

The Atlantic Whitefish Recovery Project

Smallmouth Bass Habitat and Distribution Study

Summer 2008

Bluenose Coastal Action Foundation

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OVERVIEW

BLUENOSE COASTAL ACTION FOUNDATION

The Bluenose Coastal Action Foundation (BCAF) is a non-profit community based charitable organization with a mandate to address the environmental concerns within Lunenburg County. As an established member of the Lunenburg County, since their inception in 1993, their goal is to promote the restoration, enhancement, and conservation of our ecosystem through research, education and action. In 2003, they were asked to join the recovery efforts of the Atlantic Whitefish Recovery Team (AWCRT) and are involved in promoting education and stewardship about the Atlantic whitefish (*Coregonus huntsmani*).

2008 FIELD SEASON

The Atlantic whitefish is an endemic Canadian species found only in one global location: the Petite Rivière watershed in Lunenburg, Nova Scotia. It is believed that one of the largest threats to the whitefish is the presence of smallmouth bass (*Micropterus dolomieu*), introduced to Nova Scotia in 1942. These bass are thought to compete with the whitefish for food and competition, as well as predate upon them.

As a result of these concerns, BCAF, along with the Atlantic Whitefish Conservation and Recovery Team, have developed a project to study the presence and distribution of smallmouth bass within the three known Atlantic whitefish lakes in the Petite Rivière system, Minamkeak Lake, Millipsigate Lake and Hebb Lake. It is known that the bass have established colonies in the lower of the three lakes, Minamkeak Lake, but is not completely known whether or not they have moved up and colonized the two upper lakes, Hebb Lake and Milipsigate Lakes. Shoreline surveys, beach seines and minnow traps were conducted and set to determine the presence and abundance of the bass.

Nests were observed at the northeast end of Milipsigate Lake, and nest success in that section was 40%. In Milipsigate Lake, the middle of the three lakes, no smallmouth bass nests were observed. However, two young-of-the-year smallmouth bass were caught by means of beach seining. Capture of these young bass in Milipsigate Lake suggests that there may have been some successful nesting either in the lake or in the brooks leading into it, Birch Brook and Minamkeak Brook. No nests or young-of-the-year smallmouth bass were observed in the upper lake, Hebb Lake, at any point throughout the summer, so it cannot be confirmed whether or not they have moved up and successfully colonized this lake.

INTRODUCTION

Atlantic whitefish (*Coregonus huntsmani*) is an endemic species that is not found anywhere in the world except for Nova Scotia. The Atlantic whitefish was the first fish species in Canada in to be classified as "endangered" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in 1984. This status was reconfirmed by COSEWIC in 2000. The Atlantic whitefish is also protected under Maritime Fishery Regulations, the federal Species at Risk Act, and the Nova Scotia Endangered Species Act.

Many factors, including over-fishing, acidification, inadequate fish passage, and the introduction of non-native species, are believed to have contributed to the loss of this species from the Tusket River in Yarmouth County, as well as the decline in the Petite Rivière populations. Currently, Atlantic whitefish are restricted to only three lakes on the Petite Rivière watershed: Hebb Lake, Milipsigate Lake and Minamkeak Lake.

It is believed that one of the largest threats to the remaining whitefish populations is the presence of smallmouth bass (*Micropterus dolomieu*). These bass were introduced to Nova Scotia in 1942 and are invasive species. Detrimental effects that smallmouth bass might have on the whitefish, in terms of habitat and food competition, could warrant future eradication or imposed limitations on bass reproduction in these lakes.

In 2003, Bluenose Coastal Action Foundation (BCAF) entered into the Atlantic Whitefish Recovery Project (AWRP) in cooperation with the Atlantic Whitefish Conservation and Recovery Team (AWCRT). The AWCRT is a joint venture between the Department of Fisheries & Oceans Canada (DFO), Nova Scotia Department of Fisheries and Aquaculture (NSFA) and Department of Natural Resources (DNR). Formed in 1999, the AWCRT is mandated to work toward preserving the remainder of Atlantic whitefish found in the Petite Rivière.

