Tłı̨chǫ Aquatic Ecosystem Monitoring Program (TAEMP)

Final Report, Whatì, 2014

September 30, 2016

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Cover Photo: Paul Vecsei, Golder Associates Ltd.

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Acknowledgements

The 2014 Tłı̨chǫ Aquatic Ecosystem Monitoring Program (TAEMP) was guided by many elders from the community of Whatì, and we give thanks for their dedication to the project and their interest in sharing their knowledge and expertise. We thank all the participants and support staff who made the 2014 TAEMP on Lac la Martre a success. The elders who participated were: Joe Champlain, Madeline Champlain, Jimmy Nitsiza, Margaret Nitsiza, Lucy Nitsiza, Francis Simpson, and Georgina Simpson. The youth who participated from Mezi Community School: Mason Beaverho, Jacintia Flunkie, Twyla Nitsiza, Anika Romie, Alexander Simpson, Isiah Zoe. Whatì Support at camp: Archie Nitsiza, John Beaverho, Lawrence Peter Nitsiza, Elizabeth Young, and Bernice Beaverho. Translation at meetings and at camp was provided by: Jonas Lafferty, and James Rabesca. Partner staff who participated: Susan Beaumont, Wek'èezhìı Renewable Resources Board (WRRB), Roberta Judas, Wek'èezhìı Land and Water Board (WLWB), Francois Larouche Department of Fisheries and Oceans Canada (DFO), Sean Richardson Tłı̨chǫ Government (TG), Boyan Tracz (WRRB), and Paul Vecsei (Golder Associates Ltd.); additional partner support provided by Sarah Elsasser (WLWB), Brett Wheler (WLWB), Sjoerd van der Wielen (TG), Jody Pellissey (WRRB), Marlene Evans, Environment Canada (EC), Elsie DeRoose, Government of Northwest Territories Health and Social Services (GNWT HSS), Duane Fleming (GNWT HSS), and Ellen Lea (DFO). Support in Whatì was provided by Tłı̨chǫ Government staff: Shirley Beaverho, Freddie Flunkie, Alestine Nitsiza, and Ted Nitsiza. Activities at on-the-land camp were filmed, and a video produced by Alan Booth of Yellowknife Films.

Lab analyses were conducted by: ALS labs, BC (fish tissue), Taiga Environmental Lab, NT (water and sediment), and North/South Consultants Inc., MB (otoliths). Golder Associates Ltd. provided QA/QC support on fish and otolith samples, and the WLWB / TG on water and sediment samples.

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Summary

The purpose of the Tłı̨chǫ Aquatic Ecosystem Monitoring Program (TAEMP) is to continue to build and maintain a successful community-based monitoring program that meets the needs of the Tłı̨chǫ people in determining whether fish, water, and sediment quality are changing over time, and whether fish and water remain safe to consume. The TAEMP rotates science-based fish, water and sediment sampling through each of the four Tłı̨chǫ communities so that every community will have samples collected and analyzed once every four years. The TAEMP continues to provide a means of addressing community concerns related to observed changes in the environment, and builds on work carried out since 2010. As a successful community-driven program, it meaningfully involves community members in conducting contaminants-related research, including the collection of samples and observations using both Tłı̨chǫ and scientific knowledge to address the question: “Are the fish safe to eat and is the water safe to drink?”

In June and August 2014, community elders and youth in Whatì were informed of the TAEMP through introductory and planning workshops, where program support staff and community members discussed concepts such as: monitoring, indicators of change, as well as Tłı̨chǫ and scientific knowledge relevant to water, sediments, fish, and potential contaminants. A key outcome of the workshops was advance planning of a 5-day on-the-land monitoring camp. The location, which supports an aboriginal subsistence fishery, was selected by community members from Whatì. At the workshops and at the on-the land camp, elders and community members had opportunities to provide assessments of current fish and aquatic ecosystem health on Lac la Martre. From September 8-12, 2014, the on-the-land monitoring camp occurred. Elders and community members provided direction on where fish and water samples were collected, and youth were provided basic training on how samples are collected in a standardized manner. Support staff and community members collected fish in order to have tissue samples for analysis of a variety of metals, including mercury. Water and sediment samples were also collected and analyzed for metals, as well as chemical and physical properties. Results were brought back to Whatì in February 2015 after analyses were completed. Overall, results indicated that fish, water, and sediment quality are good, and that there were no health concerns as no results were considered abnormal. Community members had an opportunity ask questions at the public results meeting and have open discussion with the visiting support staff. Students from Mezi Community School also attended the results meeting, and all participants had an opportunity to view a draft video which captured the activities at the on-the-land camp.

Introduction

The purpose of the Tłı̨chǫ Aquatic Ecosystem Monitoring Program (TAEMP), or “fish camp” as it is known, is to continue to successfully implement an aquatic ecosystem monitoring program based on Tłı̨chǫ Knowledge (i.e. Traditional knowledge, or TK) and scientific knowledge in order to determine whether fish health, water, and sediment quality are changing over time at locations near Tłı̨chǫ communities. There are historic, currently operating, and proposed developments in Wek’èezhìı, and there is concern in Tłı̨chǫ communities that contamination of nearby aquatic ecosystems may occur, or has already occurred. As a result of these concerns and a general lack of information (WWF 2014), there is a need to collect information and have ongoing monitoring of the aquatic ecosystems in Wek’èezhìı in anticipation of continuing pressures on watersheds.

It is important to have Tłı̨chǫ community members (including elders and youth) directly involved in monitoring, and provide a genuine opportunity for community members to exchange knowledge with research scientists in appropriate community and on-the-land settings. By meaningfully involving community members in conducting contaminants-related research, including the collection of samples and observations using both Tłı̨chǫ and scientific knowledge, the TAEMP provides a means to help to address the question: “Are the fish safe to eat and is the water safe to drink?”

The TAEMP rotates sampling through each of the four Tłı̨chǫ communities once every four years. With the conclusion of the 2014 camp near Whatì, the TAEMP has completed its initial baseline sampling phase. In 2015, the first round of comparative sampling will begin when the TAEMP returns to the community of Behchokǫ̀. The next phase of sampling (2015-2018) will continue to build on work carried out since 2010 and allow for comparative analysis of sampling results collected in each of the four communities. The comparative sampling will provide a way to continue to address community concerns related to changes in the environment.

TAEMP partners include: community members (e.g. elders, harvesters and youth), the Wek’èezhìı Renewable Resources Board (WRRB), the Tłı̨chǫ Government (TG), the Wek’èezhìı Land and Water Board (WLWB), the Department of Fisheries and Oceans (DFO), the Department of Health and Social Services (HSS) and Environment Canada (EC).

Methods

The 2014 TAEMP consisted of three main phases:

1. Introductory and planning workshops in Whatì;
2. On-the land camp near Whatì on Lac la Martre where samples were collected; and,
3. Results workshop in Whatì.

Translation was provided during all project activities by Jonas Lafferty, and James Rabesca. See Appendix 1 for lists of participants in each phase.

1. Introductory / Planning Workshops

Prior to the on-the-land camp, one-day workshops were held with community members in June and August to discuss the TAEMP. The workshops provided a forum to discuss concerns related to ecosystem health (including water and fish quality) from a Tłı̨chǫ perspective, and explore scientific concepts such as monitoring and indicators of aquatic ecosystem change.

Key outcomes of the introductory workshop were building understanding regarding what needs to occur at "fish camp" and to allow for advance planning. Specifically, the planning workshop allowed the list of participants to be finalized and clarification(s) regarding assorted logistics for the on-the-land camp, scheduled to take place in late August / early September 2014. The location of the camp and locations for sampling were based on direction given at workshops and in ongoing consultation with elders in the community.

2. On-the-land Monitoring Camp – Lac la Martre

a. Overall

To assess fish, water, and sediment quality, samples were collected during a 5-day on-the-land "fish camp" where elders, youth, and research scientists cooperated in the implementation of an aquatic ecosystem-based monitoring program. The camp (and associated planning meetings previously mentioned) allowed for continued sharing of science and traditional knowledge-based approaches to monitoring, and built relationships and mutual respect.

The camp provided an opportunity for researchers and community members to work collaboratively to combine aspects of Tłı̨chǫ knowledge with scientific-based monitoring methods. It provided teaching opportunities in Tłı̨chǫ ways of understanding the aquatic ecosystem, assessing the health of the ecosystem, and catching, preparing, and preserving fish. The camp also provided an opportunity to "de-mystify" scientific monitoring methods by having community members directly involved in sample collection, and through on-shore demonstrations of sampling methods. The camp also provided youth with hands-on experience with science-based sampling methods and approaches to aquatic ecosystem monitoring, and provided youth with opportunities to ask visiting researchers / support staff questions about science and about possibilities for training and employment in the environmental monitoring field.

b. Water Quality

Surface water samples were taken as "grab samples". Field Staff used fresh disposable vinyl gloves at each sample site to minimize the potential for contamination from the sampler's hands. Different sample bottles were used for each laboratory analysis group including: physicals, nutrients, total and dissolved metals, and microbiological analysis. All bottles (except sterile bottles) were rinsed three times with sample water before filling.

Standard physical and chemical parameters were used as water quality indicators, including: temperature, pH, conductivity, clarity, turbidity, Total Suspended Solids (TSS), Total Dissolved Solids (TDS), alkalinity, dissolved Oxygen, major nutrients, ions, and trace metals. These parameters are comparable to Aboriginal Affairs and Northern Development Canada

(AANDC; now Indigenous and Northern Affairs Canada) Water Resources' datasets for the Frank Channel on Great Slave Lake, the closest water quality monitoring station. Water sampling was led by the Tłı̨chǫ Government (TG) Wildlife Coordinator and the Wek'èezhìı Land and Water Board (WLWB) Regulatory Technician; procedures were followed to minimize contamination, such as implementation of appropriate QA/QC procedures, in accordance with instructions from the Government of the Northwest Territories Taiga Environmental Laboratory (Taiga) located in Yellowknife.

