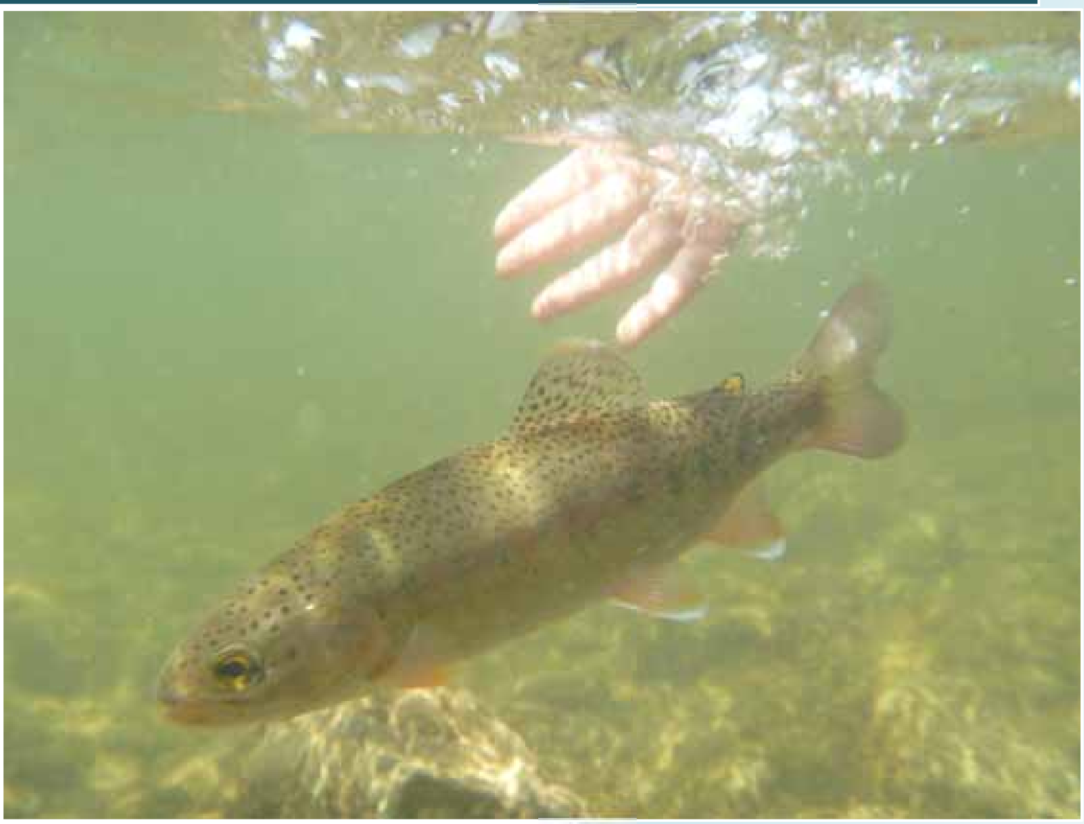
Central Lake Ontario Conservation

2011

Aquatic Monitoring Report



What we do on the land is mirrored in the water

Working In Partnership:

DURHAM REGION

Conservation ONTARIO Natural Champions

Report No.: 2011-03MR

Acknowledgements

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1.0 INTRODUCTION

In order to make sound, science-based management decisions about local **watersheds**, the Central Lake Ontario Conservation Authority (CLOCA) conducts long-term watershed health monitoring. This information helps CLOCA understand current conditions, identify ecological trends, provides a strong basis to measure the effectiveness of stewardship activities and also provides guidance in making informed land-use decisions. Typical components of the watershed are monitored and include: aquatic habitat (e.g., habitat assessments and temperature monitoring); fish and benthic macroinvertebrates (benthos); terrestrial habitat (e.g., riparian and tableland vegetation, wildlife); and, water quality and quantity of both surface water and groundwater. This report focuses on the Aquatic Monitoring Program, specifically Spawning Surveys, Stream Temperature, Biological Water Quality and Fisheries Sampling.

To ensure that monitoring is done using standardized protocols, whenever possible, CLOCA participates in national, provincial or municipal networks. Our partners include Environment Canada (EC), Fisheries and Oceans Canada (DFO), Ministry of Environment (MOE), Ministry of Natural Resources (MNR) and other Conservation Authorities.

Located east of Toronto within the Region of Durham (Figure 1), the Authority's jurisdiction encompasses 638 square kilometers and is defined by the area drained by fifteen watersheds (Figure 2). Local municipalities located within the jurisdiction, in whole or in part, include the cities of Oshawa and Pickering, the towns of Ajax and Whitby, the Municipality of Clarington, and the townships of Scugog and Uxbridge.

While every effort has been made to accurately present the findings reported in this document, factors such as significant digits and rounding, and processes such as computer digitizing and data interpretation may influence results. For instance, in data tables no relationship between significant digits and level of accuracy is implied, and as a result values may not always sum to the expected total.

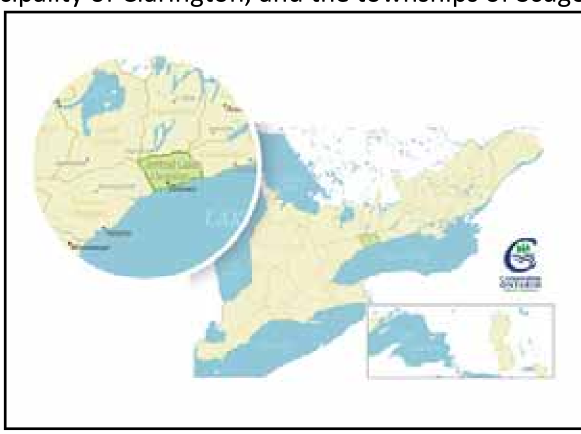

Figure 1: Location of CLOCA Jurisdiction (highlighted in green).

A **watershed** is defined as an area drained by a river or creek and its tributaries.

Figure 2: CLOCA Jurisdiction

2.0 SPAWNING SURVEY

2.1 Introduction

Sampling methods for capturing fish are sometimes not suitable for obtaining all data needed about a fishery. Many limiting factors may prevent a species of fish from reproducing successfully (producing young). These include poor water quality, migration barriers, temperature, water levels, illegal works etc. Spawning surveys provide useful information for identifying critical spawning habitat. This information is complimentary to standard fish community surveys and is a beneficial component when describing the health of a watershed.

A spawning survey involves observing indicators of spawning, in a specific watershed. These indicators include: the presence of adult fish in a likely spawning area (e.g., Rainbow Trout), the occurrence of active spawning (e.g., fish present on redds) and signs that spawning has taken place (i.e., spawning depressions or **redds)**. "Not all fish species bury their eggs in substrate: some lay eggs on material, others broadcast their eggs into the water column. Salmonids, both true Salmon and Trout (*Salmo* and *Oncorhynchus*) as well as char (i.e. Brook Trout, *Salvelinus fontinalis*) build depressions in the bottom of streams and then lay their eggs into these depressions or redds." (Imhof, 1997).

redd - the gravel nest of salmonid fishes.

Spawning locations are not evenly distributed within a watershed. Therefore, collecting information consistently over 3-5 years will identify where important reproduction areas exist and are consistently used by Salmonid populations (Imhof, 1997).

Spawning surveys within the CLOCA jurisdiction typically are conducted in both the spring and fall. The spawning periods for the fishes most commonly targeted by CLOCA are listed in Table 1. These spawning periods are when we would typically expect to see these fishes migrating during a normal year. Seeing as temperature and rainfall can alter migration routes, seasonal variation can alter these dates.

Table 1: Spawning periods for selected southern Ontario fishes.

Brown Trout	mid-October to late November
Brook Trout	late-October to mid-December
Rainbow Trout	mid-April to late-June
Chinook Salmon	late-September to early-October
White Sucker	May to early-June

[1] - Imhof, J. Salmonid Spawning Survey - Methodology.
[2] - Scott, W. B., and E. J. Crossman. 1973. Freshwater fishes of Canada. *Fish. Res. Bd. Canada Bull.* 184:184-191

2.2 Results (Spring)

Spawning surveys targeting migratory adult Rainbow Trout and White Sucker were conducted on the following watersheds:

- Bowmanville Creek
- Bennett Creek
- Corbett Creek
- Darlington Creek
- Gold Point Creek
- Harmony Creek
- Lynde Creek
- Oshawa Creek
- Pringle Creek
- Robinson Creek
- Tooley Creek
- Soper Creek

Survey locations and fish observations are shown in Figure 3. Specific locations and significance are outlined below and within Table 5:

2.2.1 Bowmanville Creek

There were eleven spawning survey locations within Bowmanville Creek during 2011. Rainbow Trout were observed at four of the sites and White Suckers were not observed at any. Through alternative sampling methods, Ontario Stream Assessment Protocol (OSAP), Rainbow Trout young-of-year were consistently found throughout the watershed. This would suggest that sites where adult migratory fish were not observed is likely related to the timing of site specific observations and limited effort.

It should be noted that spawning surveys can become more difficult to complete as creek size increases. Since Bowmanville Creek is large, this could have contributed to lack of observed fishes. Large creeks can make spawning surveys more difficult for the following reasons: presence of many deep pools with limited visibility, turbulent waters and wide wetted width.

2.2.2 Bennett Creek

During the 2011 spawning survey sampling, no adult migratory fish were observed in Bennett Creek. Since there was low effort, i.e. too few sampling sites, in Bennett Creek during 2011, it is unknown if this accurately represents the number of fish that utilize this creek for spawning.

2.2.3 Corbett Creek

No adult migratory fish were observed in Corbett Creek during the 2011 spawning survey. Since there was low effort, i.e. too few sampling sites, in Corbett Creek during 2011, it is unknown if this accurately represents the number of fish that utilize this creek. During 2010 sampling, White Suckers were found on both the east and west branches of Corbett Creek.

2.2.4 Darlington Creek

During 2011 spawning survey sampling, no adult migratory fish were observed in Darlington Creek. Since there was low effort, i.e. too few sampling sites, in Darlington Creek during 2011, it is unknown if this accurately represents the number of fish that utilize this creek. No fish were observed in Darlington Creek during 2010 but through supplemental sampling young-of-year Rainbow Trout were caught. This emphasizes the importance of multiple sampling methods. Resources to conduct other sampling methods were not available during 2011 so it is unknown if young-of-year Rainbow Trout were in Darlington Creek.

White Sucker

Rainbow Trout

2.2.5 Gold Point Creek

During 2011 spawning survey sampling, no adult migratory fish were observed in Gold Point Creek. Since there was low effort, i.e. too few sampling sites, in Gold Point Creek during 2011, it is unknown if this accurately represents the number of fish that utilize this creek. Since this was only the second time that spawning surveys have been completed in Gold Point creek, continued monitoring will help establish fish usage trends. This is an example of where long-term monitoring is important to fully understand how fish use this creek.

2.2.6 Harmony Creek

During 2011 spawning survey sampling, no adult migratory fish were observed in Harmony Creek. During the summer of 2011 Rainbow Trout young-of-year were caught while doing fish removal for a channel stabilization project. This would suggest that adult Rainbow Trout successfully migrated to at least north of Rossland Road during the spring of 2011. It is encouraging to see Rainbow Trout reproduction in a watershed that is highly urbanized. It is likely that with higher levels of effort these adult migratory fish would have been picked up on spawning surveys.

2.2.7 Lynde Creek

In 2011, an incidental site was chosen to conduct the spawning survey. The site selected was identified as a spawning site in 2010 where just upstream a beaver dam prevents fish passage. In 2011, no adult migratory fish were observed at this site. It is noted that the beaver dam was no longer present, hence allowing fish to migrate further upstream. The site was located north of Rossland Road.

2.2.8 Oshawa Creek

During 2011 eight spawning survey sites were sampled in Oshawa Creek. Of these sites, four had Rainbow Trout, four had White Sucker and one had a redd with active spawning taking place. Trout were observed in high numbers on the north side of Conlin Road which is as far north as the spawning surveys took place.

2.2.9 Pringle Creek

There were four spawning survey sampling sites in Pringle Creek during 2011. Of these sites, two had Rainbow Trout and one had White Sucker. Rainbow Trout were found north of Rossland Road but not north of the beaver dam between Rossland Road and Taunton Road.

2.2.10 Robinson Creek

White Suckers were documented in Robinson Creek during 2011 within Darlington Provincial Park. No Rainbow Trout were documented during 2011 which is consistent with previous years spawning surveys. Low effort i.e. too few sampling sites could be the cause of this since reproduction has been documented in the past through stream electrofishing.

2.2.11 Tooley Creek

During 2011 sampling, Rainbow Trout adults were documented in Tooley Creek south of Highway 401. At this site, active spawning was documented as well as numerous White Suckers. Low effort i.e. too few sampling sites could have contributed to the limited observations north of Highway 401.

Rainbow Trout – Bowmanville Creek

Rainbow Trout – Bowmanville Creek

2.2.12 Soper Creek

During 2011 sampling, Rainbow Trout adults were documented at three sites with two sites having acting spawning taking place. Rainbow Trout were observed north of Taunton Road. Limited effort, i.e. too few sampling sites, could of contributed to the limited results at other sites. This combined with the increased difficulty of spawning surveys in larger creeks could explain the absence of Trout in more northern locations. Rainbow Trout young-of-year were found extensively throughout the watershed during stream electrofishing later in the summer.

2.3 Results (Fall)

Spawning survey effort was limited during the fall of 2011. The following watersheds had Chinook Salmon documented.

- Bowmanville Creek
- Oshawa Creek
- Pringle Creek
- Soper Creek

Specific locations and significance are outlined below:

2.3.1 Bowmanville Creek

During the 2011 fall season, Chinook Salmon were observed at two locations in high numbers. The Salmon were observed at the Goodyear Dam and at the old Jackman Road bridge (near Longworth Avenue). These sites are a good place to look at sizes and origins (stocked or natural) as they often build up in large numbers as they attempt to pass these structures.

2.3.2 Oshawa Creek

Chinook Salmon were documented in Oshawa Creek during the fall of 2011. The Salmon were observed near the Ritson Road Recycle/Transfer Station.

2.3.3 Pringle Creek

Chinook Salmon were again documented in Pringle Creek during the fall of 2011. During 2010 large numbers of Chinook Salmon were observed because of the combination of low water levels and a barrier near the intersection of Dundas Street (Highway 2) and Garden Street. This barrier caused high mortality during 2010 so an effort was put forth to increase passage (see photos below). The project, completed by the Town of Whitby, generally included the retrofit of a box culvert to improve fish passage through the use of wood baffles as part of a fisheries compensation project. A total of 20 Hemlock timbers were permanently anchored to the floor of the west cell of the culvert. Although it is hard to determine how effective the new structure was, at a minimum it reduced mortality by not allowing the fish to get trapped in adjacent cells of the culvert that were dry. The success of the structure will be continued to be monitored.

Pringle Creek barrier mitigation

2.3.4 Soper Creek

During the 2011 fall season, Chinook Salmon were observed at one location in high numbers in Soper Creek. They were found on two separate occasions near the old Training School Dam north of Concession Street. This was the only site that was targeted for spawning surveys on Soper Creek in 2011 by CLOCA.


Pringle Creek barrier mitigation

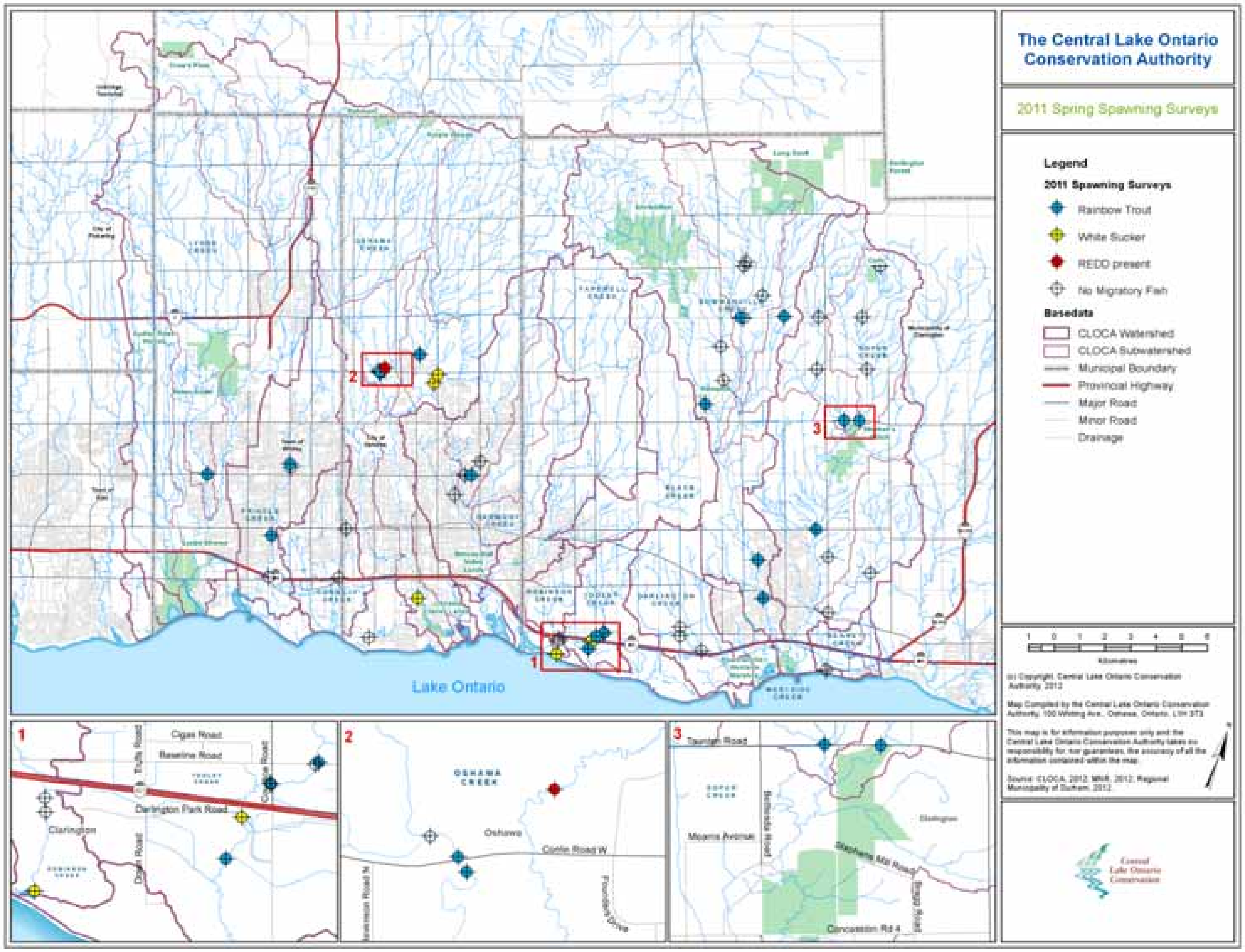

Figure 3: Location of 2011 spring migratory Rainbow Trout and White sucker observations.

3.0 BIOLOGICAL WATER QUALITY

3.1 Introduction

CLOCA monitors surface water quality through both chemical and biological sampling. In general, sampling for chemical and physical parameters measures stressors (e.g., environmental contamination), whereas biological sampling measures ecological effects. Biological surveys involve sampling creatures, such as benthic macroinvertebrates ("aquatic bugs"; see photos below) and fish, found living within the aquatic environment. Benthic macroinvertebrates or benthos, make good health indicators of aquatic ecosystems for a number of reasons:

- they generally have limited mobility that makes them vulnerable to many creek stresses that may occur;
- they have short life cycles;
- they are easily collected and identified;
- they are relatively inexpensive to sample;
- and they exist almost everywhere (Ontario Benthos Biomonitoring Network, 2005).

Similar to other biological communities, certain species of invertebrates have specific tolerances to various stresses and are referred to as indicator species. Therefore, the presence or absence of these indicator species can be related to the quality of the water.

In the past, CLOCA sampled benthos following two separate protocols. The primary protocol for assessing water quality was through BioMAP (Griffiths, 1998). The second protocol is part of the OSAP and is a coarse measure of water quality, which uses the Hilsenhoff Index. In order to harmonize long-term monitoring efforts, CLOCA is now a partner in the Ontario Benthos Biomonitoring Network (OBBN) coordinated by the MOE and EC. This provincial network allows practitioners to follow a standardized methodology, share resources and receive technical support.

One method to test whether an aquatic system has been impaired by human activity uses a reference condition approach to compare benthos at “test sites” (where biological condition is in question) to benthos from multiple, minimally impacted “reference sites”. A portion of sampling effort each season should focus on collecting reference sites (OBBN, 2005).

The online database warehoused by MOE has been undergoing upgrades and analysis tools are not yet functional. Currently, site information (i.e., identified species) has been entered into the provincial database and the results, i.e. whether a site is impaired or not, will be available once this upgrade is complete.

Another method to quantify whether an aquatic system has been impaired by human activity is to compare the percentage of three Orders of sensitive benthos; Ephemeroptera (Mayflies), Plecoptera (Stoneflies) and Trichoptera (Caddisflies) or otherwise referred to as EPT. These orders are typically only present and abundant in undisturbed areas, often inhabited by sensitive coldwater fishes like Trout and Sculpins

3.2 Results

During May 2011, CLOCA staff sampled 22 OBBN sites throughout 8 watersheds (Figure 5). One of the sites sampled was a long-term monitoring reference site and the remaining 21 sites were test sites. Of these 21 test sites, three are previously sampled CLOCA sites and 18 are new sites. This was the seventh season that CLOCA has sampled benthos using the OBBN protocol. Please refer to Table 6 in Section 12.0 Appendix II – Biological Water Quality for full summary.

3.2.1 2011 OBBN Sampling

Sampling during 2011 was not concentrated on a single watershed, but rather took place throughout CLOCA jurisdiction. In contrast to past years, while more watersheds were sampled, fewer samples in each watershed were taken. This was done to support a large scale Ministry of Environment (MOE) project titled 'The South-Central Ontario Biocriteria project'. The sites for this project were pre-determined by MOE. Poor quality sites were generally located in the urban areas and the good water quality sites were located in the headwaters of the large watersheds (Bowmanville/Soper, Oshawa, Lynde). This is a multi-year project contributing to a standardized method for analyzing and determining impairment at each OBBN site.

The one reference site sampled was located in Bowmanville Creek (BOWOB03). This was the sixth year that it has been sampled. Results from 2011 showed a very large decrease in % EPT. The average % EPT between 2005 and 2010 was approximately 36 whereas 2011 sampling resulted in an EPT percentage of 8.9 (See Figure 4). Further testing to see if this is natural variation, human error (i.e. site selection), influences by an unknown short-term anthropogenic effect (i.e. contaminant spill, excessive water taking, etc.) or long-term changes to the creek by development or climate is recommended.

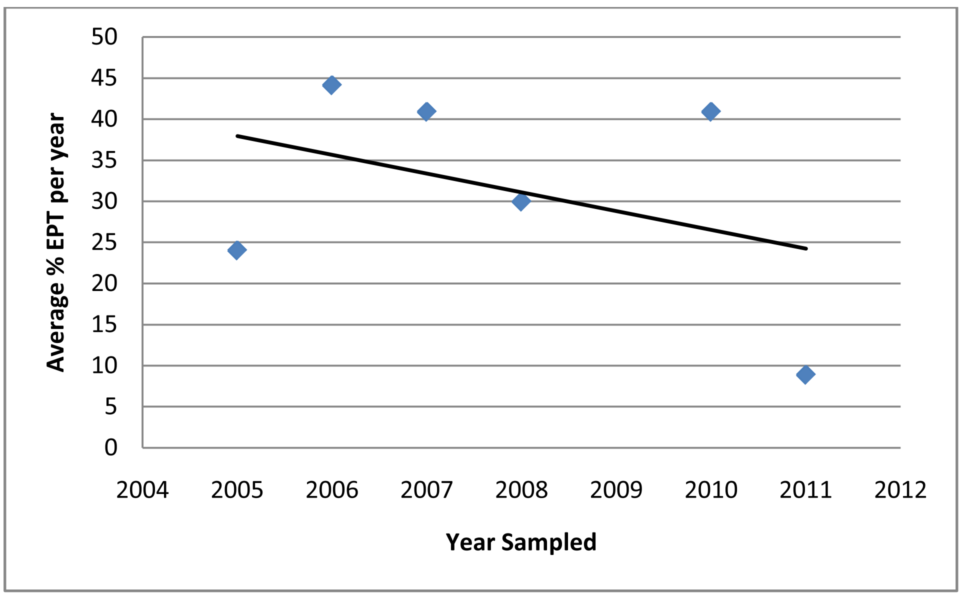

Figure 4: Summary of %EPT averaged per site (Riffle 1, Pool 1, Riffle 2) per year to determine trend data. Site is BOWOB03 located in Long Sault Conservation Area.

The three historical test sites were located in Bowmanville, Oshawa and Soper Creeks. The Bowmanville Creek site, BOWOB01, had similar %EPT in 2011 (17.2%) than it did in 2005 (18.9%) and 2006 (19.4%). The Oshawa Creek site (OAOB03) as well as the Soper Creek site (SOPOB01) both had large drops in EPT when compared to previous sampling results (Please refer to Table 6 for more information).

A summary of the new sites sampled in 2011 are listed in Table 2 below. Soper, Black and Bowmanville Creek had the highest scores for %EPT and Corbett and Harmony Creeks had the lowest scores. Based on the land cover in these watersheds, these results are expected.

Table 2: Summary of %EPT scores from new sites sampled in 2011 by CLOCA for benthic invertebrates using the OBBN protocol. Scores are calculated by averaging the %EPT for Riffle 1, Riffle 2, and Pool 1 for each site.

Watershed	Number of Sites	Minimum %EPT site average	Maximum %EPT site average	Average score within watershed
Oshawa	8	0.3	17.8	5.7
Soper	6	1.6	58.2	18.5
Bowmanville	3	16.2	26.6	20.0
Black	1	--	18.9	18.9
Corbett	1	--	1.1	1.1
Harmony	1	--	0.3	0.3
Lynde	1	--	5.3	5.3
Pringle	1	--	8.4	8.4

Although site locations were limited and lack of long-term trends at most sites reduced the ability to consider how natural variation affects a site, our sampling supports previous studies correlating a loss of important sensitive benthic invertebrates (EPT) with land alteration to urban or agricultural uses (Sponseller et al., 2001; Moore et al., 2005; Utz et al., 2009).

Riparian buffers are an important part of urban design in preserving stream water quality. Stream bank vegetation filters out pollutants from water run-off, hence mitigating some of the impacts caused by urban and agricultural uses. If the riparian buffers have not been preserved in an area of the watershed, the creek is then subject to increased flows, fluctuating temperatures, and contamination (Leblanc et al., 1997; Jones et al., 1999; Allen 2004). Riparian buffers alone, however, cannot ensure good water quality. Impervious surfaces, such as roads and parking lots, reduce the amount of water that can soak into the soil and vegetation. This water instead is directed towards creeks and brings with it many contaminants, increased temperatures and increased flow (Wang et al., 2001). The riparian buffers ability to mitigate can be limited, either through stormwater drains by-passing them or impervious surfaces increasing flow to levels which they are unable to effectively infiltrate water, due to velocities, and remove many of the contaminants. The combination of limited riparian areas and increasing impervious cover in these small watersheds contributes to low benthic invertebrate scores as evidence by the sensitive taxa (EPT) disappearing with the addition of anthropogenic stressors (Utz et al., 2009).

Ground water is also an important source of clean water and contributes to the maintenance of good water quality within a stream. Reverse particle tracking determined that the majority of ground water contributing to the small watersheds originates in the Iroquois Beach. This source is not of the same quantity as the sources supplying the larger watersheds from the Oak Ridges Moraine (Earthfx Inc, 2009). That being said, protection of these sources are critical to ensure a good source of clean, thermally suitable water for the maintenance of a healthy and robust aquatic ecosystem. Stewardship opportunities exist that would benefit the health of the aquatic ecosystems, such as, planting riparian buffers along the creek and/or cattle fencing.

Benthic invertebrates (benthics) are important for understanding water quality but also play a critical role in the food web. Benthic invertebrates are a fundamental food source for many fish. Fish species, such as Rainbow Trout and Brown Trout, require benthics as an energy source. A young salmonids diet can be comprised almost entirely by benthics and are therefore necessary for successful reproduction to occur (Oscoz et al., 2005).

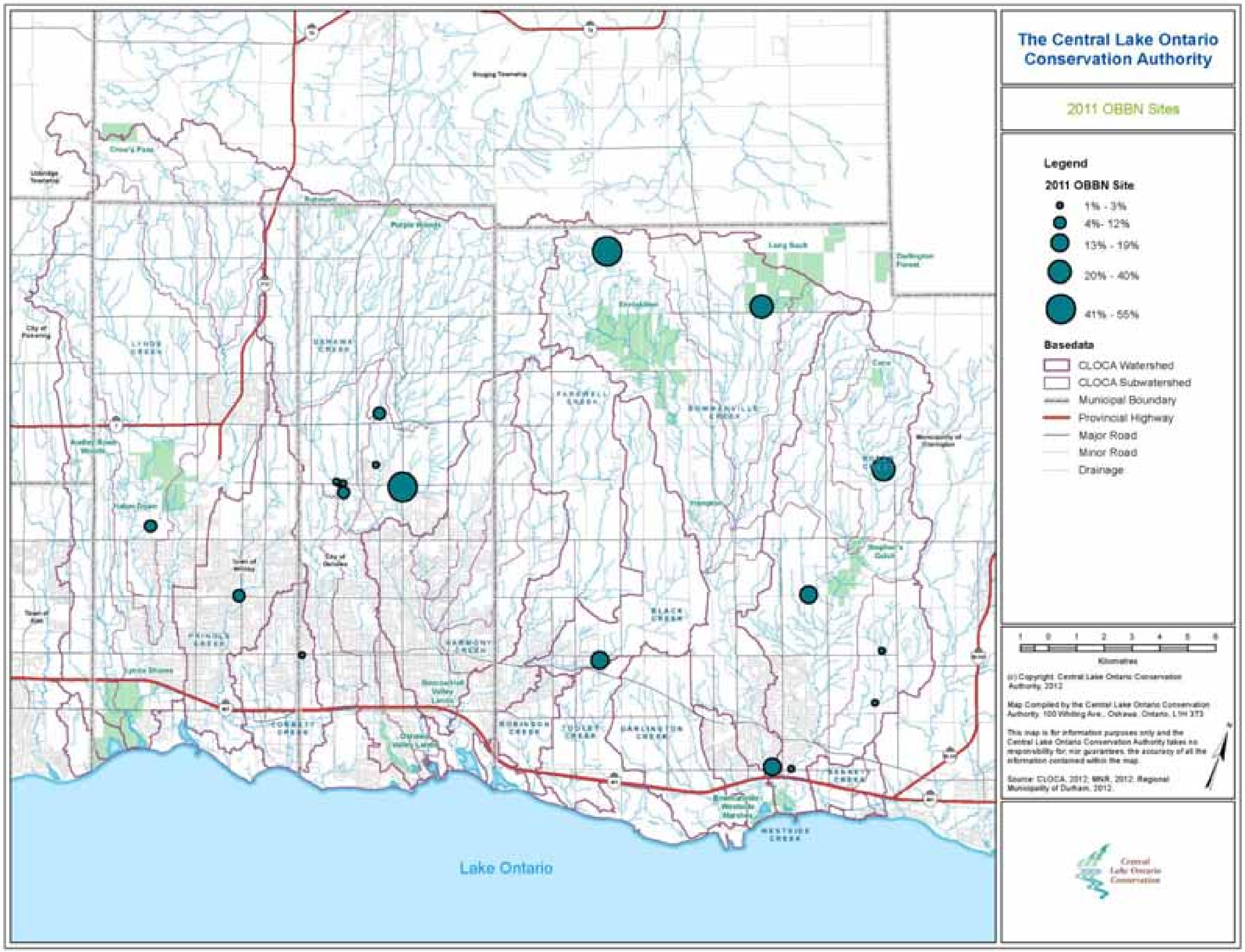

Figure 5: Percent EPT from OBBN site locations sampled during 2011.