BCAF, along with the AWCRT, have developed a project to study the presence and distribution of smallmouth bass within the three known Atlantic whitefish lakes. Starting in late May/early June, shoreline surveys were conducted to examine smallmouth bass nesting in these lakes. The information collected will help the Recovery Team in determining the distribution and spawning habitat of the bass in the lakes.

The project will address the following concerns: (1) to compile a list of all smallmouth bass breeding habitats in Minamkeak, Milipsigate and Hebb lakes, (2) to define the littoral fish (minnow) assemblage in Minamkeak, Milipsigate and Hebb lakes. These objectives will be completed by: (a) surveying the shorelines of each lake for existing smallmouth bass nests, recording the locations and collecting the data pertaining to each of the nests throughout the spawning season (late May through June), (b) choosing and performing seines on various sites around the lakes towards the end of the field season.

STUDY AREA

The study will take place in the Petite Rivière watershed in Lunenburg County, Nova Scotia. This watershed presents a unique situation in that the upper part of the watershed has been provincially designated as a Protected Watershed Area due to its importance as a water supply for the Town of Bridgewater. This designation implies that both water quality and quantity are above average and that the watershed is recognized as being significant at a local level. The value assigned to this system by the town may well have resulted in saving the last surviving population of Atlantic whitefish. Although a portion of the watershed has some degree of environmental protection; there are other sections of the system that are facing development pressures, obstacles to fish passage and competition with non-native species.

The watershed has a total area of 244 km², and includes four major lakes; Fancy, Milipsigate, Minamkeak and Hebb, 22 smaller lakes, 8 tributaries and multiple swamps and bogs. The estimated total size of Hebb Lake, Milipsigate Lake and Minamkeak Lake is 16 km² and is 100% of the Atlantic whitefish species' range. These three lakes drain into each other, so the concern is that since the smallmouth bass have undeniably established populations in Minamkeak Lake, it is probable that they will move up and colonize the other two lakes.

METHODOLOGY

Surveying for bass nests occurred on all three of the lakes in which the Atlantic whitefish are found between May 26 and June 27. Since it is known that smallmouth bass can be found in Minamkeak, surveys were intended to take place only once a week and any nests located were tallied for an abundance survey. Surveying on this lake ended up being less than once a week however due to issues surrounding transporting the boat between access points.

It was currently unknown whether or not the bass populations had started to move into Milipsigate or Hebb, so surveys took place on Milipsigate three to four days a week. The primary focus of the study was directed towards Milipsigate since it is directly connected to Minamkeak. Hebb lake was surveyed only once every two weeks to determine whether or not bass were absent or present.

A fourteen-foot aluminum boat, powered by a 4 horsepower 4-stroke gas motor, was used to navigate the shorelines of the three lakes during the spawning season. The boat was also equipped with oars for approaching the nests to ensure that disturbance was kept to a minimum and that visibility was at its highest. Each technician had polarized sunglasses to cut down on the glare from the water and when a nest was found, a view-finder was placed under the surface of the water for optimal viewing. Looking for nests during windy or overcast days were avoided since these weather conditions made it extremely difficult to see down into the water.

Data gathered on each nest included; depth (m), distance from shore (m), covering (if applicable), bottom substrate (silt, sand, gravel, cobble, rocks, other), temperature (°C), pH, dissolved oxygen content (%), general weather observations and GPS coordinates. In addition to the GPS coordinates, diagrams were drawn indicating the nest's location relative to the shoreline and other natural landmarks and nests were assigned numbers for future reference. When natural markers were not available for identification, a white arrow-shaped marker with the nest number on it was nailed to a tree on the shore pointing in the direction of the nest.

Once a nest was located it was re-visited every 3-4 days, to evaluate its progress until the spawning season concluded. At each visit, the developmental stage of the nest was recorded corresponding to a specific letter (Fig.1). 'A' denotes a newly excavated nest that appeared clean compared to the substrate surrounding the nest. Nests classified as 'B' contained newly laid eggs. 'C' represented a nest in which fry hatched from the nest and remained low down in the nest, while 'D' indicated a nest in which the fry had begun to reside up higher in the water column. An abandoned nest, either previously containing eggs or not, was categorized as 'F1' and 'F2' respectively. Once the male bass abandoned the nest and fry, the nest was considered successful and labeled 'S'.

