SEINE RIVER TEMPERATURE PROJECT

A multi-year project designed to determine environmental and traditional ecological knowledge indicators for lake sturgeon spawning windows

A Five-Year Summary of Work Conducted from 2011 to 2015

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for Seine River First Nation

In Memory of Myron Johnson

As a co-worker and friend…you will be missed.

Executive Summary

In 1926, the Sturgeon Falls Generating Station was constructed along the Seine River to create hydroelectric power and this facility is currently operated by H2O Power. One of the major threats to lake sturgeon is the impact of peaking hydroelectric developments on the water levels during the spring spawning season. The purpose of the Seine River Temperature Project is to help define the spring spawn for Seine River sturgeon through surrogate environmental indicators and note any effects of peaking on spawning. In addition, a goal of the project was to determine if the increases in water levels at the Seine River First Nation community are due solely to the flow from the Seine River, or if the dam at the outlet of Rainy Lake affects the water levels resulting in the Seine River functioning as a reservoir.

Between 2011 and 2015, Seine River First Nation community technicians studied the spawning timing of lake sturgeon at two important spawning sites in Seine River below the Sturgeon Falls dam to help determine the environmental indicators (temperature, photoperiod, flows) for lake sturgeon spawning. In addition, work was done with Seine River First Nation Elders and knowledge holders in the fall of 2012 to identify Traditional Ecological Knowledge (TEK) indicators for lake sturgeon spawning in Seine River. This TEK study resulted in field observations of poplar leaf size and tiger swallowtail butterflies during the spring of 2013, 2014, and 2015 to determine the relationship between these environmental indicators and the lake sturgeon spawning timing. Adult and juvenile lake sturgeon netting and tagging was conducted in partnership with Ontario Ministry of Natural Resources and North-South Consultants.

The project results indicate that water temperature, photoperiod, and observations of tiger swallowtails are three environmental indicators of lake sturgeon spawning on the Seine River. The lake sturgeon spawning occurred as soon as the water temperature reached 13˚C as long as this temperature was reached when the photoperiod was between 15 hours, 49 minutes and 15 hours, 52 minutes. Tiger swallowtails were first observed each season approximately at the time of the lake sturgeon spawn and no more than four days from the peak spawning activity on Seine River. The peaking water levels/flows from the Sturgeon Falls dam did have the potential to negatively impact upon the spawning success of lake sturgeon in the Seine River in 2011 and 2014, which was one-half of the spawning seasons where data was available (no data for 2013). The results of the juvenile and adult lake sturgeon netting/tagging data from 2011 to 2015 provides strong evidence that the Seine River provides important spawning and rearing habitat for lake sturgeon but appears is only used by adult lake sturgeon for spring spawning. Water level data collected during this project provides evidence that the dam at the outlet of Rainy Lake does affect the water levels in Seine River, and that the Seine River from its outlet to Rainy Lake at Kettle Point upstream to the Highway 11 bridge does function as part of the Rainy Lake reservoir, particularly during years of high levels on Rainy Lake.

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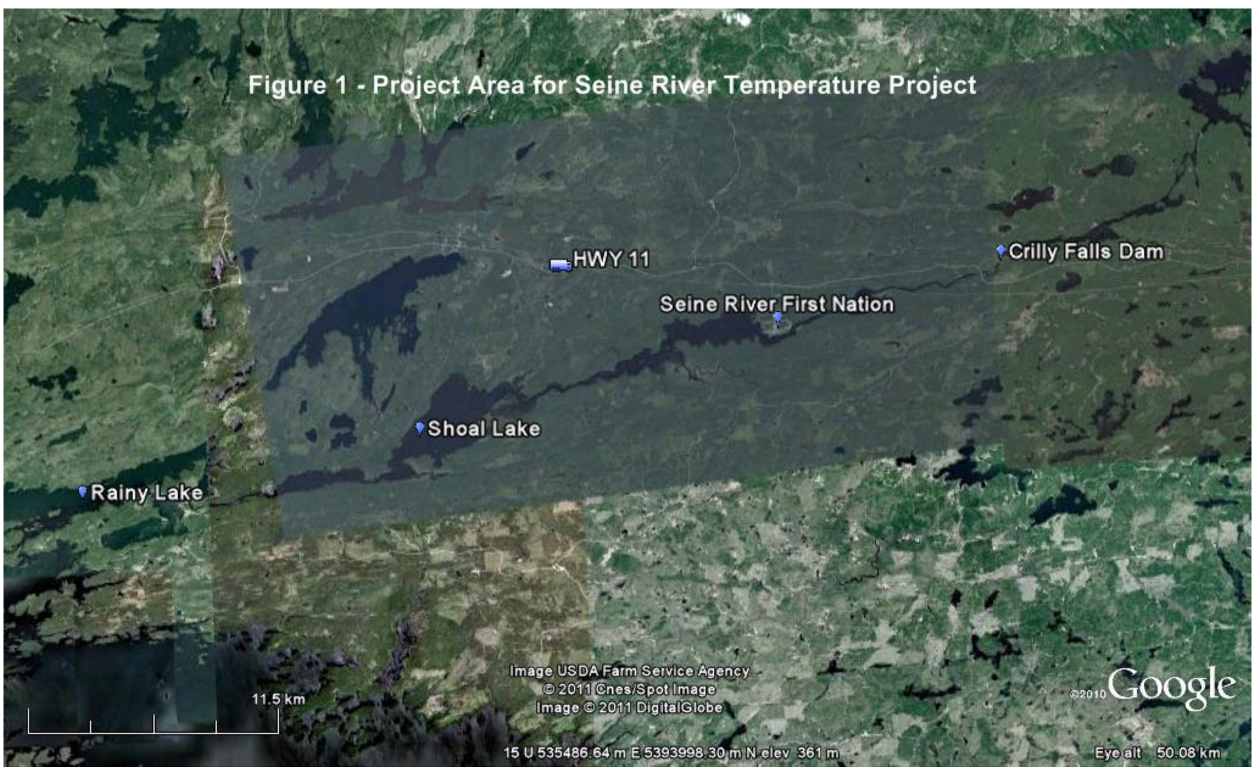
1.0 INTRODUCTION

1.1 Project Area

In 1926, the Sturgeon Falls Generating Station (also known as the Crilly Falls Dam) was constructed along the Seine River to create hydroelectric power. The 7 Megawatt facility is currently owned by H20 Power. The height of this dam (approximately 20 m from the tailrace to the headpond) created a barrier to upstream fish passage. This is the first barrier to fish along the Seine River, located approximately 45 km upstream from Rainy Lake (Figure 1). This project is focussing on the area from the Sturgeon Falls dam downstream to the outlet of the Seine River at Rainy Lake. This lower section of the Seine River has a total surface area of 3,630 ha, and is comprised of distinct river stretches (213 ha) and five unsurveyed coolwater lakes, including Partridge Crop (144 ha), Wild Potato (950 ha), Shoal (1,538 ha), Grassy (323 ha) and Little Grassy Lake (462 ha). Tributaries that flow into the river along its length include Bad Vermilion/Chief Neverwash Creek, Camp River and Stamp Creek. Maximum depth of the entire river system is 16 m (51 feet), with most of the deep water associated with the main river channel. The lake sections are generally shallow (less than 4 m (13 feet)), with maximum depths not exceeding 9 m (30 feet) (McLeod, D.T. 1999).



1.2 Project Rationale

With the listing of the north-western Ontario lake sturgeon population as threatened by the province of Ontario, protection of the habitat for this species has become a priority for resource managers, power corporations, water management boards, and First Nations. One of the major threats to lake sturgeon is the impact of peaking hydroelectric facilities on the water levels during the spring spawning season. The purpose of the Seine River Temperature Project is to help define the spring spawn for Seine River sturgeon through surrogate environmental indicators and note any effects of peaking on spawning. Of particular interest is how these indicators and effects relate to other peaking hydroelectric facilities, particularly those in the trans-boundary waters. If the water downstream of the dam fluctuates dramatically during the gestation period and results in stranded eggs or the drying out of the spawning area, the success of the spawn will be dramatically reduced. Using environmental indicators to define the spawning season as opposed to pre-set calendar periods is felt to be important to ensure that the efforts made to protect this species provide the maximum benefit while not adversely impacting upon the electricity needs in the area during periods when lake sturgeon spawning habitat is not being utilized.

There has been previous work done on the Seine River lake sturgeon population. During a master's thesis by Wells Eugene Adams Jr. in 2004, it was determined that "…Movement of lake sturgeon between the Seine River and the South Arm of Rainy Lake indicates the likelihood of one integrated population on the east end of the South Arm. The lack of re-locations in the Seine River during the months of September and October may have been due to lake sturgeon moving into deeper water areas of the Seine River and out of the range of telemetry gear or simply moving back into the South Arm..." (Adams, Jr. W.E. 2004). During work conducted from 1993 to 1995 by Ontario Ministry of Natural Resources, 48 lake sturgeon were captured and tagged, with only 3 recaptures and no observation of lake sturgeon spawning activities (McLeod, D.T. 1999). A great deal of knowledge of the Seine River lake sturgeon population is held by Seine River First Nation (SRFN) community members and Elders. The design of this project, supported by the International Joint Commission (IJC) is intended to provide a cooperative atmosphere between SRFN knowledge holders, OMNRF field staff, and the owner of the hydroelectric development at Sturgeon Falls on Seine River (H2O Power) to help utilize the traditional ecological knowledge (TEK) held within the community to better understand this fish population. TEK in the community has indicated that lake sturgeon continued to spawn immediately downstream of the Sturgeon Falls dam.