Samples were placed in an electric cooler to preserve the integrity of the water samples. Microbiological analysis is particularly time-sensitive and samples for this analysis were delivered to the lab on the same day they were collected. Taiga performed all analyses, and Taiga is a member of the Canadian Association of Environmental Analytical Laboratories (CAEAL), a national organization established to ensure consistent laboratory quality assurance.

c. Sediment Quality

Sediment sampling used methods outlined in Metal Mining Technical Guidance for Environmental Effects Monitoring (Environment Canada, 2012), and samples were analyzed for standard physical and chemical properties as well as trace metals. Lake sediments were sampled using an Ekman grab sampler suitable for collecting soft, fine grained sediments typically observed in the area.

Sediment samples were collected using an Ekman dredge, transferred to a stainless steel tray, then placed into sterile glass jars/ziplock bags. Sediment samples were stored in an electric cooler (along with the water samples) and provided to Taiga Labs for analysis after supports staff returned to Yellowknife. If two distinct layers of sediment were captured by the Ekman, they were sampled and submitted for analysis separately.

All appropriate QA/QC procedures were followed according to Taiga Environmental Laboratory (Yellowknife) instructions, including the analysis of travel and field blanks. Field Staff used fresh disposable vinyl gloves at each sample site to minimize the potential for contamination from the sampler's hands. Different sample bottles were used for each laboratory analysis group including: physicals, nutrients, total metals, mercury, and microbiological analysis. All bottles (except sterile bottles) were rinsed three times with sample water before filling. Water sampling was led by the Tłı̨chǫ Government (TG) Wildlife Coordinator and the Wek'èezhìı Land and Water Board (WLWB) Regulatory Technician.

d. Fish Sampling

Fish were collected through use of gillnets set at different locations as determined by community members; nets provided fish for sample collection as well as for consumption at camp. Four gillnet sets were conducted over the course of the camp on Lac la Martre (Table 1). The 4.0 and 4.5-inch nets were used to target larger fish such as *Łih* (Lake Whitefish), *Łiwezǫ̀* (Lake Trout) and *Ɂhdaa* (Northern Pike) which are the fish primarily caught for food. The number and duration of the gillnet sets was subject to field conditions and safety considerations.

The fish caught were identified to species, were measured to total and fork length (TL and FL) to the nearest millimeter (mm), and weighed (g). Additional data collected included: gender, stage of maturity, and a general description of the contents of the stomach, any

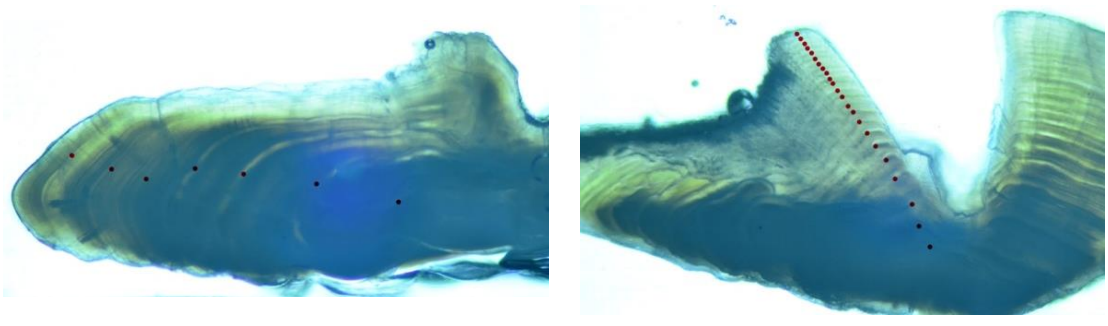
parasites and/or deformities. The target for tissue (for contaminants) and otoliths (for aging) samples was 20 łih and 20 łiwezǫ̀. Łih and łiwezǫ̀ are typically consumed by community members, and focusing tissue sampling on the two species also provided a way to account for differences between benthic (bottom feeding) and predatory (feeding on smaller fish) strategies.

Table 1. Details for net sets used to collect all fish samples at the TAEMP on Lac la Martre near the community of Whatì, September 2014.

Net set / pull date	Set Length (hours)	Location (Lat/Long)	Net Length / Width (m)	Mesh size (inches)
Sept. 9 / Sept. 9	4.42	N 63°08.774 W-117°34.585	100 /2	4.0
Sept. 9 / Sept. 10	13.25	N 63°08.908 W -117°33.939	50 /2	4.5
Sept. 10 / Sept. 10	9.00	N 63°08.908 W -117°33.939	50/2	4.5
Sept. 10 / Sept. 11	14.50	N 63°08.896 W -117°33.062	100/2	4.0

Note: Lat/Long are NAD 83

Fish age was estimated by taking otolith samples, having them cut and mounted on slides, and the annual growth rings counted by experts. Figure 1 shows examples of sagittal cross-sections of otoliths and how the annual growth rings (annuli) may be counted to estimate age; a red dot is positioned between each individual growth ring. The example on the left shows a łih estimated to be 7 years, and on the right a łiwezǫ̀ estimated at 23 years.



LKWH LKTR

Figure 1. Two examples of otolith cross-sections obtained from samples collected on Lac la Martre, 2014; a łih (LKWH) estimated at 7 years is shown on the left, and a łiwezǫ̀ (LKTR) estimated at 23 years on the right. Photos and interpretation provided by North/South Consultants Inc.

e. Fish Tissue Analysis

To determine current levels of contaminants in fishes regularly consumed by local communities, fish tissue samples were collected from łıwezǫ̀ǫ̀ and łih, fish species regularly consumed by Whatì residents. Fish processing was led by Golder Associates Ltd. and DFO biologists, and samples were collected under the guidelines established by Environment Canada for sampling for metals (Environment Canada 2012) and the Golder technical protocol “Fish Health Assessment-Metals”.

3. Results Workshop

After analyses of fish, water and sediment samples were completed and support staff had an opportunity to review the results, a public meeting was held in Whatì to review the goals and objectives of the program, as well as present the results of the analyses. Importantly, the results workshop provided an opportunity for participants and community members to ask questions and get clarification. An open format proved to be an effective and appropriate way to present results to participants and interested community members. Collaboration with Government of Northwest Territories Health and Social Services (GNWT HSS), along with other TAEMP partners, aided in the development of appropriate messaging and communication strategies prior to presentation of results. This collaboration ensured community members are informed and educated on the status of contaminants, if any, in the fish they may be eating and that nutritional guidance is provided to ensure these foods continue to remain healthy choices (GNWT HSS 2015, AMAP 2011). The results workshop was also the venue for the premiere the draft fish camp video; input was gathered from camp participants prior to a final version of the video being posted on the WRRB website.

Results

1. Introductory / Planning Workshops

On June 25, 2014, a one-day workshop was held with community members from Whatì to introduce and discuss the TAEMP. Participants expressed interest in fish camp and having the same opportunity as other Tłı̨chǫ communities where the TAEMP had already occurred. They agreed that monitoring fish, water, and sediment quality is important to monitor changes near Whatì and agreed that elders, youth and scientists can take the opportunity to work together. There was agreement on safety as priority and that community members going out to the camp site a day early to prepare was a good idea. There was understanding about limitation(s) in funding and that planning the 2014 TAEMP was subject to some financial restrictions. Meeting participants suggested a potential list of elders for fish camp, and participants provided preliminary input on where sampling could occur, as well as a possible location for camp. It was understood that September was the available window for the camp, and that community support would be required, including the selection of engaged youth. General concerns about impact(s) that fire and smoke may on camp were also voiced, on account of the severe fire season experiences in Wek’èezhìı / North Slave region.

On August 7, 2014, a second workshop was held in Whatì to finalize planning for the fish camp and to deal with logistical issues. Concepts related to monitoring were re-visited, as well as the primary tasks which needed to be achieved at camp. Community members and

elders stressed the importance of Lac la Martre to visiting support staff, and clarified that not only are fish caught in Lac la Martre important to Whatì residents, but to other Tłı̨chǫ communities as well. On a related note, it was mentioned that water levels were low in 2014, and that not many fish were being caught. General concerns about impact of fire on camp (e.g. travel routes, places to set nets) were voiced again, as was the importance of safety. There were also questions regarding the knowledge of fish and water sampling conducted in the 1970's regarding the old fishery (note: Lac la Martre used to have a commercial fishery active in the 70-80's), and where results from the previous sampling could be found.

Workshop participants agreed that the dates for the camp were Monday, September 8 to Friday, September 12. It was agreed that community members would examine and prepare the camp location on Sunday, September 7 (e.g. general inspection of site, set up of cook / meeting tents, gather firewood).

Workshop participants developed a list of elders who could potentially participate in the fish camp. The hope was to have equal representation of men and women elders, with couples preferred. Participants also clarified the need for elders without health concerns that may cause challenges while out-on-the land. It was also agreed that TG staff in Whatì, in conjunction with WRRB staff, would discuss selection of youth with the principal and science teacher at Mezi Community School, with the hope being that 3 young men and 3 young women with an interest in the environment would be selected to participate. It was clarified that students would also receive credit for their participation, given the time they would spend at the camp and the information relevant to the science curriculum.

