Population Characteristics and Adult Movement of Lake Sturgeon in the Lower Seine River System

(Seine River downstream of Sturgeon Falls Generating Station)

2011-2014

Brian Jackson
Amy Godwin

Ontario Ministry of Natural Resources
Atikokan Area – Fort Frances District

May 2015

In memory of Myron Johnson (1965-2015)

Executive Summary

Prior to 2010, there was little information available about the lake sturgeon population of the Lower Seine River System (McLeod, 1999). With lake sturgeon being identified as a threatened species under the Endangered Species Act in September 2009, there was a need to fill in the identified knowledge gaps regarding the species and its movements and spawning behaviour in the Seine River. There was also a requirement to assess effectiveness of changes to operation of the Sturgeon Falls Hydroelectric dam operation as part of the 2004 Seine River Water Management Plan (Boileau 2004). The project focussed on three information needs – adult population status, juvenile sturgeon monitoring and recruitment and adult sturgeon movement patterns. In addition, water level and temperature data was collected from two locations in the river to better understand how the Seine River flow and downstream lake levels may be interacting to affect lake sturgeon spawning habitat.

Between 2011 and 2013, a study of adult lake sturgeon in the Lower Seine River System was initiated. Adult netting occurred out during the spring spawning window and again in the fall to gather information about the adult spawning population of the river. A total of 48 individual adult sturgeon were captured. Data from the three years of sampling the adult population have shown relatively low catches, with fewer older fish and fewer age classes suggesting a population that is less healthy and more at risk than other populations in the Rainy River watershed.

Juvenile sturgeon monitoring occurred in spring of 2012, spring and fall of 2013 and fall of 2014. By focussing efforts on deep (>10m) holes in we were able to effectively capture sturgeon from age 0 to 5 years (71 individual sturgeon captured in 2013, 43 in 2014). Age and size of juveniles captured varied by location in the river. There was also considerable variation in year class representation although it is not clear at this time how much of this is influenced by vulnerability of different size/age groups to the capture gear and how much is due to differences in annual recruitment. The 2012-14 work has demonstrated an effective method to monitor juvenile sturgeon as an approach to assess impacts of Sturgeon Falls dam operation on recruitment of lake sturgeon in the Seine River and adjust mitigation actions as required.

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. This information will assist in defining when Sturgeon Falls Generating Station operation is most likely to impact sturgeon populations. There are also questions about the relationship between fish spawning in the Seine River and those spawning at other locations in Rainy Lake such as the Namakan River inflow (Squirrel/Kettle Falls) or the Turtle River (Sand Island Falls). Additional receivers have been placed in Rainy Lake sites to help with understand the relationship between lake sturgeon living within the Rainy Lake system.

Table of Contents

Purpose of Study

The primary purpose of this study is to determine the status of the lake sturgeon population in the Seine River and any effects of the operation and flow regime of the Sturgeon Falls generating station as prescribed by the Seine River Water Management Plan (Boileau 2004) might be having on lake sturgeon spawning and recruitment in the Lower Seine River System. It will also expand the baseline information available on lake sturgeon in the Seine River which is needed to monitor the effects of the operation of the stations on the species according to regulations under the Endangered Species Act. This will be accomplished by investigating habitat availability, population characteristics, recruitment and distribution and movement of lake sturgeon in the Lower Seine River System.

There may be other factors impacting the lake sturgeon spawning population in the Seine River other than flow regime which is being investigated by this study. Information from this project will also be used to assess the relative impact of the flow and level management is having on the lake sturgeon population using the Seine River to spawn.

Introduction

Lake sturgeon (*Acipenser fulvescens*), also known as Name (Ojibwe), are Ontario's largest and longest-lived fish species. They also have one of the lowest rates of reproduction and are sensitive to both over exploitation and habitat alterations. The life history traits exhibited by lake sturgeon, including large body size, late age of maturation, low natural mortality, longevity and high fecundity have allowed this species to survive short term extremes in environmental conditions and have contributed to the long term success of the species (Golder 2011). The species has exhibited a remarkable ability to adapt to change over periods of many centuries. The decline of this species over much of its range, over a relatively short period of time (e.g., since the late 1800s) suggests that lake sturgeon are not able to adapt rapidly to changes in their environment caused by multiple stressors (e.g., high rates of exploitation coupled with habitat loss). Adaptation by populations or groups of organisms is generally measured over several generation times. The same life history characteristics that have helped this species survive in the past may contribute to the inability of sturgeon to adapt rapidly to changes in their environment or to recover quickly from perturbation (Golder 2011).

Lake sturgeon spawn in rivers with swift-flowing water or rapids. Although spawning occurs every year, maturation of adults is delayed and individuals do not spawn every year. Mosindy and Rusak (1991) suggest that the mean age of first reproduction is 17 years for males and 26 years for females in Rainy River/Lake of the Woods. Spawning frequency varies between the sexes as well with individual males spawning every 2-3 years and females spawning even less frequently, every 4-9 years. Lake sturgeon are currently considered threatened in northwest Ontario and afforded protection under the Endangered Species Act (2007).

Dams in general and generating stations in particular have been shown to have negative impacts on sturgeon populations in other locations (Kerr 2010). However, water management is

not the only threat to the success of lake sturgeon reproduction and survival. Current threats across their range include habitat alteration and fragmentation, pollution, illegal harvest, exploitation, species invasions and climate change (Golder 2011). Life history traits make the species extremely vulnerable to exploitation; historic levels of exploitation throughout much of their natural range reduced many populations to a fragment of their historical numbers (Haxton, 2011). These factors have impacted lake sturgeon and have resulted in the decline of the species. They also impede the success of recovery efforts. The remaining populations require protection and monitoring if this species is to survive.

The Seine River lake sturgeon population is defined as the population of sturgeon that use the Seine River for spawning. The Sturgeon Falls generating station is located between the stretch of the river between the Calm Lake dam and the Sturgeon Falls dam (sometimes referred to as Laseine Lake) and the Lower Seine lakes including Wild Potato Lake on which the Seine River First Nation is located (Figure 1). This structure currently impedes passage of sturgeon further upstream into the Seine River system and affects flow of the Seine River between the dam and Rainy Lake. There have been anecdotal reports of lake sturgeon present in Laseine Lake in the past. However, MNR netting in 2002 as well as discussions with residents and cottagers on the lake, Seine River FN community members and conservation officers failed to provide evidence that sturgeon currently exist there and that stretch is not considered sturgeon habitat at this time.

Prior to 2010, there was relatively little available information on lake sturgeon in the Seine River. Members of the Seine River First Nation community have an extensive knowledge of sturgeon stretching back for generations but very little of it has been documented in print. A preliminary study of sturgeon in the Lower Seine River was completed in 1993-1995 (McLeod, 1999) identified concerns with the populations status of the Seine River fish. A study by Adams et al. (2006) that focussed on sturgeon in the South Arm of Rainy Lake but included some work in the Seine River suggested that there were interactions between lake sturgeon that spawn at the south end of Rainy Lake at the inflow from Namakan Lake and those that migrate up the Seine River to spawn. However limited, the information suggested concerns with the Seine River population including low abundance and lack of older, larger fish present (McLeod 1999).

The Seine River First Nation (SRFN) is also concerned with conserving lake sturgeon populations. Lake sturgeon is a very important part of the culture of the community at Seine River. It is one of their traditional harvested species and there remains one inactive commercial fishing license for the species on the Seine River that belongs to the SRFN but has been under voluntary moratorium since the mid-90's. Members of the community have a long history with lake sturgeon and extensive knowledge of past distribution, spawning and population levels. Much of this knowledge remains undocumented at this time although the community is currently working on a project to correlate traditional spawning indicators with temperatures and sturgeon spawning events.

The area identified as the main spawning location for Seine River sturgeon is located immediately downstream of the Sturgeon Falls Generating station and the area below the

Highway 11 bridge. With the goal of increasing production of renewable energy, the Ontario government is encouraging the development of many new hydro-electric facilities on many of its rivers and retrofitting existing facilities. However, current facilities on the Seine River may be adversely affecting lake sturgeon. The effect of current water management regime on lake sturgeon populations needs to be studied more intensely as the extent of the any impacts remains largely unknown at this time.

Currently, the Lakes and Rivers Improvement Act required that a Water Management Plan be developed for the Seine River to address the operation of the river storage and generating facilities (Figure 1). The current management plan originally covered the period from 2004 until 2014 (Boileau 2004) although it was recently extended for an additional 2 years with minor administrative amendments to the text. The Seine River Water Management Plan (SRWMP) outlines a monitoring program to evaluate how well the management of water levels and flows during the life of the plan are meeting the objectives identified for sturgeon in the plan. The fate of the plan beyond 2016 is currently uncertain.

The SRWMP considers lake sturgeon a valued ecosystem component (VEC). The plan sets forth objectives to manage water levels and flows to maintain conditions necessary for sturgeon spawning in the spring. To evaluate the effectiveness of the plan, a sturgeon population assessment within the Lower Seine River is required. This is complicated by the probable intermixing of fish from Rainy Lake; it is not currently known if there is one stock of fish that moves back and forth from the lake to the river or whether there are separate stocks or sub-populations in each water body.

Until recently, there was little bathymetry data available for the area immediately below the Sturgeon Falls generating station and even less known about the substrate types with regards to suitable sturgeon spawning habitat. The effects of varying water flow regimes on sturgeon spawning habitat and the impact on spawning, egg survival, and recruitment imposed by the generating station are currently unknown.

Since lake sturgeon were designated as a threatened species in Ontario in 2009, each hydroelectric generating station that may cause adverse effects to the species is required to enter into an agreement with the Minister by 2012 according to O. Reg. 242/08, s. 11 under the Endangered Species Act (ESA, 2007). Part of this agreement includes identifying actions to mitigate impacts on a species at risk and conducting a monitoring program to assess the effectiveness of these actions.

The Fish Community Objectives for the Seine River System (Godwin 2013) identify the following specific management objectives for lake sturgeon: 1) ***protect and increase the extant lake sturgeon spawning population in the Seine River at an abundance commensurate with the capacity of the habitat available to support them and in consideration of the existing fish community; 2) maintain, enhance or restore habitat in the Seine River in order to support lake sturgeon.***

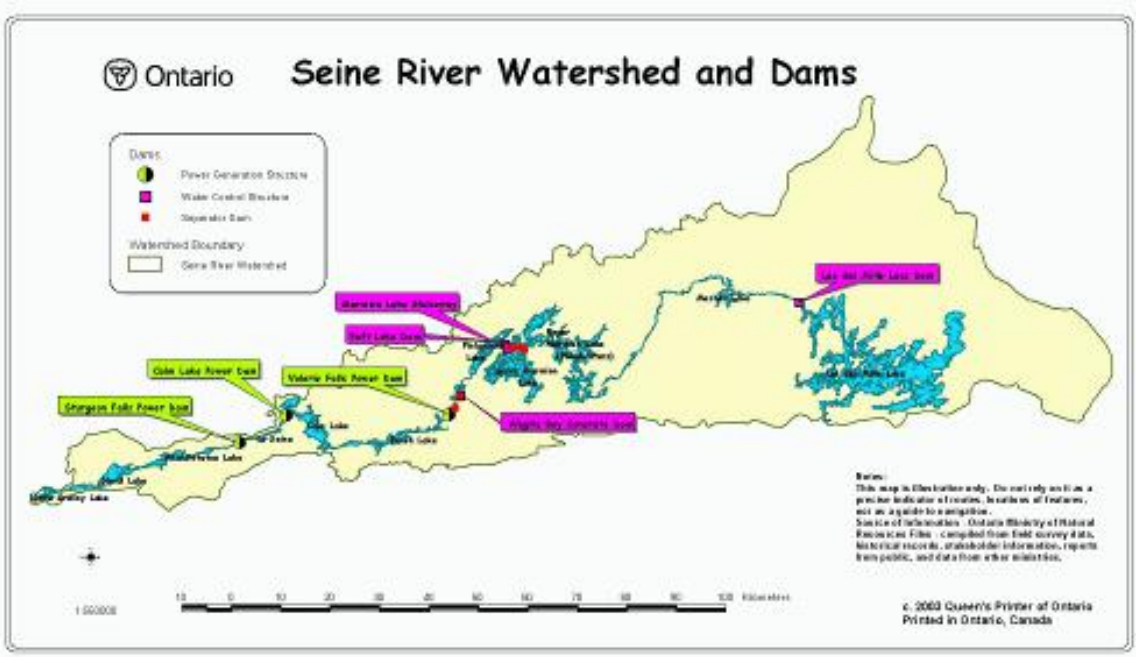


Figure 1: The Seine River Watershed including dams, water control structures and power generating stations.

Approach to Seine River Sturgeon Population Data Collection – 2010-2014

For the period 2010 to 2014, the MNR in partnership with the Seine River First Nation and H2O Power Ltd., have been assessing sturgeon population status and collecting data to assess effectiveness of current water management to provide successful spawning and recruitment and eventually the recovery of the sturgeon spawning in the Seine River.

The following report summarizes 1) the adult population characteristics, 2) characteristics of the juvenile sturgeon population and 3) adult movement study results for the period 2011 to 2014.

Table 1. Summary of current Seine River sturgeon data collection and monitoring.

Data needs	Method	Lead	Partner	Completion date	Product
Spawning habitat suitability and distribution	Bathymetry, substrate and velocity mapping	OMNR (assessment completed by North/ South Consulting)		2011	Lake Sturgeon Spawning Habitat Assessment Sturgeon Falls 2012. North South Consulting Inc.
Flow and Level data	Measuring daily average flow and level data at sturgeon Falls station (hourly for the period	H20 Power		ongoing	Flow and level data summary (as per Seine River Water Management Plan requirements)
Impact of downstream levels on river levels	Comparison of flow and level data from Sturgeon Falls dam with downstream levels.	SRFN	OMNR		Understanding of the relative impact of Sturgeon Falls dam and Rainy Lake dam on water levels in sturgeon spawning sites
Adult sturgeon population status	Adult gill netting	OMNR	SRFN	2011-2013	Population status data
Spawning timing	Egg mats, larval drift netting, underwater cameras	SRFN		Initiated in 2011 - ongoing	Determination of sturgeon spawning times and environmental cues and triggers
Recruitment	Juvenile netting	OMNR	SRFN; H20	2012-2014	Juvenile sturgeon monitoring protocol to assess recruitment

Part I: Population Characteristics of Adult Lake Sturgeon in the Lower Seine River System

Introduction

Assessment of the adult sturgeon using large mesh gill nets have been completed for many of the sturgeon populations in the Rainy River system. Assessing the Seine River spawning population allows comparison to previous adult assessments completed on the Seine River as well as comparison to other populations in the watershed to provide an understanding of the current level of risk to this population.

Methods

Sturgeon Netting on the Lower Seine River – 2011 to 2013

Adult sturgeon netting has occurred for 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. For a more detailed description of methods, see Appendix I.

Lake Sturgeon Sampling

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. For a more detailed description of surgical procedures, see Appendix III.

Results and Discussion

Adult Lake Sturgeon Netting

Table 1-1. Summary of results for Seine River Adult Sturgeon Netting – 2011-2013

Year	Number of sets			Number sturgeon captured	Catch/unit effort (#/ 1000m)		
	Spring	fall	total	Total	Spring	fall	total
2011	47 (3.73 km)	14 (1.27 km)	61 (5.00km)	14 (+2 recap)	3.2 (3.8 incl. recaps)	1.6	2.8 3.2 (incl. recaps)
2012	49 (4.48 km)	-	49 (4.48 km)	7 (+1 recap)	1.6 (1.8 incl. recaps)	-	1.6 1.8 (incl. recaps)
2013 - MNR	14 (1.24 km)	9 (0.82 km)	23 (2.06 km)	4	1.6	2.4	1.9
2013 – North-South	*15 (1.50 km)*			*16 (+1 recap)*	*10.7 (11.3 incl. recap)*		*10.7 (11.3 incl. recap)*
Total – MNR+ North South	***125 (11.0km)***	***23 (2.1 km)***	***148 (13.1 km)***	***41 (+4 recap)***	***3.4*** *(3.7 incl recap)*	***1.9***	***3.1*** *(3.4 incl recap)*
Total - MNR	**110 (9.5 km)**	**23 (2.1 km)**	**133 (11.6 km)**	**25 (+3 recap)**	**2.2** (2.5 incl recap)	**1.9**	**2.2** (2.4 incl recap)

Between 2011 and 2013, MNR crews 133 nets totalling 11.6 km of length. This resulted in the catch of 25 individual sturgeon for a catch per unit effort of 2.2 sturgeon/km. In addition, 3 sturgeon were recaptured over the three years. In 2013, crews from North South Consulting also set large mesh nets for adult sturgeon with 15 sets total 1.5 km. One of the techniques used by North South Consulting crews was placing very short nets (23m/75') in eddy pools used as staging habitat during the spring spawning run, with resulted in very high catch rates (66 sturgeon/km). Catch rates of North South nets that were similar to MNR gear and set in similar locations were more typical of MNR catch rates. Because the technique of using very short sets in eddy pools is not typically used in MNR studies, for comparison to other populations, only the MNR data was used (Table 1-1)

The combined catch rates for MNR nets between 2011 and 2013 was 2.2 sturgeon/km (2.4 sturgeon/km including recaps).

These catch rates were compared to other similar studies on population in Designatable Unit (DU) 6 and have been presented in Table 1-2. The Seine River catch rate for the 2011 & 2012 study was slightly higher than in the 1993-1995 study (McLeod, 1999), but Seine River values are much lower than other studies done previously on populations in Designatable Unit (DU) 6 including Namakan River (McLeod et al., 2009), Lake of the Woods/Rainy River (Stewig, 2005), and Rainy Lake (Adams, et al, 2006).

Table 1-2. Summary of selected lake sturgeon status indicators from Rainy River watershed populations

Lake	Year(s)	Sample size	Abundance (catch/km large mesh net)	% over 25 years	# of age classes	Maximum age	%>1400 mm TL
Namakan River	2006-08	430	72	49%	39	61	14%
Sturgeon Lake	2008-10	303	23	88%	43	68	9%
Lac La Croix	2010-11	67	19	52%	26	51	8%
Rainy R./LOTW	2004				33	38	5%
Rainy Lake	2002-04	283	35	52%	41	59	22%
Seine River	**1993-95**	**48**	**2**	**(14%)**	**27**	**42**	**14%**
Seine River	**2011-13**	**40**	**2.2**	**17%**	**18**	**34**	**5%**

The average total length of fish caught between 2011 and 2013 was 122 cm (range of 103-143 cm) with an average weight of 11.8 kg (range of 7.4 - 23.2 kg) (Figure 1-1). The average size of fish caught has increased over the 3 years of the study (Figure 1-2).

Compared to the previous survey of adult sturgeon in the Seine River between 1993 and 1995, the average size is larger in 2011-2013 (Figure 1-3) but the proportion of sturgeon larger than 140cm is generally less (Figure 1-4).

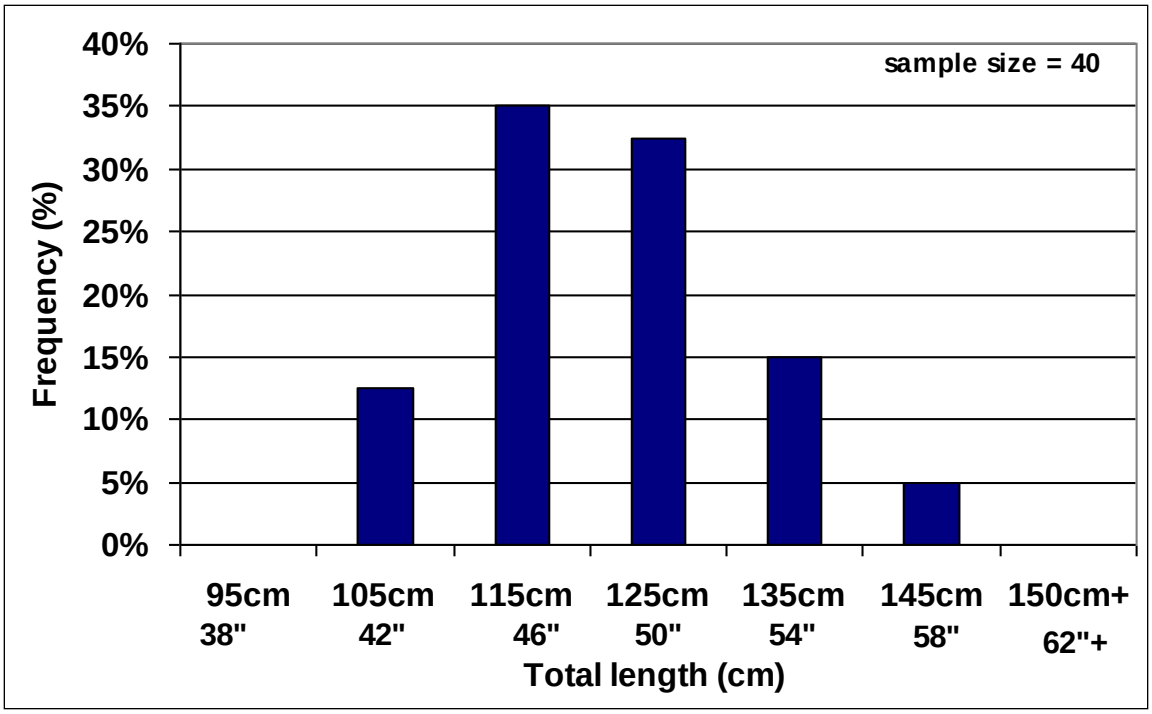


Figure 1-1 Size distribution of lake sturgeon caught in large mesh gill nets from the Seine River between 2011 and 2013.

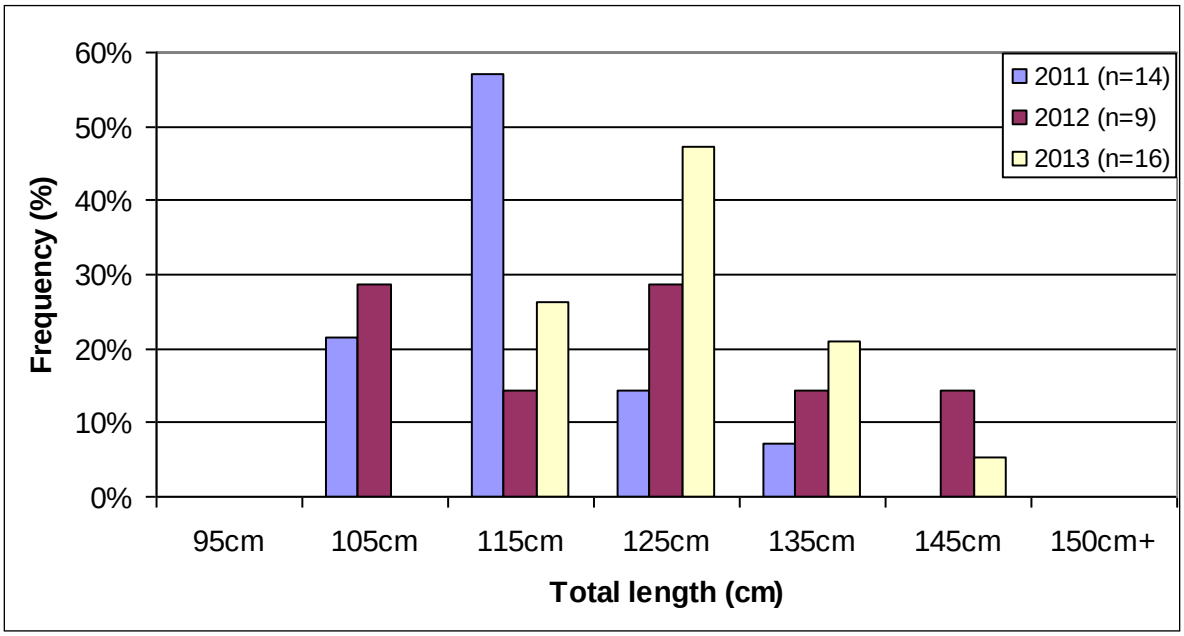


Figure 1-2 Size distribution of lake sturgeon caught in large mesh gill nets from the Seine River for the years 2011, 2012 and 2013.

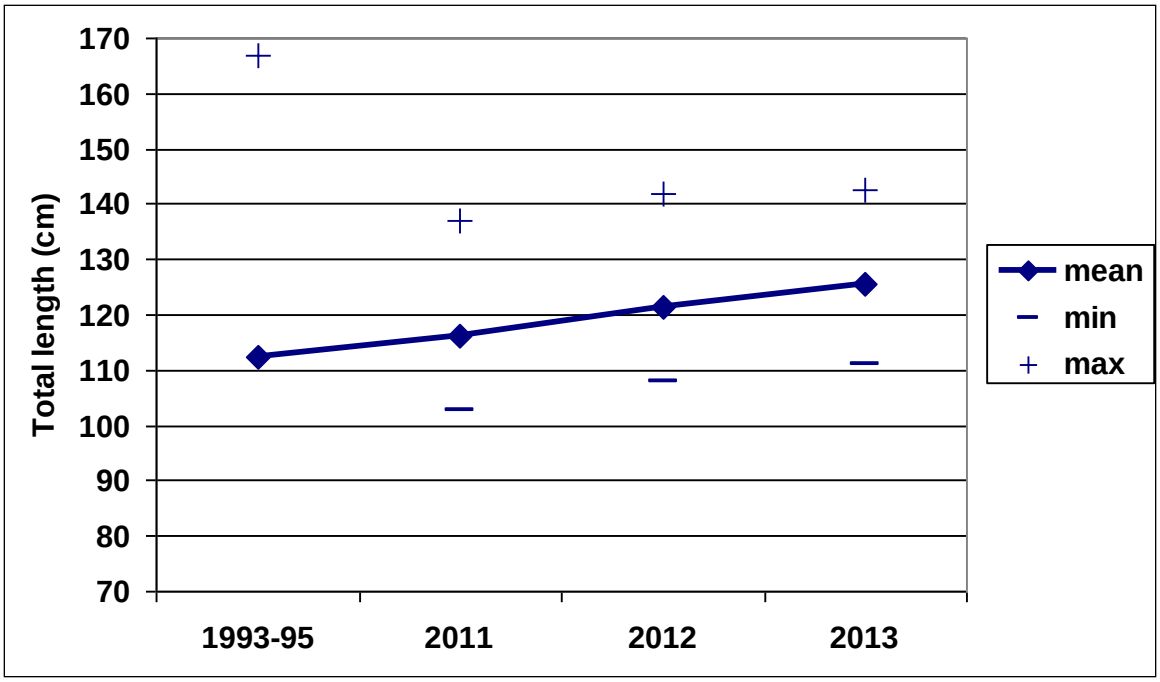


Figure 1-3. Average size of lake sturgeon caught in large mesh gill nets from the Seine River for the years 2011- 2013 compared to 1993-1995.

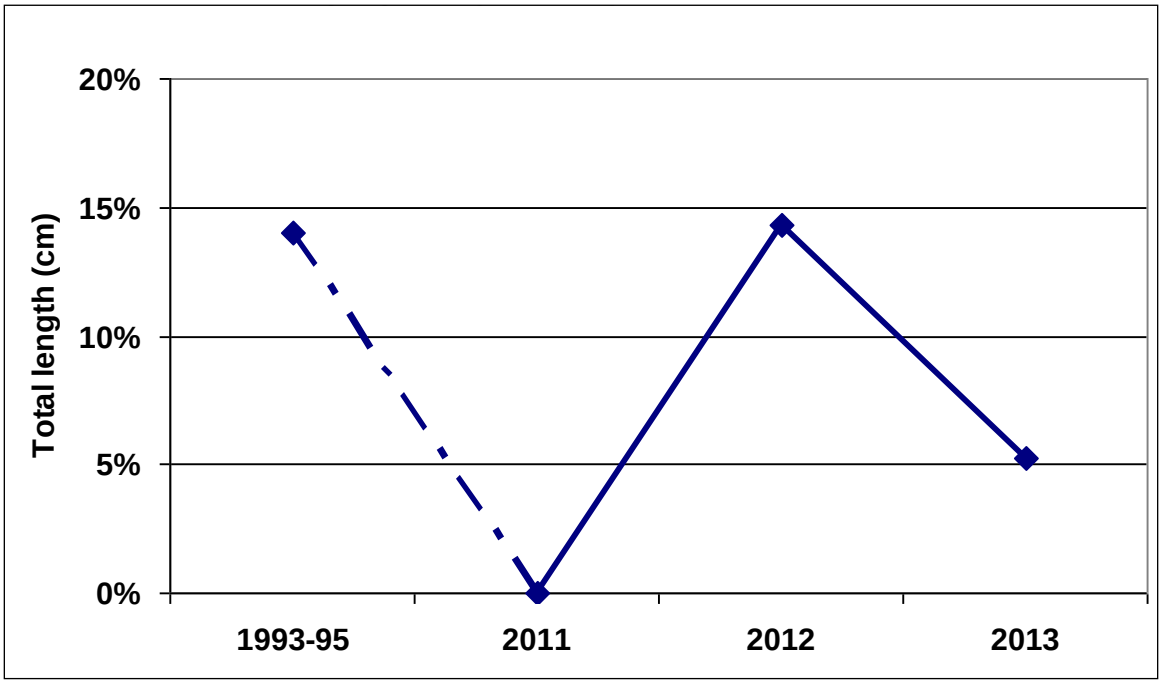


Figure 1-4. Proportion of lake sturgeon larger than 140cm (55") caught in large mesh gill nets from the Seine River for the years 2011- 2013 compared to 1993-1995.

The average age of adult lake sturgeon from the first two years of netting in the Lower Seine River was 19.8 years (median age was 19 years). It has been proposed (Mosindy et al. 1991) that the mean age of first reproduction in lake sturgeon is 17 years for males and 26 years for females. Ages for sturgeon caught in large mesh nets ranged from 10-34 years over the three years.

The age distribution of sturgeon that were sampled between 2011 and 2013 is shown in Figure 1-5. Based on the age estimates of the first spawning event (Mosindy et al. 1991), more than half of the fish captured would not have been mature or ready to spawn. Of the 36 fish that were aged, only 6 (17%) were 26 years or older (female spawning age) and 11 (31%) were less than 17 years (immature regardless of sex). The distribution suggests that the population has been adversely impacted and may have resulted in reduced recruitment as a result.

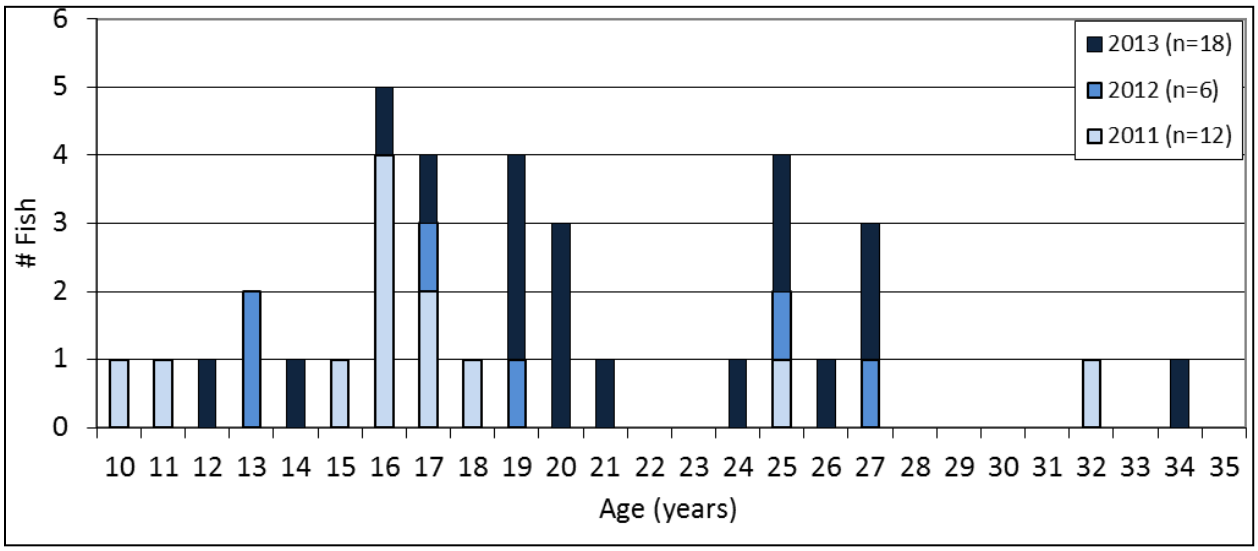


Figure 1-5: Age distribution of lake sturgeon sampled from large mesh nets in the Seine River between 2011 and 2013.