4.0 WATER TEMPERATURE

4.1 Introduction

Temperature is considered a controlling factor with respect to habitat suitability for fish. For species such as Slimy Sculpin or Brook Trout, summer stream temperature is considered the single most important factor influencing distributions (Jenkins and Burkhead, 1993; MacCrimmon and Campbell, 1969). Temperature monitoring provides a good indicator of habitat suitability and allows one to assess the impacts of landscape changes on stream health. CLOCA relies on quality stream temperature data for use in plan review, watershed management plans, aquatic resource management plans, fisheries management plans, etc.

Temperature monitoring was conducted between May 2011 and February 2012. This sampling period allows CLOCA to capture stream temperature during the critical summer months when sensitive fish species are vulnerable to warm weather. In addition, by leaving the temperature loggers in the streams through the winter months, CLOCA staff are able to detect the relative contribution of groundwater in the stream. Groundwater temperature is moderated by the sub-surface ground temperature. Depending on the amount of groundwater entering a stream it has the ability to moderate the stream temperature. If enough groundwater enters a stream it will have more of an influence than the air temperature and prevent the stream from freezing.

In total, 78 portable temperature loggers (Figure 6) were installed throughout the CLOCA jurisdiction during 2011 (Figure 7). The primarily focus for temperature monitoring was in the Bowmanville/Soper watersheds. In addition, long-term monitoring sites and areas of interest in various other watersheds were measured. All of the loggers were programmed to collect water temperature every half-hour.

Figure 6: Attributes of one of the temperature logger models used by CLOCA.

Classification of stream temperature was divided into three categories: coldwater, coolwater and warmwater (Coker et al., 2001). The thermal classification for each site was determined by analyzing data summarized through ThermoSTAT V2 (MNR, 2010). This program was designed to help interpret the very large data set acquired by the temperature logger. This new software replaces the previous analysis tool, Stream Temperature Analysis Tool and Exchange (STATE) (Table 7; Jones and Chu, 2007). ThermoSTAT V2 has a finer temporal resolution that provides a more realistic summary of the duration within specific thermal ranges. Conversion of historical data collected using the STATE program was necessary to compare past results with future data. Even though the programs analyze the results slightly differently, it is not expected to significantly impact or change the thermal classification of CLOCA's streams.

It should be noted that stream temperature classification can be confusing. Historically in Ontario only two thermal classification categories were used, coldwater and warmwater. Coldwater fishes such as Trout and Salmon can be found in both coldwater and coolwater temperature zones and so these zones represent coldwater streams in the traditional sense (Bowlby, 2008).

It is important to note some of the limitations of this data. Although the data provides an excellent idea of what the water temperature is at an individual section of creek throughout the critical periods, it should be understood that the logger is representing a fixed point. The logger takes the temperature measurement at that location and is not representative of the entire habitat in that section of creek. Temperature is the single most important abiotic factor to a fish because of it being poikilothermic or "cold-blooded". For this reason there are values derived for most fish that represent what the maximum temperature they can tolerate before their biological functions cease. For example, Rainbow Trout, has a maximum tolerable temperature of 26° Celsius (Coker et al., 2001). If a temperature logger exceeds that threshold it is often assumed that no Rainbow Trout can survive in that section of creek. Although this may be true if the water temperature remains above this threshold for an extended period of time, it is not certain especially if the duration of exceedence is short. Fish are experts at seeking out thermal refugia to avoid their lethal maximum temperatures. Deep pools, undercut banks, riparian vegetation, groundwater discharge areas and high flow areas can all provide thermal refuges in which the temperature is lower than the rest of the creek. For this reason Rainbow Trout have been found in creeks with readings over 26° Celsius (Ebersole et al., 2001; Fowler et al., 2009). The same has been found for other coldwater species, such as Chinook Salmon (Torgersen et al., 1999). Their ability to use behavioural thermoregulation, whereby the fish seeks out thermal refugia, allows them to survive periods where the majority of the creek has a temperature that exceeds its maximum thermal limits.

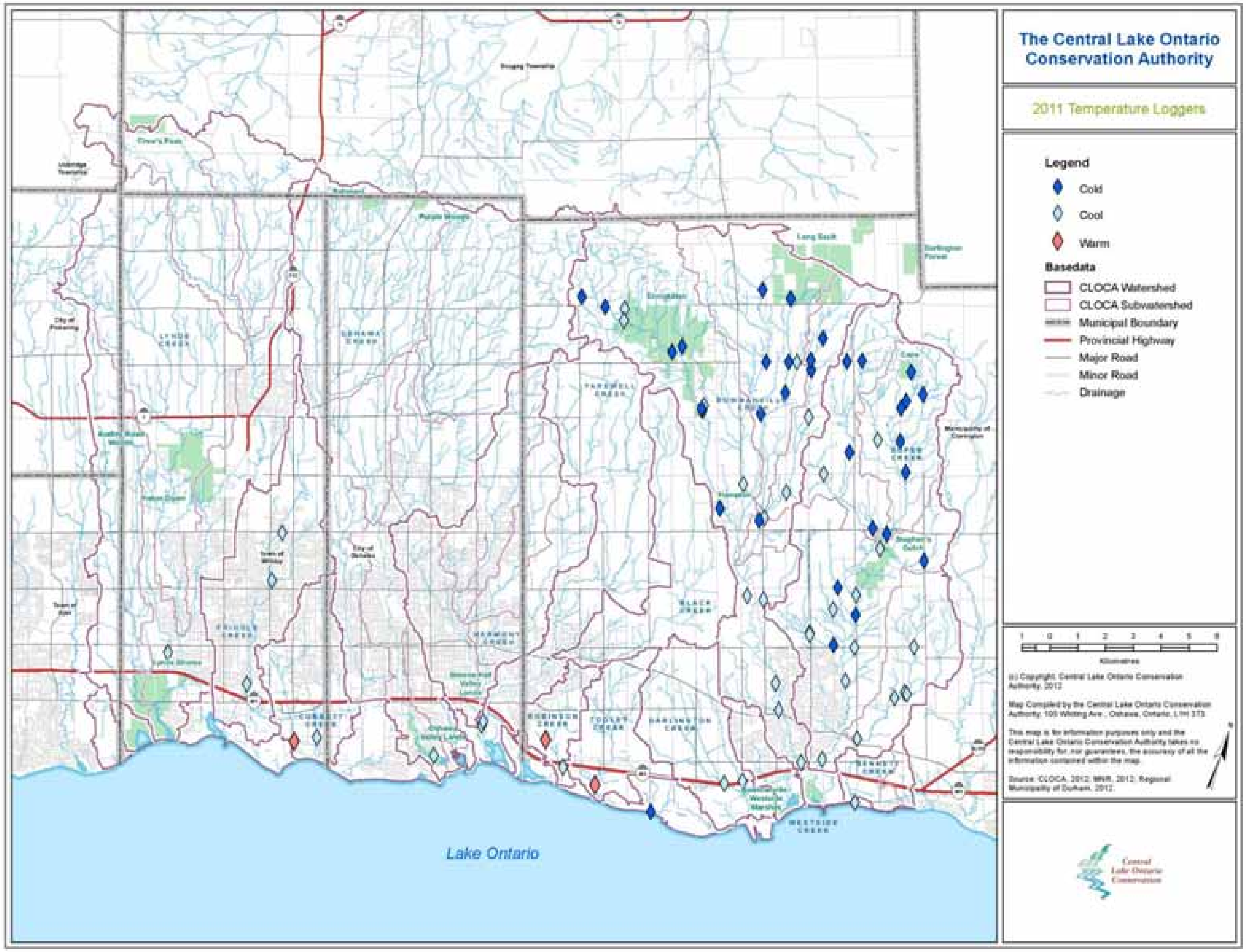

Figure 7: Location and thermal classification of stream temperature loggers during 2011.

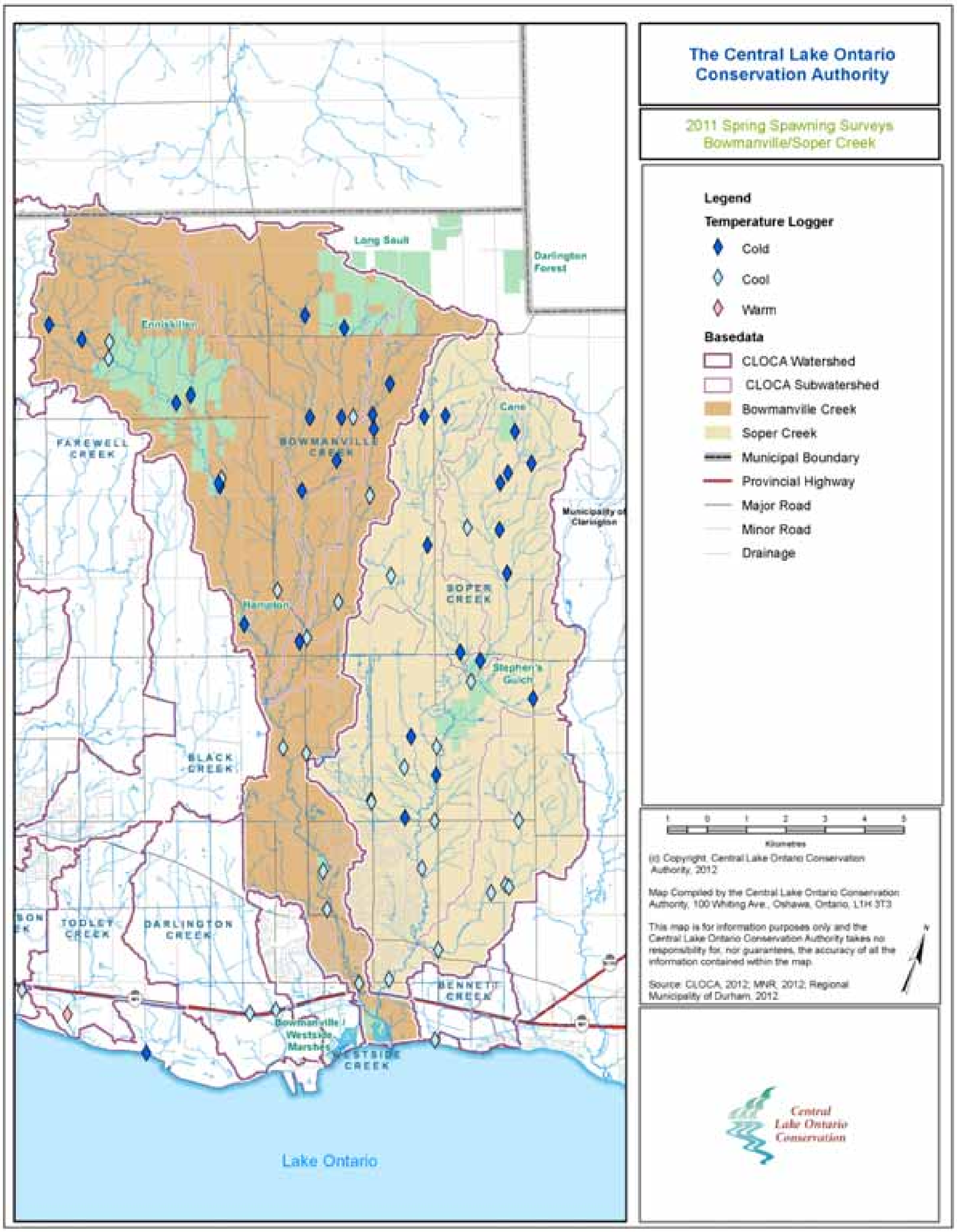

Figure 8: Location and thermal classification of stream temperature loggers within the Bowmanville/Soper Watershed during 2011.

4.2 Results

Please refer to Table 7 in Appendix III – Stream Temperature and Figure 7 and Figure 8 regarding temperature logger data discussion below.

4.2.1 Bowmanville Creek

During the 2011 season, 30 temperature loggers were installed within Bowmanville Creek. The Bowmanville Creek, along with Soper Creek, has a thermal regime most similar to pre-development conditions within the CLOCA jurisdiction, which is believed to be a full coldwater system.

In the northern sections of the watershed the thermal regime is predominately coldwater with a few coolwater sites scattered throughout where land use changes have impacted them. Throughout the middle of the watershed there is a mix of both cold and coolwater sites. The southern part of the watershed, in and around the Town of Bowmanville, is dominated by coolwater sites. These thermal regimes are confirmed with biological evidence as healthy Brook Trout, as well as other Salmonids, populations are found in the northern areas while the southern areas still support healthy populations of both Brown and Rainbow Trout as well as seasonal migrants. Continued monitoring to identify if the warming trend in the southern portion of the watershed continues is recommended. With continued development in that area, increased pressured could make it difficult to maintain a thermal regime suitable for the fish that currently occupy the creek.

Of the 30 loggers installed in Bowmanville Creek during 2011, seventeen were found to be coldwater and thirteen were found to be coolwater. There were no coldwater sites located below Taunton Road.

Loggers were placed upstream and downstream of most of the large barriers having a considerable sized pond upstream. Ponds and barriers can impact downstream temperatures so the placement of loggers above and below a barrier can determine if any significant increases of temperature occur. Results from 2011 show that although there are some increases in the rate of temperature change per day, there does not appear to be any significant thermal impacts. However, without historical temperature data (prior to installation of the barrier), it is difficult to quantify exactly how much the barrier and pond is impacting stream temperature. As a result of this information, it would appear as though the protection of upstream Brook Trout populations is a stronger positive than the possible negative thermal impacts that it is creating.

4.2.2 Bennett Creek

During the 2011 season, one temperature logger was installed in Bennett Creek. This is the second year data has been retrieved from this site. Both years it has been found to be coolwater, which is consistent with the fish species caught in this area.

4.2.3 Corbett Creek

During the 2011 season, two temperature loggers were installed in Corbett Creek. Both of these temperature loggers are installed at long-term monitoring sites south of Wentworth Drive, one on the east branch and one on the west branch. Results from the east branch (TLCE01) show the coolest temperatures to date whereas the results from the west branch (TLCW01) show the highest temperature to date. A definitive explanation is not currently known, however, there is more riparian cover directly upstream of the east branch. There is also a piped section of the creek upstream on the east branch that discharges cold water as found in 2010 because the water is not being heated up by the sun (but also not providing any habitat to aquatic species). Although both branches are highly impacted, the west branch has limited riparian and is low gradient upstream of the temperature logger. These low gradient areas are visible as wetlands. The limited flow in these areas allow for increased water temperature. These reasons could be contributing to the difference in temperature between the two branches.

4.2.4 Darlington Creek

During the 2011 season, two temperature loggers were installed in Darlington Creek. Each of these temperature loggers are installed at long-term monitoring sites north of the 401 and south of Baseline Road. One site, TLDN01, is on the west branch and the other site, TLDN02, is on the east branch. Results from TLDN01 show an increased maximum temperature nearing the warmest maximum temperature recorded in 2006. Although the stream did come near the warmwater mark, it still fell within the coolwater window. Results from TLDN02 are consistent with the four previous sampling years at this site. All years have been found to be coolwater.

4.2.5 Farewell and Harmony Creeks

During the 2011 season, a total of three temperature loggers were installed around the area of the Harmony and Farewell confluence. Two loggers were located upstream of the confluence, one on each Harmony (TLHA01) and Farewell creeks (TLFA02), and the other below the confluence (TLFA01).

The logger on Harmony Creek (TLHA01) was monitored for the fourth year. It once again was determined to be coolwater. The 2011 season did have the warmest summer temperatures to date with a maximum temperature reaching up to 27.8°C.

The two loggers on Farewell Creek (TLFA01, TLFA02) were found to be coolwater for the fourth straight year. The 2011 season did have the warmest summer temperatures to date at these sites. TLFA01, which is downstream of the confluence, consistently has higher temperatures than TLFA02. This could be partially attributed to the slightly higher temperatures coming from Harmony Creek.

4.2.6 Gold Point Creek

During the 2011 season, one temperature logger was installed in Gold Point Creek. It was located near the mouth to Lake Ontario and was found to be coolwater. It is not clear how much of an impact water processes from Lake Ontario would have affected this logger.

4.2.7 Lynde Creek

One annual monitoring temperature logger was installed within Lynde Creek during 2011. This was the third year that temperature had been measured at this location. The site was found to be coolwater for the second straight year. Even though it is coolwater, when compared to the previous sampling year (2009) results temperatures are much higher. Continued monitoring to be able to identify long-term trends apart from seasonal variability is required.

4.2.8 Oshawa Creek

One annual monitoring temperature logger was installed within Oshawa Creek during 2011. This was the third year that temperature had been measured at this location. The data indicated that this section of creek is coolwater. All three years that this site has been monitored has resulted in a coolwater designation. Further monitoring will help to determine if the thermal regime stays as coolwater or if the high density urban land use upstream of the site increases the temperature over the long-term.

4.2.9 Osbourne Creek

In Osbourne Creek, one temperature logger was installed in 2011. The logger was placed just upstream from Lake Ontario. This was the third year that this logger had been put in this location. This season, including the previous two years, resulted in a thermal designation of coldwater. This was supported by finding YOY Rainbow Trout at this location during 2010 fisheries sampling.

4.2.10 Pringle Creek

During the 2011 season, three temperature loggers were installed in Pringle Creek. All of the loggers where found to be coolwater. This is consistent with previous years sampling results. The one logger located near Garden Street and Consumers Drive (TLPR01) has been rising in temperature since 2007. It is not known if this is related to land use or if it is coincidence with natural variation in summer weather. Continued monitoring should help determine this.

4.2.11 Robinson Creek

During the 2011 season, two temperature loggers were installed in Robinson Creek. TLROB01 was selected as a site for the fourth time. This site was recorded as warmwater again, remaining consistent with the previous three seasons. This is not surprising because it is a small tributary with an outlet from a stormwater pond upstream, limited groundwater discharge in the area, and the area around the logger is historical pasture for livestock. CLOCA did a stewardship project at this location to remove livestock from the area. It will be interesting to continue monitoring temperature at this site to see if the improving riparian habitat can help to provide enough shading to impact the thermal regime.

The other temperature logger, TLROB02, was located in the northern part of Darlington Provincial Park. Data indicated that this section of creek is coolwater, which is consistent with the three previous sampling events at this site.

4.2.12 Soper Creek

During the 2011 season, 30 temperature loggers were installed in Soper Creek. The Soper Creek, along with Bowmanville Creek, has a thermal regime most similar to pre-development conditions, which is believed to be a full coldwater system. It is similar to the Bowmanville Creek in that the northern section is dominated by coldwater sites with only a couple coolwater sites. On the north side of Taunton Road there is a total of ten coldwater sites and two coolwater sites. South of Taunton, there are more coolwater sites than coldwater. There are five sites south of Taunton Road that are classified as coldwater and thirteen classified as coolwater. There is an obvious trend showing an increase in temperature as you move farther south in the watershed (aside from site specific extremes). This coincides with an increase in urban development and an increase in the amount of agriculture upstream of the site.

Biological data from the summer fisheries sampling confirms that Soper Creek is a coldwater system as there is a healthy Salmonid population as well as non-game fish that are tolerant of only coldwater systems (e.g. Slimy Sculpin). Continued monitoring to determine long-term trends, especially in the east branch and near Bowmanville on the main branch, is recommended.

In 2005 two loggers (TLSOP09 and TLSOP10) were purchased by Irv Harrell for his stewardship property (Hawkridge Farm) located within Soper Creek watershed (Gibb Road/Concession Road 7). A section of Soper Creek flows through Hawkridge Farm and data from 2005 to 2011 indicates that it is coldwater. No cool or warmwater days have been recorded during this time. During 2011, the highest maximum temperature for either logger was 17.9° Celsius. This is a slight increase from 2010 but below the high set back in 2009. The average maximum temperature since 2005 is 16.9° Celsius at TLSOP09 and 17.2° Celsius at TLSOP10. Figure 9 shows evidence of a possible warming trend (over the past seven years of temperature recording) of approximately ¾ of a degree based on the line of best fit for TLSOP10 and over one degree Celsius based on the line of best fit for TLSOP09. Continued monitoring to see if this trend is correct or is being influenced by natural variation in weather patterns is recommended.


Temperature Logger Removal

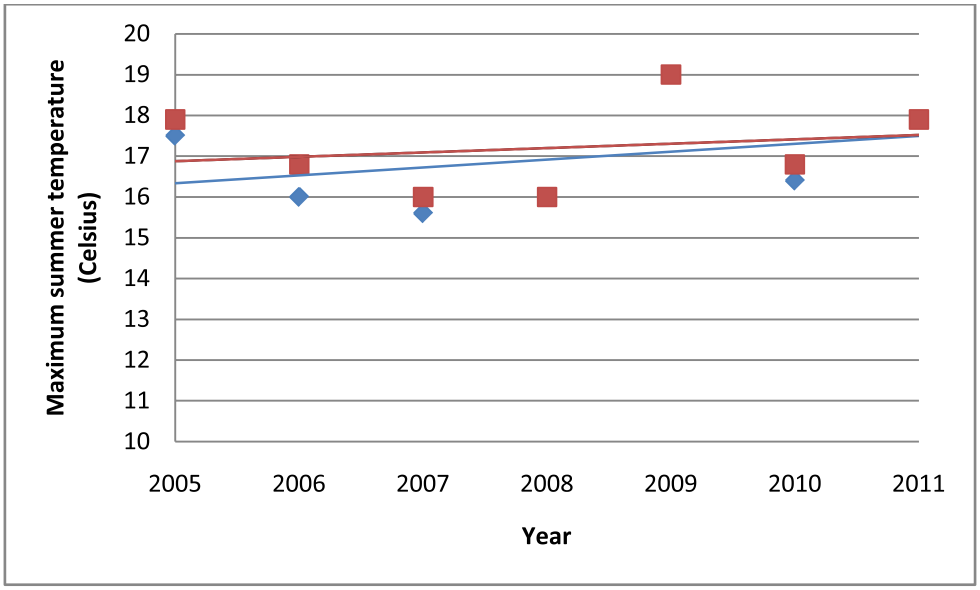

Figure 9: Trend data from Soper Creek Temperature loggers (TLSOP09 (blue/triangle), TLSOP10 (red/square)) from 2005 to 2011. Temperature is measured in degrees Celsius. Loggers are located near Gibb Road and Concession Road 7.

4.2.13 Tooley Creek

During the 2011 season, one temperature logger was installed in Tooley Creek. This is the fifth year that temperature has been monitored at this site. This was the second year out of the five that the site has been classified as warmwater. The three previous sampling events recorded coolwater. This is a site that fluctuates around the threshold between cool and warmwater and can go either way depending on how cool or hot the summer is relative to other years.

4.3 Temperature monitoring methodology

Previous to temperature loggers becoming more affordable, different methodologies were required to classify water temperature. Without having a thermometer in the creek for an extended period of time it becomes difficult to determine maximum temperature without putting an unrealistic amount of effort into each site. A widely used methodology that allows you to determine maximum temperature with a single temperature measurement was developed by Stoneman and Jones (1996). This methodology was used by CLOCA previous to large scale use of temperature loggers because it was locally developed, simple to use and required only one measurement after a heat wave (as defined by Stoneman and Jones, 1996). After temperature loggers became available in large quantities CLOCA no longer used the Stoneman and Jones (1996) methodology because as they stated in their paper, “when resources are available, continuous temperature data collected over a period of weeks or months will invariably provide a more accurate description of the stream’s thermal regime”.

During the 2011 summer, CLOCA used both temperature logger data analyzed by ThermoStat V2 and Point-in-time measurements using the Stoneman and Jones (1996) methodology. The sites were classified as cold, cool or warmwater. Since ThermoStat V2 does not actually provide you with a thermal classification, CLOCA used the data analysis provided by ThermoStat V2 and our previous in-house classification methodology to determine thermal classification. The classifications were then compared to determine the similarity between the two methodologies.

Results showed considerable difference between temperature logger results and point-in-time measurements (Figure 10). When compared with temperature logger data, it was found that depending on which maximum air temperature was used there could be anywhere from five to 20 sites (of a total of 35) that had different thermal classifications. In all cases, when thermal classification differed, the Stoneman and Jones (1996) methodology was the higher temperature designation. For example, if there was a difference, Stoneman and Jones (1996) would be Coolwater and the temperature logger would be Coldwater or Stoneman and Jones (1996) would be Warmwater and the temperature logger would be Coolwater.

The main problem that was found when dealing with the Stoneman and Jones (1996) methodology was the variability in the outcome based on the maximum air temperature that is used in determining the thermal classification. Figure 11 demonstrates the variability depending on the air temperature that is used. In the CLOCA jurisdiction, one maximum air temperature is often not suited to the entire area. The area closer to Lake Ontario tends to have less temperature fluctuations compared to the north end of the jurisdiction and a slight cooling effect caused by Lake Ontario (in the summer months). Using the same temperature for all sites will likely decrease the accuracy of both the south and north ends of the watersheds depending on the location of the air temperature source. This makes picking the source of the maximum air temperature critical. The two closest sources of maximum air temperature were posted by Environment Canada and Farmzone.ca (The Weather Network). Their posted maximums were different resulting in different classifications at some sites. It was found, in the CLOCA jurisdiction, that unless more air temperature monitoring stations were set up at different locations throughout the watershed, the resulting thermal water temperature will invariably have error associated with it.

In conclusion, Stoneman and Jones (1996) is a good tool for supplementary temperature data but when available continuous in-stream temperature data is the most accurate and should be used as the basis for thermal management decisions.


Bowmanville Creek – temperature logger installation.

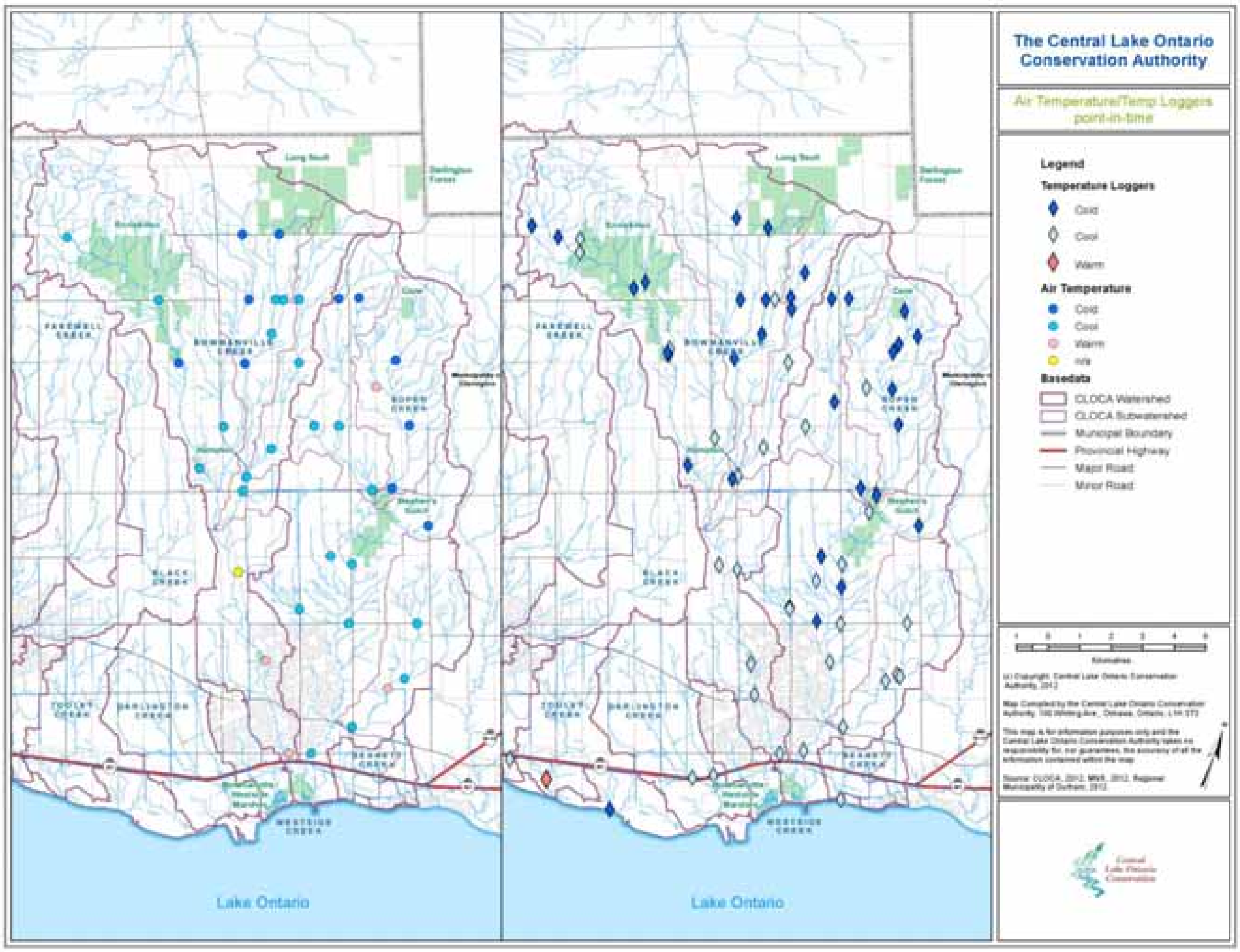

Figure 10: Comparing Temperature Logger and Point-in-time (using farmzone.ca) temperature measurements from the 2011 season in select Bowmanville and Soper Creek Sites.

