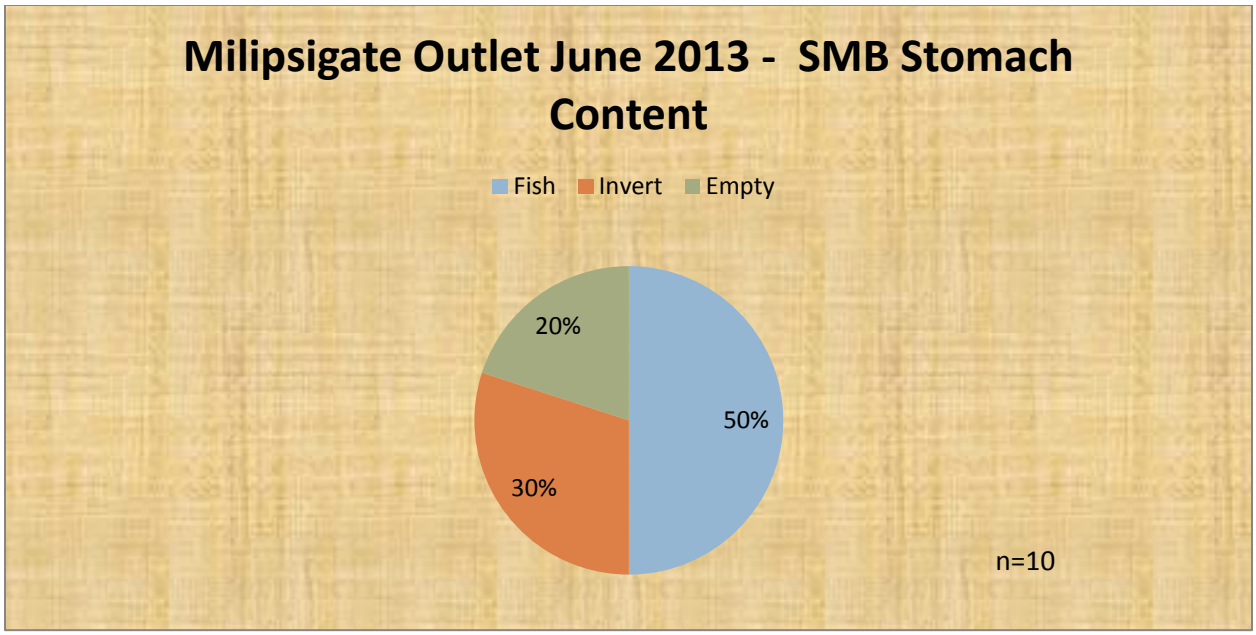


**Figure 27**: Stomach content of 10 SMB captured in June 2013 in the Milipsigate Outlet.

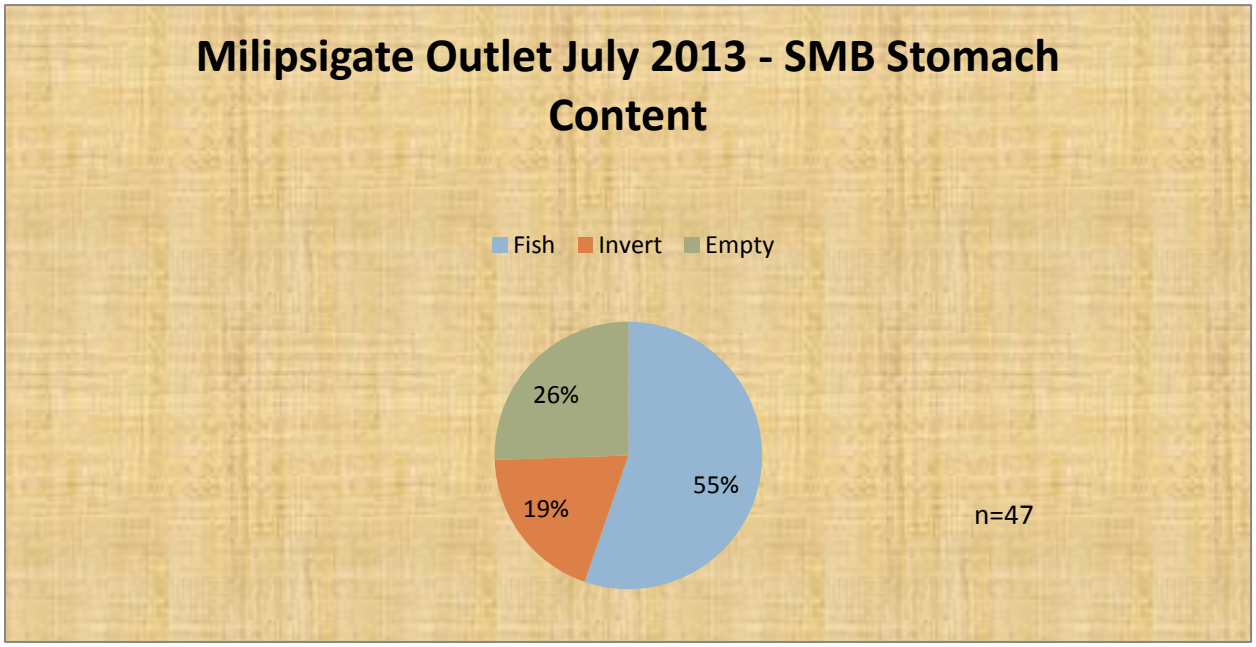


**Figure 28**: Stomach content of 47 SMB captured in July 2013 in the Milipsigate Outlet.

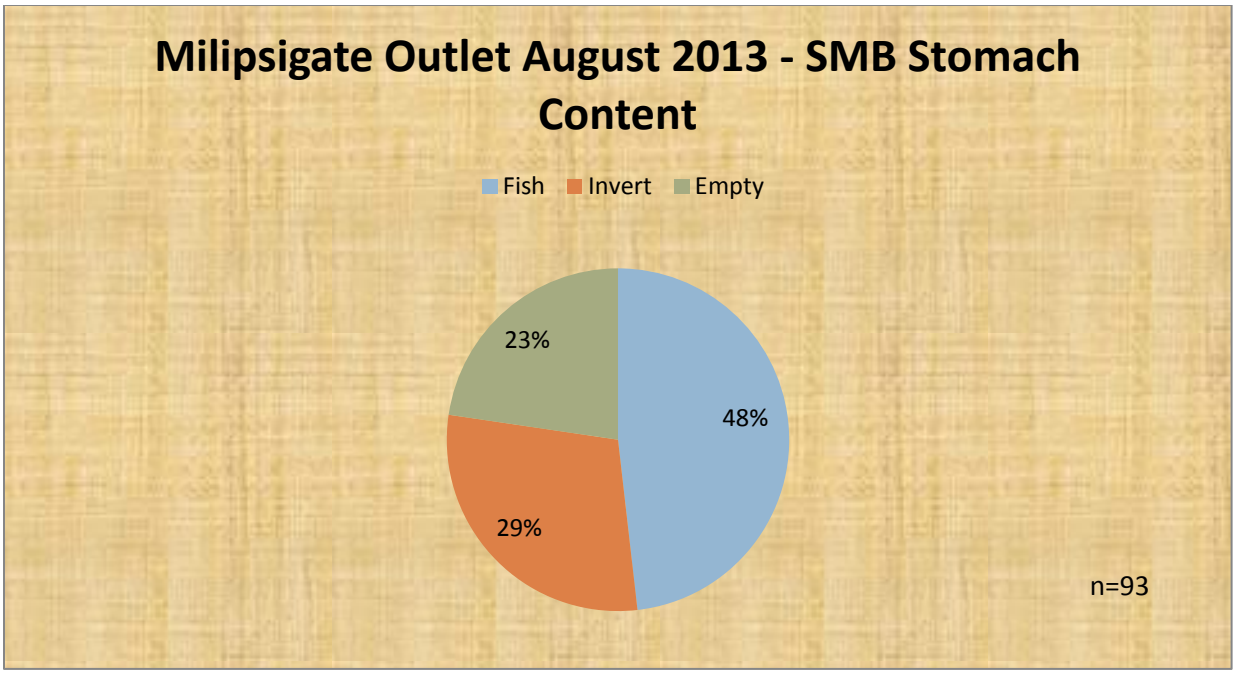


**Figure 29**: Stomach content of 93 SMB captured in August 2013 in the Milipsigate Outlet.

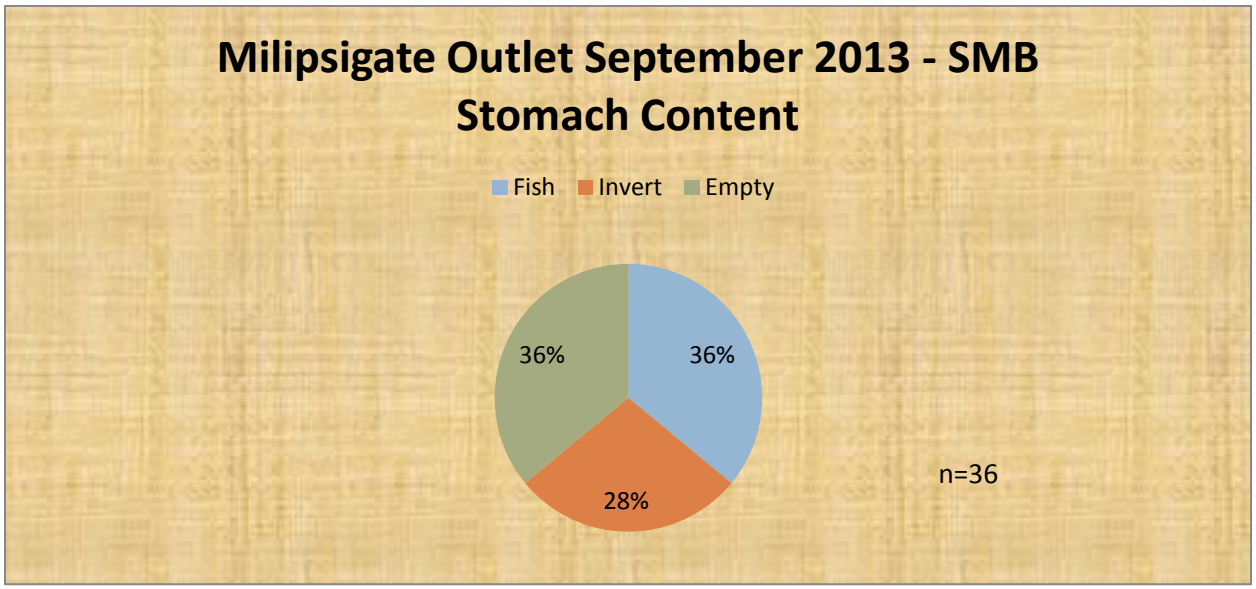


**Figure 30**: Stomach content of 36 SMB captured in September 2013 in the Milipsigate Outlet.

## Chain Pickerel Biological Study

A total of 28 chain pickerel were removed by angling, eel pots, and fyke nets between May 14, 2013 and October 7, 2013. In addition, another 32 chain pickerel were removed from Milipsigate Lake during boat

electrofishing operations; however, there will be no other discussion of the 2013 boat electrofishing activities in this report.