The von Bertalanffy growth equation developed by McLeod (1999) was used to compare the fish caught during 2011-13 to those sampled from 1993-95. This equation was calculated with unweighted fork length data by age-interval as follows (McLeod 1999):

$$L_t = 1343\ [1 - e^{-0.1017\ (t + 0.858)}]$$

The results from 1993-95 were converted to total length using TL = 1.0797FL + 23.766 (r^2 = 0.9964) and compared to the results of fish sampled between 2011 and 2013. Growth rates from fish sampled in 2011 – 2013 appear to be very similar to fish sampled in the 1993-1995 study (Figure 1-6) (McLeod, 1999).

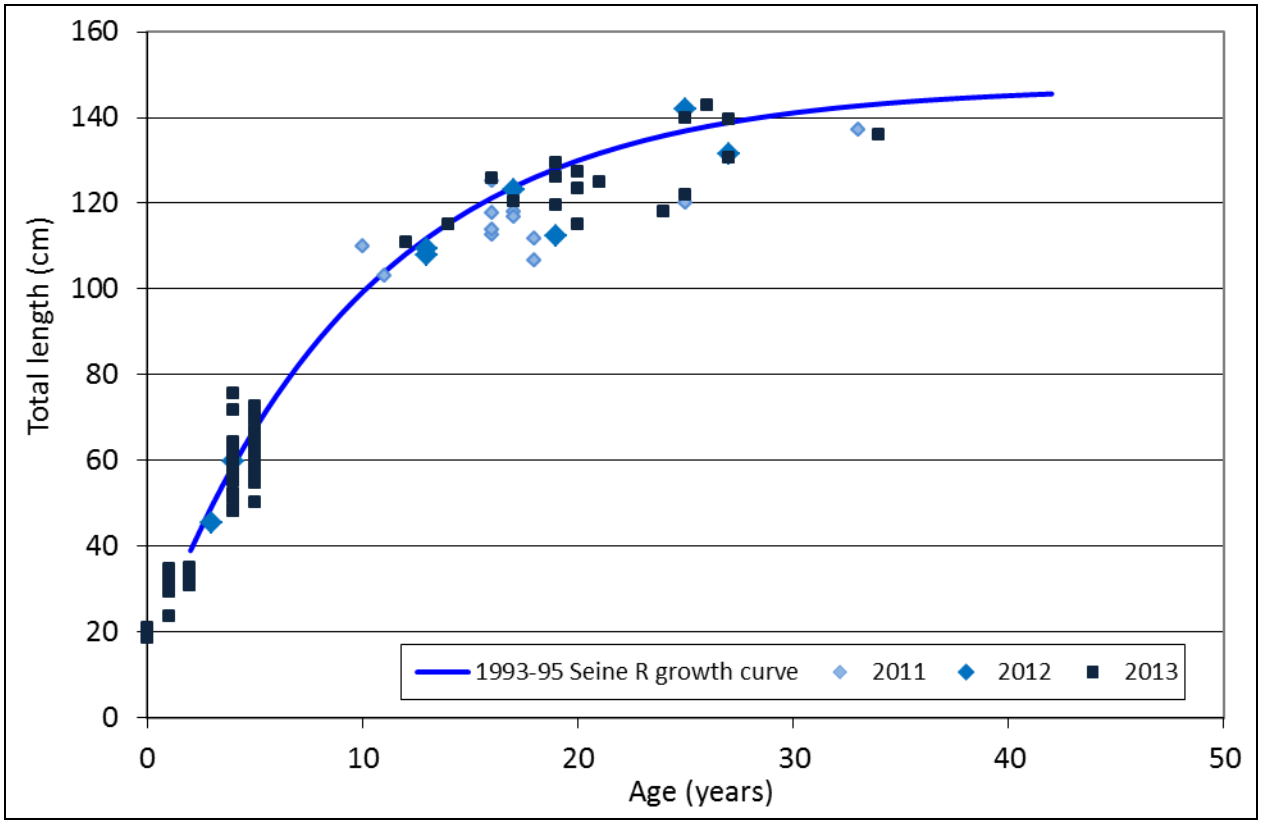


Figure 1-6: Length at age for lake sturgeon sampled in the Seine River between 2011 and 2013 (including juveniles) compared to the estimated growth curve from Seine R. fish sampled between 1993-1995 (Mcleod 1999)

Summary

Data from the past three years of sampling the adult population have shown relatively low catches, with fewer older, larger fish and fewer age classes suggesting a population that is less healthy and more at risk compared to other populations in the Rainy River watershed. Abundance is similar to that observed in 1993-95 although the number of age classes and % of large fish appears to have declined.

Part II: Population Characteristics and Distribution of Juvenile Lake Sturgeon in the Lower Seine River System

Introduction

Juvenile lake sturgeon can be an important life stage to study to assess the effectiveness of rehabilitation or mitigation measures (Haxton, 2011). Investigation into the requirements of the juvenile stage of lake sturgeon has been the focus of much study in the last few years (Haxton, 2011; Trembath, 2013; Barth, 2011).

The lack of knowledge concerning the life history traits, and the ecological processes that influence population growth for many fish species inhabiting large river systems has complicated efforts to manage and restore populations (Reynolds et al. 2005). This is of particular concern regarding lake sturgeon since there is often a lack of information available on their basic ecology, especially with regards to younger life stages. This knowledge gap is mainly due to complications associated with gathering data in the habitats inhabited by juvenile lake sturgeon which are often found living in deep, flowing, main channel environments of large rivers (Barth, 2011). The nature of their habitat can make capture and study of this life stage difficult (Secor et al. 2002).

Past studies have found that juvenile lake sturgeon in the Winnipeg River system have specific habitat requirements in large river systems. Regardless of season, juveniles prefer habitats that have sufficient depth and water velocities and both fine and course substrate types (Barth, 2011). Studies on the Seine River have shown a preference for deep pools with greater than 10m of depth (Jackson 2014) which is similar to the results of other studies such as on the Namakan system where studies show a preference for holes greater than 10m in depth (Trembath, 2013). They also prefer areas with some current since they appear to have adapted a drift feeding strategy; they will sit at the head end of deep pools and let the food come to them. Studies have shown that habitat selection of juvenile lake sturgeon is in direct contrast to larger, older sturgeon that prefers shallower habitats (Barth, 2011).

Given the life history characteristics of the species (slow growth, late maturity, longevity, etc.) it is difficult to effectively detect changes in lake sturgeon through adult sampling. Therefore, by studying the abundance of juveniles, it should be possible to evaluate the effectiveness of management decisions and actions and produce results in a more realistic timeline compared to assessing spawning adult stages which could result in a lag time of 25–30 years (Harkness and Dymond, 1961; Bruch, 1999). As such, it is imperative to understand the spatial distribution of juveniles in a river system like the Seine River to allow for effective sampling of this younger life stage of the species (Haxton 2011). Only through effective sampling can population changes be detected in this culturally important yet threatened fish species (Hansen et al., 2007).

The purpose of this portion of the ongoing study, which was initiated in 2012, is to develop effective juvenile lake sturgeon sampling methods for the Seine River system which requires information on where juvenile lake sturgeon are found in the Seine River system and how to effectively sample them. The overall objective of this study is to use juvenile sturgeon year class production to explore the relationship between juvenile recruitment and water management and determine if mitigation measures being proposed for Sturgeon Falls GS under the current Water Management Plan and ESA mitigation plan are positively impacting lake sturgeon spawning and recruitment in the river.

Because this assessment requires capture of sufficient numbers of juveniles to determine year class strength, a targeted sampling approach focussed on preferred juvenile habitat was chosen over the provincial juvenile sampling protocol which uses a random approach to more effectively compare between populations (Haxton et al, 2014). This study would inform the development of this methodology which will also include results of previous juvenile habitat and monitoring studies in the Nelson River watershed (Trembath, 2013; Barth 2011; Barth et al. 2011).

This type of study is beyond the scope of the monitoring portion of the ESA waterpower agreements but will be used to develop a protocol by filling critical information gaps that can be used by the ESA waterpower agreement monitoring plans. As these methods become standardized in the future, it is expected that a monitoring program using this method will be helpful in determining the effectiveness of mitigation measures at the Sturgeon Falls GS through measurable population changes as seen in the juvenile lake sturgeon population. This segment of the population is being targeted because it should show population responses to mitigation actions over a relatively short term in comparison to monitoring the adult populations. An effective juvenile sampling program is predicted to show the effects of the mitigation measures through year class strength in the <10 year old fish. By ageing fish and back calculating to the year in which they were hatched, we can determine which years and conditions would be considered good years for recruitment and assess the impacts of flows and flow management. This information will be used to inform water management decisions in the Seine River directly related to the Seine River Water Management Plan.

An experimental spring juvenile lake sturgeon netting program was developed and carried out during the spring of 2012, spring and fall of 2013 and fall of 2014 in the Seine River. Nets were designed to target juvenile lake sturgeon and actual design varied between surveys in an effort to identify an effective gear.

Methods

In 2012 and 2013, MNR used two types of small mesh gill nets were used: one made of monofilament and one made of multifilament. In 2013, North South Consulting (NSC) assisted the juvenile netting using a multifilament net with a wider range of mesh size. In 2014, both OMNR and SRFN used the North American Standard Index net (NASIN), a monofilament gill net with a range of mesh sizes similar to the 2013 NSC nets which is also used in the OMNR Broad-scale Monitoring program. The specifications of the juvenile lake sturgeon gill nets are found in Appendix II. Net locations were chosen based on the results of other juvenile lake sturgeon netting programs (Trembath 2013; Barth et al. 2011; Chiasson et al. 1997; Haxton et al. 2011). As a result, locations along the Seine River with depths greater than 10m were targeted although nets were set in shallower locations as well in 2012 and 2013 (see Jackson 2014 for more details). Deep holes are rare in the Seine River system (<1% of total area). These areas are located within the main channel of the river and should have adequate current to attract juvenile sturgeon. To assess gear mesh type, paired net sets were used in 2012 and 2013. In the selected locations, one multifilament net and one monofilament net were set close to each other, but with sufficient distance from one another to not influence the other's catchability. Nets were set perpendicular to the direction of the main current and left to fish overnight although in 2014 both parallel and perpendicular to flow sets were conducted to compare effect of fishing success. Sampling in 2012 and 2013 was initially focussed on the upper stretches of the Lower Seine River (form Sturgeon Falls dam to Shoal Lake). In fall of 2013, North South Consulting focussed sampling on similar deep water habitat but further downstream (Shoal Lake to Rainy Lake). In 2014, all deepwater habitat (i.e. holes with greater than 10m depth) between Sturgeon Falls and into Rainy Lake were assessed.

Captured juvenile fish were measured (fork length, total length, weight), aged (using leading pectoral fin ray), and most of the fish were tagged using Passive Integrated Transponder (PIT) tags (see Appendix 2 for juvenile sturgeon data). PIT tags (Biomark HPT12, 12.5mm, 134.2kHz) were applied to juvenile fish under the third scute from the anterior end using a plastic syringe-style implanter with a 1.25" non replaceable needle (Biomark, MK7 Implanter). Prior to insertion, the function of each PIT tag was verified using a PIT tag reader (Biomark, Pocket Reader EX) and the unique tag number was recorded. Following insertion, the function of each tag was again verified using a PIT tag reader before the fish was live released.

Results and Discussion

It should be noted that the year class data is preliminary at this time and it is not entirely clear whether the year class patterns observed in the 2012-2014 data are the result of differences in annual recruitment or age/size differences in vulnerability to be captured by the gear. Results from the 2014 to help assess the impact of gear on year class assessment. Results of the effectiveness of the netting program are reported in a separate document (see Jackson 2014).

During the 2012 - 2014 juvenile netting program, 111 juvenile nets were set totalling over 4500m of total net length. Average catch/net was approximately 2.5 sturgeon/100m overnight

set although depth of set had a large influence on catch (Figure 2-1). There was also a location effect with downstream sites tending to have higher catches of sturgeon (Figure 2-2).

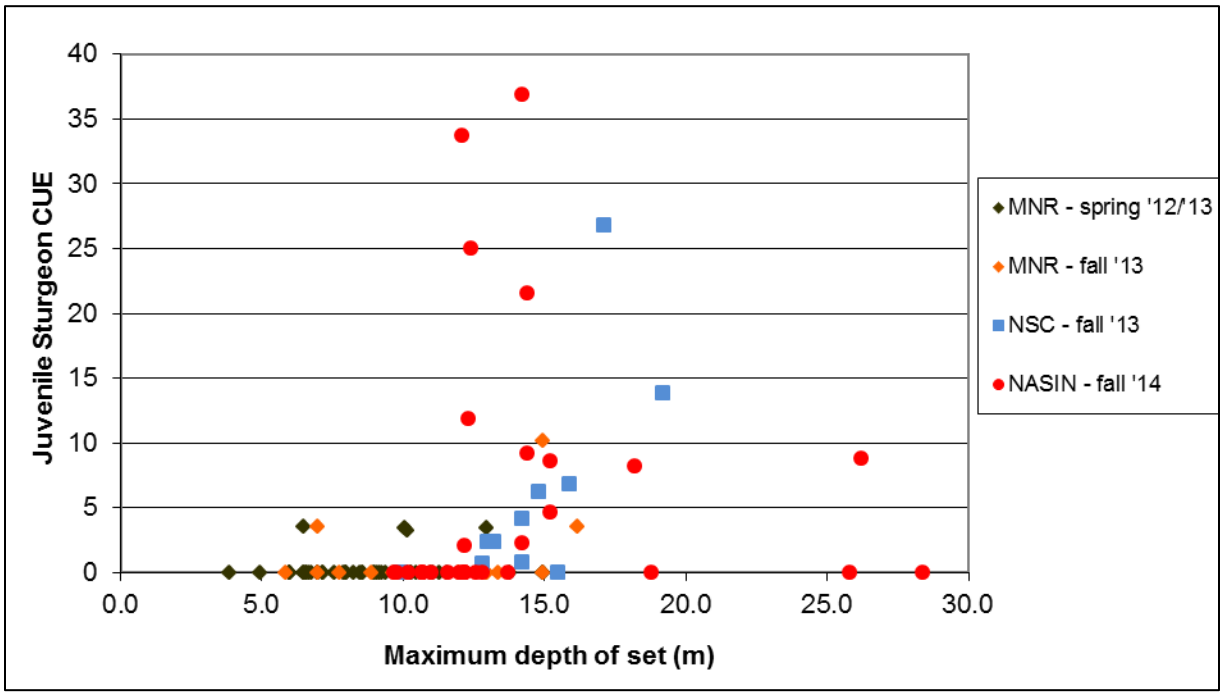


Figure 2-1. Juvenile sturgeon CUE versus maximum depth of set from the Seine River 2012-2014.

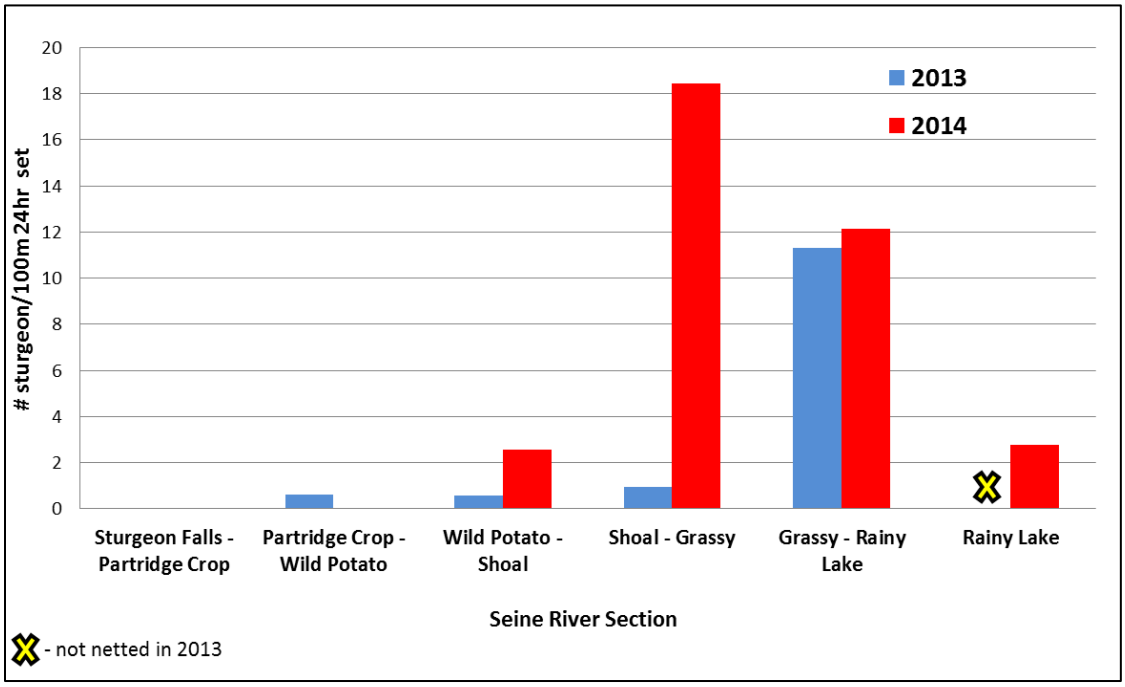


Figure 2-2. Juvenile sturgeon CUE versus section of the Seine River netted 2012-2014.

A total of 112 individual sturgeon were captured (2 in 2012, 69 in 2013 and 41 in 2014) (Table 2-1). Lengths ranged from 186mm TL to 756 mm TL and ages ranged from 0 to 6 yrs (Figure 2-3, 2-4). Length at age information shows clear size separation between age 0 and age 1 fish however difference between some of the other ages are not as apparent (Figure 2-5). This may suggest either error in preliminary age data or high annual variability in growth. Pre-maturity growth has been found to be linear for many fish species (Lester et al 2004). Assuming this, the average growth of Seine River juvenile sturgeon for this period is approximately 80 mm/year.

Table 2-1. Juvenile sturgeon data from Seine River – 2012-2014

	Fork length (cm)	Total length (mm)	Weight (g)	Age (yrs)
number	112	112	106	111
average	43.6	49.3	706	3.1
min	16.5	18.6	15	0
max	66.8	75.6	2000	6

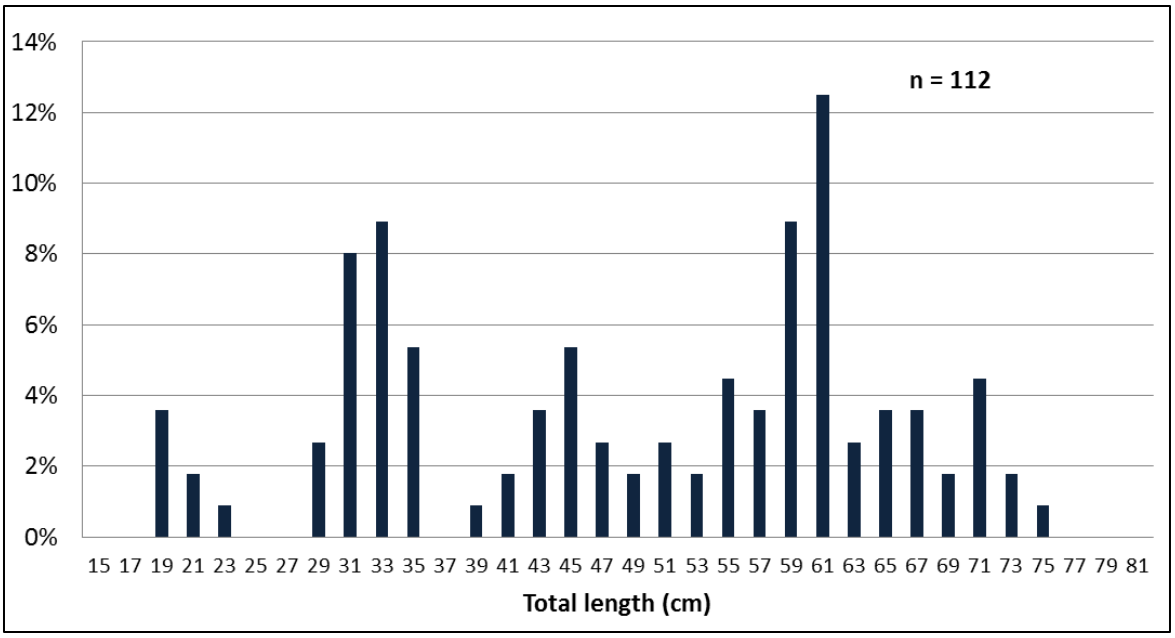


Figure 2-3. Length distribution of juvenile sturgeon caught from the Seine River 2012-2014 (combined).

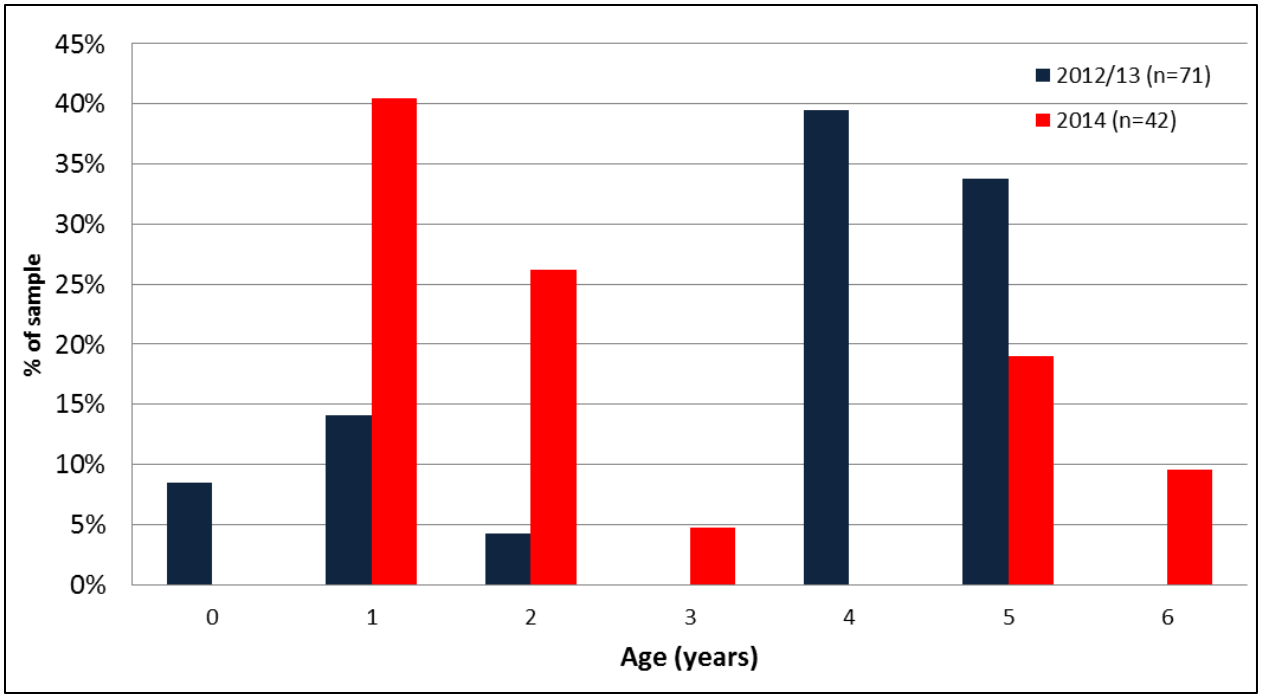


Figure 2-4. Age distribution of juvenile sturgeon caught from the Seine River 2012-2014.

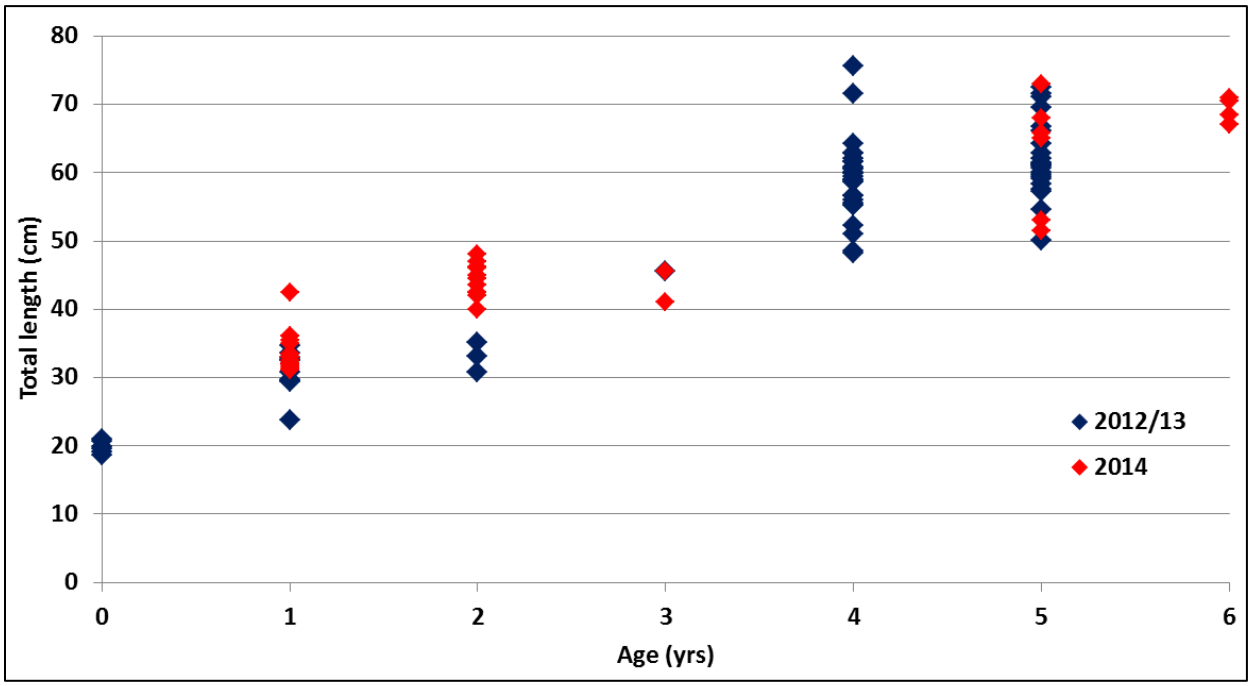


Figure 2-5. Length at age of juvenile sturgeon caught from the Seine River 2012-2014

Age data suggests variable recruitment of sturgeon between 2007 and 2014 with differences in both length and year class distribution between years that were sampled. (Figure 2-6, 2-7). The impact of size of fish and recruitment to the sample gear on age data is not yet completely understood, particularly around how effectively the youngest ages are being captured and

being represented in the catch. However, it is clear that there are some strong year classes (2008 and 2009) and very weak year classes (e.g. 2010, 2011).

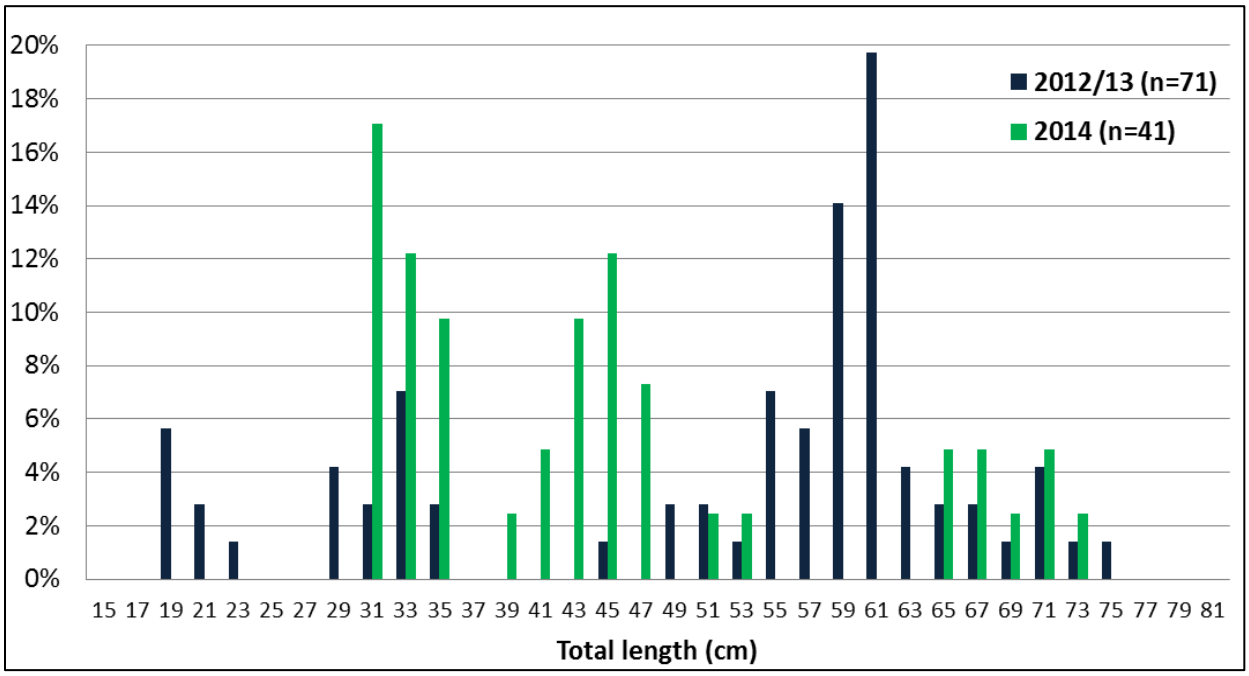


Figure 2-6. Length distribution of juvenile sturgeon caught from the Seine River 2012/13 vs. 2014.

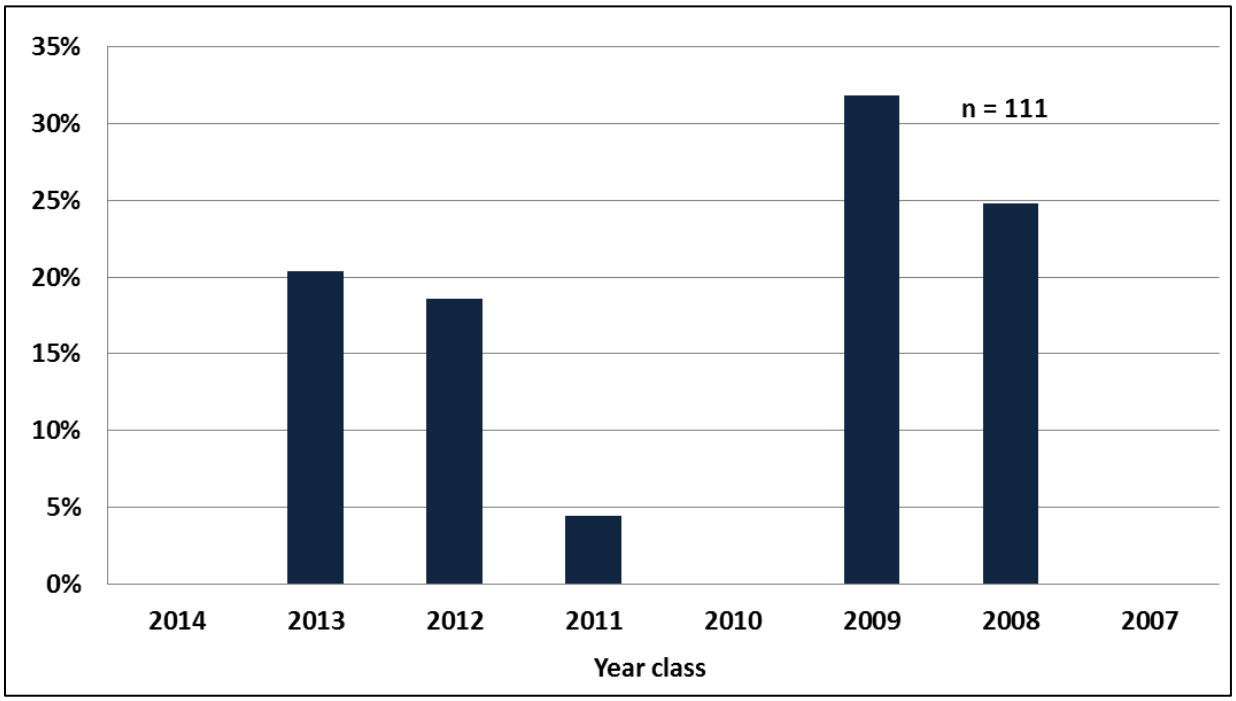


Figure 2-7. Year class distribution of juvenile sturgeon caught from the Seine River 2012 - 2014.

