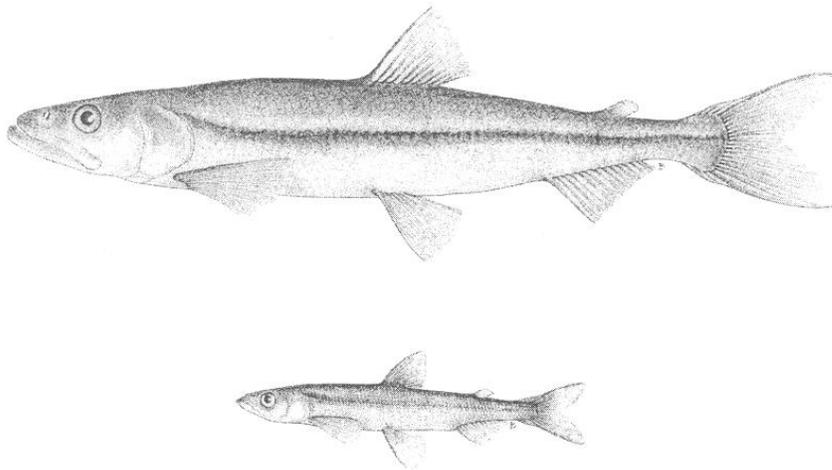


Maritime Aboriginal Peoples Council
IKANAWTIKET Environmental Incorporated

Presence/Absence of Lake Utopia Rainbow Smelt (*Osmerus mordax*) Large-bodied Population and Small-bodied Population

April – May 2014 Spawning Run Field Study



September 30, 2014

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Front Cover

Lake Utopia Rainbow Smelts, Large-bodied Form (top) and Small-bodied Form (bottom). Illustrations by Diana McPhail. Taken from COSEWIC, 2008.

Back Cover

Lake Utopia Rainbow Smelts, "Giant-bodied form" (image center) Spawning with Large-bodied form on Mill Lake Stream, Lake Utopia. Time-Series of four images taken from video by Andy Seeley on April 6, 2014.

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Abstract

*From April 1 to May 18 2014, the Maritime Aboriginal Peoples Council completed a dedicated presence/absence spawning survey of the sympatric pair of Lake Utopia Rainbow Smelt (LURS) (*Osmerus mordax*), Large-bodied Population (LbP) and Small-bodied Population (SbP) on historic spawning tributaries of Lake Utopia in Southern New Brunswick.*

This project was a continuation of a similar project undertaken by the New Brunswick Aboriginal Peoples Council in 2013. The projects were jointly developed between the Maritime Aboriginal Peoples Council-Maritime Aboriginal Aquatic Resources Secretariate, IKANAWTIKET Environmental Incorporated, the New Brunswick Aboriginal Peoples Council, and the Department of Fisheries and Oceans Canada-Maritimes Region Species at Risk Office. This survey work also continues a working partnership between the organizations with the aim to continue, over the next few years, a series of dedicated field studies to daily note the presence or absence of LURS spawners which would be useful for the next LURS population assessment, as well as to provide some enumeration survey data (since the presence/absence survey also included rough visual estimates of nightly spawner abundance) to ground-truth the draft Recovery Strategy (March, 2013). For 2014, the project was formalized via a DFO Purchase Order Contract F5238-140007.

The study found a total of 16,036 LURS-LbP spawning on Mill Lake Stream from April 1-8, though none were found on Trout Lake Stream. The Summation of the 5 Highest Daily Estimates was 15,750, which was more than 7 ½ times that required to meet the proposed population abundance objective of the draft Recovery Strategy. Fork length measurements were opportunistically observed and it was noted that the average length of LURS-LbP spawners (excluding “giant-body form”) were at the extreme low end (~17 cm) of the size range suggested in the draft Recovery Strategy.

Unfortunately, weather conditions and high, turbid water prevented LURS-SbP surveys for most of the peak spawning period from late-April to early May. Small numbers of a few hundred each were recorded on Unnamed Brook and Smelt Brook, as well as eggs from previous spawning, during the first week of May. The metric of the ‘Summation of the 5 Highest Daily Estimates’ for LURS-SbP on Second Brook, Unnamed Brook, and Smelt Brook could not be calculated due to the lack of data.

For the second year in a row, LURS-SbP were recorded on Mill Lake Stream. 7,000 spawners were recorded on April 13th, which brings into question the use of Mill Lake Stream as spawning habitat for LURS-SbP.

Six key recommendations were proposed for future study:

- 1. LURS-LbP spawning should be observed annually for at least the next 3-4 years to confirm that the draft Recovery Strategy abundance objective is being met.*
- 2. LURS-LbP should be located and enumerated at times other than spawning, if possible, to confirm that spawning abundance is an appropriate measure of overall population abundance.*
- 3. A mathematical formula should be developed for estimating LURS-LbP fecundity based on length or weight of spawning females and potential spawning success should be estimated as part of future studies.*
- 4. Mill Lake Stream should be monitored as part of the overall monitoring for LURS-SbP spawning, i.e., included with Smelt Brook, Unnamed Brook, and Second Brook surveys.*
- 5. The Critical Habitat component for LURS-SbP should be re-evaluated to include Mill Lake Stream as a spawning stream Critical Habitat.*
- 6. Work should continue to gain access to the LURS-SbP historic spawning streams of Smelt Brook, Unnamed Brook, and Second Brook during the spawning season in order to enumerate LURS-SbP and understand their behaviour and possibly why LURS-SbP may be utilizing Mill Lake Stream.*

Four additional recommendations were presented for consideration:

- 7. More thought should be given to the schooling/massing nature for LURS at specific fish passageways and spawning habitat when designing surveys or projects. As was noted, in some instances, schools will stop and in others they will proceed with migration. Until their spawning migratory behaviour is more fully understood, a precautionary approach should be used.*
- 8. A greater emphasis should be placed on threats at a very localized level and more work should be done to survey and improve stream habitat for back-up or secondary spawning locations, in the case that one of the “historic spawning sites” is lost.*
- 9. Work should continue to validate presence/absence survey results, for example by seining, photographic/video verification of numbers counted, or by mark-recapture methods. The last method may be useful for also helping to determine actual numbers in years when spawning migration is highly pulsed, like in 2013.*
- 10. Given that spawning can occur quickly and in unfavourable conditions for field technicians, environmental variables, including moon cycle, should be monitored in order to better understand the cue(s) that initiate spawning migration, so that survey effort is most effective.*

Partially as a result of this project and the 2013 presence/absence survey, MAPC-MAARS and IKANAWTIKET have gained additional technical and knowledge capacity to undertake a continued presence on Lake Utopia for future LURS spawning runs, provided that funding is available. In addition, MAPC has indicated that it will undertake a leadership role for LURS in the areas of monitoring surveys, watershed planning, and educational/outreach activities, which has been noted in the draft recovery implementation schedule for inclusion in the draft Action Plan currently under development.

Introduction

This publication is the second in a series produced by the Maritime Aboriginal Peoples Council – IKANAWTIKET to report on the spawning runs of the Lake Utopia Rainbow Smelt (*Osmerus mordax*) (LURS) as well as give a status update as to the growing working relationship between the Department of Fisheries and Oceans Canada (DFO) – Maritimes Region Species at Risk Office and MAPC regarding LURS conservation. The introduction and methods recap and update those laid out in the 2013 report, while the results section presents the data for the 2014 spawning season. The report’s conclusions looks at both the 2014 spawning run and also highlights similarities or differences to the 2013 spawning run.