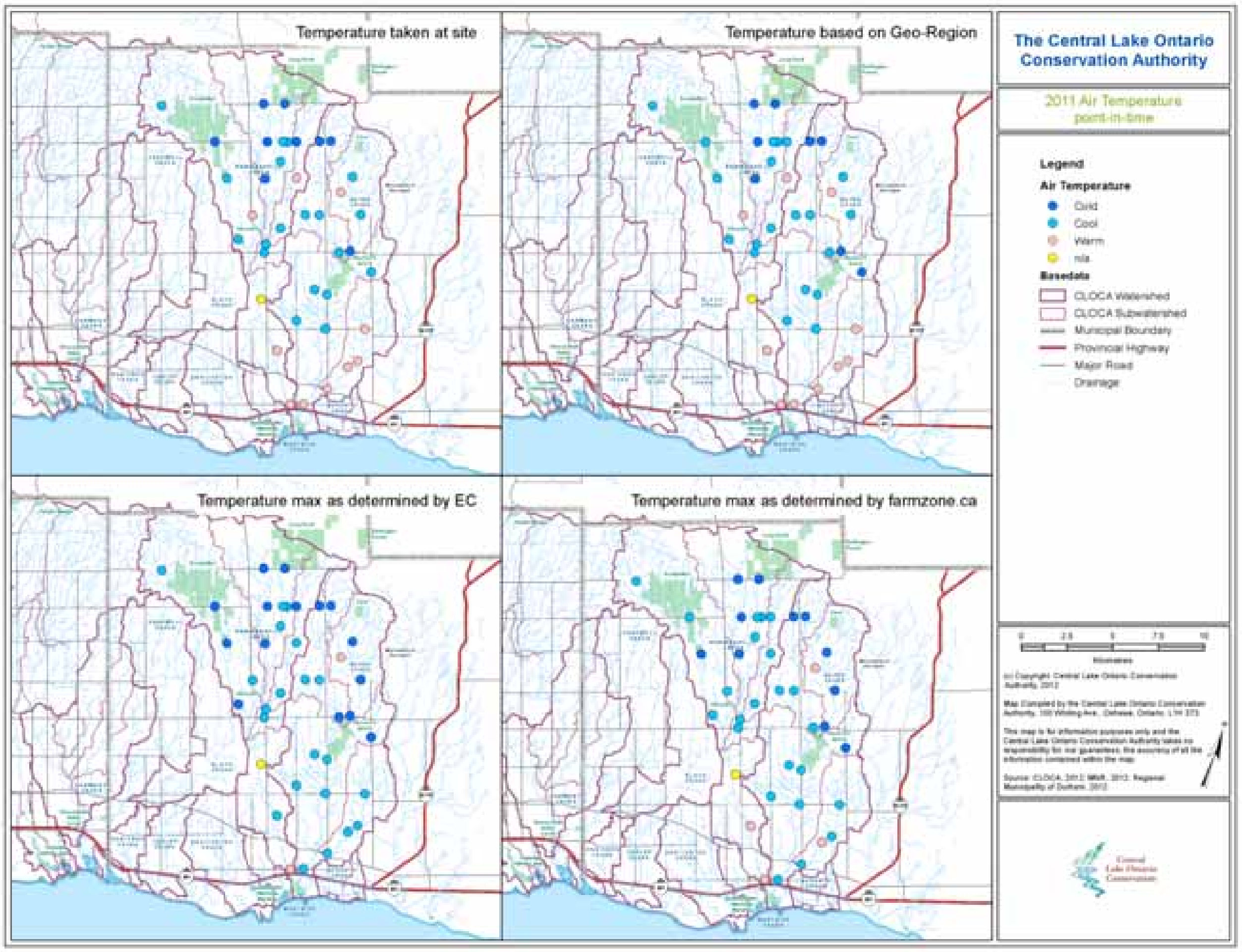

Figure 11: Comparing four different results of the Stoneman and Jones (1996) thermal classification methodology by using four different methods for collected maximum air temperature. The recommended method, nearest weather station, was used by looking up maximum temperature on Environment Canada (EC) and farmzone.ca (Weather Network as well as using maximum temperature recorded at each site and average maximum temperature recorded at each site after being broken up into georegions.

5.0 FISHERIES SAMPLING (STREAMS)

5.1 Introduction

Fish are one of our most valued natural resources from ecological, economic, social and cultural perspectives. Healthy fish and environments result from protecting and/or restoring aquatic ecosystems (Draft Terms of Reference, 2005). In order to help determine aquatic ecosystem health and monitor it over time CLOCA conducts fisheries assessments in various watersheds each season. Ongoing annual aquatic monitoring is recommended in the Central Lake Ontario Fisheries Management Plan (CLOFMP; CLOCA/MNR 2007). Information collected during these programs supports the goals and objectives of the CLOFMP and allows for an adaptive management approach.

Historically, watersheds within the Central Lake Ontario Conservation Authority supported healthy coldwater fish communities and a strong Brook Trout and Atlantic Salmon fishery. With increasing urbanization and changing land-use patterns, many of the coldwater streams have become cool or warmwater systems. The Atlantic Salmon fishery has since collapsed and has been supplemented by stocking of Pacific Salmon and Trout species. In CLOCA's jurisdiction, the distribution of Brook Trout has typically been reduced to the undeveloped headwater reaches in the natural settings of the Oak Ridges Moraine (CLOCA/MNR, 2007).

While there have been many changes to the fish communities and fish habitat within CLOCA's jurisdiction, the watersheds are still home to a diverse array of fishes including cold-, cool- and warm-water species. The Bowmanville/Soper watershed has the highest diversity of Salmonids in CLOCA jurisdiction. Angling opportunities include Rainbow Trout and White Sucker during the spring and Chinook and Coho Salmon and Brown Trout during the fall; all during the regular season (refer to **Error! Reference source not found.** for more information). Brook, Brown and Rainbow Trout resident populations also exist in most of the watershed. Anglers also take advantage of fishing popular warm-water species such as, Bass, Sunfish, Pike, and Carp in the coastal areas (CLOCA/MNR, 2007).

Generally, CLOCA conducts fisheries sampling in streams using a common sampling method called **electrofishing** (see photo on right). On occasion, when electrofishing is not a suitable technique, other sampling methods, such as seine nets, fyke nets, dip nets and minnow traps, are utilized. Backpack electrofishing, is conducted, for the most part, according to the Ontario Stream Assessment Protocol (OSAP) published by the MNR (Stanfield, 2005).

Electrofishing is a sampling method that temporarily immobilizes fish in water using electricity. Once immobilized, they can be captured with nets and fisheries staff can collect biological information (e.g., species, length, weight) before releasing them.

5.2 OSAP Monitoring Results

During 2011, 58 OSAP sites were sampled by CLOCA as part of the annual aquatic monitoring program and another four were sampled through the OSAP Training Course in the Oshawa Creek watershed (Figure 12). Fish species that were captured are listed in Table 8, Table 9, Table 11, Table 12 and Table 13. The main focus for sampling during 2011 was in the Bowmanville and Soper watersheds. Other sites were selected to monitor long-term trends in other watersheds or provide fisheries data needed for plan review.

The draft Central Lake Ontario Fisheries Management Plan (MNR/CLOCA 2007) outlines watershed and subwatershed-based goals and objectives for the fisheries resource and habitat within Bowmanville and Soper Creeks, and identifies target species and fish communities for management. CLOCA's annual aquatic monitoring helps to assess these goals and objectives and is consistent with the management recommendations made within the Plan. Further, it allows for an adaptive management approach.

The results of the 2011 CLOCA Aquatic Monitoring are consistent with the goals and objectives of the FMP. The main branches of Bowmanville and Soper Creeks are still dominated by migratory salmonids and should remain managed as such. Upstream of impassable barriers to fish migration, streams remain dominated by resident coldwater fish communities including Brook Trout, Brown Trout and Sculpin species (Figure 13). These headwaters should continue to be managed for these sustainable and diverse fish communities.

Balancing development and environmental integrity can be a difficult process but is necessary to meet the economic goals of the municipalities while still maintaining an ecologically sustainable landscape. Since many of the species that inhabit Bowmanville and Soper watersheds are sensitive to land use it will be important to mitigate the negative impacts that urban and agricultural lands can have on the surrounding area. With best management practices in place and well thought out planning, Bowmanville and Soper Creeks should have a healthy population of Trout, Salmon and Sculpin for years to come.



5.2.1 Bowmanville Creek watershed

During the 2011 season, 21 sites were sampled in Bowmanville Creek. The Brook Trout populations that were sampled in 2011 showed mixed results (Locations in Figure 14). Three sites (BA04, BC06, BD04) show some signs of decrease in their population whereas the other four sites with Brook Trout (BB08, BB09, BB17, LMP3) all showed consistent trends or an increase in numbers. It is interesting to note that three of the sites with increasing numbers of Brook Trout were located on the Hampton Branch (formally known as “B” branch) which is where considerable land acquisition by CLOCA has taken place. The Enniskillen Conservation Lands provide important protection for the headwaters of this branch which is likely benefiting the aquatic communities downstream. Since the land acquisition has been fairly recent it is unknown if the positive effects are being transferred downstream already or if other factors are at play.

The Brown Trout population does not appear to have any trends that stand out. Their population continues to be strong throughout most of the watershed.

Migratory Salmonids were found throughout the entire watershed except where movement is impeded by barriers. Rainbow Trout are the most numerous as many of the young-of-year spend much of the summer in the creeks before swimming downstream to Lake Ontario. Most of the Coho and Chinook Salmon have left the creeks for the Lake Ontario by the time sampling begins in July, but pockets of them were found in various locations in the watershed. Coho Salmon numbers increased from previous years.

The Darter species in the Bowmanville Creek, Rainbow and Johnny Darters, were found in one location during 2011 sampling. Johnny Darter numbers at this site (BA01) appear to be decreasing whereas the Rainbow Darters numbers have fluctuated in large amounts with 2011 numbers being similar to 1998 sampling results. Darters have specific habitat needs which may explain why they are only found at this one site in Bowmanville Creek and why numbers might be decreasing. Since they are benthic species, a changing substate can decrease their population size as they have a hard time adapting. Another group of small, sensitive species are the Sculpins (Mottled and Slimy). The Mottled Sculpin are spread throughout much of the watershed while the Slimy Sculpin are restricted to the headwater areas. Mottled Sculpin numbers appear to be decreasing slightly at the sites that are located closer to the Town of Bowmanville but have no obvious trend higher up in the watershed. Sites containing Slimy Sculpin are limited but the sites that do have them show that the population is holding steady in these areas.


Rainbow Trout young-of-year


Brown Trout

Overall the Bowmanville Creek watershed is in good health. The best areas are found higher in the watershed where there is less impact from urban and agricultural land uses and where ground water contributions provide excellent water quality and thermal preferences of the fishes that live in that area. The lower sections of Bowmanville Creek are still in good condition but the effects of urbanization and the cumulative land use changes upstream are becoming apparent. That being said, some Trout, Salmon, Sculpin and Darter species are still able to survive in these sections which is evidence of good water quality (Figure 13).

5.2.2 Farewell Creek watershed

During the 2011 season, one site in Farewell Creek was sampled. This site, FA12, was sampled later in the fall when the opportunity came up for CLOCA to fill a data gap in conjunction with a stewardship project taking place. The site was found to have Rainbow Trout young-of-year, Creek Chub and Blacknose Dace. This was an interesting observation because this section of creek is often intermittent and dries up during the summer. It is unknown if the creek was dry this summer, but if it was, the fish were able to quickly inhabit the area again after flow resumed. This could be demonstrating the importance of all fish habitat regardless of its seasonal flow pattern.

5.2.3 Gold Point Creek watershed

During the 2011 season, one site was sampled in Gold Point Creek. This site (GM02) was sampled for the second time by CLOCA. It is considered to be located in the Coastal Wetland (drowned river mouth) section of Gold Point Creek. 2011 sampling results showed very consistent results to the previous sampling. Species total and total fish caught were almost identical.

5.2.4 Lynde Creek watershed

In the Lynde Creek watershed, two sites were sampled in 2011. Both sites were located on a small tributary within the Lynde Main subwatershed. The sites were located near Rossland Road and Coronation Road. At site LA24 Brook Stickleback was caught and site LA25 resulted in a no-catch.

5.2.5 Osbourne Creek watershed

One site was sampled in Osbourne Creek in 2011. This was the third time that this site was sampled, the first being in 2004 and the second being in 2010. Sampling resulted in a no catch during 2011. Continued monitoring to see how fish from the lake utilize these small coastal watersheds is recommended.

5.2.6 Oshawa Creek watershed

In 2011, three sites were sampled in Oshawa Creek. All of these sites were located near Simcoe Street and Conlin Road intersection. This was the first time that any of the sites had been sampled by CLOCA. The primary purpose was to collect fish presence/absence data for plan review purposes. Sampling results show that all three are direct fish habitat and based on the fish species caught were representative of a cool/coldwater fishery.

5.2.7 Robinson Creek watershed

During the 2011 season, one site in Robinson Creek was sampled. This site was located within the Robinson Creek Coastal Wetland in Darlington Provincial Park. This was the second time this site has been sampled by CLOCA. The total number of fish caught was higher in 2011 than 2010, but species richness dropped. Threespine Stickleback was caught for the first time and White Sucker numbers increased from 14 to 85. Bluntnose Minnow, Green Sunfish, Johnny Darter and Largemouth Bass were the species caught in 2010 but not in 2011. Continued monitoring to see how fish use this coastal wetland is recommended.

5.2.8 Soper Creek watershed

During the 2011 season, 21 sites in Soper Creek were sampled. Twelve sites were sampled using the OSAP protocol and nine sites were sampled to determine presence/absence of fish for plan review purposes.

The Salmon and Trout in Soper Creek appear to have strong, stable populations. Brown Trout (see photo below/right) has the strongest resident Trout populations as this species was found in high numbers throughout much of the watershed. Brown Trout provide excellent angling opportunities. Overall, Brook Trout are found in lower numbers as they are restricted to the higher areas in the watershed. It is thought that competition from other Salmonids (Brown Trout, Rainbow Trout, Chinook Salmon and Coho Salmon), decreases in water quality and increases in temperature through loss of riparian habitat are the main reasons why the range of Brook Trout is currently a fraction of historical distribution in the area (Stanfield et al., 2006).

Other intolerant species, such as Mottled and Slimy Sculpin and Rainbow and Johnny Darter are also found in Soper Creek. Both of these Darter species were found at two of the sites sampled in 2011. It is hard to determine from the limited data at these sites, but currently it appears as through their population sizes might be decreasing. Since they are benthic dwelling species, changes to the substrate (which are common in areas with increased agriculture and/or impervious surfaces) make adaptation difficult. Mottled Sculpin are found throughout the Soper Watershed. The results do appear to show a decreasing number or individuals at sites near urban areas, but more sampling will be needed in order to confirm trends.

Overall the Soper Watershed is in good health. The headwaters support a healthy community of intolerant species, such as Trout, Salmon, Darters and Sculpin. Some areas of the watershed are impacted by agriculture and urban land use, but the main branch of Soper Creek down to Baseline Road still supports sensitive species.

5.2.9 Tooley Creek watershed

During the 2011 season, one site in Tooley Creek was sampled. The site was located in the Tooley Creek Coastal Wetland at the end of Courtice Road. This was the second year that CLOCA has sampled this location. Results from 2011 were similar to 2010 with the exception of Brown Bullhead. During 2011 sampling a school of young-of-year Brown Bullhead were caught increasing their numbers considerably. There were 425 young-of-year Brown Bullhead captured in 2011 and none in 2010. Long-term monitoring will help even out these trends.

These results are impressive given the stresses that are on this coastal wetland. The majority of the wetland is pasture for grazing cattle. The cattle are free to use the creek, which results in: increased sedimentation through disturbance and destabilized banks, no substantial vegetative buffer to limit nutrient loads and limit sunlight penetration, increased turbidity, and an unproductive benthic zone because disturbance prevents healthy vegetative communities. This demonstrates the resilience of this wetland making it a great candidate for stewardship initiatives.


Tooley Creek Coastal Wetland

5.2.10 Annual Long-term Monitoring Sites overview

Ideally, every watershed would be sampled each year to avoid missing any significant events and to develop trend data faster. Due to current resources this is not possible. Therefore, six sites were chosen within CLOCA jurisdiction to be monitored annually long-term. This trend data can be used to determine fish assemblages' shifts and monitor the creeks for establishment of invasive species populations. For this reason, sites in the lower reaches were chosen as they generally exhibit the highest diversity, the most potential anthropogenic impacts and historical records of Round Goby. The annual long-term monitoring sites are located on the larger watersheds. For site locations please refer to Figure 12 and for full fish data please refer to Table 11 and Table 12. Summary of the six long-term monitoring sites are listed below.

5.2.11 Black Creek – BL01

This is the fourth year that BL01 has been sampled. The following is a summary of notable observations at this site. Number of fish caught and species total remained relatively consistent with the previous three sampling seasons. Green Sunfish (please refer to Section 8.1 for more information) population at this site rebounded from zero the previous year to record the highest number yet (7). This trend will be interesting to monitor over long-term to see if they can establish a consistent population. Brown Trout were caught for the first time in 2010 but none were found during 2011. Rainbow Trout on the other hand were found in their highest numbers since 2002. Mottled Sculpin recorded their lowest catch at this site out of the four years it has been sampled.

BL01 – 2011 Site marking

5.2.12 Bowmanville Creek – BWDJ

BWDJ has been sampled from 1996-2006 and in 2010-2011. Sampling in 2011 was the 13th year that this site has been sampled providing excellent long-term trend data. The following are a summary of notable observations at this site. The total number of fish caught and the number of species caught were the third lowest and second lowest respectively in the 13 years BWDJ has been sampled. The reason for this is unclear at this point. Rainbow Trout population remained abundant at this site during 2011. With close to 150 Rainbow Trout caught at this site, it is clear this is an important area for the life cycle of the Rainbow Trout. Another Salmonid, Chinook Salmon were also caught indicating the importance of this creek for their life cycle. Since it is thought that approximately 60-80% of Salmons smolt in the spring, the amount caught is likely only a small fraction of the number of salmon that would have occupied these waters during the fall and winter.

5.2.13 Farewell Creek – FA04

This was the fourth year that FA04 has been sampled. The following are a summary of notable observations at this site. The total number of individual fish and the total number of species caught remained relatively consistent with previous years sampling. 2011 is the first year that a confirmed American Brook Lamprey has been caught at this site. It is encouraging to see species that are sensitive to land use changes doing well at this site. Rainbow Trout and Mottled Sculpin populations remain consistent with previous years and show no signs of decline since CLOCA has been monitoring this location.

5.2.14 Lynde Creek – LA01

This was the fourth year that LA01 has been sampled. The following are a summary of notable observations at this site. Total number of individual fish caught was the lowest of the four years sampled. Total number of species caught remained relatively consistent with previous years. During 2011 sampling, the first American Brook Lamprey was caught. This is an unusual catch in this area as they are considered a sensitive species. It is still being confirmed at the Royal Ontario Museum that it is in fact an American Brook Lamprey and not a young Sea Lamprey. These two species look almost identical at a young age. Darter numbers appear to be decreasing for both Johnny Darter and Rainbow Darters. Continued monitoring of this trend is recommended.

5.2.15 Oshawa Creek – OA05

This was the fourth year that OA05 has been sampled. The following are a summary of notable observations at this site. Total number of individual and total number of species caught remained relatively consistent with previous years sampling. Johnny Darter numbers appear to be declining with another slight decline in numbers from 2010 to 2011. On a positive note, Mottled Sculpin appear to be maintaining high numbers from previous years sampling. This was the first year that White Sucker were not caught at this site by CLOCA.

5.2.16 Soper Creek – SB01

This was the fourth year that SB01 has been sampled. The following are a summary of notable observations at this site. During 2011 sampling, total individual fish caught was the lowest out of the four years sampled. One Chinook Salmon was caught at this site for the first time by CLOCA. Rainbow Trout were also caught but in low numbers (3). It is interesting to note how different the Rainbow Trout populations are between Bowmanville and Soper just north of Baseline. It would be interesting to determine if this is watershed related or simply site specific variation. Round Goby were caught for the second consecutive year. Monitoring the Round Goby to see if it permanently establishes a population is recommended.


LA01 – 2011 Site marking


OA05 – 2011 Site marking


SB01 – 2011 Site marking

5.3 OSAP Training Course

The 2011 OSAP Training Course was held from June 6-10 at Durham College/UOIT. This was the fifth year that as part of the training program a selection of 4 CLOCA ARMP sites within Oshawa Creek watershed was sampled. Due to the fact that this is a training exercise with participants taking turns in order to gain practical sampling experience, abundance data is not reported (Table 13).

During testing and safety checks, prior to sampling a site for the OSAP training course, a juvenile American Eel was captured. American Eels are classified as endangered in Ontario. The once abundant species have seen their numbers drop dramatically because of overfishing and barriers. Their unique life history make them both an interesting species and a challenging one to manage. Efforts are being made to restore connectivity within the St. Lawrence and allow this species to recover. For more information on the importance of American Eel, their life cycle, threats and what is being done to help them, please refer to the MNR document in Section 17.0 on American Eel.


Brown Trout

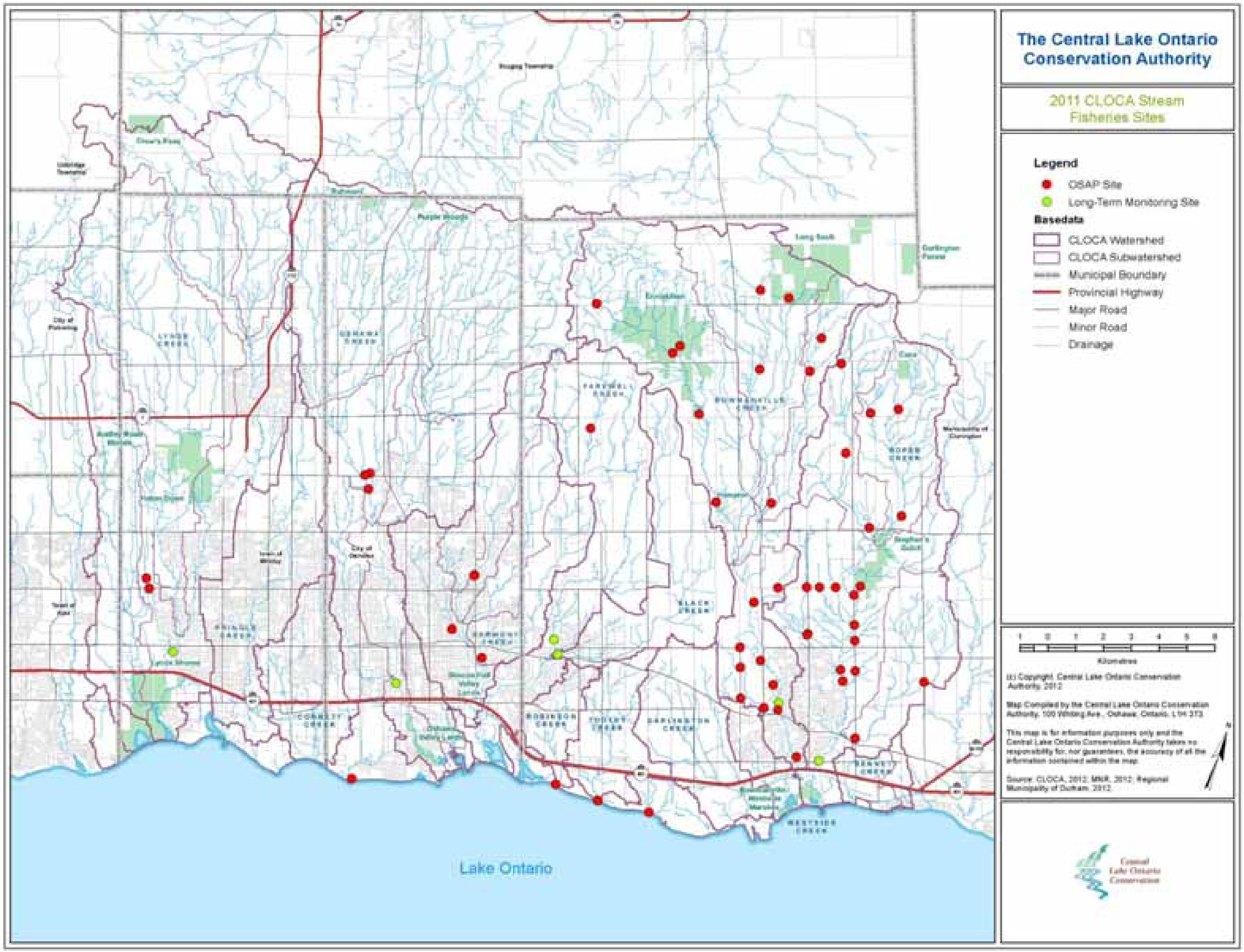

Figure 12: 2011 stream fisheries site locations.

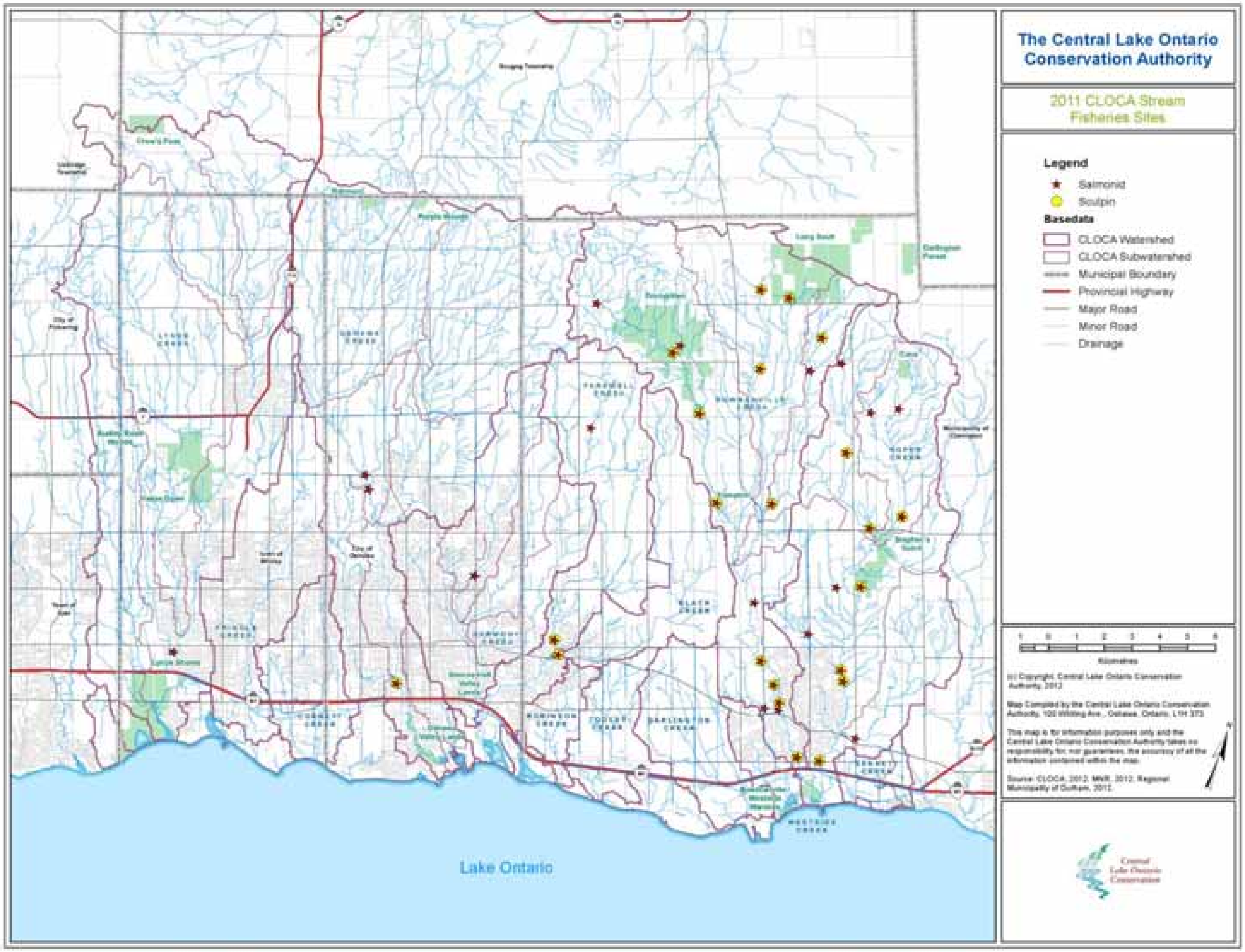

Figure 13: Locations where Salmonid and Sculpin species were caught during 2011 fisheries sampling.

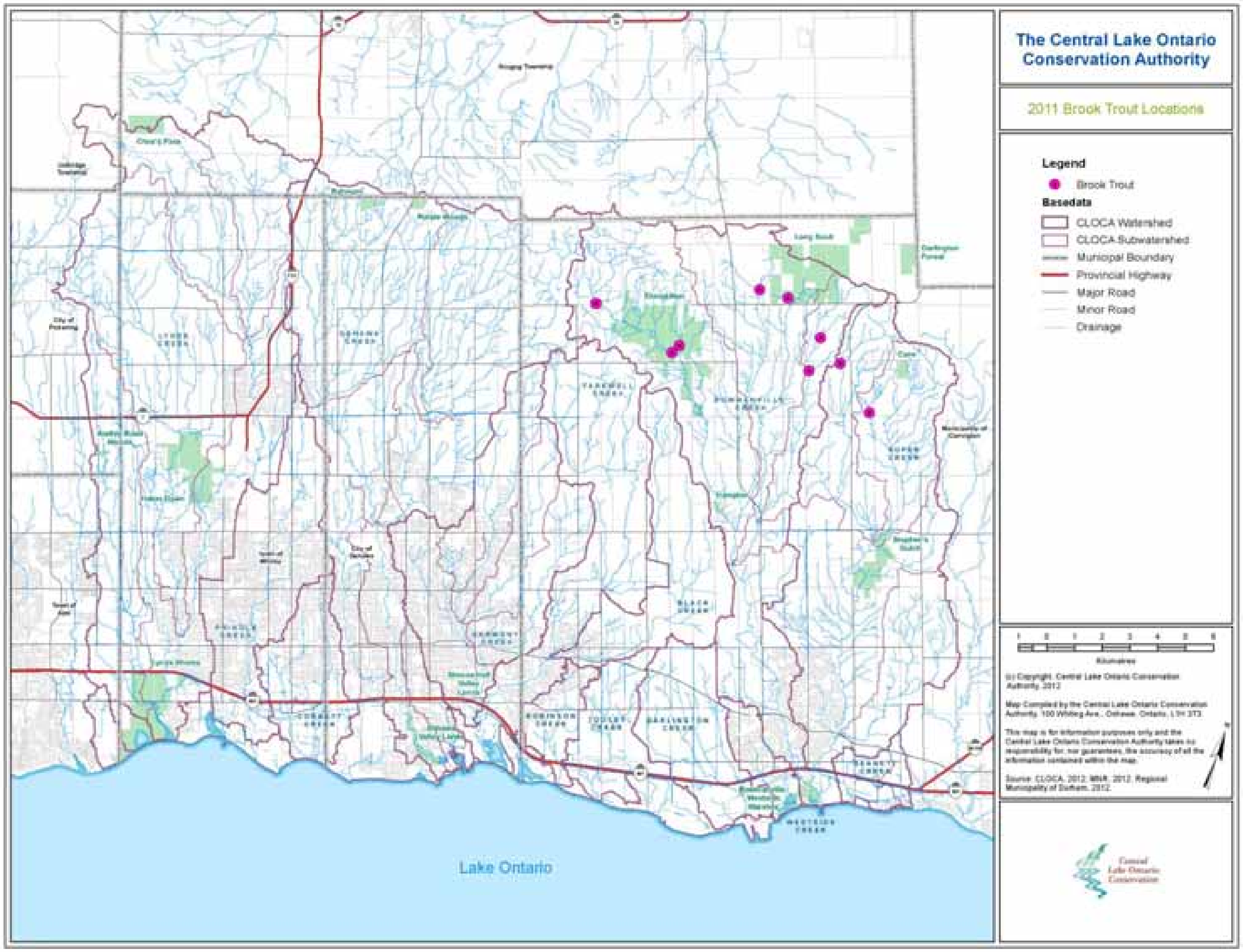

Figure 14: Brook Trout locations found through 2011 fisheries sampling.

6.0 FISHERIES SAMPLING (COASTAL WETLANDS)

6.1 Introduction

Great Lakes coastal wetlands are a unique wetland type that have formed at the mouths of streams and rivers where they empty into the lakes, or in open or protected bays along the shoreline.

Lake Ontario's water level has been regulated since 1960 to accommodate increased demand for shipping and hydroelectric power. Natural water level variability has been diminished, reducing the biological diversity of coastal wetlands that depend on water level fluctuations to maintain diverse vegetation communities (Environment Canada and Central Lake Ontario Conservation Authority, 2004a).