LITTORAL FISH ASSEMBLAGE SURVEYS

Littoral fish assemblage surveys took place mid to late summer (August 11-27) using a 8 meter seine net to capture fish in the shallow water along the shore (Fig.7). One end of the seine net was held onshore while another field technician, wearing waders, walked the other end into the deeper water. The field technicians then walked parallel to the shore, capturing the fish in area with the net. When the complete length of the study area was walked, the two ends of the net were brought together onshore and any captured fish were placed in holding buckets to be measured and identified. The 2008 AWRP field crew members seined six different sites on Milipsigate Lake and three sites on Hebb Lake. Sites were chosen based on advice gathered from both the DFO and NSFA. Parameters recorded at each site included: GPS coordinates, length of seine (m) species, weather, temperature (°C), depth (m) and vegetation.

Minnow traps were used as another method to observe the littoral fish species in both Hebb Lake and Milipsigate Lake. Three sites were sampled every one or two days, on both lakes, and were chosen based on areas close to shore where there was lots of vegetation. On Milipsigate Lake, two minnow pails (one silver and one black) were set at each site and baited using beef liver, sardines and tuna. On Hebb Lake, only black pails were used and varied in number from one to two, depending on the size and vegetation of the area. These pails were also baited with beef liver, sardines and tuna. Any fish caught were transferred to a holding bucket for examination and the data recorded at each site was the GPS coordinates of the traps, the different species caught, and the number of fish of each species.

RESULTS

MINAMKEAK LAKE

Smallmouth bass nesting success was observed only in Minamkeak Lake, as this was the only lake of the three Atlantic whitefish lakes that smallmouth bass nests could be properly identified. In total, ten bass nests were identified at the northeast section of the lake, and of these nests, four were deemed successful. Conclusively, nest success this season was 40%. At each of the ten nests discovered, the depth, distance, cover, substrate and GPS coordinates were recorded and are summarized in Table 1. All of the nests, both successful and unsuccessful, were located in areas with gravel bottoms and used boulders as cover. The average distance from shore was 3.9m and the average depth was 0.718m.

Littoral fish assemblage surveys were not completed on this lake due to time restraints.

MILIPSIGATE LAKE

The presence of smallmouth bass in Milipsigate Lake could not be confirmed based on the results of the shoreline surveys. No nests were located over the course of the field season, but, areas that could be conducive to spawning in the future were noted and recorded (Table 2). The criteria used for determining potential spawning areas were based on observations of the successful nests found in Minamkeak Lake – areas that contained bottom substrate such as sand, gravel or small cobble, and had resources available for cover (boulders, vegetation, logs, etc.).

Water levels throughout the course of the summer field season were observed to be fluctuating, and official measurements taken at Hebb dam were obtained from the Town of Bridgewater. The measurements were taken from the top a piece of rebar that was permanently placed at the dam to the top of the water level.

Littoral assemblage surveys were completed during the last two weeks of the summer field season using minnow pails (Table 3) and beach seines (Table 4). Species observed included yellow perch, tadpole, creek chub, golden shiner, killifish, lake chub and smallmouth bass. All of the fish caught were either young-of-the-year or minnow species.

HEBB LAKE

Smallmouth bass nests were not located on Hebb Lake during the 2008 field season, but areas that could possibly support nests were identified and recorded (Table 5).

Similar to Milipsigate Lake, littoral assemblages were completed in Hebb Lake by means of minnow pails (Table 6) and beach seines (Table 7). Species caught included yellow perch, tadpole, brown bullhead, killifish and lake chub. Again, all of the fish caught were juvenile of the year or minnow species. No smallmouth bass were observed.