1.3 Research Questions

The project design was intended to answer a number of research questions. The research questions were developed to meet the needs and answer questions of all those involved in the project. Following is a list of research questions that are hoped to be answered through the design and implementation of the project:

1. What are the environmental indicators (water temperature, flow rate, photoperiod) that trigger lake sturgeon spawning on the Seine River below the Sturgeon Falls dam?
2. What are the correlating TEK environmental indicators for lake sturgeon spawning and do these correlate to the environmental indicators provided using western science data collection methods?
3. What are the potential impacts of current flow regimes at the Sturgeon Falls dam on lake sturgeon spawning success? How can the understanding of these impacts be related to other peaking hydroelectric facilities, particularly those in the trans-boundary waters?

4. Can the environmental and TEK indicators for lake sturgeon spawning be applied to other peaking hydroelectric facilities in the area?
5. What is the habitat utilization of adult lake sturgeon in the Seine River (i.e. are the adult fish remaining in the Seine River year-round, or are they using the river only during the spring spawning season)?
6. Are the increases in water levels at the Seine River First Nation community due solely to the flow from the Seine River, or does the dam at the outlet of Rainy Lake affect the water levels resulting in the Seine River functioning as a reservoir?

These research questions were designed to respond to the needs of all of those involved in the project. These six questions will provide the basis for the discussion section of this report.

2.0 METHODOLOGY

2.1 Spawning Confirmation Using Egg Mats

Figure 2 – Egg mat ready for deployment

Figure 3 – Seine River technician checks for sturgeon eggs

As shown in figures 2 and 3, egg mats were used to help determine spawning timing of lake sturgeon in the Seine River. During the 2012 to 2015 field seasons, the placement of egg mats focussed on potential spawning habitat immediately downstream of the Sturgeon Falls dam and/or near the Highway 11 bridge. The areas where egg mats were placed varied during different field seasons due to fluctuating water levels and dangerous flows (Figure 4 and 5).

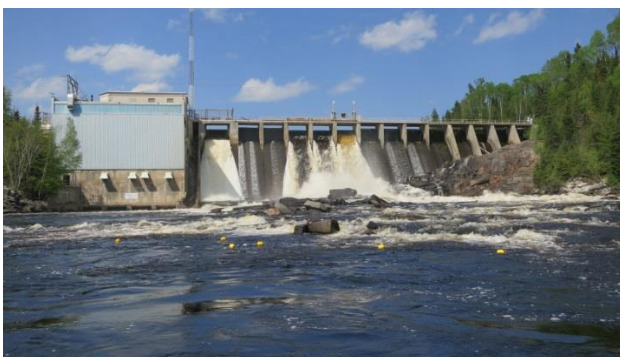


Figure 4 – Eggs mats set below dam during 2015 field season

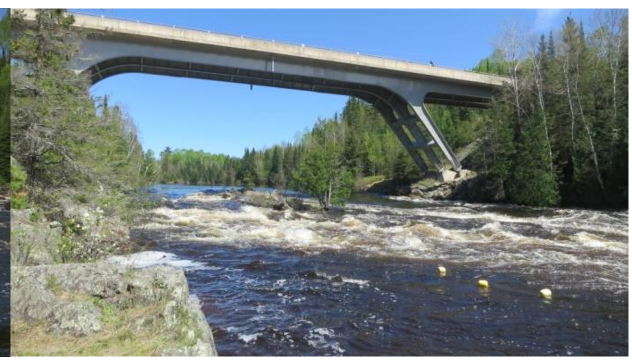


Figure 5 – Egg mats set below bridge during 2014 field season

For the egg mats, 39 cm X 19 cm X 9 cm blocks were used. Each block was wrapped with a 90 cm X 30 cm piece of blue furnace filter and then secured using a bungee cord. Each egg mat was then attached to a yellow float for deployment from the boat.

All egg mats were checked for presence of lake sturgeon eggs once daily during week days throughout the field season and once daily on weekends during potential peak spawning timing. The egg mats were removed from the water, investigated for presence of eggs using a focussed visual inspection, and then placed back into the water on the identified high potential spawning areas.

2.2 Underwater Camera Videography

Underwater video was recorded using the Aqua Vu House View system, with a Sony colour camera, and the Aqua Vu Mini Video Recorder DVR. The camera was mounted to a cement block using 1-inch wood material and cable clamps (Figure 6). The camera/cement block was then place in the water near the spawning habitat to observe the presence of fish in the area. Once the camera was settled into a location that allowed for acceptable visibility and stability, the camera cable was run overland to a large plastic container, which housed 12-volt RV deep-cycle batteries and DVR. The camera cable was then hooked up to the DVR and then, following confirmation that the video was providing a quality picture, the recording on to a 32 GB SD card began. The plastic container was then closed and then locked to a tree using a two-metre length of chain and two padlocks. There were one to two cameras placed near identified spawning areas below the dam and below the bridge during each field season from 2012 to 2015.

Figure 6 – Underwater camera rig

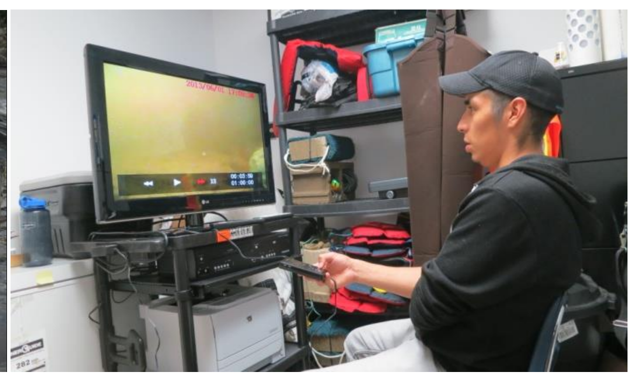


Figure 7 – Viewing underwater videos

The cameras were checked daily, with a change of batteries and exchanging of the SD card conducted. The underwater video was then observed using an additional DVR and a television. The underwater footage was observed at a fast forward speed of eight times the real-time speed, with slower speeds (real-time or two times) used for viewing and documenting any fish observed (Figure 7).

2.3 Larval Drift Nets

During the 2012 to 2015 field seasons, larval drift nets were set below the dam and below the bridge downstream of identified spawning areas for lake sturgeon (Figures 8 and 9).

Figure 8 – Checking larval drift nets below bridge

Figure 9 – Larval drift net location below dam

The larval drift nets were tied to boulders close to the shoreline or king anchors using approximately 5 m of blue multi-braided polypropylene rope. The drift nets were set in water approximately 50 cm of water depth so that the top of the drift nets were just above the water when set. Drift nets were checked once daily by removing the detachable collection bucket and then sorting through the debris collected with tweezers to identify the presence of larval lake sturgeon (Figure 10 and 11). The detachable collection bucket was then reattached to the drift net and set again for approximately 24 hours.

Figure 10 – Technicians sort through drift net catch

Figure 11 – Larval sturgeon mixed in with invertebrates

In order to determine the applicability for Seine River of the calculations used by Mike Friday at OMNR in Thunder Bay (Mike Friday, personal communication, email, January 16, 2013), the same methodology was applied to the 2012 to 2015 larval drift data to determine the calculated spawning timing and its relationship to the actual spawning timing where available. This method uses the first larvae captured to indicate the start of the drift. Using the date of the first larvae captured the cumulative thermal (water temperature) units are used to determine when the spawning occurred. The data Mike Friday has collected indicate that the difference in time between the larval drift and spawn is 150 cumulative thermal units (CTU). The daily CTU value is determined by taking the mean daily water temperature and subtracting 5.8°C. This will provide a thermal unit for the day. Once the sum of all of the daily CTU values reach 150, that is the approximate date of spawning.

2.4 Traditional Ecological Indicators

In the fall of 2012, Kenora Resource Consultants worked with the Elders of Seine River First Nation to identify traditional ecological indicators of lake sturgeon spawning. The common ecological indicators of lake sturgeon spawning given during the interviews included “yellow monarch” (tiger swallowtail) butterflies and the size of the poplar leaves near the community. During the 2013 to 2015 field seasons, efforts were made to document both of these ecological indicators to determine their relationship to the spawning timing of lake sturgeon in Seine River.

2.4.1 Poplar Leaves

Throughout the spring field season, technicians gathered leaves from trembling aspen, *Populus tremuloides*, located on the hill near the water tower on Seine River First Nation. This was the location most identified by the Elders for the relationship between the size of the leaves and lake sturgeon spawning. Five leaves were gathered from four different sites located near the water tower (Figure 12). The length and width of each leaf was then measured using digital callipers (Figure 13) and an average of all 20 leaves taken from the four sites was used to determine the leaf size on that date.

Figure 12 – Five leaves collected from each site

Figure 13 – Leaves measured with digital callipers

2.4.2 “Yellow Monarch” Butterflies

The butterflies identified by the Elders as “Yellow Monarchs”, or Tiger Swallowtail (*Papilo glaucus*) were found on the roadsides during the 2013 to 2015 field seasons. The numbers and locations were documented as lake sturgeon spawning and larval drift netting field work was conducted.