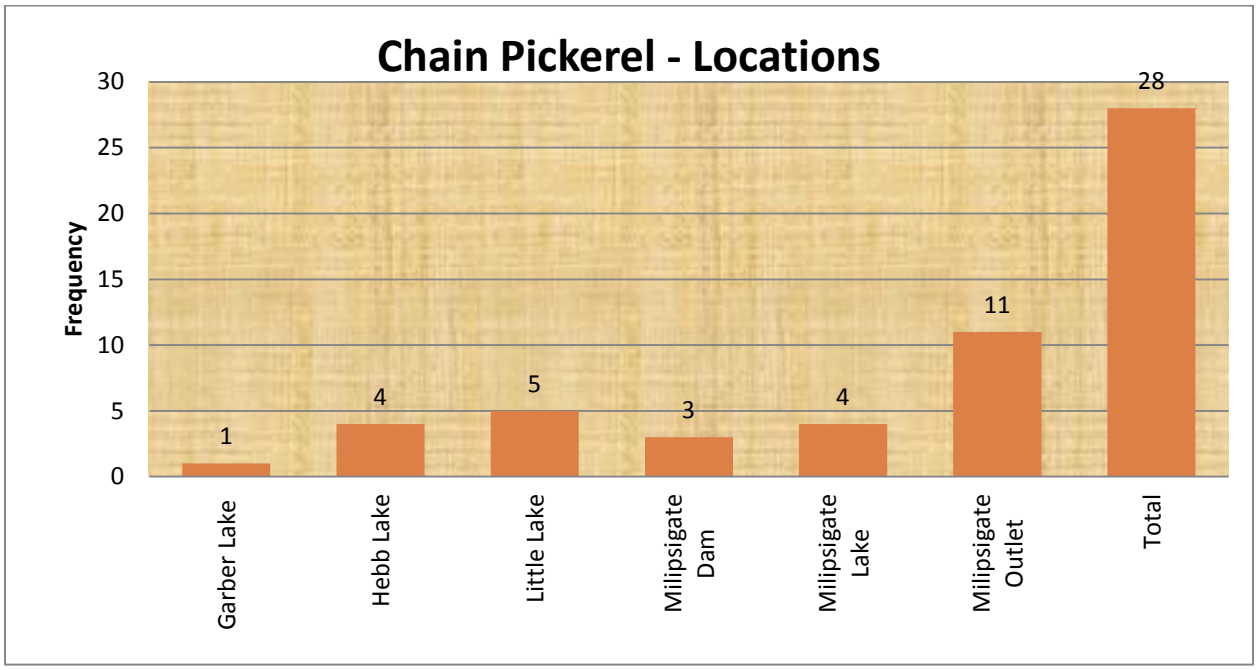


**Figure 31**: Location and abundance of chain pickerel caught by angling, eel pots, and fyke net in 2013.

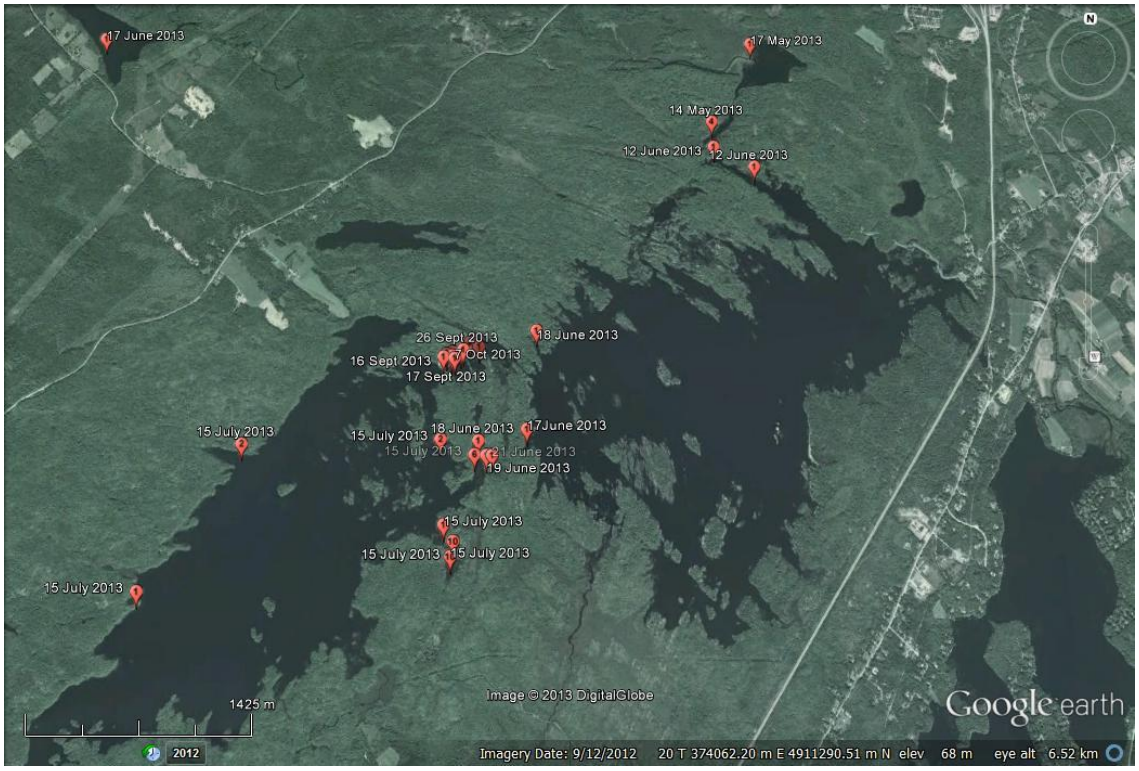


**Figure 32**: This aerial photo shows the location of all chain pickerel caught in 2013.

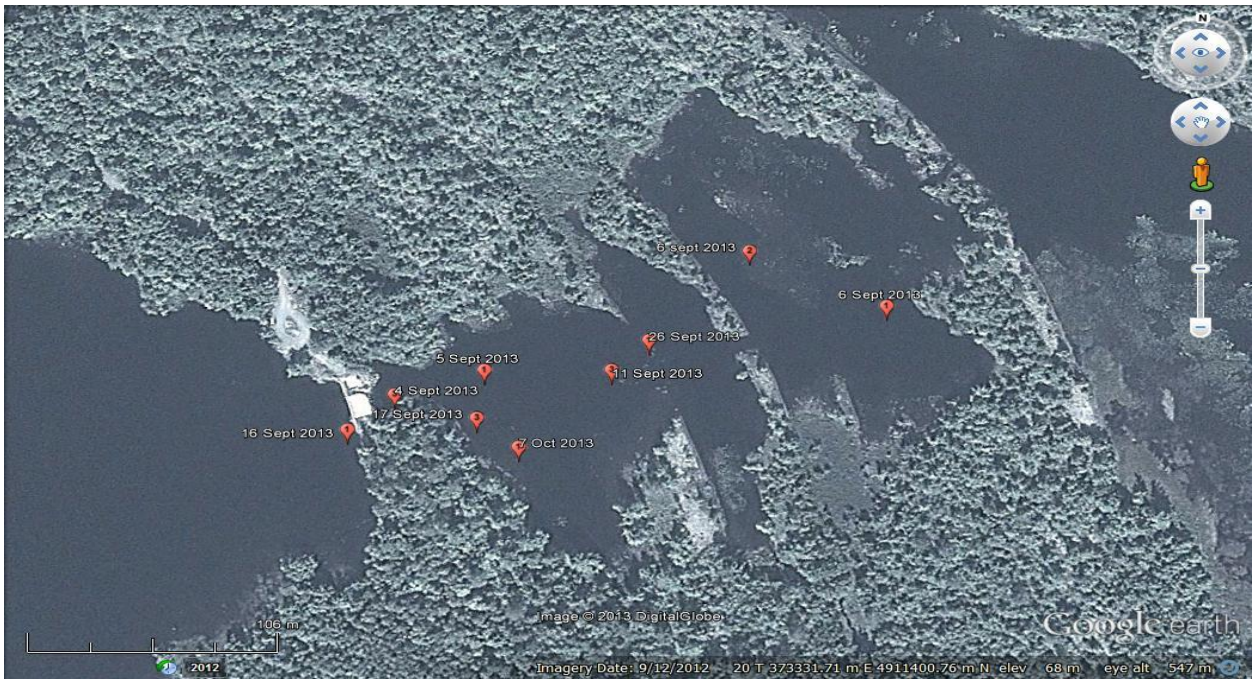


**Figure 33**: Chain pickerel caught in the Milipsigate Outlet.

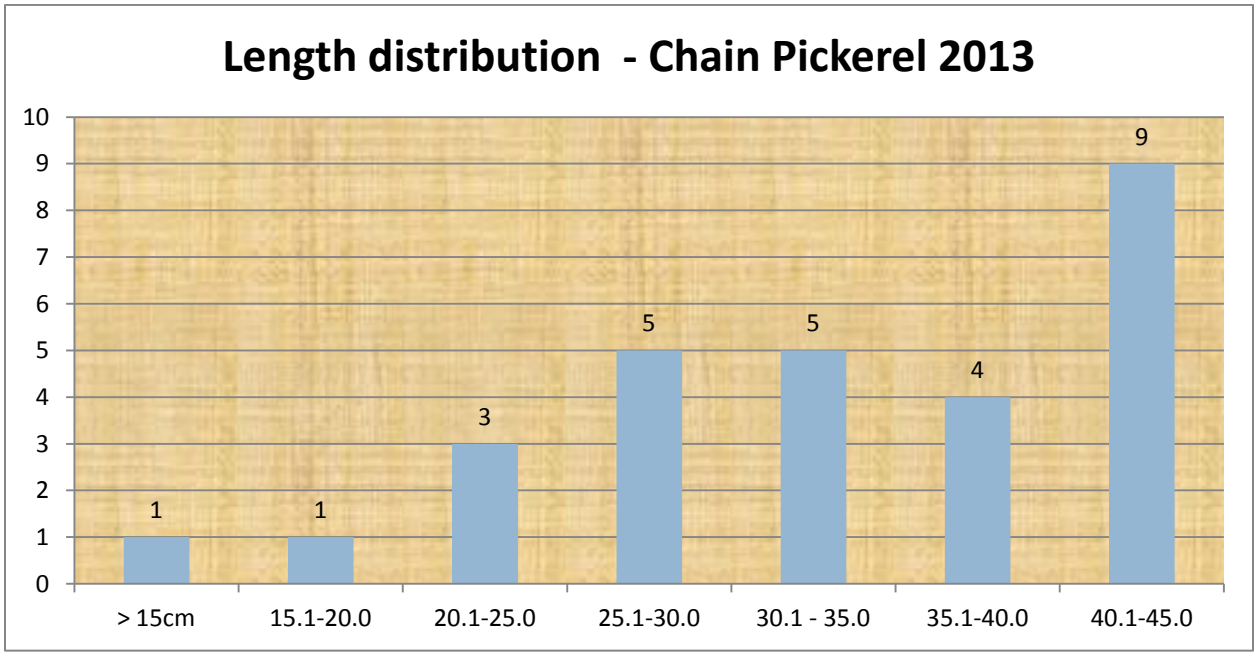


**Figure 34**: Length distribution of chain pickerel captured during 2013.

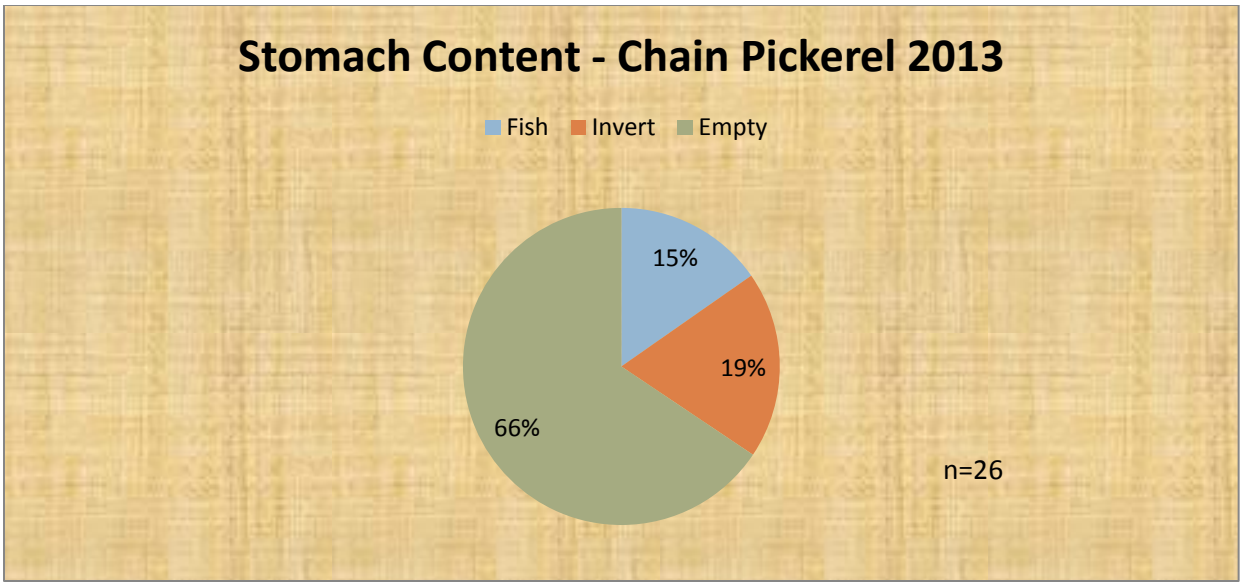


**Figure 35**: Stomach content of 26 chain pickerel captured in 2013. (Note: 2 chain pickerel captured were not sampled).

## Smallmouth Bass - Age determination

Scale samples were used to age 121 SMB caught in Milipsigate Outlet in2013. The graph below plots age against weight of SMB in the Petite Watershed.

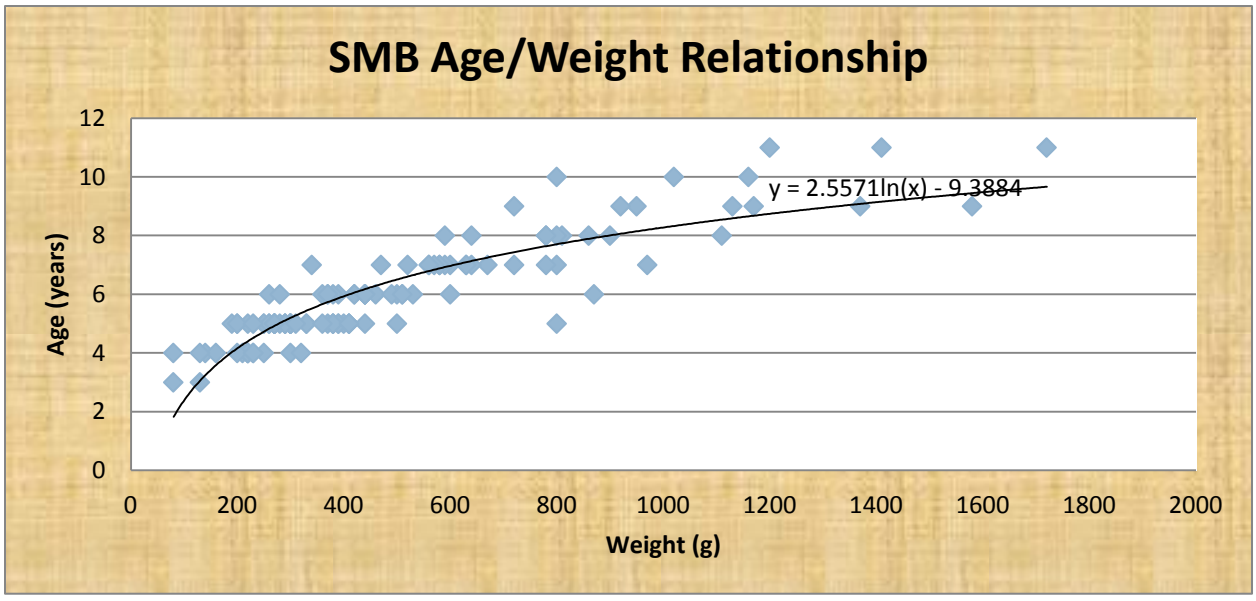


**Figure 36**: Smallmouth bass age / weight relationship.

### Smallmouth Bass – Fecundity Study

The graph below shows the relationship between SMB weight and fecundity in SMB from the Petite Watershed. In total, 39 fish were sampled between May 13, 2013 and June 4, 2013.