LURS is a rainbow smelt, consisting of two “genetically diverging” body forms or populations, consisting of a Large-bodied or “normal/giant” form (LbP) and a Small-bodied or “dwarf” form (SbP), which is endemic to Lake Utopia and associated water bodies on the Magaguadavic River system in southwestern New Brunswick (45° 10’ N, 66° 47’ W) (COSEWIC, 2008) (Figure 1).

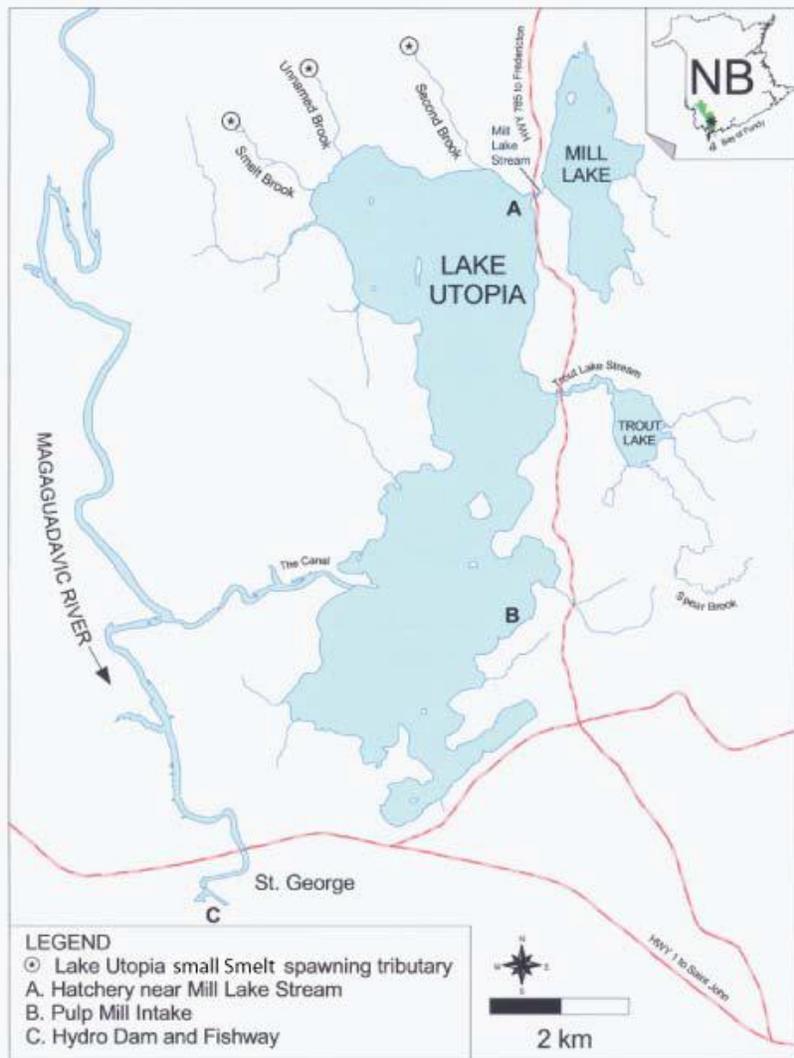


Figure 1: Lake Utopia, New Brunswick (taken from DFO, 2011).

LURS is a unique smelt being both:

- 1) obligative potadromous (meaning it can only migrate within freshwater to spawn, unlike other smelt populations which migrate from salt water to freshwater to spawn; LURS being obligative due to barriers preventing migration to salt water); and
- 2) a sympatric pair of body forms/populations (meaning the two body forms/populations act as separate species but are still dependent on each other for maintaining each other's "distinctiveness").

Thus, not only have LURS become genetically distinct from other nearby rainbow smelt populations as a result of their geographic isolation, the sympatrically paired species itself is also rapidly undergoing the process of speciation into two distinct species whilst still occupying the same habitat. This is a phenomenon which only occurs in a few other cases amongst smelt in North America (COSEWIC, 2008).

The uniqueness and endemism of LURS has prompted the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) to assess each body form as a separate Designatable Unit (DU) – LURS Large-bodied Population (LURS-LbP) and LURS Small-bodied Population (LURS-SbP). Each was assessed in 2008 as Threatened (COSEWIC, 2008).

Currently only LURS-SbP (previously referred to as the Lake Utopia Dwarf Smelt) is Listed under Schedule 1 of the federal *Species at Risk Act* (SARA); though the draft SARA Recovery Strategy prepared by DFO addresses both DUs as a sympatric pair (DFO, 2013). A SARA Listing has been proposed for LURS-LbP as of 2008. Species population data collection and habitat projects for LURS which are undertaken by MAPC are for the benefit of both DUs.

Both COSEWIC and DFO have noted the high level of uncertainty with existing population abundance data, as little attention has been paid to undertaking dedicated LURS population surveys in the past. Current population estimates are derived mainly from data which had been gathered opportunistically during LURS genetic studies (COSEWIC, 2008; DFO, 2013).

The March 2013 draft SARA Recovery Strategy proposes an interim 5-year abundance objective of 100,000 spawning LURS-SbP and 2,000 spawning LURS-LbP. The draft Recovery Strategy also proposes an interim 5-year distribution objective of maintaining LURS-SbP spawning on the frequently noted spawning sites on Second Brook, Unnamed Brook, and Smelt Brook and maintaining LURS-LbP spawning on the one frequently noted spawning site on Mill Lake Stream (DFO, 2013).

Lake Utopia is within the traditional ancestral homeland territories of the Mi'kmaq, Maliseet, and Passamaquoddy Peoples, who continue to enjoy treaty liberties to fish throughout all their traditional ancestral homeland territories "as usual" extended to "their heirs and to the heirs of their heirs, forever" (Gould & Simple, 1980; NCNS, 1993). The New Brunswick Aboriginal Peoples Council (NBAPC), represents Aboriginal Peoples continuing on their traditional

ancestral homeland territories (i.e., living off-reserve) throughout modern day New Brunswick. NBAPC maintains a treaty liberty natural life harvesting regime for its members, as well as, annually negotiates a community-level food, social, and ceremonial (FSC) harvest arrangement with DFO under the DFO Aboriginal Fisheries Strategy (NBAPC, 2009).

Aboriginal Peoples holding an eco-centric worldview have long expressed concern about habitats and species, which in some ways parallel the interdependent struggle of Aboriginal Peoples for international, national, and local recognition of Aboriginal Peoples' rights to lands, waters, and resources and for all of humanity to respect Mother Earth. In the Maritimes Region, Aboriginal Peoples have continued to advocate for species and habitat protection and the protection of Aboriginal and Treaty Rights since before SARA was passed in 2001 (McNeely and Hunka, 2011).

MAPC is the intergovernmental leaders forum of the New Brunswick Aboriginal Peoples Council, the Native Council of Nova Scotia, and the Native Council of Prince Edward Island, which advocates for the Mi'kmaq/Maliseet/Passamaquoddy Aboriginal Peoples living on traditional ancestral homeland territories throughout the Maritimes Region (MAPC, 2014). MAPC established the Maritime Aboriginal Aquatic Resources Secretariate (MAPC-MAARS), which is a technical advisory body to the Aboriginal Communal Commercial Fisheries Entities of the three partner Native Councils, to collectively advance the rightful share to Atlantic aquatic resources and aquaculture operations for the sustained, viable economic growth of the Maritime Aboriginal Peoples. IKANAWTIKET Environmental Incorporated is a Registered Charity to promote the preservation of the natural environment by educating and informing the public about environmental issues and biodiversity in the Maritime Provinces, and Aboriginal culture, worldviews, and knowledge in relation to the environment (MAARS, 2013).