Workshop participants proposed a number of locations for sampling, and a map was developed (Figure 2). The location of the camp was at *ʔenèego* (Burnt Island), west of Whatì by approximately 15km. Benefits to the location included that it was near to Whatì and was on a point, thus providing shelter from wind on either side. After continued discussions, one site South/Southeast of Big Island near the centre of Lac la Martre was omitted after clarification that there were limitations to the number of samples which could be collected for analyses. Priority locations for sampling were selected, with 8 samples total taken: six on Lac la Martre were the community had indicated interest, along with 2 additional samples taken at the community dock and at the sewage lagoon outflow. Samples were to be collected near the community dock to address community concerns that youth were being exposed to residues from the dock (note, the dock and outflow sampling locations are not shown in Figure 2 as they essentially overlap with Whatì and would not be visible at the scale of the map).

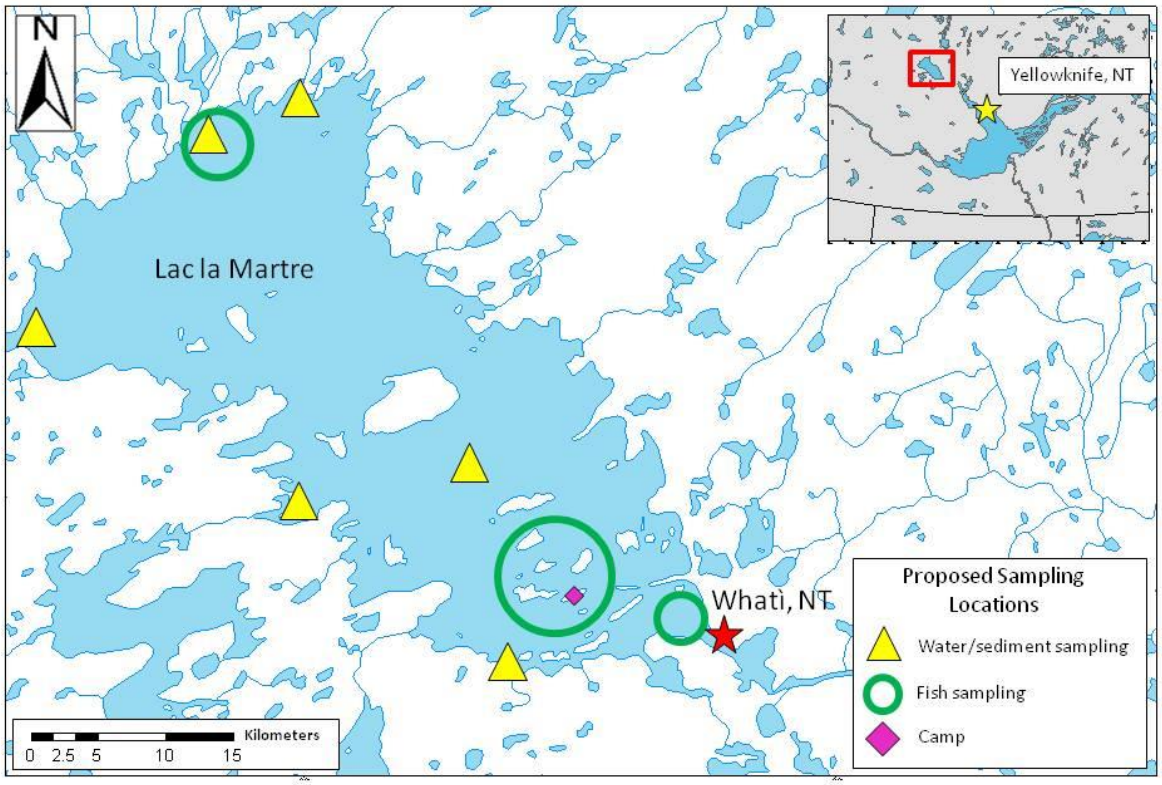


Figure 2. Proposed locations for the camp, fish, water, and sediment sample collection for the TAEMP near the community of Whatì (on Lac la Martre) as decided by community members at introductory and planning meetings June and August, 2014.

2. On-the-land Monitoring Camp – Lac la Martre

a. Overall

The on-the-land phase of the TAEMP occurred from September 8 to 12th, 2014. Travel to the camp occurred on September 8th, sampling and other activities occurred September 9-11th, and participants returned to Whatì on September 12th.

The three young women initially selected to participate in the camp chose not to participate the morning of departure to camp. Through assistance of the science teacher and support staff at Mezi Community School, discussions with interested students quickly occurred, and three different young women were able to attend, with minimal delays in departure to camp.

At camp, there were morning and evening sessions in the meeting tent. These planning meetings at the beginning and end of each day provided an effective means to discuss activities and voice concerns. For example, during morning meetings, roles and responsibilities for the day were clarified, safety concerns discussed, and the best approaches to the day's activities selected based on local expertise and sampling requirements. In the evening meetings, the day's activities were discussed, possibilities for improvement(s) voiced, and plans for the following day suggested.

The objective to catch 20 łıwezǫ̀ and 20 łih for collection of tissue samples was achieved. The desired number of water and sediment samples were also collected. However, windy conditions affected sampling. Though sampling crews attempted to gain access to locations at the North/Northwest end of Lac la Martre, wind and wave conditions made sampling crews return to camp due to safety considerations. Participants quickly discussed alternative locations, and final sampling locations were decided upon based on priority interest and safety considerations (Figure 3). Further, should be noted that low water levels also influenced where samples could be collected. For example, WS-1 was placed as far as the low water and aquatic vegetation would safely allow access. As a result, WS-1 could not be placed as far towards the east as was initially intended.

The 5-day camp provided various educational opportunities focused on ways of understanding aquatic ecosystems and assessing the health of the ecosystems through a variety of methods. Participants worked collaboratively to combine Tłı̨chǫ knowledge with science-based monitoring methods. Experiences shared at the camp, including youth gaining hands-on experience with sampling methods and a visit to an elder's gravesite where a ceremony was performed, were captured on video. An educational video was produced, showcasing the involvement of the youth and the value and importance of environmental monitoring and the sharing of Tłı̨chǫ knowledge and scientific perspectives.

Though visibility / air quality conditions were good during the on-the-land phase, the impact of fires (to land and water) over the summer was regularly mentioned by elders. Further, water levels were considered to be low by community participants, and water levels made routing and safety important considerations during camp operations.

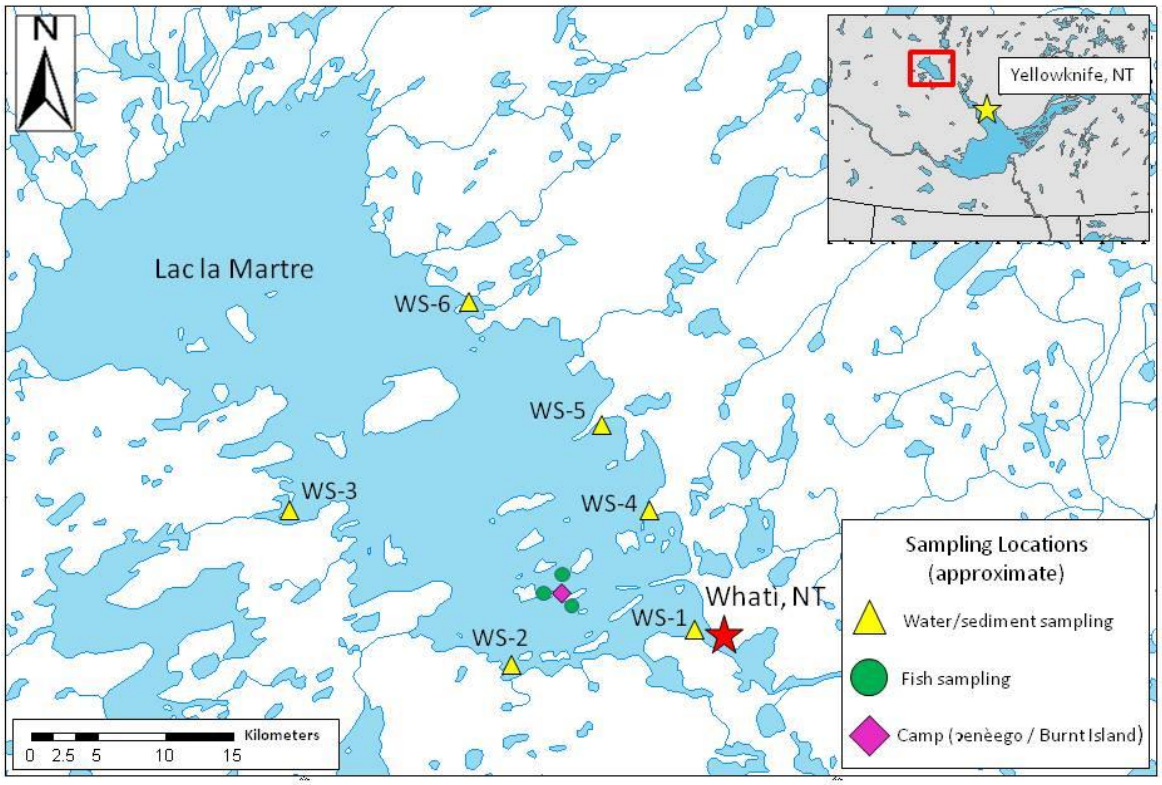


Figure 3. Final locations for the camp and where fish, water, and sediment samples were collected during the TAEMP near the community of Whatì (on Lac la Martre), September, 2014.

b. Water Quality

Final locations for all water and sediment samples taken are provided in Table 2. Water sample analysis indicated the pH ranged from 8.35-8.39, and hardness levels (i.e. the mineral content) at all sites indicated the water can be considered “hard”.