Spatial distribution of juvenile sturgeon by age and size

Both the 2012/13 data and 2014 data showed a pattern of increasing size and age of juvenile sturgeon in the downstream reaches of the river (Figure 2-8; Figure 2-9). However the average size/age differed between years with 2014 tending to have smaller/younger fish in each section than in 2013.

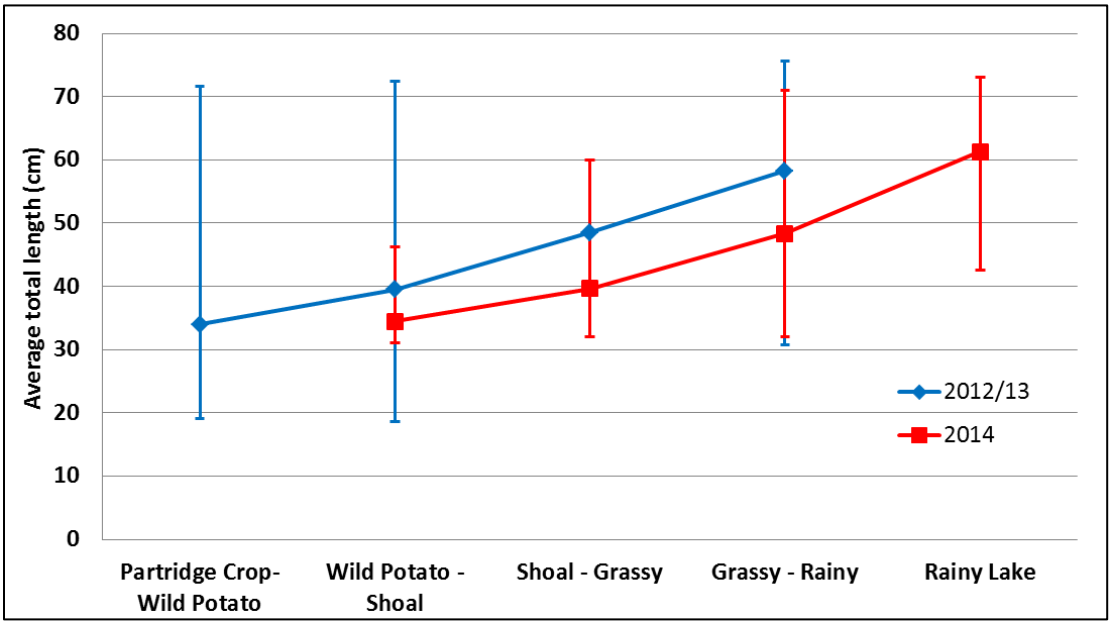


Figure 2-8. Average length of juvenile sturgeon by section of the Seine River 2012/13 versus 2014 (bars indicate minimum and maximum size captured).

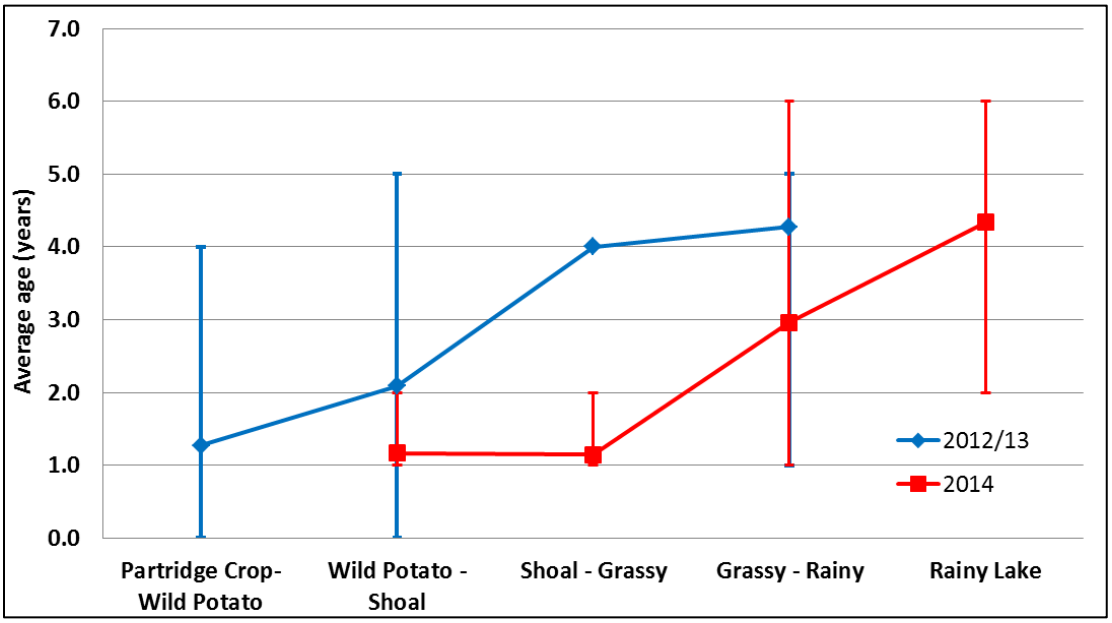


Figure 2-9. Average age of juvenile sturgeon by section of the Seine River 2012/13 versus 2014 (bars indicate minimum and maximum age captured).

There was a noticeable difference in the distribution of age 0 and age 1 fish. In 2013, all fish aged as age 0 (n=6) were captured only upstream of Shoal Lake in Sections 3 and 5 of the Seine River (Figure 2-10). No age 0 fish were caught in 2014 based on aging results or size characteristics (i.e. length <25cm/weight< 30g).

Fish identified as age 1 in 2013 (n=10) and 2014 (n=13) have a much wider distribution in the Seine River than age 0 fish and were found from Partridge Crop Lake downstream to the mouth of the river (Figure 2-11). There was a tendency for fewer age 1 fish in the upstream section and more in the downstream areas in 2014 compared to 2013.

It would appear that there is a tendency for juvenile sturgeon to move downstream between age 0 and age 1 (Figure 2-12). In 2013, age 0 fish were caught mainly between Partridge Crop and Wild Potato Lake (Section 3) with the furthest down being between Wild Potato and Shoal Lake (Section 5). In 2014, this same age class (now age 1 fish) were mainly caught in the area of Devil's Elbow (Section 9) and between Shoal Lake and Grassy Lake (Section 7) with the furthest upstream being caught between Wild Potato and Shoal Lake (Section 5).

Figure 2-10 Spatial distribution of age 0 sturgeon captured in 2013 in the Seine River. No age 0 fish were captured in 2014

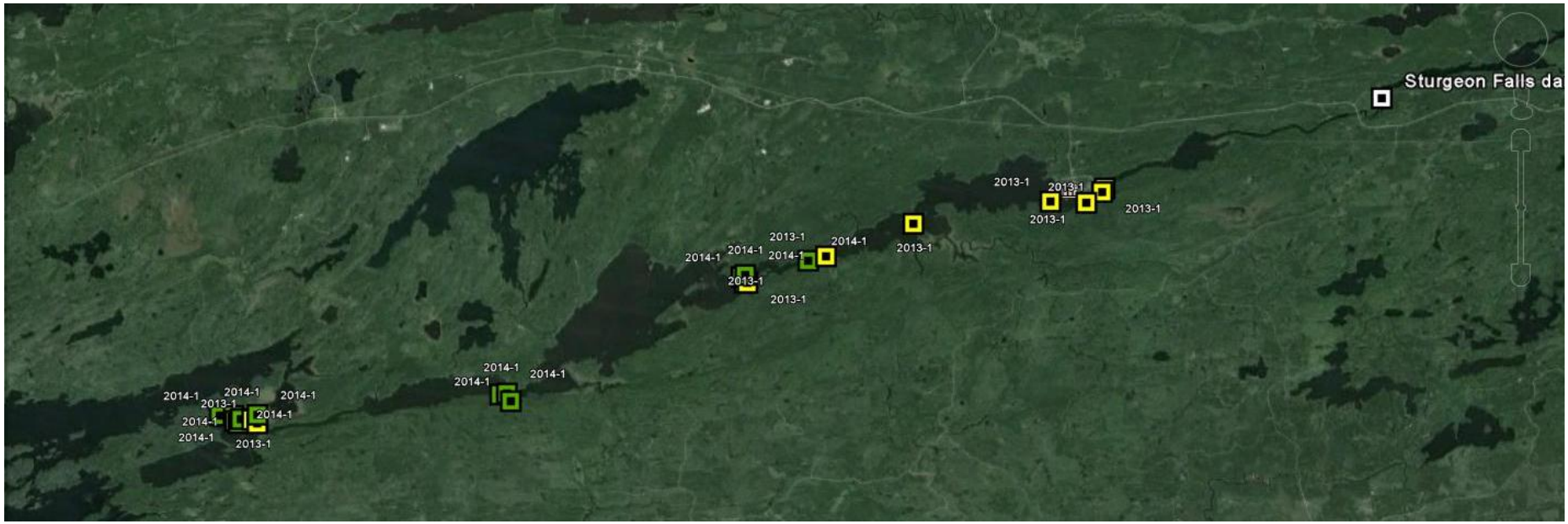


Figure 2-11. Spatial distribution of age 1 sturgeon captured in 2013 (yellow; n=10) and 2014 (green; n=13) in the Seine River.

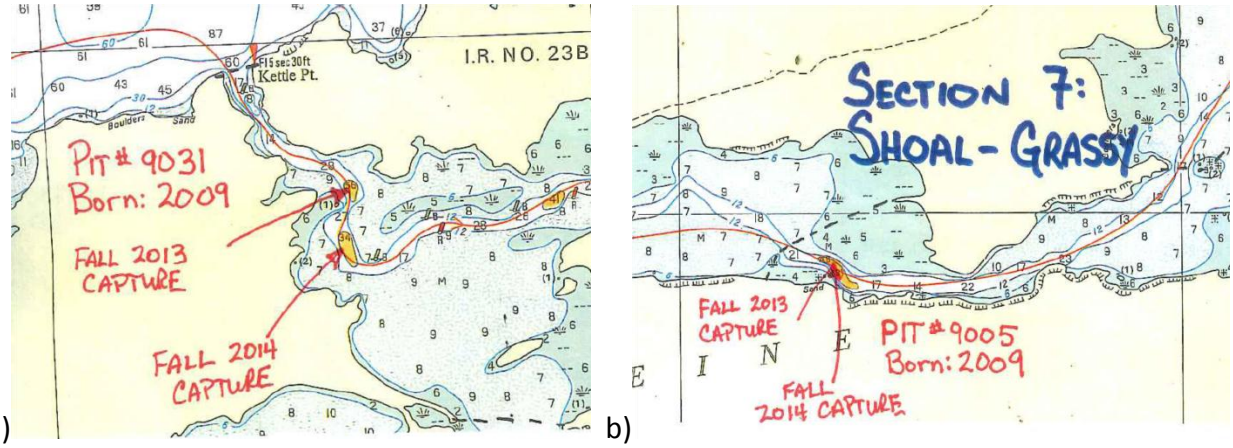
Figure 2-12. Spatial distribution of age 0 sturgeon captured in 2013 (red circles; n=6) and age 1 in 2014 (green squares; n=13) in the Seine River.

Marked and Tagged Juvenile Sturgeon

All juvenile sturgeon captured since 2012 (n= 112) have left pectoral fin clips (the leading fin rays of the left pectoral fin as used as the aging structure). In 2013, a number of juveniles were implanted with PIT tags allowing identifications of individuals (n= 24) and all new juveniles caught in 2014 were implanted with PIT tags (n=41) for a total of 65 tagged juvenile sturgeon as of October 2014.

Although it is not clear that all assumptions are valid for proper mark-recapture population estimates (eg. older juvenile fish marked in the river in 2013 may be moving into the lake in 2014 and be under sampled), a modified Petersen population estimate based on netting results to date would suggest a juvenile sturgeon population based on fin clips of 774 juvenile sturgeon (95% confidence interval between 316 and 1935) (marked fish = 71, captures = 41, recaptures = 3). If the population estimate is based on just PIT tag recaptures it is lower at 358 fish (95% confidence interval between 131 and 896) (marked fish = 24, captures = 41, recaptures = 2). These estimates are based on relatively few recaptures of tagged fish resulting in wide ranges in confidence intervals and should be taken as very preliminary estimates at this time.

Two sturgeon which had been tagged in 2013 with PIT tags were recaptured in 2014, both of which were 4 year olds in 2013 and 5 year olds in 2014. Both individuals were caught in almost the same locations as the previous year which may suggest little annual movement by individual juvenile sturgeon at least between the ages of 4 and 5 (Figure 2-10).



a) b)

Figure 2-13. Locations of juvenile sturgeon tagged in 2013 and recaptured in 2014 (n=2).

Summary

By focussing efforts on deep (>10m) holes, we were able to effectively capture sturgeon from age 0 to 6 years. There was considerable variation in year class representation and the distribution although it is not completely understood how much of this is influenced by

vulnerability of different size/age groups (particularly the youngest age groups) to the capture gear as well as movement patterns of juveniles, the sampling method appears to provide the necessary data to assess year class strength and allow identification of factors affecting recruitment.

There was a consistent pattern during the sampling period of larger, older sturgeon being captured in downstream stretches of the river. Two theories have been discussed that may explain this pattern. One theory is that larval sturgeon are carried downstream after hatching and the distance they are carried is dependent on spring flows. Once they reach a suitable habitat, they remain in this location for the juvenile period. The other hypothesis is that juvenile sturgeon are constantly moving downstream searching for suitable habitat. While there is some evidence for the first theory (i.e. the recapture of the two individual sturgeon in the same locations between 2013 and 2014), it would appear that the dominant factor affecting spatial distribution is a slow downstream movement of juveniles during the early years of their lives and a possible movement out into Rainy Lake for fish over age 5. It may be the relative lack of large deep areas in the Seine River has resulted in this pattern as a method of reducing competition between juvenile sturgeon. This pattern affects the amount of time that juvenile sturgeon are susceptible to a sampling program focussed on the river and the sampling design to determine year class strength.

Part III: Movement Patterns of Adult Lake Sturgeon in the Lower Seine River System

Introduction

Information from the Seine River First Nation indicated that sturgeon spawning in the Seine River move up locations in Rainy Lake. Earlier studies that used radio tracking to monitor movement of sturgeon also found that Seine River fish moved between Rainy Lake and the Seine River (Adams et al. 2006). However, the nature of sturgeon movement patterns and the amount of time spent in the river remained unclear. The use of permanent underwater recievers and acoustic transmitters has been found to be an effective means of monitoring sturgeon movement in other river systems in the area including the Namakan River (McLeod and Debruyn 2009; McLeod and Denyes 2012). It was also felt the by placing receivers near suspected spawning locations at the Hwy 11 bridge and below the Sturgeon Falls dam, information on location and timing of spawning events could be collected.

Methods

As part of the movement study 14 adult sturgeon were captured in 2011 using large mesh gill nets and surgically implant them with VEMCO V16-4x-A69-1303 coded implantable transmitters that transmit acoustic pings at a frequency of 69Hz. Sturgeon were captured in various locations along the lower Seine River from the Sturgeon Falls generating station downstream to Shoal Lake. Details on surgical procedures are included in Appendix III and are based on methodology used by OMNR on the Namakan River study (McLeod and Debruyn 2009).

In spring of 2013, an additional 10 adult sturgeon were implanted with transmitters although one of these was harvested within a month. The total sample size of fish starting in 2013 was 23.

Vemco Receiver Deployment and Data Collection

Three VEMCO VR2W coded underwater receivers were deployed in the Lower Seine River in June and July 2011 to detect the presence of sturgeon implanted with acoustic receivers. Receiver #1 was placed near the mouth of the Seine River to monitor sturgeon movement between the river and Rainy Lake. Receivers #2 and #3 were placed at suspected spawning locations at the Hwy 11 bridge and below the Sturgeon Falls dam respectively to monitoring sturgeon movement into these areas and identify potential spawning events. In 2013, an additional receiver (Receiver #4) was placed between Wild Potato and Shoal Lake to monitor sturgeon movement within the river. (Figures 3-1 and 3-2).

All receivers were downloaded in October of 2014 (Table 3-1). Receivers #1, #2 and #3 have movement data from spring of 2011 to October 2014 while Receiver #4 has data from the period July 2013 to October 2014. For a more detailed description of methods, see Appendix 3-I.

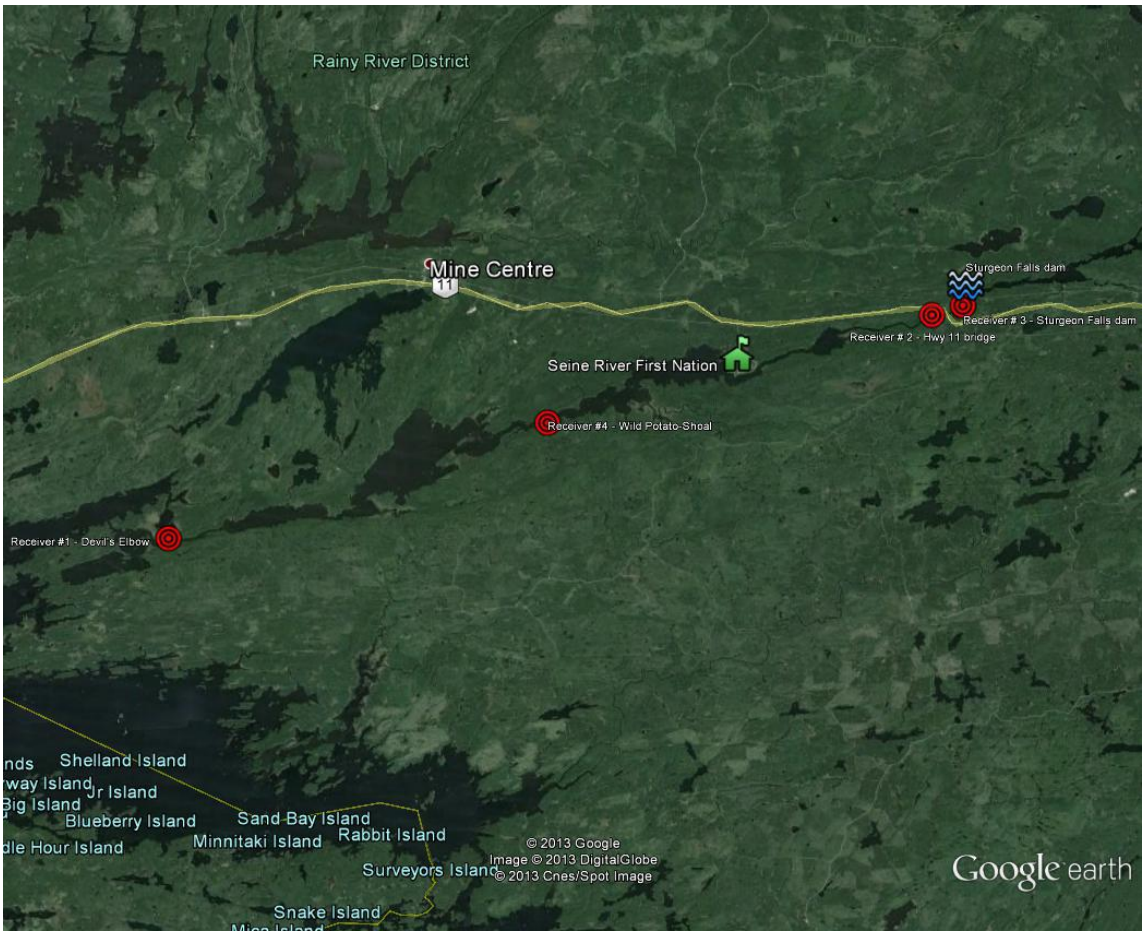


Figure 3-1: Locations of the four receivers along the Lower Seine River.

Figure 3-2: Locations of receivers #2 and #3 in Lower Seine River near Sturgeon Falls GS.

Table 3-1: Receiver data collected to date.

Receiver	Receiver Name	Location (UTM, NAD83)	Date Deployed	Last Date Downloaded
1	Devil's Elbow	15U 0515896 5389363	June 17, 2011	October 21, 2014
2	Highway 11 bridge	15U 0551105 5398665	July 14, 2011	October 21, 2014
3	Sturgeon Falls dam	15U 0552512 5399042	July 14, 2011	October 21, 2014
4	Wild Potato-Shoal	15U 0532775 5394042	July 4, 2013	October 21, 2014

Results and Discussion

Lake Sturgeon Movement Patterns

14 individual sturgeon were implanted with transmitters in 2011 and all were detected by at least one receiver in 2011 and there have been no known mortalities of these fish. An additional 10 sturgeon were implanted with transmitters in spring 2013 although one of these was harvested after less than one month. Currently (in 2014), there are 23 sturgeon with transmitters in the Seine River/Rainy Lake system. Table 3-2 provides a summary of movement patterns for these fish.

Table 3-2. Summary of movement of sturgeon implanted with transmitters in the Seine River system between June 2011 and October 2013 for a) all fish and b) only fish tracked since 2011.

a) all fish including additional fish from 2013

Year	2011	2012	2013	2014
Number of tracked fish	14	14	23	23
Number of sturgeon observed in river	*14*	7	18	15
% of sturgeon observed in river	*100%*	50%	*78%*	*65%*
# that moved to Hwy bridge in spawning period	*3*	6	16	8
% that moved to Hwy bridge in spawning period	*25%*	43%	70%	35%
# that moved to Sturgeon Falls in spawning period	*2*	3	9	5
% that moved to Sturgeon Falls in spawning period	*17%*	21%	39%	22%
# that moved to/remained in Rainy Lake for winter	12	14	22	
% that moved to/remained in Rainy Lake for winter	86%	100%	96%	

b) only fish tracked since 2011.

Year	2011	2012	2013	2014
Number of tracked fish	14	14	14	14
Number of sturgeon observed in river	*14*	7	9	8
% of sturgeon observed in river	*100%*	50%	64%	57%
# that moved to Hwy bridge in spawning period	*3*	6	7	5
% that moved to Hwy bridge in spawning period	*25%*	43%	50%	36%
# that moved to Sturgeon Falls in spawning period	*2*	3	5	3
% that moved to Sturgeon Falls in spawning period	*17%*	21%	36%	21%
# that moved to/remained in Rainy Lake for winter	12	14	14	
% that moved to/remained in Rainy Lake for winter	86%	100%	100%	

Sturgeon in the Seine River follow a general pattern of overwintering in Rainy Lake and then a portion of the population moving upstream to the Highway 11 bridge/Sturgeon Falls area during May, June and July (Figure 3-3). Most fish then make their way back to Rainy Lake by late summer/early fall with very few fish overwintering in the Seine River (Figure 3-4). A similar pattern was shown with the additional 9 sturgeon which were implanted with transmitters in the spring of 2013. 100% of these fish were present in the river during May and June but by September, almost 80% of them had moved into Rainy Lake. Between half and two thirds of the sturgeon implanted in 2011 were observed each year in the Seine River between 2012 and 2014 (Figure 3-5).

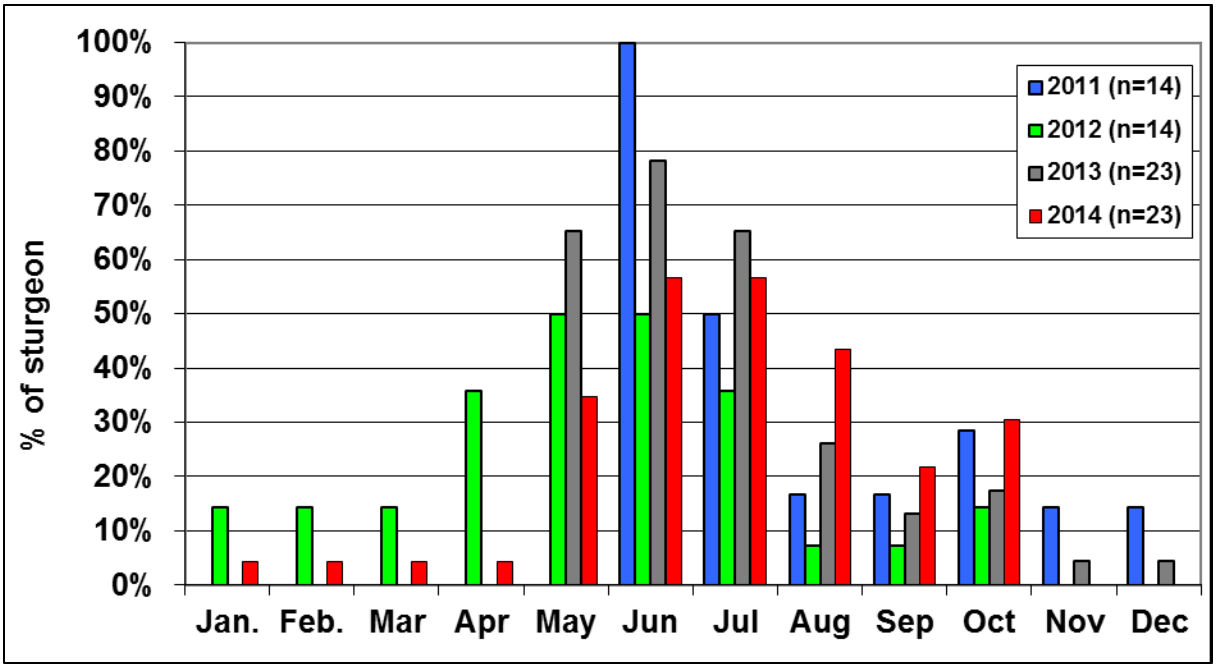


Figure 3-3. Proportion of tracked sturgeon detected in the Seine River by month between June 2011 and October 2014.

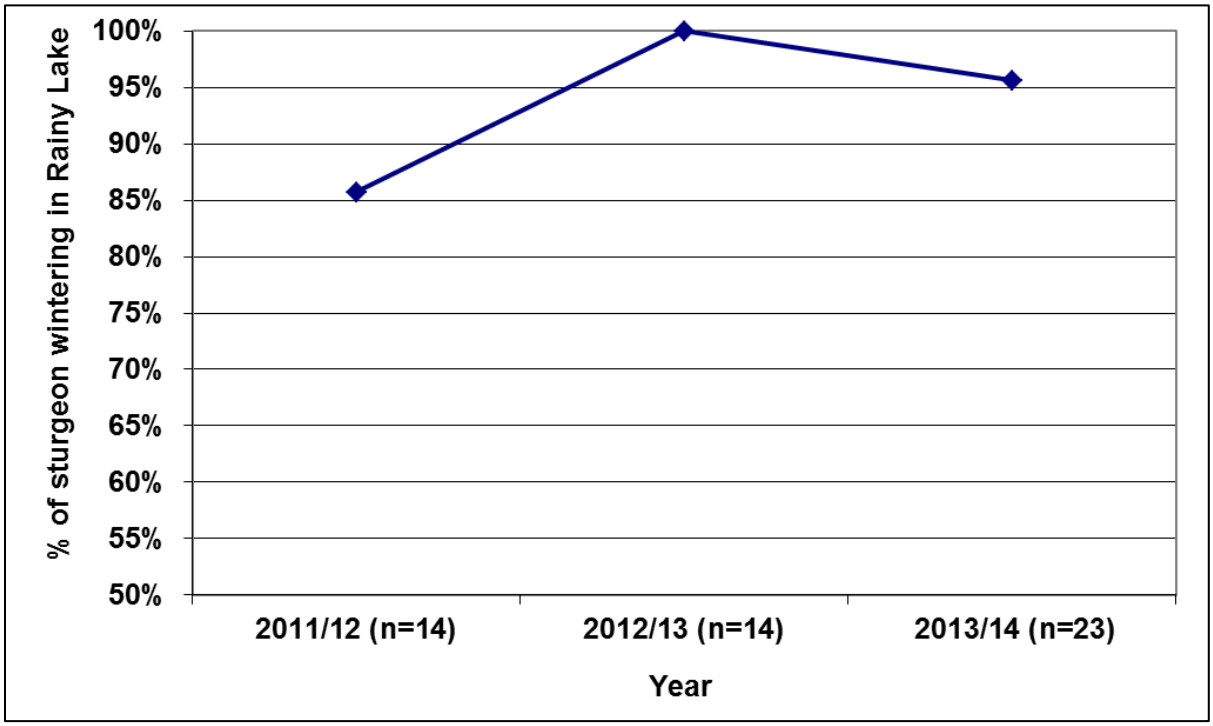


Figure 3-4 Proportion of tracked sturgeon thought to have wintered in Rainy Lake by year between 2011/12 and 2013/14

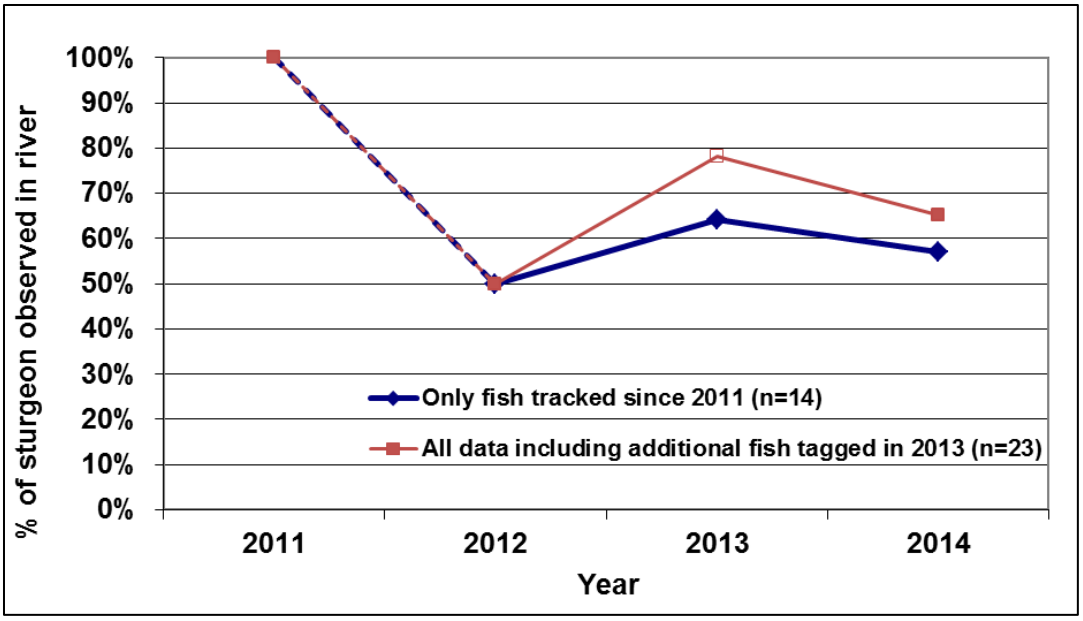


Figure 3-5 Proportion of tracked sturgeon detected in the Seine River by year between 2011 and 2014.

