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**Maritimes Region**

# **Atlantic Sturgeon (*Acipenser oxyrinchus*) of the Saint John River, New Brunswick: Spawning Population Characteristics and Migration Timing**

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## Foreword

This series documents the scientific basis for the evaluation of aquatic resources and ecosystems in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

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## ABSTRACT

Several measures are used to manage the commercial fishery for Atlantic Sturgeon in the Saint John River (SJR), including a closure during June to protect spawning adults. The degree of overlap between the June closure and the timing of Sturgeon spawning was examined using commercial catch data, experimental fishing during June in 2016, the migration timing of acoustically tagged Sturgeon, and the degree of gonad maturation in females caught and harvested or released by the fishery. Spawning began in June in some years and was underway by early July in all years, based on the appearance of spent females during commercial fishing between July 2 and July 8, and during experimental fishing in June. Using the patterns observed in daily catch rates and sex ratios during commercial and experimental fishing in 2016, it can be predicted that Sturgeon first arrive in the area of the commercial fishery in May, with abundance peaking in early June. Females were a little later than males in arriving and may not have been sufficiently ripe to be harvested before June 1. Residence time in the river for females was variable, with some spawning and leaving relatively quickly post-spawning, while others spawned later or spent variable amounts of time in the river after spawning. Ripe Sturgeon were present in the river in some years until mid-August. The closure does not prevent the fishery from accessing ripe females; female Sturgeon are still ripening in July and frequenting the area where the fishery occurs. The closure directs fishing activity to a time when spent females are at greater risk of interception within the commercial fishery.

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## INTRODUCTION

Atlantic Sturgeon, *Acipenser oxyrinchus oxyrinchus*, occur in major rivers and coastal environments from the east coast of Labrador, Canada to Florida, USA. The Saint John River (SJR), New Brunswick, is one of two locations of known spawning populations of Atlantic Sturgeon in Canadian waters. In 2011, the SJR Atlantic Sturgeon population was designated as the Maritimes Population or Designatable Unit (DU) by the Committee on the Status of Endangered Wildlife (COSEWIC) and assessed as Threatened because of its relatively small breeding population and its exposure to regulated commercial and recreational fisheries (COSEWIC 2011). Threats included lack of quantitative data on population responses to exploitation and changes to habitat, but pollution and commercial fishing were considered the most significant factors in the population's decline in the past. The SJR Atlantic Sturgeon (herein referred to as Sturgeon) population is under consideration for listing under the *Species at Risk Act*.

A commercial fishery has existed in the SJR since the late 1800s, but the first evaluation of the sustainability of Sturgeon removals occurred in 2009. The Department of Fisheries and Oceans Canada (DFO) reviewed total removals and other sources of mortality in response to an application to export wild Sturgeon products from the SJR (DFO 2009). A maximum of 350 animals (175 female and 175 males) was set as the allowable harvest. This was a short-term objective based on the perception that the population had supported a commercial harvest of about 400 fish per year, over the previous 40 years, while maintaining a healthy age structure (DFO 2009). Other sources of human-induced mortality were thought to be low (less than 50 animals per year).

The first formal assessment of the SJR spawning population was a Recovery Potential Assessment (RPA) to provide information on the current status of the population, threats to its survival and recovery, habitat needs, and feasibility of recovery (DFO 2013, Bradford et al. 2016). The RPA estimated annual spawner abundance in the range of 1,000–3,000 individuals for the years 2009–2012. Total abundance was not estimated because Sturgeon do not return to spawn every year (availability to capture varies between years) and the spawning periodicity for individual fish was not known. It concluded that the population would persist at current levels in the short to medium term (5–10 years), based on a large number of age classes observed in the adult spawning population, as well as apparent high abundance of juveniles and sub-adults of presumed SJR origin in the nearby Minas Basin.

The status of the SJR spawning population was most recently assessed by Dadswell et al. (2017) using annual tag returns from the fishery to estimate population abundance, as well as length data to estimate total mortality and mean survival. The total abundance of the current SJR population (2013–2015) was estimated at 18,000 to 21,000 adult Sturgeon. The numbers of Sturgeon that might have been harvested during the seven years of the fishery was estimated based on total reported landings and an average individual weight. They concluded that the population abundance is now similar to the virgin population size, and the current exploitation rate is very low (less than 2%).

Advice on the status of the spawning population was requested by DFO Resource Management to improve management of the Sturgeon commercial fishery, including to:

- provide an estimate of the current spawning stock biomass, as well as advice on appropriate reference points; and
- provide advice as to whether the current 350 fish commercial quota (175 males and 175 females) is appropriate relative to the estimate of spawning stock biomass.