The Durham Region Coastal Wetland Monitoring Project (DRCWMP) is designed to be a long-term monitoring program that enables reporting on the condition of coastal wetlands in the Region (Figure 15). The project was initiated in 1999 and monitoring began in 2002. Partners involved include Environment Canada, Central Lake Ontario Conservation Authority, Toronto Region Conservation Authority (TRCA) and Ganaraska Region Conservation Authority (GRCA) (Environment Canada and Central Lake Ontario Conservation Authority, 2004b).

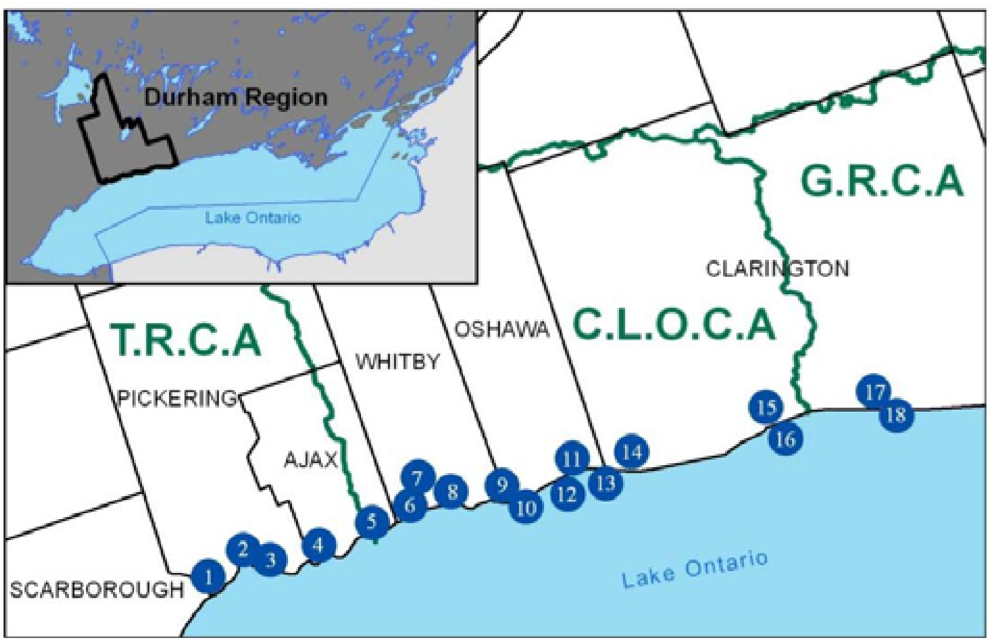

Figure 15: Location of Durham Region coastal wetlands. Wetland information is listed in Table 3.

Table 3: Durham Region coastal wetlands.

Wetland Name	Keymap Number	Wetland Type*	Conservation Authority
Rouge River Marsh	1	DR	TRCA
Frenchman's Bay Marsh	2	BB	TRCA
Hydro Marsh	3	BB	TRCA
Duffins Creek Marsh	4	DR	TRCA
Carruthers Creek Marsh	5	DR	TRCA
Cranberry Marsh	6	BB	CLOCA
Lynde Creek Marsh	7	DR	CLOCA
Whitby Harbour Marsh	8	DR	CLOCA
Corbett Creek Marsh	9	DR	CLOCA
Gold Point Marsh	10	DR	CLOCA
Oshawa Creek Marsh	11	DR	CLOCA
Pumphouse Marsh	12	BB	CLOCA
Oshawa Second Marsh	13	BB	CLOCA
McLaughlin Bay Marsh	14	BB	CLOCA
Westside Marsh	15	BB	CLOCA
Bowmanville Marsh	16	DR	CLOCA
Wilmot Creek Marsh	17	DR	GRCA
Port Newcastle Marsh	18	DR	GRCA

* DR = drowned river mouth; BB = barrier beach lagoon

As part of the DRCWMP, fish communities in wetlands are assessed using a sampling method called boat electrofishing (see photo on right; see page 26 for a definition of electrofishing). In order to have consistent sampling effort, fish are sampled within the DRCWMP wetlands using the same electrofishing boat, owned and operated by CLOCA. Boat electrofishing is conducted according to DRCWMP fish sampling protocol (Environment Canada and Central Lake Ontario Conservation Authority, 2003).

The relative condition of the fish community at each wetland and over multiple years is compared using an Index of Biotic Integrity (IBI). IBIs, which are multi-metric indices, were first developed for use with stream fish communities by James Karr in central Illinois and Indiana (Karr, 1981). Metrics, or attributes, appropriate to Lake Ontario coastal wetland fish communities were selected and tested for suitability in the IBI based on a significant ($p<0.05$) or moderate ($p<0.20$) response to disturbances of the wetland. Six metrics were found to correlate either negatively or positively with disturbance and were, thus, retained for use in this IBI (Table 4). Each wetland receives an IBI score between 0 and 100 each year/time that it is sampled (Table 20) (Environment Canada and Central Lake Ontario Conservation Authority, 2004b).

Table 4: Six metrics used in DRCWMP IBI.

1	Number of native species (SNAT),
2	Number of centrarchid species (SCEN),
3	Percent piscivore biomass (PPIS),
4	Number of native individuals* (NNAT),
5	Percent non-indigenous biomass* (PBNI),
6	Biomass (g) of Yellow Perch (BYPE).

*Metric was corrected for site-specific interaction.

6.2 Durham Results

Water levels were high enough during the 2011 season allowing sampling to occur in all of the wetlands, although not all areas of each wetland were accessible. Sampling continued where possible and certain biases were noted.

Overall wetland health increased in all jurisdictions (Ganaraska CA, Central Lake Ontario CA, Toronto Region CA, Quinte) as indicated by the IBI averages (See Figure 16 and Table 21). It is interesting to note the consistent highs and lows recorded by all jurisdictions. This would suggest a strong climatic or other significant large scale factor plays a significant role in determining year to year fish communities and therefore marsh health. More in-depth results for each wetland are included below.

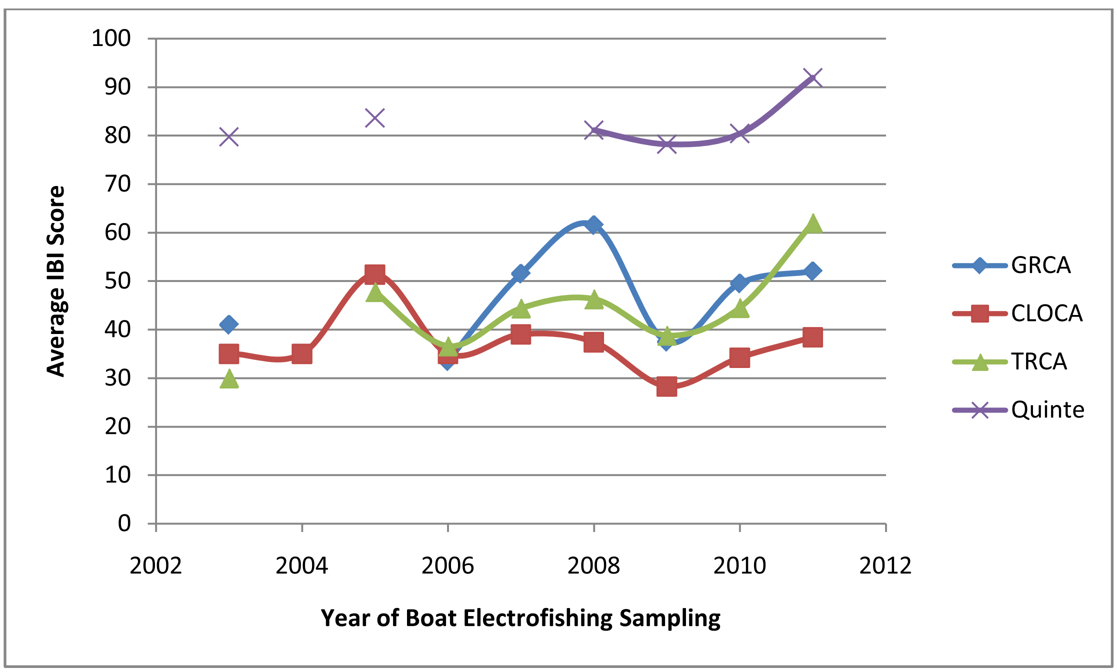

Figure 16: Trends looking at Wetland IBI averages sampled with a boat electrofisher. Wetlands are divided into four jurisdictions, Ganaraska Region CA, Central Lake Ontario CA, Toronto Region CA, Quinte. Number of Wetlands sampled per jurisdiction vary as well as number of wetlands sampled per jurisdiction each year.

6.2.1 Lynde Creek Marsh

Northern Pike

This is the ninth season that Lynde Creek Marsh has been sampled through the DRCWMP using CLOCA's boat electrofisher. Sampling resulted in an IBI score of 60, which is an increase from 2010 sampling as well as being above the average IBI score for this marsh and tying the highest score recorded at Lynde Creek Marsh. Interesting results include the first time that a Rock Bass had been caught in Lynde Creek by CLOCA, high numbers of Fathead Minnow and Gizzard Shad and a juvenile Northern Pike (see photo right). The large numbers of Fathead Minnow and Gizzard Shad are largely responsible for high total individual fish caught as well as increasing the IBI score. It will be interesting to see if this trend continues into the future. Round Goby were not caught during 2011 sampling but another non-native species, the Common Carp, was (see photo below/left).

Sampling completed by the Ministry of Natural Resources during 2011 targeting Freshwater mussels found that Eastern Pondmussels are present in Lynde Creek Marsh. This is an interesting find because the Eastern Pondmussel is classified as a species at risk (SAR). For more information on Eastern Pondmussel, please refer to Section 7.0 Fisheries Related Research.

During 2010 sampling, CLOCA partnered with MOE to determine contaminant levels in sport fish. Results from the sampling have just been updated for Lynde Creek on the MOE site (http://www.ene.gov.on.ca/environment/en/mapping/sportfish/index.htm). Please refer to Section 8.2 for more information on the partnership and the guide.

The fish sampled for contaminants included Brown Bullhead, Yellow Perch and Common Carp. Both Brown Bullhead and Yellow Perch show relatively safe levels of contaminants whereas the Common Carp had high levels of PCBs as shown in the guide by recommending only one serving of carp per month be consumed at a maximum of 65cm in length for the general public. It is recommended that sensitive people (e.g. women of child bearing age, children under 15) do not eat any Common Carp from Lynde Creek Marsh. It is not clear at this point whether the carp are picking up the contaminants from Lynde Creek Marsh or if they have acquired them in another location. Common Carp are known to spawn in wetlands and then either stay in the marsh or disperse back into Lake Ontario (Jude and Pappas, 1992). Further sampling is scheduled to try and determine the source of the contamination.

6.2.2 Whitby Harbour Wetland Complex

Fish Sampling was conducted for the fifth year as part of the DRCWMP within the Whitby Harbour Wetland Complex. Results showed a large increase in species richness from 3 species in 2010 to 13 species in 2011. Three new species were first detected in the marsh through DRCWMP during 2011: Largemouth Bass, Rock Bass (See below/left) and Round Goby (please refer to Section 8.1 for more information). Common species caught in this wetland, such as Common Carp, White Sucker (see below/right) and Fathead Minnow, were once again caught in 2011. The 2011 IBI score was 32 making it the highest to date. This is a large increase from the previous year's score of 13.


Rock Bass


White Sucker

Whitby Harbour Wetland Complex has the lowest IBI average of any of the wetlands sampled through DRCWMP even with a stronger score in 2011. Although this is discouraging to see consistently low results previous to 2011, it is promising to see native species important to Great Lakes coastal wetlands were found in higher numbers this year (e.g. Pumpkinseed, Yellow Perch, Largemouth Bass) compared to previous sampling events. It is important to monitor this trend to see if this is a one-time event or gradual improvement in the Whitby Harbour Wetland Complex.

6.2.3 Corbett Creek Marsh

This is the eighth season that Corbett Creek Marsh has been sampled through the DRCWMP using CLOCA's boat electrofisher. Results from 2011 show an IBI score of 22 down from 41 in 2010. This is likely attributed to the lack of diversity found in the marsh. During 2011 sampling, total number of species caught remained high as well as total fish, although, Brown Bullhead made up the majority of the marsh population. Of the 91 fish caught in 2011, 82 were Brown Bullhead. The reason for dominance of Brown Bullhead is unknown at this time. Continued monitoring of the barrier beach in relation to the fish community is recommended. Pumpkinseed were caught for the eighth straight year and Common Carp (see photo top/right and bottom/left) were caught once again making it five out of the eight years sampled they have been captured. Neither Largemouth Bass nor Northern Pike, which were caught in 2010, were caught during 2011 sampling. Continued monitoring of Corbett Creek Marsh to determine if the top predator population can recover in this area is recommended.

6.2.4 Pumphouse Marsh

For the sixth time as part of the DRCWMP, fish sampling was conducted within the Pumphouse Marsh. During 2011 sampling six species, the highest number found to date in this wetland, were found to inhabit the Pumphouse Marsh. One new species was found during 2011 sampling, Bluegill, but because of their similarities to Pumpkinseed while they are a young-of-year it is not known for certain if this is actually the first time they have been found in this wetland through DRCWMP. Brown Bullhead, Fathead Minnow, Common Carp and Pumpkinseed were found consistently throughout the marsh. Goldfish made up the largest proportion of the community (74 of the 159 total). These are the highest numbers found to date. During sampling Goldfish were often in such high numbers it was not possible to net all of them. It is important to monitor this trend to see if the Goldfish population stabilizes or they continue to be a dominant species in this wetland. For more information of the effects of Goldfish please refer to Section 8.2. The IBI score from 2011 sampling was 36. This is a slight decline from 2010 but still above the marsh average. Considering so many Goldfish were caught during 2011, this is a good score and is reflective of the increased number of species present.

6.2.5 Oshawa Creek Coastal Wetland Complex

For the fourth time as part of the DRCWMP, fish sampling was conducted within the Oshawa Creek Coastal Wetland Complex. Sampling resulted in an IBI score of 41 which is slightly lower than the wetland average. The number of species caught decreased from 13 in 2010 to eight in 2011. That and total number of fish caught were the lowest in the four years this site has been sampled. Difficult conditions (high winds/rain) could have influence the results. Interesting results include catching a natural 32 pound Chinook Salmon (see photo below/left), large numbers of Brown Bullhead, catching Northern Pike for the fourth consecutive year, and the absence of Round Goby.

Staging Chinook Salmon were observed during shocking in the creek channel as well as in the harbor. During 2011 sampling the Ministry of Environment (MOE) participated and took specimens for contaminant analysis. The results from the contaminant analysis have yet to be received. For more information on the MOE Guide to Eating Sport Fish please refer to Section 8.2.

6.2.6 Oshawa Second Marsh

This is the seventh season that Oshawa Second Marsh has been sampled through the DRCWMP using CLOCA's boat electrofisher. Sampling resulted in an IBI score of 30, slightly lower than the marsh average of 34 but up considerably from the previous score of eight. Total number of fish caught during 2011 was the highest ever recorded at Oshawa Second Marsh through DRCWMP. This is largely due to the high number of Goldfish captured increasing further from last year to 186 of the total 387 fish caught. Since sampling began, Goldfish (see photo below/left) have been consistently captured in high numbers. Pease refer to section 8.2 for more information. Common carp was found for the third consecutive year since the control structure was compromised through vandalism. Interestingly, Pumpkinseed, a native warmwater species which historically was an important part of the fish community at Oshawa Second Marsh until it disappeared from sampling in 2010, made a slight recovery in 2011. Continued monitoring is recommended to see how the Pumpkinseed competes with more tolerant native and non-native species.

All fishes that enter or leave the marsh must pass through a water-level control structure that connects Oshawa Second Marsh to Farewell Creek. An adjustable grate is used to manage fish passage allowing for control of undesirable fish species such as Common Carp (see photo below/right) which is part of the Goldfish family. Unfortunately, this grate can also exclude desirable fishes such as adult Northern Pike if not positioned correctly. Managers are able to make informed decisions regarding the grate setting by using data collected through the DRCWMP fish sampling each year. This method of decision making is often referred to as adaptive management.

6.2.7 McLaughlin Bay Marsh

This was the eighth year that McLaughlin Bay Marsh was sampled through the DRCWMP. It's IBI score was 47 in 2011, improving from 2010 by 19 points and well above the marsh average of 35. Interesting results include: White Perch caught for the fifth year in a row making it only two out of eight years they have not been caught, Largemouth Bass caught for the third consecutive year, four Black Crappie caught (see photo below/left) and Northern Pike (see photo below/right) caught for the first time through DRCWMP sampling. The diversity found in the McLaughlin Bay Marsh contributed to the higher than average score. During 2011, 11 different species were caught which is just one short of the highest diversity recorded at McLaughlin Bay. Even with non-native species, such as, Common carp (see photo above/right) and White Perch, the presence of many native species including a couple piscivores (Largemouth Bass and Northern Pike) increased this year's IBI score.

During 2011 sampling the Ministry of Environment (MOE) participated and took specimens for contaminant analysis. The results from the contaminant analysis have yet to be received. For more information on the MOE Guide to Eating Sport Fish please refer Section 8.2.

6.2.8 *Westside Marsh*

This is the seventh season that Westside Marsh has been sampled through the DRCWMP for fish. Sampling resulted in an IBI score of 31 dropping slightly from last year and the marsh average of 36. Water levels in the marsh were high due to the closed barrier beach. Although in 2010 this was thought to be a potential reason for low numbers of prey species because of high predation pressure, it did not appear to be the case during 2011 sampling as prey species were high even with the barrier beach being closed. An exact date on when the barrier beach was open or closed is not known. Interesting catches include: Black Crappie caught at this marsh in six of the seven years sampled, Largemouth Bass (see photo below/right) caught again in high numbers, Common Carp (see photo below/left) and Brown Bullhead (see photo below/middle). It should be noted that the consistent catching of Largemouth Bass could be attributed or affected by the stocking event during the 2005 season (Dillon Consulting, 2009). Goldfish were caught in Westside Marsh for the first time during DRCWMP sampling.



6.2.9 *Bowmanville Marsh*

This is the ninth season that Bowmanville Marsh has been sampled through the DRCWMP using CLOCA's boat electrofisher. Sampling resulted in an IBI score of 29, well below last year's score and the marsh average, with eight different fish species caught. This is the second lowest IBI score recorded at Bowmanville Marsh. Results from 2011 showed three new species being caught through the DRCWMP sampling: Bluegill, Goldfish and Largemouth Bass (see photo below/left and right). The poor score could be the result of the dominance by Brown Bullhead (49 of 66 fish) and the addition of a non-native species, Goldfish. Please refer to Section 8.1 for more information on this species.


6.2.10 Wilmot Creek Marsh

This is the eighth season that Wilmot Creek Marsh has been sampled through the DRCWMP using CLOCA's boat electrofisher. Sampling resulted in an IBI score of 37, a large decrease from last year's score and well below the marsh average of 47. 2011 sampling recorded ten different species, which is only half of the 20 caught during 2010, but consistent with the marsh average. The total number of fish caught also decreased from 162 in 2010 to 36 in 2011, the second lowest total out of the eight years this marsh has been sampled. Interesting results include: catching Brown Trout, high numbers of migratory Chinook Salmon (see photo below/right), high numbers of Northern Pike (see

photo below/bottom/left), Round Goby was caught for the third consecutive year, and a juvenile Bowfin (see photo above/left). Wilmot Creek Marsh has been found to be a relatively healthy wetland for the area but does have considerable seasonal variation in how fish use the area.

6.2.11 Port Newcastle Marsh

2011 sampling catch results were relatively consistent with the three previous year's results. Species total (13-14) and total fish caught (88-115) all remained similar. Results from 2011 sampling showed a large increase in IBI scoring at 67. This is the highest ever at Port Newcastle Marsh and 20 points above the marsh average. Gizzard Shad and Pumpkinseed were the most abundant species caught with 23 and 22 individuals respectively. Other species caught include: Largemouth Bass, Yellow Perch, Bowfin (see photo right) for the first time in this marsh through DRCWMP, and Brown Bullhead. Interestingly, Round Goby and Common Carp were not caught in 2010 or in 2011 and are likely contributing to the higher IBI scores. This was only the second time Common Carp was not caught at Port Newcastle. Continued monitoring of the trends is recommended.

6.2.12 Frenchman's Bay Marsh

In Frenchman's Bay Marsh total fish caught decreased from 2010 as well as species richness but IBI increased to 56. Interesting results include Round Goby being caught again making it six years in a row that they have been found at this site. It appears as though Round Goby have established a population in Frenchman's Bay Marsh. Largemouth Bass has been caught all eight times this marsh has been sampled recording its highest numbers by far in 2011. Common Carp were again caught in high numbers.

6.2.13 Rouge River Marsh

This is the eighth year that Rouge River Marsh was sampled through the DRCWMP. During 2011 it recorded its highest total number of fish caught (142) as well as the highest number of species caught (14). Interesting catches include: the first time Rock Bass and White Perch (please refer to section 8.1 for more information) have been caught in this marsh through DRCWMP, an absence of Common Carp, the highest numbers of Largemouth Bass caught in the marsh through DRCWMP, and Northern Pike. The IBI score for 2011 was 68, considerably higher than the marsh average of 45.

6.2.14 Carruthers Creek Marsh

Carruthers Creek Marsh was sampled for the sixth time through DRCWMP sampling. Species richness was the second highest recorded at this marsh through DRCWMP but total fish caught was below the marsh average. Interesting results include: high numbers of Largemouth Bass, Northern Pike and the first time White Sucker has been caught in this marsh through DRCWMP. The IBI score of 57 reflected the increased numbers of piscivores making it well above the marsh average of 41.

6.2.15 Duffins Creek Marsh

This is the tenth year that Duffins Creek Marsh has been sampled through the DRCWMP. During 2011 it recorded slightly less than average number of fish caught but recorded its highest, and tied DRCWMP highest (Wilmot Creek), total species caught at 20. The IBI score in 2011 was 56, which is above the marsh average of 37. Interesting catches include catching a Chinook Salmon, Rainbow Trout, Northern Pike, Largemouth Bass for the first time since 2002, Johnny Darter (see photo below/left), Logperch (see photo below/middle) and Yellow Perch (see photo below/right). This was also the first year that Round Goby has been found through DRCWMP sampling. Continued monitoring of the Round Goby population is recommended. It should also be noted that three Northern Pike were caught just outside the Northern Pike habitat project being completed by Toronto Region Conservation Authority (TRCA) and Ontario Power Generation (OPG). Continued monitoring at this location to determine the success of the project is recommended.



6.2.16 Hydro Marsh

This is the eighth year that Hydro Marsh has been sampled through the DRCWMP. During 2011 it recorded an IBI score of 71, well above the marsh average of 45. Due to low water levels not all transects normally sampled were accessible. Even with these low water levels, total fish numbers and species richness were the highest ever recorded in this marsh through DRCWMP. Interesting results include Largemouth Bass being caught for the sixth consecutive year and in much higher numbers than any other year and Common Carp being found in large numbers. The very high score could be partially reflective of our restriction to the area of the marsh that has restoration completed. Although it is encouraging to see a healthy fish community in this area, it might not be reflective of the entire marshes health.



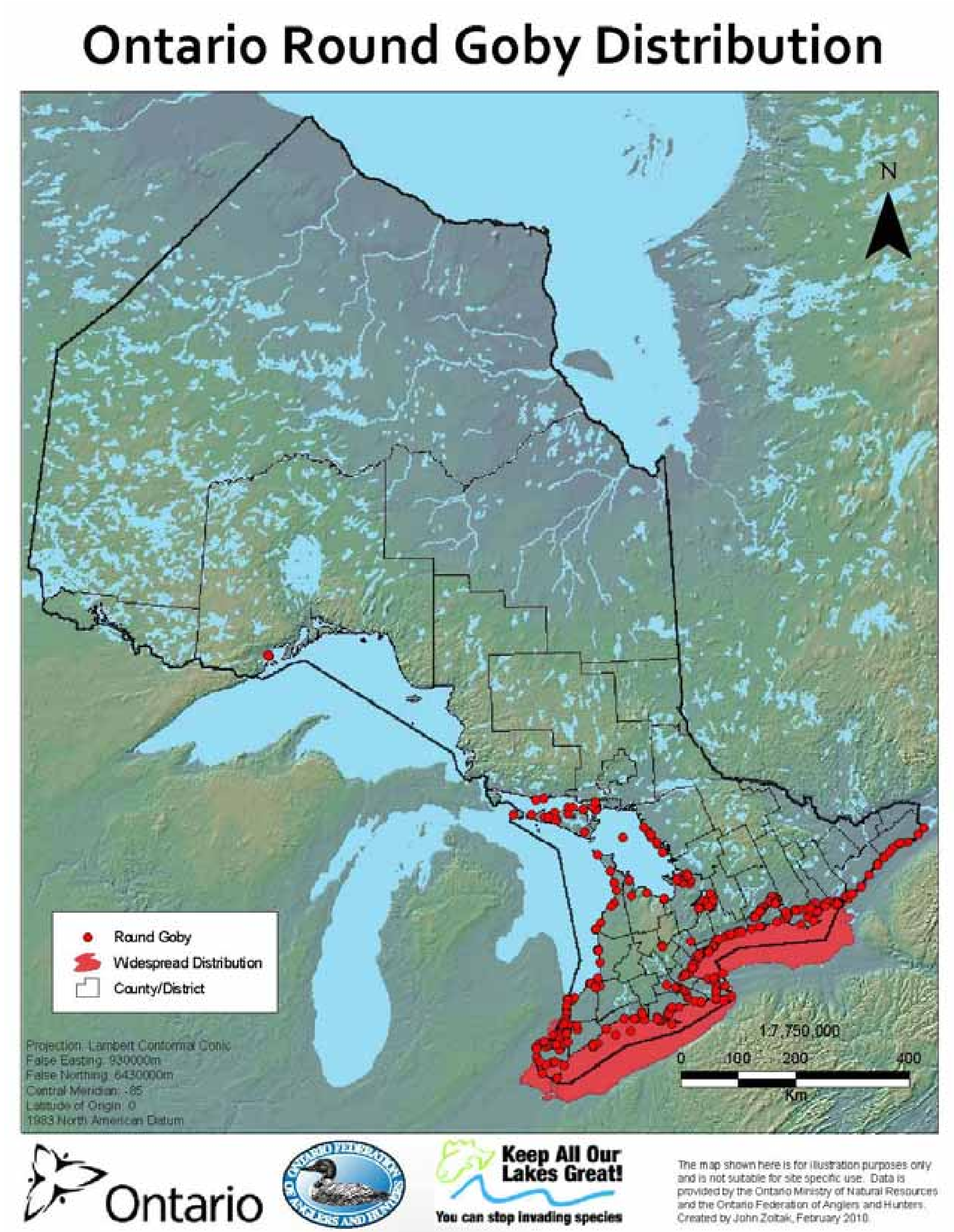

Figure 17: Round Goby distribution in Ontario as of February 2010 (OFAH 2010).

6.3 Bay of Quinte RAP

6.3.1 Introduction

Fish sampling through the DRCWMP in the Bay of Quinte and surrounding area first took place in 2003 with the sampling of two wetlands followed by an additional five in 2005. Data from these wetlands helped to strengthen the Durham project and other EC initiatives.

In 2008 CLOCA partnered with the Bay of Quinte Remedial Action Plan (BQRAP) to sample approximately 15 wetlands over a 3-year period. See below for details regarding the BQRAP.

> ***Great Lakes Water Quality Agreement (GLWQA):***
> *An international treaty made between Canada and the United States in 1978. The purposes of this agreement were:*
>
> *1) To provide measurable goals to restore, protect and maintain the environment quality of the Great Lakes Ecosystem.*
>
> *2) To identify Areas of Concern where the environmental quality does not meet international standards.*
>
> ***Area of Concern (AOC):*** *An area where the environmental quality does not meet international standards set out by the GLWQA. Each AOC is required by the GLWQA to have a Remedial Action Plan. Currently there are 17 AOC's in Ontario.*
>
> ***Remedial Action Plan (RAP):*** *Under the GLWQA, each AOC is required to have a Remedial Action Plan to enforce an "ecosystem approach" to improving water quality so that international standards can eventually be met.*

Bay of Quinte RAP – The Big Cleanup, (www.bqrap.ca)

6.3.2 Results

This past summer, fisheries sampling as part of the BQRAP began on August 11th and finished August 31st with five Quinte wetlands being sampled (for marsh locations refer to Figure 17):

1. Carnachan Bay Marsh
2. Carrying Place Marsh
3. Hay Bay South
4. Lower Napanee Marsh
5. Sawguin North Marsh

Of the five marshes, Lower Napanee Marsh had the lowest IBI score of 81 and Sawguin Creek North Marsh receiving the highest score of 100 (Table 19). All marshes were found to have high scores in

2011. Lower Napanee Marsh does prove challenging to sample because of its large size. Quinte continues to produce a high diversity of predator species as well as smaller forage fish. Interesting results include catching Bowfin (see photo middle/right), Grass Pickerel (see photo top/left) which is considered a species at risk (COSEWIC), Common Carp (see photo top right), Northern Pike (see photo middle/left and bottom/right), and Largemouth Bass (see photo bottom left).