2.5 Levelogger Installation and Data Collection

During the 2011 to 2013 field seasons, OMNR Atikokan staff installed a Solinst Levelogger Gold in the Seine River at a near shore location upstream of the highway 11 bridge. The logger was secured to a metal plate weight and lowered in the water to a depth of approximately 1 m. The weight was tied off to shore. A Solinst Barologger Gold was secured to the base of a young balsam fir tree located approximately 5 m southeast of the Levelogger location. The data collected by the Barologger allows the depth measurements taken by the Levelogger to be corrected for changes in atmospheric pressure. A second Solinst Levelogger Gold was installed in the Seine River near the First Nation community under a resident’s dock. The levelogger was secured to a metal plate weight and lowered under the dock to a depth of approximately 0.5 m. It was tied off to the resident’s dock. This sheltered location was chosen because there will likely be little disturbance to the unit while it is installed in the river. Unfortunately, OMNR staff was unable to retrieve the Levelogger from beneath the bridge following the 2013 field season, so logger data on water levels and temperature is not available for this field season. The daily temperature readings taken by Seine River First Nation field technicians using a thermometer were used for data analysis during the 2013 field season.

During the 2014 and 2015 field seasons, Seine River First Nation installed three Leveloggers and one Barologger on Seine River. One Solinst Levelogger was placed in the Seine River downstream of the highway 11 bridge and one downstream of the Sturgeon Falls dam. The loggers were secured to a metal plate weight and lowered to the bottom of the river behind boulders, with a cable wrapped around the boulder to facilitate retrieval of the logger. A Solinst Barologger was placed in the large plastic container used to house the underwater camera equipment immediately downstream of the bridge. The data collected by the Barologger allows the depth measurements taken by the Levelogger to be corrected for changes in atmospheric pressure. The third Solinst Levelogger was installed in the Seine River near the First Nation community under a resident's dock. This Levelogger was fastened to a cement block which was placed on the substrate at the end of the resident's dock.

At the end of the open water season, all three Leveloggers and the Barologger were removed from the Seine River and a Solinst Leveloader was used to download the data from the three Leveloggers in addition to the Barologger. The collected data from the Leveloader was then downloaded to a PC for analysis. The Leveloggers and Barologger were removed from the field for the winter seasons.

Figure 14 – Locations of the community, bridge, and dam Leveloggers during 2014 and 2015 field seasons

Figure 15 – Small scale map of bridge and dam Levelogger locations during 2014 and 2015 field seasons

2.5.1 Establishing Benchmarks

On October 22nd, 2015, a crew with a surveyor from the EXP. office in Fort Frances established three vertical benchmarks on the shoreline of Seine River. Each of the three benchmarks is located near the three Levelogger sites and was measured to a vertical accuracy of 0.03 meters. These benchmarks will be used to determine the orthometric elevation of the water level at each site to allow for comparison with vertical data from other gauges in the watershed. A complete copy of the benchmark report (exp. Geomatics File 6470) has been submitted to the IJC for their records.

2.6 Determining Potential Impacts of Current Flow Regimes at the Sturgeon Falls Dam on Lake Sturgeon Spawning Success

With respect to lake sturgeon requirements for spawning activities, "Most sub-populations spawn in high-gradient reaches of large rivers, often below waterfalls, with current velocities of 0.5 to 1.3 m/s, water depths of 0.1 to 2 m, and substrates of coarse gravel, cobble, boulders, hardpan or sand (Auer 1996; Lane et al.1996; McKinley et al. 1998; Peterson et al. 2007)" (Golder Associates Ltd. 2011).

Due to the documentation of lake sturgeon spawning in depths as low as 0.1 m, it is felt that any drops in water levels of greater than 0.1 m from the time that spawning activities have begun until larval drift is complete will be a potential risk to lake sturgeon spawning success. This is due to the risk that eggs or larval sturgeon will become exposed or stranded if water levels drop significantly following the spawn, resulting in reduced recruitment, future year-class strength, and sustainability of the population.

To determine potential impacts of current flow regimes at the Sturgeon Falls Dam on lake sturgeon spawning success, the identified lake sturgeon spawning period will be analyzed to determine if water levels drop by more than 0.1 m during this time period. Following the identified spawning period, water levels will be analyzed for the time period from the end of the spawn until the last captured larval lake sturgeon or calculated larval drift period to determine if the water levels drop by more than 0.1 m when compared to the maximum water level during the spawning period.

2.7 Adult Lake Sturgeon Netting, Tagging, and Tracking

Monitoring of the adult habitat utilization in the Seine River was conducted by the Ontario Ministry of Natural Resources Atikokan office. The May, 2015 report prepared by OMNR biologists Brian Jackson and Amy Godwin states:

> “Adult sturgeon netting occurred during three springs (May 31st to June 17th, 2011; May 28th to June 15th, 2012; and May 25-28; June 18-21, 2013) and two falls (from October 3rd to October 13th, 2011 and Sept. 24, 25; Oct 10, 2013) to assess the status of adult lake sturgeon in the Seine River. The goals of the study were 1) to collect biological data on lake sturgeon to assess population status and 2) to catch up to 15 adult sturgeon and surgically implant them with acoustic transmitters to monitor movement patterns (VEMCO V16-4x-A69-1303 coded implantable transmitters that transmit acoustic pings at a frequency of 69Hz). Numerous MNR staff, members of the Seine River First Nation, and consultants participated in the study. Netting was led by MNR except for 2013 where a portion of the spring netting was led by North-South Consulting who was under contract to implant, an additional 10 adult sturgeon with acoustic transmitters.
>
> Extra-large multifilament gill nets were set at selected locations along the Seine River from the Sturgeon Falls generating station downstream to Shoal Lake. Fish were mainly captured using 203 mm (8"), 228 mm (9"), 254 mm (10"), and 305 mm (12") stretched mesh, multifilament gill nets. These nets were 91 m (300') long and 2.8 m (9') high.
>
> All captured lake sturgeon were sampled for fork length (mm), total length (mm), girth (mm), and weight (kg), and were live released. A clip from the anterior portion (1-2 cm) of the left pectoral fin (leading or marginal ray) was collected for age determination. If the left pectoral fin appeared damaged or deformed, the clip was taken from its right pectoral fin. A tissue sample was taken from its caudal fin for future genetic analysis. Sex and maturity were only determined externally for ripe fish. During 2011 and 2013, lake sturgeon were implanted with acoustic transmitters. In 2012 and 2013, captured lake sturgeon were tagged with coded wire Passive Integrated Transponder (PIT) tags to allow long term identification of individual fish.”

2.8 Juvenile Lake Sturgeon Netting

Juvenile lake sturgeon netting on Seine River took place during early fall from 2012 to 2015. Field crews conducting the lake sturgeon juvenile netting varied from season to season, with Seine River First Nation, North-South Consultants, and Ontario Ministry of Natural Resources staff all taking part in the netting at some point, but none of these groups participated in all four years of netting. Four types of nets were used between 2012 and 2014 – MNR-mono; MNR-multifilament, North South Consulting multifilament and North American Standard Index Nets (Table 1). Nets varied in range of mesh size and length and height and material.

Table 1 – Gear types used during juvenile sturgeon monitoring – Seine River 2012-2015

	MNR - monofilament	MNR - multifilament	North/South Consulting	North American Standard Index Net (NASIN)
Total length (m)	30m	30m	114m	25m single gang (also fished as a 2 gang net of 50m)
Mesh sizes (mm)	38, 51, 64,76	38, 51, 64,76	25, 51,76,127,152	38,51,64,76,89,102 ,114,127
Length of each individual panel (m)	7.4m	7.4m	22.9m	3.1m
Material	monofilament	multifilament	multifilament	monofilament
Height	1.8m	1.8m	2.5m	1.8m

Captured lake sturgeon were biologically sampled including length and weight measurements, a pectoral fin ray clip for an ageing structure, and insertion of a PIT tag behind the third dorsal scute on the left side of the fish. Fish were then live released (Figures 16 and 17).


Figures 16 and 17 – Photos of juvenile lake sturgeon project from 2014 field season

3.0 RESULTS

3.1 Results for Environmental Indicators

The measured water temperatures at the time of the peak spawning for lake sturgeon in the Seine River varied from 11˚C to 14.8˚C. During the 2011, 2014, and 2015 field seasons, lake sturgeon spawning activity began when water temperatures first exceeded 13˚C (on June 2nd in 2011, June 1st (bridge) and June 4th (dam) in 2014, and May 31st in 2015). During the 2012 field season, water temperatures were at 13.5˚C and had been above 13˚C for at least five days when spawning activity began (May 29th). During the 2013 field season, spawning activity began when water temperatures were at 11˚C (June 3rd). The water temperature data collected during the 2013 field season differed from the other field seasons as the Levelogger data was not retrieved so the temperature data was collected by field technicians once daily with thermometers. During the 2014 field season, there were two major spawning events at the dam, the first occurred on June 4th (three days after spawning at the bridge) when water temperatures first reached 13˚C and then a second spawning even when water temperatures were 14.8˚C and this occurred on June 9th (nine days after spawning was documented at the bridge and five days after peak spawning below the dam in 2014).

The water level changes on the date of the peak spawning events range from a decrease in water level of 29 cm in 2011 (this was part of a 53 cm drop over a 54 hour period) to a 8 cm increase in 2012. Two of the identified peak spawning events occurred on dates when water levels were decreasing (2012 and the second spawning event peak at the dam in 2014) and three of the identified peak spawning events occurred on dates when water levels were increasing (2012, 2015, and the first spawning event peak at the bridge in 2014). Note that the 2012 water levels were not available due to the Levelogger not being retrieved at the end of the field season.

The day length (sunrise to sunset) during the peak spawning activities varied from 15 hours and 46 minutes (May 29, 2012) to 16 hours and 2 minutes (June 9, 2014 – second peak spawning event at dam). The longest day length for a first peak spawning event was 15 hours and 54 minutes on June 3, 2013.