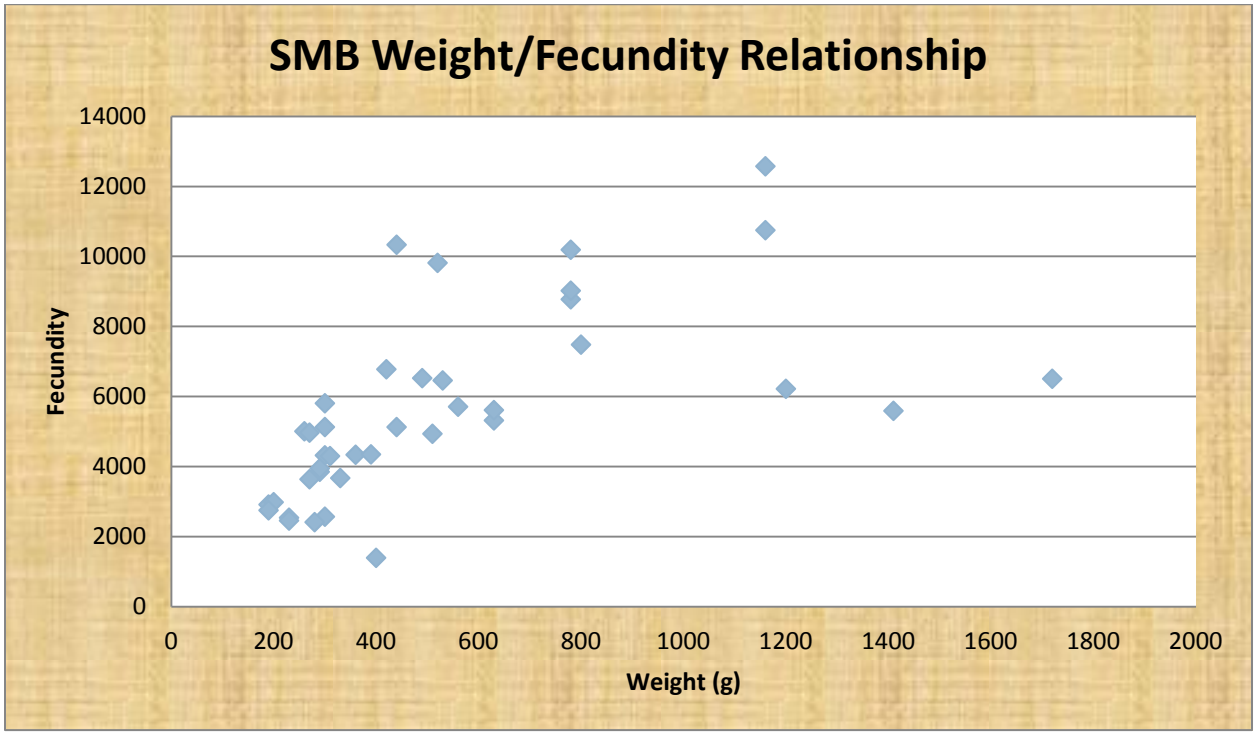


**Figure 37**: Smallmouth bass weight / fecundity relationship.

## Rotary Screw Trap Study

A rotary screw trap (RST) was deployed in the Petite Riviére between April 9, 2013 and June 27, 2013. Over that time period, 1469 total fish were captured including 14 different species. The most abundant fish captured was the American eel (1020) individuals, followed by white sucker, white perch, and alewife. Unlike the RST study from 2012, the Hebb Lake Dam Fish Passage Facility was open to allow upstream migration for certain species in 2013. (See Appendix 1: 2013 Hebb Dam Monitoring Protocol for details).

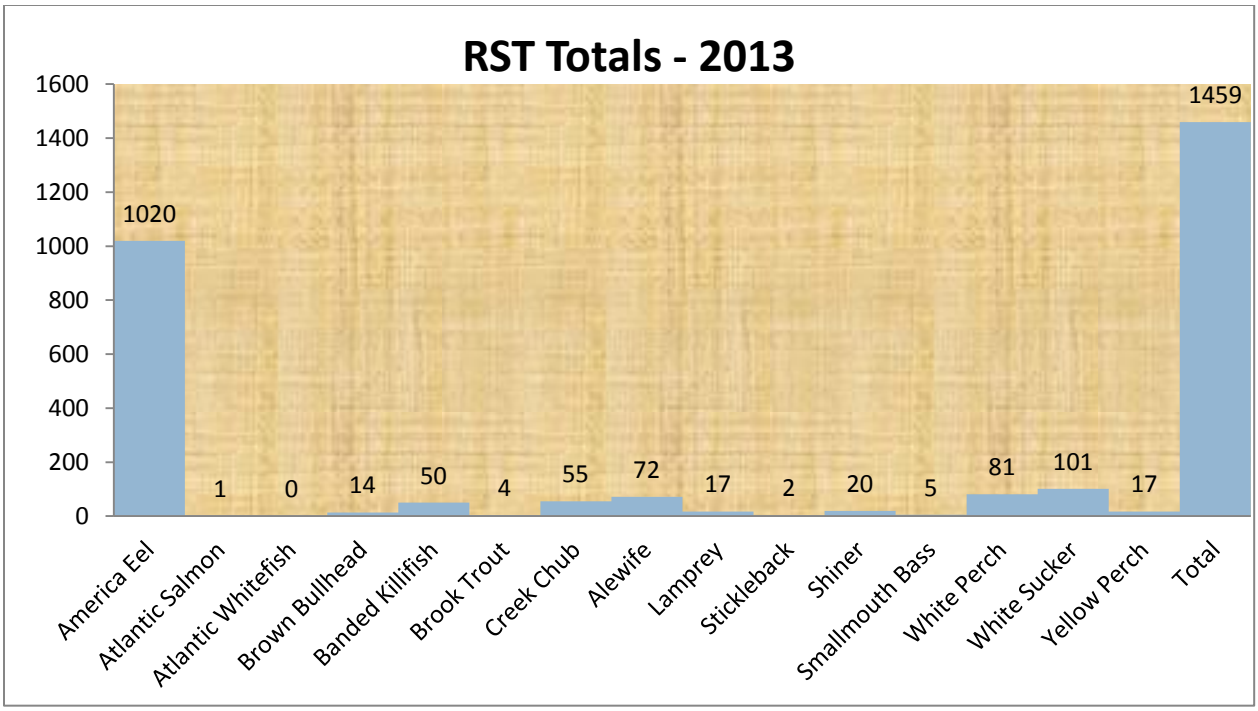


**Figure 38**: RST totals for 2013.

The majority of the fish captured in the RST came in two separate time periods; the first between May 11, 2013 and May 13, 2013 and the second between June 5, 2013 and June 11, 2013.

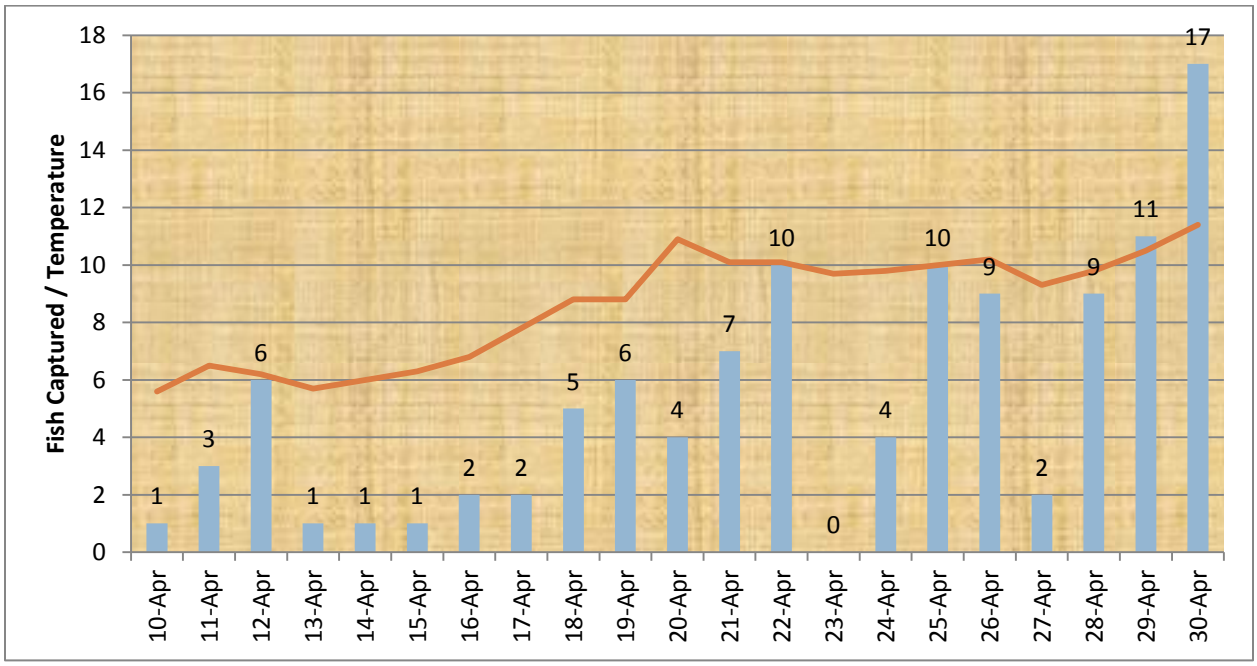


**Figure 39**: Fish captured and water temperatures - Petite Riviére RST, April 2013.

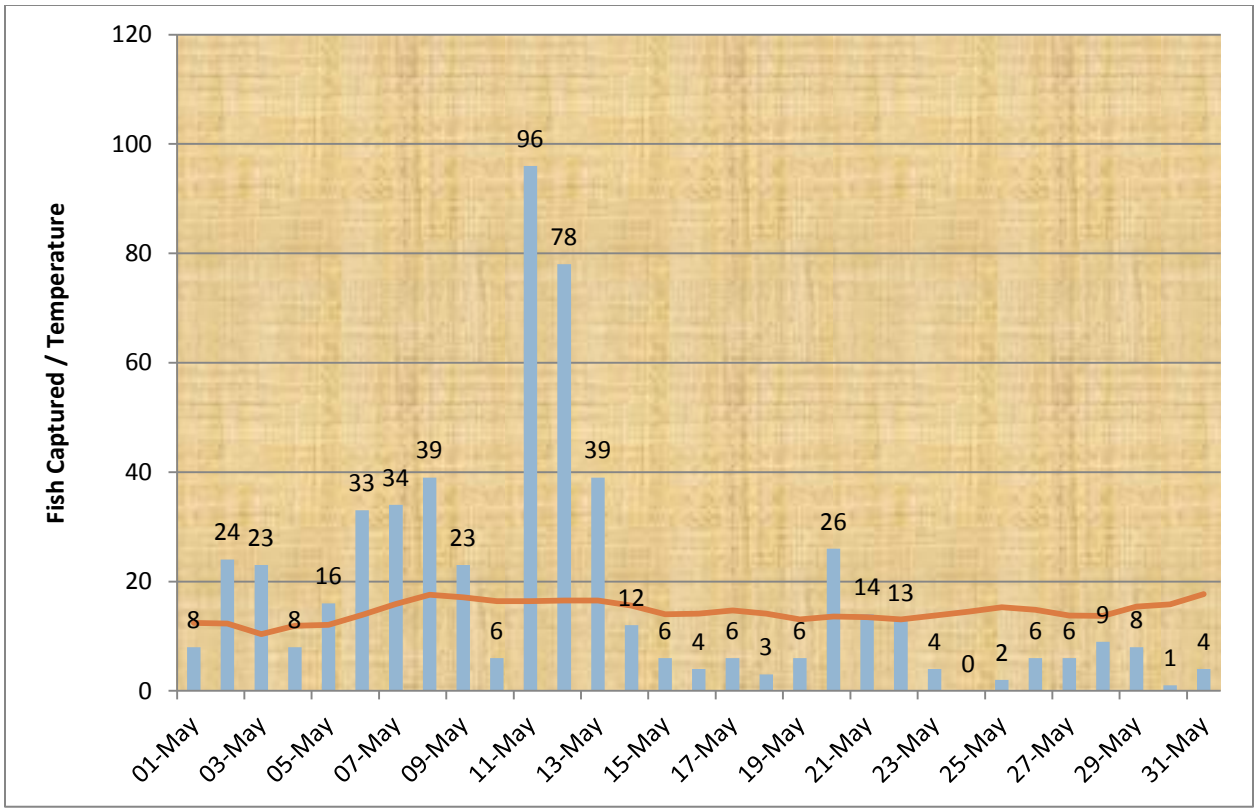


**Figure 40**: Fish captured and water temperatures - Petite Riviére RST, May 2013.

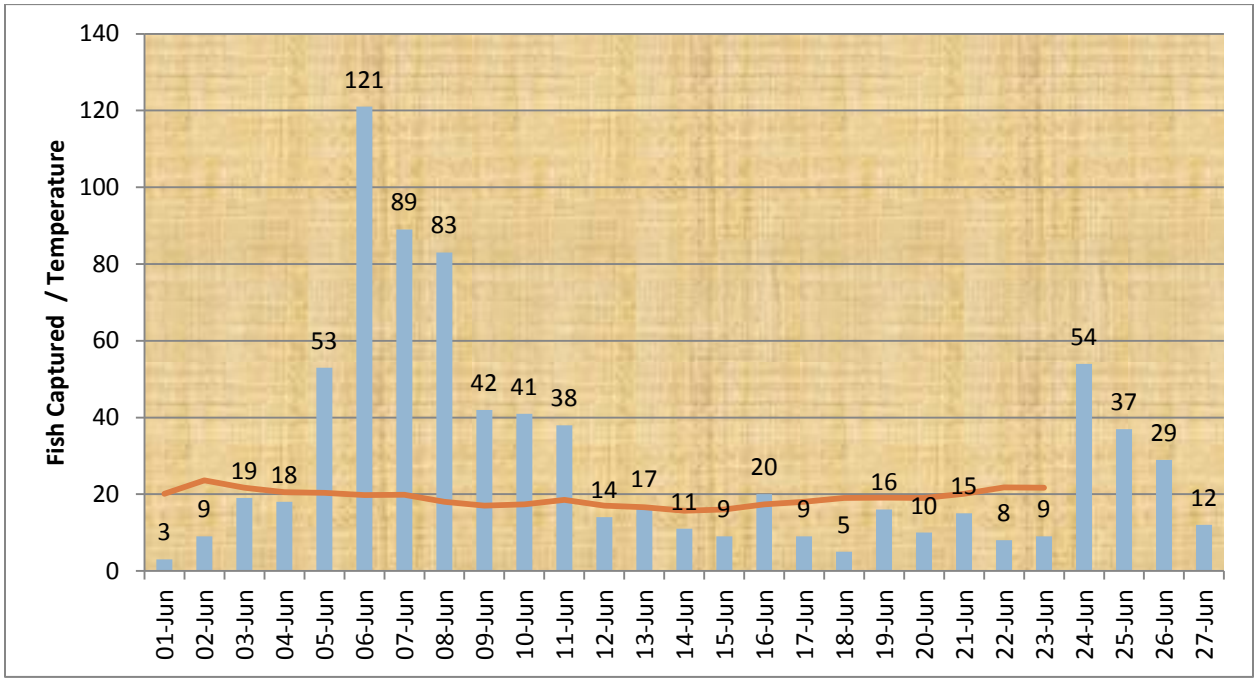


**Figure 41**: Fish captured and water temperatures - Petite Riviére RST, June 2013.

Although no Atlantic whitefish were caught in the RST in 2013, there were some species of interest captured.