The proportion of the fish that were detected in potential spawning areas at the Hwy 11 bridge and below Sturgeon Falls dam between 2012 and 2014 ranged from 35% to 50% of fish at the Hwy. 11 bridge and 20%-35% of fish below Sturgeon Falls dam (Figure 3.6). The proportion detected in 2014 declined from 2013 observations to approximately the same levels as 2012.

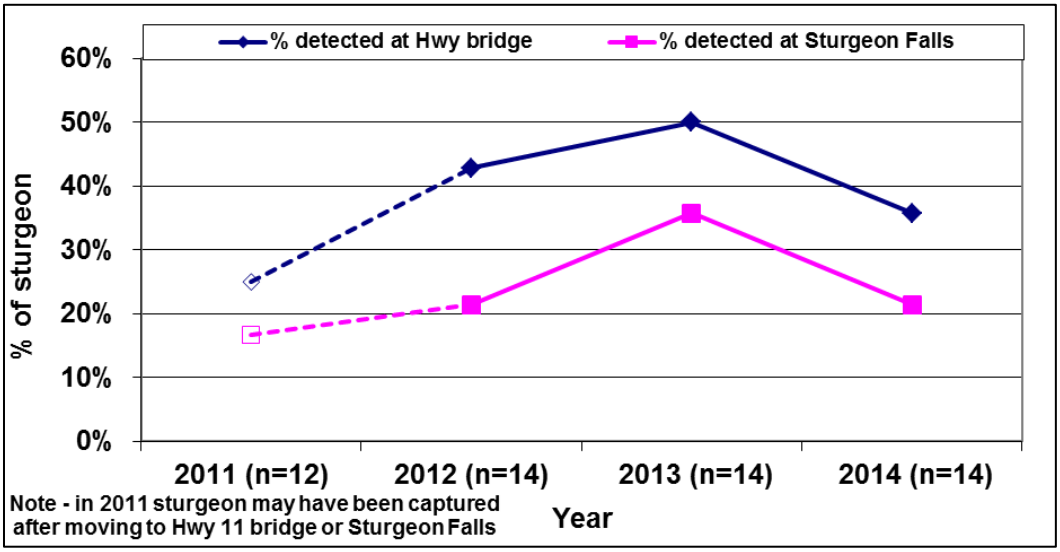


Figure 3-6 Proportion of sturgeon detected at potential Seine River spawning locations between May 1 and July 15 in 2012 and 2014 (only data for sturgeon tracked from 2011 – n=14)

In 2012, there was a maximum of 4 fish detected on May 10th at the Highway 11 bridge and generally fish present for much of May but mostly absent by June 15th. (Figure 3-7). In 2013 and 2014, the number of fish detected peaked on May 30th on both years. In 2013, fish were detected at the Highway bridge to July 15th while in 2014, there were only sporadic detections of fish after June 15th.

Much fewer sturgeon were detected at the Sturgeon Falls site than at the area below the Highway 11 bridge (Figure 3-8). The number of fish detected never exceeded 1/day in 2012 and most observations occurred in May. In 2013, sturgeon were first detected on June 4th and detections peaked at 5 fish/day on July 3rd with few observations after July 5th . In 2014, the number of observations/day peaked at 3 on June 3rd and never exceeded 1 per day after June 5th.

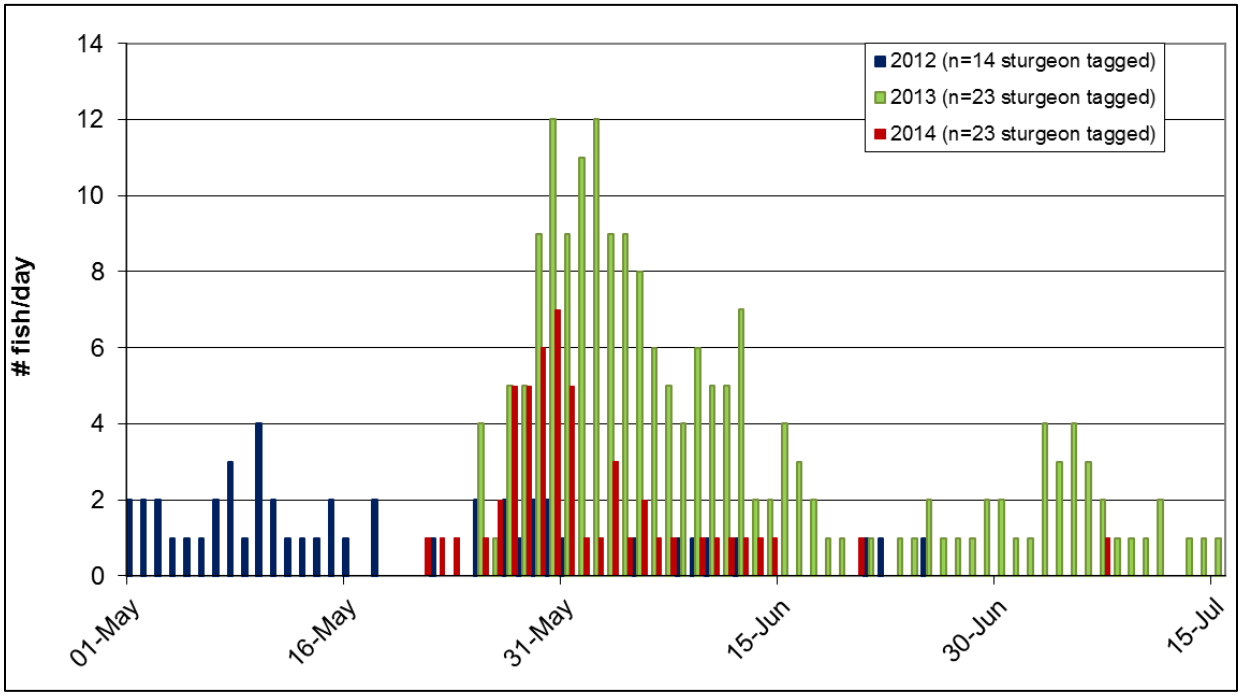


Figure 3-7 Number of fish detected/day at the Hwy 11 bridge site 2012-2014 for the period between May 1 and July 31.

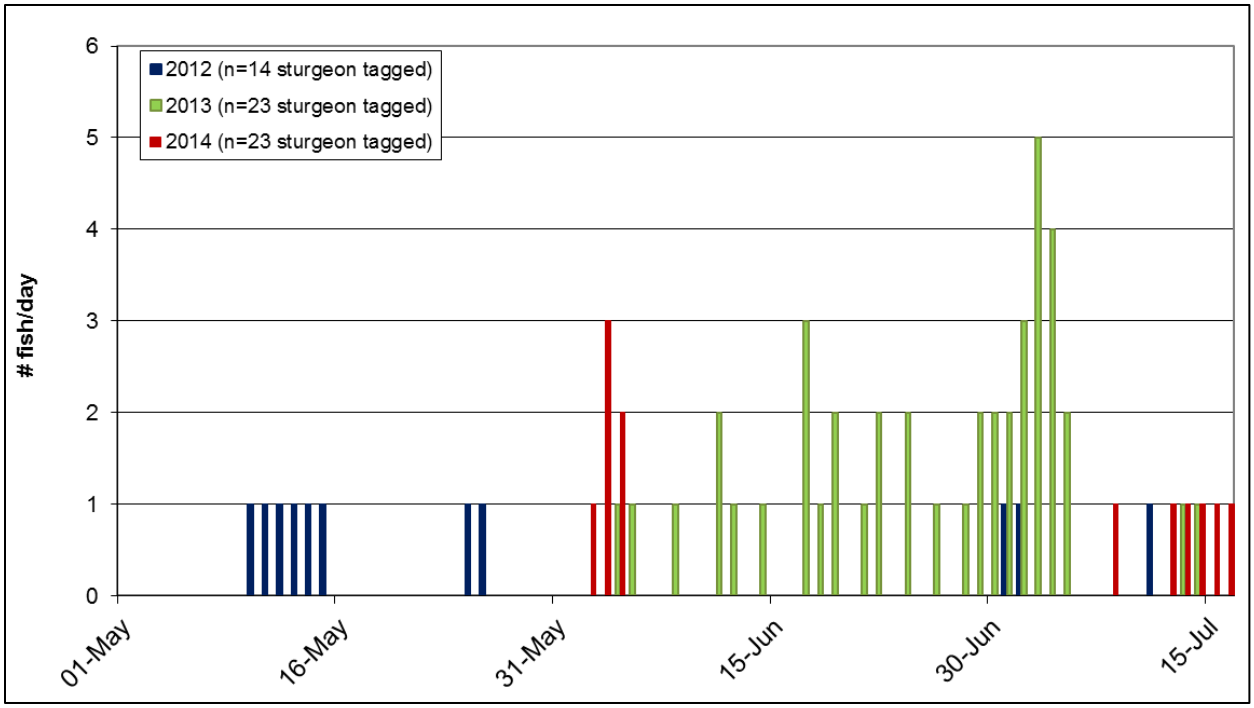


Figure 3-8 Number of fish detected/day at Sturgeon Falls dam in 2012-2014 for the period between May 1 and July 31.

Studies of lake sturgeon have found the spawning frequency to be every 2-3 years for males and 4-9 years for females (Mosindy and Rusak 1991). In spite of this, a number of tagged fish have made spring movements to spawning areas more frequently than the expected spawning frequency. For the 14 fish that were tagged in 2011, one fish (7%) has been observed in the spawning area every year between 2011 and 2014 and four (29%) have been detected in 3 of 4 years. Only 5 (36%) have been detected in the spawning area once over that period.
For the 9 fish tagged in 2013, 4 (45%) have been observed in both 2013 and 2014 while 5 (55%) were only observed in 2013. It is very possible that some of these sturgeon detected at the Highway 11 bridge and Sturgeon Falls dam are engaging in spring migration movements without taking part in spawning activities.

Water Temperatures during the Spring Spawning Period

Water temperatures in the area below Sturgeon falls were measured at the Highway 11 bridge in 2011 and 2012 and at the Sturgeon Falls dam tailrace in 2013 and 2014. Temperatures have varied greatly between 2011 and 2014 with the date water temperatures reached 10°C ranging from as earlier as May 11th in 2012 to as late as about June 4th in 2013 (Figure 3-9).

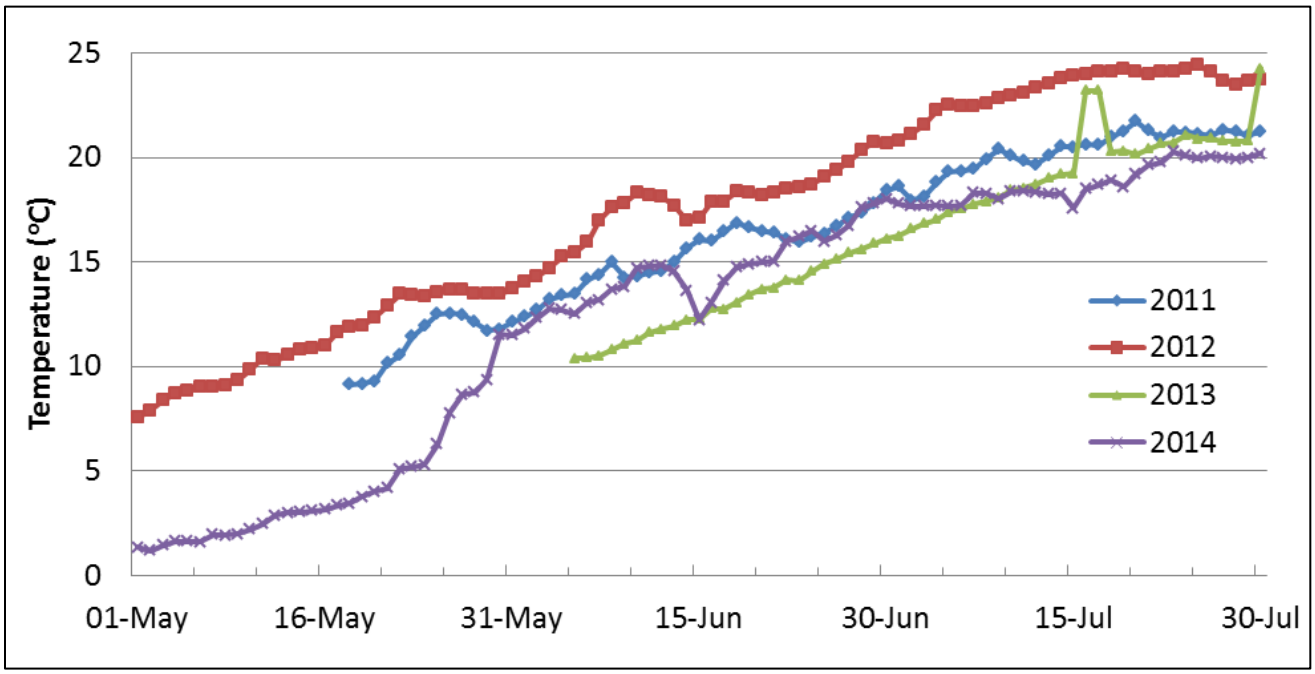


Figure 3-9: Water temperatures in sturgeon spawning area – (2011-2012 at highway bridge/2013-2014 measured at Sturgeon Falls dam tailrace.

The peak number of sturgeon detected at the Highway 11 bridge tends to correspond with water temperatures of approximately 10°C which has been identified as the beginning of the spawning period for lake sturgeon in Ontario (Golder 2011).

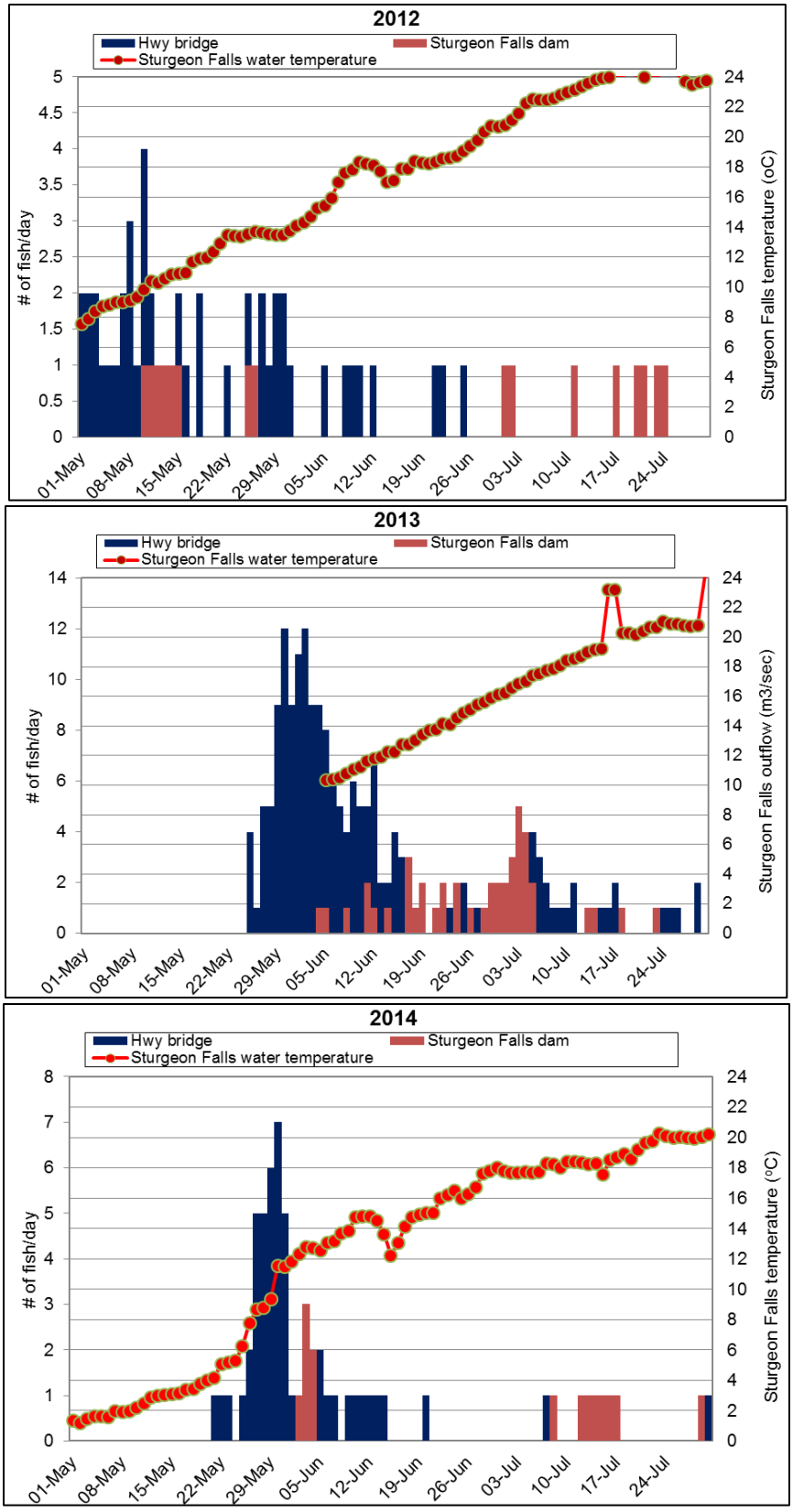


Figure 3-10. Number of sturgeon detected/day at the Highway 11 bridge and at Sturgeon Falls dam with the daily average water temperatures for 2012-2014

Water Flows during the Spring Spawning Period

Adequate flows are required to attract adult lake sturgeon to suitable spawning habitat, to keep eggs clean and oxygenated during development, and to carry larvae downstream once they hatch. Due to the climatic differences between the years of study, flows varied substantially between 2011 and 2014 (Figure 3-11). Increased spring precipitation and late spring freshet in 2013 and 2014 resulted in higher flows compared to 2011 which has less precipitation over the same period. A very early spring in 2012 resulted in average flows entering the spawning period although high precipitation over the upper part of the watershed in June resulted in high flows for the last part of the spawning period.

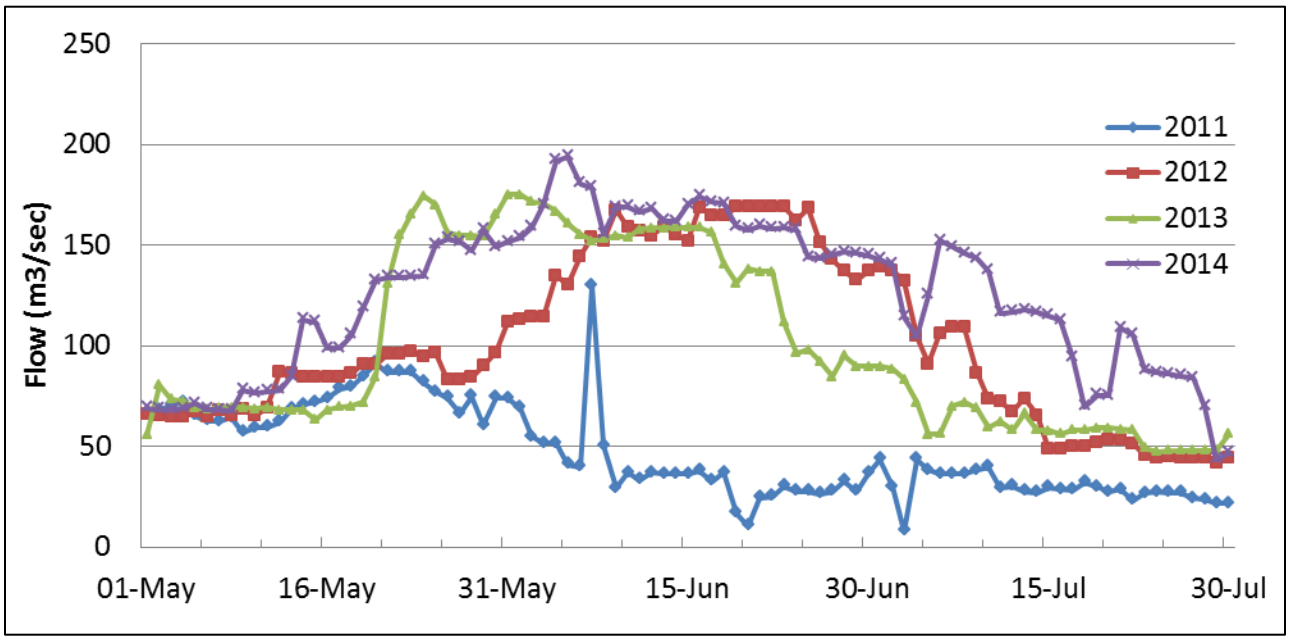


Figure 3-11: Daily average flows at the Sturgeon Falls generating station from 2011 to 2013 showing the annual variation in flows likely due to natural yearly variation in precipitation (snowmelt and rain).

The number of sturgeon detected/day at the Highway 11 bridge and at Sturgeon Falls dam is shown with the daily average flow for 2012-2014 ((Figure 3-12).

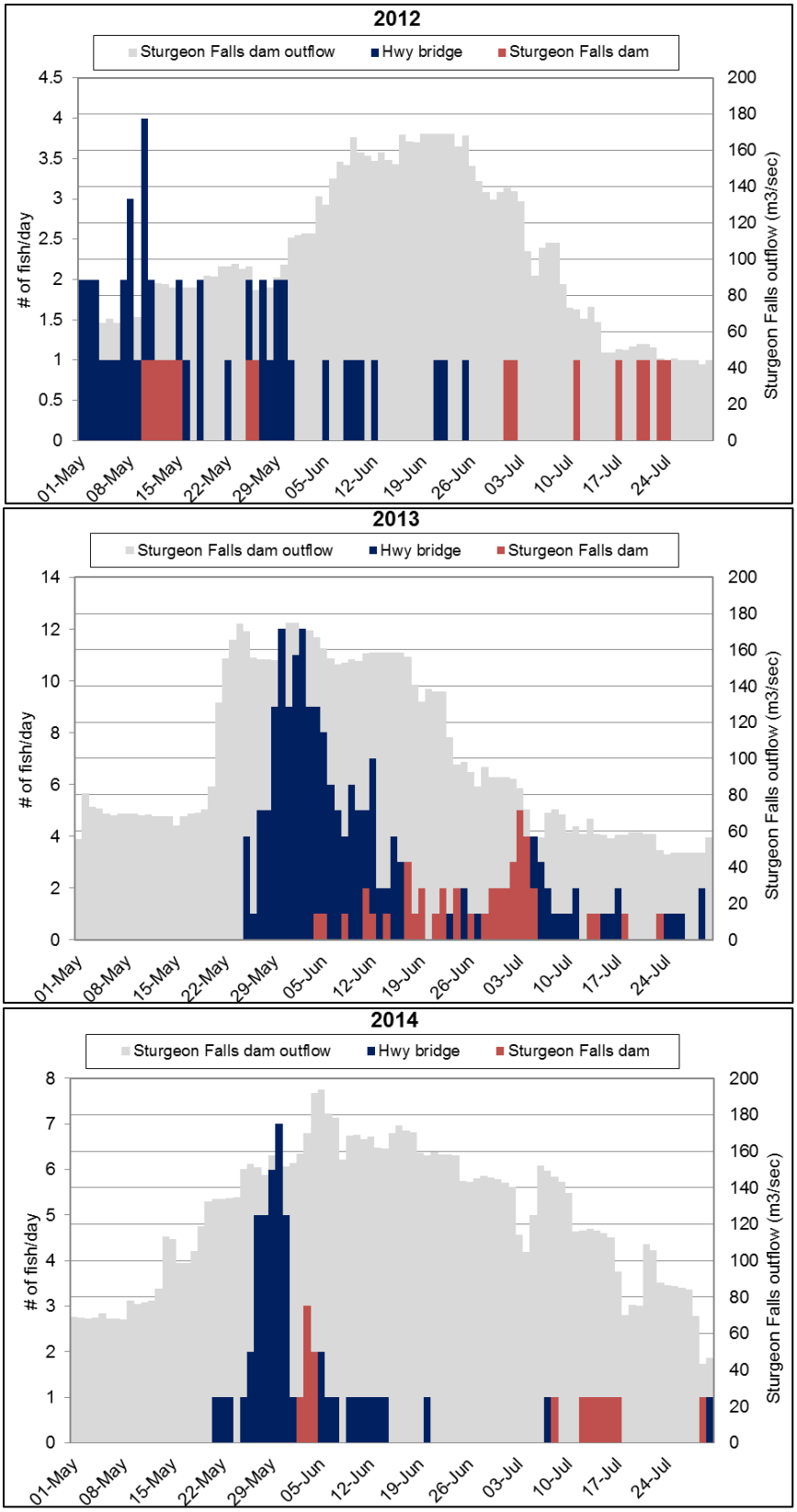


Figure 3-12. Number of sturgeon detected/day at the Highway 11 bridge and at Sturgeon Falls dam with the daily average flow for 2012-2014

Summary

After monitoring movement of 14 sturgeon in the Seine River between spring of 2011 and fall of 2014, we have confirmed that lake sturgeon make annual spring movements upstream from Rainy Lake into the Seine River to spawning locations downstream of the Sturgeon Falls generating station and at the Highway 11 bridge site. An additional 10 sturgeon were implanted with transmitters in spring of 2013 which increased the sample size of fish in the short term and will also extend the duration of the movement monitoring study. It appears that most lake sturgeon are spending fall and winter in Rainy Lake with some moving into the river during the spring and then returning to Rainy Lake during the summer/early fall. Additional receivers have been installed in the river to increase our knowledge of sturgeon movements within the system. This will help to narrow in on the specific timing that lake sturgeon move into the river and to specific spawning sites. There are also questions about the relationship between fish spawning in the Seine River and those spawning at other locations in Rainy Lake such as the Namakan River inflow (Squirrel/Kettle Falls) or the Turtle River (Sand Island Falls). Additional receivers have been placed in Rainy Lake sites to help with understand the relationship between sturgeon living within the Rainy Lake system.

Movement into spawning areas has been observed at total flows at the Sturgeon Falls dam ranging from 60 m^3/sec to 160 m^3/sec

Acknowledgements

Much thanks to the many people have been involved in all aspects this project.

The following people have assisted in the field work portion of the study:
Tom Johnson (SRFN)
Pat Kabatay (SRFN)
Mike Kabatay (SRFN)
John Kabatay Jr. (SRFN, technician)
Myron Johnson (SRFN, technician)
Nathan Boshkaykin (SRFN, technician)

Amy Godwin (MNR, Management Biologist)
Lisa Solomon (Quetico Park Biologist)
Michelle Desaulniers (Quetico Park biologist's assistant)
Brian Jackson (MNR Area Biologist)
Phil DeCorte (MNR SEP Student)
Brittaney Emms-Richards (MNR Area Tech)
Luke Richards (MNR Area Tech)
Sheldon Haw (MNR Area Tech)
Jeannine Barna (MNR, Business Services Clerk)
Jesse Anderson (Atikokan High School Co-Op student)
Morey Green (MNR, SEP student)
Mallory Miller (MNR Area Tech)
Sean Thibert (MNR SEP Student)
Tim Cano (MNR NWSI)

Ryan Haines (Ryan Haines Consulting)
Paul Cooley (North/South Consultants)
Cam Barth (North/South Consultants)

References

Adams, W.E., Kallemeyn, L.W., and Willis, D.W. 2006. Lake sturgeon, *Acipenser fulvescens*, movements in Rainy Lake, Minnesota and Ontario. Canadian Field-Naturalist. 120(1): 71-82.

Barth, C.C., Anderson, W.G., Henderson, L.M. and Peake, S.J. 2011. Home range size and season movement of juvenile lake sturgeon in a large river in the Hudson Bay drainage basin. Transactions of the American Fisheries Society. **140**: 1629-1641.

Barth, C.C. 2011. Ecology, behaviour, and biological characteristics of juvenile lake sturgeon, *Acipenser fulvescens*, within an impounded reach of the Winnipeg River, Manitoba, Canada. PhD Thesis, University of Manitoba. Winnipeg, Manitoba. 221 pp.

Benson, A.C., Sutton, T.M., Elliott, R.F., and Meronek, T.G.. 2006. Biological attributes of age-0 lake sturgeon in the lower Peshtigo River, Wisconsin. J. Appl. Ichthyol. **22**: 103-108.

Boileau, D. 2004. 2004 to 2014 Seine River Water Management Plan. Seine River Watershed Information: Water Mgmt Plan. http://www.seineriverwmp.com/ApprovedWMP_28May2004.pdf 199p + appendices

Chiasson, W.B., Noakes, D.L.G. and Beamish, F.W.H. 1997. Habitat, benthic prey, and distribution of juvenile lake sturgeon (*Acipenser fulvescens*) in northern Ontario rivers. Can. J. Aquat. Sci. 54: 2866-2871.

Godwin, A. 2013. Fish Community Objectives for the Seine River System. Ont. Min. Natur. Resour. Ft. Frances Dist. - Atikokan. 39 pp.

Golder Associates Ltd. 2011. Recovery Strategy for Lake Sturgeon (*Acipenser fulvescens*) – Northwestern Ontario, Great Lakes-Upper St. Lawrence River and Southern Hudson Bay-James Bay populations in Ontario. Ontario Recovery Strategy Series. Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario. vii + 77 pp.

Hansen, M. J.; Beard, T. D., Jr; Hayes, D. S. 2007: Sampling and experimental design. In: Analysis and Interpretation of Freshwater Fisheries Data. C. S. Guy, M. L. Brown (Eds). American Fisheries Society, Bethesda, MD, pp. 51–120.

Hartviksen, C. and Momot, W. 1987. Fishes of the Thunder Bay area of Ontario. Wildwood Publications: Thunder Bay.

Haxton, T. 2011. Depth selectivity and spatial distribution of juvenile lake sturgeon in a large, fragmented river. J. Appl. Ichthyol. **27** (Suppl. 2): 45-52.

Kerr, S. J., M. J. Davison and E. Funnell. 2010. A review of lake sturgeon habitat requirements and strategies to protect and enhance sturgeon habitat. Fisheries Policy Section, Biodiversity Branch. Ontario Ministry of Natural Resources. Peterborough, Ontario. 58 p. + appendices.

McLeod, D.T. 1999. An assessment of lake sturgeon populations in the Lower Seine River System, Ontario 1993-95. OMNR. Fort Frances District. District Report Series No. 43.

McLeod, D. and C. Debruyne. 2009. Movement and seasonal distribution of lake sturgeon in the Namakan River, Ontario. Preliminary Report 2007-08. Ontario Ministry of Natural Resources. Fort Frances District Report Series No. 82. 89 p.

McLeod, D. and D. Denyes. 2012. Movement and seasonal distribution of lake sturgeon in the Namakan River, Ontario. Progress Report (Update) 2007-11. Ontario Ministry of Natural Resources. Fort Frances District Report Series No. 92. 63 p.

Mosindy, T. S. and J. Rusak. 1991. An assessment of lake sturgeon populations in Lake of the Woods and the Rainy River, 1987-90. Lake of the Woods Fisheries Assessment Unit Report 1991-01. Ontario Ministry of Natural Resources. Kenora, Ontario. 66 pp.

Secor, D. H.; Anders, P. J.; Van Winkle, W.; Dixon, D. A., 2002: Can we study sturgeons to extinction? What we do and don't know about the conservation of North American Sturgeons. Am. Fish. Soc. Symp. 28, 3-10.

Shaw, S.L. 2010. Lake sturgeon (Acipenser fulvescens) population attributes, reproductive structure and distribution in Namakan Reservoir, Minnesota and Ontario. MSc Thesis. South Dakota State University. 77 p + appendices.

Solomon, L. and C. Baljko. 2011. A population assessment of lake sturgeon in Sturgeon Lake, Quetico Provincial Park: 2008-2010, Completion Report. Ontario Parks.

Stewig, J.D.. 2005. Completion Report: A population assessment of the lake sturgeon in Lake of the Woods and the Rainy River, 2004. Minnesota Department of Natural Resources, Division of Fisheries. Minnesota. 38pp.