The spawning events listed in Table 2 below were determined using; visual confirmation in underwater video camera footage (2014); lake sturgeon eggs collected on egg mats (2013, 2014); capture of larval lake sturgeon and then using the capture date and water temperature data to calculate spawning timing (2012 and 2015); and milt expelled from male lake sturgeon captured near spawning site (2011).

Table 2 – Peak Spawning Events (in red) and Secondary Spawning Events (in yellow) Relative to Environmental and Traditional Ecological Knowledge Indicators for Lake Sturgeon Spawning on Seine River Below the Highway 11 Bridge and Sturgeon Falls Dam for 2011 to 2015 Field Seasons

2011 - Bridge																	
Month	**May**							**June**									
Day	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**1**	**2◊**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Temp	12.7	12.6	12.5	12.3	11.8	11.8	12.3	12.5	13.1	13.5	13.5	13.9	14.8	15.1	15.2	14.5	14.5
Level	-0.03	-0.11	-0.02	-0.02	0.05	-0.03	0.05	0.07	-0.29	-0.16	0.03	-0.03	0	-0.03	0.03	0	-0.07
Day L	15:37	15:39	15:41	15:43	15:45	15:46	15:49	15:51	15:52	15:53	15:55	15:56	15:58	15:59	16:01	16:01	16:02
Btrfly	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Pop Lf	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
◊ - June 2, 2011 – water level at bridge maximum drop was 53 cm between 07:00 on June 1 and 01:00 on June 3																	
2012 - Bridge																	
Month	**May**							**June**									
Day	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Temp	13.5	13.7	13.7	13.5	13.5	13.5	13.7	14.0	14.3	14.7	15.2	15.4	15.9	17	17.6	17.8	18.3
Level	-0.09	-0.03	-0.01	0.07	0.08	0.19	0.09	-0.03	-0.01	0.20	0.03	0.15	0.16	0.00	0.14	0.03	-0.07
Day L	15:39	15:41	15:43	15:44	15:46	15:48	15:50	15:51	15:53	15:54	15:56	15:58	15:59	16:01	16:01	16:02	16:04
Btrfly	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Pop Lf	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

LEGEND

Temp – Peak Temperature Measured for Day
Level – Total Water Level Change for Day
Day L. – Length of Day from Sunrise to Sunset in Hours and Minutes (HH:MM)
Btrfly – Tiger Swallowtail Butterfly Observations
Pop Lf – Average Diameter of Poplar Leaves

2013 - Bridge																	
Month	**May**							**June**									
Day	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Temp	n/a	11	11	11	11	11	11	11	11	11	11	n/a	12.5	12	13	12	12.5
Level	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Day L	15:38	15:40	15:42	15:44	15:46	15:48	15:49	15:51	15:53	15:54	15:56	15:58	15:59	15:59	16:01	16:02	16:04
Btrfly	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y
Pop Lf	n/a	n/a	n/a	40.98	39.59	n/a	42.01	n/a	n/a	48.23	n/a	n/a	n/a	52.97	n/a	n/a	50.26
2014 - Bridge																	
Month	**May**							**June**									
Day	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Temp	7.7	8.6	10.1	10.5	11.4	12.7	12.9	13.7	13.9	14.5	14.5	13.3	14.0	14.9	14.9	14.9	15.3
Level	0.05	0.04	0.00	0.01	0.02	0.02	0.04	0.04	0.05	0.12	0.05	0.06	0.03	0.00	-0.01	-0.01	0.02
Day L	15:37	15:39	15:41	15:44	15:46	15:48	15:49	15:51	15:53	15:54	15:56	15:56	15:58	15:59	16:01	16:02	16:02
Btrfly	N	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Pop Lf	n/a	27.1	28.4	34.6	26.6	29	n/a	n/a	35.8	28.9	29.6	30.1	30.5	n/a	n/a	36.7	39.6
2015 - Bridge																	
Month	**May**							**June**									
Day	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Temp	11.3	11.2	11.6	12.7	12.6	12.5	13.2	13.4	13.0	12.5	13.5	14.6	14.6	14.8	15.4	15.9	15.8
Level	0.00	0.01	0.01	-0.02	0.04	-0.01	0.00	0.01	0.01	0.05	0.04	0.03	0.02	0.07	0.07	0.04	0.03
Day L	15:37	15:39	15:41	15:43	15:45	15:46	15:49	15:51	15:52	15:53	15:55	15:56	15:58	15:59	16:01	16:01	16:02
Btrfly	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Pop Lf	41.4	n/a	n/a	39.5	n/a	n/a	n/a	51.3	52.1	48.6	n/a	n/a	n/a	n/a	n/a	n/a	n/a

LEGEND

Temp – Peak Temperature Measured for Day
Level – Total Water Level Change for Day
Day L. – Length of Day from Sunrise to Sunset in Hours and Minutes (HH:MM)
Btrfly – Tiger Swallowtail Butterfly Observations
Pop Lf – Average Diameter of Poplar Leaves

2014 - Dam																	
Month	**May**							**June**									
Day	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Temp	6.2	7.1	8.7	9.0	10.0	11.3	11.5	12.3	12.6	13.4	13.2	12.0	12.7	14.0	14.1	14.0	14.5
Level	0.12	0.09	0.00	-0.02	0.04	0.02	0.00	0.03	0.07	0.10	0.22	0.09	-0.12	-0.05	-0.11	-0.01	0.00
Day L	15:37	15:39	15:41	15:44	15:46	15:48	15:49	15:51	15:53	15:54	15:56	15:56	15:58	15:59	16:01	16:02	16:02
Btrfly	N	N	N	N	N	N	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y
Pop Lf	n/a	27.1	28.4	34.6	26.6	29	n/a	n/a	35.8	28.9	29.6	30.1	30.5	n/a	n/a	36.7	39.6
2015 - Dam																	
Month	**May**							**June**									
Day	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Temp	11.3	11.2	11.5	12.6	12.6	12.4	13.3	13.3	12.9	12.5	13.6	14.6	14.5	14.7	15.4	15.9	15.8
Level	0.00	-0.03	-0.01	-0.02	0.02	0.00	0.07	0.06	0.03	0.18	0.21	0.02	0.00	0.05	0.14	0.17	0.00
Day L	15:37	15:39	15:41	15:43	15:45	15:46	15:49	15:51	15:52	15:53	15:55	15:56	15:58	15:59	16:01	16:01	16:02
Btrfly	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Pop Lf	41.4	n/a	n/a	39.5	n/a	n/a	n/a	51.3	52.1	48.6	n/a	n/a	n/a	n/a	n/a	n/a	n/a

LEGEND

Temp – Peak Temperature Measured for Day

Level – Total Water Level Change for Day

Day L. – Length of Day from Sunrise to Sunset in Hours and Minutes (HH:MM)

Btrfly – Tiger Swallowtail Butterfly Observations

Pop Lf – Average Diameter of Poplar Leaves

3.2 Results for Traditional Ecological Indicators

Trembling aspen (poplar) leaves measured during peak spawning events ranged from approximately 35 mm in diameter (first spawning peak below the bridge in 2014) to approximately 51 mm (2015). The average leaf size measured on May 22nd, 2013 (22.44 mm) was the closest to the size identified by the Elders with lake sturgeon spawning (the size of a quarter – diameter 23.88 mm.).

The first sightings of tiger swallowtail butterflies during field work occurred one day prior to spawning activity in 2013; two days after the first peak spawn in at the bridge, one day before the first peak spawn below the dam, and six days prior to the second peak spawn in 2014 (Figure 18); and four days prior to identified peak spawning activity in 2015.

Figure 18 – Tiger swallowtail butterflies observed near the Sturgeon Falls dam in 2013

While there were not any salamander calls documented during the field work conducted during this project, there was one anecdotal report by a community member that salamanders were heard calling during the night of June 3rd, 2013. This was the same date that the peak spawning activity was observed on Seine River at the bridge.

3.3 Water Level Results – Impacts of Rainy Lake Levels on Seine River

As shown in Figures 19 and 20, the relationship between data collected on the relative water levels from the Leveloggers downstream of the Sturgeon Falls Dam, downstream of the Highway 11 bridge, and at the Seine River First Nation community differed during average Rainy Lake water levels (2015) and flood years on Rainy Lake (2014) during the months of June and July. These months were analyzed to determine the potential impacts of the elevated levels of Rainy Lake as this was the time period of the highest levels of Rainy Lake during 2014. The Pearson correlation coefficient (*R)* was similar for comparisons between the relative water levels at the community and at the bridge in both 2014 (0.9984) and 2015 (0.9918). However, the correlation coefficient differed for comparisons between the relative water levels at the dam and at the bridge for 2014 (R = 0.1856) and 2015 (R = 0.7356).

To ensure that any delays in the effects of changes to water levels at the dam were taken into account in the calculation of the correlation coefficient, data for the 2015 season (average water levels and flows) was analyzed using the data set from the Levelogger at the dam with comparisons of the Levelogger at the bridge with delays at 15 minute intervals. The correlation coefficient was calculated for each 15 minute delay of the bridge data until the correlation coefficient peaked and began to decline with each subsequent 15 minute delay. Using these calculations, the correlation coefficient (which was at R = 0.6187 with no delay taken into account) peaked at R = 0.7356 when a delay of 49 hours was applied to the bridge data. For this reason, a 49 hour delay was applied to the bridge data for correlation coefficient calculations for both the 2014 and 2015 data sets.