MAPC-MAARS and IKANAWTIKET continues to advocate for the respect of Mother Earth and respect of Aboriginal, Treaty, and Other Rights through detailed responses to federal and provincial government departments concerning on-going work to develop national SARA policies, SARA Listing recommendations, and recovery planning documents, as well as through educational initiatives and supporting community conservation efforts (McNeely & Hunka, 2011; Hunka & McNeely, 2012).

In 2011-2012, NBAPC expressed concern about the status of LURS, as well as the on-going history of the continued slow derogation of Aboriginal and Treaty Rights. NBAPC, in partnership with MAPC-MAARS and IKANAWTIKET, proposed a range of options to DFO-Maritimes to accommodate mutual interests of protecting LURS and respecting Aboriginal, Treaty, and Other Rights; of which, one item proposed was new avenues of government support for NBAPC to undertake additional research and a stewardship lead on LURS (Nash-McKinley and McNeely, 2012).

Together NBAPC, MAPC-MAARS, and IKANAWTIKET approached DFO in 2013 to undertake a species at risk project to provide some base-line data to inform both the proposed SARA Listing and Recovery Strategy processes for LURS. The parties agreed to undertake a dedicated

(though limited in effort) presence/absence survey of LURS during the spawning run of late winter/early spring 2013. The results of the 2013 spawning run are presented in the IKANAWTIKET report "*Presence/Absence of Lake Utopia Rainbow Smelt (Osmerus modax) Large-bodied Population and Small-bodied Population: March-May 2013 Spawning Run Field Study*".

DFO and MAPC renewed their commitment in March 2014 to undertake a similar presence/absence survey for the April-May 2014 spawning run. It was also agreed that both would work together to coordinate for a DFO-led team to undertake a mark-recapture survey of the LURS-LbP, something which was recommended in the 2013 report.

In addition to the two projects described above, MAPC-MAARS-IKANAWTIKET have undertaken LURS habitat projects in 2013 and 2014 funded through the Aboriginal Funds for Species at Risk. As a result of the community's interest in LURS conservation and sustainable use, and the capacity which is being built as a result of these projects, MAPC agreed to take on several leadership and partnership roles for the LURS Action Plan, including:

- a) annually estimating spawner abundance
- b) annually monitoring streams for the presence/absence of LURS
- c) identifying attributes of Critical Habitat, including areas that support spawning, and identifying areas which could be Critical Habitat or spawning areas
- d) habitat restoration activities
- e) watershed planning
- f) general and specific educational and awareness activities

In addition to providing raw data for LURS assessment purposes, projects such as this spawning run assessment increases MAPC's overall capacity to undertake on-the-water projects. Thus, an anticipated, though not detailed in this project's Purchase Order arrangement, is a continued building of a working relationship between MAPC and DFO on LURS conservation and sustainable use.

Methods

MAPC hired two NBAPC community members living near Lake Utopia to survey the known frequented spawning locations for LURS each day/night, weather permitting, during the spawning period of early April to mid-May in order to capture the "five highest days/nights of spawner abundance", which is the standardized data set useful for the Recovery Strategy.

For the purposes of this report, the two community members are referred to as "field technicians"; however, it should be understood that neither has any formal training in conducting species assessments. One of the community members worked on the project last year and they have field experience, while the other one was new to the project. The technicians were supported by MAPC-MAARS and IKANAWTIKET personnel with training and

experience using presence/absence surveys; and the flexibility of the project allowed for a “learning curve”. Thus the project was multi-purpose of providing data and increasing technical capacity, though from a strictly technical aspect of the DFO contract, only data and data analysis were required as deliverables.

The streams surveyed for the presence/absence of LURS-LbP were: Mill Lake Stream and Trout Lake Stream and for LURS-SbP were: Mill Lake Stream, Trout Lake Stream, Spear Brook, Second Brook, Unnamed Brook, and Smelt Brook. GPS coordinates and descriptions of the survey sites and spawning areas are contained in Tables 3 & 4 in Appendix A, which also includes reference photographs (Figures 3-5) of the Mill Lake Stream spawning habitat and water conditions for 2014. Also provided for reference in Appendix A are drawings of: Fig. 7, the lower portion of Mill Lake Stream and Fig. 8, lower portion of Unnamed Brook; including noted spawning locations and important features.

The field technicians noted the presence or absence of LURS-LbP and LURS-SbP, as well as the time of day, effort (in hours), and estimated the number of spawners by visual counting/ extrapolating methods. If the survey took place during the night and extended past mid-night, the date reported is that for the beginning of the survey.

Learning from the previous year, new field data sheets were developed to more accurately track the activities of the crew and counts throughout the course of a night. Thus, the data provided in this 2014 report is a somewhat finer scale of information than just total nightly abundance, which was reported in 2013. In addition to reporting total nightly abundance, the 2014 data was collected at 30 minute to 1 hour intervals when possible, using a 5 minute or 15 minute walkthrough snapshot (depending on survey location) to estimate abundance. During the remainder of the interval, the activity of the spawners was closely monitored to determine what portion of the group had migrated in or out of the stream since the last snapshot. Thus the data was reported as total number of new spawners for each snapshot, and tabulated to determine nightly abundance.

This study did not have the objective to measure lengths of LURS, nor to capture LURS for any reason; however, because field technicians did observe that the LURS-LbP seemed to be abnormally small compared to the length range suggested in the draft Recovery Strategy, the field technicians did take opportunistic length measurements. Since, the field technicians did not have a DFO permit to remove LURS-LbP for accurate measurements, the method employed was to hold a ruler next to a resting fish and visually estimate its fork length, without removing the fish from the water. Though there are obvious limitations with such opportunistic measurements, such errors should be on the side of reading length measurements which are larger than the actual fish, e.g., light refraction through water produces a larger image.

It is important to note that the most often recommended method for identifying the body-form populations of LURS (Large-body form and Small-body form) is the length of the fish. The draft Recovery Strategy recommends that size classification is “the most useful and practical criteria for general description”, though other distinctive morphological and genetic characteristics

exist. Based on the 2011 DFO Recovery Potential Assessment, the draft Recovery Strategy classifies LURS-SbP as less than 170 mm fork length and LURS-LbP as equal to or greater than 170 mm fork length. However, the COSEWIC Status Report, based on older information, suggests that the fork length division between LURS-SbP and LURS-LbP is much lower (150 mm). A clear definition is important for reasons which will be seen in the results of this report concerning the observed average length of LURS-LbP.

Results

LURS-LbP

As per the DFO Purchase Order, surveys began on April 1, 2014. The first instance of spawning was recorded on that night at Mill Lake Stream (3,000 spawners). Checks continued each night on Mill Lake Stream through until April 9th (0 spawners). Peak spawning activity occurred between April 1-7, but with unexpected lows on April 3rd (270 spawners) and 4th (8 spawners). Water conditions precluded surveys on April 10th and 11th. A follow-up on the 12th did not find any LURS-LbP. Trout Lake Stream was also checked daily throughout this time period and LURS-LbP were absent (Table 1).

A total of 16,036 LURS-LbP spawners were observed on Mill Lake Stream over an 8 day period in which spawners were observed from April 1 to April 8. The peak spawning abundance was 4,000 on April 6th. The five highest daily summations of spawner abundance were: Apr. 1 (3,000), Apr. 2 (3,000), Apr. 5 (2,750), Apr. 6 (4,000), and Apr. 7 (3,000), for a total of 15,750 (Figure 2).