Trembath, C. 2013. An assessment of juvenile lake sturgeon movement and habitat use in the Namakan River of northwestern Ontario. MSc thesis. Lakehead University. 32 p.

Trembath, C., Windels, S., McLeod, D., McLaren, B., Chipps, S., and Mackereth, R. 2011. Lake sturgeon research in the Namakan System: 2010 Progress Report. Report to Voyageurs National Park. Released August 4, 2011. 24p.

Appendix I – Adult Netting Data

App1-1: Lake sturgeon data from fish captured in in large mesh nets from the Seine River during the 2011 - 2013 field seasons.

Year of capture	Fish No.	Girth (cm)	Fork Length (cm)	Total Length (cm)	Weight (kg)	Sex	Age (years)	Acoustic Transmitter ID	PIT Tag ID
2011	2011-1	50.9	122.8	136.9	16.6	male	32	31756	
2011	2011-2	37.9	91.0	102.7	8.0	unknown	11	31742	
2011	2011-3	41.8	111.1	119.9	11.8	unknown	25	31745	
2011	2011-4	41.3	104.7	117.6	11.0	unknown	17	31753	
2011	2011-5	40.8	107.0	120.1	9.5	unknown	No Age, Leading ray eroded away	31748	
2011	2011-6	37.2	98.6	109.7	7.5	unknown	10	31754	
2011	2011-7	39.7	99.8	112.5	8.2	unknown	16	31751	
2011	2011-8	44.1	102.1	111.4	9.9	male	18	31743	
2011	2011-9	45.4	107.3	113.5	11.2	unknown	16	31744	
2011	2011-10	42.9	112.6	125.0	12.1	unknown	15	31755	
2011	2011-11	44.5	104.0	116.4	10.8	unknown	16	31747	
2011	2011-12	43.1	102.4	106.3	10.0	unknown	17	31746	
2011	2011-13	43.1	106.0	117.5	7.4	unknown	16	31750	
2011	2011-14	38.6	104.2	117.5	9.0	unknown	No Age, Leading ray eroded away	31749	
2012	2012-1	42.5	113.5	122.4	9.4	male	No Age; No main ray - looked like cartilage		900 1180 01555501
2012	2012-2	51.5	130.5	142.0	18.8	unknown	25		900 1180 01558668
2012	2012-3	51.5	121.5	131.5	18.1	unknown	27		900 1180 01556947
2012	2012-4	44.6	111.0	123.0	13.5	unknown	17		900 1180 01559826
2012	2012-5	39.9	98.0	109.5	8.0	unknown	13		900 1180 01556231
2012	2012-6	41.8	100.0	108.0	9.0	unknown	13		900 1180 01561397
2012	2012-7	45.4	110.0	112.4	12.0	unknown	19		900 1180 01558381
2013	2013-1	41.9	106.1	119.5	9.5	unknown	19	27356	989 0010 00524348
2013	2013-2	50.2	123.6	136.1	16.3	male	34	27353	989 0010 00524344
2013	2013-3	44.5	106.2	115.2	11.4	male	14	27354	989 0010 00524330
2013	2013-4	43.8	104.5	115.0	9.1	male	20	-	989 0010 00524339
2013	2013-5	45.7	126.1	139.8	14.1	male	25	27350	989 0010 00524351
2013	2013-6	40.0	112.2	125.9	10.0	male	16	27355	989 0010 00524354
2013	2013-7	47.6	116.8	129.5	12.7	unknown	19	-	989 0010 00519880
2013	2013-8	43.2	101.2	110.9	8.2	unknown	12	27351	989 0010 00519873
2013	2013-9	49.5	115.5	127.3	14.1	female	20	27352	989 0010 00519876
2013	2013-10	50.2	113.2	126.1	13.2	female	19	27347	989 0010 00519889
2013	2013-11	43.8	111.4	124.9	11.4	female	21	27348	989 0010 00519905
2013	2013-12	45.7	118.5	130.6	9.5	unknown	27	-	989 0010 00519916
2013	2013-13	43.8	109.2	123.4	10.4	unknown	20	-	989 0010 00519898
2013	2013-14	47.0	107.1	120.3	9.5	male	17	-	989 0010 00519892
2013	2013-15	50.2	124.0	139.5	15.9	male	27	-	989 0010 00519919
2013	2013-16	57.8	139.2	142.7	23.2	female	26	27349	989 0010 00519885
2013	2013-17	41.5	113.0	122.0	12.3	unknown	25	-	900 1180 0557154
2013	2013-18		106.0	118.1	13.2	unknown	24		900 2360 00039068
2013	2013-19	45.6	111.5	121.5	14.8	unknown			899 1180 01003252

n=	39	40	40	40		36
Average:	44.6	110.6	121.6	11.8		19.7
Max :	57.8	139.2	142.7	23.2		34.0
Min :	37.2	91.0	102.7	7.4		10.0

Appendix II - Juvenile Netting Data

App2-1: Juvenile lake sturgeon data from fish captured in the Seine River in 2012-2013.

Netting Agency	Sample	Fish #	Species	Date	River Stretch	Net site	Gear	Mesh Size	Surface Water Temp	Start Depth	End Depth	Max Depth	FLEN (mm)	TLEN (mm)	RWT (g)	Age	Year Class	Condition (Fulton's K- FL)	PIT TAG	Clip Applied
MNR	J6	2012-J1	31	12/05/2012	3	12-J6	multi		13.5	8.6	10.1	10.1	529	599	970	4	2008	0.66	900118001566902	LP
MNR	J64	2012-J2	31	12/06/2012	5	12-J8	mono	38	17.8	7.1	10.2	10.2	406	455	470	3	2009	0.70	900118001560702	LP
MNR	J3-1	2013-J1	31	18/06/2013	5	13-J3	mono	38	16.9	2.8	6.5	6.5	207	237	90			0.68	900118001560408	LP
MNR	J1-2	2013-J2	31	19/06/2013	5	13-J1	mono	76	16.0	5.0	13.0	13.0	555	620	1520			0.89	900118001567625	LP
MNR	J4-3	2013-J3	31	24/09/2013	3	13-J4	multi	64	17.1	5.5	7.0	7.0	261	294	70	1	2012	0.39	900236000039085	LP
MNR	J10-1	2013-J4	31	09/10/2013	3	13-J10	mono	38	13.5	13.0	15.0	15.0	185	210	20	0	2013	0.32		LP
MNR	J10-1	2013-J5	31	09/10/2013	3	13-J10	mono	38	13.5	13.0	15.0	15.0	180	207	15	0	2013	0.26		LP
MNR	J10-1	2013-J6	31	09/10/2013	3	13-J10	mono	38	13.5	13.0	15.0	15.0	176	199	15	0	2013	0.28		LP
MNR	J12-1	2013-J7	31	10/10/2013	5	13-J12	multi		12.4	13.0	16.2	16.2	234	325	130			1.01	900118001557448	LP
NS		1	31	01/10/2013	9	JUV-005	multi	76		11.0	9.0	17.1	481	546	700	5	2008	0.63	-	LP
NS		2	31	01/10/2013	9	JUV-005	multi	76		11.0	9.0	17.1	499	566	800	4	2009	0.64	900236000089084	LP
NS		3	31	01/10/2013	9	JUV-005	multi	76		11.0	9.0	17.1	539	597	1000	5	2008	0.64	900236000089023	LP
NS		4	31	01/10/2013	9	JUV-005	multi	76		11.0	9.0	17.1	532	613	900	4	2009	0.60	900236000089070	LP
NS		5	31	01/10/2013	9	JUV-005	multi	76		11.0	9.0	17.1	486	560	700	5	2008	0.61	-	LP
NS		6	31	01/10/2013	9	JUV-005	multi	76		11.0	9.0	17.1	541	608	1050	4	2009	0.66	900236000089062	LP
NS		7	31	01/10/2013	9	JUV-005	multi	76		11.0	9.0	17.1	515	586	900	4	2009	0.66	900236000089056	LP
NS		8	31	01/10/2013	9	JUV-005	multi	76		11.0	9.0	17.1	446	510	600	4	2009	0.68	900236000089015	LP
NS		9	31	01/10/2013	9	JUV-005	multi	152		11.0	9.0	17.1	496	555	700	4	2009	0.57	-	LP
NS		10	31	01/10/2013	9	JUV-005	multi	152		11.0	9.0	17.1	537	620	950	4	2009	0.61	900236000089047	LP
NS		11	31	01/10/2013	9	JUV-005	multi	51		11.0	9.0	17.1	518	587	800	5	2008	0.58	900236000089031	LP
NS		12	31	01/10/2013	9	JUV-005	multi	51		11.0	9.0	17.1	496	552	800	5	2008	0.66	900236000089038	LP
NS		13	31	01/10/2013	9	JUV-005	multi	51		11.0	9.0	17.1	270	308	100	2	2011	0.51	-	LP
NS		15	31	01/10/2013	9	JUV-005	multi	127		11.0	9.0	17.1	542	615	1050	5	2008	0.66	-	LP
NS		16	31	01/10/2013	9	JUV-005	multi	127		11.0	9.0	17.1	522	601	1000	5	2008	0.70	900236000089092	LP
NS		17	31	01/10/2013	9	JUV-005	multi	127		11.0	9.0	17.1	521	590	900	4	2009	0.64	900236000089063	LP
NS		18	31	01/10/2013	9	JUV-005	multi	127		11.0	9.0	17.1	516	584	2000	5	2008	1.46	900236000089013	LP
NS		19	31	01/10/2013	9	JUV-005	multi	127		11.0	9.0	17.1	506	575	800	4	2009	0.62	-	LP
NS		20	31	01/10/2013	9	JUV-005	multi	127		11.0	9.0	17.1	542	616	1000	4	2009	0.63	-	LP
NS		21	31	01/10/2013	9	JUV-005	multi	127		11.0	9.0	17.1	535	609	950	5	2008	0.62	-	LP
NS		22	31	01/10/2013	9	JUV-005	multi	127		11.0	9.0	17.1	485	501		5	2008	0.00	-	LP
NS		23	31	01/10/2013	9	JUV-005	multi	127		11.0	9.0	17.1	622	711	1500	5	2008	0.62	-	LP
NS		24	31	01/10/2013	9	JUV-005	multi	127		11.0	9.0	17.1	467	552	600	5	2008	0.59	-	LP
NS		25	31	01/10/2013	9	JUV-005	multi	127		11.0	9.0	17.1	515	594	950	5	2008	0.70	-	LP
NS		26	31	01/10/2013	9	JUV-005	multi	127		11.0	9.0	17.1	471	523	625	4	2009	0.60	-	LP
NS		27	31	01/10/2013	9	JUV-004	multi	127		9.5	7.5	19.2	562	642	1150	5	2008	0.65	-	LP
NS		28	31	01/10/2013	9	JUV-004	multi	127		9.5	7.5	19.2	532	605	800	4	2009	0.53	-	LP
NS		29	31	01/10/2013	9	JUV-004	multi	127		9.5	7.5	19.2	668	756	1800	4	2009	0.60	-	LP
NS		30	31	01/10/2013	9	JUV-004	multi	127		9.5	7.5	19.2	551	629	1100	4	2009	0.66	-	LP
NS		31	31	01/10/2013	9	JUV-004	multi	127		9.5	7.5	19.2	640	716	1650	5	2008	0.63	-	LP
NS		32	31	01/10/2013	9	JUV-004	multi	127		9.5	7.5	19.2	540	616	1050	4	2009	0.67	-	LP
NS		33	31	01/10/2013	9	JUV-004	multi	127		9.5	7.5	19.2	548	629	950	4	2009	0.58	-	LP
NS		34	31	01/10/2013	9	JUV-004	multi	127		9.5	7.5	19.2	532	606	1000	4	2009	0.66	-	LP
NS		35	31	01/10/2013	9	JUV-004	multi	127		9.5	7.5	19.2	531	612	1000	5	2008	0.67	-	LP
NS		36	31	01/10/2013	9	JUV-004	multi	127		9.5	7.5	19.2	516	589	800	4	2009	0.58	-	LP
NS		37	31	01/10/2013	9	JUV-004	multi	127		9.5	7.5	19.2	510	586	800	4	2009	0.60	-	LP
NS		38	31	01/10/2013	9	JUV-004	multi	127		9.5	7.5	19.2	416	482	500	4	2009	0.69	-	LP
NS		39	31	01/10/2013	9	JUV-004	multi	51		9.5	7.5	19.2	279	308	100	1	2012	0.46	-	LP
NS		40	31	01/10/2013	9	JUV-004	multi	152		9.5	7.5	19.2	558	629	1000	5	2008	0.58	900236000089086	LP
NS		41	31	01/10/2013	9	JUV-004	multi	76		9.5	7.5	19.2	579	668	1250	5	2008	0.64	900236000089010	LP
NS		42	31	01/10/2013	7	JUV-003	multi	152		9.4	14.2	14.2	458	485	550	4	2009	0.57	900236000089005	LP
NS		43	31	01/10/2013	5	JUV-002	multi	127		10.2	9.0	14.2	558	642	1200	4	2009	0.69	900236000089099	LP
NS		44	31	01/10/2013	5	JUV-002	multi	152		10.2	9.0	14.2	622	725	1900	5	2008	0.79	900236000089057	LP
NS		45	31	01/10/2013	5	JUV-002	multi	76		10.2	9.0	14.2	292	331	300	2	2011	1.20	-	LP
NS		46	31	01/10/2013	5	JUV-002	multi	76		10.2	9.0	14.2	301	336	100	1	2012	0.37	-	LP
NS		47	31	01/10/2013	5	JUV-002	multi	76		10.2	9.0	14.2	170	195		0	2013	0.00	-	LP
NS		48	31	01/10/2013	5	JUV-002	multi	76		10.2	9.0	14.2	165	186		0	2013	0.00	-	LP
NS		49	31	09/10/2013	5	JUV-001	multi	127		5.5	12.5	12.5	270	296	100	1	2012	0.51	-	LP
NS		50	31	03/10/2013	9	JUV-007	multi	127		5.5	2.4	14.5	610	696	1800	5	2008	0.70	900236000089087	LP
NS		51	31	03/10/2013	9	JUV-007	multi	127		5.5	2.4	14.5	520	601	950	4	2009	0.68	-	LP
NS		52	31	03/10/2013	9	JUV-007	multi	152		5.5	2.4	14.5	591	661	1300	5	2008	0.63	-	LP
NS		53	31	03/10/2013	9	JUV-007	multi	152		5.5	2.4	14.5	529	591	900	5	2008	0.61	-	LP
NS		54	31	03/10/2013	9	JUV-008	multi	127		6.3	3.5	15.9	520	594	900	4	2009	0.64	-	LP
NS		55	31	03/10/2013	9	JUV-008	multi	127		6.3	3.5	15.9	556	606	1175	5	2008	0.68	-	LP
NS		56	31	03/10/2013	9	JUV-008	multi	127		6.3	3.5	15.9	504	572	900	5	2008	0.70	-	LP
NS		57	31	03/10/2013	9	JUV-008	multi	51		6.3	3.5	15.9	282	326		1	2012	0.00	-	LP
NS		58	31	03/10/2013	3	JUV-010	multi	76		10.5	11.2	13.0	634	716	1750	4	2009	0.69	-	LP
NS		59	31	03/10/2013	3	JUV-010	multi	76		10.5	11.2	13.0	269	297	100	1	2012	0.51	-	LP
NS		60	31	03/10/2013	3	JUV-010	multi	51		10.5	11.2	13.0	167	191		0	2013	0.00	-	LP
NS		61	31	03/10/2013	3	JUV-011	multi	76		10.5	13.2	13.2	314	351	125	2	2011	0.40	-	LP
NS		62	31	03/10/2013	3	JUV-011	multi	76		10.5	13.2	13.2	306	347	100	1	2012	0.35	-	LP
NS		63	31	03/10/2013	3	JUV-011	multi	51		10.5	13.2	13.2	297	330	100	1	2012	0.38	-	LP
NS		Recap	31	03/10/2013	9	JUV-007	multi	76		5.5	2.4	14.5	463	-	1025	-			-	
NS		Recap	31	03/10/2013	9	JUV-007	multi	127		5.5	2.4	14.5	536	-	2000	-			-	
NS		Recap	31	03/10/2013	9	JUV-007	multi	152		5.5	2.4	14.5	547	-	1025	-			-	
NS		Recap	31	03/10/2013	9	JUV-008	multi	127		6.3	3.5	15.9	523	-	750	-			-	
NS		Recap	31	03/10/2013	9	JUV-008	multi	76		6.3	3.5	15.9	421	-	600	-			-	
NS		Recap	31	03/10/2013	9	JUV-008	multi	76		6.3	3.5	15.9	546	-	900	-			-	
NS		Recap (13)	31	01/10/2013	9	JUV-005	multi	25		11.0	9.0	17.1	516	584	2000	-			900236000089013	
NS		Recap (40)	31	03/10/2013	9	JUV-008	multi	127		6.3	3.5	15.9	558	629	1000	-			900236000089086	

Appendix 2-2: Juvenile lake sturgeon data from fish captured in the Seine River in 2014.

Netting Agency	Sample	Fish #	Date	River Stretch	Net site	Gear	Mesh Size	Surface Water Temp	Start Depth	End Depth	Max Depth	FLEN (mm)	TLEN (mm)	TLEN (cm)	RWT (g)	Age	Year Class	Condition (Fulton's K - FL)	PIT TAG # if recap	PIT TAG # inserted	Previous clip	Clip Applied
SRFN	87-1	**14-1**	23/09/2014	11	14-87	BsM-mono	89	16.5	25.7	26.2	26.2	380	425	42.5	450	2	2012	0.82		98900100376 4222	LP	
SRFN	87-1	**14-2**	23/09/2014	11	14-87	BsM-mono	76	16.5	25.7	26.2	26.2	600	685	68.5	1500	6	2008	0.69		98900100376 4287		LP
SRFN	34-1	**14-3**	23/09/2014	9	14-34	BsM-mono	76	15.6	10.2	12.4	12.4	597	660	66	1350	5	2009	0.63	90022600003 9031		LP	
SRFN	34-1	**14-4**	23/09/2014	9	14-34	BsM-mono	89	15.6	10.2	12.4	12.4	470	530	53	700	5	2009	0.67		98900100376 4278		LP
SRFN	34-1	**14-5**	23/09/2014	9	14-34	BsM-mono	89	15.6	10.2	12.4	12.4	360	400	40	250	2	2012	0.54		98900100376 4292		LP
SRFN	34-1	**14-6**	23/09/2014	9	14-34	BsM-mono	102	15.6	10.2	12.4	12.4	560	651	65.1	1200	5	2009	0.68		98900100376 4290		LP
SRFN	34-1	**14-7**	23/09/2014	9	14-34	BsM-mono	102	15.6	10.2	12.4	12.4	445	515	51.5	550	5	2009	0.62		98900100376 4277		LP
SRFN	34-1	**14-8**	23/09/2014	9	14-34	BsM-mono	102	15.6	10.2	12.4	12.4	627	705	70.5	1600	6	2008	0.65		98900100376 4279		LP
SRFN	56-1	**14-9**	24/09/2014	9	14-56	BsM-mono	127	16.1	12.1	14.1	14.1	580	658	65.8	1250	5	2009	0.64		98900100376 4223		LP
SRFN	56-1	**14-10**	24/09/2014	9	14-56	BsM-mono	89	16.1	12.1	14.1	14.1	635	710	71	1700	6	2008	0.66		98900100376 4263		LP
SRFN	41-1	**14-11**	24/09/2014	9	14-41	BsM-mono	51	15.7	12.1	12.0	12.1	310	360	36	150	1	2013	0.50		98900100376 4272		LP
SRFN	41-1	**14-12**	24/09/2014	9	14-41	BsM-mono	89	15.7	12.1	12.0	12.1	300	330	33	150	1	2013	0.56		98900100376 4254		LP
SRFN	41-1	**14-13**	24/09/2014	9	14-41	BsM-mono	89	15.7	12.1	12.0	12.1	410	455	45.5	375	3	2011	0.54		98900100376 4243		LP
SRFN	41-1	**14-14**	24/09/2014	9	14-41	BsM-mono	89	15.7	12.1	12.0	12.1	370	410	41	350	3	2011	0.69		98900100376 4237		LP
SRFN	41-1	**14-15**	24/09/2014	9	14-41	BsM-mono	127	15.7	12.1	12.0	12.1	380	445	44.5	300	2	2012	0.55		98900100376 4293		LP
SRFN	41-1	**14-16**	24/09/2014	9	14-41	BsM-mono	64	15.7	12.1	12.0	12.1	280	320	32	125	1	2013	0.57		98900100376 4269		LP
SRFN	41-1	**14-17**	24/09/2014	9	14-41	BsM-mono	64	15.7	12.1	12.0	12.1	290	325	32.5	125	1	2013	0.51		98900100376 4221		LP
SRFN	41-1	**14-18**	24/09/2014	9	14-41	BsM-mono	64	15.7	12.1	12.0	12.1	425	460	46	400	2	2012	0.52		98900100376 4296		LP
SRFN	41-2	**14-19**	25/09/2014	9	14-41	BsM-mono	76	15.7	12.3	11.5	12.3	390	435	43.5	300	2	2012	0.51		98900100376 4306		LP
SRFN	41-2	**14-20**	25/09/2014	9	14-41	BsM-mono	89	15.7	12.3	11.5	12.3	435	480	48	500	2	2012	0.61		98900100376 4302		LP
SRFN	41-2	**14-21**	25/09/2014	9	14-41	BsM-mono	102	15.7	12.3	11.5	12.3	590	670	67	1350	6	2008	0.66		98900100376 4280		LP
SRFN	62-2	**14-22**	25/09/2014	9	14-62	BsM-mono	64	15.8	18.2	14.9	18.2	305	330	33	150	1	2013	0.53		98900100376 4252		LP
SRFN	62-2	**14-23**	25/09/2014	9	14-62	BsM-mono	114	15.8	18.2	14.9	18.2	600	680	68	1250	5	2009	0.58		98900100376 4309		LP
SRFN	87-4	**14-24**	26/09/2014	11	14-87	BsM-mono	127	16.1	14.2	12.7	14.2	635	730	73	1650	5	2009	0.64		98900100376 4266		LP
SRFN	56-2	**14-25**	26/09/2014	9	14-56	BsM-mono	114	16.3	14.4	14.3	14.4	375	420	42		2	2012			98900100376 4310		LP
SRFN	56-2	**14-26**	26/09/2014	9	14-56	BsM-mono	51	16.3	14.4	14.3	14.4	290	335	33.5	150	1	2013	0.62		98900100376 4303		LP
SRFN	56-2	**14-27**	26/09/2014	9	14-56	BsM-mono	89	16.3	14.4	14.3	14.4	390	445	44.5	350			0.59		98900100376 4295		LP
SRFN	56-2	**14-28**	26/09/2014	9	14-56	BsM-mono	89	16.3	14.4	14.3	14.4	380	425	42.5	325	2	2012	0.59		98900100376 4238		LP
SRFN	56-2	**14-29**	26/09/2014	9	14-56	BsM-mono	102	16.3	14.4	14.3	14.4	395	450	45	400	2	2012	0.65		98900100376 4284		LP
SRFN	48-1	**14-30**	26/09/2014	7	14-48	BsM-mono	76	16.5	14.2	11.2	14.2	280	320	32	150	1	2013	0.68		98900100376 4264		LP
SRFN	48-1	**14-31**	26/09/2014	7	14-48	BsM-mono	114	16.5	14.2	11.2	14.2	530	600	60	950	5	2009	0.64	90023600003 9005		LP	
SRFN	48-1	**14-32**	26/09/2014	7	14-48	BsM-mono	51	16.5	14.2	11.2	14.2	310	350	35	200	1	2013	0.67		98900100376 4232		LP
SRFN	48-1	**14-33**	26/09/2014	7	14-48	BsM-mono	51	16.5	14.2	11.2	14.2	280	320	32	150	1	2013	0.68		98900100376 4307		LP
SRFN	48-1	**14-34**	26/09/2014	7	14-48	BsM-mono	51	16.5	14.2	11.2	14.2	295	335	33.5	150	1	2013	0.58		98900100376 4265		LP
SRFN	48-1	**14-35**	26/09/2014	7	14-48	BsM-mono	89	16.5	14.2	11.2	14.2	380	425	42.5	350	1	2013	0.64		98900100376 4234		LP
SRFN	48-1	**14-36**	26/09/2014	7	14-48	BsM-mono	127	16.5	14.2	11.2	14.2	430	470	47	500	2	2012	0.63		98900100376 4249		LP
SRFN	48-1	**14-37**	26/09/2014	7	14-48	BsM-mono	64	16.5	14.2	11.2	14.2	315	360	36	200	1	2013	0.64		98900100376 4258		LP
MNR	9-1	**14-38**	25/09/2014	5	14-9	BsM-mono	64	15.6	15.2	7.6	15.2	273	315	31.5	100	1	2013	0.49		98900100376 4212		LP
MNR	10-1	**14-39**	25/09/2014	5	14-10	BsM-mono	89	15.6	15.2	7.6	15.2	278	313	31.3	110	1	2013	0.51		98900100376 4294		LP
MNR	10-1	**14-40**	25/09/2014	5	14-10	BsM-mono	127	15.6	15.2	7.6	15.2	405	462	46.2	400	2	2012	0.60		98900100376 4274		LP
MNR	10-1	**14-41**	25/09/2014	5	14-10	BsM-mono	89	15.6	15.2	7.6	15.2	274	311	31.1	110	1	2013	0.53		98900100376 4271		LP
MNR	10-1	**14-42**	25/09/2014	5	14-10	BsM-mono	114	15.6	15.2	7.6	15.2	318	354	35.4	140	1	2013	0.44		98900100376 4308		LP
MNR	10-2	**14-43**	26/09/2014	5	14-10	BsM-mono	64	16.3	11.6	15.2	15.2	280	319	31.9	105	1	2013	0.48		98900100376 4268		LP
																			Recaps (PIT tags)	New PIT's	aps (LP	new clips
																			2	41	3	40
						n =	43	43	43	43	43	43		42	42	42	42					
						average =	16	14	13	14	406	458		537	3	2011	0.60					
						min =	15.6	10.2	7.6	12.1	273	311		100	1	2008	0.44					
						max =	16.5	25.7	26.2	26.2	635	730		1700	6	2013	0.82					

Appendix 3-1: Juvenile lake sturgeon gill net specifications.

- a) OMNR Multifilament nets (2012-2013):

ONTARIO MNR JUVENILE MULTIFILAMENT FISH GEAR SPECIFICATIONS (30m NET)				
Stretch measure (in.)	1.5	2	2.5	3
Stretch measure (mm)	38	51	64	76
Multifilament diameter	210/3	210/3	210/3	210/3
Series order	1	2	3	4
Panel length (m)	7.5	7.5	7.5	7.5
Panel length (ft.)	25	25	25	25
Panel height (m)	1.83	1.83	1.83	1.83
Panel height (ft.)	6	6	6	6
Material and colour	light green multifilament			
Float Line	13mm (1/2" Braided polyfoam floatline)			
Leaded Line	no. 60 (60 LBS/600 ft. = 10.0 LBS/100 ft. net)			
Bridle length	4 ft sinking line (non-matching color - 4.0mm sideline)			
Mesh labels	yes (mm) - high visibility bird bands			
Special notes	Use braided cross ties for better vertical support			

- b) OMNR Monofilament nets (2012-2013):

ONTARIO MNR JUVENILE MONOFILAMENT FISH GEAR SPECIFICATIONS (30m NET)				
Stretch measure (in.)	1.5	2	2.5	3
Stretch measure (mm)	38	51	64	76
Mono diameter (mm)	.23mm	.23mm	.28mm	.28mm
Series order	1	2	3	4
Panel length (m)	7.5	7.5	7.5	7.5
Panel length (ft.)	25	25	25	25
Panel height (m)	1.83	1.83	1.83	1.83
Panel height (ft.)	6	6	6	6
Material and colour	Clear monofilament			
Float Line	13mm (1/2" Braided polyfoam floatline)			
Leaded Line	no. 60 (60 LBS/600 ft. = 8.12 LBS/81.2 ft. net)			
Spanner length	4 ft. sinking line (non-matching color – 4.0mm sideline)			
Mesh labels	yes (mm) - high visibility bird bands			
Special notes	Use braided cross ties for better vertical support			

- c) North-South Consulting nets (2013):

North South GEAR SPECIFICATIONS (114m NET)					
Stretch measure (in.)	1	2	3	5	6
Stretch measure (mm)	25	51	76	127	152
Multifilament diameter (mm)					
Series order	1	3	5	2	4
Panel length (m)	22.8	22.8	22.8	22.8	22.8
Panel length (ft.)	75	75	75	75	75
Panel height (m)	2.5	2.5	2.5	2.5	2.5
Panel height (ft.)	8.2’	8.2’	8.2’	8.2’	8.2’
Material and colour	multifilament				

- c) North American Standard Index Nets (NASIN) (2014):

Stretch measure (in)	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00
Stretch measure (mm)	38	51	64	76	89	102	114	127
Mono diameter (mm)	0.28	0.28	0.28	0.33	0.33	0.33	0.40	0.40
Series Order	5	3	7	1	4	8	2	6
Panel length (m)	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
Panel length (ft)	10.2	10.2	10.2	10.2	10.2	10.2	10.2	10.2
Panel height (m)	1.8	1.8	1.8	1.8	1.8	1.8	1.8	1.8
Panel height (ft)	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9
Mono color	clear							
Float line	13 mm (1/2 in)							
Lead line	no. 27 (27lbs/300 ft)							
Mesh labels	yes (mm)							

<u>Appendix III</u> - Movements of individual lake sturgeon captured and tagged in the Seine River

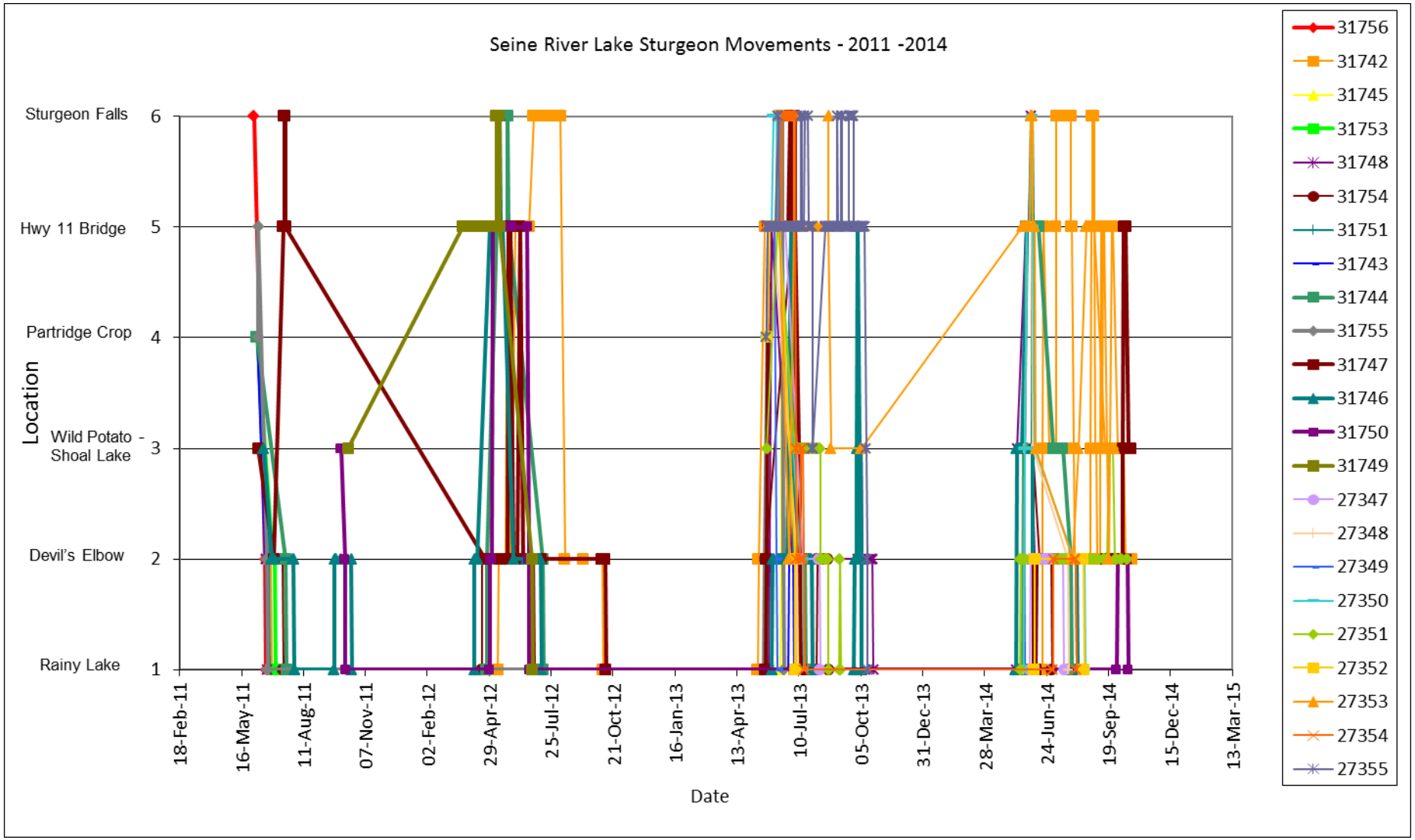


Figure App 3-1: Lake sturgeon movements in the Seine River between 2011 and Oct 2014 – all fish.