Samples WS-3 (total: 2.4µg/L, dissolved: 4.6µg/L) and WS-4 (duplicate: 2.9µg/L) were over the Canadian Council of Ministers of the Environment (CCME) Guidelines for the Protection of Aquatic Life (CCME 2014) for copper (2µg/L). Copper was also over the guideline in the field blank (total: 0.4µg/L) (Figure 4; see Figure 3 for sampling locations).

Samples WS-5 (total: 0.9µg/L) and WS-6 (total: 0.8µg/L) were over the Guideline (CCME 2014) for silver (0.1µg/L). Silver was also over the Guideline in the travel blank (0.2 µg/L) (Figure 4; see Figure 3 for sampling locations).

No samples exceeded the Guideline for mercury (0.026 µg/L; CCME 2014). Mercury concentrations (dissolved) were lower than 0.01µg/L at all sampling locations. Mercury concentrations (total) were lower than 0.01µg/L at all sampling locations except for WS-6 (0.01µg/L) and WS-5 (0.02µg/L).

Samples were collected near the sewage lagoon to assess bacteria (e.g. *Escherichia coli*, total Coliforms, and Fecal Coliforms). However, lab results were not obtained due to processing delays at the lab, rendering the samples invalid.

Samples were also collected near the community dock. Results for benzene, ethylbenzine, toluene and xylenes were all below minimum detection levels, and hydrocarbons (total purgable) were found at 2.5mg/L.

c. Sediment Quality

Mercury exceeded the CCME Sediment Quality Guideline (SQG), but not the Probable Effects Level (PEL; CCME 2014) at WS-1 (0.3mg/kg) and WS-3 (0.2mg/kg); the SQG for mercury is 0.17mg/kg and the PEL is 0.486mg/kg (Figure 5; see Figure 3 for sampling locations). Mercury was lower than 0.01µg/L in the water samples at WS-1 and WS-3.

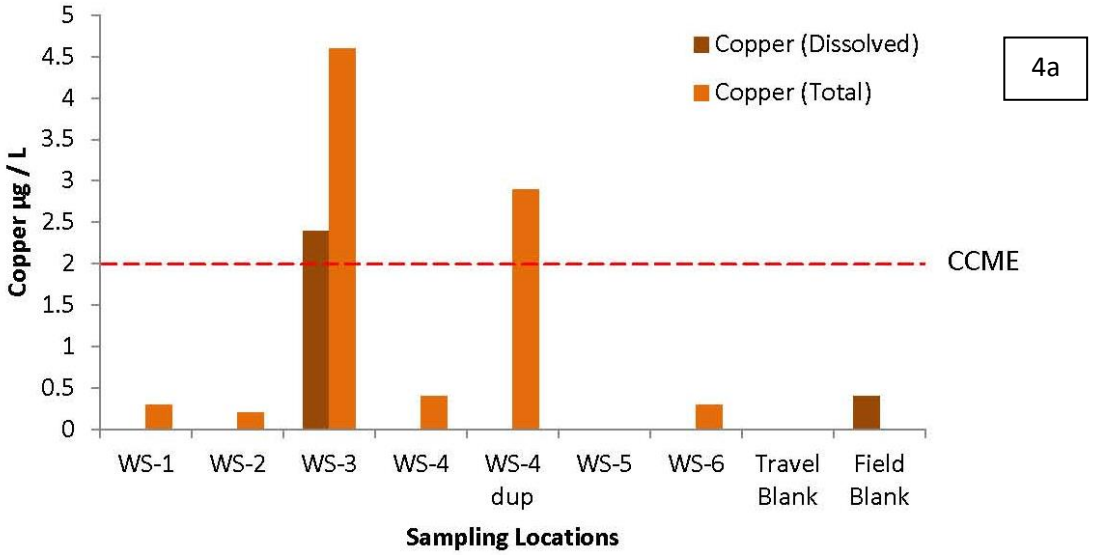
Copper exceeded the CCME SQG, but not the PEL (CCME, 2014) at WS-3 (0.99mg/kg), WS-4 (41mg/kg), and WS-5 (41mg/kg); the SQG for copper is 0.36µg/kg and the PEL is 1.97mg/kg (Figure 5, see Figure 3 for sampling locations). Copper in water samples was above CCME Guidelines at WS-3 and WS-4.

No other parameters exceeded the CCME SQG or PEL in the sediments analyzed.

Table 2. Details for water and sediment sampling locations at the TAEMP on Lac la Martre near the community of Whatì, September 2014.

ID	Description	Location (Lat/Long)
WS-1	Lac la Martre Lake outflow	N 63°07.492 / W-117°15.593
WS-2	Near sucker spawning area	N 63°05.653 / W -117°37.803
WS-3	Near area of boreal wood caribou activity (*ʔedèezhìì* / Horn Plateau)	N 63°11.917 / W -117°06.557
WS-4	Near area of traditional net sets	N 63°13.093 / W -117°23.365
WS-5	Near area of traditional net sets / near old Lac la Martre Lodge (the one that burnt down)	N 63°18.407 / W -117°29.325
WS-6	Near current Lac la Martre Lodge	N 63°23.231 / W -117°47.408
Community Dock	Near community dock	N 63°08.650 / W-117°16.868
Sewage outflow	Near sewage outflow	N 63°07.745 / W-117°13.973

Note: Lat/Long are NAD 83;



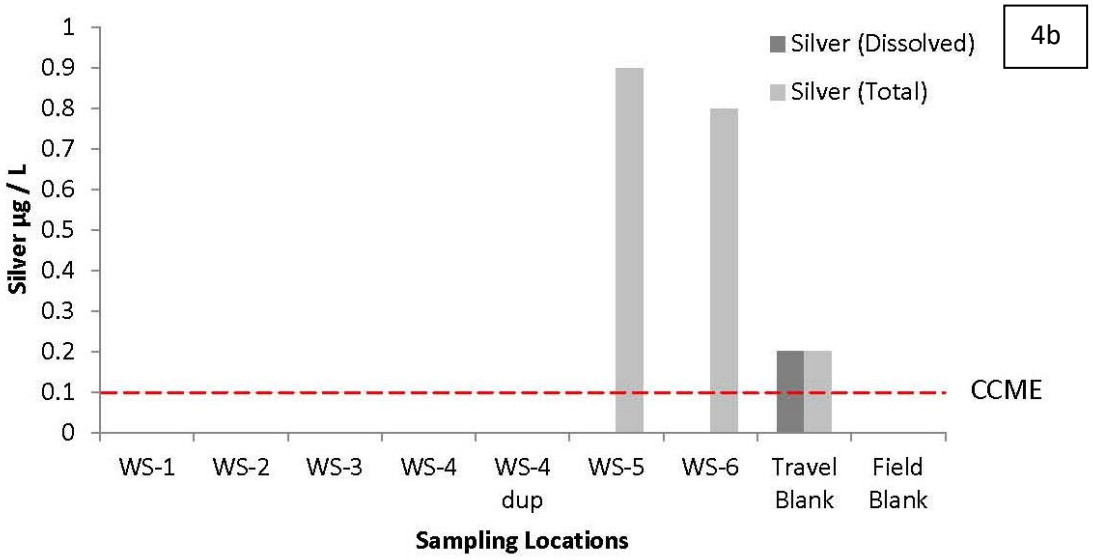


Figure 4. Results of water quality analyses for Copper (4a) and Silver (4b) (total and dissolved) for six samples (with one duplicate), a travel blank, and a field blank (µg/L) collected during the TAEMP near Whatì (on Lac la Martre) September, 2014. Canadian Council of Ministers of the Environment (CCME) guidelines provided for both metals (2.0µg/L and 0.1µg/L for copper and silver, respectively).