Table 1: Enumeration of LURS-LbP on Mill Lake Stream (MLS) and Trout Lake Stream (TLS) (hashed cells) during the 2014 spawning run

Date	Stream	Start Time	Effort (hrs)	Visual Estimate		
				Observed	Change	Daily Total
2014-04-01	MLS	20:00	0.08	0	0	
2014-04-01	MLS	21:00	0.08	0	0	
2014-04-01	MLS	22:00	0.08	1500	1500	
2014-04-01	MLS	23:30	0.08	3000	1500	3000
2014-04-01	TLS	1:00	0.25	0	0	0
2014-04-02	MLS	21:00	0.08	50	50	
2014-04-02	TLS	22:00	0.25	0	0	
2014-04-02	MLS	22:30	0.08	500	450	
2014-04-02	MLS	23:00	0.08	1200	700	
2014-04-02	TLS	23:30	0.25	0	0	0
2014-04-02	MLS	2:00	0.08	3000	1800	3000
2014-04-03	MLS	21:30	0.08	1	1	
2014-04-03	MLS	22:30	0.08	20	19	
2014-04-03	MLS	23:00	0.08	70	50	
2014-04-03	MLS	0:30	0.08	270	200	

Table 1 (cont.): Enumeration of LURS-LbP on Mill Lake Stream (MLS) and Trout Lake Stream (TLS) (hashed cells) during the 2014 spawning run

Date	Stream	Start Time	Effort (hrs)	Visual Estimate		
2014-04-03	MLS	1:00	0.08	0	-270	270
2014-04-04	MLS	21:00	0.08	0	0	
2014-04-04	MLS	22:00	0.08	1	1	
2014-04-04	MLS	22:30	0.08	5	4	
2014-04-04	MLS	23:00	0.08	8	3	
2014-04-04	MLS	0:00	0.08	0	-8	8
2014-04-05	MLS	21:30	0.08	150	150	
2014-04-05	MLS	22:00	0.08	500	350	
2014-04-05	TLS	23:00	0.25	0	0	0
2014-04-05	MLS	0:00	0.08	1200	700	
2014-04-05	MLS	1:00	0.08	2750	1550	
2014-04-05	MLS	1:30	0.08	2000	-750	
2014-04-05	MLS	5:30	0.08	650	-850	
2014-04-05	MLS	6:00	0.08	20	-630	2750
2014-04-06	MLS	22:30	0.08	10	10	
2014-04-06	MLS	23:00	0.08	20	10	
2014-04-06	MLS	0:00	0.08	500	480	
2014-04-06	MLS	0:30	0.08	750	250	
2014-04-06	MLS	1:00	0.08	2000	1250	
2014-04-06	MLS	1:30	0.08	1000	-1000	
2014-04-06	MLS	2:00	0.08	1600	600	
2014-04-06	MLS	3:00	0.08	3000	1400	
2014-04-06	MLS	4:00	0.08	2000	-1000	
2014-04-06	MLS	4:30	0.08	1500	-500	
2014-04-06	MLS	5:00	0.08	1000	-500	4000
2014-04-07	MLS	21:00	0.08	20	20	
2014-04-07	MLS	21:30	0.08	100	80	
2014-04-07	TLS	21:45	0.25	0	0	0
2014-04-07	MLS	22:00	0.08	500	400	
2014-04-07	MLS	22:30	0.08	2000	1500	
2014-04-07	MLS	23:00	0.08	3000	1000	
2014-04-07	MLS	23:30	0.08	3000	0	
2014-04-07	MLS	23:30	0.08	3000	0	3000
2014-04-08	MLS	21:30	0.08	3	3	
2014-04-08	TLS	22:00	0.25	0	0	0
2014-04-08	MLS	22:30	0.08	1	-2	
2014-04-08	MLS	23:30	0.08	6	5	
2014-04-08	MLS	1:00	0.08	0	-6	8
2014-04-09	MLS	21:30	0.08	0	0	
2014-04-09	TLS	22:00	0.25	0	0	0

Table 1 (cont.): Enumeration of LURS-LbP on Mill Lake Stream (MLS) and Trout Lake Stream (TLS) (hashed cells) during the 2014 spawning run

Date	Stream	Start Time	Effort (hrs)	Visual Estimate		
2014-04-09	MLS	22:30	0.08	0	0	
2014-04-09	MLS	23:30	0.08	0	0	
2014-04-09	MLS	1:00	0.08	0	0	0
2014-04-12	MLS	11:00	0.08	0	0	0
2014-04-12	TLS	15:00	0.25	0	0	0
Total	MLS					16,076
Total	TLS					0

Although the purposes of this study did not include the measurement of lengths of LURS and given the limitations of the opportunistic measurements which were taken, as well as the belief that such measurements would produce an error of overestimating size, it is worthy to note that the observed average for an estimated $\frac{3}{4}$ of LURS-LbP was 17 cm fork length. This would place the fork length of the 2014 spawning run of LURS-LbP at the extreme low end of the length scale (using the DFO, 2011 criteria).

LURS-SbP

The issue of safely gaining access to the known LURS-SbP spawning streams, namely Second Brook, Unnamed Brook, and Smelt Brook, was not resolved prior to the start of the LURS-SbP spawning run. A combination of cold temperatures and snow kept ice on the lake well into April. This was followed by an extended period of rapid rise in temperature, rain, and gusty wind conditions during the second week of April which, although clearing the lake of ice, still made it dangerous for night-time small boat passage. Water-levels increased dramatically during the second week of April, up to 3 feet in the lake and over the tops of the culverts on Mill Lake Stream. The water levels remained high throughout the end of April and were highly turbid which made stream-side counting impossible.

The result was that Second Brook, Unnamed Brook, and Smelt Brook could only be checked for spawning activity on two nights (May 2 and May 9), which likely coincided with the tail end of the spawning run for LURS-SbP.

Mill Lake Stream was opportunistically observed on April 13th, during which 7,000 LURS-SbP spawners were counted. Mill Lake Stream was again opportunistically observed more than a week later and low numbers of LURS-SbP spawners were still present. 20 LURS-SbP were collected on Mill Lake Stream on April 13th and sent to the DFO St. Andrews Biological Research Station for identification confirmation via gill raker count and/or genetic analysis (Figure 6). Spear Brook and Otter Brook were also intermittently checked when weather conditions were favorable, but no spawning activity was noted. The limited data is presented in Table 2 and Figure 2.

Table 2: Enumeration of LURS-SbP on Mill Lake Stream (MLS), Trout Lake Stream (TLS), Second Brook (SCB), Unnamed Brook (UNB), and Smelt Brook (SMB) during the 2014 spawning run.