**Table 5**: RST species of interest.

| Species | Fork length (cm) | Date caught | Water temperature (°C) |
|---|---|---|---|
| **Atlantic salmon** | 68.5 | June 22, 2013 | 21.8 |
| **Brook trout** | 23.4 | April 22, 2013 | 10.1 |
| **Brook trout** | 28.5 | April 25, 2013 | 10.0 |
| **Brook trout** | 25.1 | May 11, 2013 | 16.4 |
| **Brook trout** | 21.1 | June 4, 2013 | 20.5 |

**Figure 42**: Brook trout (23.4 cm) caught on April 22, 2013.

**Figure 43**: White sucker (41.5 cm) caught on May 19, 2013.

**Figure 44**: White perch (21.0 cm) caught on May 27, 2013.

**Figure 45**: Smallmouth bass (46.0 cm) caught on May 29, 2013.

**Figure 46**: Atlantic salmon (68.5 cm) caught on June 22, 2013.

## Milipsigate Dam/Minamkeak Lake Trap Net

### Milipsigate Dam Trap Net

The Milipsigate Dam trap net was fished on May 30, May 31, June 10, and June 13 for a total of 36 hours.

**Table 6**: Total numbers of fish captured in Milipsigate Dam trap net between May 30, 2013 and June 13, 2013.

| Species | American Eel | Creek Chub | Alewife | Smallmouth Bass | White Perch | White Sucker |
|---|---|---|---|---|---|---|
| **Number of fish caught** | 2 | 1 | 95 | 24 | 372 | 353 |

### Minamkeak Lake Trap Net

Two trap nets were fished on Minamkeak Lake from September 30 to October 30, 2013. Trap net 1, with a 10-ft net was fished for the entire time period; however, trap net 2, with a 15-ft net was fished from October 7 to October 30, 2013. The traps were not fished during the weekends. During this time period the traps caught a total of 305 fish, 50 fish in trap net 1 and 255 fish in trap net 2. Trap net 1 was set for a total time of 429.25 hours and trap net 2 was set for a total time of 337.5 hours.

**Table 7**: Minamkeak Lake trap net 1 totals.

| Species | Brown Bullhead | White Perch |
|---|---|---|
| **Number of fish caught** | 1 | 49 |

**Table 8**: Minamkeak Lake trap net 2 totals.

| Species | American Eel | Brown Bullhead | White Perch | White Sucker |
|---|---|---|---|---|
| **Number of fish caught** | 1 | 2 | 251 | 1 |

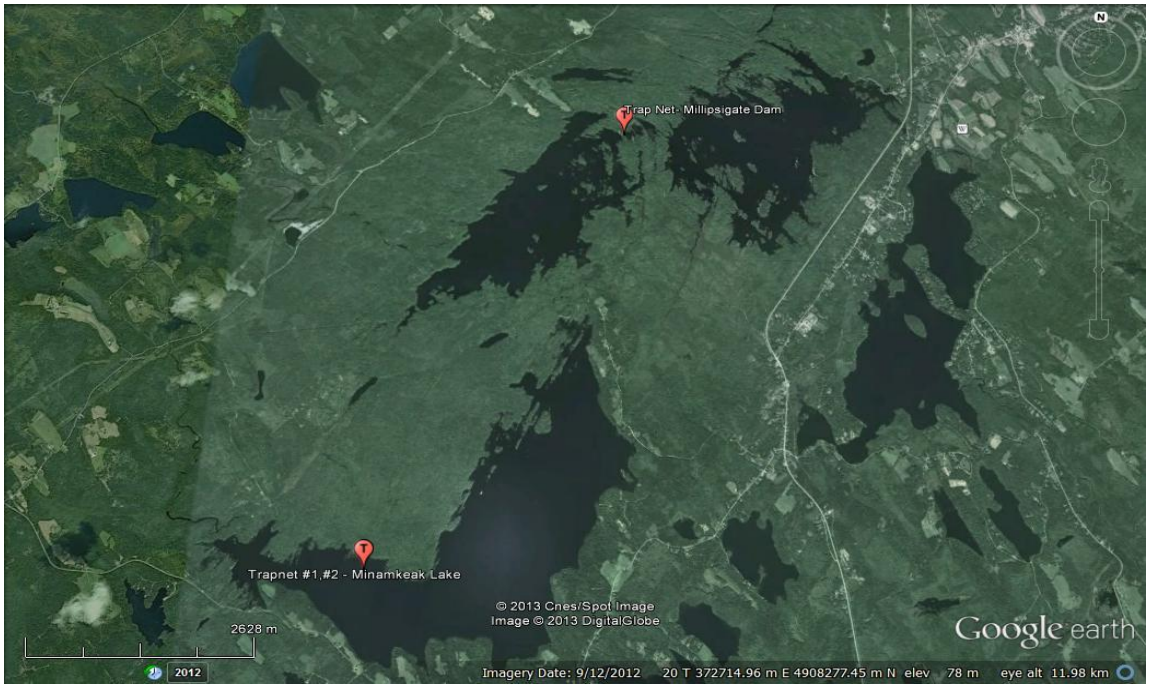


**Figure 47**: Aerial view of Milipsigate Dam and Minamkeak Lake trap nets.

## Hebb Lake Dam Fish Health Collections

Brook trout were collected from the Petite Rivière watershed as part of the required fish health screening prior to the opening of the Hebb Lake Dam Fish Passage Facility in 2013. A total of 57 trout were collected from the watershed, 27 from below Hebb Dam and 30 from above Hebb Dam. All trout were analysed and tested for disease and parasites. All of the fish tested were confirmed healthy. Other species observed during the electrofishing operations included white sucker, yellow perch, Atlantic salmon parr, American eel, smallmouth bass, and brown bullhead.

**Table 9**: Data obtained from the fish health collections prior to the opening of the Hebb Lake Dam Fish Passage Facility.

| | Location | Date | Water Temperature (°C) | Adult Brook Trout | Juvenile Brook Trout | Total |
|---|---|---|---|---|---|---|
| **Above Hebb Lake Dam** | Wildcat Brook | April 22, 2013 | n/a | 13 | 2 | 15 |
| | Sarty Brook | April 22, 2013 | n/a | 1 | 0 | 1 |
| | U/S Newcombeville Lake | April 22, 2013 | n/a | 3 | 0 | 3 |
| | D/S Newcombeville Lake | April 22, 2013 | n/a | 11 | 0 | 11 |
| **Below Hebb Lake Dam** | Trib of Brown Branch Brook | April 15, 2013 | 6.0 | 1 | 3 | 4 |
| | Brown Branch Brook | April 16, 2013 | 6.5 | 5 | 0 | 5 |
| | Trib of Branch Lake | April 16, 2013 | 6.5 | 4 | 0 | 4 |
| | D/S Fitch Lake | April 17, 2013 | 7.0 | 2 | 0 | 2 |
| | U/S Publicover Lake | April 17, 2013 | 7.0 | 2 | 0 | 2 |
| | Brown Branch Brook | April 23, 2013 | 9.1 | 3 | 4 | 7 |
| | Trib of Brown Branch Brook | April 23, 2013 | 9.1 | 0 | 2 | 2 |
| | RST | April 22, 2013 | 10.1 | 1 | 0 | 1 |

## Weagle's Dam Fyke Net

The Weagle's dam fyke net was deployed from April 10 to May 9, 2013. During this deployment, the fyke net caught a total of 89 fish consisting of 10 different species and was fished for a total of 816 hours. No Atlantic whitefish were caught in this trap. The most common species caught was white perch (50), followed by yellow perch (25).

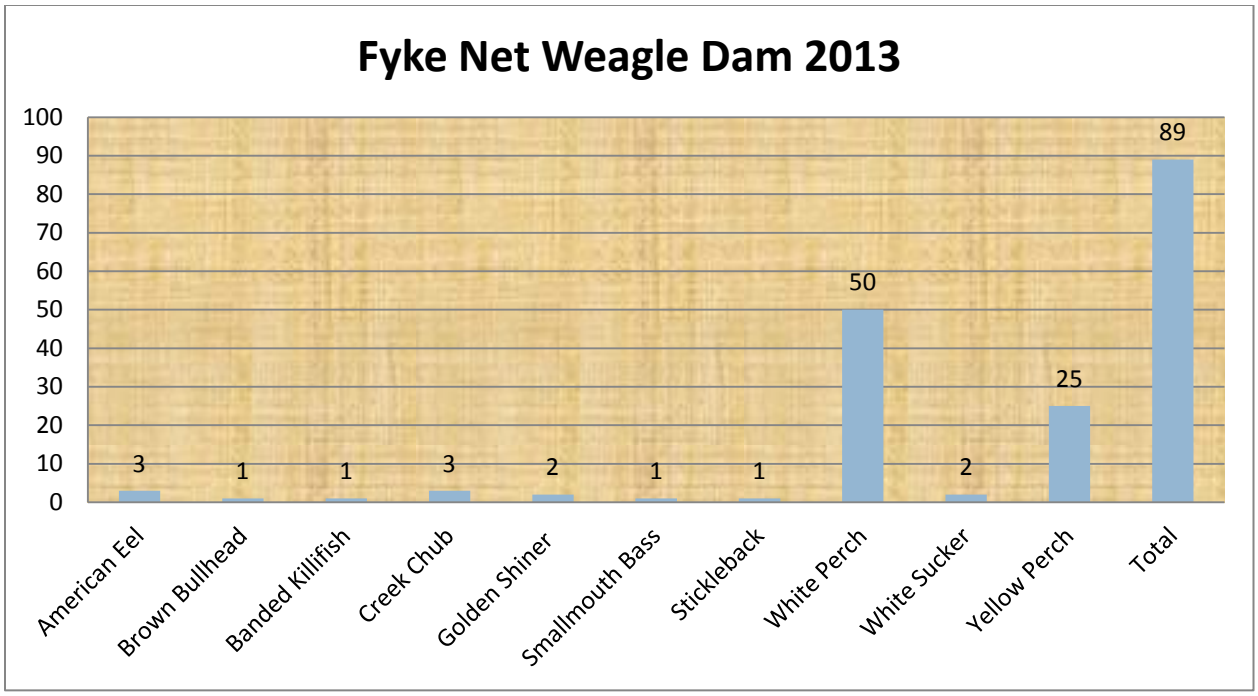


**Figure 48**: Total fish caught in Weagle's Dam fyke net.

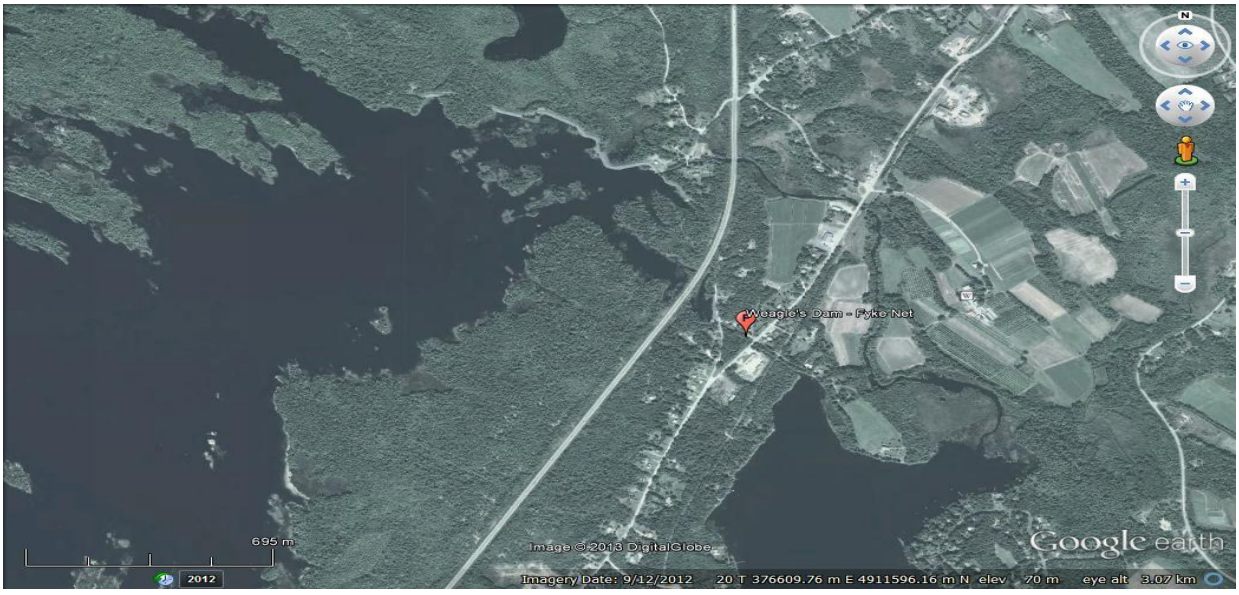


**Figure 49**: Aerial view of location of Weagle's Dam fyke net.

## Milipsigate Lake Overflow Channel Fyke Net

The Milipsigate Lake Overflow Channel fyke net was deployed from June 17 to June 21, 2013. During this time period, the fyke net caught a total of 7 fish including 2 smallmouth bass and 2 chain pickerel, both invasive

species. In addition, an alewife was captured thus indicating that the overflow channel was accessible and provided upstream passage for a significant part of the year.


