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Maritimes Region

Status of Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) in the Saint John River, New Brunswick

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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

A recovery potential assessment of Atlantic Sturgeon was conducted by Fisheries and Oceans Canada (DFO) in January 2013 to provide information on the current status of the population, threats to its survival and recovery, habitat needs and feasibility of recovery. The Maritimes population unit occurring in the Saint John River (SJR) was designated threatened by the Committee of the Status of Endangered Wildlife in 2011. Abundance estimates derived from mark-recapture experiments indicate modest numbers of 1,000 to 3,000 spawners. Sex ratio, mean length, mean age and growth parameters were calculated for commercially caught fish. A mean estimate of effective population size (Ne = 110) indicates that the population is above the critical threshold (Ne = 50) for risk of inbreeding, but is very low for a population subjected to commercial exploitation. Age validation using Carbon-14 indicate pectoral fin spines underestimate sturgeon age in old fish. The primary threat to SJR sturgeon is the commercial fishery, which has been capped at 350 fish per year. Maintaining annual spawner abundances of approximately 1,000-3,000 adults in the lower Saint John River, while supporting a population with a broad body size and age distribution for both sexes, and improving upon the understanding of the genetic diversity within the population is proposed as a medium-term abundance recovery target. A potential distribution target would be that all life-history stages should be found in the Saint John River, with interannual appearances of multiple age classes within known marine foraging areas such as Minas Basin, Nova Scotia.

État de la population d'esturgeon noir (*Acipenser oxyrinchus oxyrinchus*) dans le fleuve Saint-Jean, au Nouveau-Brunswick

RÉSUMÉ

Une évaluation du potentiel de rétablissement de l'esturgeon noir a été réalisée par Pêches et Océans Canada (MPO) en janvier 2013, afin de fournir des informations relatives à l'état actuel de la population d'esturgeon noir, aux menaces qui pèsent sur sa survie et son rétablissement, à ses besoins en matière d'habitat et à la faisabilité de son rétablissement. L'unité de la population des Maritimes présente dans le fleuve Saint-Jean a été désignée « menacée » par le Comité sur la situation des espèces en péril en 2011. Les estimations de l'abondance tirées d'expériences de marquage-recapture indiquent un modeste total de 1 000 à 3 000 géniteurs. Le sex-ratio, la longueur moyenne, l'âge moyen et les paramètres de croissance ont été calculés pour les poissons visés par la pêche commerciale. Une estimation moyenne de la taille effective de la population (Ne = 110) indique que la population est supérieure au seuil critique (Ne = 50) pour le risque de consanguinité, mais qu'elle est très faible pour une population visée par une exploitation commerciale. La validation de l'âge par l'usage de carbone 14 sur les épines de la nageoire pectorale sous-estime l'âge du poisson chez les esturgeons âgés. La principale menace pour les esturgeons du fleuve Saint-Jean est la pêche commerciale, limitée à 350 poissons par année. On propose, comme cible de rétablissement de l'abondance à moyen terme, de maintenir l'abondance annuelle des reproducteurs autour de 1 000 à 3 000 adultes dans le cours inférieur du fleuve Saint-Jean, en soutenant une population avec une vaste répartition selon la taille et l'âge chez les deux sexes, et en améliorant la compréhension de la diversité génétique au sein de la population. Un objectif possible en matière de répartition serait de pouvoir observer des poissons à tous les stades biologiques dans le fleuve Saint-Jean, avec la présence d'une année sur l'autre de plusieurs classes d'âge dans les zones d'alimentation marines connues, telles que le bassin Minas, en Nouvelle-Écosse.

INTRODUCTION

The Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) is a large-bodied, slow-growing and late-maturing anadromous fish. Although wide-spread, with a range extending along the Atlantic coast from northern Labrador to Florida (Scott and Scott 1988), the number of discrete spawning populations is relatively low and currently estimated to be fewer than 25 (ASSRT 2007). Two spawning populations presently exist in Canadian waters, one in the Saint John River, New Brunswick, and another in the St. Lawrence River, Québec (Figure 1). Each population represents the sole contributing population to genetically and demographically recognizable Designatable Units (DU), the Maritimes Population DU and the St. Lawrence River Population DU respectively (COSEWIC 2011).