Date	Stream	Start Time	Effort (hrs)	Visual Estimate			
				Observed	Change	Daily Total	
2014-04-12	SCB	12:00	0.25	0	0	0	
2014-04-12	UNB	13:00	0.25	0	0	0	
2014-04-12	SMB	14:00	0.25	0	0	0	
2014-04-12	TLS	15:00	0.25	0	0	0	
2014-04-13	MLS	18:00	0.08	7000	7000	7000	
2014-04-14	MLS	Poor water conditions					
2014-04-20	MLS	Poor water conditions					
2014-04-22	MLS	10:30	0.08	10	10		
2014-04-22	MLS	11:30	0.08	70	60		
2014-04-22	MLS	13:00	0.08	20	-50	70	
2014-04-23	MLS	Poor water conditions					
2014-04-27	MLS	Poor water conditions					
2014-05-02	MLS	11:00	0.08	0	0	0	
2014-05-02	SCB	14:00	0.25	0	0	0	
2014-05-02	UNB	15:00	0.25	100	100	100	
2014-05-02	SMB	18:00	0.25	300	300	300	
2014-05-09	TLS	18:00	0.25	0	0	0	
2014-05-09	MLS	19:00	0.08	0	0	0	
2014-05-09	UNB	20:00	0.25	20	20		
2014-05-09	UNB	23:00	0.25	30	10	30	
2014-05-18	MLS	Poor water conditions					
Total	SCB					0	
Total	UNB					130	
Total	SMB					300	
Total	MLS					7,070	
Total	TLS					0	

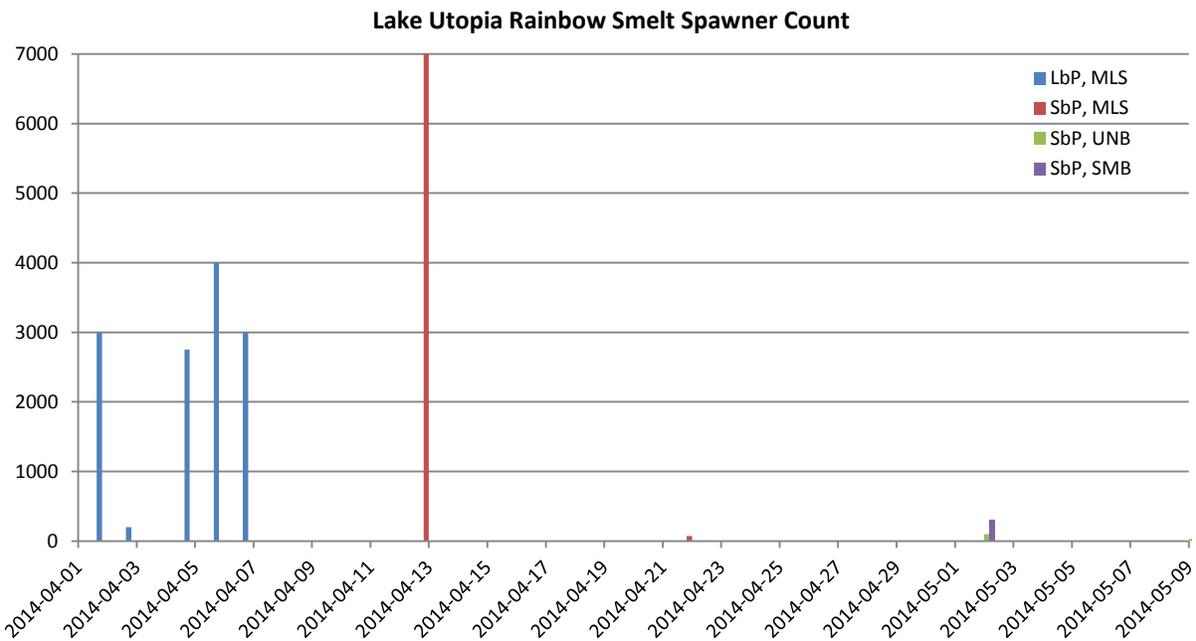


Figure 2: Lake Utopia Rainbow Smelt Spawner Count from Apr. 1-May 9, 2014. LbP = Large-bodied Population; SbP = Small-bodied Population; MLS = Mill Lake Stream; UNB = Unnamed Brook; SMB = Smelt Brook.

As with the LURS-LbP, and in the same manner as stated above, the field technicians also opportunistically measured the length of LURS-SbP. The observed average fork length for an estimated $\frac{3}{4}$ of the LURS-SbP on Mill Lake Stream was 9-12 cm.

Large-bodied v. Giant-bodied

This study counted 30 “Giant-bodied” LURS (greater than 30 cm total body length) spawning amongst the LURS-LbP on Mill Lake Stream. These were included within the counts for LURS-LbP. Photographs and video were taken (e.g., back cover of this report) which show the significant size difference between the Large-bodied form and “Giant-bodied form”. However, without counting gill rakers or measuring other morphological or genetic characteristics, this study cannot comment further as to the significance of these “Giant-bodied form” individuals. Video evidence taken on April 6th shows the “Giant-body form” and “Large-body form” spawning with each other on Mill Lake Stream.

Conclusion & Discussion

Spawner Abundance

It is believed that this 2014 study captured the majority of the spawning run for LURS-LbP. Therefore an observed estimation is given, unlike for the 2013 study which only proposed a conservative estimate given that key survey dates were missing. The 5 Highest Daily Summations of LURS-LbP Spawner Abundance was 15,750. The abundance of more than 7 ½ times higher than considered necessary lends some credit to the conservative estimate proposed in 2013 of at least 2,600 to 5,500 LURS-LbP spawners. In fact, the 2014 observation alone is high enough to, by itself, meet the draft Recovery Strategy Performance Measure #6: “The average of the yearly means [*for a 5-year period*] of the 5 highest daily summations of the spawner abundance in Mill Lake Stream over the spawning period is no less than 2,000 individuals.”

During several nights of LURS-LbP Presence/Absence survey work of this study, DFO conducted a separate LURS-LbP Mark/Recapture survey. Though the results of that study are not presented here, it is worthy to note that the ability of this study’s Presence/Absence survey team to visually count LURS, closely matched the DFO Mark/Recapture team’s ability to capture LURS with nets (which is detailed below). It is suggested that both studies’ data be compared for evaluating spawner abundance.

It is believed that a majority of the LURS-SbP run was missed due to unfavourable weather conditions, high water, and turbidity throughout most of the spawning run, making stream-side visual counting impossible. For a visual comparison of high and low water conditions on Mill Lake Stream please refer to Figure 5 in Appendix A. A few hundred LURS-SbP were counted on Smelt Brook and Unnamed Brook on May 2nd, which was believed to be the end of the run due to the presence of eggs from previous spawning.

However, an unexpectedly large count of LURS-SbP (7,000) was made during an opportunistic survey of Mill Lake Stream on the night of April 13th. This was unexpected, because, as noted in the 2013 report, LURS-SbP are not known for choosing Mill Lake Stream for spawning. In fact, spawning Critical Habitat for LURS-SbP in the draft Recovery Strategy is restricted to Smelt Brook, Unnamed Brook, and Second Brook. Second, the large number of spawners on Mill Lake Stream came only four days after a night-time observation of zero and six days after the last LURS-LbP spawners were observed. The event was also several days before the expected beginning of the LURS-SbP spawning run on the historic spawning brooks.

Unfortunately, Mill Lake Stream was not routinely monitored between April 9-12 and water conditions after the 13th prevented survey work. It is unknown whether the 7,000 LURS-SbP counted in Mill Lake Stream on April 13th was part of a longer-term spawning run on Mill Lake Stream, a result of preference switching due to some unknown factor(s) in the other noted spawning streams, or a random event. If the former, the spawning component on Mill Lake Stream would be the earliest of the LURS-SbP spawners and suggests that there may be a

shorter period for the widely accepted “temporal separation” which is, in part, used to characterize the two DUs. If the later, what factor(s) are contributing to LURS-SbP selection of Mill Lake Stream as a spawning stream?

Characteristics of Spawning Runs

LURS-LbP on Mill Lake Stream never migrated above the culverts and 100% spawning for 2014 took place within 85 feet below the culverts. This is in contrast to 2013 when 100% of the spawning was above the culverts. It is likely that this was due to lower water conditions during the 2014 spawning run for LURS-LbP as compared to 2013. In fact, during the 2014 LURS-LbP spawning run, the water level in Mill Lake Stream was low enough that no water ran through the small culvert on the north side of the stream. The team observed that even though water levels were high enough for fish to transit the large culvert on the south side of the stream, they chose not to, instead opting to mass at the lower end of the culvert.