DISCUSSION

Minamkeak Lake has been known in the past to contain smallmouth bass and support spawning. This summer was no exception, as bass nests were identified and monitored, with forty percent of those found considered to be successful (Table 1). In Nova Scotia, the mean percentage of successful smallmouth bass nests in the past has been approximately 30% (LeBlanc, 2007). Minamkeak Lake harbours a great deal of gravel, sand shorelines and clear water with lots of cover; all of which are traits known to be favourable for smallmouth bass nesting (**SOURCE?**). Milipsigate Lake and Hebb Lake both contain rockier bottom substrate than Minamkeak Lake, and much darker waters. The dark water may have factored in the difficulty of finding bass nests during the spawning season. Furthermore, since the lake is so rocky, the nests would not have been as large or as noticeable compared to those found on Minamkeak Lake. The abundance of large rocks also limits the available space for the bass to nest in. Another factor observed on Milipsigate Lake that potentially affected nesting was the change in the water level over the course of the summer (Fig.2). Between May 5 and July 9, during the expected period of spawning, the water level dropped a total of 0.508m (Fig.2). There is no established connection between a lack of observed nests and a water level drop; however, a link between the two factors should be strongly considered as a possibility given that the successful nests on Minamkeak Lake were observed in depths between 0.6-0.79m. Sudden fluctuations in the water level could have had disastrous effects on nests that were already in shallow waters, causing the water to become too warm or even exposed entirely. These factors may have contributed in a large part to why nests could not be found on Milipsigate Lake or Hebb Lake. Areas in these two lakes that matched the substrate conditions of spawning bass in Minamkeak Lake (Table 2 & 5) should be the primary focus for any future field studies on nesting patterns in these lakes.

Although nests were not observed in Milipsigate Lake, smallmouth bass young-of-the-year were caught during two different beach seines toward the end of the field season (Table 4 & Fig.3). Capture of these young bass suggests that nesting could have in fact taken place in the lake over the course of the summer, or in the two brooks that drain directly into Milipsigate Lake (Birch Brook and Minamkeak Brook). No smallmouth bass were found in Hebb Lake and it cannot be confirmed that they have or have not moved into this lake.

Littoral fish assemblages took place at the end of the field season during a time that would provide the greatest advantage for catching and putting together a list of species of fish in the lake, as well as catching juvenile bass, if they were in fact in the lake. Minnow pails were used as well as beach seines. However, setting the minnow pails for longer periods of time and, in general, starting the fish assemblage surveys earlier in the field season would have been beneficial to data collection. Unfortunately, during this field season there were many times that no fish were caught in the minnow pails (Table 3 & 6), and more time was spent looking for areas available to seine than actually seining. Mapping out areas to seine and setting minnow pails all the way through the season may have allowed a greater area to be covered on each of the lakes and in turn perhaps provided a better representation of each of the lake's species.

CONCLUSION

The basis of this study was to examine the nesting habits and abundance of smallmouth bass in the only three lakes in which the endangered Atlantic whitefish are found: Hebb Lake, Milipsigate Lake and Minamkeak Lakes in the Petite Rivière watershed in Lunenburg County.

Nests were observed in the lower of the three lakes, Minamkeak, where bass populations have been known to establish successfully reproducing colonies in previous years. These nests were found at the North-East end of the lake and nest success was 40%.

In Milipsigate Lake, the middle of the three lakes, no smallmouth bass nests were observed. However, two young-of-the-year were caught by means of beach seining. Capture of these young bass suggests that nesting could have in fact taken place in the lake over the course of the summer, or in the two brooks that drain directly into Milipsigate Lake: Birch Brook and Minamkeak Brook. Accordingly, further studies should be executed, focusing exclusively on smallmouth bass nesting in the potentially conducive areas on Milipsigate Lake, as well as nesting in both Birch Brook and Minamkeak Brook.

No nests or bass were observed in the upper lake, Hebb Lake, at any point throughout the summer. Therefore, it cannot be confirmed whether or not they have moved up and successfully colonized this lake.