**Figure 50**: Aerial view of location of Milipsigate Lake Overflow Channel fyke net.

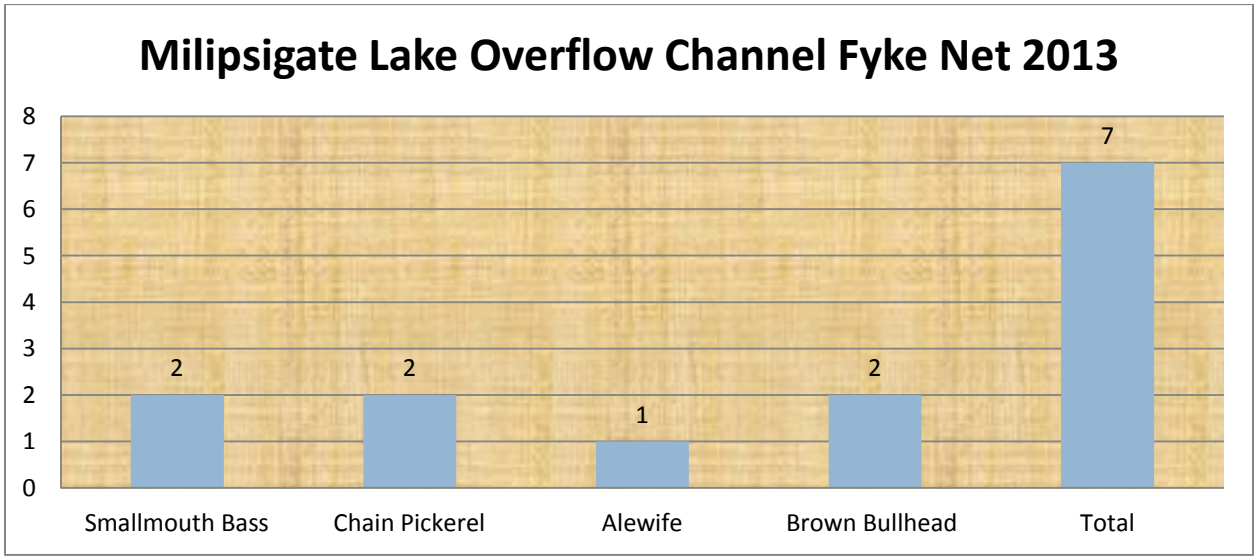


**Figure 51**: Fish caught in Milipsigate Lake Overflow Channel fyke net.

## Eel/Minnow Pot Deployment – Hebb Lake

Eel and minnow pots were deployed in Hebb Lake and Milipsigate Outlet from June 10 to June 19, 2013.

**Table 10**: Fish caught in pots at the Pinch Gut, June 12, 2013.

| Species | Chain Pickerel | Brown Bullhead | American Eel | Yellow Perch |
|---|---|---|---|---|
| **Number of fish caught** | 1 | 4 | 3 | 1 |

**Table 11**: Fish caught in pots at the Pinch Gut, June 13, 2013.

| Species | Yellow Perch |
|---|---|
| **Number of fish caught** | 1 |

**Table 12**: Fish caught in pots in the Hebb Lake Cove, June 19, 2013.

| Species | Chain Pickerel | American Eel | Yellow Perch |
|---|---|---|---|
| **Number of fish caught** | 1 | 1 | 2 |

**Table 13**: Fish caught in pots in Milipsigate Outlet, June 19, 2013.

| Species | Brown Bullhead | American Eel |
|---|---|---|
| **Number of fish caught** | 2 | 4 |

## Spring Monitoring and Sampling Activities at the Hebb Lake Dam Fish Passage Facility

The Hebb Lake Dam Fish Passage Facility monitoring trap was fished daily from May 10, 2013 to June 28, 2013. A total of 2323 fish were intercepted comprising of 8 different species. In 2013, Alewife were permitted to access the upper watershed for the first time in over 40 years, they were also the most abundant species comprising of over 91% of the catch. The Alewife spawning migration peaked between May 29, 2013 and June 4, 2013. Of the 8 species caught Alewife, American eel, creek chub, white sucker, and Brook trout were allowed to continue into Hebb Lake, the lone Shad was released downstream and all invasives were removed.

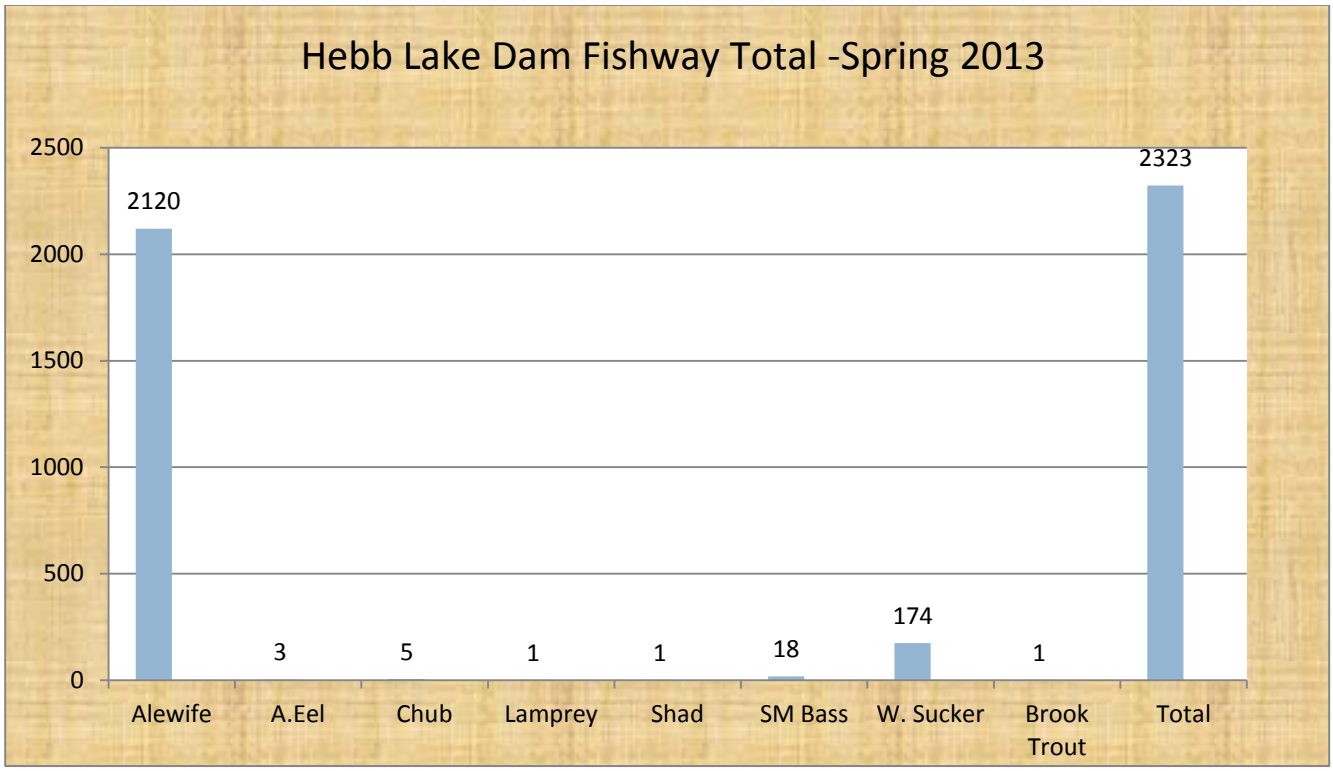


**Figure 52**: Breakdown of total fish caught in the Hebb Lake Dam Fish Passage Facility fish trap during Spring 2013 monitoring.

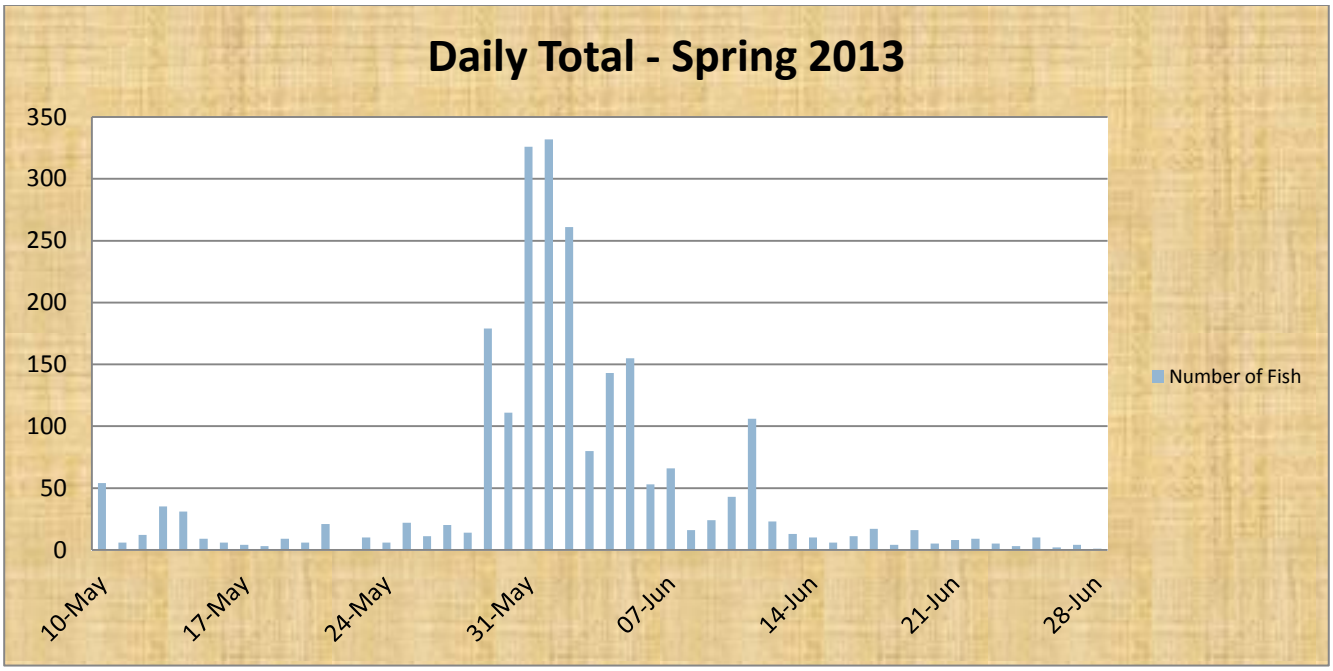


**Figure 53**: Daily totals of fish caught in the Hebb Lake Dam Fish Passage Facility fish trap during Spring 2013 monitoring.