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These first two objectives are addressed in Huynh et al. (In press).

A third component of the request for advice was to:

- provide advice as to the usefulness and appropriateness of the current annual closure (month of June) to protect spawning adults, i.e., does the closure provide benefits and is it of the appropriate duration and at the appropriate time of year.

The following report uses information summarized in the RPA and monitoring information collected from the fishery since 2009 to provide context on the biology of the SJR Atlantic Sturgeon population and the commercial fishery, as well as to address this third management question.

## **ATLANTIC STURGEON LIFE HISTORY**

Information on the biology, ecology and life history of Sturgeon populations in North America was recently summarized by Hilton et al. (2016), from which most of the following description is taken, supplemented with information specific to SJR Sturgeon as reported by Dadswell (2006), COSEWIC (2011), Taylor and Litvak (2017), Taylor et al. (2016), Dadswell et al. (2016, 2018), and Beardsall et al. (2016).

Sturgeon are anadromous, with pre-spawning adults of northern populations migrating into rivers of the Gulf of Maine and north from mid-May to August (Bradford et al. 2016, Dadswell et al. 2018, Wippelhauser et al. 2017). Following spawning, adults emigrate from northern rivers in August through October to Maine rivers (Wippelhauser et al. 2017), mid-August to the St Lawrence River (Hatin et al. 2002), and to the SJR in August and September (Taylor and Litvak 2017). The timing has been shown to differ for males and females in the Hudson River, with males remaining in the estuary until fall, while females leave after spawning (Smith 1985). Taylor and Litvak (2017) also reported that males appeared to remain in the estuary until fall, while females left after spawning.

Spawning occurs above the salt-freshwater interface in freshwater over hard bottom or clay bits (Hilton et al. 2016). Larvae develop from yolk-sac larvae within 10–14 days and initiate downstream dispersal that lasts 6–12 days. Free embryos, larvae, and Sturgeon less than one year old are not salt tolerant, with salinities as low as 5–10 ppt causing mortality.

Neither the historical (i.e., prior to construction of the Mactaquac Dam in 1968), nor current, spawning locations have been documented for SJR Sturgeon. The capture of yolk sac larvae and exogenous feeding larvae in late July 2011 near Burton, New Brunswick (NB) indicates that spawning occurred that year between mid-June and mid-July in locations above 106 km from the Reversing Falls at the mouth of the SJR (Taylor and Litvak 2017).

Migration is a characteristic of Sturgeon, from larval through juvenile stages and adult life stages (Hilton et al. 2016). Young Sturgeon likely spend their first winter in freshwater and then move downstream into saline water in the following spring. Juveniles migrate seasonally within the estuarine portion of the rivers, moving to deep, wintering areas in winter and upstream in spring. In the SJR, tagged Sturgeon less than 100 cm Total Length (TL) primarily concentrated in the lower 40 km with only a few individuals briefly exiting the river (Whitmore and Litvak 2018). Juveniles leave their natal estuary generally between 2–6 years of age and at lengths of 80–120 cm to initiate a coastal foraging migration (Hilton et al. 2016). Coastal juvenile migrants forage along the coast and also enter the estuarine areas of non-natal rivers and forage during the summer and fall, with some remaining all winter. During the fall, spring, and summer, Sturgeon may occur near the mouths of large bays, estuaries in shallow water over sandy and muddy substrates (Dunton et al. 2010).

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Sturgeon tagged with acoustic transmitters in the SJR have mainly been detected in the Bay of Fundy. However, detections have also been recorded on receivers in locations as distant as the Rivière Jean at the mouth of the St Lawrence River on the array maintained by the Ocean Tracking Network that extends across the Scotian Shelf near Halifax, Nova Scotia (NS) and the coastal United States (US) in Cape Cod, Casco and Massachusetts bays (Taylor et al. 2016, Tsitrin et al. 2021). Minas Basin is a known feeding location for juvenile, sub-adult, and adult Sturgeon, including those originating from the SJR (Wirgin et al. 2012, McLean et al. 2014, Beardsall et al. 2016, and Dadswell et al. 2016). Satellite tags deployed on juvenile and adult Sturgeon in the SJR and Minas Basin indicate that the deeper portions of the Bay of Fundy may serve as important winter habitat for dense aggregations with little or no movement (Taylor et al. 2016, Beardsall et al. 2016).