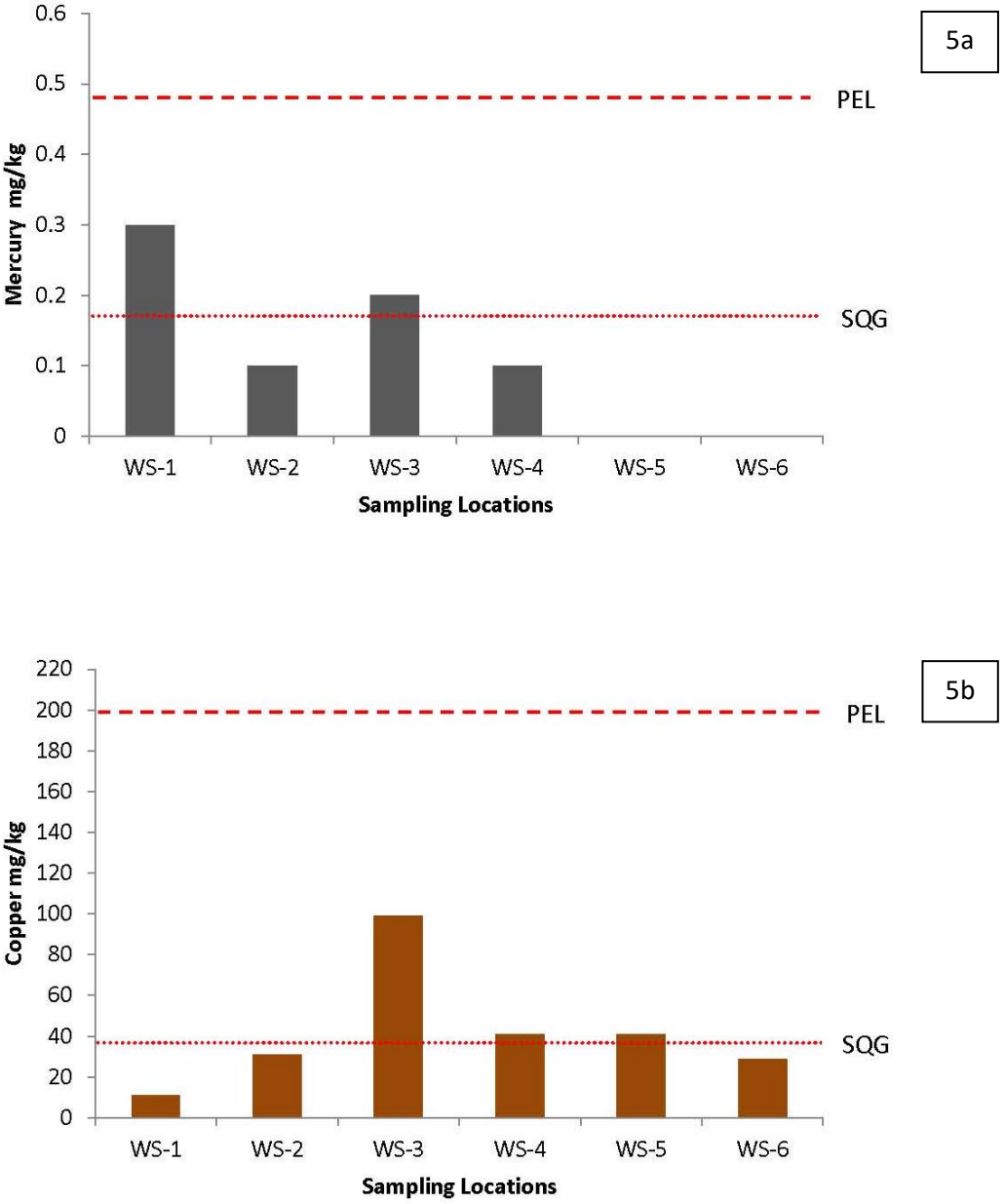


Figure 5. Results of sediment quality analyses for Mercury (5a) and Copper (5b) for six samples (mg/kg) collected during the TAEMP near Whatì (on Lac la Martre) September, 2014. Canadian Council of Ministers of the Environment (CCME) Probable Effects Level (PEL) and Sediment Quality Guidelines (SQL) are provided for both metals (PEL 0.486mg/kg and SQG 0.17mg/kg for mercury; PEL 197mg/kg and SQG 36mg/kg for copper, respectively).

d. Fish Species Diversity

Three species of fish were caught on Lac la Martre (Table 2), with łıwezǫ̀ǫ̀ (LKTR) and ıhdaa (NRPK) the common top predators, and łih (LKWH) representing benthic invertebrate feeders. There were 27 łıwezǫ̀ǫ̀, 27 łih, and 17 ıhdaa caught, for an overall total of 71 fish caught over a combined total of 41 hours of net sets. Smaller fish fauna could not be effectively sampled with the mesh size in the nets used. and łih

Table 3. Date and duration of net sets, and number of łıwezǫ̀ǫ̀ (LKTR), łih (LKWH) and ıhdaa (NRPK) caught on Lac la Martre near the community of Whatì during the TAEMP, September 9-11, 2014.

Net set / pull date	Location (Lat/long)	LKTR	LKWH	NRPK
Sept 9 / Sept 9	N 63°08.774 W-117°34.585	6	2	0
Sept 9 / Sept 10	N 63°08.908 W -117°33.939	7	6	3
Sept 10 / Sept 10	N 63°08.908 W-117°33.939	9	7	2
Sept 10 / Sept 11	N 63°08.896 W-117°33.062	5	12	12
Totals		27	27	17

Note: Lat/Long are NAD 83

e. Fish Tissue Analysis

The average mercury concentration for łıwezǫ̀ǫ̀ sampled (n=20) was 0.330mg/kg (95% CI+/-0.048) and ranged between 0.202-0.591mg/kg. The majority of fish which had tissues analyzed for contaminants (18 of 20) were below the mercury concentration guideline of 0.5mg/kg, (wet weight, wwt; Health Canada, 2014a). The two łıwezǫ̀ǫ̀ found to be above the guideline, at 0.589 and 0.591mg/kg (wwt), were the two oldest łıwezǫ̀ǫ̀ sampled (18 and 21 years, respectively), and included the largest (821mm) and heaviest (4720g) fish sampled. Review of mercury concentrations in muscle tissue in relation to age, weight, and fork length (Figures 6a, 7a, and 8a; respectively) suggest positive relationships; no regression analyses were performed.

The average mercury concentration for łih sampled (n=20) was 0.035mg/kg (95% CI+/-0.007) and ranged between 0.0148-0.0781mg/kg (wwt). All of the łih sampled fell well below the guideline for mercury 0.5mg/kg, (wet weight, wwt; Health Canada, 2014a). Review of mercury concentrations in muscle tissue in relation to age, weight, and fork length suggest positive relationships (Figures 6b, 7b and 8b, respectively); no regression analyses were performed).

No deformities/abnormalities were noted in any of the fish sampled; parasites (e.g. worms) were found in fish sampled, though not at levels considered to be abnormal. It should also be noted that the Health Canada Guidelines are for retail fish. There are no Health Canada Guidelines for fish caught for recreational or subsistence purposes.

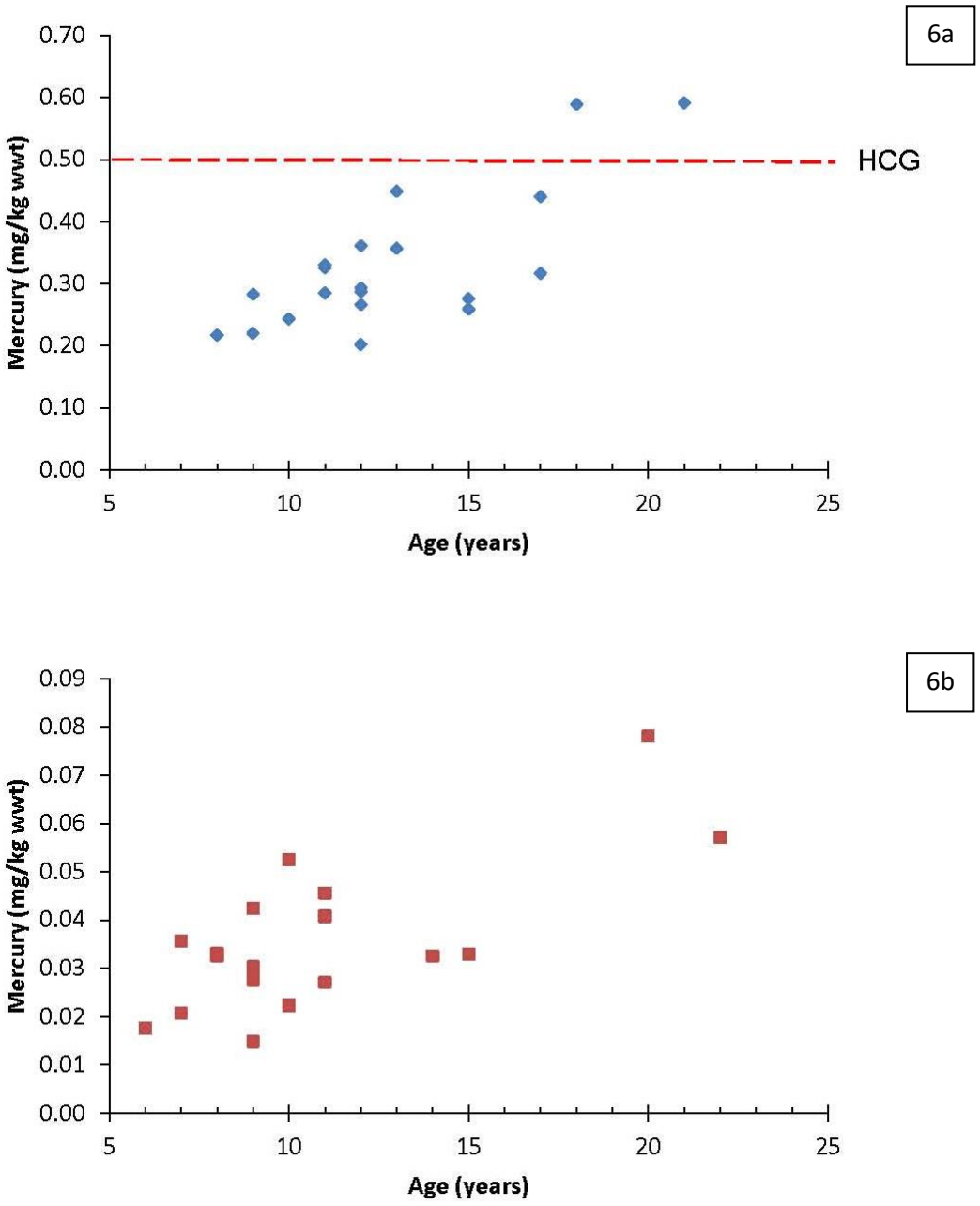


Figure 6. Relationship between mercury concentration in tissues (mg/kg; wet weight) and age (years; estimated via otolith aging) of łıwezǫ̀ǫ̀ (6a) and łih (6b) collected during the TAEMP near Whatì (on Lac la Martre), September 2014. Health Canada Guideline (HCG) for mercury (0.5mg/kg for retail fish) provided.