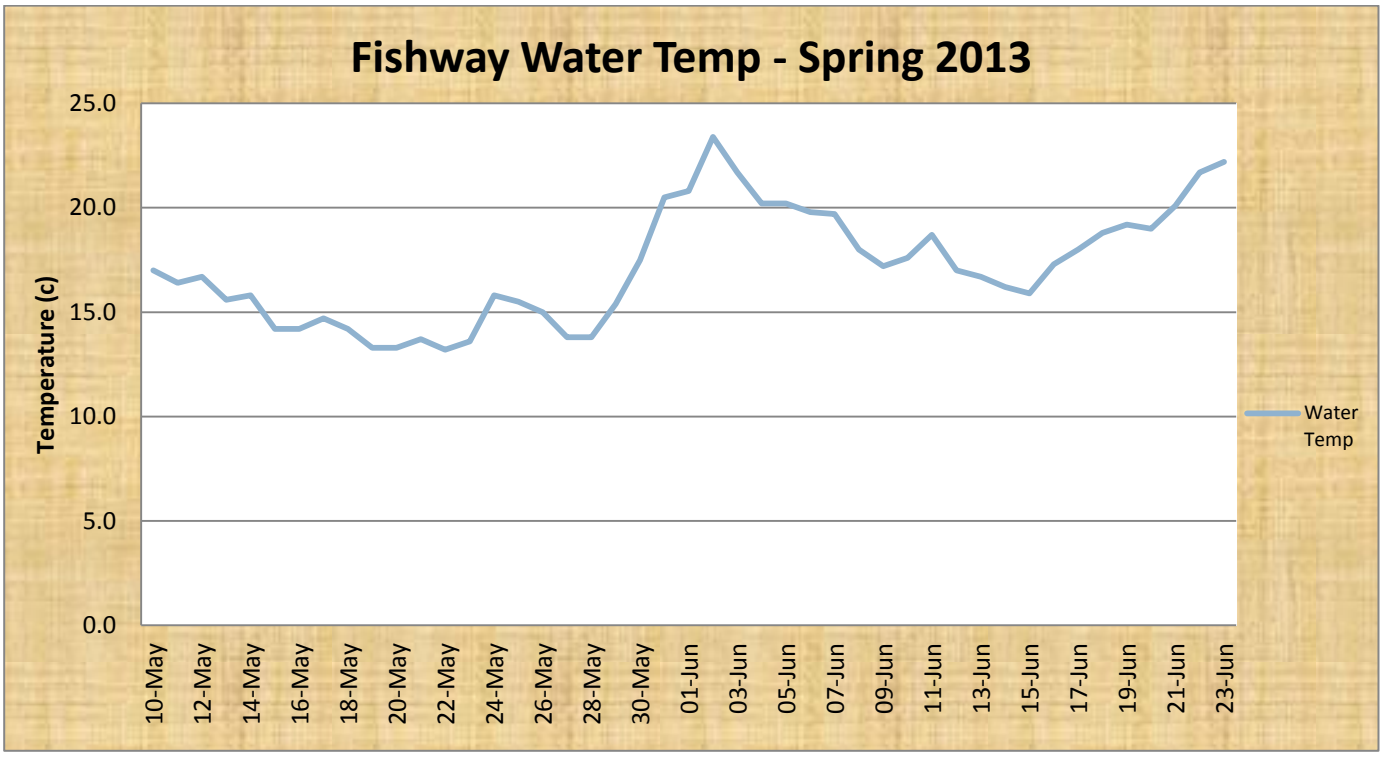


**Figure 54**: Daily water temperatures recorded at the Hebb Lake Dam Fish Passage Facility during Spring 2013 monitoring activities.

## Fall Monitoring and Sampling Activities at the Hebb Lake Dam Fish Passage Facility

The Hebb Lake Dam Fish Passage Facility monitoring trap was fished daily from October 2, 2013 to November 29, 2013. A total of 20 fish were captured at the fishway trap (18 ascending upstream and 2 descending downstream). Unfortunately, unlike 2012 no wild Atlantic whitefish were caught in the Hebb Lake Dam Fishway monitoring trap. However, in 2013, two chain pickerel were intercepted at the monitoring trap. On November 3, 2013, a 22.8 cm specimen was caught migrating upstream and two days later on November 5, 2013 a 25.5 cm specimen was caught migrating downstream (Figures 59, 60).

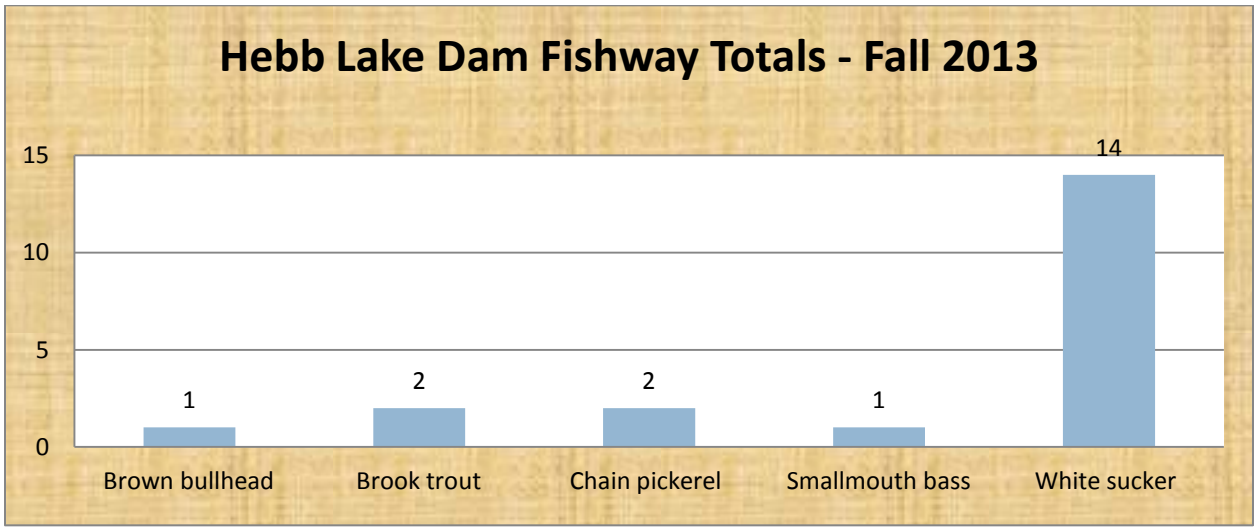


**Figure 55**: Fish caught at Hebb Lake Dam Fishway Monitoring Trap, Fall 2013.

**Table 14**: Number of species intercepted at the Hebb Lake Dam Fish Passage Facility as well as the first and last day each species was observed in the fishway.

| | Brown Bullhead | Brook Trout | Chain Pickerel | Smallmouth Bass | White Sucker |
|---|---|---|---|---|---|
| **# of fish** | 1 | 2 | 2 | 1 | 14 |
| **First Arrival** | Nov 5, 2013 | Nov 16, 2013 | Nov 3, 2013 | Oct 18, 2013 | Oct 3, 2013 |
| **Last Arrival** | Nov 5, 2013 | Nov 23, 2013 | Nov 5, 2013 | Oct 18, 2013 | Nov 6, 2013 |

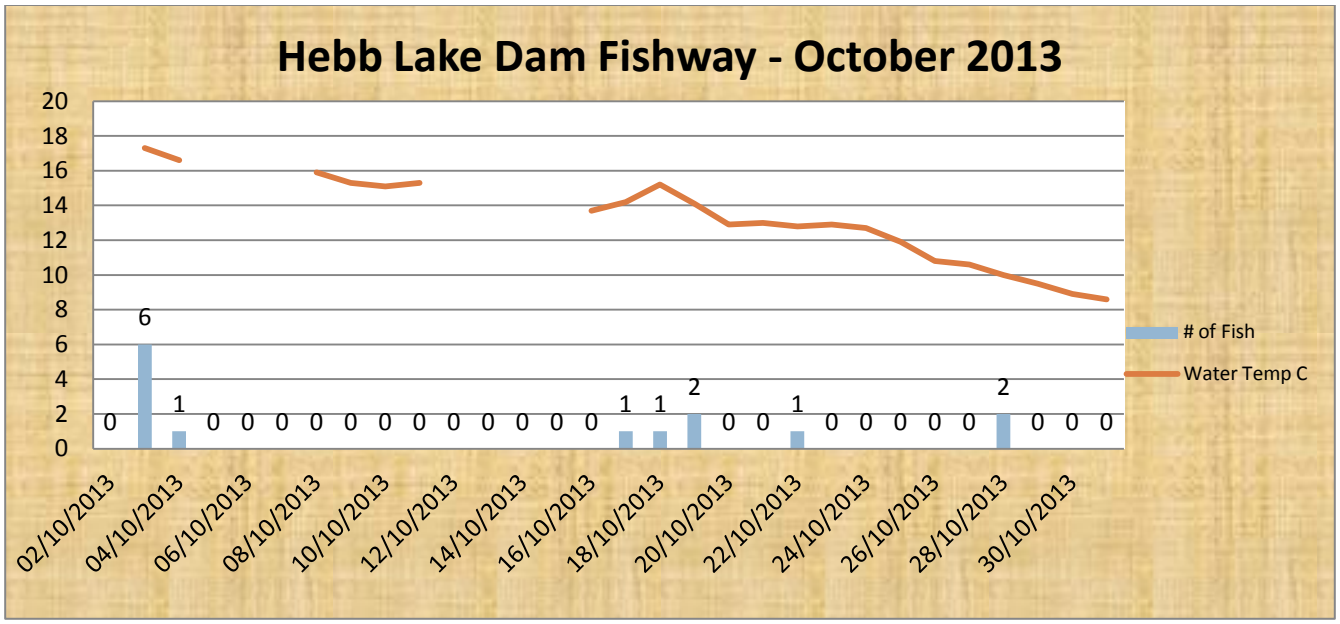


**Figure 56**: Total number of fish caught each day and water temperature, October 2013.

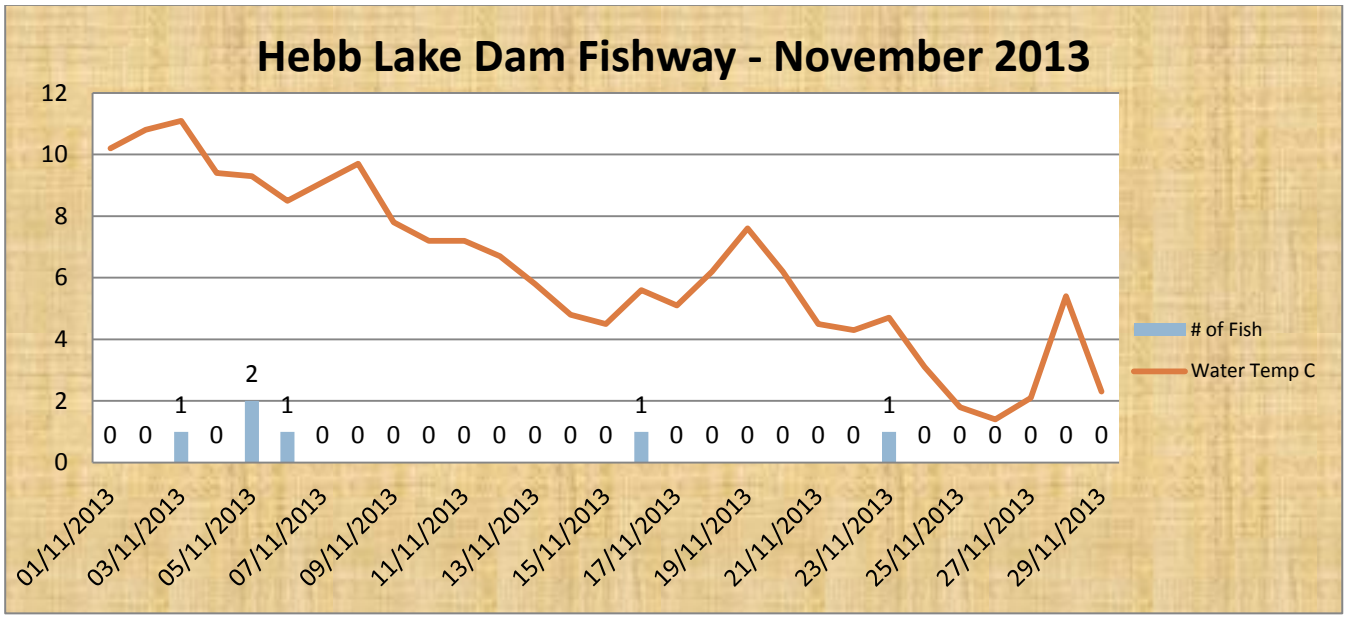


**Figure 57**: Total number of fish caught each day and water temperature, November 2013.

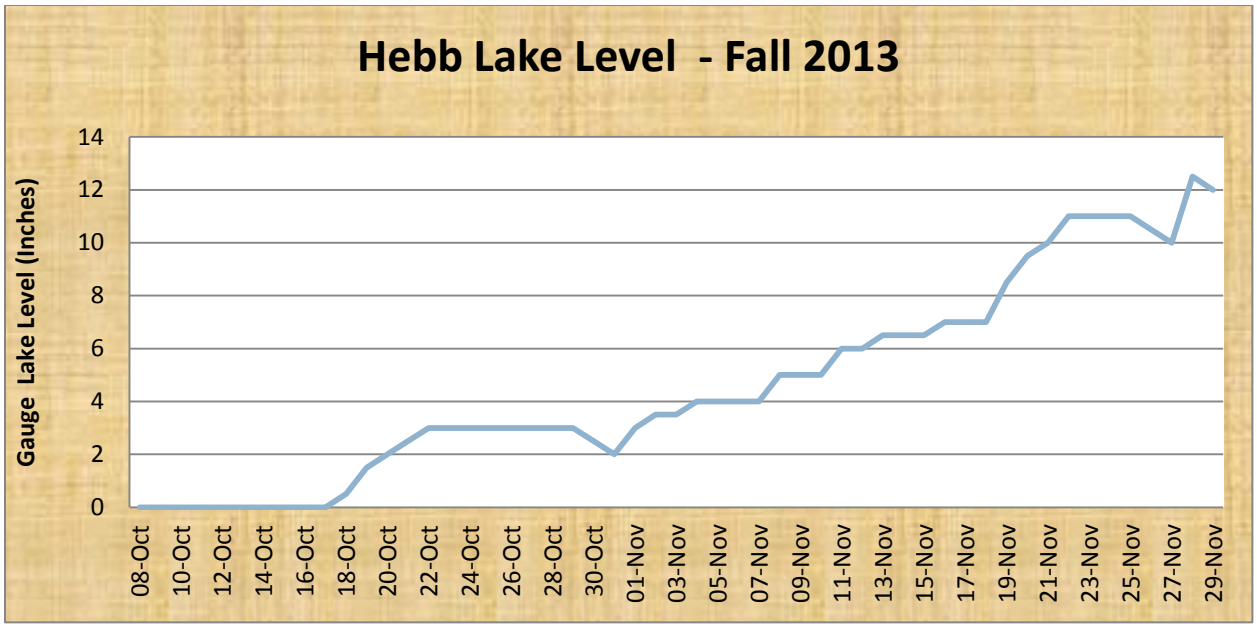


**Figure 58**: Lake level measured at Hebb Lake Dam Fishway gauge, Fall 2013.

**Figure 59**: Chain pickerel 22.8 cm caught November 3, 2013 at Hebb Lake Dam Monitoring Trap.

**Figure 60**: Chain pickerel 25.5 cm caught November 5, 2013 at Hebb Lake Dam monitoring trap. (Note: This specimen was migrating downstream and was caught on the fishway trap gate.)