Table 3 – Correlation Coefficients for Levelogger Data on Seine River for Months of June and July in 2014 and 2015

	2014 *R*-value	**2015 *R*-value**
Community vs Bridge	0.9984	0.9918
Dam vs Bridge*	0.1856	0.7356

* - 49 hour delay on bridge data

Figure 19 - Relative Water Levels for Leveloggers at Sturgeon Falls Dam, Hwy. 11 Bridge, and Seine River First Nation Community for June and July of 2014

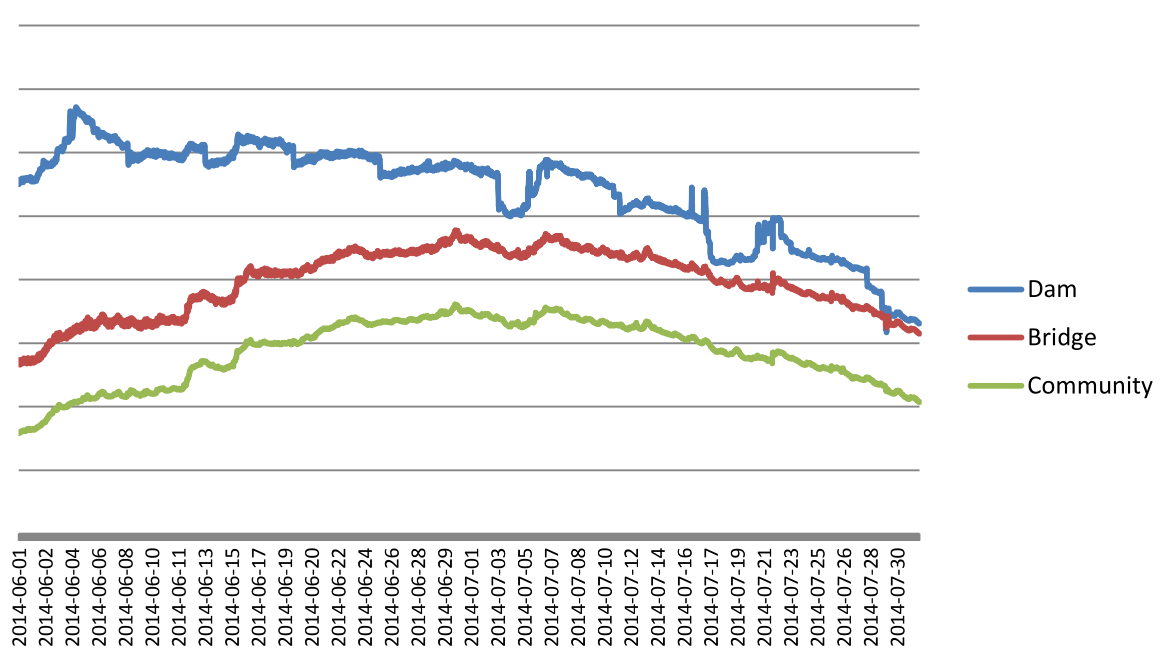
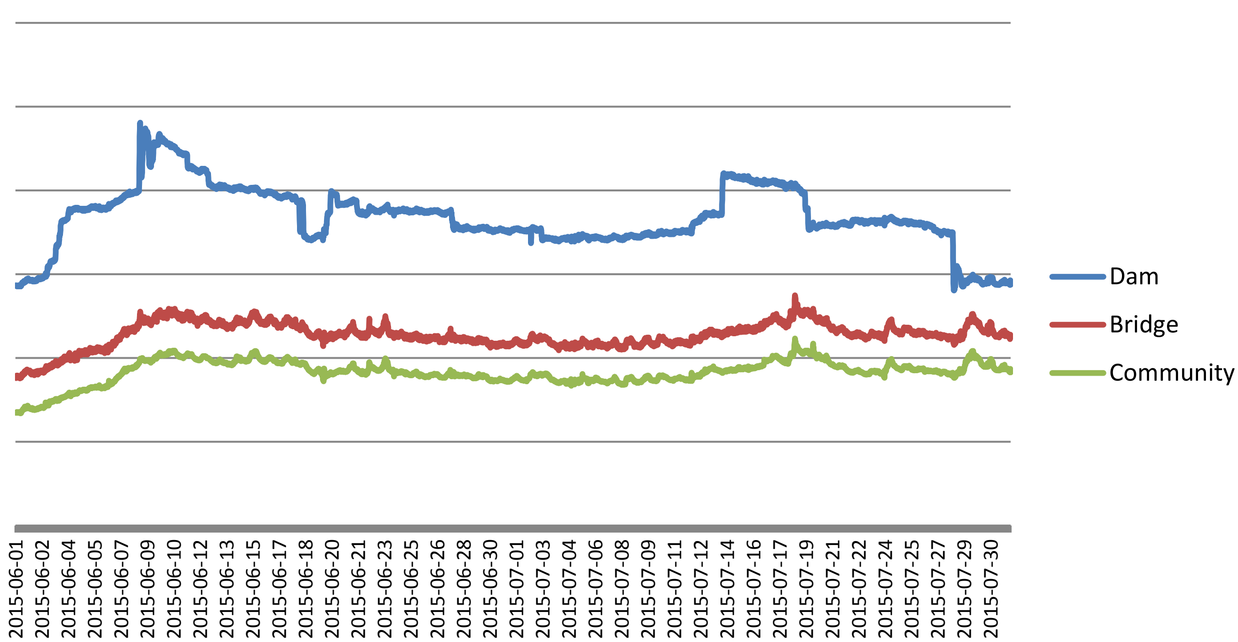


Figure 20 - Relative Water Levels for Leveloggers at Sturgeon Falls Dam, Hwy. 11 Bridge, and Seine River First Nation Community for June and July of 2015



Further analysis of the Levelogger data, with the addition of data from a gauge on Rainy Lake, was conducted to explore the water level relationship between Rainy Lake and Seine River. The results of the 2014 and 2015 data for the Seine River Leveloggers and Rainy Lake can be found in figures 21 and 22.