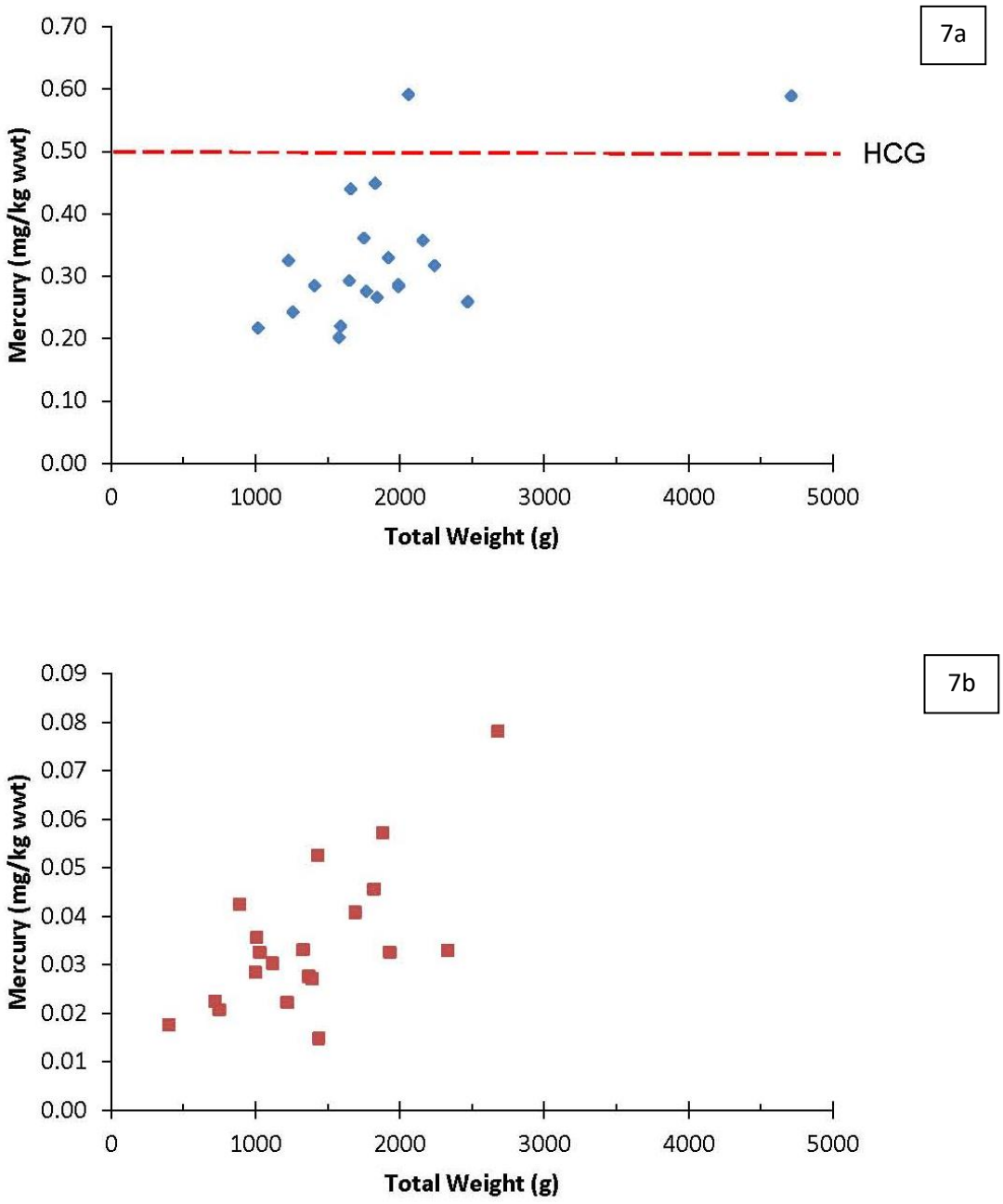


Figure 7. Relationship between mercury concentration in muscle tissue (mg/kg; wet weight) and total weight (g), of łıwezǫǫ̀ (7a) and łih (7b) collected during the TAEMP near Whatì (on Lac la Martre), September 2014. Health Canada Guideline (HCG) for mercury (0.5mg/kg for retail fish) provided.

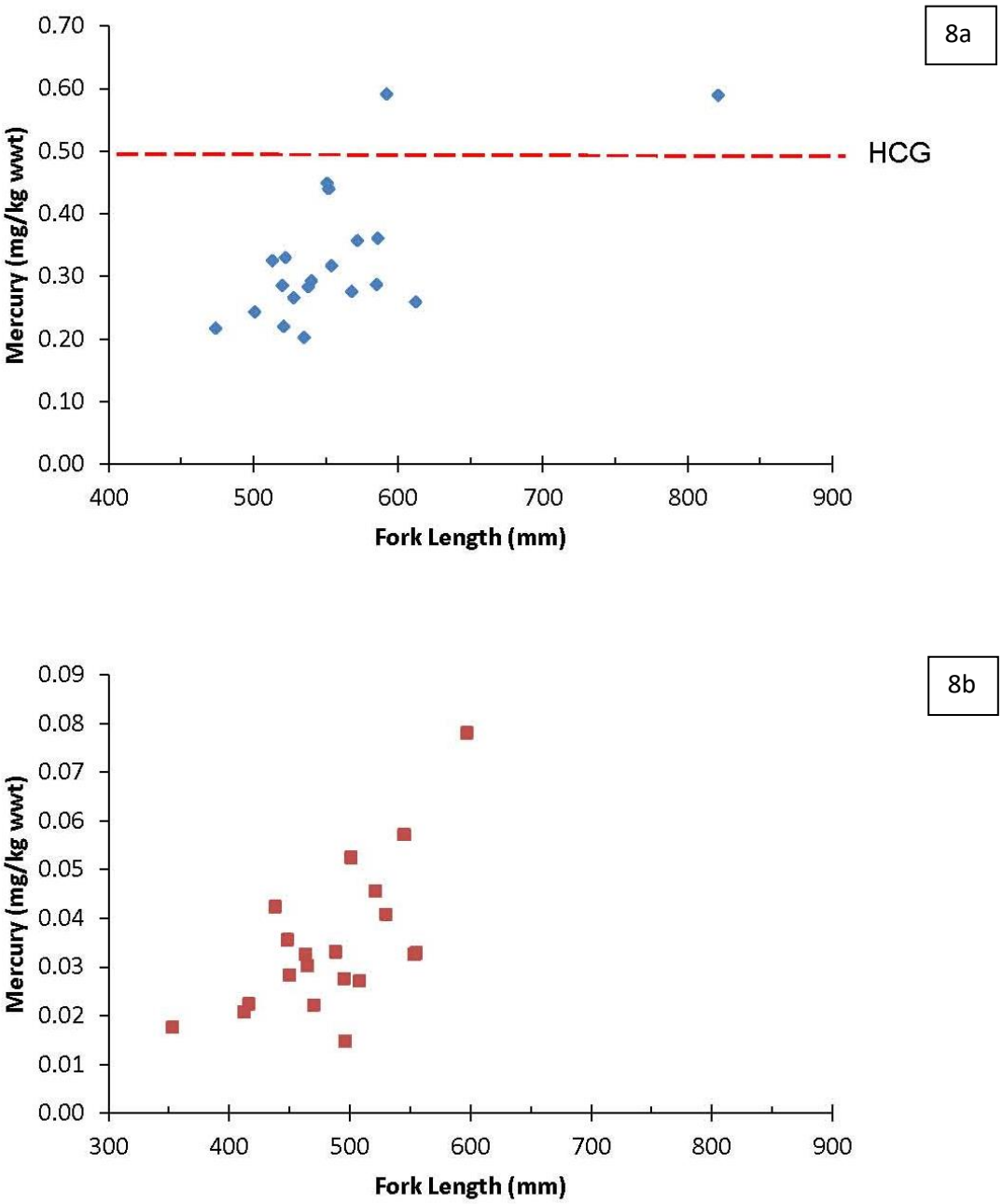


Figure 8. Relationship between mercury concentration in muscle tissue (mg/kg; wet weight) and fork length (mm), of łıwezǫ̀ǫ̀ (8a) and łih (8b) collected during the TAEMP near Whatì (on Lac la Martre), September 2014. Health Canada Guideline (HCG) for mercury (0.5mg/kg for retail fish) provided.

f. Fish Growth

Review of age in relation to length for both łih and łıwezǫ̨ǫ̨ captured in Lac la Martre suggest positive relationships (Figure 9); no regression analyses were performed.

Łiwezǫ̨ǫ̨ sampled for tissue analyses (n=20) ranged from 474-821mm in fork length, 1020-4710g in weight, and were estimated to be 8-21 years of age. Average fork length was 559.25 (95% CI+/-30.78), and average weight 1905.5g (95% CI+/-328.66). All łıwezǫ̨ǫ̨ caught (n=27) also ranged from 474-821mm and 1020-4710g, though average fork length was slightly higher at 575.19mm (95% CI+/-28.84), as was the average weight at 2115.93g (95% CI+/-339.29).

Łih sampled for tissue analyses (n=20) ranged from 353-597mm fork length, 400-2680g in weight, and were estimated to be 6-22 years of age. Average fork length 485.20mm (95% CI+/-25.32) and average weight was 1315g (95% CI+/-221.55). All łih caught (n=27) also ranged in fork length from 353-597mm, with average fork length slightly lower at 472.20mm (95% CI+/-25.32). Weight was only documented for łih sampled for tissue analyses (n=20) so no differences in the average weigh for all fish caught (n=27) can be reported.