As noted earlier, the water-levels were much higher toward the end of April-early May, during the LURS-SbP spawning run. On the few days that Mill Lake Stream was surveyed for LURS-SbP, water-levels were high enough for water to pass through both culverts. In this case, LURS-SbP did pass through both culverts and 100% of the LURS-SbP spawning took place above the culverts.

It has been widely stated that smelt will migrate as far as possible upstream and spawn in mass below a natural barrier. However, others have noted that what constitutes a natural barrier for smelt passage is still somewhat a mystery. For example, this study showed LURS-LbP spawning below the large culvert on Mill Lake Stream, even though there was enough water passing through the culvert for fish to pass through in order to reach historic spawning areas further upstream. In other streams, LURS-SbP have passed numerous partial blockages on their way to historic spawning areas.

After observing LURS for two years in very different water conditions, the team has observed that the schooling/massing behaviour of LURS is particularly strong when the choice is made at a partial obstruction or disturbance. In 2013, it was noted that spawners travelled in and out of the spawning area in large groups, giving a pulsed effect to nightly spawning events. In 2014, spawners more or less entered the stream at a steady rate, amassing at either the lower end of the culvert, in the case of LURS-LbP, or proceeding upstream, in the case of LURS-SbP. Also, on nights when the stream was disturbed as a result of the mark-recapture survey, it was noted that LURS-LbP would amass near the mouth of the stream, and most would not enter.

Finally, it has been hypothesized that LURS spawning migration may be cued by the phase of the moon. The LURS 2012 Spawning Season Monitoring Project by Eastern Charlotte Waterways report prepared by Emma Hebb raised that recreational LURS-LbP fishers indicated that LURS-LbP always spawn “after the full moon in early April”. To substantiate this, the report graphs eight LURS-LbP “earliest recorded spawning events” with their corresponding “early April full moon” since 1922. While the results were inconclusive because of a lack of data, the data does seem to show that for six of the eight years with data the earliest night of LURS-LbP

spawning occurs on or within a week of the full moon closest to April 1st. The report further notes that 2012 was one such year. Although it was not noted in our 2013 report, the first spawning night for LURS-LbP was eight days after the full moon on March 27, 2013. However, for 2014, the first observed spawning night for LURS-LbP, which was the first day of the survey, was April 1st, one day after the new moon, i.e., half-way between full moons. It may also be worthy to note that for 2014, the peak spawning period for LURS-LbP was over a week in duration, whereas in 2013 it was 4-5 days. Moon cycle should continue to be recorded along with water temperature and other environmental variables to help better understand spawning cues.

Average Lengths

As explained above, during the course of the survey, the field technicians opportunistically observed fork lengths of resting fish without removing them from the water. Though there would be obvious error in such measurements, the observed measurements should be smaller than actual. Thus, the observed average fork length for LURS-LbP of 17 cm is troubling as it suggests 1) the 2014 spawning run of the LURS-LbP was comprised of very small individuals and 2) the actual fork length of those individuals may be significantly smaller.

Although, DFO does not know of any fecundity estimates based on fork length for LURS-LbP, the 2011 DFO Recovery Potential Assessment reports the LURS-SbP fecundity estimate to be:

$$\text{Eggs} = 0.0003(\text{Fork Length})^{3.465}$$

This suggests a much greater fecundity for larger females than small females, as much as 6 times more eggs over their given size range. Assuming that a similar relationship exists for LURS-LbP, it is predicted that the fecundity for the 2014 spawning year of LURS-LbP was low. Thus the interpretation of LURS-LbP spawning success for 2014 should be very conservative despite the very high numbers of spawners observed. Given that this study reports high spawning numbers for LURS-LbP but small sizes of individuals (and thus probably lower fecundity), future spawning run surveys should incorporate both counts and length/weight measurements to estimate the overall potential success of the spawning run. This would also require scientific agreement on what would be the fecundity mathematical formula for LURS-LbP.

The observed average fork length of LURS-LbP of 17 cm also suggests that the criteria of “equal to or greater than 170 mm” used as part of the DFO definition for LURS-LbP may need to be revisited.

Threats

It was again noted that extreme fluctuations in water levels are likely the key threat to egg survivorship. Although smelt have life-history characteristics to compensate for high egg mortality, e.g., mass spawning and fast egg development, the much more extreme water-level fluctuations in Lake Utopia due to the operation of the Saint George hydroelectric dam and rapid water run-off from surrounding agricultural land may put more strain on eggs than for

what LURS life-history can compensate. In particular, the very small areas used for spawning, make LURS, especially the Large-bodied Population, susceptible to very localized changes in water-level, e.g., potential loss of a high proportion of total eggs due to one localized low-water air exposure event.

Also better understood in 2014 was that schools or spawning groups are very sensitive to any changes or disturbances in spawning streams. As noted earlier, the presence of researchers in the water or that water was not passing through both culverts on Mill Lake Stream was correlated to LURS-LbP not migrating upstream, even though migration was technically possible, and probably easy, and ample good historic spawning area was available upstream. Clearly, LURS consider more than just the ability to pass a partial obstruction or disturbance, and a decision is made for or by the group about migration which takes into consideration maintaining a large group for spawning. Although spawning migration in 2014 was not as pulsed as in 2013, it was still noted that group dynamics seem to play a large role in determining when and where to spawn. This characteristic needs to be taken into more detailed consideration in the future when determining the types or levels of threats to LURS or when designing projects.

Experience

The technical experience of the MAPC crew has grown considerably in the past year. In addition to better, more refined data, as described in the methods, MAPC has also learned much more about the behaviour and life-history of LURS based on daily observations over an extended period of time under varying habitat conditions during the spawning season. The team has also become more proficient at enumerating LURS, as evidenced by a visual estimate of 270 LURS during one survey, which was immediately followed by seining of the stream by DFO for a DFO mark-recapture survey which captured 276 LURS, i.e., the visual estimate was less than a 3% underestimation of what was captured.

Recommended Next Steps

Given that the number of LURS-LbP spawners visually counted in Mill Lake Stream during the 5 nights of highest abundance was more than 7 ½ times higher than the draft Recovery Strategy abundance objective of an average of 2,000, and considering the conservative estimate from 2013 which was at least 2 ½ times higher than the objective, it is recommended that:

1. LURS-LbP spawning be observed annually for at least the next 3-4 years to confirm that the draft Recovery Strategy abundance objective is being met;
2. LURS-LbP should be located and enumerated at times other than spawning, if possible, to confirm that spawning abundance is an appropriate measure of overall population abundance; and
3. a mathematical formula should be developed for estimating LURS-LbP fecundity based on length or weight of spawning females and potential spawning success should be estimated as part of future studies.

Given that 2014 is the second year that LURS-SbP have been noted to spawn on Mill Lake Stream, and in 2014 the spawning component of at least 7,070 was not insignificant, it is recommended that:

4. Mill Lake Stream be monitored as part of the overall monitoring for LURS-SbP, i.e., included with Smelt Brook, Unnamed Brook, and Second Brook surveys;
5. the Critical Habitat component be re-evaluated to include Mill Lake Stream as spawning stream Critical Habitat for LURS-SbP; and
6. work continue to gain better access to the LURS-SbP historic spawning streams of Smelt Brook, Unnamed Brook, and Second Brook during the spawning season in order to enumerate LURS-SbP and understand their behaviour and possibly why LURS-SbP may be utilizing Mill Lake Stream.