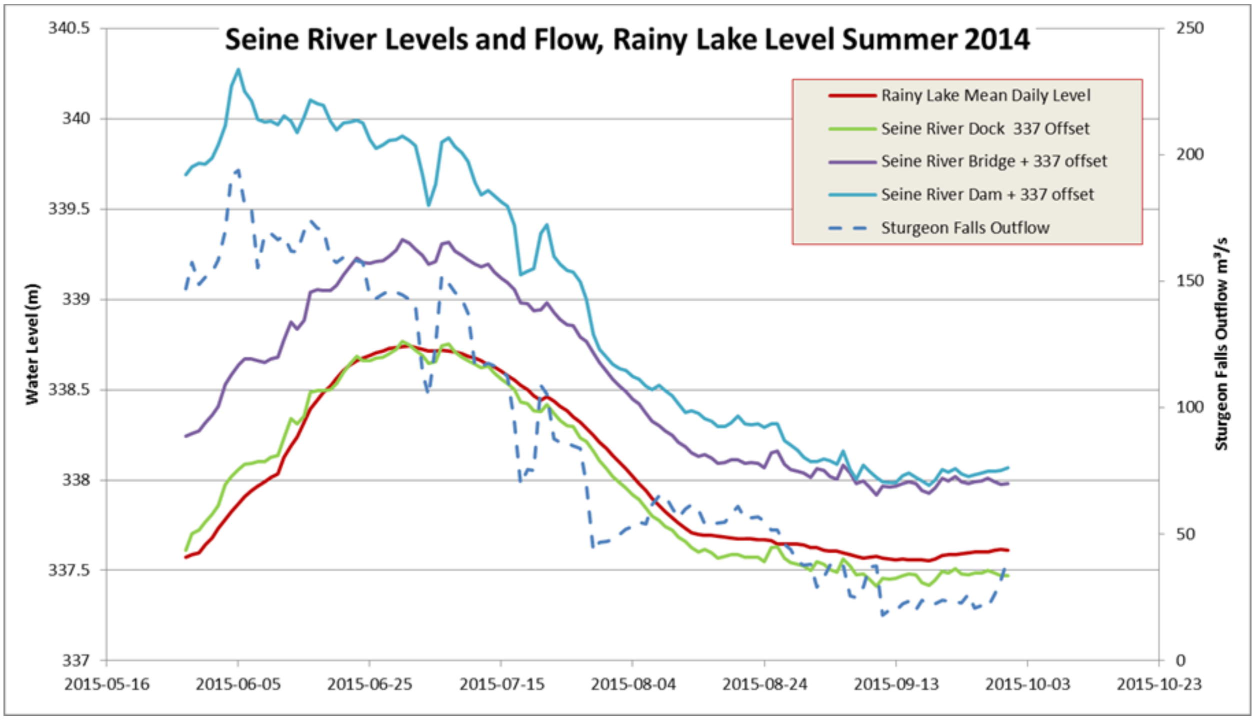


Figure 21

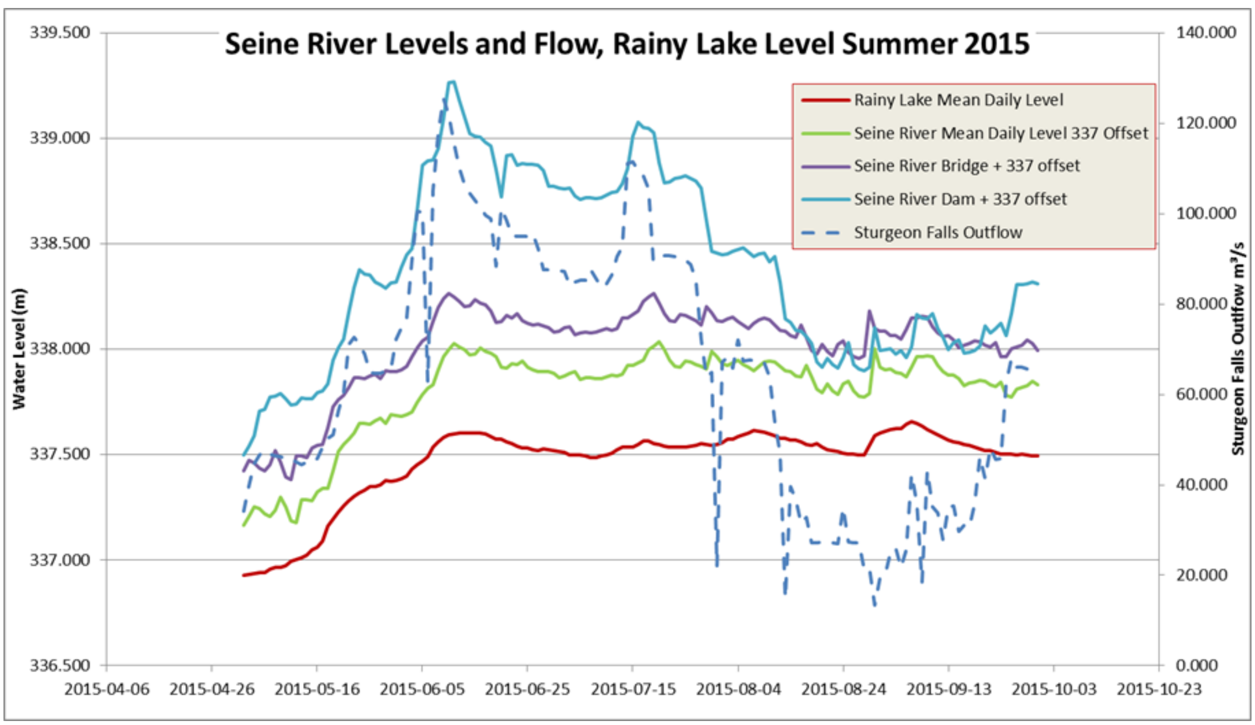


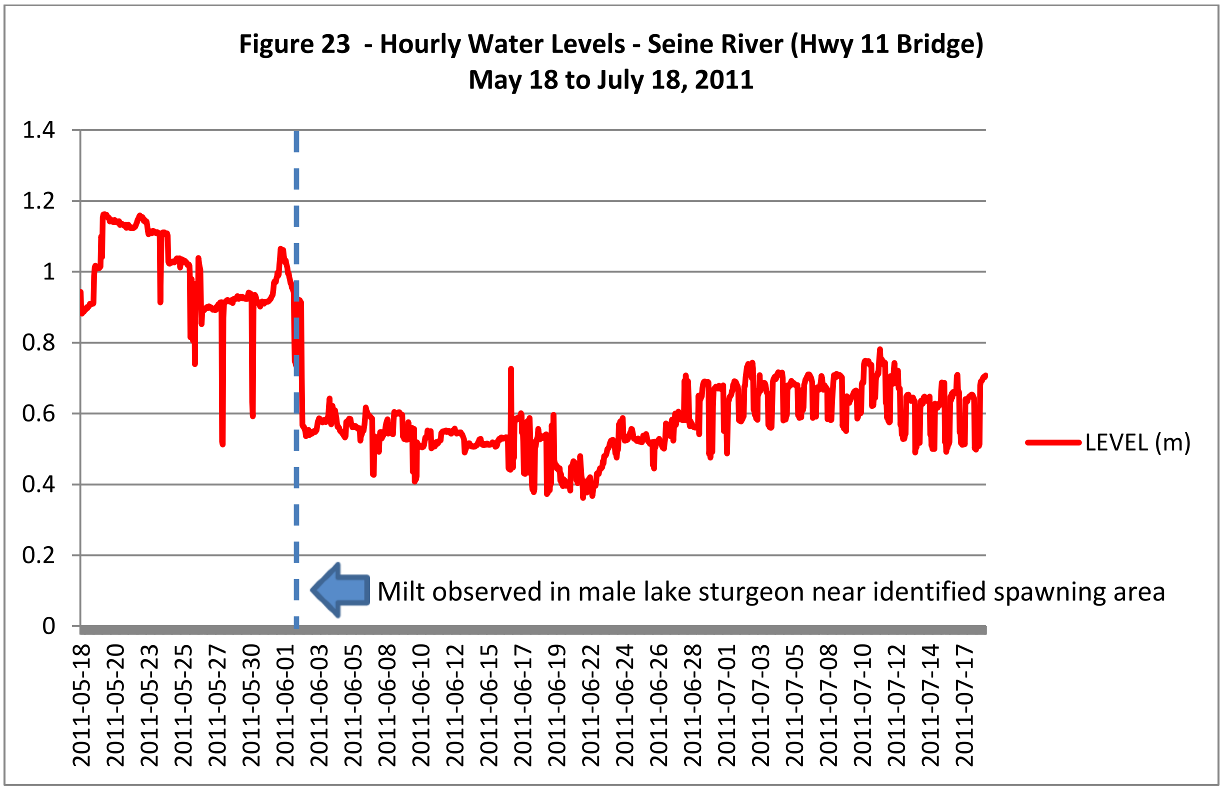
Figure 22

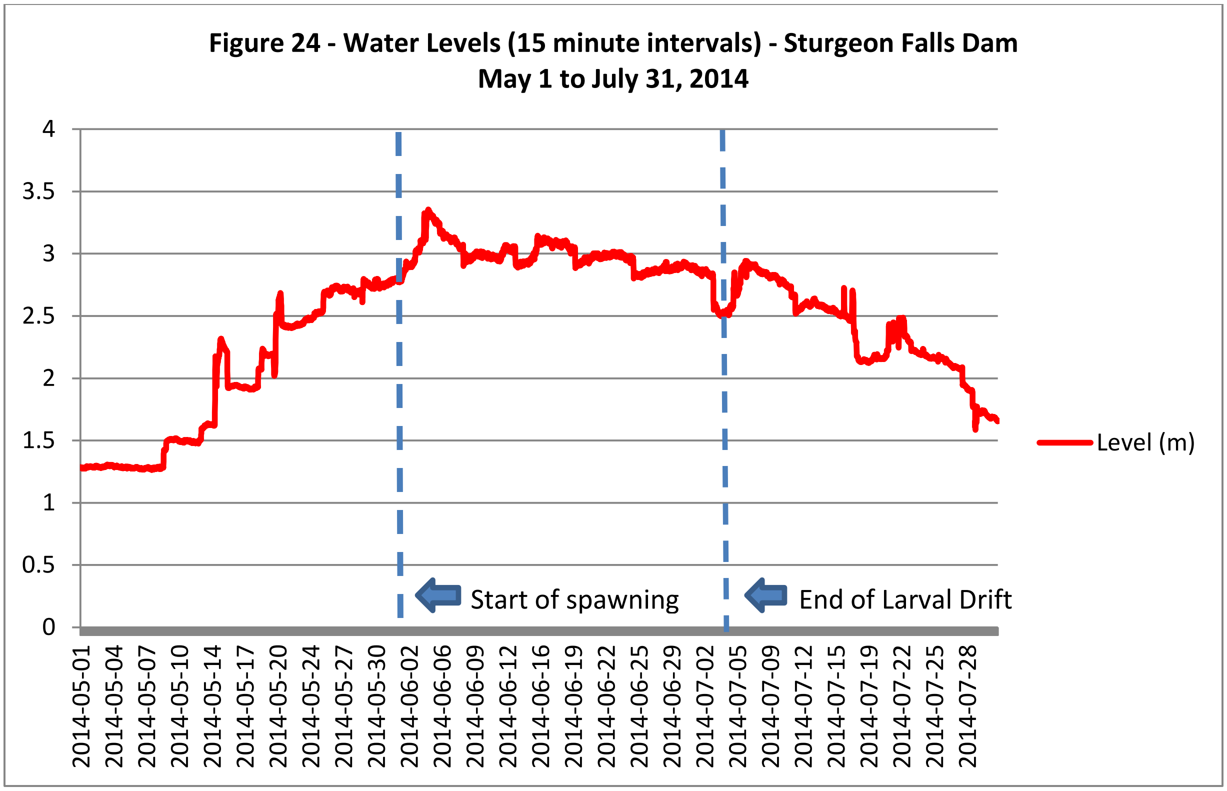
3.4 Water Level Results – Impacts on Lake Sturgeon Spawning Success

The water levels at the identified spawning sites dropped by more than 0.1 m (0.566 m in 2011, 0.860 m in 2014) during the spawning or gestation period for two of the four years when water level data was available. A summary of the data can be found in Table 4 and Figures 23 and 24.

Table 4 – Spawning Period, Larval Drift End, and the Water Level Changes for Seine River Lake Sturgeon Spawning from 2011 to 2015

Year	Spawning Period	Max Spawning Level (m)	Larval Drift End	Minimum Level (m)	Max Drop (m)
2011	**June 2**	**0.944**	**June 18**	**0.378 (June 18)**	**0.566**
2012	May 29	2.065	June 13	1.989	0.076
2013	May 31 to June 10	n/a	June 28	n/a	n/a
2014	**June 1 to June 9**	**3.357 (June 4)**	**July 4**	**2.497 (July 4)**	**0.860**
2015	May 31	1.444	June 19	1.427 (June 1)	0.017





3.5 Relative Lake Sturgeon Numbers – 2012 to 2015

While the data collected on the spawning lake sturgeon as part of this project were not designed to provide population estimates, it is felt that some inferences can be made on the strength of the annual lake sturgeon runs utilizing the data collected. Following in Figure 25 and Table 5 is a summary of the data collected and number of observations for the 2012 to 2015 field seasons. While some of the data collection methods (e.g. egg mats) varied from year to year depending on flow levels, others (e.g. larval drift nets, underwater cameras) were in similar locations over multiple field seasons.