ACKNOWLEDGEMENTS

BCAF and the AWRP team would like to thank and acknowledge the support and assistance of the following community members:

- Jason LeBlanc, NSDFA
- Tim Hiltz, Town of Bridgewater
- Karl Nauss, BCAF Board Member
- Philip Longue, DFO
- Phillip Townsend, Halifax Public Gardens
- Chip Veinotte, BCAF Board Member
- Ralph Getson, Fisheries Museum of the Atlantic
- Dawn Septon, DFO
- John Whitelaw, DFO
- Noel Burkhead, US Geological Survey
- Joy Black, Graphic Designer
- Donna Christopher, Environment Canada

REFERENCES

http://www.dfo-mpo.gc.ca/csas/Csas/DocREC/2004/RES2004_110_e.pdf

APPENDIX

Table 1. Summary of bass nesting observed on Minamkeak Lake for summer 2008 field season. For nest cover B=boulder, for substrate G=gravel.

Nest Number	Depth (m)	Distance (m)	Cover	Substrate	GPS Coordinates	Successful (S) or Unsuccessful (U)
1	0.73	5	B	G	N 44°18.942 W 64°35.655	U
2	0.73	6	B	G	N 44°18.942 W 64°35.655	S
3	0.77	4	B	G	N 44°18.945 W 64°35.661	U
4	0.69	3	B	G	N 44°18.937 W 64°35.650	U
5	0.77	5	B	G	N 44°18.937 W 64°35.651	U
6	0.79	2	B	G	N 44°18.938 W 64°35.651	U
7	0.77	3	B	G	N 44°18.929 W 64°35.645	S
8	0.6	3	B	G	N 44°18.927 W 64°33.644	U
9	0.6	3	B	G	N 44°18.909 W 64°35.638	S
10	0.73	5	B	G	N 44°18.864 W 64°35.621	S

Table 2. Areas observed in Milipsigate Lake during summer 2008 field season that may be suitable for bass nesting. For available cover, B=boulder, O=overhanging vegetation. For available substrate, G=gravel, C=cobble.

GPS Coordinates	Available Cover	Available Substrate
N 44°20.236' W 64°36.180'	B	G
N 44°20.231' W 64°36.184'	B	G
N 44°20.235' W 64°36.204'	B	G
N 44°20.181' W 64°36.196'	B	G
N 44°20.239' W 64°36.145'	B	G
N 44°20.286' W 64°35.203'	O	G
N 44°20.195' W 64°35.315'	O	C
N 44°20.176' W 64°35.364'	B	G
N 44°20.042' W 64°35.707'	B	C
N 44°20.078' W 64°35.658'	B	G
N 44°20.082' W 64°35.655'	B	G
N 44°20.093' W 64°35.650'	B	G
N 44°20.091'	B	C

<i>W 64°35.632'</i>		
<i>N 44°19.785'</i> <i>W 64°36.186'</i>	<i>B</i>	<i>C</i>
<i>N 44°19.662'</i> <i>W 64°36.976'</i>	<i>B</i>	<i>C</i>

Table 3. Summary of the location, minnow pail colour, bait used, species and number of species caught using minnow pails on Milipsigate Lake during the 2008 field season.