Maturity in Sturgeon varies with northern populations maturing at an older age than southern populations and males maturing at a younger age than females. Sturgeon from the SJR and St Lawrence River have similar ages of maturity with males maturing around 16–24 years and females around 17–28 years (DFO 2013, Bradford et al. 2016). Among the SJR population, females spawn at intervals of 2–5 years, while males may spawn every 1–5 years (Taylor and Litvak 2017, Tsitrin et al. 2021). Tagged adult Sturgeon were observed to return to the SJR after a minimum of two years (Taylor and Litvak 2016, Dadswell et al. 2017). Not all Sturgeon migrating into the river may spawn that year. Taylor and Litvak (2017) observed that four of their tagged Sturgeon migrated into the river during the summer migration, but remained seaward of the salt-freshwater interface, except for brief forays.

There is no evidence of a second spawning migration in the SJR, such as observed for some rivers, although Taylor and Litvak (2017) reported two fish remained in a possible spawning area into September and they reported capturing ripe fish as late as August 9. Some Sturgeon may overwinter in the river as indicated by the occurrence of adult Sturgeon at the mouth of Washdemoak and Grand lakes in the SJR (Dadswell 2006). Taylor and Litvak (2017) observed that one fish remained in the river until early November.

## **MANAGEMENT OF ATLANTIC STURGEON FISHERIES**

### **Commercial Fisheries Targeting or Incidentally Catching Sturgeon**

Commercial fishing for Sturgeon in the SJR began as an intense, unregulated gillnet fishery in 1880. Regulations, set the following year, closed the SJR to Sturgeon fishing from August 31 to May 1, and required gillnets with mesh sizes of 33 cm (13 inches). Following a rapid decline in landings, the commercial fishery was closed in 1886 (Bradford et al. 2016). When commercial fishing resumed in 1897, harvest was prohibited from May 31 to July 15 to protect spawning Sturgeon. In 1965, regulations adjusted the closed season to June 1–30 and implemented a minimum size limit for landed Sturgeon of 120 cm TL. The minimum size limit was increased to 130 cm by variation order in 2017, with the intention of protecting Shortnose Sturgeon (*Acipenser brevirostrum*), a species of Special Concern that also resides in the SJR.

The number of Sturgeon licences authorized to fish in the SJR increased from two to four licences between 1975 and 1980, and again to 13 by the mid-1980s. Around that time, entry into the fishery was restricted and concurrently, commercial licences were made non-transferrable and terminated with the departure of the existing licence holder from the fishery. A single licence, issued in 1987, that authorized fishing in the Shubenacadie River, NS, was changed to authorize fishing in the SJR in 2013.

Currently, there are two remaining commercial licences fishing a total of 11 gillnets (610 m total length), and the fishery is restricted to the SJR and tributaries in Kings County, NB. Commercial

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fishing occurs during the months of May, July, and August, when adult Sturgeon are present in the river. The start of the fishing season is largely determined by the degree of spring flooding and river access. The fishery occurs within a 31 km section of the SJR known as Long Reach that stretches roughly from Grand Bay-Westfield to Evandale (Figure 1). Long Reach is within the bounds of the spawning area described in DFO (2013) from the Mactaquac Dam to Reversing Falls. In light of the presence of saline water throughout much of Long Reach, it is considered to function as a migration corridor used by Sturgeon to reach spawning and wintering areas further upriver (Bradford et al. 2016).

A Total Allowable Catch (TAC) of 350 fish per year has been set for the Maritimes population (DFO 2009). Directed fisheries are authorized to remove 175 male and 175 female Sturgeon, for a potential total of 350 fish per year. The fishery closes when either the male or female quota is reached. The level of reporting in logbooks has increased through regulations and voluntary contributions of information regarding the biological composition of the commercial catch by licence holders (Bradford et al. 2016). Since 2010, licence holders must report their fishing effort and the number and sex of fish caught daily as a condition of their licence. Sturgeon held temporarily to provide eggs and sperm for fish culture facilities are counted against the annual quota, even if they are subsequently returned to the wild. An additional 50 fish have been set aside by DFO (above the commercial quota) to account for incidental mortalities in other fisheries, possible hydro-electric turbine interactions, Indigenous food, social and ceremonial fisheries, and any retentions in a recreational fishery.