In 2011, 14 adult sturgeon were surgically implanted with VEMCO V16-4x-A69-1303 coded implantable transmitters that transmit acoustic pings at a frequency of 69Hz (12 in spring ; 2 in fall). Extra large monofilament gill nets were set in various locations along the lower Seine River from the Sturgeon Falls generating station downstream to Shoal Lake to capture the fish. Surgical procedures are based on methodology used by McLeod et al. (2009) and McLeod et al. (2010).

Surgical Procedures

In preparation for surgical implantation of transmitters, a 350-litre fish holding tank was filled with 300 litres of clean river water and 1.5 kg of salt (NaCl) was added. Lake sturgeon were placed ventral side up in a canvass cradle suspended in the holding tank and water was continually flushed over the gills using a small pump and hose. A disinfectant solution was prepared by adding 50 ml of Germiphene germicidal concentrate to 4 litres of distilled water. Surgical instruments and transmitters (which were activated by removing the attached magnet) were immersed in this solution for at least 10 minutes to ensure full spectrum disinfection then subsequently rinsed with sterile saline solution prior to surgery.

Surgical procedures followed guidelines by Hart and Summerfelt (1975), and were similar to McLeod et al. (2009). Lake sturgeon were not anaesthetized for the procedure. A 3-5 cm incision was made with a surgical scalpel on the ventral surface approximately 1 cm off the midline and 3-4 cm anterior to the pelvic girdle. The transmitter was inserted into the abdominal cavity with minimal pressure exerted on the internal organs. Following implantation, the peritoneum and associated muscle tissue and skin were closed with multiple (minimum 8) single interrupted sutures (2-0 Ethicon Prolene, ½" SH needle) to close the incision. The wound was sprayed with liquid bandage to protect the incision and speed healing. Post-operative fish were released at the surgical site which was in close proximity to the capture site.

During the spring 2011 netting program, 12 adult sturgeon were measured and surgically implanted with acoustic transmitters. This procedure was repeated during the fall of 2011 when 2 additional adult lake sturgeon were caught, measured, implanted, and released. This brought the total number of implanted adult lake sturgeon in the Seine River in 2011 to 14.

- Passive Integrater Transponder (PIT) Tagging Procedures

There was no funding available during 2012 to purchase additional transmitters so fish were tagged with PIT tags (Biomark HPT12, 12.5mm, 134.2kHz) during the spring 2012 netting program. PIT tags were applied under the third scute from the anterior end using a plastic syringe-style implanter with a 1.25" non-replaceable needle (Biomark, MK7 Implanter). Prior to insertion, the function of each PIT tag was verified using a PIT tag reader (Biomark, Pocket Reader EX) and the unique tag number was recorded. Following insertion, the function of each tag was again verified using a PIT tag reader before the fish was live released.

Receiver Deployment - 2011

Three VEMCO VR2W coded underwater receivers were deployed in the Lower Seine River to detect the presence of sturgeon implanted with acoustic receivers (Table 3 and Figures 2 and 3). Receiver #1 was deployed on June 17th 2011 at the downstream end of the lower Seine River near Devil's Elbow at UTM 15U 0515896 5389363. This location was chosen because the

river is narrow here (approximately 130 m across) and well within the signal range of the receivers. Any implanted fish that passes by this receiver should be detected. The other two receivers were deployed on July 14th 2011. Receiver #2 was installed just downstream of the highway 11 bridge over the Seine River at UTM 15U 0551559 5398665. Receiver #3 was installed just downstream of the Sturgeon Falls generating station at UTM 15U 0552512 5399042. These two locations were selected in an attempt to focus in on the exact location of sturgeon spawning. There are a few potential spawning sites in this general area. These two receivers should provide us with the information needed to determine whether sturgeon spawn just downstream of the highway 11 bridge, or whether they move all the way upstream to just below the generating station.

On July 18th, 2011 the data from Receiver #1 was downloaded using a Bluetooth adapter and VUE software installed on a toughbook field computer. There were 1846 detections which occurred from June 19th until July 18th, 2011. All 12 implanted sturgeon were detected by Receiver #1 over this period. As such, it appears that all 12 implanted sturgeon likely moved from the river to Rainy Lake to spend the summer in the lake.

An attempt was made to download the telemetry data from Receiver #1 on November 15 2011, but technical difficulties made this impossible.

Receiver Data Downloading - 2012

Two of the three VEMCO VR2W receivers were retrieved in September 2012. The third receiver's line broke as it was being retrieved and has yet to be recovered. All data was downloaded from the 2 receivers that were retrieved using a Bluetooth adapter to connect the receivers wirelessly to a Panasonic tough book computer running VUE software (v.3.0). As well, the receiver firmware was updated and the code map was updated to MAP-113.

Receiver Data Downloading - 2013

Receiver # 4 deployment - 2013

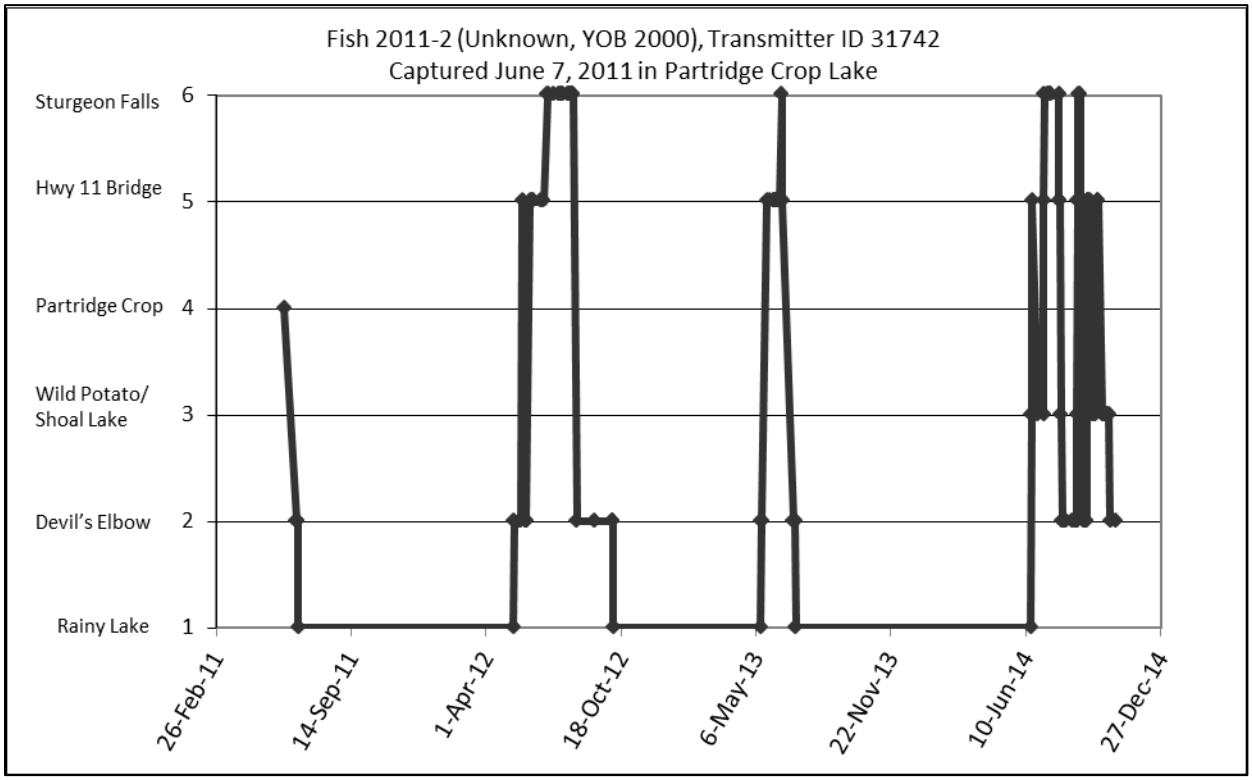
Receiver #2 movement - 2013

Individual Fish Movements in the System

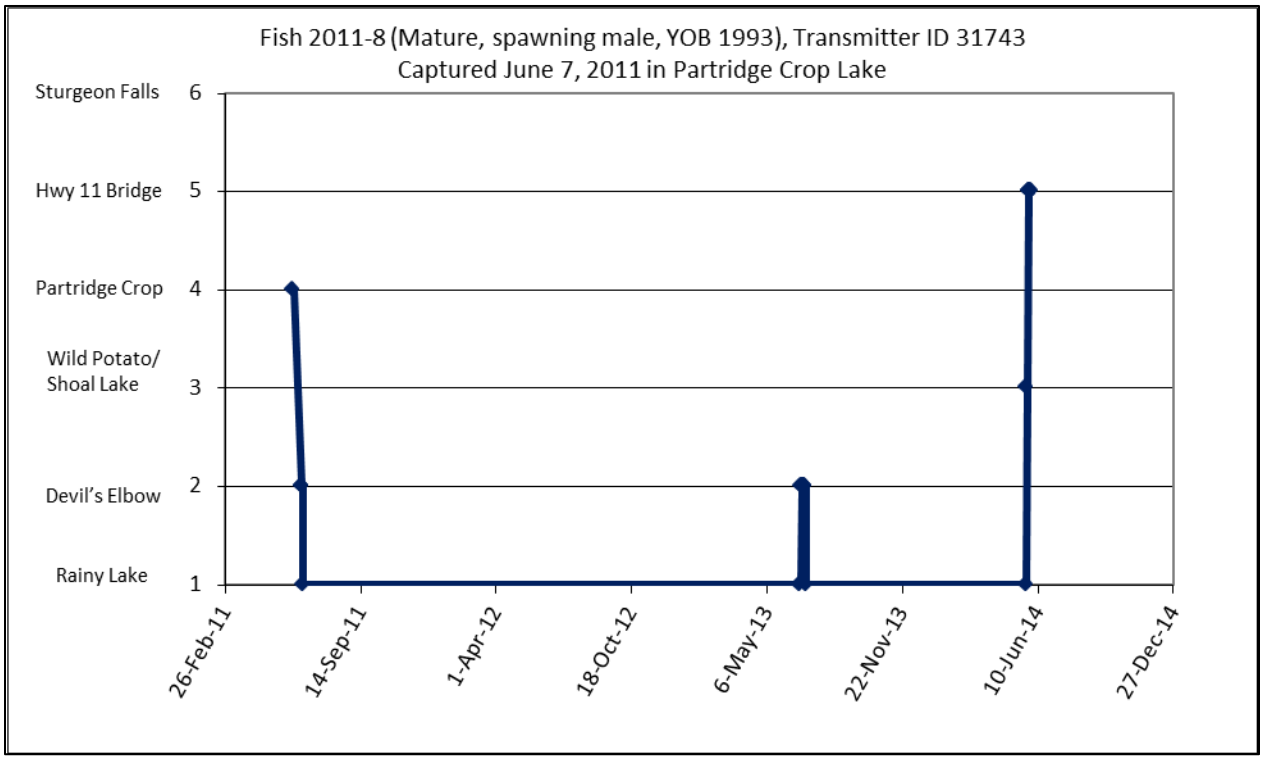
Figure App3-2 shows recorded movement for each individual sturgeon being monitored in the Seine River.

Figure App3-2: Individual lake sturgeon movements in the Seine River (a - w).

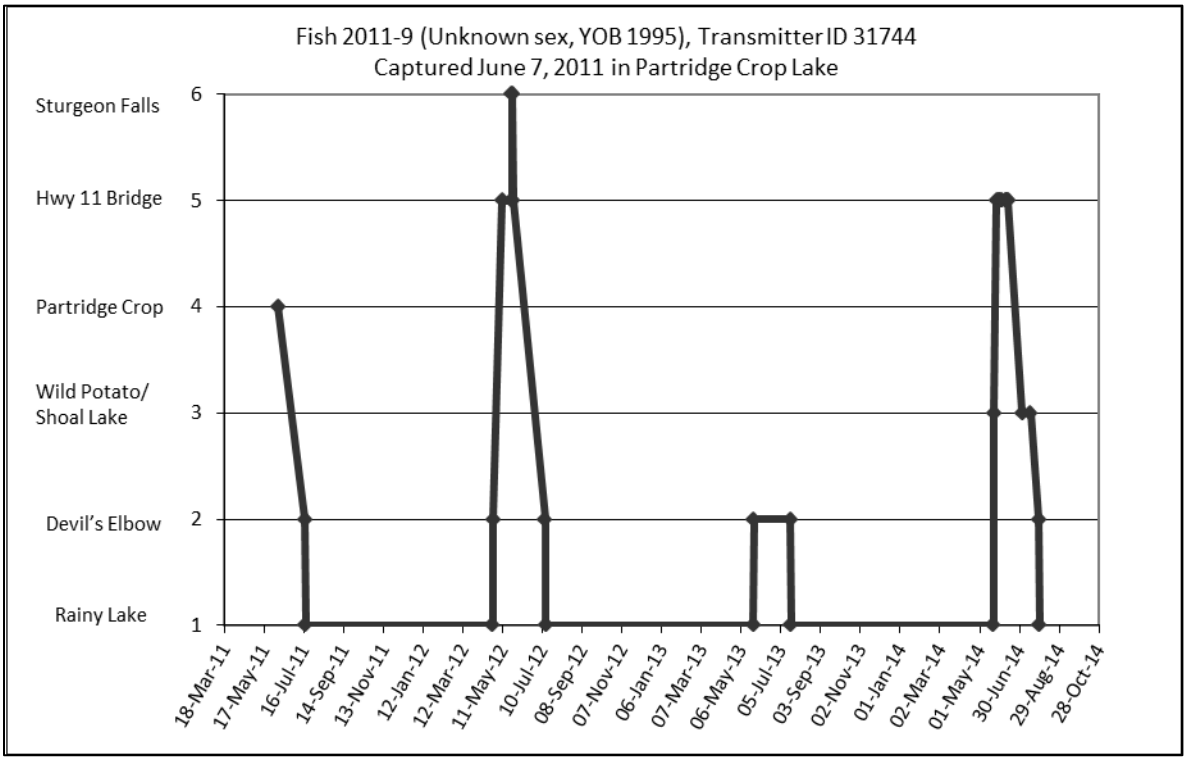
a)



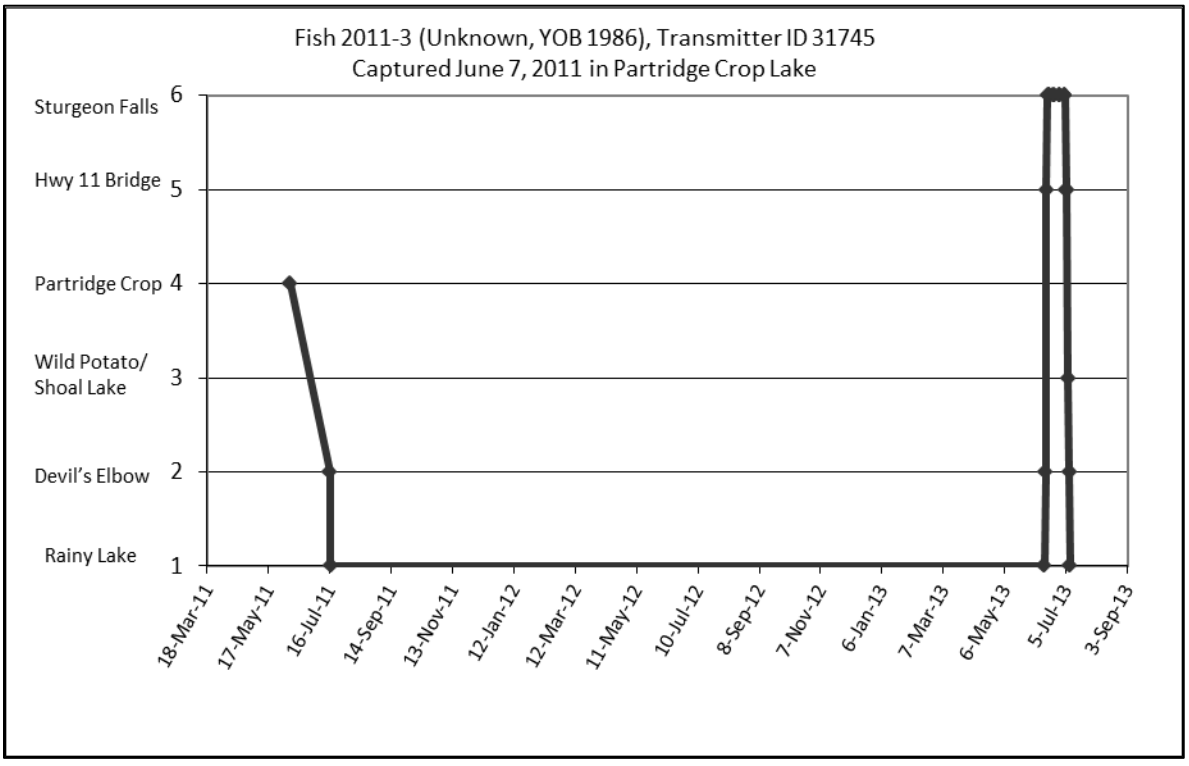
b)



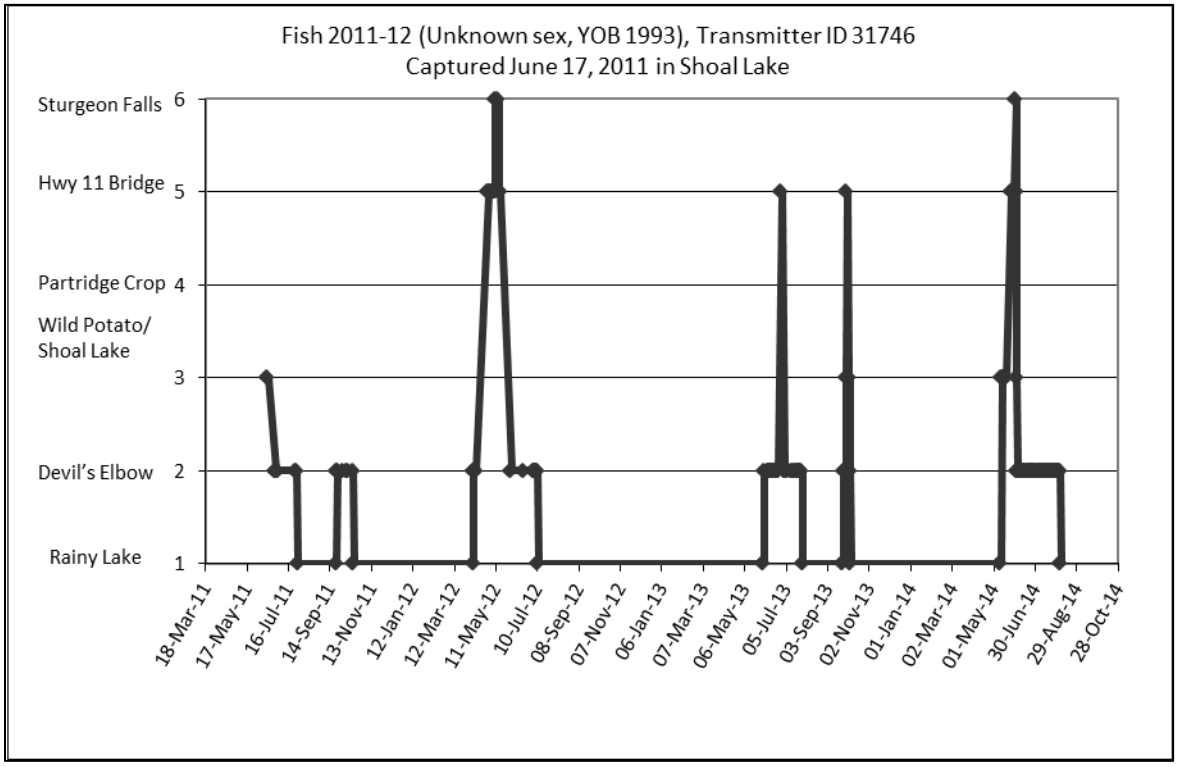
c)


Fish 2011-9 (Unknown sex, YOB 1995), Transmitter ID 31744
Captured June 7, 2011 in Partridge Crop Lake
Sturgeon Falls
Hwy 11 Bridge
Partridge Crop
Wild Potato/
Shoal Lake
Devil's Elbow
Rainy Lake
6
5
4
3
2
1
18-Mar-11
17-May-11
16-Jul-11
14-Sep-11
13-Nov-11
12-Jan-12
12-Mar-12
11-May-12
10-Jul-12
08-Sep-12
07-Nov-12
06-Jan-13
07-Mar-13
06-May-13
05-Jul-13
03-Sep-13
02-Nov-13
01-Jan-14
02-Mar-14
01-May-14
30-Jun-14
29-Aug-14
28-Oct-14

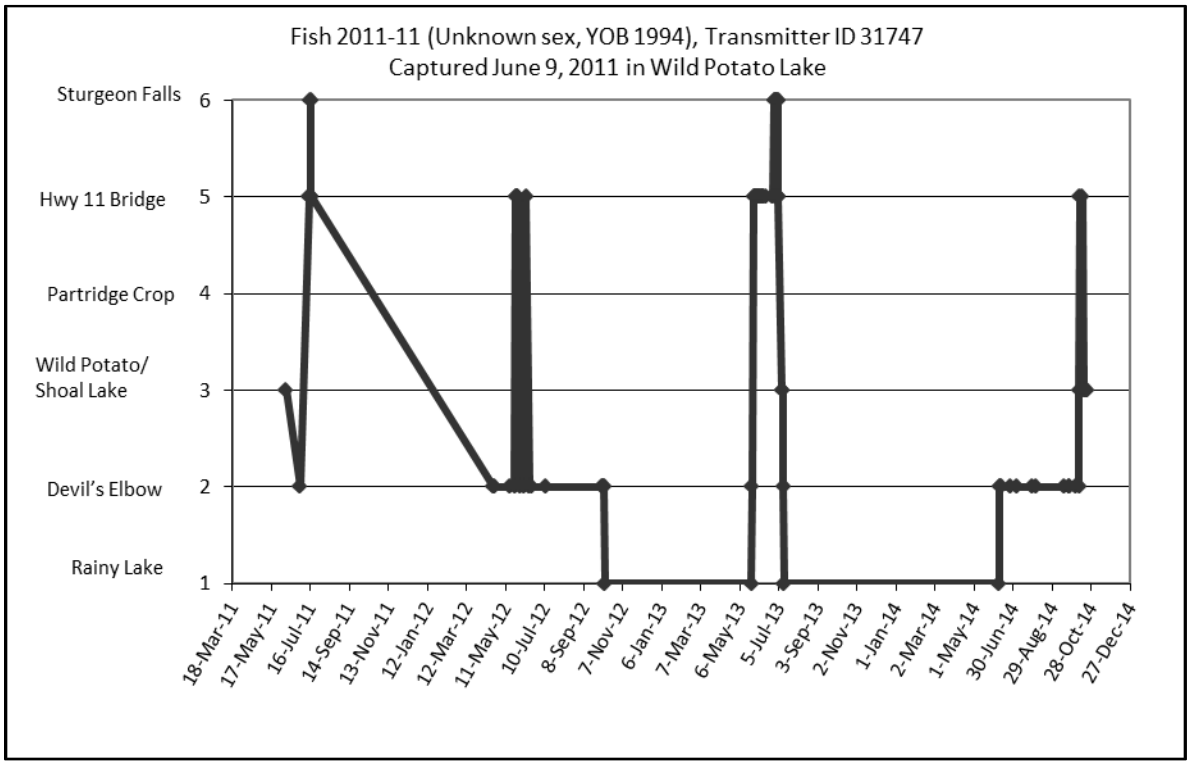
d)


Fish 2011-3 (Unknown, YOB 1986), Transmitter ID 31745
Captured June 7, 2011 in Partridge Crop Lake
Sturgeon Falls
Hwy 11 Bridge
Partridge Crop
Wild Potato/
Shoal Lake
Devil's Elbow
Rainy Lake
6
5
4
3
2
1
18-Mar-11
17-May-11
16-Jul-11
14-Sep-11
13-Nov-11
12-Jan-12
12-Mar-12
11-May-12
10-Jul-12
8-Sep-12
7-Nov-12
6-Jan-13
7-Mar-13
6-May-13
5-Jul-13
3-Sep-13

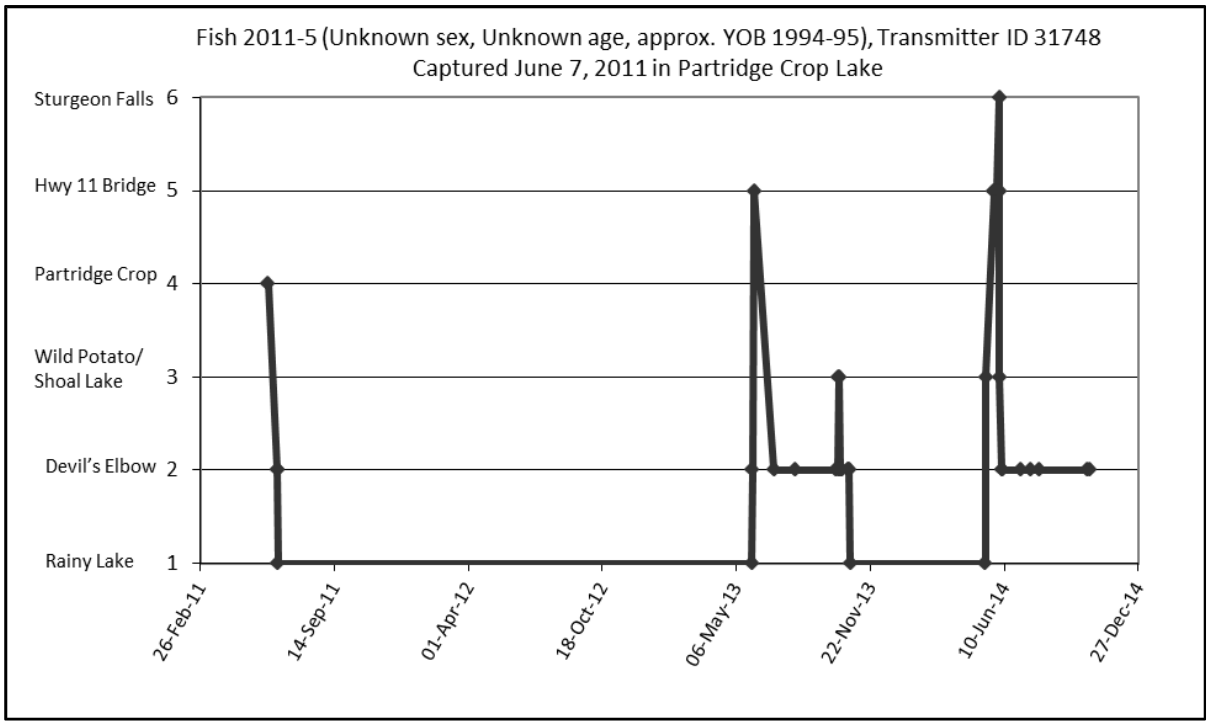
e)


Fish 2011-12 (Unknown sex, YOB 1993), Transmitter ID 31746
Captured June 17, 2011 in Shoal Lake
Sturgeon Falls
Hwy 11 Bridge
Partridge Crop
Wild Potato/
Shoal Lake
Devil's Elbow
Rainy Lake
6
5
4
3
2
1
18-Mar-11
17-May-11
16-Jul-11
14-Sep-11
13-Nov-11
12-Jan-12
12-Mar-12
11-May-12
10-Jul-12
08-Sep-12
07-Nov-12
06-Jan-13
07-Mar-13
06-May-13
05-Jul-13
03-Sep-13
02-Nov-13
01-Jan-14
02-Mar-14
01-May-14
30-Jun-14
29-Aug-14
28-Oct-14

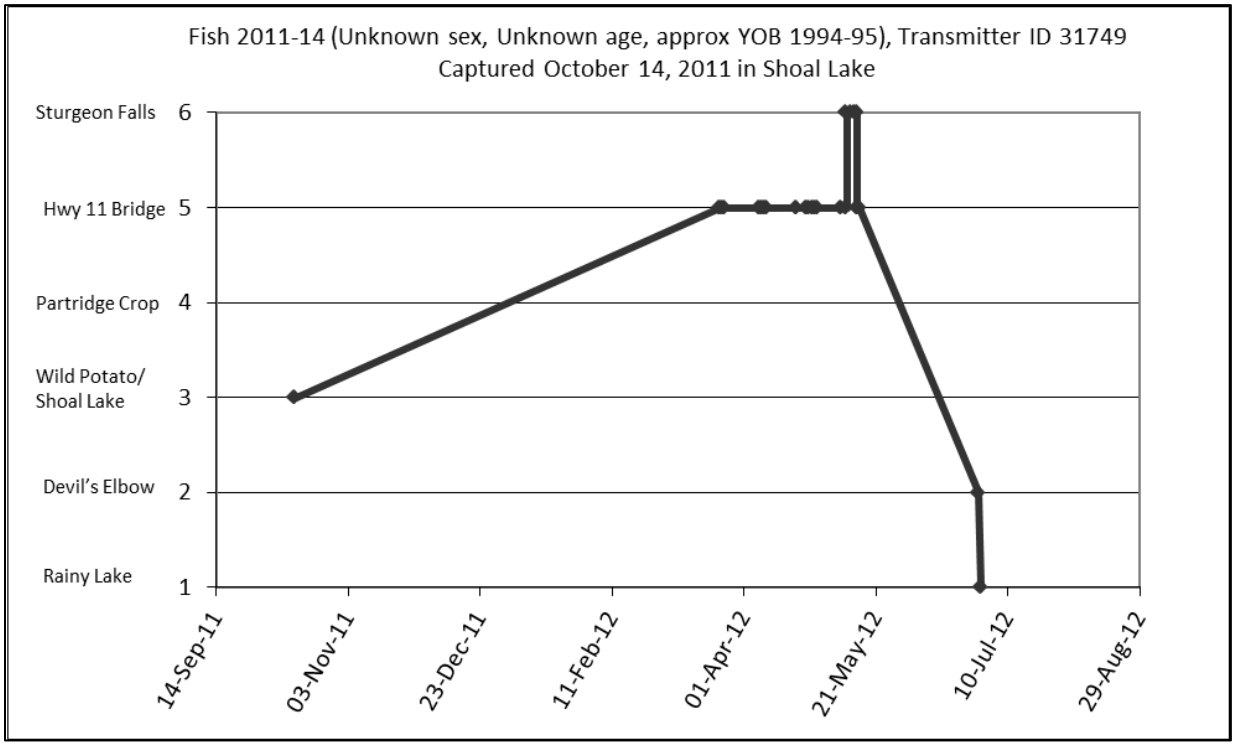
f)