## Crousetown Dam Fish Trap

The fishtrap at the Crousetown Dam was checked daily from October 8, 2013 until December 5, 2013. A total of 459 fish were caught; however, 93% of these fish were young of the year Alewife migrating downstream. The majority of fish were caught after significant rainfall events which occurred on October 17 and 27 respectively (Figure 62). The total number of fish caught per species is shown in (Figure 61). A total of 9 Atlantic salmon were caught, and interestingly at least 4 of these fish were male precocious parr. No Atlantic whitefish or Atlantic salmon adult females were caught.

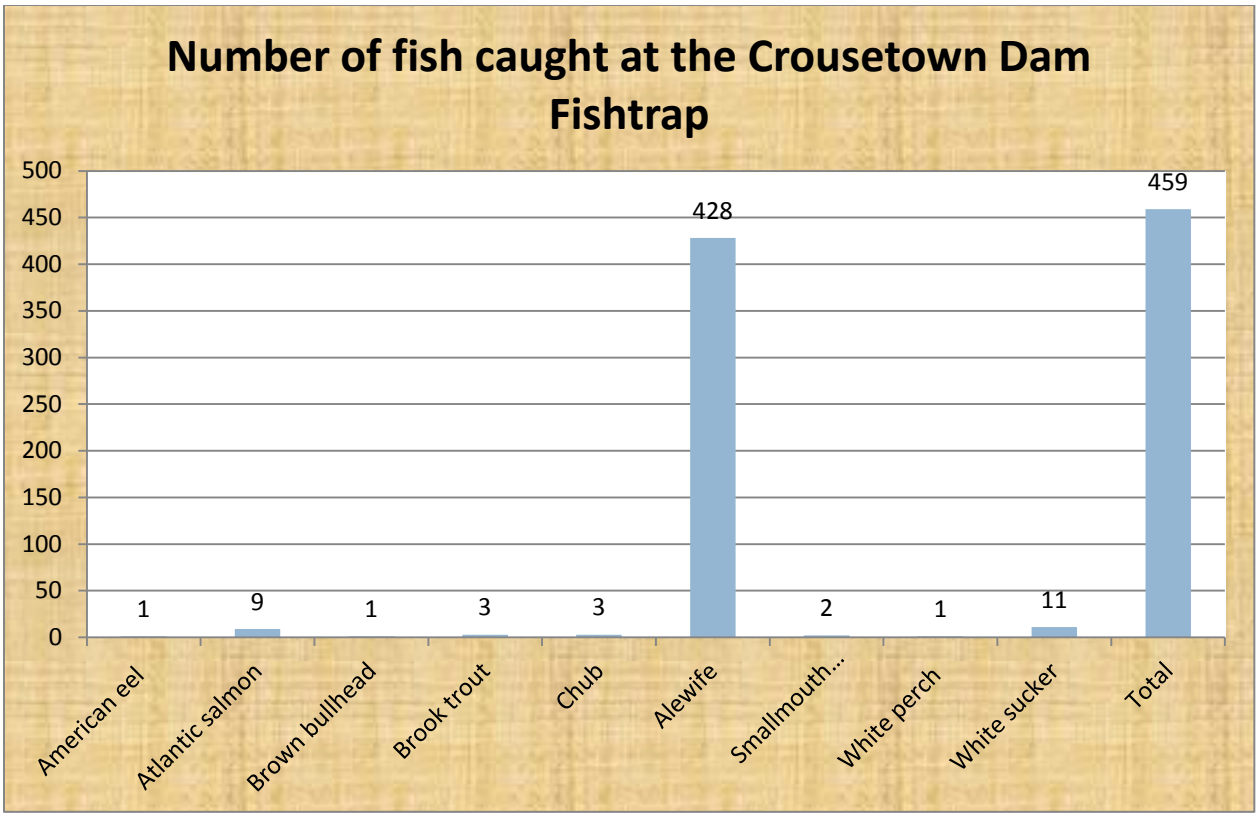


**Figure 61**: Total number of fish caught at the Crousetown Dam fishtrap.

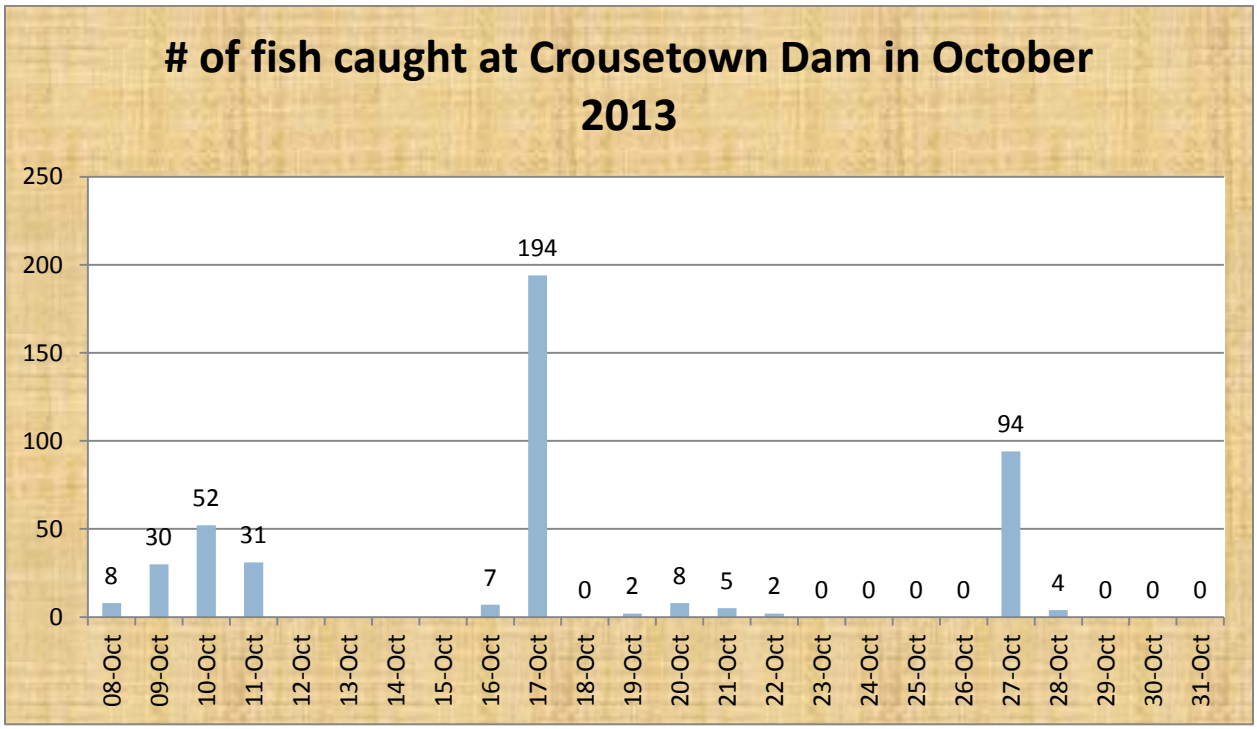


**Figure 62**: Daily fish count in October 2013 at Crousetown Dam.

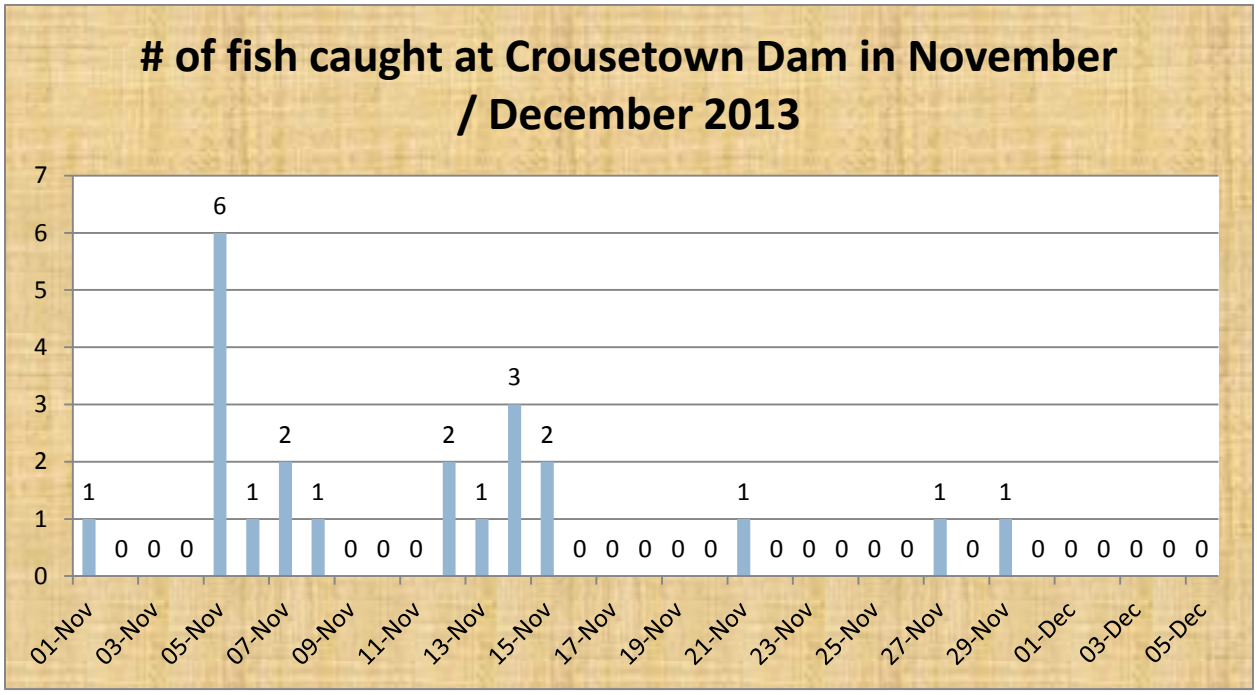


**Figure 63**: Daily fish count in November / December 2013 at Crousetown Dam.

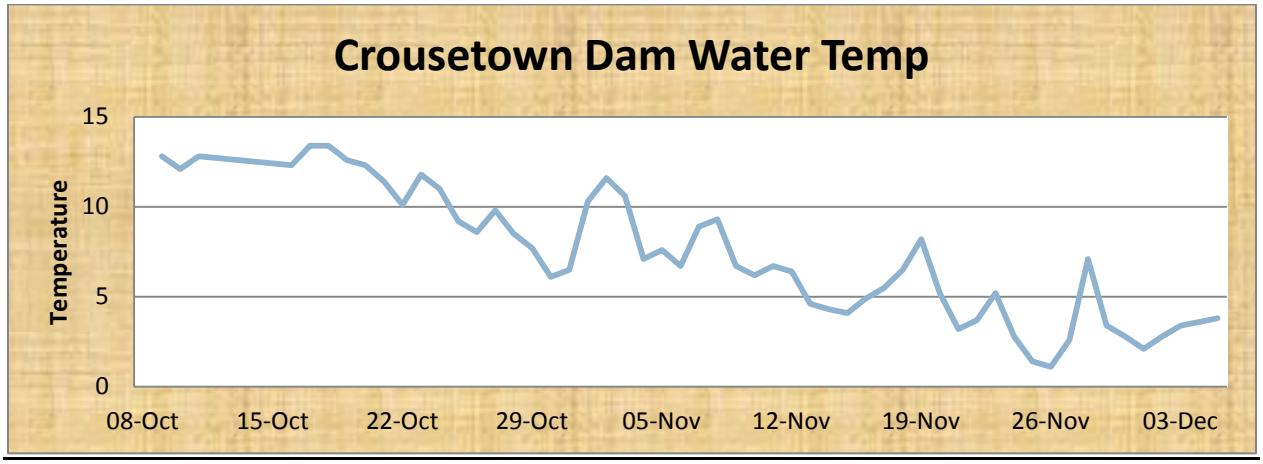


**Figure 64**: Water temperature at Crousetown Dam.

# Discussion

## Outreach and Education

Each year Bluenose Coastal Action Foundation attempts to highlight the plight of the Atlantic whitefish to the local community. This task was even more important in 2013 with the discovery of chain pickerel in the Petite Watershed. This invasive predator, along with the smallmouth bass, has the potential to extirpate the Atlantic whitefish from its only remaining home. In addition, it is the belief that these predatory species will, and are, having an impact on all salmonid species in the Southern Uplands region of Nova Scotia. By continuing to educate all stakeholders, along with the general public, about the interactions between these illegally introduced species and our native Atlantic whitefish as well as other salmonid species, improved fisheries management procedures may be initiated.

## Invasive Species Monitoring

Smallmouth bass are known to be successfully spawning in Hebb, Milipsigate, and Minamkeak Lakes. Smallmouth bass nest construction began in mid-May when water temperatures approached 16°C. Spawning activity and nest occupation continued until early July. Smallmouth bass typically nest in calm, shallow areas, with rocky substrate, adjacent to some form of cover, such as a log or boulder (Scott and Crossman 1973, Robbins and MacCrimmon 1974, Funnell 2012). The nesting surveys carried out by Bluenose Coastal Action were compromised by two factors in 2013. Firstly, the realization on May 14 that chain pickerel were present in Hebb Lake, and secondly poor weather conditions and visibility during late May and the early part of June.