Retention of Sturgeon by other fisheries (bycatch) has been prohibited by condition of licence throughout the Maritime provinces since 2000. Prior to this, Sturgeon could be retained from shad drift-gillnet fisheries, otter trawls, and brush weir fisheries in the Bay of Fundy. This retained bycatch contributed significantly to total annual Sturgeon catch in some years (Bradford et al. 2016). Juvenile Sturgeon are caught in fixed gillnets and trap nets in fisheries directing for Shad and Gaspereau in the Lower SJR (DFO 2013, as well as otter trawls and brush weirs in the upper Bay of Fundy. No at-sea observations are available for the gillnet, brush weir, and trap net fisheries, but post-release mortality is presumed to be low, based on self-reporting of licence holders and observations by DFO Conservation officers. Post release survival by Sturgeon caught in brush weirs and otter trawls in the upper Bay of Fundy was estimated as greater than 94% (Beardsall et al. 2013).

Sturgeon were caught and discarded in an otter trawl fishery directing for Longhorn Sculpin in St Mary's Bay, NS, in April and May (Bradford et al 2016, DFO 2021). Based on at-sea observer data, Sturgeon discards from this fishery are estimated at 2.5 mt per year (DFO 2021). The fishery was closed in 2020.

### **Recreational Fisheries**

Directed recreational angling fishing for Sturgeon is authorized on the SJR using artificial fly or baited single barbless hooks with a minimum retention size of 130 cm TL. There are no bag or possession limits and catches are not reported. DFO (2009) reported that a recreational fisheries survey conducted in 2005 indicated 2,339 Sturgeon were angled, of which 41 were retained.

### **Food, Social and Ceremonial Fisheries**

There are two food, social and ceremonial fisheries licences that authorize the harvest of Sturgeon (Oromocto First Nation and the New Brunswick Aboriginal Peoples Council). No landings were reported between 2007 and 2012 (Bradford et al. 2016). Five sturgeon (species not specified) were landed in 2012–2013 (Greg Stevens, DFO, pers. comm.).



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## **COMMERCIAL LANDINGS AND EFFORT**

Commercial catches from 1880 to 2012 were compiled by Bradford et al. (2016). A total of 712 mt of Sturgeon were landed by the SJR fishery between 1880 and 1886. Landings remained low from the resumption of the commercial fishery in 1897 until the 1960s, rarely exceeding 4 mt per year. Landings increased in the years between 1965 and 2012, averaging 9 mt per year and peaking at 41 mt in 1988 and 1989 (Bradford et al. 2016). Landings were likely under-reported in the years from 1965 to 1985, as data was compiled using primarily purchase slips and supplementary reports (DFO 2009). No landings were reported in 2005 and 2006.

Sturgeon landings from locations in the Bay of Fundy (NB and NS) were less than 1 mt for most years from 1880 to 1956. Landings from 1957 to 2000 averaged 5 mt, with a peak at 18 mt in 1985.

No record of effort (numbers of nets, hours fished) were available for the years prior to 1990. Beginning in 1990, commercial licence holders were required to report catch (kg) and hours fished by month. Landings may have been underreported until 1996 when returning logbooks became a condition of licence. Detail in reporting has increased through regulations and voluntary efforts by licence holders. Landings as numbers of fish by sex have been reported since 2007. Since 2009, landings and progress toward the harvest quota have been tracked by mandatory tagging (unique tag numbers) for each fish landed, as well as, daily reports of the sex, length, date and location of capture, and effort (number gillnets fished). Commercial licence holders have also voluntarily maintained daily records of effort, catch, length, and sex of both retained and released fish. Estimates of daily catch per unit effort can be generated for the years 2007–2020.

Landings and catch for the years 2007–2020 are shown in Table 1.

## **USEFULNESS AND APPROPRIATENESS OF THE CURRENT JUNE CLOSURE TO PROTECT SPAWNING ADULTS**

### **METHODS**

Several information sources were examined to determine the degree of overlap between the June closure and when Sturgeon spawning occurs in the river.

The first information source was detailed catch information from 2009–2020 provided by Acadian Sturgeon and Caviar (Carters Point, NB) on body size, sex, and the state of gonad maturation for both harvested and released fish at their time of capture. As Sturgeon were removed from the gillnets, they were sexed using a biopsy probe; a procedure that is also used to assess the quality of the eggs (ripeness) or whether females had spawned. Spawned fish were recorded as spent. Most Sturgeon not harvested were marked with Passive Integrated Transponder (PIT) and Floy tags before release. Recaptures of marked Sturgeon within or from previous years were recorded.