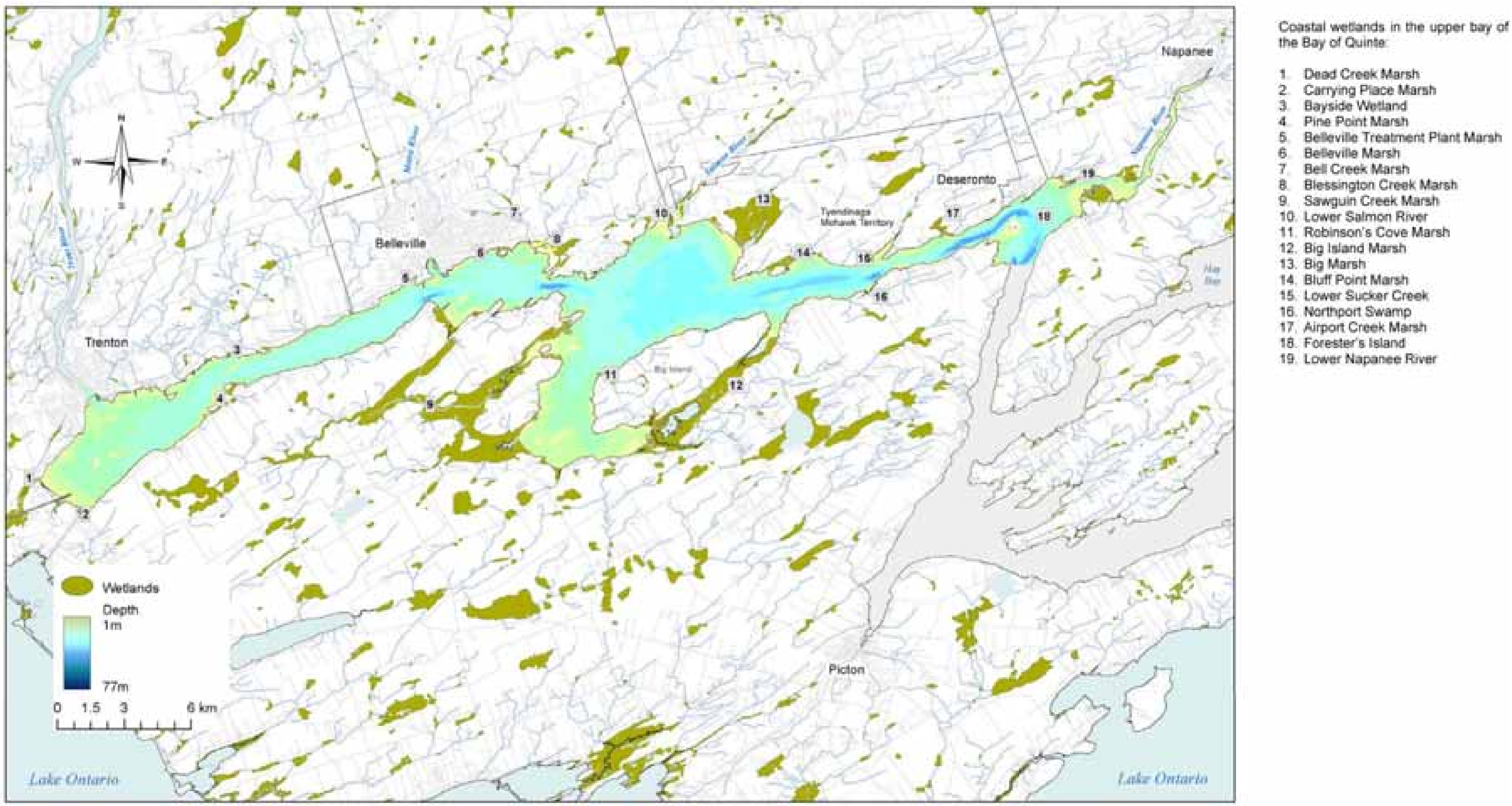

Figure 18: Map of the upper Bay of Quinte showing wetlands and depth contours (Bay of Quinte Remedial Action Plan, 2007)

7.0 Fisheries Related Research

Freshwater mussels are part of the Phylum Mollusca (molluscs), which also includes snails, slugs, clams, scallops, oysters, squids and octopuses. In Ontario all of the mussels are part of the Family Unionidae. Of the 55 species that occur in Canada, Ontario has 41, 28 of which are showing signs of decline. In North America 21 species are already extinct (Metcalfe-Smith and MacKenzie and Carmichael and McGoldrick, 2005).

Many methods are used to sample mussels and include: visual searches, tactile searches, sediment collection and sieving, or special methods such as brail bars, dredges, or muskrat middens (Strayer and Smith, 2003).

Mussels are preyed upon by various animals such as River Otters, Mink, Raccoons, Muskrats, birds and fish. Many of these predators especially Muskrats, leave piles of mussel shells called "middens" along the shore and around structures such as tree roots and bridge abutments. During periods of low water, shorelines can be walked to determine if mussels are present in the area (Metcalfe-Smith and MacKenzie and Carmichael and McGoldrick, 2005).

No one agency or organization has unlimited resources available to devote to environmental monitoring and research. To help address this fact, whenever possible, CLOCA participates in and partners with national, provincial or municipal networks and agencies. Through just such a partnership, during the summer of 2011, an important discovery was made within the Lynde Shores Conservation Area; specifically the Lynde Creek Marsh. A survey targeting freshwater mussels was conducted by the MNR at various sample locations within the marsh as part of a larger study area along Lake Ontario coastal wetlands. This resulted in the first known record of the Eastern Pondmussel within Lynde Creek Marsh and the CLOCA jurisdiction. This discovery was important due to the fact that the Eastern Pondmussel is a Species at Risk (SAR).

Some of the threats facing the Eastern Pondmussel include upstream watershed land uses, Lake Ontario water level regulation, global warming, and likely the largest threat being the Zebra and Quagga Mussel. The Zebra and Quagga Mussel are invasive species that attaches itself to other mussels in large numbers, causing them to suffocate or die from starvation, (MNR, 2010).

8.0 Partnerships

8.1 Non-native Aquatic Species

Non-Native species (also known as Introduced, Invasive, Alien, Exotic, Naturalized) are plants, animals and microorganisms introduced into areas beyond their native range due to human actions. The introduction might be:

- Deliberate or accidental
- Beneficial or harmful
- From other continents, neighboring countries or from other ecosystems in Canada

Invasive species are those most commonly heard about as they are the non-native species whose introduction and spread threatens the environment, the economy or society, including human health.

Non-native species are recognized as a serious problem that threatens global biodiversity and human health worldwide. They are one of the leading causes of native species becoming rare, threatened or endangered. The economy also suffers with the spread of non-native species. Millions of dollars are spent on trying to control invasive species when they alter aquatic and terrestrial environments, destroy crops, etc.

In the Great Lakes Basin alone, nearly 200 species from around the world have been introduced, including such well known species as the Sea Lamprey and Round Goby (OMNR, 2009).

Currently within CLOCA jurisdiction there are six aquatic non-native species of concern:

- Round Goby
- Sea Lamprey
- Common Carp
- Goldfish
- Green Sunfish
- White Perch

Management of aquatic invasive species is a difficult task because of their wide range and aggressive life history strategies. For this reason partnerships are critical to monitor and manage changes in their populations. Through our aquatic monitoring programs we actively monitor population sizes and changes and report it each year’s Aquatic Monitoring Report.

When possible, management of species within our Conservation Lands occurs by either dealing with the biota directly or using education as a tool. Partners with CLOCA, such as Ontario Federation of Anglers and Hunters, the Department of Fisheries and Oceans and the Ministry of Natural Resources, work together to manage and deal with these species as effectively as possible.

Information for each species is contained within CLOCA's 2010 Aquatic Monitoring Report. For more information please refer to InvadingSpecies.com through Ontario Federation of Anglers and Hunters (OFAH) or the Aquatic Invasive Species program through MNR.

8.2 Guide to Eating Ontario Sport Fish (2011-2012 Edition)

Through the Durham Region Coastal Wetland Monitoring Project (DRCWMP), CLOCA staff partnered with Ministry of the Environment staff to collect fish samples from various Durham Region Coastal Wetlands. The results from 2010 and 2011 will be incorporated in a future update of the Guide to Eating Ontario Sport Fish. It is anticipated that other locations included in the DRCWMP will be sampled in the near future as well.

8.2.1 About the guide

Staff from the Ontario Ministry of Natural Resources and Ministry of the Environment collect the fish which are then analyzed for a variety of substances, including mercury, PCBs, mirex, DDT and dioxins. The results are used to develop the advisory tables which give size-specific consumption advice for each species tested from each location. The guide is published every other year. A new interactive version of the guide is available at Guide to Eating Ontario Sport Fish (2011-2012 Edition).

8.2.2 Contaminants in Ontario sport fish

Ontario is not unique in having consumption restrictions on sport fish. Most jurisdictions in North America also have them. An extensive review of consumption restrictions on sport fish in North America is available on the Internet at www.epa.gov/waterscience/fish/.

Contaminants found in sport fish originate not only from local sources, but some are transported thousands of kilometers in the atmosphere before being deposited with rainfall. Mercury, PCBs and toxaphene are a few of the contaminants that are known to be transported long distances and can cause low-level contamination even in isolated lakes and rivers.

8.3 Fishing Regulations and Enforcement

8.3.1 Overview

Where permitted, fishing regulations within Conservation Areas as well as throughout the CLOCA jurisdiction are regulated through the Ontario Ministry of Natural Resources (MNR). For up-to-date information on specific Regulations and Acts pertaining to fishing in Ontario, please contact the Ministry of Natural Resources.

8.3.2 Report a Violation

All Ontarians can play a part in protecting our natural resources from waste, abuse and depletion. If you are witness to a resource violation within Ontario, please call the Ministry of Natural Resources TIPS line at:

1-877-TIPS-MNR (847-7667)

In order to investigate an occurrence, it will assist an officer to know the following information:

- Nature of violation
- Vehicle information
- Location of violation (address, county, township, municipality, lot, concession)
- Particulars of violation, other relevant information

The TIPS-MNR reporting line is not an emergency response telephone number. If you are calling to report public safety matters please call 911 or the police. Please Note: This is not an information line. For general inquiries please call 1-800 667-1940.

Information for section 10.2 is from http://www.mnr.gov.on.ca/en/Business/Enforcement/2ColumnSubPage/STEL02_163377.html accessed on April 1, 2011.

9.0 Recommendations

Section	Results	Recommendations
2.0 Spawning Survey	During 2011, spawning surveys targeting migratory adult Rainbow Trout, Chinook Salmon and White Sucker were conducted on various CLOCA watersheds: 1. Bennett 2. Bowmanville Creek 3. Corbett Creek 4. Darlington Creek 5. Gold Point Creek 6. Harmony Creek 7. Lynde Creek 8. Oshawa Creek 9. Pringle Creek 10. Robinson Creek 11. Tooley Creek 12. Westside Creek Fishes were observed within Bowmanville, Oshawa, Pringle, Soper and Tooley Creek. High numbers of both Rainbow Trout and Chinook Salmon make runs up the Bowmanville and Soper Creeks in particular. The other creeks may have had runs that were not detected because of low sampling effort.	Overall stream monitoring efforts during the 2012 season will be focused in the Oshawa Creek watershed. Spawning Surveys should also continue on the Small Watersheds to determine accurate uses by different species. It is recommended that spawning surveys continue as this information is complimentary to standard fish community surveys. Continuing Spawning surveys during the fall is recommended in order to compare the following summer's catch of young-of-year Chinook Salmon.

Section	Results	Recommendations
3.0 Biological Water Quality	During May and June 2011, CLOCA staff sampled 22 OBBN sites throughout 8 watersheds (Figure 5). One of the sites sampled was a reference site and the remaining 21 sites were test sites, generally at new locations. This was the seventh season that CLOCA has sampled benthos using the OBBN protocol.	Overall stream monitoring efforts during the 2012 season will be focused in the Oshawa watershed. In order to compliment this, it is recommended that the OBBN test site locations be selected with regard to OSAP site locations.
4.0 Stream Temperature	In total, 78 portable temperature loggers (Figure 6) were installed throughout the CLOCA jurisdiction in 2011 largely in the Bowmanville/Soper Watershed (Figure 7).	Overall stream monitoring efforts during the 2012 season will be focused in the Oshawa Watershed. In order to complement this, it is recommended that the majority of stream temperature loggers that are not dedicated to long-term sites be installed at or near OSAP site locations.
	Data indicates that coolwater and coldwater habitat dominates the areas surveyed with few warmwater sites recorded during 2011. The Bowmanville/Soper Creeks have maintained thermal stability is most areas within the headwaters but are at coolwater and close to warmwater in some areas near urban development.	Continue to monitor and report on the thermal regimes within these sites over the long-term following the CLOCA Aquatic Monitoring Schedule.
	Fisheries staff coordinated logger sites with engineering staff as their respective programs complement each other i.e., thermal impacts of stormwater ponds on fish and fish habitat.	It is recommended that fisheries staff continue to coordinate logger sites with engineering staff.
	No new temperature loggers were acquired in 2011.	It is recommended that additional temperature loggers be acquired as needed to replenish aging stock.
	As recommended in the 2008 Aquatic Resource Monitoring Report temperature loggers continued to collect minimum temperature data in order to validate groundwater modeling.	It is recommended that temperature loggers continue to collect minimum temperature data in order to validate groundwater modeling.

Section	Results	Recommendations
5.0 Fisheries - Streams	During 2011, 58 OSAP sites were sampled by CLOCA as part of the annual aquatic monitoring program and another four were sampled through the OSAP Training Course in the Oshawa Creek watershed. Fish species that were captured are listed in Table 8, Table 9, Table 11, Table 12, and Table 13.	Overall stream monitoring efforts during the 2012 season will be focused in the Oshawa watershed. It is recommended that a selection of historical CLOCA fisheries sites and new sites be sampled consistent with the goals and objectives of the FMP.
	The results of the 2011 CLOCA Aquatic Monitoring are consistent with the goals and objectives of the FMP. The main branches of Bowmanville and Soper Creeks are still dominated by migratory Salmonids and should remain managed as such. Upstream of impassable barriers to fish migration, streams remain dominated by resident coldwater fish communities including Brook Trout, Brown Trout and Sculpin species. These headwaters should continue to be managed for these sustainable and diverse fish communities.	It is recommended that the Aquatic Monitoring Program continue to acknowledge and support the goals and recommendations of the CLOCA FMP.

Section	Results	Recommendations
5.0 Fisheries – Streams con't	As with all CLOCA watersheds, aquatic invasive species are present within the Bowmanville/Soper Creek Watershed. Round Goby (Figure 16) are present in the lower sections of both Soper and Bowmanville Creek and although it is thought that Goby likely utilize other areas close to Lake Ontario, there was no evidence of it in 2011.	It is recommended that fisheries monitoring be conducted annually in the lower section of the major watersheds to help detect change over the long-term e.g., invasion of Round Goby. Continued monitoring of other invasive species and range expansions is recommended for all of the watersheds.
	Electrofishing was that main method used for conducting fisheries assessments during 2011.	It is recommended that we continue to explore other methods of sampling, such as rapid dip netting and minnow traps, as a supplemental technique. Each method provides good species distribution data with minimal effort and is a useful technique to help fill in data gaps.
	During the 2011 season, Gold Point, Robinson and Tooley Coastal Wetlands were sampled for the second time using the OSAP protocol. Results varied from the first round of sampling in 2010.	It is recommended that these three sites continue to be monitored. Further data will help determine the importance of these systems to fish and how impacted they are.

Section	Results	Recommendations
6.0 Fisheries - Wetlands	In Durham, fisheries sampling was conducted within 15 coastal wetlands through the Durham Region Coastal Wetland Monitoring Project (DRCWMP) in 2011. See tables for more information (Table 14, Table 15, Table 16, Table 17, Table 19 and Table 20).	Sampling through the DRCWMP in 2012 will include all wetlands in the project.
	This past summer, fisheries sampling as part of the BQRAP began on August 11th and finished August 31st with five Quinte wetlands being sampled: 1. Carnachan Bay Marsh 2. Carrying Place Marsh 3. Hay Bay South 4. Lower Napanee Marsh 5. Sawguin North Marsh	Sampling in the Bay of Quinte area in 2012 through the DRCWMP will re-sample five different BQRAP wetlands.
	As recommended in the 2008 Aquatic Resource Monitoring Report Round Goby locations (i.e., Frenchman's Bay Marsh and Port Newcastle Marsh) were monitored to track changing population trends. Round Goby were found in the following marshes for the first time: Whitby Harbour Complex, Hydro Marsh, Duffins Creek Marsh.	It is recommended that currently known Round Goby locations (i.e., Frenchman's Bay Marsh and Port Newcastle Marsh) continue to be monitored to track any changing population trends.

Section	Results	Recommendations
6.0 Fisheries – Wetlands con't	As recommended in the 2008 Aquatic Resource Monitoring Report the barrier beach at McLaughlin Bay Marsh was monitored for breakages to help better understand fish utilization of the marsh.	It is recommended that the barrier beach at McLaughlin Bay Marsh continue to be monitored for breakages to help better understand fish utilization of the marsh.
	As recommended in the 2008 Aquatic Resource Monitoring Report the currently known Goldfish locations (i.e., Rouge River Marsh, Corbett Creek Marsh, Pumphouse Marsh and Oshawa Second Marsh) were monitored to track any changing population trends. Populations in Pumphouse Marsh and Oshawa Second Marsh appear to be rising continuously. These two marshes have the most established populations of Goldfish.	It is recommended that currently known Goldfish locations (i.e., Rouge River Marsh, Corbett Creek Marsh, Pumphouse Marsh and Oshawa Second Marsh) continue to be monitored to track any changing population trends. Public education regarding the harmful effects of releasing non-native species into waterways should continue through the DRCWMP, proper signage and public outreach events in which CLOCA is involved.
	Results from MOE contaminant sampling showed elevated levels of PCB in Common Carp within Lynde Creek Marsh.	It is recommended that more sampling and analysis occur at Lynde Creek Marsh. Common Carp should again be analyzed to determine if they are continually high in contaminates and fish with a smaller range should also be analyzed to try and determine if the PCBs are being picked up from Lynde Creek Marsh or a neighbouring wetland and/or Lake Ontario.
	Sampling conducted by the Ministry of Natural Resources found a population of Eastern Pondmussel (SAR) within Lynde Creek Marsh.	It is recommended that CLOCA encourage continued sampling of Eastern Pondmussel in Lynde Creek Marsh and the other wetlands within DRCWMP. CLOCA should also consider Eastern Pondmussel when reviewing planning applications and managing the Conservation Area as directed by MNR.

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11.0 APPENDIX I – SPAWNING SURVEYS

Table 5: Summary of 2011 Spring Spawning Survey observations.

Site	Number of Times Surveyed	Type of Survey	Observed			
			Rainbow Trout	White Sucker	Redd	Spawning
SSBOW01	1	Road Side	X			
SSBOW02	1	Road Side	X			
SSBOW03	1	Road Side				
SSBOW04	1	Road Side	X			
SSBOW05	1	Road Side	X			
SSBOW06	1	Road Side				
SSBOW07	1	Road Side				
SSBOW08	1	Road Side				
SSBOW09	1	Road Side				
SSBOW10	1	Road Side				
SSBOW11	1	Road Side				
SSBT01	1	Roadside				
SSCOR02	1	Road Side				
SSCOR04	1	Road Side				
SSDAR01	1	Road Side				
SSDAR02	1	Road Side				
SSDAR05	1	Road Side				
SSGP01	1	Creek Walk				
SSHAR06	1	Creek Walk				
SSHAR07	1	Creek Walk				
SSHAR14	1	Creek Walk				
SSLYN36	1	Creek Walk				
SSOSH06	1	Creek Walk	X			X
SSOSH07	1	Creek Walk	X	X		
SSOSH08	1	Creek Walk	X			
SSOSH09	1	Creek Walk	X			
SSOSH10	1	Creek Walk				
SSOSH11	1	Creek Walk		X		
SSOSH12	1	Creek Walk		X		
SSOSH13	1	Creek Walk		X		
SSPRI08	1	Creek Walk				
SSPRI12	1	Road Side				
SSPRI15	2	Creek Walk	X	X		
SSPRI16	2	Creek Walk	X			
SSROB03	1	Creek Walk				
Site	Number of Times	Type of Survey	Observed			

	Surveyed		Rainbow Trout	White Sucker	Redd	Spawning
SSROB04	1	Creek Walk		X		
SSTLY01	2	Road Side				
SSTLY03	2	Road Side				
SSTLY04	2	Road Side	X	X		X
SSSOP02	1	Road Side				
SSSOP04	1	Road Side				
SSSOP05	1	Road Side				
SSSOP09	1	Road Side	X			X
SSSOP10	1	Road Side	X			
SSSOP11	1	Road Side				
SSSOP12	1	Road Side				
SSSOP13	1	Road Side				
SSSOP14	1	Road Side				
SSSOP15	1	Road Side				
SSSOP16	1	Roadside	X			X

Roadside survey is observations made at the intersection of the road and Creek Walk has a start point and an end point over a larger area

12.0 APPENDIX II – BIOLOGICAL WATER QUALITY

Table 6: Percent EPT and Family Richness for OBBN sites sampled in 2011 including their historical results if applicable.

	Side Code	Date	Methodology	%EPT	Family Richness
1	BOWOB01	05/10/05	Combined	18.9	9
		05/23/06	Riffle 1	25.5	9
			Riffle 2	14.0	9
			Pool 1	18.6	7
		05/18/11	Riffle 1	12.3	10
			Riffle 2	26.5	11
			Pool 1	12.7	10
2	BOWOB03	05/27/05	Combined	24.0	9
		05/30/06	Riffle 1	27.2	7
			Riffle 2	62.8	10
			Pool 1	42.3	10
		08/05/07	Riffle 1	59.6	11
			Riffle 2	48.7	7
			Pool 1	14.3	8
		05/30/08	Riffle 1	40.4	10
			Riffle 2	46.5	7
			Pool 1	2.9	8
		05/19/10	Riffle 1	61.8	9
			Riffle 2	49.5	9
			Pool 1	11.3	12
		05/11/11	Riffle 1	14.7	8
			Riffle 2	5.9	8
			Pool 1	6.0	9
3	OAOB03	05/25/05	Combined	20.4	10
		05/30/11	Riffle 1	6.9	11
			Riffle 2	2.0	8
			Pool 1	1.4	9
4	OAOB22	05/27/11	Riffle 1	14.0	8
			Riffle 2	15.8	7
			Pool 1	2.7	10

	Side Code	Date	Methodology	%EPT	Family Richness
5	OAOB23	05/31/11	Riffle 1	0.0	8
			Riffle 2	2.0	11
			Pool 1	1.0	10
6	OAOB24	05/16/11	Riffle 1	0.0	6
			Riffle 2	1.9	8
			Pool 1	0.0	6
7	OAOB25	05/17/11	Riffle 1	0.0	6
			Riffle 2	3.4	9
			Pool 1	3.8	10
8	SOPOB01	27/03/05	Combined	7.6	9
		05/24/06	Riffle 1	3.8	9
			Riffle 2	11.4	7
			Pool 1	5.1	8
		05/31/11	Riffle 1	0.0	6
			Riffle 2	4.6	12
			Pool 1	3.0	9
9	2HC6440	05/30/11	Riffle 1	22.1	7
			Riffle 2	2.0	7
			Pool 1	1.0	10
10	2HD4678	05/11/11	Riffle 1	30.9	10
			Riffle 2	24.6	12
			Pool 1	26.4	13
11	2HD5784	05/27/11	Riffle 1	29.7	12
			Riffle 2	12.7	10
			Pool 1	14.4	10
12	2HD5946	05/16/11	Riffle 1	23.5	10
			Riffle 2	21.8	9
			Pool 1	3.2	7
13	2HD6003	05/17/11	Riffle 1	1.1	7
			Riffle 2	2.6	10
			Pool 1	3.6	7
14	2HD6074	05/24/11	Riffle 1	0.9	6
			Riffle 2	0.0	3
			Pool 1	0.0	5

	Side Code	Date	Methodology	%EPT	Family Richness
15	2HD6133	05/16/11	Riffle 1	3.3	7
			Riffle 2	0.0	6
			Pool 1	0.0	6
16	2HD6463	05/20/11	Riffle 1	1.0	8
			Riffle 2	0.0	5
			Pool 1	3.9	7
17	2HD6514	05/25/11	Riffle 1	0.0	7
			Riffle 2	0.0	4
			Pool 1	1.0	5
18	2HD6531	05/17/11	Riffle 1	62.0	9
			Riffle 2	64.8	12
			Pool 1	47.7	7
19	2HD6579	05/18/11	Riffle 1	10.9	10
			Riffle 2	10.9	6
			Pool 1	6.6	8
20	2HD7114	05/24/11	Riffle 1	29.0	8
			Riffle 2	15.6	10
			Pool 1	12.0	8
21	2HD7211	05/24/11	Riffle 1	13.0	14
			Riffle 2	39.5	12
			Pool 1	1.0	7
22	2HD7237	05/30/11	Riffle 1	6.9	9
			Riffle 2	0.0	7
			Pool 1	8.9	11

Table 7: Summary of temperature logger data collected from CLOCA jurisdiction during 2011 with comparison to 2005-2010 data when available.

	Site Code	Year	Logger Serial No.	Period of Record	Percent of period within thermal regime			Max. (°C)	Min. (°C)	Percent of Period Above Upper Lethal				Percent of time exceeding (for summer period)		Classification
					Cold	Cool	Warm		Entire Data Set	Chinook Salmon (> 24.1°C)	Brown/Brook Trout (> 24.9°C)	Rainbow Trout (> 25.2°C)	Atlantic Salmon (> 26.1°C)	5%	25%	
1	TLBOW01	2005	787477	July 1, 2005 to August 31, 2005	100.0	0.0	0.0	16.4	0.1	0.0	0.0	0.0	0.0	14.6	13.4	Coldwater
2		2008	2001401	July 1, 2008 to August 31, 2008	100.0	0.0	0.0	15.7	0.0	0.0	0.0	0.0	0.0	13.8	13.0	Coldwater
3		2011	2000191	July 1, 2011 to August 31, 2011	100.0	0.0	0.0	15.8	0.1	0.0	0.0	0.0	0.0	14.3	13.4	Coldwater
4	TLBOW02	2005	787475	July 1, 2005 to August 31, 2005	75.1	24.9	0.0	22.5	0.2	0.0	0.0	0.0	0.0	21.0	18.9	Coolwater
5		2008	2000191	July 1, 2008 to August 31, 2008	97.9	2.1	0.0	19.7	0.0	0.0	0.0	0.0	0.0	18.6	17.3	Coldwater
6		2011	1135911	July 1, 2011 to August 31, 2011	98.3	1.7	0.0	20.1	0.6	0.0	0.0	0.0	0.0	18.6	17.2	Coldwater
7	TLBOW03	2005	842229	July 1, 2005 to August 31, 2005	100.0	0.0	0.0	14.7	5.2	0.0	0.0	0.0	0.0	12.2	11.5	Coldwater
8		2006	877051	July 1, 2006 to August 31, 2006	100.0	0.0	0.0	16.4	4.5[†]	0.0	0.0	0.0	0.0	12.5	11.7	Coldwater
9		2007	842228	July 1, 2007 to August 31, 2007	100.0	0.0	0.0	14.9	3.8	0.0	0.0	0.0	0.0	11.9	11.2	Coldwater
10		2008	1019261	July 1, 2008 to August 31, 2008	100.0	0.0	0.0	14.8	3.7	0.0	0.0	0.0	0.0	11.8	11.1	Coldwater
11		2011	2373166	July 1, 2011 to August 31, 2011	100.0	0.0	0.0	17.4	3.5	0.0	0.0	0.0	0.0	13.4	12.4	Coldwater
12	TLBOW04	2006	842238	July 1, 2006 to August 31, 2006	33.0	58.6	8.4	29.3	0.8	13.1	9.0	7.8	4.7	26.0	22.5	Warmwater
13		2010	2312941	July 1, 2010 to August 31, 2010	31.3	60.0	8.6	29.6	0.0	12.8	9.0	7.8	3.9	25.8	22.6	Coolwater
14		2011	2373165	July 1, 2011 to August 31, 2011	36.8	55.6	7.6	29.7	0.0	12.0	8.1	7.0	3.6	25.7	22.4	Coolwater
15	TLBOW05	2006	787475	July 1, 2006 to August 31, 2006	71.2	28.8	0.0	23.4	0.5	0.0	0.0	0.0	0.0	21.2	19.3	Coolwater
16		2011	2373351	July 1, 2011 to August 31, 2011	72.1	27.9	0.0	23.9	0.0	0.0	0.0	0.0	0.0	21.6	19.3	Coolwater
17	TLBOW06	2006	787473	July 1, 2006 to August 31, 2006	94.0	6.0	0.0	21.0	0.1	0.0	0.0	0.0	0.0	19.1	17.4	Coldwater
18		2008	2000178	July 1, 2008 to August 31, 2008	100.0	0.0	0.0	18.4	0.1	0.0	0.0	0.0	0.0	17.2	16.3	Coldwater
19		2011	2373160	July 1, 2011 to August 31, 2011	98.8	1.2	0.0	20.4	0.1	0.0	0.0	0.0	0.0	18.3	16.8	Coldwater
20	TLBOW07	2006	905540	July 1, 2006 to August 31, 2006	68.1	31.9	0.0	23.2	0.4	0.0	0.0	0.0	0.0	21.4	19.4	Coolwater
21		2011	2373171	July 1, 2011 to August 31, 2011	47.5	52.5	0.0	23.4	0.0	0.0	0.0	0.0	0.0	21.5	20.1	Coolwater
22	TLBOW08	2006	877052	July 1, 2006 to August 31, 2006	100.0	0.0	0.0	18.0	0.0	0.0	0.0	0.0	0.0	16.2	14.6	Coldwater
23		2011	2373352	July 1, 2011 to August 31, 2011	100.0	0.0	0.0	18.3	0.0	0.0	0.0	0.0	0.0	15.9	14.6	Coldwater
24	TLBOW09	2006	877050	July 1, 2006 to August 31, 2006	53.3	46.7	0.0	23.8	0.0	0.0	0.0	0.0	0.0	21.9	20.4	Coolwater
25		2011	1134283	July 1, 2011 to August 31, 2011	57.1	42.9	0.0	24.0	0.0	0.0	0.0	0.0	0.0	21.5	19.8	Coolwater
26	TLBOW10	2006	905537	July 1, 2006 to August 31, 2006	99.7	0.3	0.0	19.1	1.6	0.0	0.0	0.0	0.0	18.0	16.8	Coldwater
27		2011	1134274	July 1, 2011 to August 31, 2011	97.4	2.6	0.0	21.0	0.0	0.0	0.0	0.0	0.0	18.7	17.1	Coldwater
28	TLBOW11	2006	1019270	July 1, 2006 to August 31, 2006	100.0	0.0	0.0	15.7	2.2	0.0	0.0	0.0	0.0	12.1	11.2	Coldwater
29		2007	1019270	July 1, 2007 to August 31, 2007	100.0	0.0	0.0	14.9	2.2	0.0	0.0	0.0	0.0	--	--	Coldwater∞
30		2011	2373350	July 1, 2011 to August 31, 2011	100.0	0.0	0.0	18.0	2.9	0.0	0.0	0.0	0.0	13.1	12.0	Coldwater
31	TLBOW12	2006	1019270	July 22, 2006 to August 31, 2006	100.0	0.0	0.0	16.2	2.2	0.0	0.0	0.0	0.0	--	--	Coldwater**
32		2011	2312942	July 1, 2011 to August 31, 2011	100.0	0.0	0.0	17.3	0.9	0.0	0.0	0.0	0.0	13.1	12.1	Coldwater
33	TLBOW13	2006	1019280	July 1, 2006 to August 31, 2006	47.8	52.2	0.0	24.0	13.2	0.0	0.0	0.0	0.0	--	--	Coolwater**
34		2011	1135849	July 1, 2011 to August 31, 2011	55.2	44.4	0.4	25.5	0.0	0.7	0.4	0.2	0.0	22.0	20.1	Coolwater
35	TLBOW14	2008	2000185	July 1, 2008 to August 31, 2008	76.7	23.3	0.0	23.3	0.0	0.0	0.0	0.0	0.0	20.8	18.9	Coolwater
36		2011	1134281	July 1, 2011 to August 31, 2011	75.0	20.5	4.5	32.8	0.0	5.7	4.6	4.3	3.4	24.7	19.0	Coolwater[20]