Date	GPS Coordinates	Minnow Pail Colour	Bait Used	Species Caught	Number of Species Caught
8/14/08	<i>N44°19.147'</i> <i>W64°37.153'</i>	<i>Black</i>	<i>Beef Liver</i>	<i>None</i>	<i>N/A</i>
		<i>Silver</i>		<i>None</i>	<i>N/A</i>
	<i>N44°19.510'</i> <i>W64°37.052'</i>	<i>Black</i>	<i>Beef Liver</i>	<i>None</i>	<i>N/A</i>
		<i>Silver</i>		<i>Yellow Perch</i>	<i>1</i>
	<i>N44°19.631'</i> <i>W64°36.955'</i>	<i>Black</i>	<i>Beef Liver</i>	<i>None</i>	<i>N/A</i>
		<i>Silver</i>		<i>None</i>	<i>N/A</i>
8/15/08	<i>N44°20.373'</i> <i>W64°35.259'</i>	<i>Black</i>	<i>Beef Liver</i>	<i>None</i>	<i>N/A</i>
		<i>Silver</i>		<i>Yellow Perch</i>	<i>1</i>
	<i>N44°20.138'</i> <i>W64°36.127'</i>	<i>Black</i>	<i>Beef Liver</i>	<i>None</i>	<i>N/A</i>
		<i>Silver</i>		<i>None</i>	<i>N/A</i>
	<i>N44°19.31.5'</i> <i>W64°37.014'</i>	<i>Black</i>	<i>Beef Liver</i>	<i>None</i>	<i>N/A</i>
		<i>Silver</i>		<i>Yellow Perch</i>	<i>1</i>
8/18/08	<i>N44°20.398'</i> <i>W64°35.264'</i>	<i>Black</i>	<i>Beef Liver</i>	<i>Yellow Perch</i>	<i>10</i>
		<i>Silver</i>		<i>None</i>	<i>N/A</i>
	<i>N44°19.425'</i> <i>W64°36.141'</i>	<i>Black</i>	<i>Beef Liver</i>	<i>None</i>	<i>N/A</i>
		<i>Silver</i>		<i>None</i>	<i>N/A</i>
	<i>N44°19.413'</i>	<i>Black</i>	<i>Beef Liver</i>	<i>None</i>	<i>N/A</i>

	<i>W64°35.479'</i>	<i>Silver</i>		<i>None</i>	<i>N/A</i>
8/19/08	<i>N44°20.797' W64°35.961'</i>	<i>Black</i>	<i>Beef Liver</i>	<i>Tadpole</i>	<i>6</i>
		<i>Silver</i>		<i>None</i>	<i>N/A</i>
	<i>N44°20.298' W64°35.221'</i>	<i>Black</i>	<i>Beef Liver</i>	<i>None</i>	<i>N/A</i>
		<i>Silver</i>		<i>Creek Chub</i>	<i>1</i>
		<i>Black</i>	<i>Beef Liver</i>	<i>None</i>	<i>N/A</i>
		<i>Silver</i>		<i>None</i>	<i>N/A</i>
	<i>N44°19.636' W64°35.677'</i>	<i>Black</i>	<i>Beef Liver</i>	<i>None</i>	<i>N/A</i>
		<i>Silver</i>		<i>None</i>	<i>N/A</i>
		<i>Black</i>		<i>None</i>	<i>N/A</i>
		<i>Silver</i>		<i>Yellow Perch</i>	<i>1</i>
		<i>Black</i>	<i>Beef Liver</i>	<i>Creek Chub</i>	<i>2</i>
		<i>Silver</i>		<i>None</i>	<i>N/A</i>
		<i>Black</i>	<i>Beef Liver</i>	<i>None</i>	<i>N/A</i>
		<i>Silver</i>		<i>None</i>	<i>N/A</i>
8/20/08	<i>N44°20.602' W64°35.563'</i>	<i>Black</i>	<i>Beef Liver</i>	<i>Tuna</i>	<i>Tadpole</i>
		<i>Silver</i>		<i>Sardine</i>	<i>None</i>
	<i>N44°20.292' W64°35.236'</i>	<i>Black</i>	<i>Beef Liver</i>	<i>Tuna</i>	<i>Golden Shiner</i>
		<i>Silver</i>		<i>Sardine</i>	<i>Yellow Perch</i>
		<i>Black</i>	<i>Beef Liver</i>	<i>Sardine</i>	<i>None</i>
		<i>Silver</i>		<i>Tuna</i>	<i>None</i>
	<i>N44°20.586' W64°35.555'</i>	<i>Black</i>			<i>3</i>
		<i>Silver</i>			<i>N/A</i>
		<i>Black</i>			<i>2</i>
		<i>Silver</i>			<i>1</i>
		<i>Black</i>			<i>N/A</i>
8/22/08	<i>N44°20.783' W64°35.995'</i>	<i>Black</i>			
		<i>Silver</i>			
		<i>Black</i>			
	<i>N44°20.820' W64°35.906'</i>	<i>Silver</i>			
		<i>Black</i>			
	<i>N44°19.510' W64°37.050'</i>	<i>Silver</i>			

Table 4. Summary of the location, total area, species and number of species caught using an 8m beach seine on Milipsigate Lake during the 2008 field season.