In the Milipsigate Outlet, all smallmouth bass nests were recorded; however, documenting their success was not the objective in 2013. The Milipsigate Outlet is considered a “Critical Habitat” area for Atlantic whitefish and many whitefish have been observed in this location in previous years. After the details about the bass nests were recorded, the males were actively angled from the nests and then the nests were raked to ensure their failure. During May and June, the AWRP team spent approximately 22 hours in the Milipsigate Outlet removing bass and destroying nests. Throughout the nesting period, males are particularly aggressive and are more frequently attracted to lures while guarding their nests (Jordan 2001, Suski and Philip 2004, Funnell 2012). As only a portion of the male smallmouth bass population spawn each spring, the removal of guarding males can lead to a decrease in offspring survival by exposing eggs and fry to predators (Ridgeway and Freisen 1992, DFO 2009b).

As previously stated, time and weather constraints prevented a thorough nesting survey being carried out on Milipsigate Lake. However, a small percentage of the lake was surveyed, and within several hours, 37 nests were found. Based on data from the NS Department of Fisheries and Aquaculture in 2010, up to 44% of these nests could be successful.

Again, as in 2012, the CPUE and Biological Study focused mainly on the area below Milipsigate Dam. Unlike previous years, the methodology for the biological stomach content survey called for all smallmouth bass

caught to be sampled fresh, within 6 hours of capture. This provided greater accuracy in determining the stomach content compared to sampling a previously frozen fish. Results from the biological survey below Milipsigate Dam indicated that anywhere from 19% to 55% of the time, depending on the time of the year, fish were found in the stomach content of smallmouth bass. In addition, the Bluenose Coastal Action team were successful in providing evidence that smallmouth bass were targeting Atlantic whitefish.


**Figure 65**: Atlantic whitefish removed from the stomach of a smallmouth bass, May 13, 2013.

After the initial information regarding the presence of chain pickerel in the upper Petite Watershed on May 14, 2013, and confirmation of this on May 17, 2013, there was a significant change in the focus of the Atlantic Whitefish Recovery Project. The chain pickerel was deemed to be a far more serious threat to the survival of the Atlantic whitefish than the smallmouth bass. The first priority was then to determine the range and distribution of these newly discovered invasive predators. By mid June, the AWRP field team had answered many questions; chain pickerel of all age classes had been found in Garber, Little, Hebb, and Milipsigate Lakes and that upstream fish passage was possible between Milipsigate and Hebb Lakes at the overflow channel. A fyke net at the upstream mouth of the overflow channel was successful in capturing chain pickerel and Alewife. Chain pickerel were not found in Fancy Lake, or more importantly, Minamkeak Lake; however, it can be assumed that without a monumental prevention and control effort it will only be a matter of time before their presence is confirmed there as well.

## Rotary Screw Trap

This was the second year that the rotary screw trap (RST) had been deployed immediately downstream from the Hebb Dam. In 2013, the RST was deployed on April 9, 12 days earlier than in 2012, as it was felt that there may be a possibility of an earlier downstream migration of Atlantic whitefish. This was not confirmed, and for the second year, no Atlantic whitefish were caught in the RST. Interestingly, no chain pickerel were caught in the RST over the two year period either, although it is believed that they have been established in Hebb Lake for 3- 5 years. Therefore, it is felt that very few fish use the dam spillway to migrate downstream. In addition, the AWRP field team had a fyke net deployed at Weagle's Dam, the official downstream migration channel where similar results to the RST were recorded, with no Atlantic whitefish or chain pickerel intercepted (see Weagle's Dam discussion).

On June 22, 2013, a 68.5 cm, female Atlantic salmon was captured in the RST. It was released but did not migrate upstream to the Hebb Lake Dam Fishway. This was the only adult salmon observed by the AWRP field team in the Petite Watershed in 2013. However, if conditions are suitable, it does reaffirm that Alewife and large salmon are able to migrate upstream to the Hebb Lake Dam Fishway via the Crousetown Fishway.

## Milipsigate Dam and Minamkeak Lake Trap Nets

This was the second year that no Atlantic whitefish were caught in the trap net deployed below Milipsigate Dam. The trap net was set for approximately 36 hours and caught 847 fish, comprising of 6 different species. The failure to capture any whitefish at this site during the spring, and the abundance of smallmouth bass and chain pickerel, is extremely concerning. The table below shows the results from 2012, last year the trap net was deployed 3 weeks earlier than in 2013.

**Table 15**: Total number of fish caught in the DFO trap net between May 7, 2012 and May 14, 2012.

| | American Eel | Creek Chub | Golden Shiner | Smallmouth Bass | White Perch | White Sucker | Yellow Perch |
|---|---|---|---|---|---|---|---|
| **Number of fish caught** | 8 | 1 | 1 | 11 | 1145 | 186 | 2 |

On Minamkeak Lake, the AWRP field team deployed two trap nets, a 10-ft deep and a 15-ft deep net. These nets were fished in the same general location in an area which had, in the past, yielded Atlantic whitefish. Unlike the trap net at Milipsigate Outlet, which was fished with the leaders deployed in a "V" formation, these trap nets were facing each other with the leader attached to the middle of the entrance. There has been some discussion over the effectiveness of these trap nets over the summer/fall and the best techniques when deploying the leaders. The AWRP field team felt that the trap nets were most effective when fished in the "V" formation during May and June at the mouth of a stream (i.e., at mouth of Sarty Brook on Minamkeak Lake and mouth of Minankeak Brook on Milipsigate Lake).

## Hebb Lake Dam Passage Facility Fish Health Collection

Similar to the protocol for 2012, a fish health assessment was required as a prerequisite before any fish were permitted to migrate upstream of the Hebb Lake Dam. The AWRP field team cannot comment on the necessity of this collection above and below the dam.

## Weagle's Dam Fyke Net

The Weagle's Dam fyke net was deployed to monitor the second downstream outlet from Hebb Lake. The fyke net was fished for 29 days during April and May and was finally removed when water levels became so low that it was impractical to continue to fish. During its deployment no Atlantic whitefish or chain pickerel were caught in the fyke net and associated holding box. During the summer, the AWRP field team fished the section of Hebb Lake situated between the Highway 103 and Weagle's Dam and, after 90 minutes of effort, only 1 white perch was caught. 2 submerged culverts connect this area to the main Hebb Lake and the AWRP field team felt that the culverts are partially blocked and therefore do not allow for downstream passage.

## Fall Monitoring and Sampling Activities at the Hebb Lake Dam Fish Passage Facility

This was the second year that fish were permitted to ascend the fishway into the upper Petite watershed through the Hebb Lake Dam Passage Facility. Unfortunately, compared to 2012, this was a disappointing year with no returning Atlantic whitefish compared with the 19 observed in 2012. Furthermore, unlike 2012 when 4 Atlantic salmon returned to the upper watershed, no Atlantic salmon returned during the fall of 2013. In 2013, there were no migration restrictions on white sucker, white perch, yellow perch, and brown bullhead and 14 white sucker and 1 brown bullhead were allowed above the dam. However, results showed that the amount of fish intercepted at the fishway trap was significantly lower in 2013 than in 2012. In addition, and of greater concern, was the capture chain pickerel in the fishway trap for the first time in 2013. It can be assumed that it is only a matter of time before they colonize Fancy Lake and the Lower Petite Watershed.

## Crousetown Dam Fish Trap

The AWRP field team had great expectations for the fish trap at the Crousetown Dam and were somewhat disappointed by the results of the study. All fish migrating upstream in that particular lower section of the river must pass through this man-made pinch point and staff were confident that the trap intercepted 99% of the fish. The failure to capture any whitefish in this area was a major setback as there were plans to monitor the fish and its upstream progress using radio transmitters and acoustic receivers.

The majority of fish caught in the Crousetown trap were juvenile Alewife migrating downstream to the estuary. Of the 9 Atlantic salmon parr caught in the trap, all were under 22 cm in length and at least 4 were male precocious parr.

# Conclusion and Recommendations

## Recommendations

- In 2014, the RST should be installed immediately below the Milipsigate Dam. The objective would be to remove all invasive species from this sensitive area and monitor for the presence of Atlantic whitefish on a 24 hour 7 day a week basis.

- Explore all options for invasive species control such as boat electrofishing, angling in key areas such as Milipsigate Outlet, Minankeak Brook Outlet, and Sarty Brook Outlet.

- Determine if angling effort to remove SMB in Milipsigate Outlet in 2013 affected SMB population.

- Determine if chain pickerel population is increasing using CPUE study.

- Continue with the stomach content analysis of invasive species especially in the key areas then compare with results from 2013.

- A continuation of the outreach and educational activities at local schools and community events.

- Increase efforts to monitor residual population of Atlantic whitefish in the Upper Petite Watershed (i.e., Fancy Lake and Wallace Lake).

- Re-establish a captive breeding program and increase efforts concerning range expansion.

- Construct two boat ramps for an electrofishing boat at Milipsigate Outlet (i.e., Milipsigate Lake and Hebb Lake).

## Conclusion

In many ways 2013 was a disappointing year for the Atlantic Whitefish Recovery Project, especially when compared to the fall of 2012 and the encouraging news that 19 Atlantic whitefish returned to the fishway. The discovery of chain pickerel in Hebb Lake and subsequently in Milipsigate, Little, and Garber Lakes was a devastating revelation, only slightly dampened by the news that, at least for now, Minamkeak Lake is free from chain pickerel.

The smallmouth bass biological study provided some good results and should serve as a warning regarding the piscivorous nature of this species. The AWRP field team felt that this species is probably more of a threat to

the Atlantic whitefish than the chain pickerel at this point and certainly poses significant problems for juvenile Atlantic salmon parr, smolt, and other salmonids. As noted in the recommendations for 2014, Bluenose Coastal Action staff intend to repeat the biological and CPUE studies to determine if:

1. Similar results from the stomach content survey can be obtained over two years and in different watersheds.

2. Angling has influenced the proportion of large bass over 30 cm in fork length found in the Milipsigate Outlet.

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# Appendix 1

## Hebb Lake Dam Fish Passage Facility Interim Monitoring Protocol 2013

| Species | Protocol | Sampling Considerations |
|---|---|---|
| **Wild Atlantic Whitefish** ***(Coregonus hunstmani)*** | Identify as wild, count, sample and allow passage into Hebb Lake | **Identify as a wild fish if it does not possess the captive-reared markings described below. Apply an external mark, record biological information, extract scale samples for ageing and tissue samples for later genetic assessments.**<br><br>**Apply PIT tag as directed by DFO Science.** |
| **Captive-reared Atlantic Whitefish** ***(Coregonus hunstmani)*** | Identify as captive-reared, count, sample and return to below dam | **Identify as a captive-reared fish (adipose fin markings or a red or pink VIE[1] mark on the left pectoral), record biological information, extract scale samples for ageing and tissue samples for later genetic assessments, fin clip, subsample for fish health screening.** |
| **American Eel** ***(Anguilla rostrata)*** | Count, sample and allow passage into Hebb Lake | **Record biological information** |
| **Smallmouth Bass** ***(Micropterus dolomieu)*** | Count, sample and sacrifice | **Record biological information, extract scale samples for ageing. Provide to NS DFA for science purposes** |
| **Other non-native fish species (e.g., Chain Pickerel** (Esox niger)**)** | Count, sample and sacrifice | **Record biological information, extract scale samples for ageing. Provide to NS DFA for science purposes** |
| **Atlantic Salmon – wild (adults and juveniles)** ***(Salmo salar)*** | Count, sample and return to the river below the dam. | **Record biological information, extract scale samples for ageing, collect a tissue sample (lower caudal punch) for possible later genetic assessments. Submit** |

[1] VIE: Visible Implant Elastomer is an internal coloured tag that is visible externally.

| | | |
|---|---|---|
| | | **mortalities for fish health screening.** |
| **Atlantic Salmon - Aquaculture Escapee** ***(Salmo salar)*** | Count, sacrifice or sample and return to below dam – see sampling considerations | **If clearly obvious escapee (*i.e.*, broom tail, severe fin erosion, odd body shape), sacrifice the fish and send to fish health for disease screening. Any other fish of limited odd characteristics to be sampled as per wild Atlantic salmon considerations above and the envelope marked possible aquaculture escape and returned below the dam.** |
| **Brook Trout** **(*Salvelinus fontinalis)*** | Count, sample and allow passage into Hebb Lake | **Record biological information, extract scale samples for ageing and tissue samples for possible use in later genetic assessments, fin clip. If more than several (about 12) large specimens are captured in the trap (>25cm), consideration will be given to returning additional larger specimens to the river downstream of the dam. This direction will be provided within the season by DFO, as appropriate.** |
| **Rainbow Trout escapees** **(*Oncorhynchus mykiss)*** | Count, sacrifice, provide to NS DFA for science purposes | **No sampling requirements** |
| **Alewife** **(*Alosa pseudoharengus)*** | Identify as alewife. Estimate numbers, sample and allow passage into Hebb Lake of 20,000 spawners (upper limit of 30,000 spawners) | **Sampling to confirm the gaspereau are alewife. Otherwise no other sampling requirements. The sample rate and procedure will be provided to those conducting the monitoring by DFO Science and adjusted accordingly depending on the run size.** |
| **Blueback Herring** **(*Alosa aestivalis)*** | Identify as blueback. Estimate numbers, sample and allow passage into Hebb Lake of numbers not to surpass total alewife recommendation for a total "gaspereau" count | **Sampling to confirm that the gaspereau are alewife or blueback herring, otherwise no sampling requirements. The sample rate and procedure will be provided to those conducting the** |

| | | |
|---|---|---|
| | | **monitoring by DFO Science and adjusted accordingly depending on the run size.** |
| **American Shad** **(Alosa sapidissima)** | Count, sample, and return to below the dam. | **Record biological information** |
| **Sea Lamprey** ***(Petromyzon marinus)*** | Count, sample and return to below dam | **Record biological information** |
| **Others (*e.g.*, White Perch, Yellow Perch, White Sucker, Brown Bullhead, etc.)** | **Count, sample and allow passage into Hebb Lake.** | **Record biological information** |