The Maritimes Population DU was designated 'threatened' in 2011 by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), on the basis of a single spawning location within the lower Saint John River area, a relatively small breeding population numbering in the low thousands, and uncertainty of the effects on population viability of regulated commercial and recreational fisheries (COSEWIC 2011). The population has never been formally assessed, and comprehensive information on current abundance is lacking, as is the case for most of the known spawning populations along the eastern seaboard of North America (ASSRT 2007).

In recognition of their sensitivity to over-exploitation, Atlantic Sturgeon have been listed since 1998 on Appendix II of the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES) as a species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible with their survival. As a result, exports of products derived from commercial fisheries directed at Saint John River Atlantic Sturgeon must be accompanied by a valid CITES export permit, issued by a national CITES Management Authority. Export permits cannot be issued unless a CITES Scientific Authority determines that the export of Atlantic Sturgeon products will not be detrimental to the survival of the species in the wild (also known as a Non-Detriment Finding (NDF)).

In 2009, an application for the export of specimens and products of wild Atlantic Sturgeon captured from the Saint John River compelled Fisheries and Oceans Canada (DFO) and the CITES Management Authority in Canada to review the sustainability of the total removals of Atlantic Sturgeon (i.e., the legal harvest plus other sources of mortality) from the Saint John River population (DFO 2009). The review concluded that a maximum commercial harvest of 350 Atlantic Sturgeon, comprised of equal numbers of males and females was sustainable over the short-term (5 years). However, this NDF was supported by statements of general status and trends developed from inference of commercial landings data and limited biological data that had been collected opportunistically from a few individual spawners over a few years of the fishery. Data concerning the abundance and age structure of the population was not available.

Advice concerning the status of the Saint John River population is also required to help support decisions by regional fisheries managers on whether to issue additional commercial fishing licences. Licences have not been transferable since the mid-1980s. The number of active licences has, therefore, declined from ten to four in the years since, as licence holders have left the fishery. DFO Science was asked to undertake a Recovery Potential Assessment (RPA) for the Maritimes Designatable Unit; the recommendations rising from this process were published in DFO 2013.

PURPOSE AND SCOPE

This assessment of the Saint John River Atlantic Sturgeon population is, therefore, intended to fulfill several objectives:

- To provide to the extent possible within the DFO Recovery Potential Assessment Framework (DFO 2007) information concerning the life-history, biological traits, status, trajectory, habitat requirements, threats (and alternatives and mitigation) to the Maritimes Population DU.
- To support the review of the existing commercial harvest quotas defined in the 2009 CITIES NDF (DFO 2009) and to help define export quotas for both meat products and caviar.
- To provide advice to fisheries managers on the status of Saint John River Atlantic Sturgeon in support of an anticipated review of the licensing policy for the commercial fishery.
- To identify knowledge gaps that will need to be addressed within either a Recovery Plan or Fisheries Management Plan scenario.

SAINT JOHN RIVER ATLANTIC STURGEON BIOLOGY

Saint John River Atlantic Sturgeon have not been studied extensively until recently. Published materials concerning their biology are few, and available descriptions rely extensively upon inference from the known traits of adjacent populations (see DFO 2009; COSEWIC 2011). The Saint John River population has been shown to differ genetically from the St. Lawrence River population (King et al. 2001; Grunwald et al. 2008), as well as, all other extant spawning populations occurring in more southerly rivers for which genetic information is available, including the adjacent Kennebec River (State of Maine) population (Wirgin et al. 2012). The Kennebec River population has been assigned by the United States Marine Fisheries Commission to the Gulf of Maine Distinct Population Segment (ASSRT 2007).