Figure 25 - Summary of Data Collected During 2012 to 2015 Seine River Lake Sturgeon Field Work

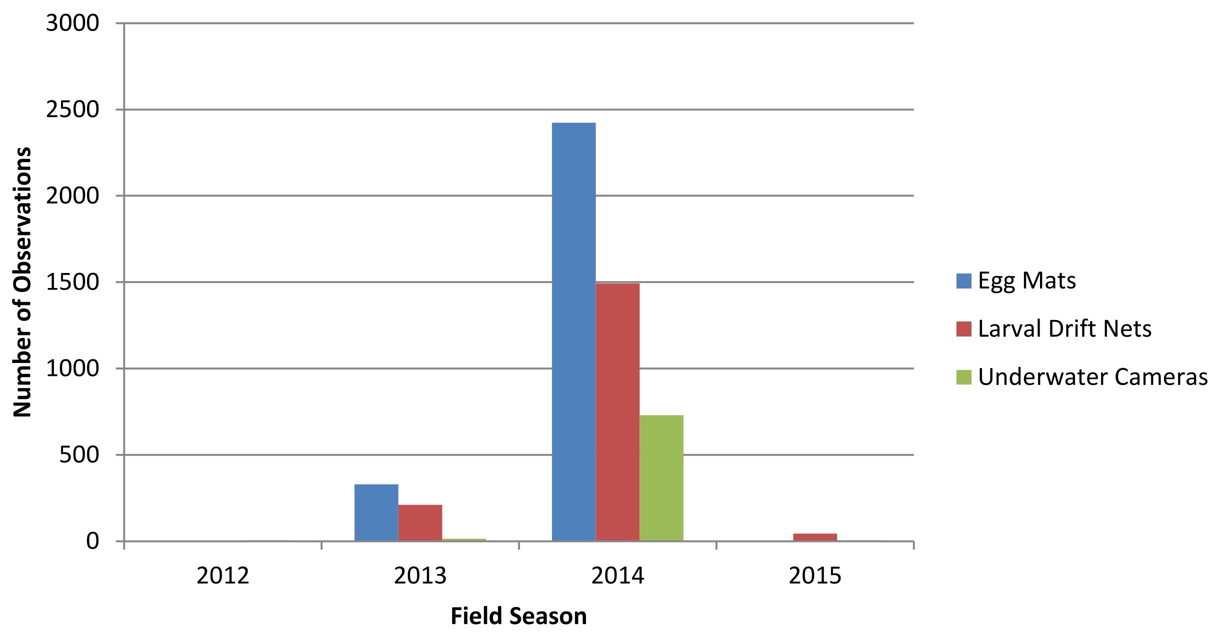
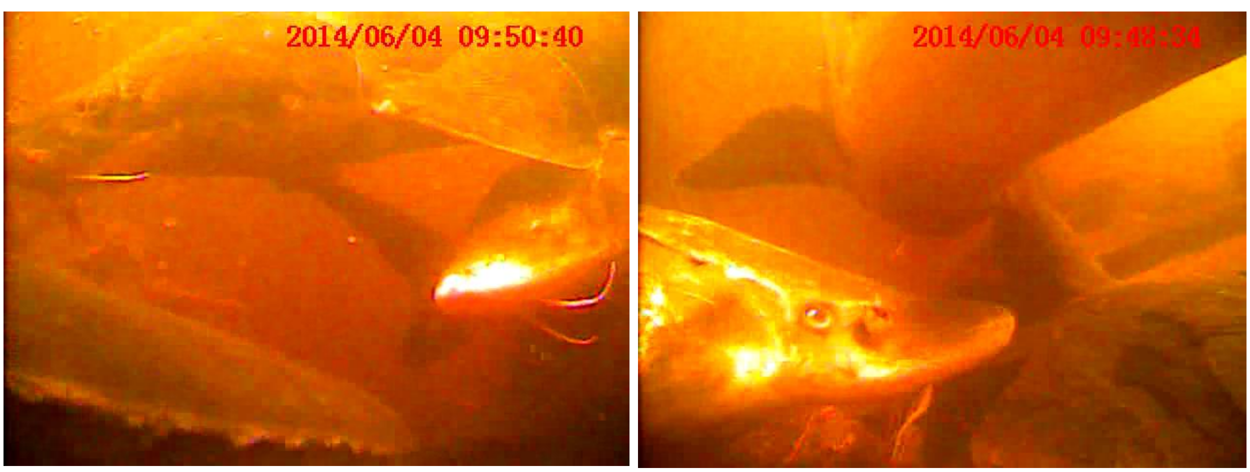


Table 5 – Lake Sturgeon Data for 2012 to 2015 Field Seasons

	2012	2013	2014	2015
Sturgeon Eggs Found in Egg Mats	0	329	2424	0
Larval Lake Sturgeon in Larval Drift Nets	2	210	1493	43
Lake Sturgeon Observations on Underwater Cameras	5	14	730	5



Figures 26 and 27 – Lake sturgeon observations in underwater cameras was highest during 2014 field season

4.0 DISCUSSION

The discussion section of this report will focus on each of the six research questions as outlined in section 1.3. The results and data collected in the five-year study will be used in an attempt to answer each of the research questions and these are found in the six sections below.*

4.1 What are the environmental indicators (water temperature, flow rate, photoperiod) that trigger lake sturgeon spawning on the Seine River below the Sturgeon Falls dam?

The results of the 2011 to 2015 data collection indicate that water temperature and photoperiod (day length)** are the two factors that could potentially trigger lake sturgeon spawning on the Seine River. The lake sturgeon spawning occurred as soon as the water temperature reached 13˚C as long as this temperature was reached when the photoperiod was between 15 hours, 49 minutes and 15 hours, 52 minutes. During the year when the water temperature reached 13˚C when the photoperiod was shorter (2012), the spawning occurred when the photoperiod was 15 hours, 46 minutes. During the year when the water temperature reached 13˚C when the photoperiod was longer (2013), the spawning occurred when the photoperiod was 15 hours, 54 minutes.

*It is felt that the spawning activities at the dam on June 9th of 2014 were a second spawning event coinciding with and potentially due to the high numbers of fish found during the 2014 season. It is felt that this June 9th, 2014 spawning event (water temperature at 14.8˚C, day length at 16:02, water level change at -0.01 m) is a unique event within the data set collected from 2011 to 2015. For this reason, this spawning event will not be included in the data analysis below. It is hoped that data collected during future years when high numbers of spawning sturgeon visit Seine River will provide additional insights into environmental and/or TEK triggers for this second spawning event.
** For the purpose of this discussion, photoperiod and day length refer to the length of time between sunrise and sunset.

Therefore, it is felt that the 2011 to 2015 data indicates that a potential environmental trigger for lake sturgeon spawning is the water temperature reaching 13˚C, providing that this temperature is reached when the photoperiod is between 15 hours, 46 minutes and 15 hours, 54 minutes. If the water temperature reaches 13˚C when the photoperiod is longer, the data indicates that a photoperiod day length of approximately 15 hours, 54 minutes could become the environmental trigger for lake sturgeon spawning. The data collected also indicates that if the water temperature reaches 13˚C when the photoperiod is shorter, than a photoperiod day length of approximately 15 hours, 46 minutes could be the environmental trigger for lake sturgeon spawning.

The water level results from the five-year study did not provide any indications of a potential relationship between flows/water levels and spawning timing. However, it is worth noting that the highest flows and water levels in the Seine River during the study period occurred during the 2014 open water season, which coincided with the highest numbers of spawning lake sturgeon and two distinct spawning peaks in Seine River that year.

The temperature/photoperiod relationship for spawning triggers could be an evolutionary response to reproductive success of lake sturgeon. It could be that spawning activity occurring prior to the day length of 15 hours, 46 minutes, increases the potential that colder weather could follow the spawning event. This colder weather could result in less food available for larval lake sturgeon when they begin to feed exogenously which can have major implications for future year class strength (critical period hypothesis). It could also be that spawning after the photoperiod has reached 15 hours, 54 minutes begins to reduce the length of the open water season for young of the year lake sturgeon to grow and survive their first winter, once again reducing reproductive success and future year class strength. This could be why lake sturgeon on Seine River have evolved to use water temperature as a spawning trigger providing it occurs within a specific time frame.

4.2 What are the correlating TEK environmental indicators for lake sturgeon spawning and do these correlate to the environmental indicators provided using western science data collection methods?

The primary TEK environmental indicator for lake sturgeon spawning on Seine River was the first observation of tiger swallowtail butterflies. The observation of tiger swallowtails occurred between four days before (2015) and two days after (2014) the identified peak lake sturgeon spawning period on Seine River. The use of tiger swallowtail observations to predict lake sturgeon spawning resulted in less variation than the use of water temperature as the environmental indicator, as water temperature at 13˚C occurred seven days before identified peak lake sturgeon spawning in 2012 and five days after in 2013.

Using the mid-point of the variation of day-lengths for observed spawning activities (15 hours, 50 minutes) is a slightly more consistent environmental indicator of the identified peak lake sturgeon spawning activities in the Seine River. As an environmental indicator, the photoperiod of 15 hours, 50 minutes occurred two days after the identified peak lake sturgeon spawning in 2012 and three days after in 2013 which is less variation (five days) than shown with water temperatures (12 days) and tiger swallowtail observations (six days) above.