Date	GPS Coordinates	Total Area Seined (m²)	Species Caught	# of Species Caught
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8/13/08	N44°19.313' W64°37.021'	248.3156	<i>Golden Shiner</i>	4
			<i>Killifish</i>	43
			<i>Lake Chub</i>	1
			<i>Smallmouth Bass</i>	1
			<i>Yellow Perch</i>	1
8/14/08	N44°19.313' W64°37.021'	248.3156	<i>Golden Shiner</i>	2
			<i>Killifish</i>	62
			<i>Lake Chub</i>	1
			<i>Creek Chub</i>	11
			<i>Smallmouth Bass</i>	1
8/15/08	N44°19.776' W64°36.172'	46.5114	None	N/A
8/18/08	N44°20.138' W64°36.127'	123.9	None	N/A
8/20/08	N44°20.822' W64°35.908'	52.40846	<i>Lake Chub</i>	24
			<i>Killifish</i>	373
8/22/08	N44°20.198' W64°35.324'	519.71934	None	N/A

Table 5. Areas observed in Hebb Lake during summer 2008 field season that may be suitable for bass nesting. For available cover, B=boulder. For available substrate, G=gravel, MS/G=mud/silt & gravel, G/C=gravel & cobble.

GPS Coordinates	Available Cover	Available Substrate
N 44°20.709'	B	S/G
W 64°34.979'		
N 44°20.693'	B	G
W 64°34.937'		
N 44°20.681'	B	MS/G

<i>W 64°34.282'</i>		
<i>N 44°20.410'</i>		
<i>W 64°35.023'</i>	<i>B</i>	<i>G/C</i>

Table 6. Summary of the location, minnow pail colour, bait used, species and number of species caught using minnow pails on Hebb Lake during the 2008 field season.

Date	GPS Coordinates	Minnow Pail Colour	Bait Used	Species Caught	Number of Species Caught
8/19/08	<i>N44°20.663' W64°35.380'</i>	<i>Black</i>	<i>Beef Liver</i>	<i>None</i>	<i>N/A</i>
		<i>Black</i>		<i>None</i>	<i>N/A</i>
	<i>N44°20.750' W64°35.240'</i>	<i>Black</i>	<i>Beef Liver</i>	<i>None</i>	<i>N/A</i>
		<i>Black</i>		<i>None</i>	<i>N/A</i>
	<i>N44°20.840' W64°34.937'</i>	<i>Black</i>	<i>Beef Liver</i>	<i>None</i>	<i>N/A</i>
		<i>Black</i>		<i>None</i>	<i>N/A</i>
8/21/08	<i>N44°20.419' W64°35.206'</i>	<i>Black</i>	<i>Beef Liver</i>	<i>Yellow Perch</i>	<i>1</i>
		<i>Black</i>		<i>None</i>	<i>N/A</i>
	<i>N44°20.406' W64°34.173'</i>	<i>Black</i>	<i>Beef Liver</i>	<i>None</i>	<i>N/A</i>
	<i>N44°20.461' W64°35.137'</i>	<i>Black</i>	<i>Beef Liver</i>	<i>Tadpole</i>	<i>12</i>
		<i>Black</i>		<i>Tadpole</i>	<i>17</i>
8/22/08	<i>N44°20.638' W64°35.354'</i>	<i>Black</i>	<i>Sardine</i>	<i>None</i>	<i>N/A</i>
	<i>N44°20.658' W64°35.349'</i>	<i>Black</i>	<i>Tuna</i>	<i>None</i>	<i>N/A</i>
	<i>N44°20.743' W64°35.246'</i>	<i>Black</i>	<i>Sardine</i>	<i>None</i>	<i>N/A</i>
	<i>N44°20.694' W64°35.931'</i>	<i>Black</i>	<i>Tuna</i>	<i>None</i>	<i>N/A</i>

	<i>N44°20.679' W64°34.290'</i>	<i>Black</i>	<i>Sardine & Tuna</i>	<i>Brown Bullhead</i>	1
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Table 7. Summary of the location, total area, species and number of species caught using an 8m beach seine on Hebb Lake during the 2008 field season.