As is the case with all other populations of Atlantic Sturgeon, the Saint John River population is anadromous meaning they spawn in fresh water and spend a portion of their lives at sea. Adults can begin to ascend the Saint John River as early as May. Spawning is thought to extend into late August. Neither historical (i.e., prior to construction of the Mactaquac Dam in 1968) nor current spawning locations have been reported. Eggs are thought to be deposited on hard surfaces on the river bottom where they adhere until hatching (Scott and Crossman 1973). Juveniles reportedly remain in fresh water for their first summer before migrating to estuaries during the first winter (COSEWIC 2011). By three to five years of age, the range of Hudson River juvenile Atlantic Sturgeon extends into the marine environment where they are thought to migrate along the coast, following temperature gradients until maturity (Dovel and Berggren 1983). Migrant, foraging juvenile, and sub-adult Atlantic Sturgeon are abundant in the Minas Basin during the summer months (Wehrell 2014; Dadswell 2006). Benthic invertebrates, principally marine worms, have been reported to represent the principle constituents of their diet (McLean et al. 2013).

Atlantic Sturgeon can reach a total length (TL) of 430 cm, and a body weight of 363 kg (Scott and Scott 1988). Females and males may live to be more than 60 years, and 30 years, respectively (Scott and Scott 1988). Atlantic Sturgeon estimated to be in the range of 4 m in length have been observed on the river in recent decades (M. Dadswell, Acadia University, Wolfville, personal communication). Males generally tend to be smaller bodied than females of the same age. Males are generally shorter lived than females. Length and age at maturity for male and female Saint John River Atlantic Sturgeon have not been determined empirically. In the St. Lawrence River, male sturgeon mature for the first time between 16 - 24 years of age, at a size of approximately 150 cm fork length (FL), and a weight of 36 kg. Females reach maturity at an age of 27- 28 years, at a size of 180 - 200 cm FL, and a weight of 64 kg (Scott and

Crossman 1973; Caron et al. 2002). In the Hudson River, male and female Atlantic Sturgeon reach maturity at 117 and 173 cm FL (133 and 197 cm TL) and ages 12 and 14 respectively (Van Eenennaam et al. 1996; Van Eenennaam and Doroshov 1998).

Size and age data specific to the Saint John River population is not available. Application of von Bertalanffy growth parameters derived from samples of St. Lawrence river fish (Magnin 1964) to available length frequency data from the Saint John River fishery (length range approximately 125 cm – 250 cm Fork Length (FL)) indicated that at least 20 age classes have been represented in the catches in recent years (DFO 2009).

Female Atlantic Sturgeon are fecund. Large bodied members of the St. Lawrence River population have been estimated to contain 25,000 eggs per kg of total body weight (Vladykov and Greeley 1963). Ovaries can represent between 12% - 25% of total body weight at maturity (Smith 1985). Generally, females are thought to spawn once every two to six years and males are thought to spawn every one to five years (DFO 2009).

Information on the ratio of males to females in Canadian waters is incomplete. A higher female to male ratio in older fish could be expected if, as for other sturgeon, the females live longer, but no age specific studies are available. Samples of commercial catches from the Saint John River indicated that the sex ratios of adults was 2.5:1 (N =91) and 1.4:1 (N=344) for males in 1998-1999 and 2007-2008, respectively (DFO 2009).

SAINT JOHN RIVER ATLANTIC STURGEON HABITAT

The ecology of Atlantic Sturgeon in the northern part of their range has not been extensively studied (Caron et al. 2002), but important habitats for Atlantic Sturgeon appear to be: a river with access to the sea, preferably with deep channels; an estuary with relatively warm, mesohaline conditions (5 - 25 ppt); and a coastal shelf region (Dadswell 2006). Vladykov and Greeley (1963) speculated that Atlantic Sturgeon spawn in freshwater, over rocky-gravel substrate in 1-3 m deep water with a strong current, and also under waterfalls and in deep pools with hard, clay bottoms. Spawning habitat in the St. Lawrence River has been more recently shown to exist in fresh water, under tidal influence and at depths varying between 14 m and 60 m (Caron 1998; Hatin et al. 2002). Substrate included rock, and bedrock with some sand and clay. However, the total area used for spawning represented only 3-4 km of the total estuary.