Other recommendations and suggestions:

7. More thought should be given to the schooling/massing nature for LURS at specific fish passageways and spawning habitat when designing surveys or projects. As was noted, in some instances, schools will stop and in others they will proceed with migration. Until their spawning migratory behaviour is more fully understood, a precautionary approach should be used.
8. A greater emphasis should be placed on threats at a very localized level and more work should be done to survey and improve stream habitat for back-up or secondary spawning locations, in the case that one of the “historic spawning sites” is lost.
9. Work should continue to validate presence/absence survey results, for example by seining, photographic/video verification of numbers counted, or by mark-recapture methods. The last method may be useful for also helping to determine actual numbers in years when spawning migration is highly pulsed, like in 2013.
10. Given that spawning can occur quickly and in unfavourable conditions for field technicians, environmental variables, including moon cycle, should be monitored in order to better understand the cue(s) that initiate spawning migration, so that survey effort is most effective.

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APPENDIX A

Table 3: Survey sites, with spawning areas, for LURS-LbP. ¹Site divided into lower and upper because the culvert(s) that divide the site cannot be adequately surveyed. LURS counts still provided on a whole stream basis.

Stream/ Brook	Abv.	Survey Start		Survey End		Spawning Area Start		Spawning Area End	
		Description	Lat./Long.	Description	Lat./Long.	Description	Lat./Long.	Description	Lat./Long.
Mill Lake Stream (lower)	MLS ¹	1. Mouth (North side) at intake pipes 2. Mouth (South side) at big rock	1. 45 12.315 N 066 46.746 W 2. 45 12.289 N 066 46.745 W	1. Large culvert 2. Large culvert	1. 45 12.313 N 066 46.713 W 2. 45 12.313 N 066 46.714 W	1. 70' below culvert 2. 85' below culvert	1. 45 12.317 N 066 46.723 W 2. 45 12.307 N 066 46.725 W	1. Large culvert (North side) 2. Large culvert (South side)	1. 45 12.313 N 066 46.713 W 2. 45 12.313 N 066 46.714 W
Mill Lake Stream (upper)	MLS ¹	Large culvert	45 12.313 N 066 46.696 W	Earthen dam	45 12.391 N 066 46.614 W	NA	NA	NA	NA
Trout Lake Stream (lower)	TLS ¹	Boat launch	45 11.024 N 066 46.501 W	Culvert	45 11.036 N 066 46.478 W	NA	NA	NA	NA
Trout Lake Stream (upper)	TLS ¹	Culvert	45 11.034 N 066 46.459	~270' upstream of culvert	45 11.038 N 066 46.405 W	NA	NA	NA	NA

Table 4: Survey sites, with spawning areas for LURS-SbP. ¹Site divided into lower and upper because the culvert(s) that divide the site cannot be adequately surveyed. LURS counts still provided on a whole stream basis.

Stream/ Brook	Abv.	Survey Start		Survey End		Spawning Area Start		Spawning Area End	
		Description	Lat./Long.	Description	Lat./Long.	Description	Lat./Long.	Description	Lat./Long.
Mill Lake Stream (lower)	MLS ¹	1. Mouth (North side) at intake pipes 2. Mouth (South side) at big rock	1. 45 12.315 N 066 46.746 W 2. 45 12.289 N 066 46.745 W	1. Small culvert (North side) 2. Large culvert (South side)	1. 45 12.322 N 066 46.715 W 2. 45 12.313 N 066 46.714 W	NA	NA	NA	NA
Mill Lake Stream (upper)	MLS ¹	1. Small culvert (North side) 2. Large culvert (South side)	1. 45 12.326 N 066 46.701 W 2. 45 12.313 N 066 46.696 W	Earthen dam	45 12.391 N 066 46.614 W	1. Small culvert (North side) 2. Large culvert (South side)	1. 45 12.326 N 066 46.701 W 2. 45 12.313 N 066 46.696 W	Beaver hut	45 12.311 N 066 46.691 W
Smelt Brook	SMB	Mouth	45 12.350 N 066 48.751 W	~150' above 4-wheeler trail	45 12.372 N 066 48.874 W	~50' above 4-wheeler trail	45 12.347 N 066 48.766 W	150' above 4-wheeler trail	45 12.372 N 066 48.874 W
Unnamed Brook	UNB	Mouth	45 12.533 N 066 48.488 W	~350' upstream of mouth	45 12.604 N 066 48.511 W	~250' upstream of mouth	45 12.590 N 066 48.496W	~350' upstream of mouth	45 12.604 N 066 48.511 W
Second Brook	SCB	Mouth	45 12.470 N 066 47.105 W	Bridge	45 12.626 N 066 47.330 W	NA	NA	NA	NA

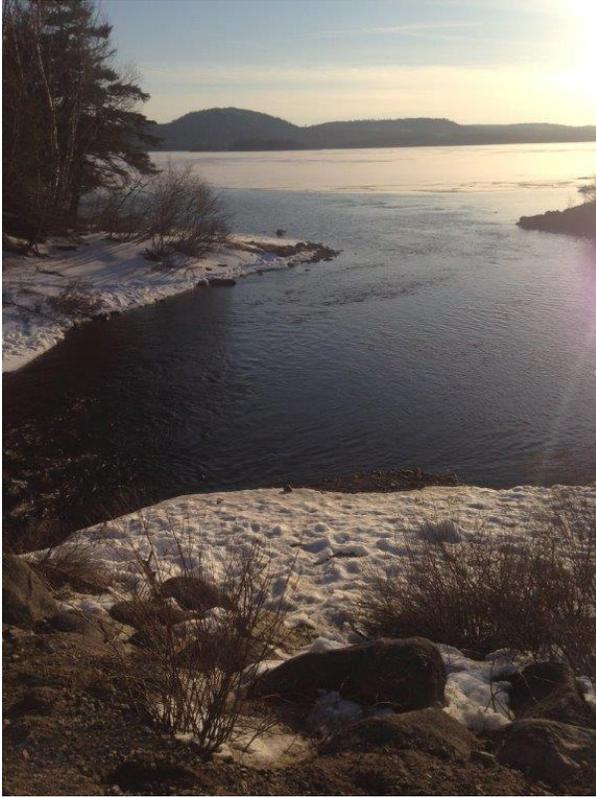


Figure 3: Mill Lake Stream Spawning Habitat During LURS-LbP Spawning Run on April 4, 2014 (Andy Seeley, Apr. 4, 2014)



Figure 4: Entrance to Mill Lake Stream During Low Water Conditions (Similar to Spring Low Water Conditions) Showing Exposed Spawning Habitat (center and left), culverts (upper left), and Salmon Aquaculture Facility Intake and Effluent Pipes (right). (Andy Seeley, Sep. 1, 2014)



A: (Andy Seeley, Aug. 13, 2014)



B: (Andy Seeley, Apr. 12, 2014)



C: (Andy Seeley, Apr. 12, 2014)

Figure 5: Comparison of Mill Lake Stream 2014 Spawning Habitat During Low Water (A) and High Water Conditions (B & C).