The second information source was data collected during 2016, when DFO authorized experimental fishing during June to acquire catch-based information on migration run timing during June, when the commercial fishery is closed by variation order. Four to six set gillnets were fished from June 1–30 under a scientific licence using the same methods, gear, and locations as during the commercial season. Nets were deployed for 24 hours and checked every morning. All Sturgeon were measured (Fork Length [FL] and Total Length [TL]) and sexed. Females were assessed for egg development. All fish were marked with Floy and PIT tags before release.

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The third source of information was a sample population of 33 adult Sturgeon captured in the SJR during the spawning migrations of 2013–2014 that were surgically implanted with acoustic transmitters and subsequently detected by acoustic receivers deployed in the SJR and coastal Atlantic regions by DFO-Science and non-government researchers from 2013–2020 (Tsitrin et al. 2021). The detection histories for fish that re-appeared in the SJR during the years 2015, 2016, and 2017 were partitioned into 'Long Reach' and 'Upper SJR' as an indicator of potential spawning activity, with the assumption that spawning occurs upstream of River Kilometer (RK) 50, the limit of the fishery.

The fourth source of information considered was the commercial fishery logbooks (date when the fishery began, the male/female ratio, catch rate) in order to gauge the similarity between annual runs. The date of first occurrence of spent females was used as an indicator that spawning activity had begun in the river. Records of female Sturgeon recaptured as spent were checked to see if they were pre-spawning when first caught and released.

## RESULTS

Some commercial fishing occurred during May in every year from 2010–2020 (Table 2). The number of Sturgeon present in Long Reach during May was variable, with at least twice as many caught in 2010, 2013, 2016–2018 as in the years 2011, 2014, 2015, 2019, 2020. More males than females were caught in May of every year except 2011. Spent females were first recorded during commercial fishing between July 2 and July 8 of every year. Multiple spent females occurred on the first day that spent fish were observed in five of the twelve years. Spent females were observed earlier than July in two years. Four spent females were recorded when scientific fishing was conducted during June 2016: on June 6, 10, 11, and 16. A spent 229 cm TL female was observed in May 2013.

Table 3 further explores patterns in the occurrence of spent females during the fishing season. Sample sizes of females released and spent when recaptured later are low with only four or more females recaptured spent in the years 2010, 2013, 2014, and 2016. Seven females tagged and released between May 26 and June 3 were spent when recaptured later in July through September. The number of days lapsed between release and recapture ranged from 25–90 days. These captures indicate that some females arriving in Long Reach spawn soon after, while others are still maturing and spawn later in July. The percentage of spent females captured during fishing over the 12 years of observation ranged from 4–50% in July and 12–82% in August (Table 3).

Figure 2 shows the catch rates and numbers of fish by sex for the 2016 year in Long Reach. Smoothed three-day averages were applied to decrease the variability apparent in daily catch rates.

The smoothed average catch rate shows a pattern with two peaks in catch rates of greater than three fish per net in the first two weeks of June. Catch rates declined to about one fish per net through July except for catch rates of two fish per net in mid-July. Catch rates were less than one fish per net for the first half of August, increasing to about one fish per net in the last week of August.

Males were caught more consistently than females in Long Reach from mid-May through early June. The number of males increased from June 2–15, a little earlier than females which peaked in numbers between June 7–17. The observed peak in catch rates in mid-July was associated with about equal numbers of males and females. The peak in August was associated with an increase in the number of females.

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Sturgeon caught and released in May and June 2016 were frequently recaptured later in the season. Of 170 Sturgeon tagged in June, 46 were recaptured in July (average number of days since capture [DSLCL] = 28.5 days) and 30 in August (DSLCL = 59.5 days). Table 4 shows the number of fish marked during 2016 and harvested following re-opening of the fishery on July 1. Approximately one half of the females marked and released in May and June were harvested as ripe females.

Acoustic receivers deployed in Long Reach between 2013–2020 first detected tagged Sturgeon in May in all years except 2014 (Tsitrin et al. 2021). The last day of detections ranged from August 14 (year 2015) to November 11 (year 2017). June had a high presence of tagged Sturgeon, followed by July and August. The numbers of tagged male Sturgeon detected each year was higher than the number of females detected. Abacus plots of the locations of detections within Long Reach indicated that some Sturgeon were only detected on a few days, while others had a high reoccurrence of detections. Detection in the upper portion of the river, where spawning is assumed to take place, generally occurred from mid-June to late-August.

Acoustic data for 2016 showed that eight of 32 tagged Sturgeon were present in Long Reach in 2016. The first detection occurred on May 4 and the last on August 22. One female and three males were first detected in May. A second female and three males were first detected in June.