Fish 2011-11 (Unknown sex, YOB 1994), Transmitter ID 31747
Captured June 9, 2011 in Wild Potato Lake
Sturgeon Falls
Hwy 11 Bridge
Partridge Crop
Wild Potato/
Shoal Lake
Devil's Elbow
Rainy Lake
6
5
4
3
2
1
18-Mar-11
17-May-11
16-Jul-11
14-Sep-11
13-Nov-11
12-Jan-12
12-Mar-12
11-May-12
10-Jul-12
8-Sep-12
7-Nov-12
6-Jan-13
7-Mar-13
6-May-13
5-Jul-13
3-Sep-13
2-Nov-13
1-Jan-14
2-Mar-14
1-May-14
30-Jun-14
29-Aug-14
28-Oct-14
27-Dec-14

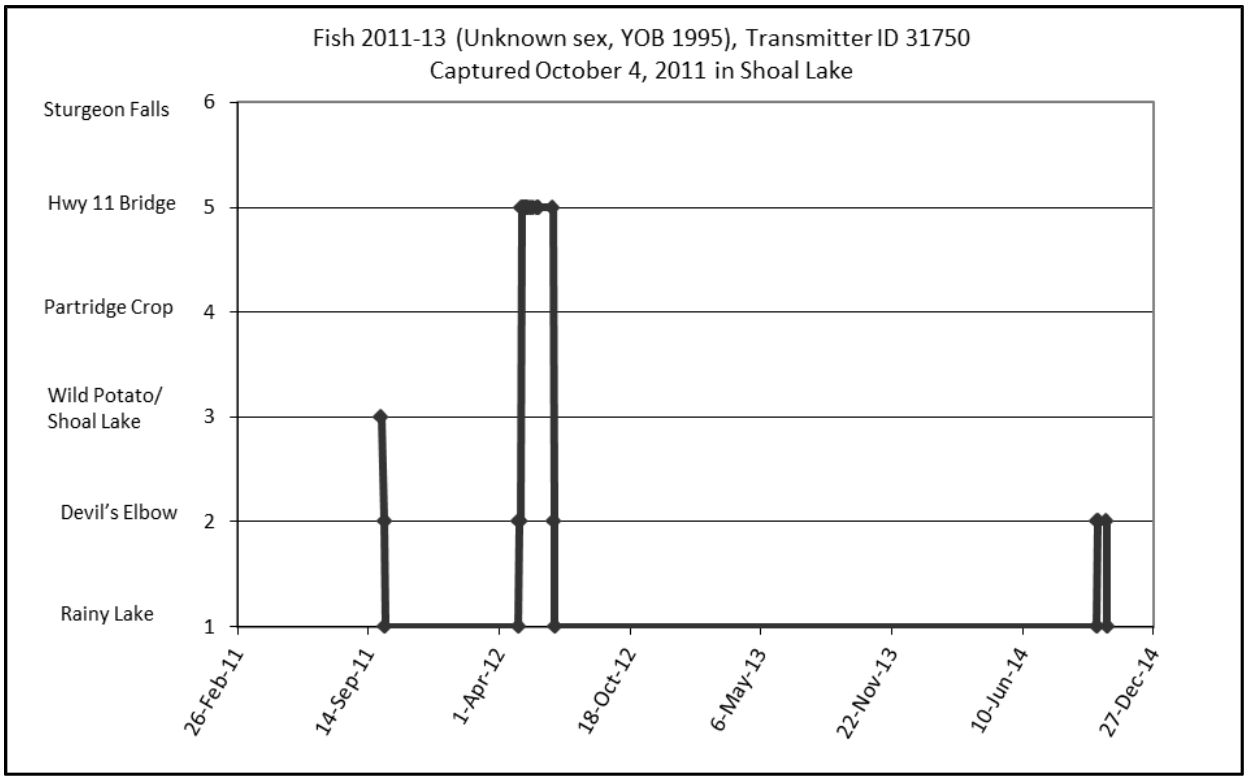
g)


Fish 2011-5 (Unknown sex, Unknown age, approx. YOB 1994-95), Transmitter ID 31748
Captured June 7, 2011 in Partridge Crop Lake
Sturgeon Falls 6
Hwy 11 Bridge 5
Partridge Crop 4
Wild Potato/ Shoal Lake 3
Devil's Elbow 2
Rainy Lake 1
26-Feb-11
14-Sep-11
01-Apr-12
18-Oct-12
06-May-13
22-Nov-13
10-Jun-14
27-Dec-14

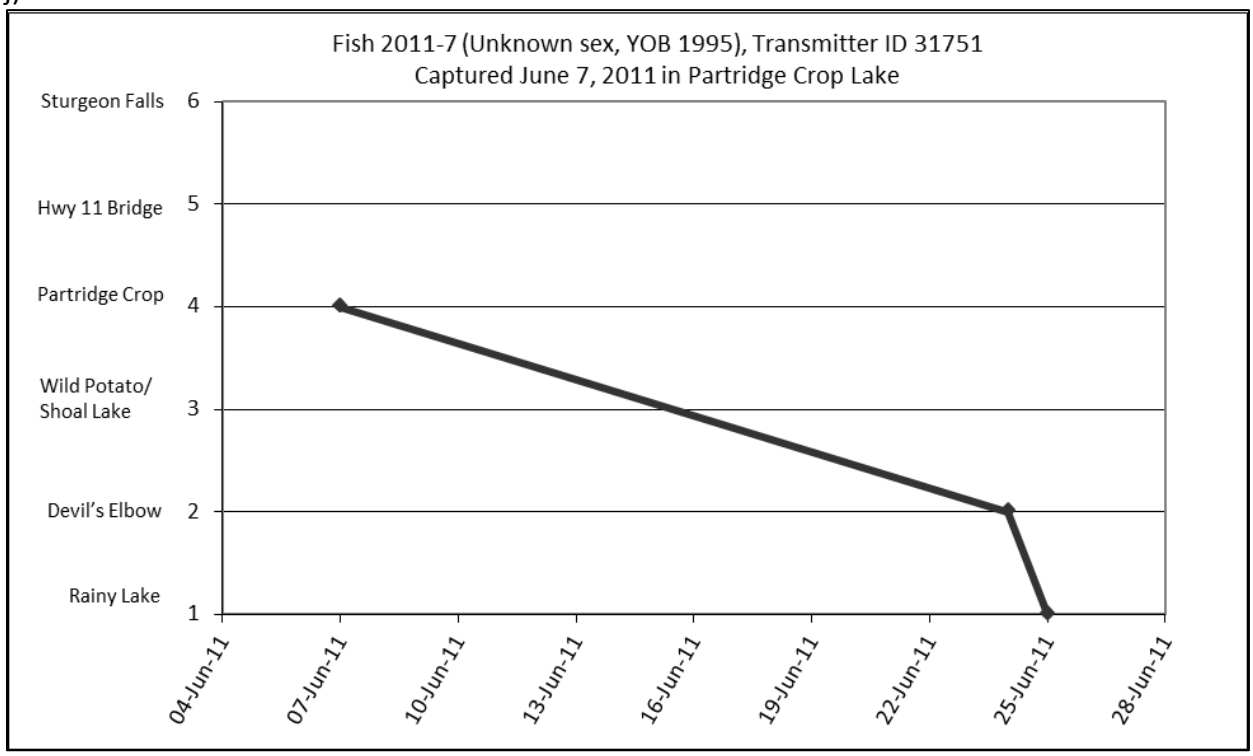
h)


Fish 2011-14 (Unknown sex, Unknown age, approx YOB 1994-95), Transmitter ID 31749
Captured October 14, 2011 in Shoal Lake
Sturgeon Falls 6
Hwy 11 Bridge 5
Partridge Crop 4
Wild Potato/ Shoal Lake 3
Devil's Elbow 2
Rainy Lake 1
14-Sep-11
03-Nov-11
23-Dec-11
11-Feb-12
01-Apr-12
21-May-12
10-Jul-12
29-Aug-12

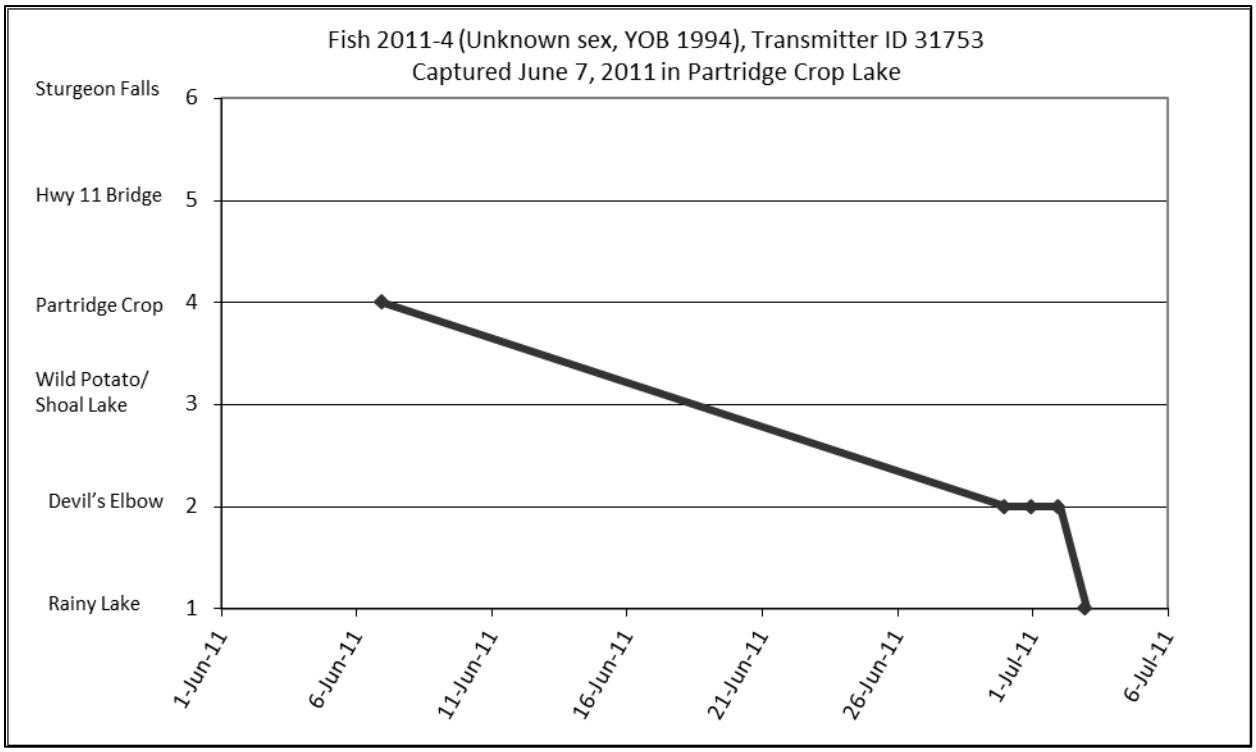
i)


Fish 2011-13 (Unknown sex, YOB 1995), Transmitter ID 31750
Captured October 4, 2011 in Shoal Lake
Sturgeon Falls
Hwy 11 Bridge
Partridge Crop
Wild Potato/
Shoal Lake
Devil's Elbow
Rainy Lake
6
5
4
3
2
1
26-Feb-11
14-Sep-11
1-Apr-12
18-Oct-12
6-May-13
22-Nov-13
10-Jun-14
27-Dec-14

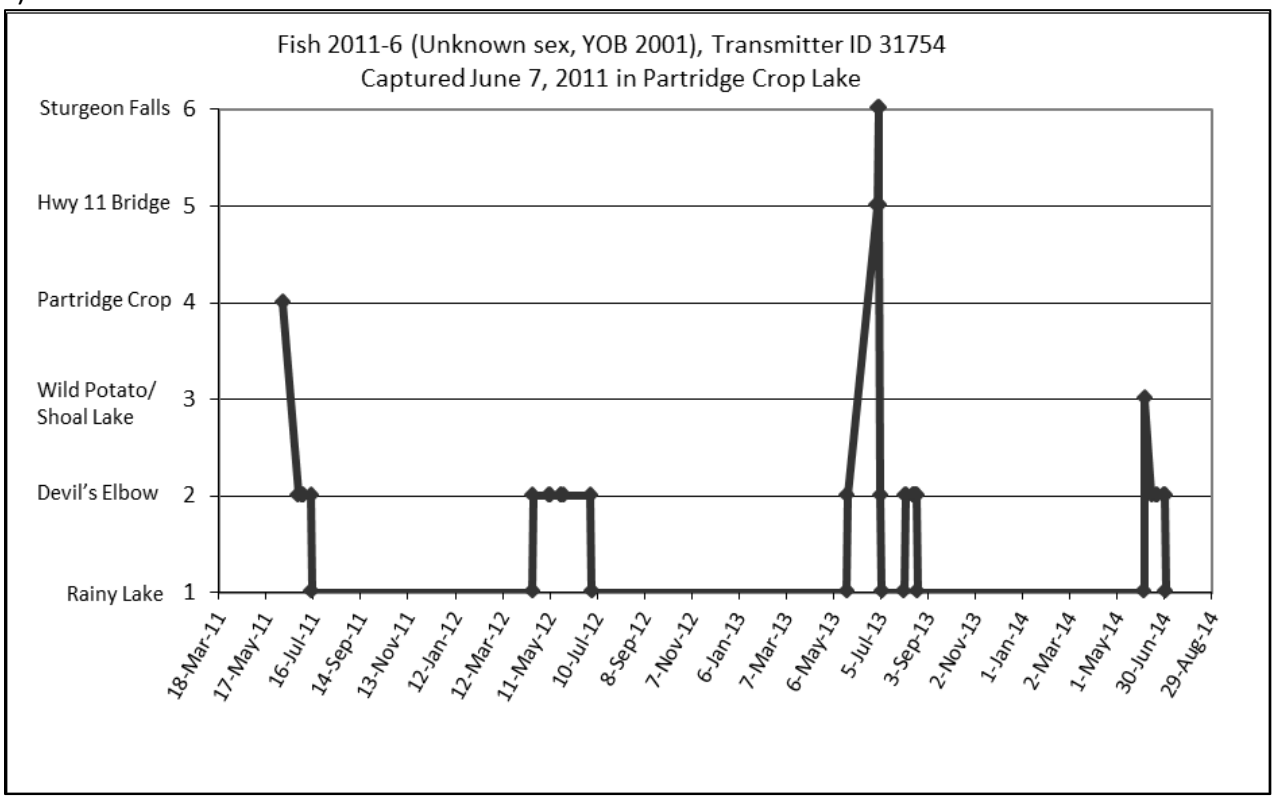
j)


Fish 2011-7 (Unknown sex, YOB 1995), Transmitter ID 31751
Captured June 7, 2011 in Partridge Crop Lake
Sturgeon Falls
Hwy 11 Bridge
Partridge Crop
Wild Potato/
Shoal Lake
Devil's Elbow
Rainy Lake
6
5
4
3
2
1
04-Jun-11
07-Jun-11
10-Jun-11
13-Jun-11
16-Jun-11
19-Jun-11
22-Jun-11
25-Jun-11
28-Jun-11

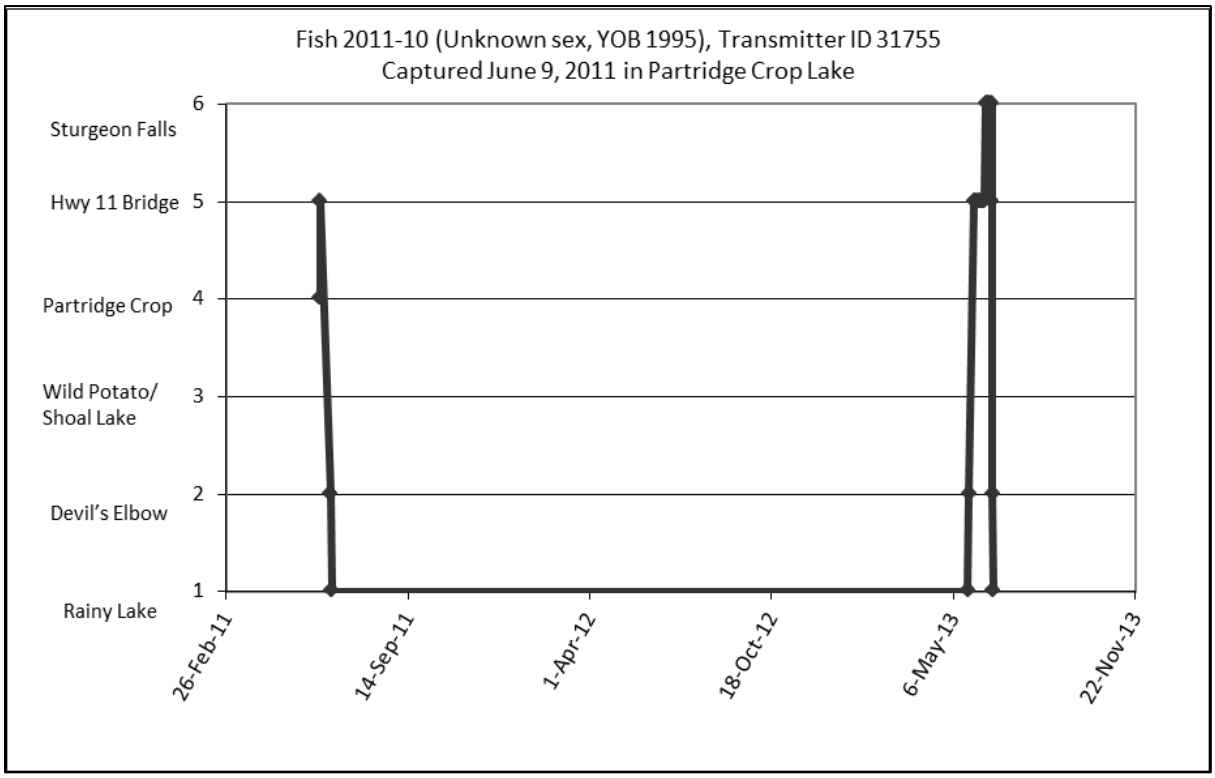
k)


Fish 2011-4 (Unknown sex, YOB 1994), Transmitter ID 31753
Captured June 7, 2011 in Partridge Crop Lake
Sturgeon Falls
Hwy 11 Bridge
Partridge Crop
Wild Potato/
Shoal Lake
Devil's Elbow
Rainy Lake
6
5
4
3
2
1
1-Jun-11
6-Jun-11
11-Jun-11
16-Jun-11
21-Jun-11
26-Jun-11
1-Jul-11
6-Jul-11

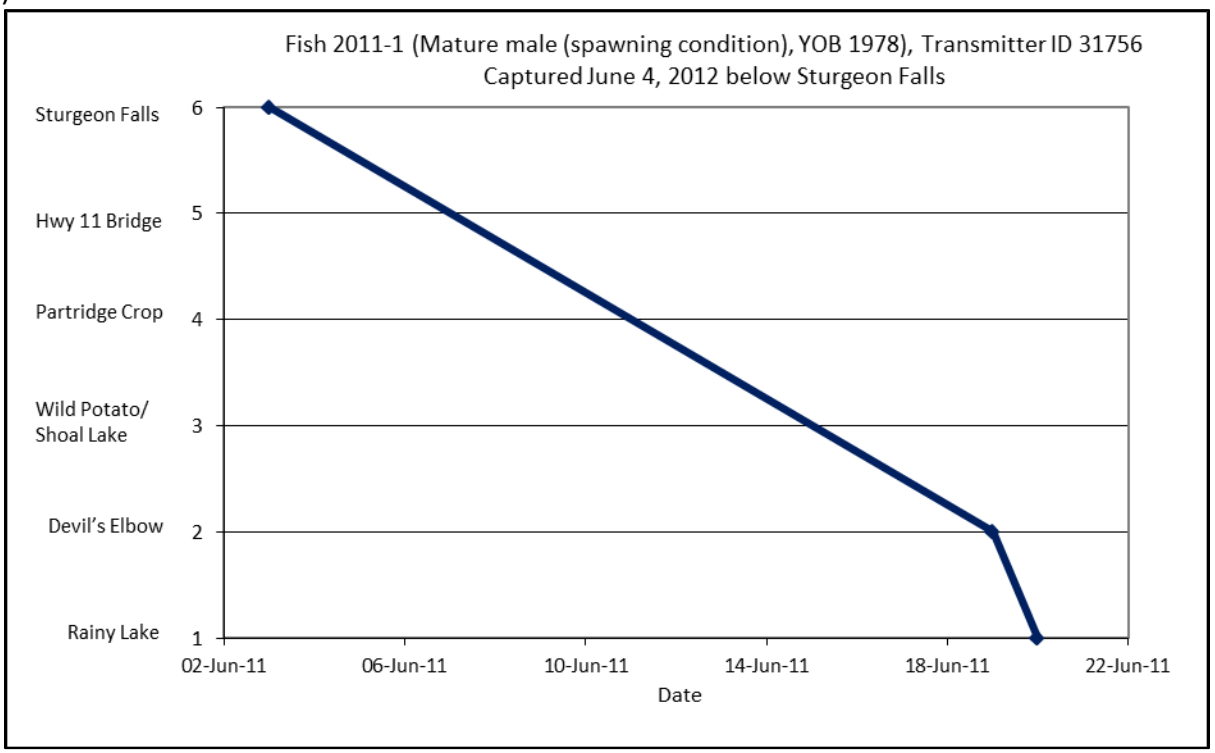
l)


Fish 2011-6 (Unknown sex, YOB 2001), Transmitter ID 31754
Captured June 7, 2011 in Partridge Crop Lake
Sturgeon Falls
Hwy 11 Bridge
Partridge Crop
Wild Potato/
Shoal Lake
Devil's Elbow
Rainy Lake
6
5
4
3
2
1
18-Mar-11
17-May-11
16-Jul-11
14-Sep-11
13-Nov-11
12-Jan-12
12-Mar-12
11-May-12
10-Jul-12
8-Sep-12
7-Nov-12
6-Jan-13
7-Mar-13
6-May-13
5-Jul-13
3-Sep-13
2-Nov-13
1-Jan-14
2-Mar-14
1-May-14
30-Jun-14
29-Aug-14

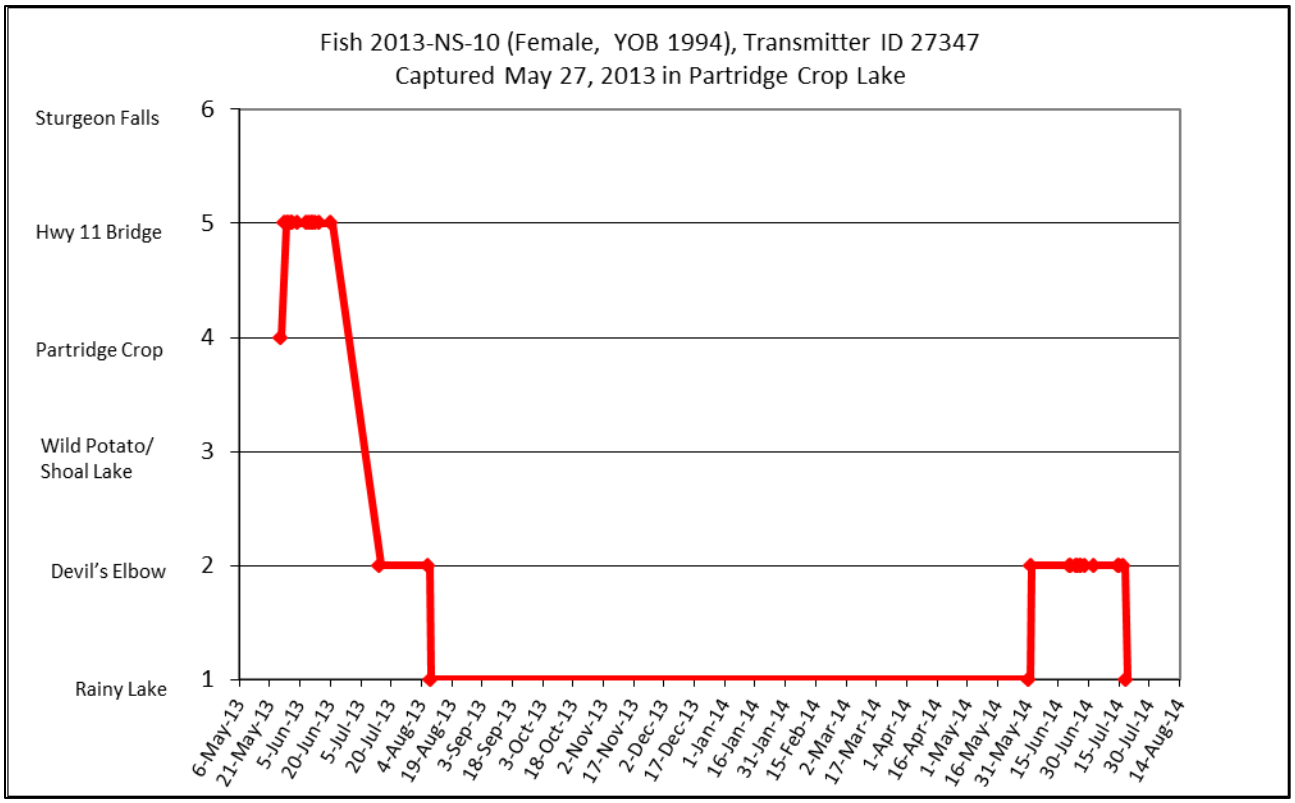
m)


Fish 2011-10 (Unknown sex, YOB 1995), Transmitter ID 31755
Captured June 9, 2011 in Partridge Crop Lake
Sturgeon Falls
Hwy 11 Bridge
Partridge Crop
Wild Potato/
Shoal Lake
Devil's Elbow
Rainy Lake
6
5
4
3
2
1
26-Feb-11
14-Sep-11
1-Apr-12
18-Oct-12
6-May-13
22-Nov-13

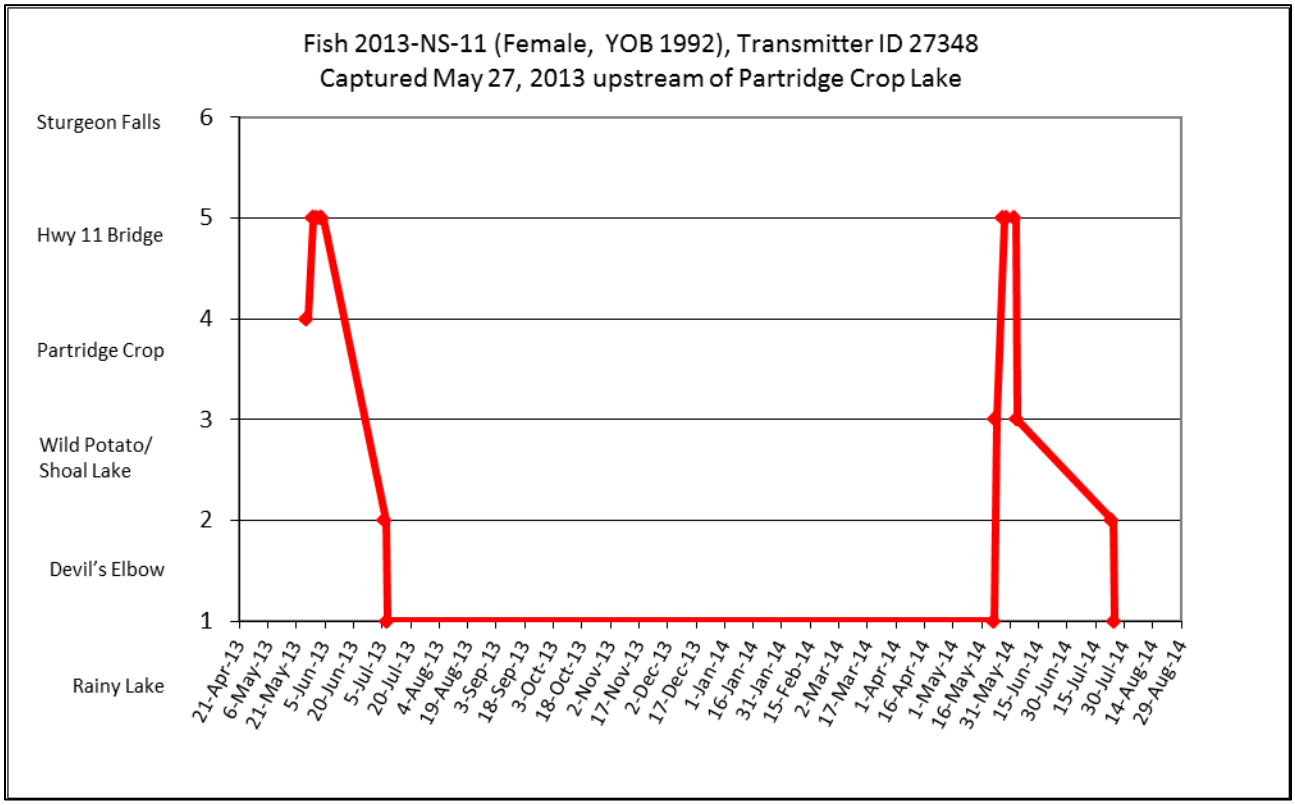
n)


Fish 2011-1 (Mature male (spawning condition), YOB 1978), Transmitter ID 31756
Captured June 4, 2012 below Sturgeon Falls
Sturgeon Falls
Hwy 11 Bridge
Partridge Crop
Wild Potato/
Shoal Lake
Devil's Elbow
Rainy Lake
6
5
4
3
2
1
02-Jun-11
06-Jun-11
10-Jun-11
14-Jun-11
18-Jun-11
22-Jun-11
Date

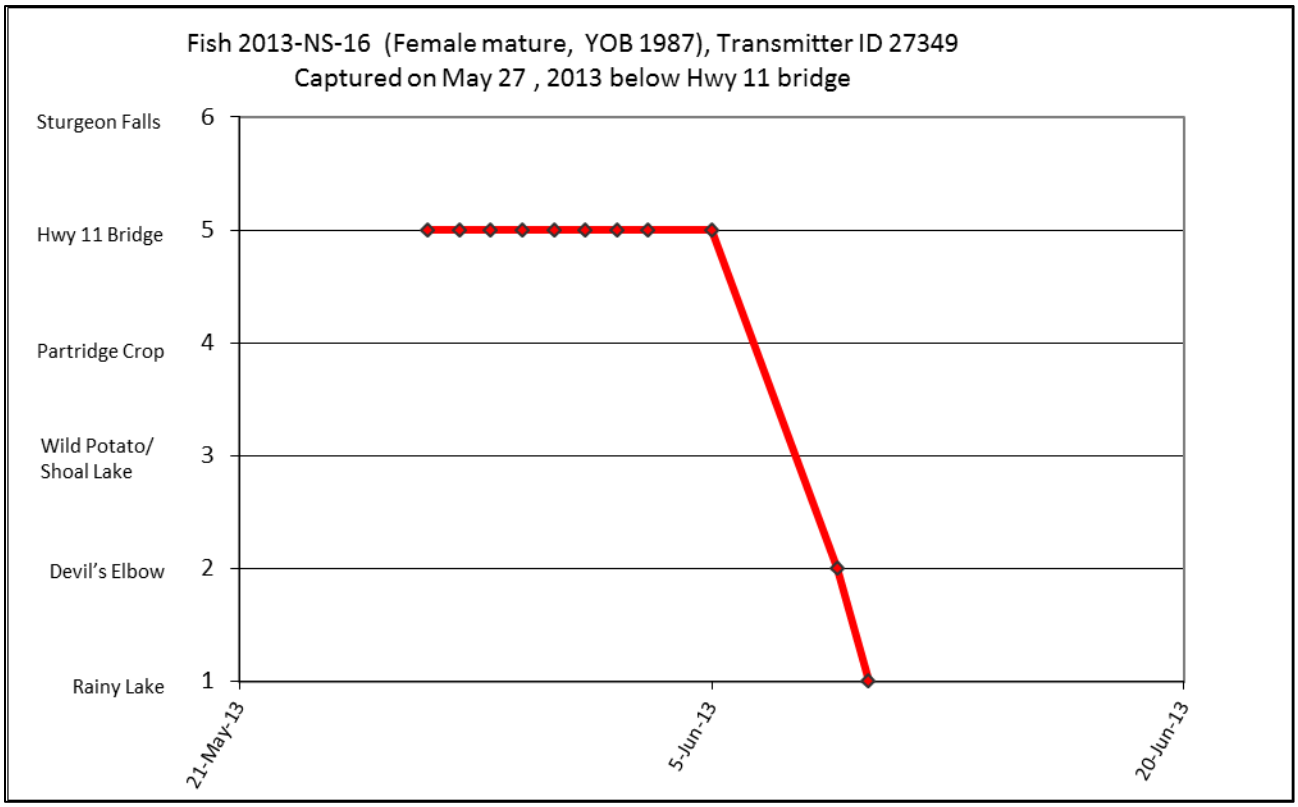
o)