Įhdaa sampled (n=17) ranged from 69.8 to 882mm in fork length, and (n=14) 1560-4480g in weight; the three smallest fish caught (69.0-76.1mm) were not weighed. The average fork length (n=17) was 595.44mm (95% CI+/-122.20), and average weight (n=14) was 2687.1495% CI+/-408.54). Įhdaa did not have clethria collected and were not aged (note: in Northern pike more often it is clethria, not otoliths, that are are used for aging).

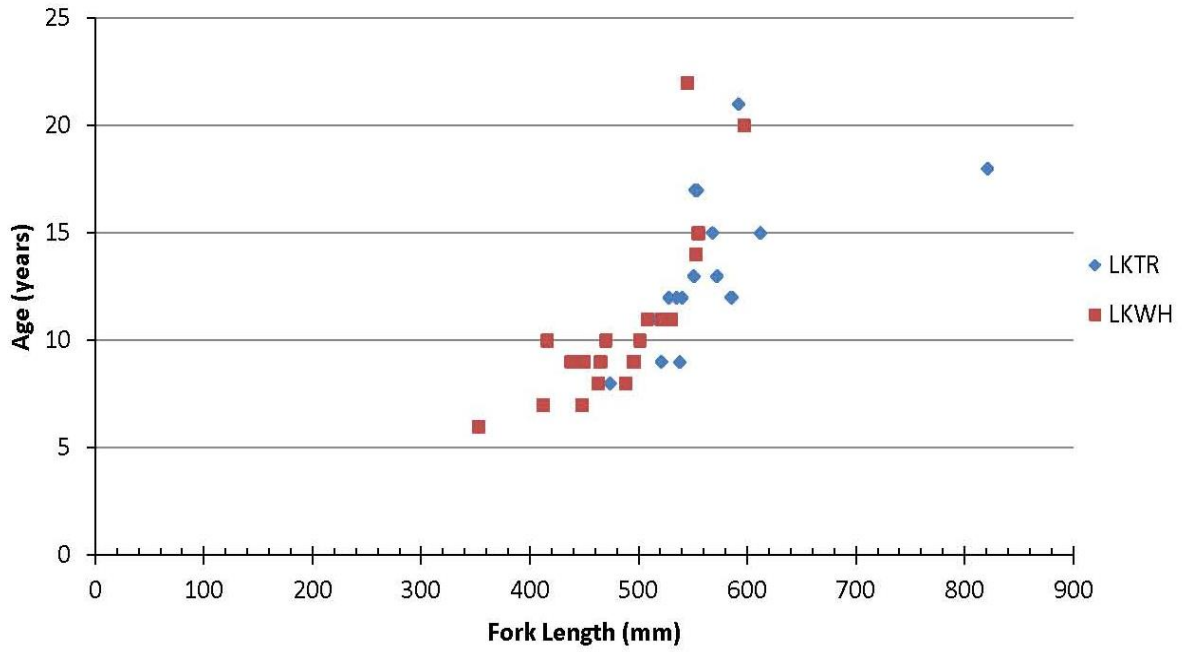


Figure 9. Relationship between fork length (mm) and age (years; estimated via otolith aging) in łıwezǫ̨ǫ̨ (LKTR) and łih (LKWH) collected during the TAEMP near Whatì (on Lac la Martre), September, 2014.

g. Cultural / Educational Activities

A highlight of the camp was a visit to a traditional gravesite where elders led prayers and held a feeding the fire ceremony. Elders explained the importance of maintaining gravesites and paying respect for those who have passed on. At camp, elders shared their knowledge and stories, and the youth assisted with camp chores and learned from the elders and support staff. Everyone enjoyed the traditional foods prepared by the camp cooks, and fish caught were used for both sampling and consumption. On the last evening, there was a hand games demonstration and drum dancing in the meeting tent. There was also a visit by a small group of community members who were interested in the activities at the camp. The visitors did not stay long, but had time to interact with camp participants and share information prior to the visitors continuing on their journey.

On-shore demonstrations were given for both fish sample processing and water and sediment sample collection. Paul Vecsei (Golder Associates Ltd.), with assistance from Francois Larouche (DFO), demonstrated how to process a fish for sampling and how to obtain the required information from the fish (e.g. length, weight, sexual maturity, and otholith extraction). Differences among the fish species caught were shown, with particular focus on the characteristics that show adaptations for different lifestyles (e.g. top predator vs. benthic feeders). Sean Richardson, Wildlife Coordinator for the TG, led the on-shore demonstration for water and sediment, focussing in particular on the need for proper procedure to avoid contamination of samples. Sampling in the field involved interested youth, and under supervision, youth assisted with the collection of samples.

Camp participants also examined aquatic invertebrates found close to shore under a magnifying glass. The impromptu demonstration led by Susan Beaumont (WRRB Communications Officer) and Francois Larouche (DFO) provided information on aquatic insects, snails, and other invertebrates that play an important role in the aquatic ecosystem, providing food for łih, young łıwezǫ̀ǫ̀ and smaller fish like *Dahts'a* (sticklebacks) and *ɬihtsoa* (ciscoes), water birds, and other animals. During the on-shore fish processing demonstration, the importance of invertebrates to a łih's diet was discussed, after examination of łih stomach contents which included small shrimp-like scuds and snails.

Camp activities were captured on video by filmmaker Alan Booth, of Yellowknife Films (available at: http://www.wrrb.ca/news/new-whati-fish-camp-video-ready-viewing). Highlights from the video include positive commentary on the camp provided by elders, youth and support staff. For example, Elder Jimmy Nitsiza spoke of how traditional knowledge and science worked "in good cooperation and good spirit" at the fish camp, and

> *"Traditional knowledge talks about the land and how to relate to land and water...and we need your expertise. Both of them work together and make a better community. The last four days showed a good example. We became good friends, we had good relationships, a good indication of working together as one people."*

3. Results Workshop

A workshop was held in Whatì on February 11, 2015 to report lab results back to camp participants and interested community members. Paul Vecsei (Golder Associates Ltd.) presented the results related to fish, and Sean Richardson (TG) presented the water and sediment results. The meeting was well attended and included elders and senior students

from Mezi Community School (some of whom were also camp participants), along with adult education students. Participants of the Reporting Back Workshop were interested in the results and asked questions of clarification. The issue of mercury contamination was discussed, and community members were relieved to hear that the Lake Whitefish and Lake Trout from Lac la Martre continue to be healthy food choices and do not pose a risk. Additional information on healthy choices was provided via GNWT HSS food sheets (GNWT HSS 2015), and clarification was provided on the potential differences between consumption of Lake Trout and Lake Whitefish. The draft educational video highlighting camp activities was premiered and was well received; no changes to the video were suggested.

Discussion

Overall, results from the 2014 TAEMP near Whatì indicated that fish are healthy and habitat is clean in Lac la Martre. The message provided to the community was that water, fish and sediment quality are good, where "good" indicates that results were not abnormal and that there were no health concerns highlighted.

No contaminant levels observed in łih or łıwezǫ̀ were considered to be abnormal. Though łıwezǫ̀ were found to have a higher mercury concentration than Lake Whitefish, this was not unexpected given that they are a large predatory fish which commonly exhibit higher levels due to bioaccumulation and biomagnification, while whitefish primarily feed on small fish and arthropods and typically show lower levels of contaminants (Health Canada, 2015, Cabana et al. 1994). No statistical analyses of mercury concentrations in muscle tissue in relation to age, fork length, and weight were conducted, given that examination of the scatter plots suggest positive relationships (as expected) and that statistical analyses of TAEMP results (2011-2015) are being discussed with academic partners (with the understanding that sample sizes are relatively small). Of note, the mercury concentrations found in łıwezǫ̀ sampled in Lac la Martre were some of the lowest observed concentrations observed over the four years of TAEMP implementation. This may be related to the size of Lac La Martre (largest of the lakes sampled over the implementation of the TAEMP) as larger lakes may have fish with lower mercury concentrations (Bodaly et al. 1993). With regards to questions of samples conducted in the 70's regarding the old fishery, queries were sent to GNWT staff knowledgeable about water and sediment sampling, but a review of the sediment data archives did not provide any records.

Results from the 2014 monitoring program near Whatì support the expectation that water quality and sediment quality are good in Lac la Martre. Basic interpretation of the water and sediment quality results involves comparison of results to CCME Guidelines for the Protection of Aquatic Life, for water, and the CCME Sediment Quality Guidelines and Probable Effects Level, for sediment. The guidelines are based on a thorough review of information on the toxicity of different parameters (e.g. metals, nutrients, etc.) and indicate the concentration of a parameter below which no adverse effects are expected. CCME guidelines are not site-specific; they are meant to be applied as Canada-wide standards for freshwater to protect all forms of aquatic life, including the most sensitive life stage of the most sensitive species. If a guideline value is exceeded, that does not necessarily indicate that a particular parameter is having a negative effect on aquatic organisms; it suggests that there is potential for an effect, depending on the species present and the natural background

characteristics of the water and sediment. These national guidelines are used in absence of baseline or control data to use as a comparison.