## **DISCUSSION**

The similarity in catch rates and proportion of males to females in May, and the appearance of spent females in early July among years, supported the assumption that the migration run in 2016 was similar to other years, and, therefore, could be used as a general model of movements of adult Sturgeon within the river.

The results from sampling in 2016 show that Sturgeon were present in Long Reach by mid-May. Males were initially more abundant than females until the beginning of June. Abundance was highest in mid-June, and spawning had begun by mid-June. Some females apparently migrated down river shortly after spawning, while others did not appear to spawn until later in July, or lingered in the river above Long Reach following spawning. Many of the fish captured by the commercial fishery in July and August had been present in the river for several weeks prior to capture.

Applying the patterns observed in 2016 as a general model of Sturgeon migration over the years 2009–2020, Sturgeon first arrived in Long Reach in May and abundance increased through early June. Residence time in the river for females was variable, with some spawning and leaving relatively quickly post-spawning, while others spawned later or spent variable amounts of time in the river after spawning. Ripe Sturgeon were present in the river in some years until mid-August. In years when the fishery continued into late August and September, the catch consisted of males and a high proportion of spent females.

Spawning began in June in some years and was underway by early July in all years. Spawning in a location or locations at or above RK 106 was proposed by Taylor and Litvak (2017). Based on the capture of very young larvae in 2011, they also proposed that spawning occurred from June to mid-July of that year, with annual variability in the timing of spawning. As this location is about 50 km upriver of Long Reach, some females are migrating back down river soon after spawning, appearing in Long Reach in the first week of July.

The June closure provides Sturgeon the opportunity to travel through Long Reach to their spawning location unimpeded. It is effective in protecting at least some females while they enter the river and ripen prior to spawning. In years when the run develops during May, the commercial fishery has an opportunity to harvest males. Females are a little later in arriving and

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also may not be sufficiently ripe to be harvested before June 1. Not all Sturgeon that enter the river in May and early June continue upriver to spawn immediately. Mark-recapture data indicated that nearly 50% of the females recaptured July 1, or later, during 2016 had yet to spawn. Some Sturgeon migrate upriver, spawn, and return to Long Reach in early July. These mix with Sturgeon that are entering Long Reach from downstream for the first time, ripening females, as well as Sturgeon that appear to spend the entire season at or near the salt-fresh water interface (Taylor and Litvak 2017).

The closure does not prevent the fishery from accessing ripe females; female Sturgeon are still ripening in July and frequenting the area where the fishery occurs. It does direct fishing activity to a time when spent females are at greater risk of interception within the commercial fishery.

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## TABLES

*Table 1. Annual catch and landings of male and female Saint John River Atlantic Sturgeon and last day of fishing (sex not always reported in year 2007–2011; Dash [ - ] indicates no observation).*

<b>Year</b>	<b>Catch</b>	<b>Numbers Harvested</b>	<b>Males Harvested</b>	<b>Females Harvested</b>	<b>Fishery end date</b>
2007	-	198	-	-	August 10
2008	405	221	61	84	August 21
2009	670	285	148	137	August 25
2010	700	278	79	111	August 21
2011	519	340	164	176	August 18
2012	414	323	162	161	August 16
2013	558	347	173	174	August 7
2014	514	340	165	175	August 15
2015	471	345	169	176	August 8
2016	413	297	125	172	September 15
2017	449	339	164	175	August 3
2018	454	350	175	175	August 16
2019	460	332	175	157	August 23
2020	298	190	102	88	September 12

*Table 2. Start date of the commercial fishery, the catch rate in May, ratio of males (M) to females (F), and the first appearance of spent females by year from 2009–2020 in the Saint John River, New Brunswick (NA: no fishing).*

<b>Year</b>	<b>1st day fishing</b>	<b>No. caught in May</b>	<b>May M:F ratio</b>	<b>First day (July) spent females observed</b>	<b>Number spent females observed first day</b>	<b>Catch rate May (fish/day/net)</b>
2009	July 2	NA	NA	July 6	1	NA
2010	May 11	148	1.3:1	July 2	3	3.7
2011	May 17	10	0.8:1	July 7	1	0.4
2012	May 4	76	1.1:1	July 2	5	0.7
2013*	May 13	148	1.6:1	July 2	1	1.8
2014	May 22	15	1.1:1	July 8	5	0.6
2015	May 26	19	2.0:1	July 7	2	0.6
2016**	May 18	85	1.5:1	July 6	1	1.7
2017	May 25	67	2.2:1	July 6	2	1.5
2018***	May 23	70	2.1:1	July 3	1	1.5
2019	May 22	33	1.6:1	July 2	1	0.6
2020	May 18	40	2.2:1	July 6	1	0.6

\* logbook recorded one 229 cm Total Length spent female May 26, 2013.