Fish 2013-NS-10 (Female, YOB 1994), Transmitter ID 27347
Captured May 27, 2013 in Partridge Crop Lake
Sturgeon Falls
Hwy 11 Bridge
Partridge Crop
Wild Potato/
Shoal Lake
Devil's Elbow
Rainy Lake
6
5
4
3
2
1
6-May-13
21-May-13
5-Jun-13
20-Jun-13
5-Jul-13
20-Jul-13
4-Aug-13
19-Aug-13
3-Sep-13
18-Sep-13
3-Oct-13
18-Oct-13
2-Nov-13
17-Nov-13
2-Dec-13
17-Dec-13
1-Jan-14
16-Jan-14
31-Jan-14
15-Feb-14
2-Mar-14
17-Mar-14
1-Apr-14
16-Apr-14
1-May-14
16-May-14
31-May-14
15-Jun-14
30-Jun-14
15-Jul-14
30-Jul-14
14-Aug-14

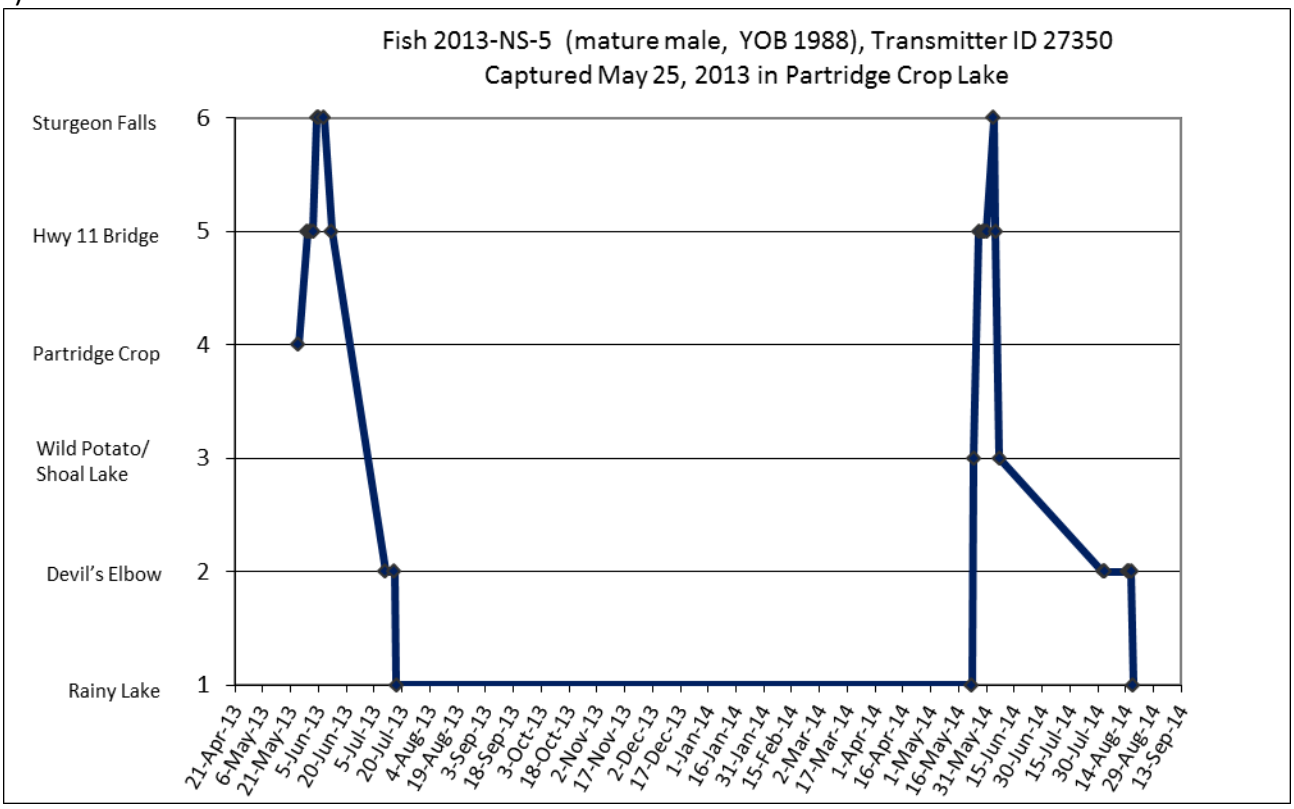
p)


Fish 2013-NS-11 (Female, YOB 1992), Transmitter ID 27348
Captured May 27, 2013 upstream of Partridge Crop Lake
Sturgeon Falls
Hwy 11 Bridge
Partridge Crop
Wild Potato/
Shoal Lake
Devil's Elbow
Rainy Lake
6
5
4
3
2
1
21-Apr-13
6-May-13
21-May-13
5-Jun-13
20-Jun-13
5-Jul-13
20-Jul-13
4-Aug-13
19-Aug-13
3-Sep-13
18-Sep-13
3-Oct-13
18-Oct-13
2-Nov-13
17-Nov-13
2-Dec-13
17-Dec-13
1-Jan-14
16-Jan-14
31-Jan-14
15-Feb-14
2-Mar-14
17-Mar-14
1-Apr-14
16-Apr-14
1-May-14
16-May-14
31-May-14
15-Jun-14
30-Jun-14
15-Jul-14
30-Jul-14
14-Aug-14
29-Aug-14

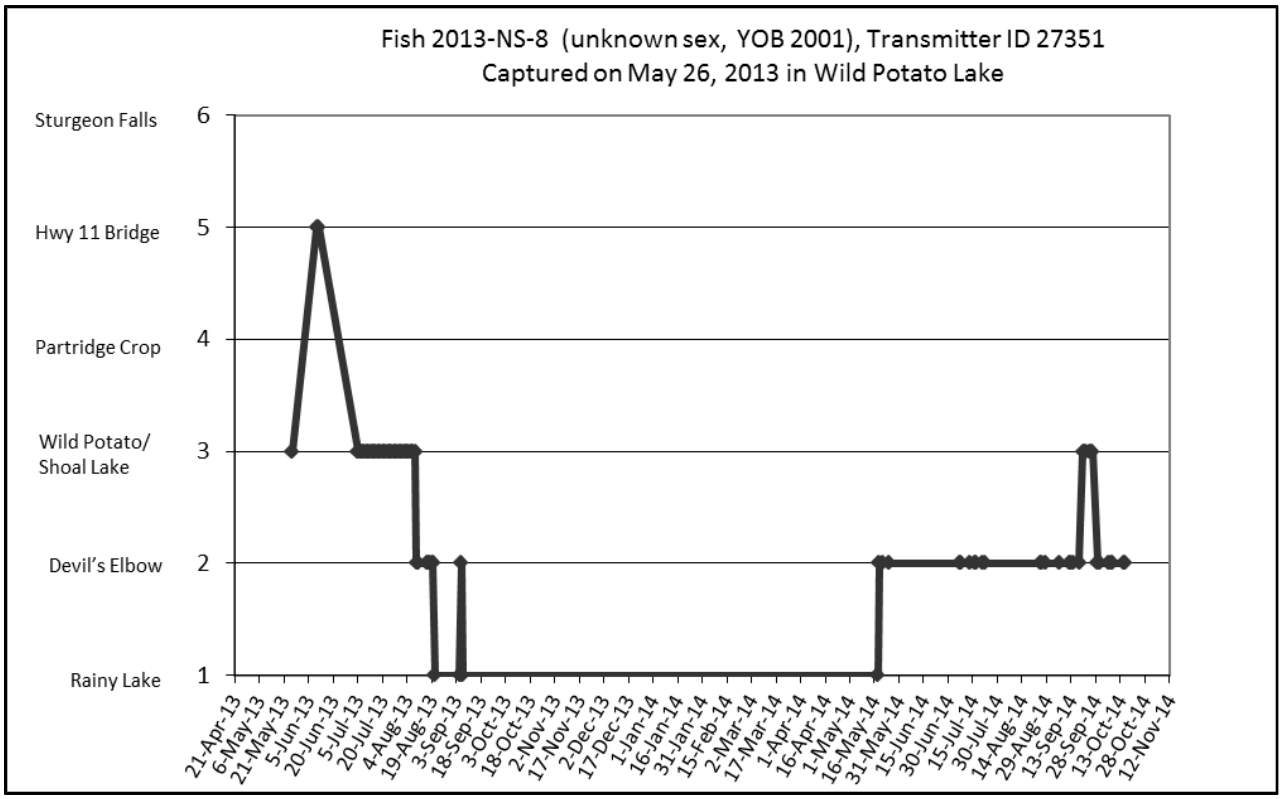
q)


Fish 2013-NS-16 (Female mature, YOB 1987), Transmitter ID 27349
Captured on May 27 , 2013 below Hwy 11 bridge
Sturgeon Falls
Hwy 11 Bridge
Partridge Crop
Wild Potato/ Shoal Lake
Devil's Elbow
Rainy Lake
6
5
4
3
2
1
21-May-13
5-Jun-13
20-Jun-13

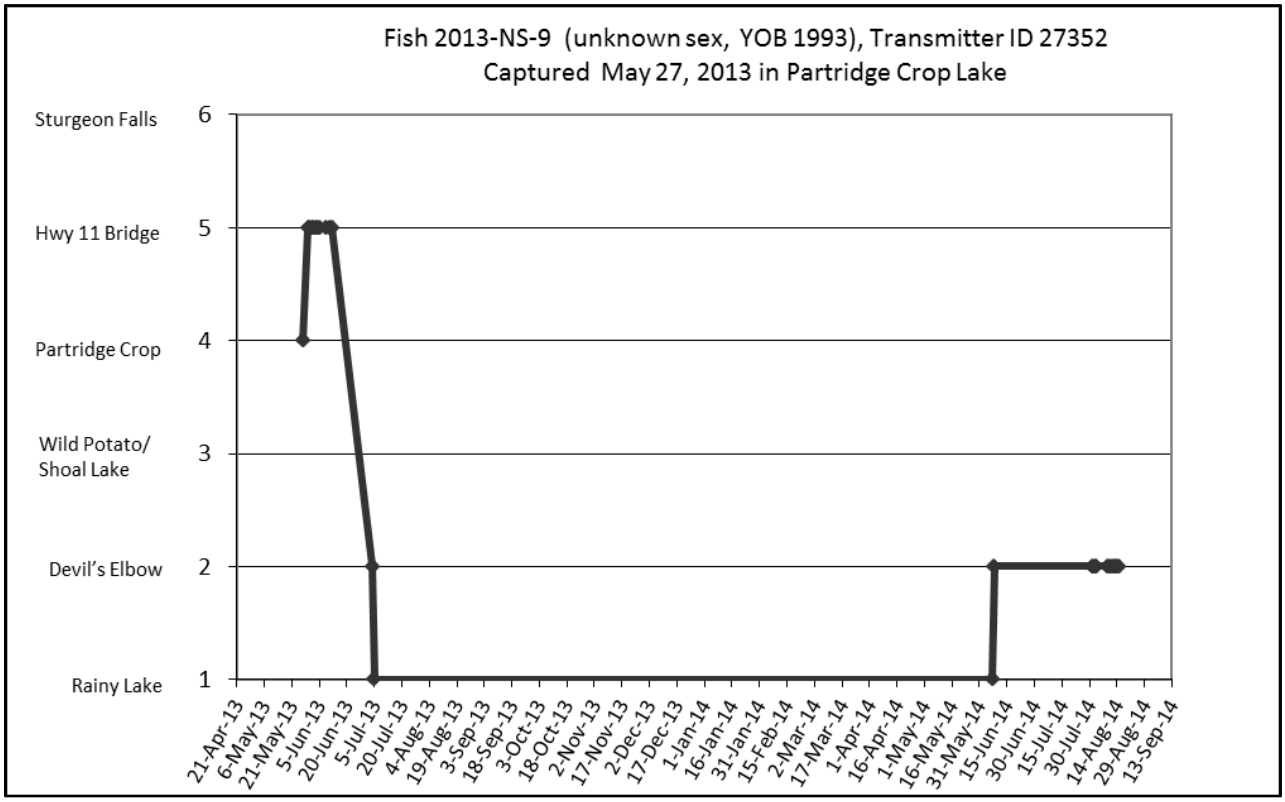
r)


Fish 2013-NS-5 (mature male, YOB 1988), Transmitter ID 27350
Captured May 25, 2013 in Partridge Crop Lake
Sturgeon Falls
Hwy 11 Bridge
Partridge Crop
Wild Potato/ Shoal Lake
Devil's Elbow
Rainy Lake
6
5
4
3
2
1
21-Apr-13
6-May-13
21-May-13
5-Jun-13
20-Jun-13
5-Jul-13
20-Jul-13
4-Aug-13
19-Aug-13
3-Sep-13
18-Sep-13
3-Oct-13
18-Oct-13
2-Nov-13
17-Nov-13
2-Dec-13
17-Dec-13
1-Jan-14
16-Jan-14
31-Jan-14
15-Feb-14
2-Mar-14
17-Mar-14
1-Apr-14
16-Apr-14
1-May-14
16-May-14
31-May-14
15-Jun-14
30-Jun-14
15-Jul-14
30-Jul-14
14-Aug-14
29-Aug-14
13-Sep-14

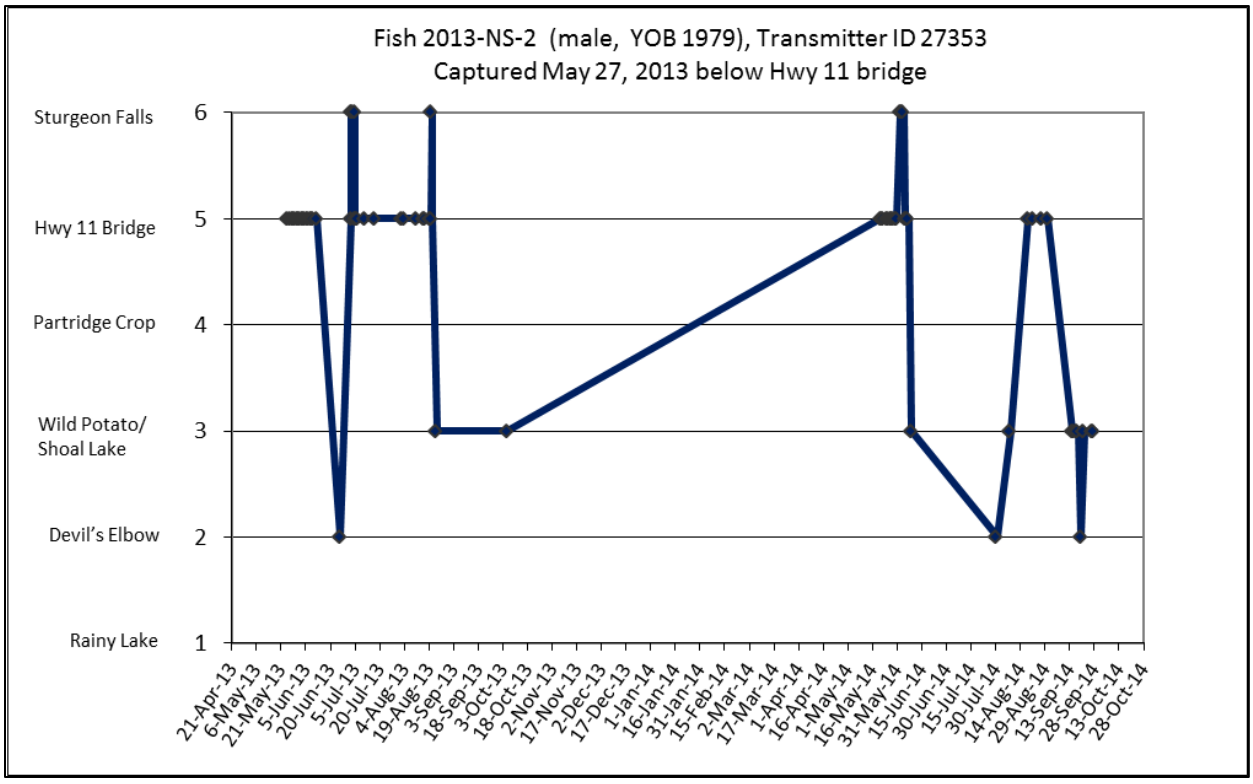
s)


Fish 2013-NS-8 (unknown sex, YOB 2001), Transmitter ID 27351
Captured on May 26, 2013 in Wild Potato Lake
Sturgeon Falls
Hwy 11 Bridge
Partridge Crop
Wild Potato/ Shoal Lake
Devil's Elbow
Rainy Lake
6
5
4
3
2
1
21-Apr-13
6-May-13
21-May-13
5-Jun-13
20-Jun-13
5-Jul-13
20-Jul-13
4-Aug-13
19-Aug-13
3-Sep-13
18-Sep-13
3-Oct-13
18-Oct-13
2-Nov-13
17-Nov-13
2-Dec-13
17-Dec-13
1-Jan-14
16-Jan-14
31-Jan-14
15-Feb-14
2-Mar-14
17-Mar-14
1-Apr-14
16-Apr-14
1-May-14
16-May-14
31-May-14
15-Jun-14
30-Jun-14
15-Jul-14
30-Jul-14
14-Aug-14
29-Aug-14
13-Sep-14
28-Sep-14
13-Oct-14
28-Oct-14
12-Nov-14

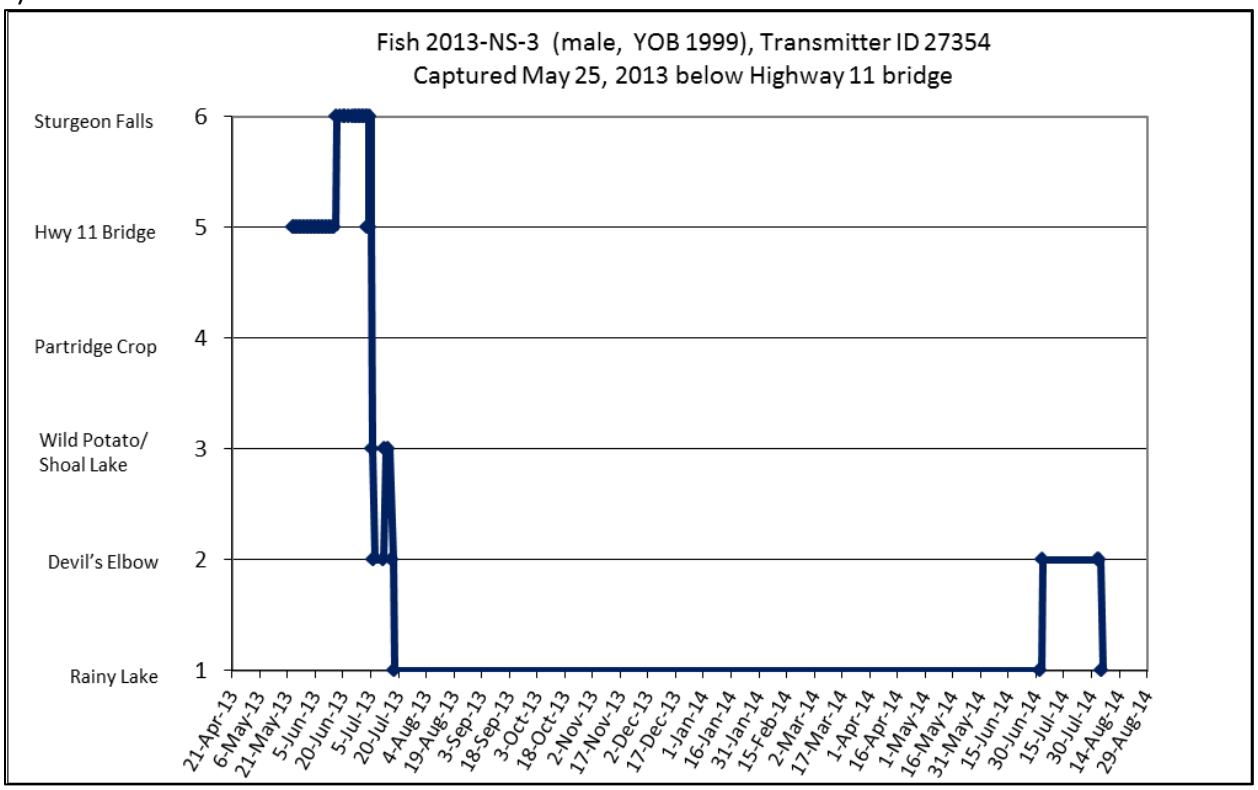
t)


Fish 2013-NS-9 (unknown sex, YOB 1993), Transmitter ID 27352
Captured May 27, 2013 in Partridge Crop Lake
Sturgeon Falls
Hwy 11 Bridge
Partridge Crop
Wild Potato/ Shoal Lake
Devil's Elbow
Rainy Lake
6
5
4
3
2
1
21-Apr-13
6-May-13
21-May-13
5-Jun-13
20-Jun-13
5-Jul-13
20-Jul-13
4-Aug-13
19-Aug-13
3-Sep-13
18-Sep-13
3-Oct-13
18-Oct-13
2-Nov-13
17-Nov-13
2-Dec-13
17-Dec-13
1-Jan-14
16-Jan-14
31-Jan-14
15-Feb-14
2-Mar-14
17-Mar-14
1-Apr-14
16-Apr-14
1-May-14
16-May-14
31-May-14
15-Jun-14
30-Jun-14
15-Jul-14
30-Jul-14
14-Aug-14
29-Aug-14
13-Sep-14

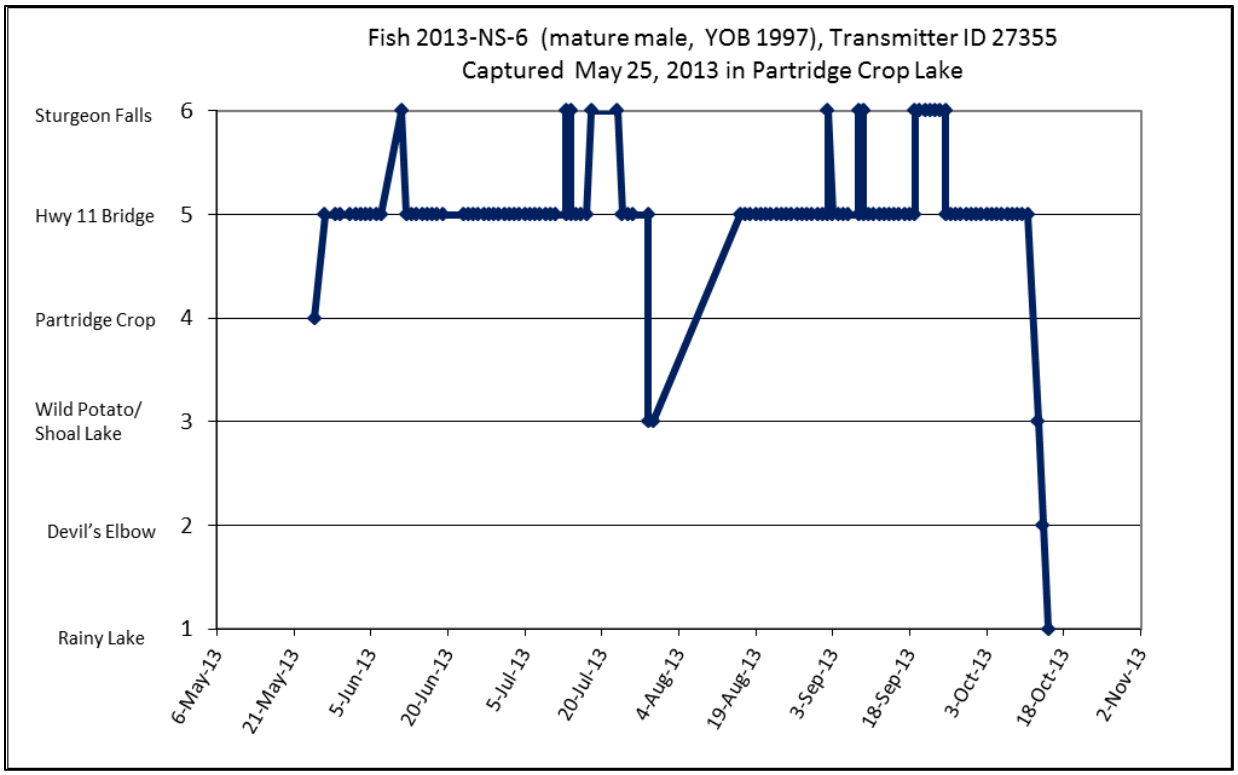
u)


Fish 2013-NS-2 (male, YOB 1979), Transmitter ID 27353
Captured May 27, 2013 below Hwy 11 bridge
Sturgeon Falls
Hwy 11 Bridge
Partridge Crop
Wild Potato/ Shoal Lake
Devil's Elbow
Rainy Lake
6
5
4
3
2
1
21-Apr-13
6-May-13
21-May-13
5-Jun-13
20-Jun-13
5-Jul-13
20-Jul-13
4-Aug-13
19-Aug-13
3-Sep-13
18-Sep-13
3-Oct-13
18-Oct-13
2-Nov-13
17-Nov-13
2-Dec-13
17-Dec-13
1-Jan-14
16-Jan-14
31-Jan-14
15-Feb-14
2-Mar-14
17-Mar-14
1-Apr-14
16-Apr-14
1-May-14
16-May-14
31-May-14
15-Jun-14
30-Jun-14
15-Jul-14
30-Jul-14
14-Aug-14
29-Aug-14
13-Sep-14
28-Sep-14
13-Oct-14
28-Oct-14

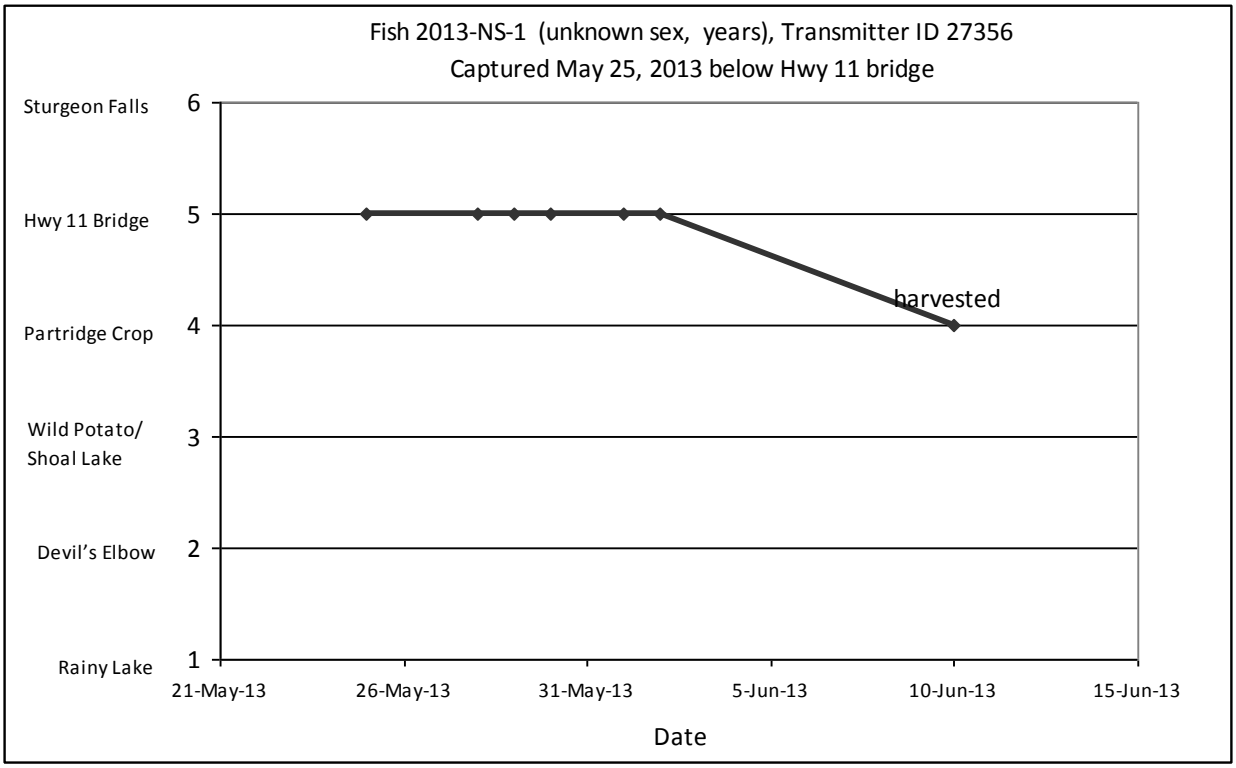
v)


Fish 2013-NS-3 (male, YOB 1999), Transmitter ID 27354
Captured May 25, 2013 below Highway 11 bridge
Sturgeon Falls
Hwy 11 Bridge
Partridge Crop
Wild Potato/ Shoal Lake
Devil's Elbow
Rainy Lake
6
5
4
3
2
1
21-Apr-13
6-May-13
21-May-13
5-Jun-13
20-Jun-13
5-Jul-13
20-Jul-13
4-Aug-13
19-Aug-13
3-Sep-13
18-Sep-13
3-Oct-13
18-Oct-13
2-Nov-13
17-Nov-13
2-Dec-13
17-Dec-13
1-Jan-14
16-Jan-14
31-Jan-14
15-Feb-14
2-Mar-14
17-Mar-14
1-Apr-14
16-Apr-14
1-May-14
16-May-14
31-May-14
15-Jun-14
30-Jun-14
15-Jul-14
30-Jul-14
14-Aug-14
29-Aug-14

w)


Fish 2013-NS-6 (mature male, YOB 1997), Transmitter ID 27355
Captured May 25, 2013 in Partridge Crop Lake
Sturgeon Falls
Hwy 11 Bridge
Partridge Crop
Wild Potato/ Shoal Lake
Devil's Elbow
Rainy Lake
6
5
4
3
2
1
6-May-13
21-May-13
5-Jun-13
20-Jun-13
5-Jul-13
20-Jul-13
4-Aug-13
19-Aug-13
3-Sep-13
18-Sep-13
3-Oct-13
18-Oct-13
2-Nov-13

x)


Fish 2013-NS-1 (unknown sex, years), Transmitter ID 27356
Captured May 25, 2013 below Hwy 11 bridge
Sturgeon Falls
Hwy 11 Bridge
Partridge Crop
Wild Potato/ Shoal Lake
Devil's Elbow
Rainy Lake
6
5
4
3
2
1
harvested
21-May-13
26-May-13
31-May-13
5-Jun-13
10-Jun-13
15-Jun-13
Date