	Site Code	Year	Logger Serial No.	Period of Record	Percent of period within thermal regime			Max. (°C)	Min. (°C)	Percent of Period Above Upper Lethal				Percent of time exceeding (for summer period)		Classification
					Cold	Cool	Warm		Entire Data Set	Chinook Salmon (> 24.1°C)	Brown/Brook Trout (> 24.9°C)	Rainbow Trout (> 25.2°C)	Atlantic Salmon (> 26.1°C)	5%	25%	
37	TLBOW15	2008	2000176	July 1, 2008 to August 31, 2008	87.4	12.6	0.0	21.4	0.0	0.0	0.0	0.0	0.0	19.8	18.2	Coolwater
38		2011	1135916	July 1, 2011 to August 31, 2011	82.0	18.0	0.0	22.9	0.0	0.0	0.0	0.0	0.0	20.6	18.5	Coolwater
39	TLBOW19	2008	1134294	July 1, 2008 to August 31, 2008	100.0	0.0	0.0	18.0	0.1	0.0	0.0	0.0	0.0	16.3	15.3	**Coldwater**
40		2011	1134286	July 1, 2011 to August 31, 2011	100.0	0.0	0.0	17.7	0.0	0.0	0.0	0.0	0.0	15.8	14.8	**Coldwater**
41	TLBOW20	2008	2001410	July 1, 2008 to August 31, 2008	89.4	10.6	0.0	20.8	0.0	0.0	0.0	0.0	0.0	19.5	18.0	**Coldwater**
42		2011	2312948	July 1, 2011 to August 31, 2011	88.9	11.1	0.0	21.7	0.0	0.0	0.0	0.0	0.0	19.8	18.0	**Coldwater**
43	TLBOW21	2008	2001410	July 1, 2008 to August 31, 2008	97.1	2.9	0.0	20.3	0.0	0.0	0.0	0.0	0.0	18.6	17.2	**Coldwater**
44		2011	2001402	July 1, 2011 to August 31, 2011	69.3	30.7	0.0	22.7	0.0	0.0	0.0	0.0	0.0	20.8	19.3	Coolwater
45	TLBOW24	2011	9774460	July 1, 2011 to August 31, 2011	96.4	3.6	0.0	20.7	0.0	0.0	0.0	0.0	0.0	18.9	17.3	**Coldwater**
46	TLBOW25	2011	2373342	July 1, 2011 to August 31, 2011	99.2	0.8	0.0	20.3	0.0	0.0	0.0	0.0	0.0	18.2	16.8	**Coldwater**
47	TLBOW26	2011	2000184	July 1, 2011 to August 31, 2011	59.0	40.8	0.2	25.1	0.0	0.6	0.3	0.0	0.0	22.2	20.1	Coolwater
48	TLBOW27	2011	2373365	July 1, 2011 to August 31, 2011	94.4	5.6	0.0	21.2	0.5	0.0	0.0	0.0	0.0	19.1	17.6	**Coldwater**
49	TLBOW28	2011	2373170	July 1, 2011 to August 31, 2011	96.9	3.1	0.0	20.7	0.0	0.0	0.0	0.0	0.0	18.5	15.6	**Coldwater**
50	TLBOW29	2011	1019261	July 1, 2011 to August 31, 2011	64.4	35.1	0.5	26.4	0.1	2.1	0.5	0.3	0.1	23.2	20.1	Coolwater
51	TLBOW30	2011	2373177	July 1, 2011 to August 31, 2011	89.2	9.9	0.8	32.2	0.5	1.3	0.8	0.8	0.5	21.1	17.0	Coolwater
52	TLBOW31	2011	2373363	July 1, 2011 to August 31, 2011	99.6	0.4	0.0	19.8	1.4	0.0	0.0	0.0	0.0	17.3	16.0	**Coldwater**
53	TLBOW32	2011	2013228	July 4, 2011 to August 31, 2011	97.7	2.3	0.0	21.4	0.0	0.0	0.0	0.0	0.0	18.2	16.7	**Coldwater**
54	TLBOW34	2011	2013240	July 4, 2011 to August 31, 2011	100.0	0.0	0.0	18.1	0.3	0.0	0.0	0.0	0.0	14.7	13.5	**Coldwater**
55	TLBOW36	2011	2373182	July 1, 2011 to August 31, 2011	81.2	18.8	0.0	22.8	0.0	0.0	0.0	0.0	0.0	20.6	18.6	Coolwater
56	TLBOW37	2011	1135922	July 1, 2011 to August 31, 2011	53.2	43.8	3.0	27.4	0.0	5.9	3.2	2.4	1.0	24.4	20.9	Coolwater
57	TLBT01	2008	842238	June 1, 2008 to August 31, 2008	56.7	42.9	0.4	30.6	0.0	0.6	0.4	0.4	0.3	22.3	20.3	Coolwater[30]
58		2010	2000178	July 1, 2010 to August 31, 2010	No Data – Logger Missing											
59		2011	2373159	July 1, 2011 to August 31, 2011	38.7	61.3	0.0	24.1	0.0	0.1	0.0	0.0	0.0	22.6	20.9	Coolwater[6]
60	TLCE01	2005	842239	June 24, 2005 to August 31, 2005	6.0	80.8	13.2	34.5	0.0	20.1	13.8	11.9	5.7	26.3	23.7	**Warmwater**
61		2006	905535	July 1, 2006 to August 31, 2006	18.1	81.9	0.0	24.6	1.1	0.6	0.0	0.0	0.0	23.4	22.0	Coolwater
62		2009	2312947	July 4, 2009 to August 31, 2009	53.2	46.8	0.0	23.7	0.0	0.0	0.0	0.0	0.0	22.3	20.3	Coolwater
63		2010	2312949	July 1, 2010 to August 31, 2010	17.5	81.6	1.0	26.3	1.7†	3.7	1.2	0.8	0.1	23.9	22.2	Coolwater
64		2011	1135917	July 1, 2011 to August 31, 2011	67.8	32.2	0.0	22.1	1.5	0.0	0.0	0.0	0.0	20.8	19.4	Coolwater
65	TLCW01	2005	787473	June 23, 2005 to August 31, 2005	15.4	70.9	13.8	29.7	0.2	20.8	14.5	12.7	8.6	26.8	23.6	**Warmwater**
66		2006	877053	July 1, 2006 to August 31, 2006	14.7	76.4	8.9	28.9	0.4	16.4	9.4	7.7	3.6	25.8	23.4	Coolwater
67		2009	2312946	July 4, 2009 to August 31. 2009	41.4	58.6	0.0	24.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Coolwater
68		2010	2312943	July 1, 2010 to August 31, 2010	14.9	75.3	9.8	29.4	0.0	16.2	10.3	8.6	4.9	26.1	23.3	**Warmwater**
69		2011	2373156	July 1, 2011 to August 31, 2011	20.1	66.6	13.3	31.8	0.0	17.8	13.6	12.3	9.0	27.6	23.1	**Warmwater**[10]
70	TLDN01	2005	842237	July 1, 2005 to August 31, 2005	50.7	49.2	0.1	27.4	0.0	0.2	0.1	0.1	0.1	22.0	20.2	Coolwater[3]
71		2006	842237	July 1, 2006 to August 31, 2006	57.3	37.5	5.2	30.1	0.0	6.8	5.4	5.0	3.7	25.2	20.3	Coolwater[3]
72		2009	2312951	July 3, 2009 to August 31, 2009	57.9	42.1	0.0	22.7	0.2	0.0	0.0	0.0	0.0	21.6	19.9	Coolwater
73		2011	1134276	July 1, 2011 to August 31, 2011	20.8	74.1	5.1	28.4	0.0	10.1	5.6	4.4	1.7	25.1	22.5	Coolwater[5]
74	TLDN02	2005	842236	July 1, 2005 to Aug 31, 2005	22.0	68.8	9.2	28.0	0.0	14.2	9.8	8.0	3.2	25.7	22.8	Coolwater
75		2006	842236	July 1, 2006 to Aug 31, 2006	38.3	56.2	5.5	28.5	0.3	9.3	5.8	4.7	3.0	25.1	21.9	Coolwater
76		2009	2312946	July 2, 2009 to August 31, 2009	57.9	42.1	0.0	22.7	0.2	0.0	0.0	0.0	0.0	21.6	19.9	Coolwater
77		2010	2000191	July 1, 2010 to August 31, 2010	25.0	75.0	0.0	24.9	0.0	0.6	0.0	0.0	0.0	23.2	21.4	Coolwater
78		2011	2373164	July 1, 2011 to August 31, 2011	26.5	69.1	4.4	27.4	0.5	9.0	4.8	3.6	1.5	24.9	22.3	Coolwater

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					Cold	Cool	Warm		Entire Data Set	Chinook Salmon (> 24.1°C)	Brown/Brook Trout (> 24.9°C)	Rainbow Trout (> 25.2°C)	Atlantic Salmon (> 26.1°C)	5%	25%	
79	TLFA01	2008	1134281	June 1, 2008 to August 31, 2008	53.6	46.3	0.0	25.2	0.0	0.6	0.1	0.0	0.0	22.2	20.0	Coolwater
80		2009	1135910	July 1, 2009 to August 31, 2009	56.7	43.1	0.1	25.3	0.0	0.7	0.1	0.0	0.0	22.6	20.1	Coolwater
81		2010	2312942	July 1, 2010 to August 31, 2010	18.5	79.6	1.9	27.1	0.2	6.0	2.2	1.5	0.4	24.3	22.3	Coolwater
82		2011	2373167	July 1, 2011 to August 31, 2011	20.3	75.4	4.3	27.7	0.0	8.2	4.5	3.9	1.6	24.8	22.4	Coolwater
83	TLFA02	2008	1134288	June 1, 2008 to August 31, 2008	58.0	42.0	0.0	25.1	0.0	0.3	0.0	0.0	0.0	22.0	19.8	Coolwater
84		2009	1135912	July 1, 2009 to August 31, 2009	66.1	33.9	0.0	24.3	0.0	0.2	0.0	0.0	0.0	21.8	19.6	Coolwater
85		2010	2001402	July 1, 2010 to August 31, 2010	24.6	74.6	0.8	26.2	1.3	2.8	0.9	0.6	0.1	23.7	21.6	Coolwater
86		2011	2373163	July 1, 2011 to August 31, 2011	28.6	69.3	2.2	27.0	0.0	4.4	2.4	1.8	0.7	24.0	21.6	Coolwater
87	TLGP01	2010	1134284	July 1, 2010 to August 31, 2010	No Data – Logger Missing											
88		2011	1134271	July 1, 2011 to August 31, 2011	4.8	95.2	0.0	23.7	5.3	0.0	0.0	0.0	0.0	23.5	22.5	Coolwater
89	TLHA01	2008	1134275	June 1, 2008 to August 31, 2008	46.0	53.8	0.2	25.7	0.0	0.6	0.3	0.0	0.0	22.1	20.3	Coolwater
90		2009	1135918	June 25, 2009 to August 31, 2009	46.5	53.3	0.2	25.4	0.0	0.9	0.2	0.1	0.0	23.0	20.5	Coolwater
91		2010	2001401	July 1, 2010 to August 31, 2010	9.2	89.5	1.2	26.5	0.6	4.6	1.3	0.9	0.2	24.1	22.9	Coolwater
92		2011	2312949	July 1, 2011 to August 31, 2011	13.1	81.1	5.7	27.8	0.0	10.6	6.1	5.0	2.6	25.2	22.6	Coolwater
93	TLLY50	2009	1135920	July 1, 2009 to August 31, 2009	44.4	54.7	1.0	26.6	0.3	2.1	1.1	0.6	0.0	23.2	20.9	Coolwater
94		2010	2000185	July 1, 2010 to August 31, 2010	No Data – Logger Missing											
95		2011	2000174	July 1, 2011 to August 31, 2011	11.7	81.4	6.9	30.1	0.0	13.1	7.4	5.9	3.2	25.4	23.0	Coolwater
96	TLOA04	2007	787475	July 1, 2007 to August 31, 2007	29.0	66.9	4.1	28.1	0.0	8.1	4.3	3.5	1.5	24.8	22.1	Coolwater
97		2010	1135920	July 1, 2010 to August 31, 2010	15.3	76.1	8.5	29.2	0.2	15.0	9.1	7.5	3.4	25.7	23.2	Coolwater
98		2011	1134279	July 1, 2011 to August 31, 2011	17.6	75.6	6.8	28.1	0.0	12.8	7.2	6.0	3.5	25.5	22.9	Coolwater
99	TLOSB01	2009	2312942	July 1, 2009 to August 31, 2009	96.1	3.9	0.0	20.3	0.0	0.0	0.0	0.0	0.0	18.8	17.6	**Coldwater**
100		2010	1134281	July 8, 2010 to August 31, 2010	90.9	9.1	0.0	20.9	0.0	0.0	0.0	0.0	0.0	19.3**	18.3**	**Coldwater**
101		2011	1134295	July 1, 2011 to August 31, 2011	90.3	9.7	0.0	20.9	0.0	0.0	0.0	0.0	0.0	19.4	18.3	**Coldwater**
102	TLPR01	2005	842230	No Data – Logger Missing												
103		2006	842229	May 24, 2006 to Jan 4, 2007	16.9	82.1	1.0	25.7	0.4	4.7	1.2	0.5	0.0	24.1	22.4	Coolwater
104		2007	1134283	July 1, 2007 to August 31, 2007	23.2	70.9	5.9	28.5	0.0	9.8	6.3	5.1	2.3	25.3	22.6	Coolwater
105		2008	877053	June 1, 2008 to August 31, 2008	38.0	62.0	0.1	25.1	0.0	0.5	0.1	0.0	0.0	22.8	20.9	Coolwater
106		2009	1134294	July 1, 2009 to August 31, 2009	45.4	54.2	0.4	25.9	0.0	2.3	0.5	0.3	0.0	23.3	20.8	Coolwater
107		2010	2373162	July 1, 2010 to August 31, 2010	14.0	84.2	1.7	26.4	2.1†	7.5	2.3	1.2	0.2	24.4	22.5	Coolwater
108		2011	2373162	July 1, 2011 to August 31, 2011	6.2	84.8	9.0	28.5	2.5	14.3	9.6	7.9	3.9	25.8	22.9	Coolwater
109	TLPR05	2007	1134280	July 1, 2007 to August 31, 2007	45.4	52.1	2.6	27.0	0.0	5.2	2.7	2.2	0.8	24.2	21.2	Coolwater
110		2008	2013209	June 26, 2008 to August 31, 2008	63.7	36.2	0.1	26.2	0.0	0.7	0.1	0.0	0.0	21.8	19.7	Coolwater
111		2010	2000184	July 1, 2010 to August 31, 2010	42.3	57.7	0.0	25.0	0.0	1.2	0.1	0.0	0.0	23.2	21.0	Coolwater
112		2011	2001401	July 1, 2011 to August 31, 2011	43.0	54.3	2.6	27.7	0.0	4.6	2.7	2.1	0.7	24.0	21.1	Coolwater
113	TLPR15	2009	1134276	July 1, 2009 to August 31, 2009	79.2	20.8	0.0	22.8	0.0	0.0	0.0	0.0	0.0	20.2	18.8	Coolwater
114		2010	1019281	July 1, 2010 to August 31, 2010	54.1	45.9	0.0	25.8	0.0	0.0	0.0	0.0	0.0	21.4	19.9	Coolwater
115		2011	1135913	July 1, 2011 to August 31, 2011	60.0	40.0	0.0	23.8	0.0	0.0	0.0	0.0	0.0	21.2	19.6	Coolwater
116	TLROB01	2005	818793	July 1, 2005 to August 31, 2005	9.3	71.7	19.0	32.3	0.7	30.0	19.9	17.3	10.8	27.4	24.4	**Warmwater**
117		2006	818794	July 1, 2006 to August 31, 2006	9.1	75.6	15.3	29.0	1.8	25.3	16.1	13.8	7.7	26.6	24.2	**Warmwater**
118		2010	1135848	July 1, 2010 to August 31, 2010	3.4	71.6	25.0	31.1	0.9	39.6	26.5	21.6	11.9	27.3	25.0	**Warmwater**
119		2011	2373172	July 1, 2011 to August 31, 2011	5.4	76.1	18.4	36.8	0.1	28.1	19.3	17.0	11.1	28.6	24.4	**Warmwater**[9]

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					Cold	Cool	Warm		Entire Data Set	Chinook Salmon (> 24.1°C)	Brown/Brook Trout (> 24.9°C)	Rainbow Trout (> 25.2°C)	Atlantic Salmon (> 26.1°C)	5%	25%	
120	TLROB02	2006	905538	July 1, 2009 to August 31, 2009	51.3	48.7	0.0	23.5	0.3	0.0	0.0	0.0	0.0	22.3	20.4	Coolwater
121		2009	2312950	July 1, 2009 to August 31, 2009	65.2	34.8	0.0	23.8	0.0	0.0	0.0	0.0	0.0	21.8	19.6	Coolwater
122		2010	2312945	July 1, 2010 to August 31, 2010	26.6	73.4	0.1	25.2	0.0	0.4	0.1	0.0	0.0	22.9	21.5	Coolwater
123		2011	2312944	July 1, 2011 to August 31, 2011	34.5	65.5	0.0	23.8	0.0	0.0	0.0	0.0	0.0	22.3	20.8	Coolwater
124		2005	818797	July 1, 2005 to August 31, 2005	31.2	45.3	23.5	34.8	0.0	28.4	24.0	22.4	18.9	30.1	24.7	Warmwater[63]
125	TLSOP01	2006	818797	July 1, 2006 to August 31, 2006	60.7	39.2	0.1	25.2	0.0	0.5	0.1	0.0	0.0	22.1	19.9	Coolwater
126		2011	1135919	July 1, 2011 to August 31, 2011	87.4	12.6	0.0	22.0	0.0	0.0	0.0	0.0	0.0	19.6	18.3	Coldwater
127		2005	842228	July 1, 2005 to August 31, 2005	35.6	63.3	1.1	26.0	0.0	3.8	1.3	0.6	0.0	23.8	21.4	Coolwater
128	TLSOP02	2006	842239	July 1, 2006 to August 31, 2006	54.9	44.7	0.5	25.8	0.2	1.5	0.5	0.4	0.0	23.0	20.6	Coolwater
129		2011	1135918	July 1, 2011 to August 31, 2011	38.9	59.9	1.2	26.6	0.0	2.4	1.3	0.9	0.4	23.4	21.3	Coolwater
130		2006	818793	May 25, 2006 to December 21, 2006	56.7	43.0	0.3	25.6	0.2	1.2	0.3	0.2	0.0	22.8	20.3	Coolwater
131	TLSOP03	2010	1135922	July 1, 2010 to August 31, 2010	45.2	54.6	0.2	25.3	0.0	1.2	0.2	0.1	0.0	22.8	20.7	Coolwater
132		2011	2373161	July 1, 2011 to August 31, 2011	49.3	50.1	0.7	26.3	0.0	1.7	0.7	0.6	0.3	23.1	20.7	Coolwater
133		2006	787477	July 1, 2006 to August 31, 2006	98.3	1.7	0.0	20.1	0.1	0.0	0.0	0.0	0.0	18.4	16.8	Coldwater
134	TLSOP04	2009	2000184	July 1, 2009 to August 31, 2009	100.0	0.0	0.0	18.8	4.3†	0.0	0.0	0.0	0.0	16.8	15.5	Coldwater
135		2011	1135921	July 1, 2011 to August 31, 2011	No Data – Logger Missing											
136	TLSOP05	2006	905539	July 1, 2006 to August 31, 2006	99.7	0.3	0.0	19.2	0.6	0.0	0.0	0.0	0.0	17.6	16.3	Coldwater
137		2011	1019280	July 1, 2011 to August 31, 2011	100.0	0.0	0.0	17.5	0.3	0.0	0.0	0.0	0.0	16.7	15.8	Coldwater
138		2006	1019261	July 20, 2006 to August 31, 2006	71.9	28.1	0.0	24.1	0.0	0.0	0.0	0.0	0.0	--	--	Coolwater**
139	TLSOP06	2009	2000191	July 1, 2009 to August 31, 2009	84.0	16.0	0.0	21.2	4.2†	0.0	0.0	0.0	0.0	19.9	18.5	Coolwater
140		2011	2312950	July 1, 2011 to August 31, 2011	82.9	17.1	0.0	22.5	0.0	0.0	0.0	0.0	0.0	20.0	18.6	Coolwater
141	TLSOP07	2006	1019277	July 26, 2006 to August 31, 2006	84.3	15.7	0.0	21.1	2.8	0.0	0.0	0.0	0.0	--	--	Coolwater**
142		2011	1135910	July 1, 2011 to August 31, 2011	60.1	37.3	2.6	34.2	0.0	4.1	2.7	2.4	1.5	23.7	19.8	Coolwater[8]
143	TLSOP08	2006	1020772	July 24, 2006 to August 31, 2006	71.8	28.2	0.0	22.9	0.0	0.0	0.0	0.0	0.0	--	--	Coolwater**
144		2011	2000187	July 1, 2011 to August 31, 2011	54.7	45.0	0.3	25.3	0.0	0.7	0.3	0.1	0.0	22.1	20.1	Coolwater
145		2005	739513	July 1, 2005 to August 31, 2005	100.0	0.0	0.0	17.5	2.9†	0.0	0.0	0.0	0.0	13.7	12.6	Coldwater
146		2006	739513	June 1, 2006 to November 13, 2006	100.0	0.0	0.0	16.0	4.6†	0.0	0.0	0.0	0.0	14.1	12.9	Coldwater
147		2007	739513	July 1, 2007 to August 31, 2007	100.0	0.0	0.0	15.6	1.2†	0.0	0.0	0.0	0.0	13.3	12.2	Coldwater
148	TLSOP09	2008	739513	July 1, 2008 to August 31, 2008	100.0	0.0	0.0	16.0	0.0	0.0	0.0	0.0	0.0	13.7	12.6	Coldwater
149		2009	739513	July 3, 2009 to August 31, 2009	100.0	0.0	0.0	19.0	0.0	0.0	0.0	0.0	0.0	13.3	12.2	Coldwater
150		2010	739513	July 1, 2010 to August 31, 2010	100.0	0.0	0.0	16.4	4.2†	0.0	0.0	0.0	0.0	13.7	12.6	Coldwater
151		2011	739513	July 1, 2011 to August 31, 2011	100.0	0.0	0.0	17.9	0.0	0.0	0.0	0.0	0.0	13.3	12.6	Coldwater
152		2005	739517	July 1, 2005 to August 31, 2005	100.0	0.0	0.0	17.9	3.7†	0.0	0.0	0.0	0.0	13.2	11.8	Coldwater
153		2006	739517	June 10, 2006 to November 22, 2006	100.0	0.0	0.0	16.8	4.2†	0.0	0.0	0.0	0.0	14.1	12.6	Coldwater
154		2007	739517	July 1, 2007 to August 31, 2007	100.0	0.0	0.0	16.0	2.5†	0.0	0.0	0.0	0.0	12.6	11.4	Coldwater
155	TLSOP10	2008	739517	July 1, 2008 to August 31, 2008	100.0	0.0	0.0	16.0	0.0	0.0	0.0	0.0	0.0	13.7	12.6	Coldwater
156		2009	739517	July 2, 2009 to August 31, 2009	100.0	0.0	0.0	19.0	0.0	0.0	0.0	0.0	0.0	13.7	12.6	Coldwater
157		2010	739517	July 1, 2010 to August 31, 2010	100.0	0.0	0.0	16.8	4.6†	0.0	0.0	0.0	0.0	13.3	12.2	Coldwater
158		2011	739517	July 1, 2011 to August 31, 2011	100.0	0.0	0.0	17.9	0.0	0.0	0.0	0.0	0.0	14.9	13.3	Coldwater
159	TLSOP11	2009	2000176	July 1, 2009 to August 31, 2009	94.7	5.3	0.0	24.5	6.8†	0.0	0.0	0.0	0.0	19.1	12.9	Coldwater[3]
160		2011	2000187	July 1, 2011 to August 31, 2011	93.5	6.5	0.0	22.6	0.1	0.0	0.0	0.0	0.0	17.6	14.4	Coldwater[3]
161	TLSOP14	2009	2000187	July 1, 2009 to August 31, 2009	99.9	0.1	0.0	19.2	7.8†	0.0	0.0	0.0	0.0	17.6	14.4	Coldwater

	Site Code	Year	Logger Serial No.	Period of Record	Percent of period within thermal regime			Max. (°C)	Min. (°C)	Percent of Period Above Upper Lethal				Percent of time exceeding (for summer period)		Classification
					Cold	Cool	Warm		Entire Data Set	Chinook Salmon (> 24.1°C)	Brown/Brook Trout (> 24.9°C)	Rainbow Trout (> 25.2°C)	Atlantic Salmon (> 26.1°C)	5%	25%	
162		2011	2000176	July 1, 2011 to August 31, 2011	71.9	18.8	9.3	33.5	1.4	10.8	9.4	8.9	7.6	28.1	19.5	**Warmwater**[26]
163	TLSOP15	2009	2000177	July 1, 2009 to August 31, 2009	99.8	0.2	0.0	20.1	4.6	0.0	0.0	0.0	0.0	14.9	13.1	**Coldwater**
164		2011	2000177	July 1, 2011 to August 31, 2011	100.0	0.0	0.0	18.7	0.0	0.0	0.0	0.0	0.0	15.0	13.9	**Coldwater**
165	TLSOP16	2011	1134291	July 1, 2011 to August 31, 2011	100.0	0.0	0.0	17.3	0.0	0.0	0.0	0.0	0.0	15.7	14.3	**Coldwater**
166	TLSOP17	2011	1135912	July 1, 2011 to August 31, 2011	99.8	0.2	0.0	19.1	0.0	0.0	0.0	0.0	0.0	17.3	16.2	**Coldwater**
167	TLSOP18	2011	2373158	July 1, 2011 to August 31, 2011	36.1	55.9	8.1	29.0	0.0	12.6	8.4	7.2	3.5	25.7	22.3	Coolwater
168	TLSOP19	2011	1135920	July 1, 2011 to August 31, 2011	100.0	0.0	0.0	17.7	0.3	0.0	0.0	0.0	0.0	13.6	12.5	**Coldwater**
169	TLSOP20	2011	2312945	July 1, 2011 to August 31, 2011	99.2	0.8	0.0	20.3	1.4	0.0	0.0	0.0	0.0	17.5	16.1	**Coldwater**
170	TLSOP21	2011	2013207	July 1, 2011 to August 31, 2011	99.2	0.8	0.0	20.3	0.0	0.0	0.0	0.0	0.0	18.0	16.7	**Coldwater**
171	TLSOP22	2011	2013209	July 1, 2011 to August 31, 2011	99.9	0.1	0.0	19.1	0.0	0.0	0.0	0.0	0.0	17.1	15.8	**Coldwater**
172	TLSOP23	2011	1135847	July 1, 2011 to August 31, 2011	42.1	57.6	0.3	26.0	0.2	1.3	0.4	0.2	0.0	23.4	21.1	Coolwater
173	TLSOP24	2011	1134292	July 1, 2011 to August 31, 2011	96.3	3.7	0.0	21.7	0.0	0.0	0.0	0.0	0.0	18.7	16.8	**Coldwater**
174	TLSOP25	2011	2312943	July 1, 2011 to August 31, 2011	84.3	15.7	0.0	22.6	0.0	0.0	0.0	0.0	0.0	20.0	18.5	Coolwater
175	TLSOP26	2011	1134294	July 1, 2011 to August 31, 2011	93.3	6.7	0.0	21.7	0.0	0.0	0.0	0.0	0.0	19.3	17.5	??
176	TLSOP27	2011	2312947	July 1, 2011 to August 31, 2011	66.6	33.4	0.0	23.7	0.0	0.0	0.0	0.0	0.0	20.8	19.4	Coolwater
177	TLSOP29	2011	1135848	July 1, 2011 to August 31, 2011	69.8	29.5	0.7	27.3	0.0	1.5	0.9	0.6	0.2	22.3	19.3	Coolwater
178	TLSOP31	2011	2013208	July 1, 2011 to August 31, 2011	76.8	23.2	0.0	23.7	0.0	0.0	0.0	0.0	0.0	21.1	18.9	Coolwater
179	TLSOP32	2011	2312941	July 1, 2011 to August 31, 2011	57.5	42.0	0.5	26.1	0.0	1.2	0.5	0.4	0.0	22.7	20.3	Coolwater
180	TLSOP33	2011	2013204	July 1, 2011 to August 31, 2011	74.3	25.7	0.0	24.5	0.4	0.3	0.0	0.0	0.0	21.4	19.1	Coolwater
181	TLSOP34	2011	2001410	July 1, 2011 to August 31, 2011	71.1	28.4	0.4	26.3	0.0	0.7	0.4	0.4	0.1	21.8	19.3	Coolwater
182	TLSOP35	2011	2373358	July 1, 2011 to August 31, 2011	61.7	37.7	0.6	26.6	0.0	1.5	0.7	0.5	0.3	22.7	20.1	Coolwater[3]
183	TLTY01	2005	842238	June 29, 2005 to August 31, 2005	19.3	62.4	18.3	30.0	0.0	23.9	19.0	17.3	12.2	27.7	24.0	**Warmwater**
184		2006	905536	July 1, 2006 to August 31, 2006	37.7	58.4	4.0	27.5	0.0	7.8	4.2	3.7	1.6	24.7	21.8	Coolwater
185		2009	2312943	July 1, 2009 to August 31, 2009	58.9	38.3	2.8	28.4	0.0	4.6	3.0	2.6	1.3	24.0	20.5	Coolwater
186		2010	1134295	July 1, 2010 to August 31, 2010	27.3	66.1	6.7	28.6	0.0	10.7	6.9	5.6	2.8	25.1**	22.3**	Coolwater
187		2011	2373157	July 1, 2011 to August 31, 2011	31.6	58.8	9.6	29.4	0.0	14.3	9.9	8.9	5.9	26.5	22.6	**Warmwater**[13]

Maximum temperature generally occurs during July or August but is reported from entire data set

Minimum temperature is reported from entire data set which generally also includes cold-weather conditions i.e., sampling period in December

†Minimum temperature does not completely reflect cold-weather conditions since the Period of Record ended before coldest part of Winter

** Exceedence based on August temperatures only

*Minimum temperature recorded during time where Logger was likely out-of-water

°Maximum temperature occurred during June

- represents the number of days the logger recorded and out-of-water day (over ten degree Celsius change in temperature within one day) – likely mis-representing thermal regime as air temperature is being recorded

Table 8: Number of fish species and individuals caught at OSAP sites during 2011 sampling compared to historical sampling results (when available).