Figure 6: Spawning LURS-SbP Collected From Mill Lake Stream on April 13, 2014 for Analysis by DFO. (Andy Seeley, Apr. 13, 2014)

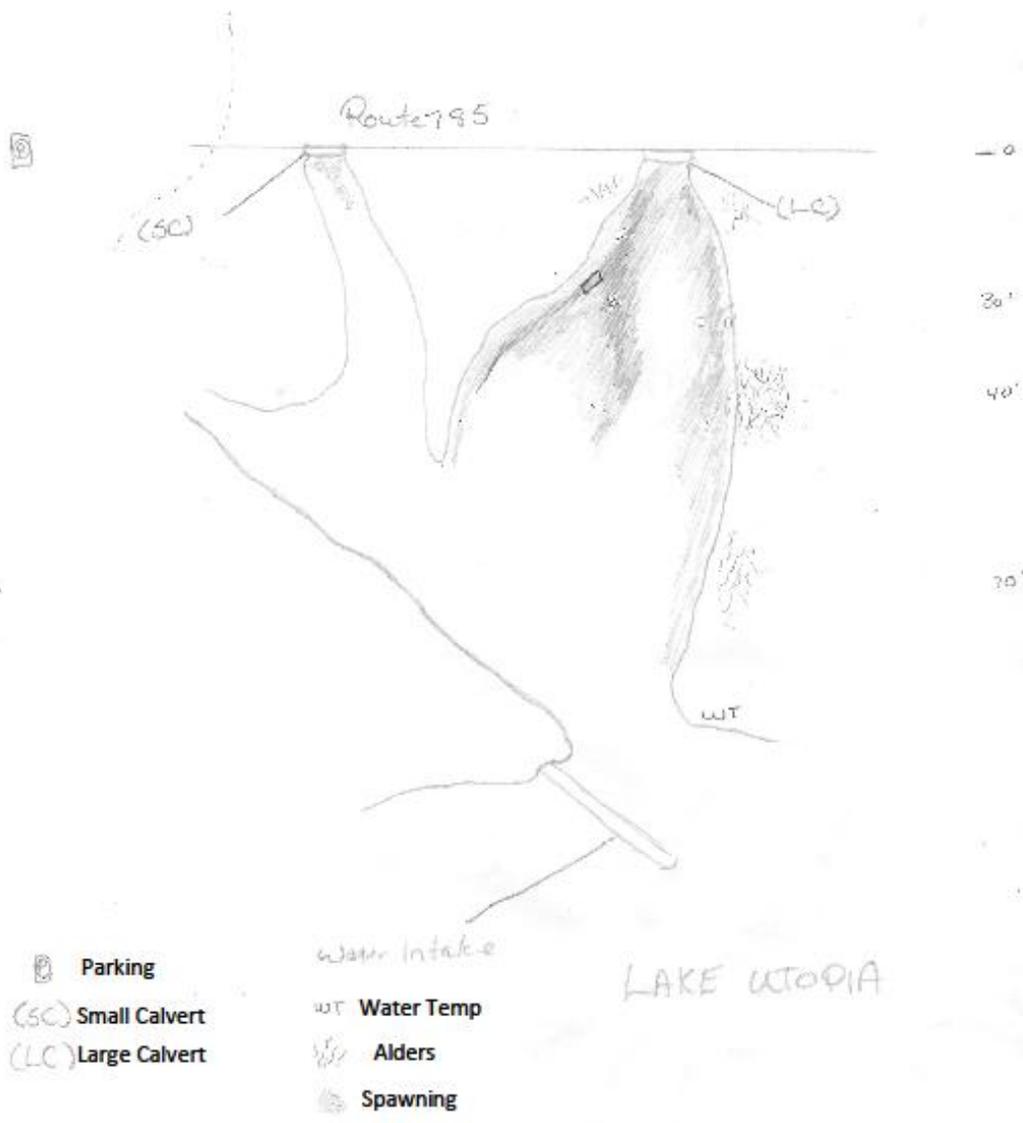


Figure 7: Lower Portion of Mill Lake Stream, noting LURS-LbP Spawning Locations Below the Culverts.
 (Drawing by Andy Seeley)

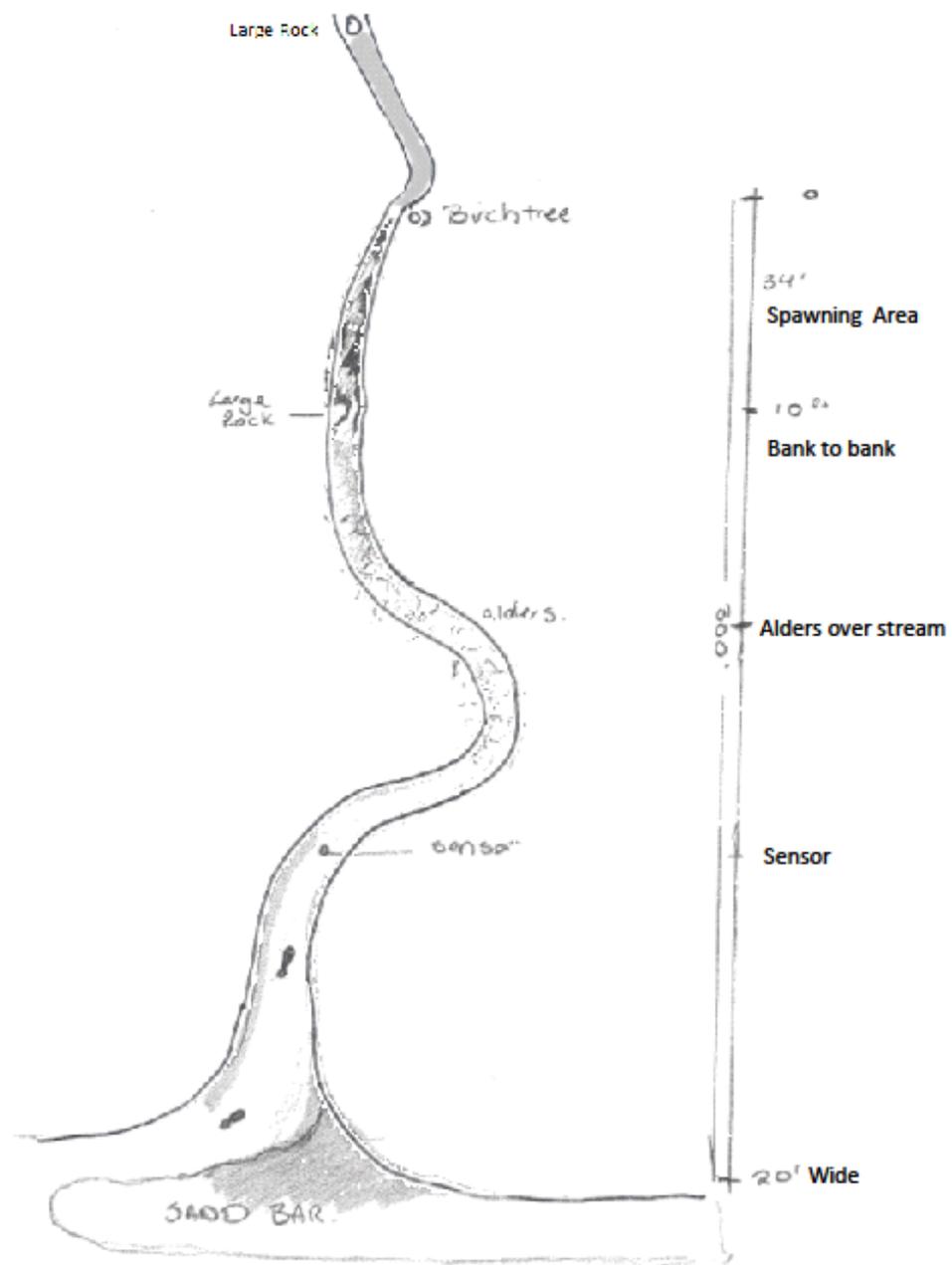


Figure 8: Lower Portion of Unnamed Brook, noting LURS-SbP Spawning Locations. (Drawing by Andy Seeley)