Date	GPS Coordinates	Total Area Seined (m²)	Species Caught	# of Species Caught
8/18/08	<i>44°20.672 64°35.379</i>	167.7186	<i>Killifish</i>	11
			<i>Lake Chub</i>	1
			<i>Yellow Perch</i>	6
8/19/20	<i>N44°20.697' W64°34.943'</i>	537.6525	<i>None</i>	N/A
8/20/08	<i>N44°20.407' W64°34.174'</i>	253.99205	<i>Lake Chub</i>	7
	<i>N44°20.410' W64°35.023'</i>	342.589728	<i>None</i>	N/A



Figure 1. Examples of each smallmouth bass nest stage, A through D. Class A, is a newly excavated nest, Class B is a nest that contains newly laid eggs, Class C is a nest with newly hatched fry located down in the nest, and Class D is a nest in which the fry have begun to move up in the water column.

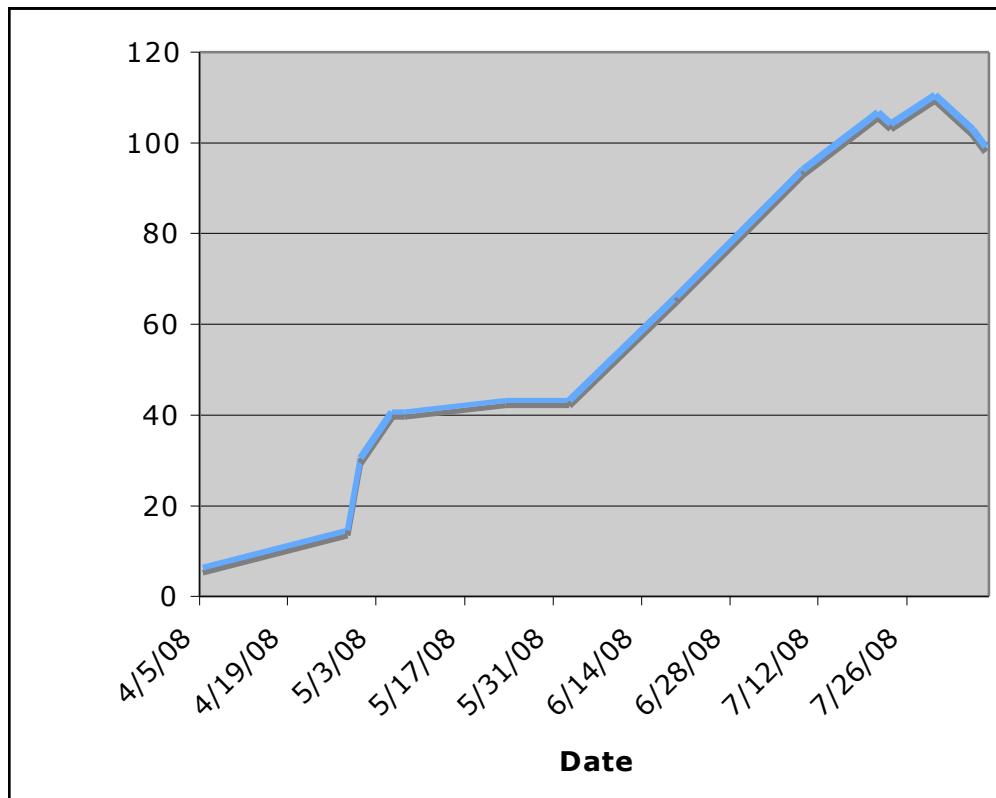


Figure 2. Water level measurements (cm) taken from the top of a piece of rebar to the top of the water level at the dam in Milipsigate Lake.



Figure 3. Young-of-the-year smallmouth bass caught during a beach seine on Milipsigate Lake.