\*\* 4 spent females caught on June 6, 10, 11, 16.

\*\*\* only catches from Long Reach included.

Table 3. Number of Atlantic Sturgeon tagged and recaptured after spawning in the same year and the percent of females recorded as spent by month during fishing (dash [-] indicates no observation).

Year	Number females tagged and recaptured spent	Date range tagged	Date range recaptured	Percent of captured females spent (Total Number females) by month			
				May	June	July	Aug
2009	-	-	-	-	-	17(165)	35(63)
2010	4	May 31–July 14	July 26–Aug 9	0(58)	-	23(146)	41(46)
2011	-	-	-	0(5)	0(9)	27(210)	63(51)
2012	2	May 12, 22	July 12, 2	0(36)	-	50(133)	60(25)
2013	7	May 13–July 18	July 9–Aug 5	2(57)	0(6)	20(174)	23(26)
2014	4	June 28–July 10	July 11–Aug 13	0(6)	0(39)	22(198)	39(46)
2015	2	July 21, 24	Aug 2, 7	0(5)	-	4(216)	18(39)
2016	7	May 26–June 3	July 9–Sept 5	0(34)	3(133)	11(107)	12(150)
2017	0	-	-	0(21)	0(5)	19(194)	89(9)
2018	1	May 28	July 7	0(22)	-	8(162)	33(40)
2019	1	May 25	Aug 10	0(13)	-	15(145)	41(61)
2020	2	May 30–July 20	July 12–Sept 12	0(12)	-	30(120)	82(22)

Table 4. Number of Atlantic Sturgeon tagged and released in 2016 and proportion later recaptured during the commercial fishery (dash [-] indicates no data).

Month Marked	Sex	Marked (N)	Post July 1 Recaptures		
			Dead	Processed	Proportion of Marks removed
May	Female	18	1	8	0.50
	Male	22	0	2	0.09
June	Female	88	5	38	0.49
	Male	82	2	5	0.09
July	Female	3	0	1	0.33
	Male	1	0	0	0.00
August	Female	0	0	0	-
	Male	1	0	0	-