	BA01			BA04		BA05			BA12			BA13	BAS01	BAS02	BAS03	BAS04	BAS05
Fish Species (common name)	1998	2006	2011	1999	2011	1998	2006	2011	2006	2010	2011	2011	2011	2011	2011	2011	2011
American Brook Lamprey													No Catch	No Catch	No Catch		No Catch
Blacknose Dace	26	24	16	28	2		10		6	2	13	83				6	
Bluntnose Minnow	29	17															
Brook Trout				6													
Brook Trout (YOY)																	
Brown Trout		1			1		4					1					
Brown Trout (YOY)																	
Chinook Salmon		3		20	3			2								1	
Coho Salmon				8			1										
Common Shiner	1	5	3														
Creek Chub	1	5	11			2	1		10		1	13					
Fathead Minnow											1						
Golden Shiner		1															
Johnny Darter	20	4	1														
Log Perch	1	1															
Longnose Dace	61	173	93	36	53	11	110	4									
Mottled Sculpin	5	3	1	16	5	12	8	6									
Northern Redbelly Dace									27		1	4				6	
Pumpkinseed		1		10			2	2	1	5	1						
Raindow Darter	20	83	23														
Rainbow Trout (YOY)		13	4			161	98		9	3	33						
Rainbow Trout	3	5	9	263	71		4	128									
Round Goby			19														
Sea Lamprey				1													
Slimy Sculpin																	
Unknown YOY minnows*		1	1						1								
Unknown YOY salmonids*																	
White Sucker	3	3	11		1		10										
Yellow Perch	1																
Grand Total	171	343	181	399	136	186	248	142	54	10	60	101	0	0	0	13	0
Species Total	12	16	10	10	7	4	9	5	5	3	6	4	0	0	0	3	0
Effort (s/m^3)	2.0	2.8	4.2	2.4	4.4	2.4	6.0	3.5	12	--	--	--	--	--	--	--	--

	BB02		BB04		BB08			BB09			BB17		BC03		BC06			BD01			BD04			BD05
Fish Species (common name)	1999	2011	1999	2011	2004	2008	2011	2004	2008	2011	2008	2011	1999	2011	1999	2006	2011	1998	2006	2011	1999	2006	2011	2011
American Brook Lamprey			4	4	1						1	11												
Blacknose Dace	12	2	14	1	15	7	2					4						7	31	2				10
Bluntnose Minnow																								
Brook Trout					1		6	5	8	11	21	48			2	4	1				14	15	6	22
Brook Trout (YOY)								11	7	5					2	1					3	2	2	28
Brown Trout	1	8	27	20	2	5	5	2	6	6			10	20	13	13	6	5	4	4				
Brown Trout (YOY)		4		2				1		3				23	4	3			3					
Chinook Salmon																								
Coho Salmon														52						10				
Common Shiner	1																							
Creek Chub				1								5						1	5					
Fathead Minnow																								
Golden Shiner																								
Johnny Darter																								
Log Perch																								
Longnose Dace		1																						
Mottled Sculpin	3	2	21	8	70	20							60		12			11	2	6				
Northern Redbelly Dace					2	2																		
Pumpkinseed					3																			
Raindow Darter																								
Rainbow Trout (YOY)															2		5	10	8	10				
Rainbow Trout				4									4	8	1	2	15	3	2	2				
Round Goby																								
Sea Lamprey																								
Slimy Sculpin							38							80		17	6				8	13	11	
Unknown YOY minnows*																								
Unknown YOY salmonids*																7								
White Sucker	1		1		1	2													3					
Yellow Perch																								
Grand Total	18	17	67	40	95	36	51	19	21	25	22	68	74	183	36	47	33	37	58	34	25	30	19	60
Species Total	5	4	5	6	8	5	4	2	2	2	2	4	3	4	4	4	4	5	6	5	2	2	2	2
Effort (s/m^3)	3.2	4.5	7.7	5.3	5.5	5.6	6.9	6.8	4.3	8.2	7.4	12	4.9	11	6.5	12	7.5	3.3	14	4.3	8.6	19	9.6	7.1

Table 9: Number of fish species and individuals caught at OSAP sites during 2011 sampling compared to historical sampling results (where available) con't.

	FA12	GM03		LA24	LA25	LMP3			OA16	OA17	OA18	OSB01			RH04		SA03		
Fish Species (common name)	2011	2010	2011	2011	2011	2002	2006	2011	2011	2011	2011	2004	2010	2011	2010	2011	1998	2006	2011
American Brook Lamprey																			
Banded Killifish																			
Blacknose Dace	30								14		13						115	100	33
Bluntnose Minnow															1				
Brook Stickleback				1								10							
Brook Trout						1	1	2											
Brook Trout (YOY)							5												
Brown Bullhead		2	1												2	5			
Brown Trout							1		1									1	
Brown Trout (YOY)																			
Chinook Salmon																			
Coho Salmon																			
Common Carp																			
Common Shiner																			
Creek Chub	29		1						21		28				5	3	20	126	
Fathead Minnow		30	9						28		1				13	1			
Finescale Dace																			
Goldfish																			
Green Sunfish															2				
Johnny Darter									1		1				11		1	16	8
Lake Chub		1			No Catch							4		No Catch					
Largemouth Bass															2				
Log Perch																			
Longnose Dace																	18	6	39
Mottled Sculpin																			
Northern Redbelly Dace																			
Pumpkinseed		2	2						7		27				2	4			
Rainbow Darter																			
Rainbow Trout (YOY)	6												3					2	4
Rainbow Trout									4	3									
Rock Bass																			
Round Goby		1																	
Slimy Sculpin						4	3	1											
Smallmouth Bass																			
Spotfin Shiner																			
Threespine Stickleback																4			
Unknown																3			
Unknown YOY minnows*			7																
Unknown YOY Sunfish			1																
Walleye																			
White Sucker		2	3						1						14	85	13	6	17
Yellow Perch																			
Grand Total	65	38	36	1	0	5	10	3	77	3	70	14	3	0	52	105	167	257	101
Species Total	3	6	6	1	0	2	3	2	8	1	5	2	1	0	9	7	5	7	5
Effort (s/m²)	7.8	2.5	2.7	–	–	9.8	8.6	10	4.6	3.8	4.6	9.8	5.0	–	–	6.0	6.8	11	6.5

	SAS01	SAS02	SB05			SB07			SB19		SB20		SB23	SBS01	SBS02	SBS03	SBS04	SBS05	SBS06	SBS07
Fish Species (common name)	2011	2011	1998	2006	2011	1999	2006	2011	2006	2011	2006	2011	2011	2011	2011	2011	2011	2011	2011	2011
American Brook Lamprey																				
Banded Killifish																				
Blacknose Dace	2	1	4			5	28	3	9		20							15		
Bluntnose Minnow																				
Brook Stickleback						10														
Brook Trout																				
Brook Trout (YOY)																				
Brown Bullhead																				
Brown Trout			3		2				14	8			3							
Brown Trout (YOY)			1	2									7							
Chinook Salmon				3	4				1	7			1							
Coho Salmon				10					2				3							
Common Carp																				
Common Shiner																				
Creek Chub		1					9									1		2		
Fathead Minnow																	1			
Finescale Dace																				
Goldfish																				
Green Sunfish																				
Johnny Darter		1	10	5					18											
Lake Chub												No Catch		No Catch	No Catch				No Catch	No Catch
Largemouth Bass																				
Log Perch																				
Longnose Dace		12	39	34	2				28											
Mottled Sculpin			58	28	19				46	16			11							
Northern Redbelly Dace																	2			
Pumpkinseed			1	15	27	1			19	4										
Rainbow Darter			2						1											
Rainbow Trout (YOY)		8	158	28	149		8	3	25	52			37					10		
Rainbow Trout			20	6	12				5	14			3							
Rock Bass																				
Round Goby																				
Slimy Sculpin																				
Smallmouth Bass																				
Spotfin Shiner																				
Threespine Stickleback																				
Unknown																				
Unknown YOY minnows*																				
Unknown YOY Sunfish																				
Walleye																				
White Sucker				1					8											
Yellow Perch																				
Grand Total	2	23	296	132	215	16	45	6	176	101	20	0	65	0	0	1	2	27	0	0
Species Total	1	5	8	9	6	3	3	2	11	5	1	0	5	0	0	1	2	3	0	0
Effort (s/m²)	–	–	2.2	7.1	4.3	4.2	19	8.5	9.4	4.1	20	9.4	6.1	–	–	–	–	–	–	–

Table 10: Number of fish species and individuals caught at OSAP sites during 2011 sampling compared to historical sampling results (where available) con't.:

	SC01		SC02		SC03		SD01		SD06	SD07	TY02	
Fish Species (common name)	1998	2011	1998	2011	1999	2011	1999	2011	2011	2011	2010	2011
American Brook Lamprey				1								
Blacknose Dace										27		
Bluntnose Minnow												
Brook Stickleback											28	69
Brook Trout					5	1				9		
Brook Trout (YOY)						1						
Brown Bullhead												4
Brown Bullhead (YOY)												425
Brown Trout	47	33	13	11	27	38	15	9	14			
Brown Trout (YOY)		5	3	9		1	17	12	1			
Chinook Salmon		27										
Coho Salmon	8							40				
Common Shiner												
Creek Chub											10	2
Emerald Shiner											3	
Fathead Minnow											2	3
Green Sunfish												
Johnny Darter											18	3
Mottled Sculpin	10	7	5	6	1		11	14				
Northern Redbelly Dace											3	4
Pumpkinseed			7								18	4
Raindow Darter												
Rainbow Trout (YOY)		6	15	7			16	14	26			
Rainbow Trout	38	16	3	1			4	3	7			
Rock Bass												
Round Goby												
Sea Lamprey	2						1					
Slimy Sculpin												
Spotfin Shiner												
Threespine Stickleback											7	17
Unknown YOY minnows*												1
Unknown YOY salmonids*												
Walleye												
White Sucker											39	24
Yellow Perch											2	
Grand Total	105	94	46	35	33	41	64	92	48	36	130	556
Species Total	5	4	4	4	3	2	4	4	2	2	10	10
Effort (s/m^2)	3.3	4.8	3.9	5.7	8.6	7.0	6.6	4.7	7.0	11	2.8	3.9

Table 11: Number of fish species and individuals caught a long-term annual monitoring OSAP sites during 2011 sampling compared to historical sampling results (where available).

	BL01				FA04				LA01				OA05				SB01			
Fish Species (common name)	2002	2008	2010	2011	2002	2008	2010	2011	2001	2009	2010	2011	2000	2007	2010	2011	1999	2006	2010	2011
American Brook Lamprey								1				1								
Blacknose Dace	20	11	10	11	19	1	4	1			1		10	30	3	7	9			1
Bluntnose Minnow				1					1	1	6	1								
Brook Stickleback											1									
Brown Trout			4											1		2	7	4		4
Brown Trout (YOY)														2			1			
Chinook Salmon													2	4	1					1
Common Shiner											13			20						
Creek Chub	16	10	3	5	4					8	12	9			1					
Fathead Minnow									1	2	1									
Green Sunfish		1		7																
Johnny Darter	7	2	3						19	20	58	7	41	14	8	7	9	3		
Largemouth Bass						1														
Logperch									3										2	
Longnose Dace	2			1	3	3	9	2	15		20	3	31	162	118	66	52	40	24	28
Mottled Sculpin	5	10	9	3	23	14	12	17					1	1	18	15	5	2	19	8
Pumpkinseed	2				2		1			1	2	1			3	1	1			
Rainbow Darter									48	20	33	20						16	26	8
Rainbow Trout		4	2	4	25	42	36	7		1		1	1	4	1	7	8	3	3	3
Rainbow Trout (YOY)	55	24	17	37	5	10	62	71					1	1	1		1		2	
Rock Bass									1								1	1		
Rosyface Shiner											2									
Round Goby																			1	2
Smallmouth Bass													1			1				
Spotfin Shiner												1								
Stonecat										1										
White Sucker	2								52	18	8	17	2	35	2		22	5	1	5
Yellow Perch																	1		2	
Grand Total	109	62	48	70	81	71	124	99	140	72	157	61	90	274	156	106	117	74	80	60
Species Total	8	6	6	7	6	5	5	5	8	9	12	10	8	9	9	8	10	8	8	9
Effort (s/m²)	5.4	2.7	4.4	6.4	4.3	4.0	2.9	5.3	4.6	2.3	3.0	2.7	2.0	3.8	2.4	2.1	3.4	3.0	3.2	2.8

Table 12: Number of fish and individuals caught at BWDJ in 2011 compared to historical results.

Species	Sampling Years - BWDJ												
	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2010	2011
American brook lamprey					2							1	
Blacknose dace	5	21	41	35	42	54	63	100	17	24	24	4	11
Bluntnose minnow					2	1	3						
Brown bullhead									2				
Brown trout (YOY)								7					
Brown trout	2	2	4	2	5	2	1	1	1		1		2
Chinook salmon				21	2	11		1			10	4	8
Coho salmon			2		2								
Common shiner			2										
Creek chub		8	5		5	3	5		1		2		
Fathead minnow							3	23	2				
Finescale dace	1												
Goldfish					2		1						
Johnny darter	1	1	4	1		2	25	5	1	1			
Lamprey sp.											2		
Longnose dace	13	27	76	54	58	81	210	186	72	205	64	42	16
Mottled sculpin		2	12	3	10	4	13	4	1		3	6	3
Pumpkinseed		1		7	30	1	9	1	3		1	4	
Rainbow darter				10	1	2	17	10	7	22	12		
Rainbow trout (YOY)		105	98	143	71	163	61	223	9	25	7	119	97
Rainbow trout	8	21	44	24	18	18	8	17	1	18	64	22	47
White sucker	16	11	19	10	9	9	35	9		14	3	4	2
Grand Total	46	199	307	310	259	351	454	587	117	309	193	206	186
Species Total	7	9	10	10	14	12	13	11	11	6	11	8	7
Effort (s/m^2)	1.6	3.0	3.1	3.0	4.2	2.5	3.5	4.3	2.8	3.1	7.9	3.0	3.3

* - undetermined identification; possibly American Brook Lamprey or Sea Lamprey
Note: YOY or young-of-the-year refers to fishes that are in their first year of life i.e., < 100 mm.

Table 13: Number of species caught at OSAP Training Course sites within Oshawa Creek watershed in 2011 compared to historical results (where applicable).

	Sites																							
	OA09	OA10	OA12					OA13					OA15				OE04				OE07			
Fish Species (common name)	2007	2007	2007	2008	2009	2010	2011	2007	2008	2009	2010	2011	2008	2009	2010	2011	2007	2008	2009	2010	2008	2009	2010	2011
American Brook Lamprey																								✓
Blacknose Dace	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓				
Bluntnose Minnow																								
Brook Stickleback																								
Brook Trout																					✓			
Brook Trout (YOY)																								
Brown Trout	✓		✓				✓	✓	✓	✓				✓		✓		✓			✓		✓	
Brown Trout (YOY)																								
Chinook Salmon (YOY)					✓	✓	✓			✓	✓									✓				
Coho Salmon (YOY)														✓										
Common Shiner						✓		✓																
Creek Chub	✓	✓		✓	✓	✓		✓		✓			✓	✓	✓	✓	✓	✓	✓	✓				
Fantail Darter		✓																						
Fathead Minnow							✓											✓	✓					
Green Sunfish																								
Johnny Darter	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓								
Lamprey spp.									✓				✓	✓				✓			✓	✓	✓	
Largemouth Bass																								
Rainbow Trout (YOY)					✓	✓				✓	✓	Not Sampled			✓				✓			✓	✓	✓
Rainbow Trout	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓		✓	✓
Longnose Dace	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓		✓		✓	✓	✓	✓				
Minnow family																✓		✓						
Mottled Sculpin						✓	✓				✓				✓	✓				✓			✓	✓
Northern redbelly Dace																								
Phoxinus sp. (minnow)																	✓							
Pumpkinseed		✓					✓	✓																
Rainbow Darter																								
Rock Bass	✓	✓	✓				✓			✓														
Salmonid	✓		✓				✓							✓		✓		✓		✓				
Sea Lamprey																✓								
Sculpin	✓	✓		✓	✓	✓		✓	✓	✓			✓	✓			✓	✓	✓		✓	✓		
Smallmouth Bass	✓						✓		✓	✓														
White Sucker	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓				
Yellow Perch																	✓							
Species Total	11	10	6	7	7	9	12	10	9	11	7	–	7	10	7	9	8	10	7	7	5	3	4	4

Note: YOY or young-of-the-year refers to fishes that are in their first year of life i.e., < 100 mm.
✓ - site was not sampled with consistent effort therefore only presence information is reported.

Table 14: Number of fish and species caught at CLOCA coastal wetlands from 2002 – 2011.

	Lynde Creek Marsh											Whitby Harbour Wetland Complex					Corbett Creek Marsh								Pumphouse Marsh						
Fish Species Common Name	2002	2003	2004[1]	2004[2]	2005	2006	2007	2008	2009	2010	2011	2007	2008	2009	2010	2011	2003	2005	2006	2007	2008	2009	2010	2011	2003	2006	2007	2008	2009	2010	2011
Alewife		1	1	1		12				7			6			1											Marsh Completely Dry				
Banded killifish																	1			2											
Black crappie	4			1		4	1				2															3					
Bluegill																		5								6					4
Bluntnose minnow		3		7		1	1		1	14	4	2	4			5															
Bowfin	1																														
Brook silverside																															
Brook stickleback																		1													
Brown bullhead	12	18	11	118	19	9	56	2	5	1	29			2		1	6	55	32	4	2	7	2	82	5	5		1		25	14
Central mudminnow																									32						
Common carp	2			4	5	1	1			1	1	5	9	5	5	2	3	6	2				6	1					2		3
Common shiner					1		5	2																							
Emerald shiner			2	31		11	2		15	6		2	157		17	2															
Fathead minnow	46	24	1	2		4	4	20		550	289	1	3			33	21	3	15	9			2		484	10		25	73	38	33
Freshwater drum																															
Gizzard shad		10	6		30	4	1	38	1	8	126	19	4			4															
Golden shiner		6	1	2		1	2	2	1	4								17													
Goldfish																			1					2	37	60			4	22	74
Johnny darter				2								1																			
Largemouth bass				1				1	1	1						2							1								
Logperch			3	6					1	2		1																			
Northern pike					3	1		1			1							1	1				2								
Pumpkinseed	92	38	6	26	45	11	7	1		3	15		3			4	8	23	3	13	3	3	17	3		36			1	45	31
Rock bass											1					5															
Round goby[T]										4						1															
Smallmouth bass	2					1			1																						
Spotfin shiner																															
Spottail shiner	23	18	1		1	6		1		3			1																		
Walleye		1		1									1																		
White perch								1																							
White sucker				5		1	5					3		2	2	1							3	3							
Yellow perch	1		1		9	3	13	4	2	13	4		4			4		1		2	1		1								
Grand Total	183	119	33	207	113	70	98	73	28	617	472	34	189	9	24	65	39	112	54	30	6	10	34	91	558	120	--	26	70	130	159
Species Total	9	9	10	14	8	15	12	11	9	14	10	8	10	3	3	13	5	9	6	5	3	2	6	5	4	6	--	2	4	4	6
IBI Score	--	41	34		60	48	50	42	38	48	60	9	29	6	13	32	27	66	31	40	23	21	41	22	27	34	--	24	16	41	36

Table 15: Number of fish and species caught at CLOCA coastal wetlands from 2002 – 2011 con'd.

	Oshawa Second Marsh								McLaughlin Bay Marsh							
Fish Species Common Name	2002	2005	2006	2007	2008	2009	2010	2011	2003	2005	2006	2007	2008	2009	2010	2011
Alewife										1						
Banded killifish		28	1	2	3		1									
Black crappie				1					13	2	12	7		1	3	4
Bluegill					13	37									1	2
Bluntnose minnow						2				3						
Bowfin																
Brook silverside																
Brook stickleback		4														
Brown bullhead	3	22	49	67	12	62	76	12	17	16	4	8		8	8	8
Central mudminnow																
Chinook salmon																
Common carp						3	17	8	1	2	3	4		2	2	1
Common shiner																
Emerald shiner																2
Fathead minnow	154	167	12	1	4	13	6	154						1		
Freshwater drum										3						
Gizzard shad							1	12		212	36	19	8	21	3	26
Golden shiner					1									1		
Goldfish	10	69	30	67	18	32	156	186								
Johnny darter																
Largemouth bass												1		1	4	2
Logperch																
Northern pike					1											1
Pumpkinseed		50	97	24	23	94		14	6	24	4	6	1	6	3	13
Rainbow Trout																
Rock bass																
Round goby[†]																
Smallmouth bass																
Spotfin shiner																
Spottail shiner										1				1		
Walleye																
White perch										4		1	2	18	10	7
White sucker		1			1					1				1		
Yellow perch	20		4	1	1	2	1	1	5	11	5	5	6	2	2	3
Sunfish																
Grand Total	**187**	**341**	**193**	**163**	**77**	**239**	**258**	**387**	**42**	**280**	**64**	**51**	**17**	**63**	**36**	**69**
Species Total	**4**	**7**	**6**	**7**	**10**	**8**	**7**	**7**	**5**	**12**	**6**	**8**	**4**	**12**	**9**	**11**
IBI Score	**--**	**46**	**41**	**27**	**36**	**45**	**8**	**30**	**36**	**57**	**30**	**35**	**24**	**21**	**28**	**47**

	Westside Marsh							Bowmanville Marsh										
Fish Species Common Name	2005	2006	2007	2008	2009	2010	2011	2002	2003	2004[(1)]	2004[(2)]	2005	2006	2007	2008	2009	2010	2011
Alewife								6	1	2				1				1
Banded killifish																		
Black crappie	1		1	10	2	2	4										2	
Bluegill		1																2
Bluntnose minnow		2							4	1		9		2		1	1	
Bowfin																		
Brook silverside																		
Brook stickleback																		
Brown bullhead	23	5	99	5	12	11	39	2	13	1	6	24	1	16		29	48	49
Central mudminnow																		
Chinook salmon																		
Common carp	3	1			3	14	6				1		3					1
Common shiner															2			
Emerald shiner				1	7					12	12				1	1		
Fathead minnow	17	7									1	3		15	1	2	1	
Freshwater drum																		
Gizzard shad	37	5	11	33	1	11	27	1				8	1	13	1		9	
Golden shiner	1							2	16	1	3	33		12	30	3		
Goldfish							1											3
Johnny darter									1									
Largemouth bass		1	1		2	5	4											1
Logperch																	1	
Northern pike				5	1	1							1					
Pumpkinseed	7	18	24	8	3	5	5	11	28	23	13	42		88	18	25	40	7
Rainbow Trout																		
Rock bass																		
Round goby[†]																		
Smallmouth bass											1							
Spotfin shiner																		
Spottail shiner	1								7	10	9	2	1	31	1	9	2	
Walleye										1								
White perch																		
White sucker			1	1			4			1						1	1	
Yellow perch	2	4	7	8	1	1	6		5			1	1	1	15	7	1	2
Sunfish																14		
Grand Total	**92**	**44**	**144**	**71**	**32**	**50**	**96**	**22**	**75**	**52**	**46**	**122**	**8**	**179**	**69**	**78**	**106**	**66**
Species Total	**9**	**9**	**7**	**8**	**9**	**8**	**9**	**5**	**8**	**9**	**8**	**8**	**6**	**9**	**8**	**10**	**10**	**8**
IBI Score	**30**	**35**	**52**	**42**	**25**	**37**	**31**	**--**	**44**	**36**		**49**	**26**	**60**	**63**	**46**	**47**	**29**

	Oshawa Harbour			
Fish Species Common Name	2008	2009	2010	2011
Alewife	2			
Banded killifish				
Black crappie				
Bluegill			2	
Bluntnose minnow				
Bowfin				
Brook silverside				
Brook stickleback				
Brown bullhead	3		6	32
Central mudminnow				
Chinook salmon	1			1
Common carp	3	4		3
Common shiner				
Emerald shiner	22		14	
Fathead minnow			1	
Freshwater drum				
Gizzard shad	4	2	1	
Golden shiner				
Goldfish				
Johnny darter				
Largemouth bass		1	6	
Logperch		5	1	
Northern pike	9	2	1	3
Pumpkinseed	12	10	16	12
Rainbow Trout				2
Rock bass	2		1	
Round goby[†]		5	4	
Smallmouth bass	1	1		
Spotfin shiner				
Spottail shiner	2			
Walleye				
White perch				
White sucker	3	13	3	1
Yellow perch	5	1	2	2
Sunfish				
Grand Total	**69**	**44**	**58**	**56**
Species Total	**13**	**10**	**13**	**8**
IBI Score	**54**	**37**	**45**	**41**

Table 16: Number of fish and species caught at GRCA coastal wetlands from 2002 – 2011.

	Wilmot Creek Marsh									Port Newcastle Marsh							
Fish Species Common Name	2003	2004[1]	2004[2]	2006	2007	2008	2009	2010	2011	2003	2005	2006	2007	2008	2009	2010	2011
Alewife													16		1	1	1
Banded killifish														1			
Black crappie						1											
Blacknose dace								1									
Bluntnose minnow	2	26	10	1	1			7			8	1	3	14		3	3
Bowfin					1				1								1
Brown bullhead	12	3	10	26	1	2	8	1	6		2	16	102	1	71	22	1
Brown trout							1		1								
Chinook salmon		3	3			1		9	11					2			
Coho Salmon								1									
Common carp	5	3	10	37	3					1	9	2	1	2	4		
Common shiner					2						3	14	2	1	3	8	7
Emerald shiner		31	20	1				13					3		1	15	1
Fathead minnow			1	5				2			3	1		1		2	
Gizzard shad								3	1		4	3	3	4	5	2	23
Golden shiner	2			6	2	20		1			97	1					4
Johnny darter	19	1	3	8		13	3	1		4	1	3					
Largemouth bass	1		1					1			1			1	2	1	3
Logperch								1					1				
Northern pike	4	2			1	5	3	3	5								
Pumpkinseed	31	4		11	25	16	12	6	6	24	85	12	46	12	6	26	22
Rainbow Trout								3									
Rock bass	1				1			1			5		2			2	2
Round goby[T]							1	10	1			✓		4	1		
Smallmouth bass													2		1		
Spottail shiner	1	2			1	1		22				3	3		2	1	
Walleye						1								1		1	
White sucker	2	7	50	11	6	3	5	74	1	1	1	1	3	8	2	19	6
Yellow perch	3	3	2	9	1	13		2	3	3	6	8	4	62	16	9	14
Grand Total	**85**	**85**	**110**	**115**	**45**	**76**	**32**	**162**	**36**	**33**	**225**	**65**	**191**	**114**	**115**	**112**	**88**
Species Total	**12**	**11**	**10**	**10**	**12**	**11**	**7**	**20**	**10**	**5**	**13**	**12**	**14**	**14**	**14**	**14**	**13**
IBI Score	**56**	**45**		**36**	**47**	**73**	**29**	**53**	**37**	**26**	**52**	**31**	**56**	**50**	**46**	**46**	**67**

[T] - invasive species, ✓ - observed through a qualitative supplemental sample

Table 17: Number of fish and species caught at TRCA coastal wetlands from 2002 – 2011.

	Rouge River Marsh								Frenchman's Bay Marsh								Hydro Marsh							
Fish Species Common Name	2003	2005	2006	2007	2008	2009	2010	2011	2003	2005	2006	2007	2008	2009	2010	2011	2003	2005	2006	2007	2008	2009	2010	2011
Alewife							25		11			41			4		4		3				15	
Banded killifish																								
Black crappie						2	5	6									1			1			1	
Bluegill									4							1								1
Bluntnose minnow	2		2						7	6		4	3	1		6		2			4	1		10
Bowfin			2											1										
Brook silverside																								
Brook stickleback																								
Brown bullhead	64	21	14	33	1		8	40	2		9		2	2	2	4	66			33	2		5	5
Chinook salmon																								
Common carp	3	1	5	1			16		5	1	1		5		6	4	3	3		6	4		5	1
Common shiner	1	1	18	3				2							2			2			18		2	
Emerald shiner	5	1			4		5	14	35	9	1	20	9	1	2				4				16	2
Fathead minnow	2		3	2			4	1			6		1				22		18					
Freshwater drum									1															
Gizzard shad	3	10	7	3	13	2	3	10	1	23	6		1	1	18	4	1	3	24		1		6	3
Golden shiner				2	2	4		4				28	33		2		5	18	7	1	3		1	36
Goldfish			1																					
Johnny darter									1															
Largemouth bass		2					2	10	5	4	4	12	16	13	12	28		1	1	7	6	2	1	22
Logperch															1									
Northern pike			1				3	4						1		3					2			3
Pumpkinseed	8	58	22	16	14	43	42	47	57	36	3	12	14	12	25	10	4	15	20	54	4	2	14	65
Rock bass								1				2												
Round goby†						1					6	12	9	6	4	1								1
Smallmouth bass									2									1						
Spotfin shiner									5															
Spottail shiner			1					1		1													1	
Sunfish																1								
Walleye																								
White perch								1				2												
White sucker			1						1		1	2							1	1				
Yellow perch	9	6	3		16	5	4	1	2	50		6	12	2	12	5		4	2	5	17	6	8	9
Grand Total	**97**	**100**	**80**	**60**	**50**	**57**	**117**	**142**	**139**	**130**	**37**	**141**	**105**	**40**	**90**	**67**	**106**	**49**	**80**	**108**	**61**	**11**	**75**	**158**
Species Total	**9**	**8**	**13**	**7**	**6**	**6**	**11**	**14**	**15**	**8**	**9**	**11**	**11**	**10**	**12**	**10**	**8**	**9**	**9**	**8**	**10**	**4**	**12**	**12**
IBI Score	**32**	**50**	**49**	**25**	**40**	**38**	**57**	**68**	**45**	**56**	**30**	**49**	**54**	**52**	**46**	**58**	**17**	**47**	**48**	**52**	**45**	**47**	**33**	**71**

Table 18: Number of fish and species caught at TRCA coastal wetlands from 2002 – 2011.

	Duffins Creek Marsh											Carruthers Creek Marsh							
Fish Species Common Name	2002	2003	2004[1]	2004[2]	2005	2006	2007	2008	2009	2010	2011	2002	2003	2006	2007	2008	2009	2010	2011
Alewife			5					13			1					Not Sampled	14	Not Sampled	1
Banded killifish																			
Black crappie			1									5		3	1				2
Bluegill													2						
Bluntnose minnow	31	6	10			5	1	3	6	2	4	37	6	3					
Bowfin																			
Brook silverside																			
Brook stickleback																			
Brown bullhead	38	1	1	4			1	3	2		9	12	8	1	31		1		13
Chinook salmon								2		1	1								
Common carp		3		1		2				1	1	7	7	1	12				
Common shiner	41	14	1		4	1				1		32							
Creek Chub											1								
Emerald shiner		1	2	6			4	6		8	4		1						
Fathead minnow		13		17		29		6		172	25		37	12	48		1		3
Freshwater drum																			
Gizzard shad	59	12	4	1	13	20	24			6	7	87	6	1	158				7
Golden shiner			3							1									
Goldfish																			
Johnny darter	5	1					1				1	6					6		
Largemouth bass	4										6	4			1		1		5
Logperch		5		1							1								
Northern pike			1				1	3			3						1		1
Pumpkinseed	45	8	6	1		5	3	7	1	9	18	66	31	12	16		2		11
Rainbow Trout											1								
Rock bass	91	1								1	2								
Round goby[1]											1								
Smallmouth bass																			
Spotfin shiner																			
Spottail shiner	36	2	23	1			17		2		1								
Walleye																			
White perch																			
White sucker		1	10	15		2		2		7	5								1
Yellow perch	2	5	1	1	6	2	7	1		14	4	5		1	6				
Grand Total	352	73	68	48	26	66	59	46	11	222	96	270	98	34	273	--	26	--	44
Species Total	10	14	13	9	3	8	9	10	4	12	20	10	8	8	8	--	7	--	9
IBI Score	--	26	32		38	23	49	46	21	42	56	--	30	33	47	--	36	--	57

Table 19: Number of fish and species caught at Quinte coastal wetlands during 2011 sampling compared to historical sampling results (where available).

	Hay Bay South			Lower Napanee Marsh		Sawguin North Marsh		Carnachan Bay Marsh		Carrying Place Marsh	
Fish Species Common Name	2005	2008	2011	2010	2011	2010	2011	2009	2011	2009	2011
Alewife		3									
Banded Killifish	3	3	4	8				1	2	2	
Blackchin Shiner			8				2				12
Blacknose Shiner		6	1								
Black Crappie			7					1			
Bluegill	53	25	158	40	15	36	64	12	28	50	17
Bluntnose Minnow	17		1	1						42	8
Bowfin	1						3	3	2		1
Bridle Shiner						1					
Brook silverside	6										
Brook stickleback											
Brown bullhead					1	1	1	4	2		3
Central mudminnow					3	18	9			5	6
Common carp	2		1								
Common shiner	1							2			
Emerald shiner											
Fathead minnow											
Freshwater drum											
Gizzard shad											
Golden shiner	2	38	22	10	1	4	1	19	7	2	2
Grass Pickerel										2	2
Johnny darter					1						
Largemouth bass	11	7	5	5	1	6	5	7	9	9	15
Logperch				1			2			1	8
Longnose Gar				1							
Northern pike		2	3		1	1		1	2		2
Pumpkinseed	24	20	18	83	40	57	49	59	173	6	26
Rock bass	1	2	2	1				1	3	1	1
Round goby[†]	1	7	1								3
Sand Shiner		1									
Smallmouth bass											
Spotfin shiner											
Spottail shiner		2									
Walleye							2				1
White sucker		1	2						3		
Yellow perch	40	87	161	79	138	120	207	34	132	48	83
Sunfish					2	2					
Grand Total	**162**	**204**	**394**	**229**	**202**	**245**	**345**	**144**	**363**	**168**	**190**
Species Total	**13**	**14**	**15**	**10**	**9**	**10**	**11**	**12**	**11**	**11**	**16**
IBI Score	**79**	**91**	**93**	**94**	**81**	**92**	**100**	**75**	**99**	**80**	**86**

Table 20: IBI results of DRCWMP Fish Sampling from 2003 – 2011.