Water samples at all sites indicated that water is considered “hard”, which is not unexpected given the natural occurrence of minerals in the environment (e.g. calcium and magnesium). Though water samples at two locations were over the CCME Guidelines for the Protection of Aquatic Life (CCME 2014) for copper, the field blank also showed some contamination for copper. Further, though three sediment samples were over the Sediment Quality Guideline for copper, only one of the corresponding water samples (WS-3) was above the CCME Guideline, though WS-3 did show the highest measured level for copper. However, levels for copper observed are within the range of natural concentrations in Canadian lakes and streams CCME 2014), and the exceedances should be interpreted with caution, and given that other samples indicated low levels of copper the overall results were not considered to be of significant concern. Two water samples were over the Guideline for silver, and questions remain regarding the influence of the 2014 fire season on aquatic and terrestrial systems in Wek’èezhìı. However, as with copper, the travel blank showed some contamination for silver. As a result, the exceedances observed for silver should also be interpreted with caution. There is also no Canadian drinking water guideline for silver because water contributes negligibly to an individual’s daily silver intake (Health Canada 2014b). Mercury exceeded CCME Sediment Quality Guideline, but not the Probable Effects Level (CCME 2014) at two of the sites sampled. However, mercury was undetectable in the water samples at these same locations. The sediment results may reflect historical deposition and are not likely of concern to human or fish health. As mentioned, the 2014 fire season was considered severe, and impacts to water quality are a possibility (Baltzer and Jillstone 2015.). Though water and sediment results did not suggest anything abnormal, a return to Whatì in 2018 may provide additional information on deposition of nutrients and metals post-fire, with results provided by fire-specific studies hopefully providing additional insights (Baltzer 2015).

Though samples taken near the sewage lagoon for bacterial analyses were not analyzed, the Community Government of Whatì must sample water quality at various locations several times per year, including the sewage lagoon, as part of their Water Licence Surveillance Network Program (SNP). In the future, program participants will work more closely with the lab to ensure that samples are processed within the required processing times after delivery. Hydrocarbon (total purgable) levels at the dock suggested some contamination (2.5mg/L; see p.10), though likely from boats. By comparison, some Water Licences have an effluent quality criteria limit of 5.0mg/L.

Elders and other community members guided all aspects of the project, with Tłı̨chǫ knowledge incorporated throughout, by design. The application of Tłı̨chǫ knowledge included: selection of participants, selection of the camp location and establishment of the on-the-land camp, direction on where samples are collected, which culturally significant places are visited, and what behaviours/practices are appropriate and respectful while at the on-the-land camp. In addition, the on-the-land component of the TAEMP provided an opportunity for youth to engage with their elders, assisting in the youth’s education in observing, monitoring and understanding the aquatic ecosystem from a Tłı̨chǫ perspective. Elders and community members passed on Tłı̨chǫ knowledge to youth fostering interest in monitoring near communities and assisting with the continuation of Tłı̨chǫ knowledge of

aquatic ecosystems and the traditions associated with each community. The TAEMP also offered an opportunity for researchers to learn from traditional knowledge holders in a culturally appropriate on-the-land context. This form of engagement allowed for building of mutual respect and trust through exchange of TK and science-based information. Lastly, by bringing results back to Whatì, findings were discussed in a public forum which helped build a shared appreciation of the similarities in perspectives provided by both Tłı̨chǫ knowledge and science.

Conclusions and Next Steps

The Tłı̨chǫ Aquatic Ecosystem Monitoring Program (TAEMP) has been developed and modified continuously through a collaborative relationship among communities and agencies based in the NWT. By design, the TAEMP is based on consultation with communities near which sampling occurs. The WRRB will continue to use a collaborative approach in the future through face-to-face meetings, conference calls, and workshops, culminating in the on-the-land "fish camp" at which dialogue with community representatives occurs constantly to ensure the Program continues to meet its objectives.

The TAEMP provides an opportunity for youth and community members to conduct scientific fish monitoring at an on-the-land camp, and allows their experience(s) to be combined with their Tłı̨chǫ knowledge of the environment near communities. This increases the capacity of Tłı̨chǫ people to understand the science-based methods used to assess the current and potential effects of contaminants within various ecosystems across their lands and how the results are interpreted, while simultaneously sharing Tłı̨chǫ knowledge and allowing for clarification of concepts in an on-the-land setting (e.g. similar to a field course-based approach). The TAEMP also offers an opportunity for researchers to learn from traditional knowledge holders in a culturally appropriate on-the-land context. This form of engagement allows for building of mutual respect and trust – as scientists and knowledge holders learn from one another while out on the land, recognizing each other's capabilities through regular camp operations (e.g. net setting, fish collection, fish processing for samples and food).

The TAEMP also involves staff from organizations inherently linked to Tłı̨chǫ communities, including the WRRB, WLWB and the TG. Long-term capacity building occurs in these organizations through continued support by their trained staff, some of whom are also Tłı̨chǫ citizens living in communities. A four-year rotation through Tłı̨chǫ communities also allows for the potential that community members will repeatedly participate in, contribute to, and learn from the TAEMP – notably the youth. Youth are exposed to, and provided basic training on, the standardized collection of samples, and the possibility for youth continuing with more specific training is strengthened by the availability of the Marian Watershed Stewardship Program led by the TG and WLWB. For example during the 2014 TAEMP, a participating youth specifically voiced an interest in continuing training in environmental monitoring, notably referring to Tłı̨chǫ Government staff tasked with leading water and sediment sampling at the Whatì fish camp, who themselves had undergone the training.

With the conclusion of the 2014 camp near Whatì, the Program has completed its initial baseline sampling phase. In 2015, the first round of comparative sampling will begin when the TAEMP returns to the community of Behchokǫ̀. The next phase of comparative sampling will provide data that will continue to provide a means of addressing community concerns

related to changes in the environment, and the TAEMP will continue to build on work carried out since 2010.

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Appendix 1 – Project Participants

Introductory Workshop (June 25, 2014)

Whatì Community members:

- Joe Champlain
- Charlie Jeremicka'ca (WRRB Board member)
- Lawrence Mackenzie
- Archie Nitsiza
- Jimmy Nitsiza
- Frankie Nitsiza
- Louie Wedawin

Support Staff:

- Sarah Elsasser WLWB
- Jonas Lafferty translator
- James Rabesca translator
- Boyan Tracz WRRB

Note: Alestine Nitsiza (TG); provided lunch, but did not participate in meeting

Planning Workshop (August 8, 2014)

Whatì Community members:

- Joe Champlain
- Freddie Flunkie
- Bennie Jeremicka'ca
- Lawrence Mackenzie
- Archie Nitsiza
- Frankie Nitsiza
- Jimmy Nitsiza
- Mike Nitsiza
- Jimmy B. Rabesca
- Francis Simpson
- Louie Wedawin

Support Staff:

- Shirley Beaverho TG - Whatì
- Jonas Lafferty translator
- Ted Nitsiza TG - Whatì
- James Rabesca translator
- Sean Richardson TG
- Boyan Tracz WRRB

Fish Camp (September 8-12, 2014)

Whatì Elders:

- Joe Champlain
- Madeline Champlain
- Jimmy Nitsiza
- Margaret Nitsiza
- Lucy Nitsiza
- Francis Simpson
- Georgina Simpson

Whatì Youth:

- Mason Beaverho
- Jacintia Flunkie
- Twyla Nitsiza
- Anika Romie
- Alexander Simpson
- Isiah Zoe

Whatì Community Members:

• Archie Nitsiza	Foreman
• John Beaverho	Foreman's Assistant
• Lawrence Peter Nitsiza	Camp Assistant
• Elizabeth Young	Head Cook
• Bernice Beaverho	Cook's Helper

Partners:

• Susan Beaumont	WRRB
• Roberta Judas	WLWB
• Francois Larouche	DFO
• Sean Richardson	TG
• Boyan Tracz	WRRB
• Paul Vecsei	Golder Associates Ltd.
• Shirley Beaverho	TG Whatì
• Freddie Flunkie	TG Whatì
• Ted Nitsiza	TG Whatì

Translation

- Jonas Lafferty
- James Rabesca

Video

• Alan Booth	Yellowknife Films

Results Workshop (February 11, 2015)

A final list of all participants was not prepared, partially due to the number of attendees and the movement of attendees (estimated at a max of 30-40, of which approximately 18 were youth). Attendees included: elders (including camp participants such as Joe and Madeline Champlain, and Francis Simpson), senior students from Mezi Community School (including camp participants, such as Jacintia Flunkie, Twyla Nitsiza, and Anika Romie), adult education students, and a number of interested community members. Support staff included Susan Beaumont (WRRB), Roberta Judas (WLWB), Jonas Lafferty (translation), James Rabesca (translation), Sean Richardson (TG), Boyan Tracz (WRRB), and Paul Vecsei (Golder Associates Ltd.).

Photo: S. Beaumont, WRRB

Appendix 2 – Results from Water Quality Travel and Field Blanks

Field quality assurance/quality control (QA/QC) measures carried out for this program consisted of a travel blank and a field blank. These QA/QC samples were incorporated into the study to ensure that no contamination was introduced through the collection, handling, shipping and analysis of the samples.

Travel blanks were prepared by Taiga and field blanks were prepared on site, using Type 1 water provided by Taiga. The blanks were carried and analyzed the same as samples which were collected on site.

The presence of measureable total metals in the field blank samples, i.e., concentrations above the method detection limit (MDL), may indicate contamination during sample preparation in the field. Measurable total metals in the travel blank may indicate contamination in the lab.

Results available upon request.

Appendix 3 – Surface Water Physical and Nutrient Analysis Results

Results available upon request

Appendix 4 – Surface Water Metal Analysis Results

Results available upon request

Appendix 5 – Sediment Metals Analysis Results

Results available upon request

Appendix 6 – Fish species diversity, length and weight

Results available upon request

Appendix 7 – Metals analysis for fish tissue samples

Results available upon request

Appendix 8 – Age analysis for fish otolith samples

Results available upon request