However, when it comes to predicting the exact peak spawning date, the water temperature at 13˚C achieved this three times (2011, 2014, 2015), the photoperiod at 15 hours, 50 minutes achieved this twice (2014, 2015) and the first observation of tiger swallowtails never did occur on the exact same date as the identified peak spawning on Seine River.

The data indicates that observations of tiger swallowtail butterflies as a TEK environmental indicator would have been and is an effective tool for predicting the approximate timing of lake sturgeon spawning in the Seine River.

The use of the size of poplar leaves as a TEK ecological indicator for lake sturgeon spawning in Seine River does not appear to as effective as tiger swallowtail butterflies. During the identified lake sturgeon spawning period on Seine River, the leaves were much larger than the size of a quarter or beaver's ear as described by the Elders and knowledge holders in Seine River First Nation. However, initial field work conducted in the Turtle River system during the 2015 field season indicate that the lake sturgeon in Turtle River spawn significantly earlier (up to two weeks earlier) than the Seine River spawning population. While subsequent data will need to be collected in future years, it is hypothesized that the size of the poplar leaves is a potential TEK ecological indicator for peak lake sturgeon spawning activities on the Turtle River system (which is another important sturgeon population for Seine River First Nation).

While anecdotal evidence does indicate that the calling or whistling of salamanders is a potential ecological indicator for lake sturgeon spawning on Seine River, field crews were unable to document this relationship as the field studies conducted did not result in any calls being heard.

4.3 What are the potential impacts of current flow regimes at the Sturgeon Falls dam on lake sturgeon spawning success? How can the understanding of these impacts be related to other peaking hydroelectric facilities, particularly those in the trans-boundary waters?

One of the main threats to fish spawning success downstream of peaking hydroelectric facilities is fluctuating water levels during spawning and gestation periods resulting in stranding or exposure of eggs and/or larval fish. During two of the four years for which water level data was available (2011 and 2014) the Sturgeon Falls dam flows/levels did drop during the spawning/gestation period for lake sturgeon in Seine River. Of particular concern was the height of the elevation drop, with both being greater than 0.5 m (2011 – 0.566 m, 2014 – 0.860 m). It is felt that the severity and timing of these drops in water levels/flows from the Sturgeon Falls dam did have the potential to negatively impact upon the spawning success of lake sturgeon in the Seine River in 2011 and 2014.

Other peaking facilities in areas with lake sturgeon populations, including those in the trans-boundary waters, should conduct analyses of spring water level fluctuations to ensure that lake sturgeon (as well as other spring spawning fish species) spawning is not negatively impacted by water level drops similar to those found on Seine River in 2011 and 2014.

4.4 Can the environmental and TEK indicators for lake sturgeon spawning be applied to other peaking hydroelectric facilities in the area?

A study was conducted during the 2012 and 2013 field seasons on the Upper Rainy River examining the spawning timing and larval drift time period for lake sturgeon downstream of the dam at Fort Frances/International Falls. Following is an excerpt from this study:

> "Lake sturgeon spawning took place at temperatures ranging from 8.5 to 16.5 °C, with eggs found from 10 May to 28 May 2012 and 25 May to 18 June 2013. The first instances of lake sturgeon drift were seen 6 June 2012 and 18 June 2013, with eggs remaining at the spawning site for approximately 27 days in 2012 and 24 days in 2013." (Smith et al. 2014)

This indicates that the lake sturgeon activities in Rainy River downstream of the International Falls/Fort Frances dam occur at a wider range of temperatures and days than is typically found in Seine River downstream of the Sturgeon Falls dam. On Seine River the spawning activities were documented on May 29th in 2012 (water temperature 13.5˚C) and between May 31st and June 10th in 2013 (water temperatures ranging from 11 ˚C and 12.5 ˚C). The 2012 spawning activities on Seine River occurred after the documented spawning activities on the Rainy River and the 2013 Seine River spawning activities occurred within the same time period as that identified on Rainy River, but over a shorter time period. The first instance of larval drift in 2012 on Seine River was on June 13th, which was one week after larval drift began on Rainy River during the same field season. In 2013, the first instance of larval drift on the Seine River was on June 18th, the same date as the first instance of larval drift on Rainy River in the same field season.

The discrepancy between the results found during the two field seasons (2012 and 2013) for the field crews working independently on the Rainy River and Seine River indicate that, while there can be overlap and similarities in spawning and/or larval drift timing between the Rainy River and Seine River, the differences in timing illustrated by the 2012 results would indicate that the environmental and TEK indicators found for the lake sturgeon spawning timing on Seine River can likely not be applied to other peaking hydroelectric facilities in the area.

The spawning timing below the dam at Rainy River is typically approximately two weeks after the spawning activity in the smaller, free-flowing or natural tributaries to the Rainy River (Tom Heinrich, Minnesota DNR, personal communications by telephone, February 11, 2016). This relationship is very similar to the one found when comparing the spawning timing below the dam at Seine River to the free-flowing or natural Turtle River system.

For the Manitoba portion of the Winnipeg River, in particular the spawning populations at Pointe du Bois and Slave Falls dams, there is a wider range of environmental variability (water temperature, photoperiod etc.) associated with the spawning timing of lake sturgeon than was found in the Seine River study from 2011 to 2015 (Paul Cooley, North-South Consultants, personal communications by telephone, February 11, 2016).

In discussions with researchers and biologists working throughout the Rainy Lake/Lake of the Woods/Winnipeg River watershed, it was speculated that the spawning activities of lake sturgeon occur under a wider variety of environmental conditions in larger river systems. Given this hypothesis, it is possible that the environmental and TEK indicators found on Seine River may be able to be applied to any dam operations on waterbodies similar in size with similar flows as those found at the Sturgeon Falls dam, but they do not seem to apply to the dam operations on the larger river systems found elsewhere in the watershed. This hypothesis is supported by the documentation of temperature being a strong indicator of the start of lake sturgeon spawning at 13˚C on the Kaministiqua River (Friday 2005, 2006), which is a relatively small river (comparable to Seine River) in the Lake Superior watershed.

4.5 What is the habitat utilization of adult lake sturgeon in the Seine River (i.e. are the adult fish remaining in the Seine River year-round, or are they using the river only during the spring spawning season)?

Monitoring of the adult habitat utilization in the Seine River was conducted by the Ontario Ministry of Natural Resources Atikokan office. The May, 2015 report prepared by OMNR biologists Brian Jackson and Amy Godwin states:

> "After monitoring movement of 14 sturgeon in the Seine River between spring of 2011 and fall of 2014 and an additional 10 fish for 2013 and 2014, we have confirmed that lake sturgeon move upstream into the Seine River from Rainy Lake to spawn downstream of the Sturgeon Falls generating station and potentially at the Highway 11 bridge site. The data indicates that most lake sturgeon are spending fall and winter in Rainy Lake with a portion moving into the river and up to spawning areas during the spring and then returning to Rainy Lake during the summer/early fall."

The juvenile lake sturgeon netting results supports indications from the adult tagging and tracking that adult lake sturgeon use the Seine River almost exclusively for spawning. During the 2012, 2013, 2014 and 2015 field seasons netting was conducted for juvenile lake sturgeon. Analyses of the data from the 112 individual sturgeon captured during the 2012 to 2014 field work found that the maximum age of juvenile lake sturgeon captured was 6 years of age (Jackson and Godwin. 2015). Additional analyses of juvenile netting conducted by North-South Consultants in the fall of 2015 indicate that the oldest of the 146 juvenile lake sturgeon captured was eight years of age (personal communications with Paul Cooley, North-South Consultants, telephone conversation on December 5, 2015). While the gear used and habitat types focussed on is skewed towards younger fish, it is felt that the data collected on lake sturgeon in Seine River to date provides strong evidence that the Seine River from Kettle Point to the Sturgeon Falls dam provides spawning and rearing habitat for lake sturgeon but does not appear to be utilized as adult summer, fall, or winter habitat.

4.6 Are the increases in water levels at the Seine River First Nation community due solely to the flow from the Seine River, or does the dam at the outlet of Rainy Lake affect the water levels resulting in the Seine River functioning as a reservoir?

The data collected and analyzed from the three Leveloggers (dam, bridge, and community) in 2014 and 2015 indicate that the entire section of Seine River downstream of the Highway 11 bridge is potentially affected by the dam at the outlet of Rainy Lake resulting in the Seine River functioning as a reservoir. The Pearson correlation coefficient (R) indicated that the relationship between the dam levels and the bridge levels was much stronger in 2015 (R = 0.7356) than it was in 2014 (R = 0.1856), indicating that this reservoir effect was much more prevalent during the high flood event that occurred in Rainy Lake in 2014. The strong relationship between the community and bridge water levels in both 2014 (R = 0.9984) and 2015 (R = 0.9918) indicate that any reservoir functioning of Seine River extends upstream past the community to the Highway 11 bridge.

Following the analysis of the 2014 and 2015 data for the Seine River Leveloggers and the Rainy Lake gauge by Matt DeWolfe, Executive Engineer with the Lake of the Woods Secretariat, found that "it is clear that the two downstream locations [bridge and community Leveloggers] follow the lake level closely, with some influence by the dam outflows, while the dam location is tied solely to the dam outflow" (Matt DeWolfe, Executive Engineer, Lake of the Woods Control Board, personal communications, email, March 21, 2016). This demonstrates that Seine River from the mouth at Rainy Lake upstream to the Highway 11 bridge acts as part of the Rainy Lake reservoir and that there is a backwater effect from Rainy Lake extending to the community of Seine River First Nation as well as a further 10 km upstream to the bridge.

5.0 ACKNOWLEDGEMENTS

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