	2011 Fish Metrics						IBI Score								
Wetlands Name	SNAT	SCEN	PPIS	NNAT	PBNI	BYPE	2011	2010	2009	2008	2007	2006	2005	2004	2003
Parrott'sBay	-	-	-	-	-	-	-	-	-	-	-	-	-	-	85.4
Hay Bay South Marsh								-	-	90.9	-	-	78.5	-	-
Hay Bay North Marsh	-	-	-	-	-	-	-	-	-	76.9	-	-	84.5	-	-
Big Island East Marsh	-	-	-	-	-	-	-	-	-	86.2	-	-	99.9	-	-
Big Island West Marsh	-	-	-	-	-	-	-	-	-	96.3	-	-	-	-	-
Robinson's Cove Marsh	-	-	-	-	-	-	-	-	67.3	-	-	-	84.6	-	-
Sawguin Creek Central Marsh	-	-	-	-	-	-	-	-	-	55.4	-	-	70.4	-	-
Huyck's Bay Marsh	-	-	-	-	-	-	-	-	-	-	-	-	-	-	74.0
Port Newcastle Marsh	7.47	5.52	8.79	2.87	9.56	6.05	67.1	45.8	45.8	50.4	55.6	31.0	52.0	-	26.4
Wilmot Creek Marsh	2.99	1.84	10.00	0.78	4.83	1.80	37.1	53.1	29.2	73.3	46.8	35.9	-	45.4	56.5
Bowmanville Marsh	3.45	4.91	6.36	1.83	0.60	0.28	29.0	46.8	45.6	62.5	59.7	26.5	49.0	36.3	43.7
Westside Marsh	6.30	7.36	1.66	2.21	0.00	0.93	30.8	37.2	24.3	42.2	51.5	35.1	30.1	-	-
McLaughlin Marsh	7.44	9.81	4.26	1.86	2.46	2.50	47.2	27.6	20.7	23.8	35.3	30.5	57.1	-	36.0
Oshawa Second Marsh	6.93	5.89	0.00	5.21	0.00	0.16	30.3	8.3	44.8	36.1	26.5	40.9	45.6	-	-
Oshawa Creek Costal Wetland	3.76	4.21	5.38	1.93	6.31	2.93	40.9	44.9	37.2	54.2	-	-	-	-	-
Pumphouse Marsh	7.97	10.00	0.00	3.60	0.00	0.00	35.9	40.1	16.4	23.6	-	34.4	-	-	26.6
Corbett Creek Marsh	3.98	2.45	0.00	2.64	4.03	0.00	21.9	40.5	20.7	23.4	40.2	31.1	65.9	-	27.1
Whitby Harbour Wetland	3.48	4.01	1.61	1.47	7.21	1.60	32.3	12.5	6.3	29.0	9.4	-	-	-	-
Lynde Creek Marsh	6.45	5.89	2.33	10.00	9.26	1.80	59.6	48.1	38.0	41.9	50.0	47.6	59.8	34.3	40.7
Carruthers Creek Marsh	5.38	7.36	10.00	1.45	9.95	0.00	56.9	-	35.6	-	47.3	32.9	-	-	29.5
Duffins Creek Marsh	6.08	5.35	10.00	2.23	8.87	1.13	56.1	41.5	21.3	45.6	49.0	23.2	37.6	32.4	26.0
Hydro Marsh	8.13	10.00	10.00	4.21	7.17	3.40	71.5	32.6	46.7	44.9	52.4	47.5	47.3	-	17.2
Frenchman's Bay Marsh	4.78	8.10	10.00	1.62	6.76	3.37	57.7	46.4	52.1	53.8	48.7	30.0	56.4	-	44.9
Rouge River Marsh	7.17	10.00	10.00	3.07	9.78	0.64	67.8	57.2	37.5	40.1	25.0	48.7	49.9	-	31.5
Camachan Bay	9.56	10.00	10.00	10.00	10.00	10.00	99.3	-	75.0	-	-	-	-	-	-
Carrying Place	10.00	10.00	10.00	5.08	9.80	6.72	86.0	-	80.4	-	-	-	-	-	-
Blessington Creek Marsh	-	-	-	-	-	-	-	-	85.5	-	-	-	-	-	-
Sawguin Ditched	-	-	-	-	-	-	-	-	82.8	-	-	-	-	-	-
Airport Creek Marsh	-	-	-	-	-	-	-	53.0	-	-	-	-	-	-	-
Dead Creek Marsh	-	-	-	-	-	-	-	85.3	-	-	-	-	-	-	-
Lower Sucker Creek	-	-	-	-	-	-	-	77.5	-	-	-	-	-	-	-
Lower Napanee River Marsh	7.65	10.00	6.00	5.18	10.00	10.00	81.4	94.0	-	-	-	-	-	-	-
Sawguin Creek North Marsh	10.00	10.00	10.00	10.00	10.00	10.00	100.0	92.2	-	-	-	-	-	-	-

Table 21: Average IBI score for all wetlands sampled within in each jurisdictional area (Ganaraska Region CA, Central Lake Ontario CA, Toronto Region CA, Quinte) per year. Years may vary in the number of wetlands sampled due to water levels or other uncontrollable conditions.

	2011	2010	2009	2008	2007	2006	2005	2004	2003	Total
Ganaraska Region CA Wetlands	52.0	49.5	37.5	61.5	51.5	33.5	--	--	41.0	46.6
Central Lake Ontario CA Wetlands	38.4	34.2	28.3	37.4	39.0	35.0	51.3	35.0	35.0	37.0
Toronto Region CA Wetlands	62.0	44.5	38.8	46.3	44.4	36.6	47.8	--	30.0	43.8
Quinte Wetlands	91.9	80.4	78.2	81.1	--	--	83.6	--	79.7	82.5

16.0 APPENDIX VI – CLIMATE TRENDS (ENVIRONMENT CANADA, 2011)

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Climate Change

Spring 2011 Summary

Spring Temperature Summary Table

Spring Precipitation Summary Table

Completed Access to Information Requests

Proactive Disclosure

Climate Trends and Variations Bulletin - Spring 2011

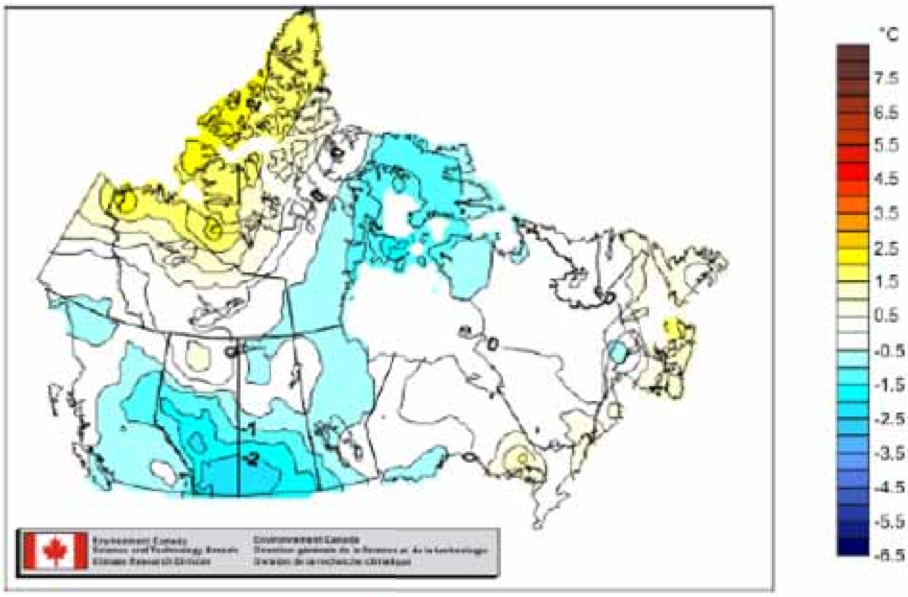
This bulletin summarizes recent climate data and presents it in a historical context. It first examines the national temperature, and then highlights interesting regional temperature information. Precipitation is examined in the same manner.

- National Temperature
- Regional Temperature
- National Precipitation
- Regional Precipitation

National Temperature

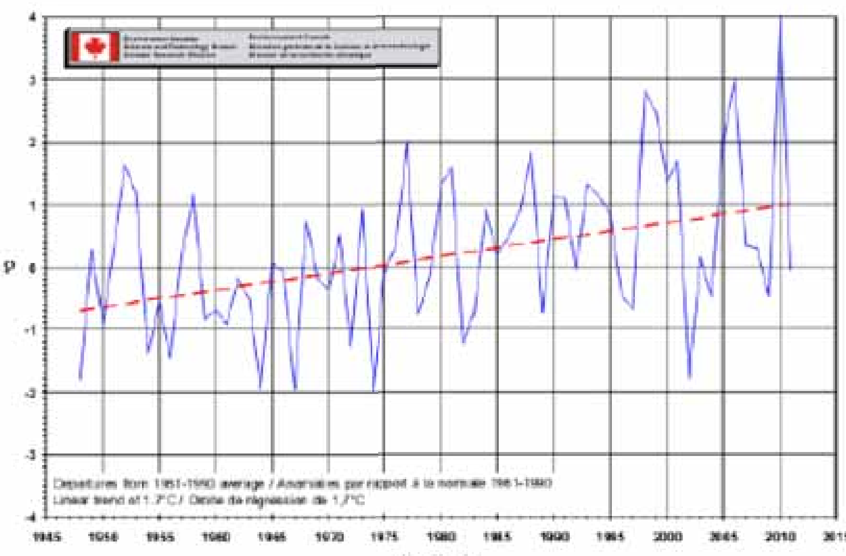
The national average temperature for the spring of 2011 was 0.1°C below normal (1961-1990 average), based on preliminary data, which makes this the 29th coolest spring since nationwide records began in 1948. The warmest was just last year, 4.1°C above normal. The coolest was 1967, 2.0°C below normal. The temperature departures map below shows most of the cooler than normal temperatures occurred across the prairies and in the eastern Nunavut and north Quebec area, warmer than normal conditions happened mainly in the western arctic.

Temperature Departures from Normal - Spring (Mar, Apr, May) 2011



The temperature trend graph below shows that spring temperatures have been quite variable with a gradual increase. The red dashed linear trend line indicates that spring temperatures have warmed by 1.7°C over the last 64 years.

Spring National temperature Departures and long-term Trend, 1948 - 2011



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Regional Temperature

Not one region had a warm enough spring to rank among the ten warmest, or a cool enough spring to rank among the ten coolest this year. The Atlantic region had the highest warm ranking, the 2011 spring was the 16th warmest, with a temperature 0.7°C above normal. South B.C. Mountains had the highest cool ranking, the 2011 spring was the 16thcoolest, with a temperature of 0.8°C below normal. However the Prairies had the largest below normal temperature among the climate regions, 1.5°C below normal, but that only ranked the spring of 2010 as the 19th coolest Prairies spring. A listing of all the regional temperatures departures and rankings are presented in the ranked regional temperatures table (MS Excel Version, 41 KB). The trends, extremes and current year rankings table shows that all of the eleven climate regions exhibit increasing trends in spring temperatures. The Mackenzie District had the greatest trend of 2.6°C over the 64 years of record. Atlantic Canada showed the least positive trend of 0.9°C over the same period.

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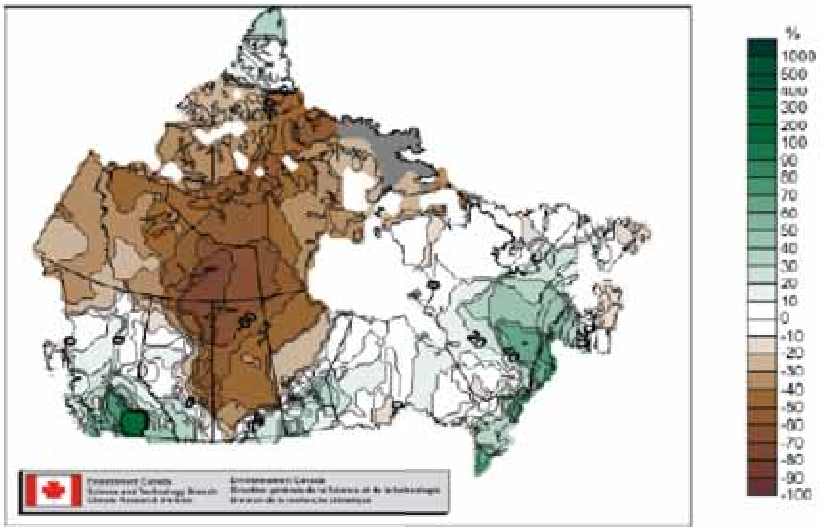
National Precipitation

As for precipitation, Canada experienced a drier than normal spring for 2011, 14% below normal (1961-1990 average). The 2011 spring ranked as the 8th driest in the 64-years of record. The wettest spring was 1979, 20% above normal, and the driest was 1956, 27% below normal. The precipitation percent departure map below shows a large area of central Canada including Saskatchewan, northern Alberta and Manitoba, and the territories were all drier than normal. The southern parts of the country, where much of the population of the country lives, were wetter than normal.

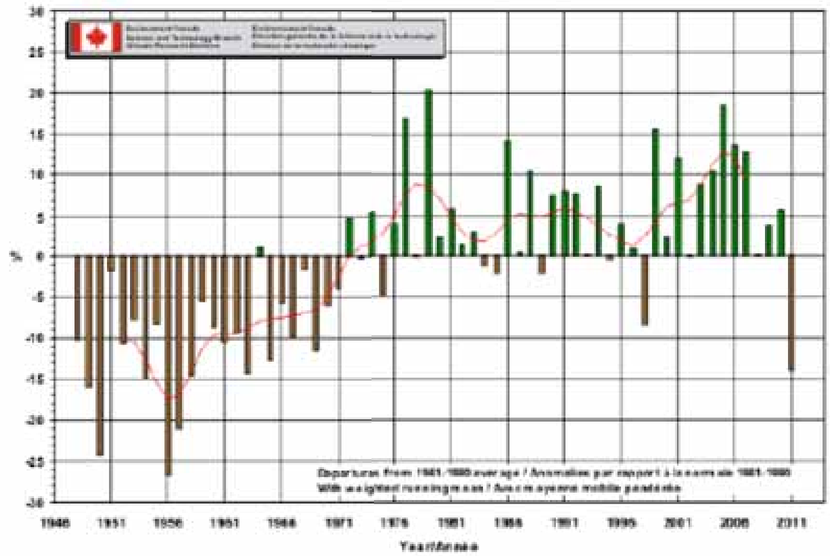
Precipitation Departures from Normal - Spring (Mar, Apr, May) 2011



It should be noted that "normal" precipitation in northern Canada is generally much less than it is in southern Canada, and hence a percent departure in the north represents much less difference in actual precipitation than the same percentage in the south. The national precipitation rankings are therefore often skewed by the northern departures and do not represent rankings for the volume of water falling on the country.

The precipitation percent departures graph below shows that since the early 1970s the majority of springs have generally been wetter than normal.

Spring National Precipitation Departures with Weighted Running Mean, 1948 - 2011



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Regional Precipitation

The Mackenzie District experienced its driest spring on record, precipitation was 50% below normal. Spring in two other regions also ranked among the ten driest springs: in Northwestern Forest (ranked 3rd driest, 29% below normal); and in Arctic Tundra (ranked 5th driest, 35% below normal). On the wetter side of country the Great Lakes/St. Lawrence Region had its wettest spring, 50% above normal. Two other regions also had ten wettest spring rankings this year: South B.C. Mountains (8th wettest, 24% above normal); and Northeastern Forest (10th wettest, 9% above normal). All of the climate regions and their rankings for the 2011 spring relative to the last 64 springs are listed in the ranked regional precipitation table (MS Excel Version, 44 KB). A summary of this past spring's precipitation rankings for each region, along with the record wettest and driest years, are listed in the extremes and current year rankings table.

To read a spreadsheet in Microsoft Excel format, you will need the Microsoft Excel Viewer.

Date Modified: 2012-05-07

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Important Notices

17.0 American Eel

Ministry of Natural Resources

Ontario

Natural. Valued. Protected.

State of resources reporting

February 2007

American eel in Ontario

American Eel Information Update (2010) on Page 5

American eel populations in Ontario have been declining since the 1980s. The Ontario Ministry of Natural Resources is working with partners to assist in the recovery of American eel by taking actions to protect their populations from further decline.

The American eel is an important part of the diversity of life in Lake Ontario and a valuable indicator of the health of the ecosystem. As a top predator, eels help to keep other fish species in balance, including invasive species such as the goby.

The formerly abundant American eel has a long history as a food and commercial product for residents of the upper St. Lawrence River and Lake Ontario. Eels were a highly valued fish resource for Aboriginal people, particularly the St. Lawrence Iroquois, who depended upon them as winter and travelling food. Historical accounts from the mid-1600s record a fisherman spearing as many as 1,000 eel in a single night.

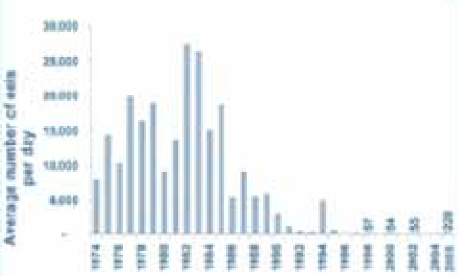

Figure 1. Average number of eels ascending the eel ladder per day, over a 31-day period for each year from 1974 to 2004. The ladder is located at the R.H. Saunders Hydroelectric Dam, in Cornwall, Ontario. Note: no data are available for 1996.

Records of commercial fisheries list catches of eel as early as 1886. During the 1980s and early 1990s, the American eel was one of the top three species in commercial value to Ontario's fishing industry. At its peak, the eel harvest was valued at $600,000 and, in some years, eel accounted for almost half of the value of the entire commercial fish harvest from Lake Ontario.

Over recent decades, the number of young American eels entering the upper St. Lawrence River and Lake Ontario has been declining dramatically (Figure 1). For example, the average number of eels migrating up the St. Lawrence River near Cornwall decreased from 25,000 per day in the 1980s to roughly 230 per day in 2005. American eel appears to be in decline throughout its global range.

At the same time, the commercial catch of eel has declined from approximately 223,000 kilograms (kg) in the early 1980s to 11,000 kg in 2002.

Distribution and life cycle of the American eel

Globally, American eel are found in coastal freshwater and marine waters stretching from Greenland along the east coast of North America to northern South America (Figure 2). Eels extend into Ontario through the St. Lawrence River and Lake Ontario.

American eels have a complex lifecycle (Figure 3). All American eel are part of a single breeding population that spawns in only one place in the world – the Sargasso Sea in the Atlantic Ocean. From there, young eels drift with ocean currents and then migrate inland into streams, rivers and lakes. This journey may take many years to complete with some eels travelling as far as 6,000 kilometres. After reaching these freshwater bodies they feed and mature for approximately 10 to 25 years before migrating back to the Sargasso Sea to spawn.

Virtually all American eels in Ontario are large, highly fecund (egg-laden) females. Prior to the decline of eel in Ontario, eels in Lake Ontario and the upper St. Lawrence River appear to have contributed substantially to reproduction of the global eel population.

Further details regarding the life history and distribution of eels can be found in the American eel fact sheet at http://www.mnr.gov.on.ca/en/Newsroom/LatestNews/MNR_E004285.html

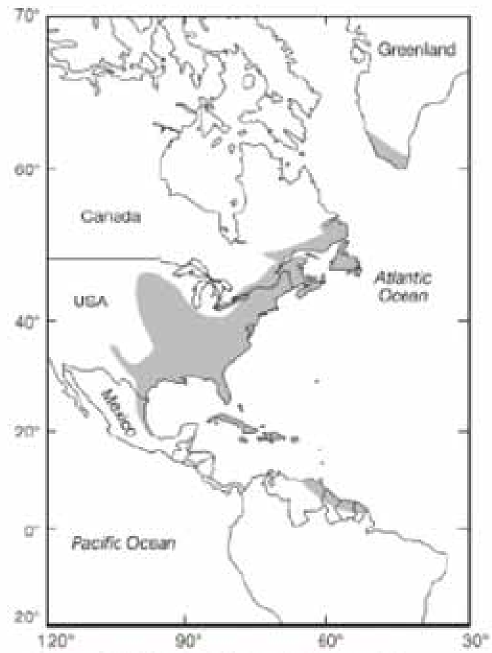

Figure 2. Global distribution of American Eel. (Fisheries and Oceans Canada, American eel, Underwater World.) (Reproduced with the permission of Her Majesty the Queen in Right of Canada, 2006)

Factors affecting eel poplulations

The long life span of American eel, combined with their vast migration route makes them susceptible to a wide range of factors. While no one factor has been identified as the single cause of the American eel decline, the actors below appear to be having a cumulative impact on American eel. These factors generally occur globally and include:

- Turbines at hydro electric facilities: eels can be killed as they migrate downstream through the turbines on their way to spawn in the Sargasso Sea. In the St. Lawrence River system, 40 per cent of mature eels that pass through turbines are killed.
- Physical barriers such as hydro dams can block eels from migrating upstream to their freshwater habitats. A large portion of the eels' freshwater habitat in Canada and the United States has been made inaccessible due to such physical barriers.
- Harvesting: American eel are harvested throughout their global range and during all of their life stages.
- Deteriorating habitat quality: contaminants such as PCBs may affect eel fertility and survival.
- Habitat loss in marine waters due to the over-harvest of seaweed in the Sargasso Sea.
- Changing ocean conditions may influence the ability of eel to drift and migrate to and from the Sargasso Sea.
- An exotic, parasitic worm that affects the health and survival of eels. (While this worm has been introduced into United States waters, it has not been found in Canadian waters).

Eel management

Ensuring the long-term sustainability of the American eel population is highly complex and requires significant coordination across many international jurisdictions. Ontario is working closely with federal, provincial, and United States governments and industry partners to facilitate the recovery of the American eel. Some of the measures include:

Stocking:

- In October 2006, the Ontario Ministry of Natural Resources, in partnership with Ontario Power Generation, the Ontario Federation of Anglers and Hunters and the Ontario Commercial Fisheries' Association released over 144,000 eels into the St. Lawrence River.
- Quebec has also started stocking eels into LakeChamplain.

Cancelling American eel harvests:

- Ontario cancelled the commercial and recreational harvest of American eels in 2004.
- The Quebec government has also reduced the commercial harvest of eels.

Reducing migration barriers:

- The Ontario Ministry of Natural Resources and Ontario Power Generation are working to improve the safety of eels as they pass through hydroelectric turbines in Ontario waters.
- An eel ladder was installed in 1974 at the R.H. Saunders Hydroelectric Dam near Cornwall, Ontario, to help eels climb over the dam as they migrate into Ontario from the Sargasso Sea. By counting the number of eels that pass through these ladders, biologists are able to monitor changes in the size of local eel populations over time.
- Quebec Hydro and New York Power Authority, in association with provincial and United States state authorities, have also established eel adders at their dams in the St. Lawrence River.

Management Plans:

- In September 2004, the Department of Fisheries and Oceans Canada with the Quebec and Ontario governments agreed to develop a co-ordinated management plan for American eel in Canada.

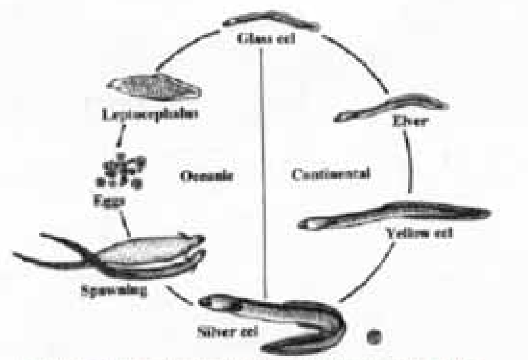

Figure 3: Life cycle of the American eel (created by Rob Slapkauskas).

> American eels might be confused with sea lamprey. The eel has a snake-like body and a dorsal fin that extends from half way down the length of its back to the underside of its body. At maturity, eel range from 75 to 100 centimetres (cm) in length and weigh one to three kilograms. Sea lamprey grow up to roughly 85 cm in length. A major difference between sea lamprey and the American eel is that, unlike eels, sea lamprey has a circular, suction-cup like mouth with numerous teeth used to attach themselves to fish.

- This draft management plan is now available for comment on the Fisheries and Oceans Canada website. (http://www.aquaticspeciesatrisk.gc.ca)
- While there is no North American management plan for American eel, efforts are under way to ensure the coordination of management actions between Canada and the United States. Ontario is working with Fisheries and Oceans Canada, other provincial governments, the Great Lakes Fishery Commission, and United States federal and state governments to develop inter-jurisdictional management plans for American eel.

Status Designation:

- American eel is being considered for listing as a species at risk on the Species at Risk in Ontario List and under the Canadian Species at Risk Act and the United States Endangered Species Act. The Species at Risk Act Legal Listing Consultation Workbook for the American Eel has been posted for comment on the Canadian Species at Risk Act Public Registry website.

Outlook for the resource

The future of the American eel in Ontario waters is uncertain. The low numbers of eel migrating into the upper St. Lawrence River and Lake Ontario in recent years suggest that the eel populations will remain low and will not provide a commercial resource for at least the next decade.

Information Sources

The information provided in this document is based on data collected for the Ontario Ministry of NaturalResources' fish monitoring programs and on information from scientific reports and research scientists.

Related Information

- Ministry of Natural Resources, Lake Ontario Management Unit - Annual Report 2005 (http://www.ontla.on.ca/library/repository/ser/185926/2005.pdf)
- American eel returning to Ontario waters (http://www.mnr.gov.on.ca/en/Newsroom/LatestNews/MNR_E004286.html)
- American eel Fact Sheet produced by the Ministry of Natural Resources (http://www.mnr.gov.on.ca/en/Newsroom/LatestNews/MNR_E004285.html)
- DFO and Provinces Release American Eel Management Strategy (http://www.dfo-mpo.gc.ca/media/npress-communique/2004/hq-ac79-eng.htm)
- Underwater World: American Eel published by Fisheries and Oceans Canada (http://www.dfo-mpo.gc.ca/Science/publications/uww-msm/articles/eel-anguille-eng.htm)
- The American Eel: Considering Endangered Species Act Protection, published by the United States Fish and ildlife Service (http://www.fws.gov/northeast/newsroom/eels.html)
- Casselman, J. M. 2003. Dynamics of resources of the American eel, Anguilla rostrata: Declining abundance in the 1990s. In Aida, K., K. Tsukomoto, and K. Yamauchi, Editors. Eel Biology. Springer-Verlag, Tokyo, Japan.
- Castonguay, M., P.V. Hodson, C.M. Couillard, M.J. Eckersley, J-D Dutil, and G. Verreault. 1994. Why is recruitment of the American eel, Anguilla rostrata, declining in the St. Lawrence River and Gulf? Canadian Journal of Fisheries and Aquatic Sciences 51:479-488.
- EIFAC/ICES Working Group on Eels. 2001. Report of the EIFAC/ICES Working Group on Eels, St. Andrews, N.B., 28 August – 1 September 2000. Advisory Committee on Fisheries Management, International Council for the Exploration of the Sea, ICES CM 2001/ACFM:03, Copenhagen. Information

American Eel Update – 2010

Since 2007, the Ontario Ministry of Natural Resources (MNR) has partnered with Ontario Power Generation (OPG), Hydro Québec, Québec Ministère des Ressources naturelles et de la Faune (Natural Resources and Wildlife), and Fisheries and Oceans Canada to work toward the protection and recovery of American eel populations in Ontario. The result of these collaborations has been innovations at hydroelectric generating stations, government policy changes, and new management and research initiatives.

In 2008, American eel was designated as an endangered species and became protected under the Endangered Species Act, 2007 (ESA 2007). Its habitat will be protected as of June 30, 2013, or earlier if a habitat regulation is developed.

The R.H. Saunders Generating Station on the St. Lawrence River near Cornwall, Ontario became exempt from certain prohibitions under the ESA when they entered into an agreement with the Minister to take reasonable steps to minimize adverse effects on the American eel. These exemptions may only be made when the survival or recovery of a species is not jeopardized and when it will not interfere with protection and recovery plans.

As a result of this exemption, the Saunders Generating Station will continue to operate. OPG will be undertaking the following measures to minimize the effects of Saunders Station on American eel:

- Stocking young eel into the St. Lawrence–Lake Ontario watershed
- Trapping and transporting eel around Saunders Station during their downstream migration
- Monitoring eel mortality
- Operating, maintaining, and reporting on the effectiveness of the Saunders eel ladder

In 2009, OPG installed a 300-metre extension to the eel ladder at the Saunders Station as well as a new surface to help eels climb the ladder faster. The purpose of the extension is to increase the ease of upstream migration and reduce the number of eels that are swept back through the dam. A new photoelectric counter installed on the ladder will improve estimates of the number of eels migrating upstream past the Saunders Station. The New York Power Authority, the owner and operator of the R.H. Moses Generating Station (the other half of the dam, situated in U.S. waters), also recently constructed and began operating a ladder to facilitate the upstream passage of American eel during 2006.

The number of American eel that move upstream via eel ladders is an indicator of overall eel abundance (Figure 4). The total number of American eel that passed through the ladder at the Saunders Station in 2008 was twice that recorded in recent years. However, even though this trend is encouraging, it is still less than 3% of that observed in the early 1980s.

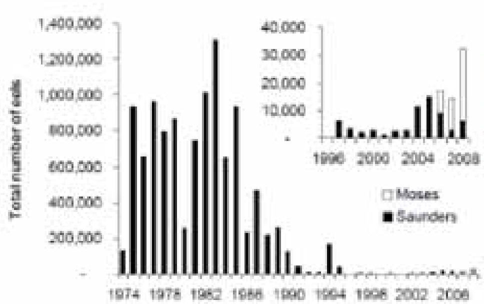

Figure 4. Total number of eels ascending the eel ladder(s) at the Moses Saunders Dam from 1974 to 2008. No counts are available for 1996.

To support recovery efforts, 3.9 million young eels have been stocked by OPG in Ontario since 2006. In addition, a pilot project was initiated in 2008 to explore whether safe downstream passage of eels could be accomplished through transporting mature eels around hydroelectric dams in Ontario and Quebec. Work on these projects is continuing.

The MNR is currently working with partners to prepare a recovery strategy for the American eel. Additionally, several projects on American eel have been funded through the MNR's Species at Risk Stewardship Fund. These stewardship projects include studies on population abundance and downstream migration as well as developing a guide to best management practices for waterpower operators. Governments and partners throughout the eel's North American range will need to continue to coordinate and collaborate on their efforts to recover American eel populations.

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