Fishing for adult Atlantic Sturgeon in the Saint John River has traditionally been centred within the section of the river lying between Westfield and Evandale (Figure 2). This section of the river remains the principle fishing area.

Sulak and Clugston (1998) and Hatin et al. (2002) have suggested that freshwater spawning habitat and estuarial juvenile habitat are limiting factors because the amount of coastal shelf habitat used by older age classes is much greater (COSEWIC 2011).

ATLANTIC STURGEON FISHERIES MANAGEMENT IN MARITIMES REGION

Atlantic Sturgeon fisheries are managed in the Maritimes Region under the *Canada Fisheries Act*, the primary legislative basis for fisheries management in Canada. The *Act* authorizes the Minister of Fisheries and Oceans Canada to make decisions about the conservation of fisheries resources and habitat, to establish and enforce standards for conservation, to determine access to and allocation of the resource, and to undertake projects and develop partnerships to improve or develop commercial fisheries. The Maritime Provinces Fishery Regulations (SOR/93-55) provide the regulatory framework within which fishery managers regulate harvests in the fisheries.

CHANGES IN STURGEON FISHERY REGULATIONS WITH TIME

Regulations specific to the fishery for adult Saint John River Atlantic Sturgeon were implemented within a year of the commencement of fishing activities in 1880 (Prince 1904). The chronology of measures implemented since 1881 is as follows:

1881

- Close Time: August 31st to May 1st.
- Mesh of nets fixed at 33 cm (13 inches) extension measure.
- Licence fee of $5.

1882

- Licence fee raised to $15 (as a disincentive to fish).

1886

- Commercial fishery closed.

1891

- Uniform close time of May 31st - July 15th established for all sturgeon fisheries in Canada.

1897

- Commercial fishery re-opened.

1965

- Close time: June 1st to June 30th (stated in the New Brunswick Fishery Regulations for 1965. The close time was possibly implemented prior to 1965).
- Minimum size limit of 120 cm Total Length (TL).
- Minimum gill net mesh size of 33 cm (13 inches) maintained.

1981

- Licence freeze suggested by DFO-Science, implemented by the mid-1980s.
- Non-transferable restriction likely introduced at the same time, effectively limiting participation in the fishery to no more than 10 licence holders (G. Stevens, DFO Dartmouth, personal communication).

1993

- Fishery (General) Regulations prohibit retention of incidentally caught species for which a person is not licensed to catch and retain.

2000

- All Atlantic Sturgeon captured incidentally in commercial fisheries are required by condition of licence to be released.

2011

- Quota management implemented.
- Dock Side Monitoring and tracking of individual landed fish introduced.

2012

- Tethering of live wild-caught sturgeon until sold prohibited by condition of licence.
- No fish to be transported from location of capture unless tagged.

STURGEON FISHERY MANAGEMENT MEASURES PRESENTLY IN EFFECT

The following summarizes key monitoring and enforcement elements for the Canadian Atlantic Sturgeon commercial fishery in the Bay of Fundy. These elements are applied under the existing provisions of the federal *Maritime Provinces Fishery Regulations*; the *Fishery (General) Regulations*; and through amended licence conditions. These are also expected to represent the core elements of a Regional Conservation Strategy and Monitoring/Enforcement Regime as required by CITES Resolution Conf. 12.7 (Rev. CoP14).