**FIGURES**

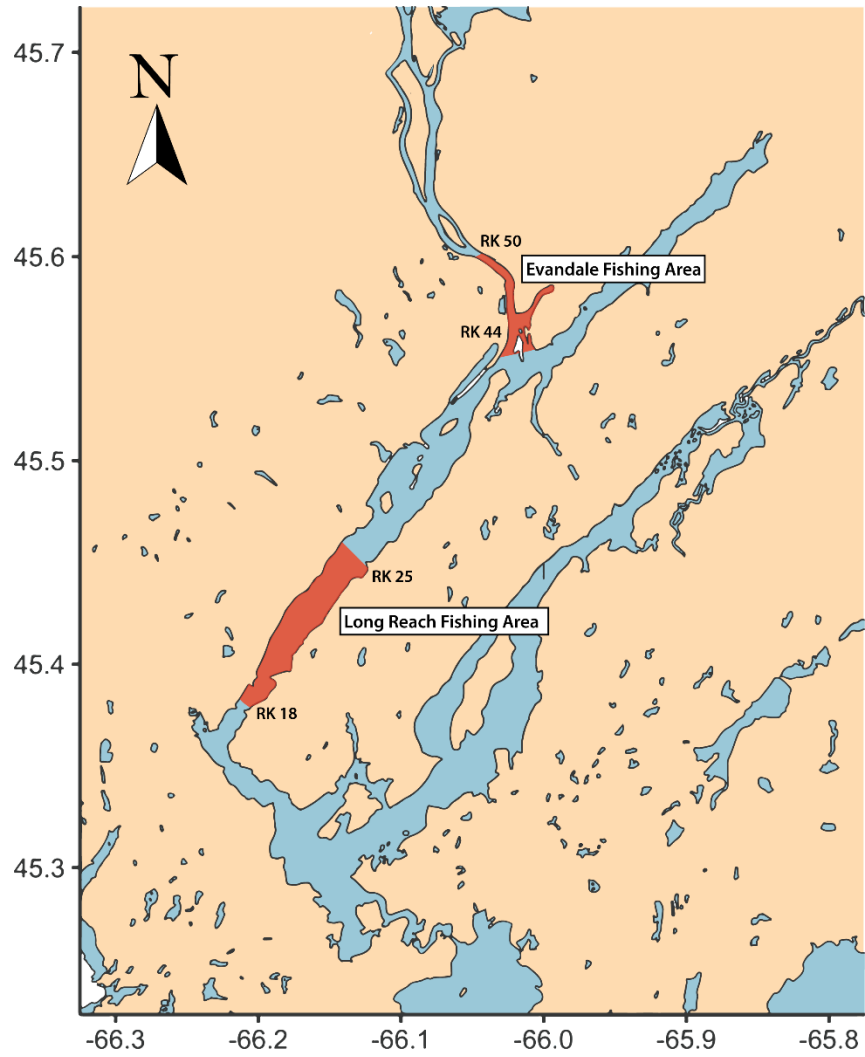


Figure 1. Location of the commercial Atlantic Sturgeon fishery in the Saint John River, New Brunswick.

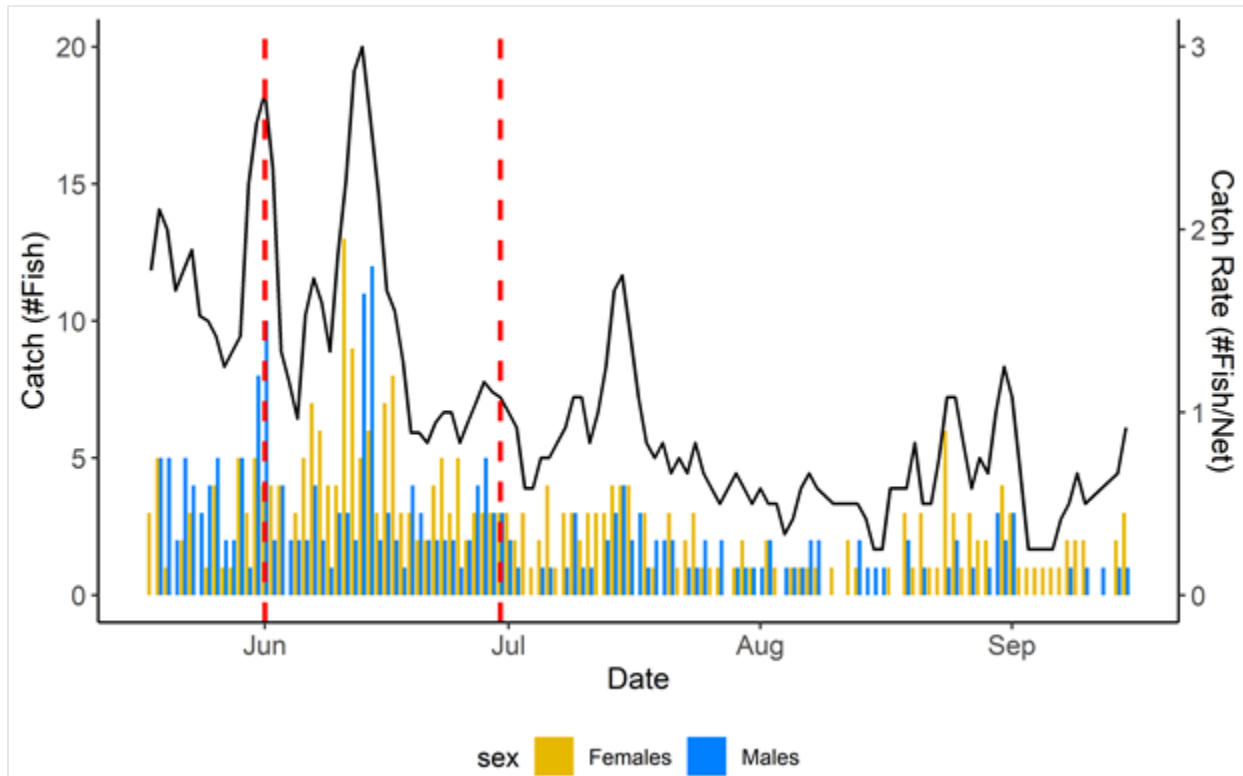


Figure 2. Three-day smoothed average of daily catch rates and numbers of males and females caught by gillnets in 2016 in Long Reach, Saint John River. Vertical red dashed lines indicate the start and end of the June closure.