Commercial Fishery

- Commercial fishing can potentially occur at any time, except during the month of June, when the fishery is closed. Because adult fish are the target of the Saint John River fishery, fishing activity occurs during the months of May, July and August.
- The June closure is intended to protect spawners for approximately one third of the assumed June-August spawning season.
- There are presently four commercial licence holders in the Bay of Fundy. Three licences are valid for the Saint John River/Harbour, and licence conditions restrict fishing to tidal waters of the counties through which the Saint John River in New Brunswick flows. One licence is valid for one county in the province of Nova Scotia through which the Shubenacadie River flows.
- In accordance with the 2009 CITES Non-Detriment Finding (DFO 2009), a Total Allowable Catch (TAC) of 400 fish per year has been set for the Maritimes Population. Directed fisheries are authorized to remove 175 male and 175 female Atlantic Sturgeon for a total of 350 fish per year. The commercial fishery is closed when 175 fish of either sex is reached.
- Wild-caught Atlantic Sturgeon diverted to fish culture facilities (hatcheries) are counted against the annual quota even if the fish are subsequently returned to the wild.
- The remaining 50 fish of the 400 fish TAC are intended to cover any retentions in Aboriginal and recreational fisheries, incidental mortalities from turbines (Annapolis causeway), research, and commercial fisheries targeting other species.
- Minimum gill net mesh size of 33 cm (13 inches).
- Minimum length limit set at >120 cm in total length.
- Individual tagging of every fish landed and sold in order to enable tracking of the fish and progress toward filling of the quota.
- Completion and submission of detailed logbooks is a condition of the commercial licence.
- Retention of incidentally caught sturgeon in other fisheries is prohibited.
- The fishery is monitored on a regular basis by fishery officers.
- Fisheries Management reviews the fishery annually.

Recreational Fishery

Directed recreational angling for sturgeon occurs predominantly within New Brunswick in the Saint John River, where both tournament and non-tournament angling occurs. The recreational fishery is primarily catch-and-live release; however, a small proportion of the caught sturgeon are thought to be retained. The minimum retention size limit for recreationally angled Atlantic Sturgeon is 120 cm (48 inches) TL. Shortnose sturgeon (*A. brevirostrum*) are a significant proportion of the angled catch. Both direct and post-release survival of Atlantic Sturgeon is assumed to be high (e.g., 97%) as has been estimated for recreationally angled white sturgeon (*A. transmontanus*) (Robichaud et al. 2006).

Aboriginal Fishery

There are currently two Aboriginal fishing licences (Food, Social, and Ceremonial) that authorise the harvest of Atlantic Sturgeon in the Maritimes Region (Oromocto First Nation and the New Brunswick Aboriginal Peoples Council (NBAPC)). There is a negotiated daily allocation of 10 Atlantic Sturgeon per day per person for NBAPC.

Aquaculture

There is one producing Atlantic Sturgeon aquaculture facility in New Brunswick and another under development. These facilities may remove a small number of fish from the Bay of Fundy stock. There are two options available for aquaculturists to obtain wild Atlantic Sturgeon in the Maritimes Region. Aquaculturists may purchase fish that have been legally caught in the commercial fishery (and included and reported in the commercial landings records), or in the event that a commercial supply is not readily available, they may apply to DFO for written permission under the *Fisheries Act* to fish for broodstock. Any such permission imposes terms and conditions with respect to the quantity and size of fish that may be taken, the gear that may be used, and the facility where the fish will be kept. Annual reporting of collection activities is required.

Canadian Quotas Submitted to the CITES Secretariat

An interim Canadian caviar quota of 400 kg/year based on a catch quota of 350 fish with a sex ratio of 50:50 has been agreed to by Canada and the United States and was submitted to the CITES Secretariat in December 2010.

SAINT JOHN RIVER ATLANTIC STURGEON DISTRIBUTION AND ABUNDANCE

DATA SOURCES

Catch Data

Commercial

Reported annual landings of Atlantic Sturgeon captured in Maritimes Region commercial fisheries are available by Province and by Fisheries Statistical District (FSD) for the years 1880-2012. The Annual Reports of the Department of Marine and Fisheries contain the catch records for the years up to 1946. However, the means by which the data were gathered are not documented. Between the years 1947 and 1989, catch statistics were compiled by Fisheries Officers from sales slips -- the records of sales by individual licence holders to commercial buyers. No records of effort (e.g., nets deployed, hours fished) are available for the years prior to 1990.

Beginning in 1990, DFO-Science issued commercial licence holders with logbooks that allowed for the reporting of both catch (kgs) and effort (hours fished) for the fishing year, but only to the level of the month of fishing. Internal records maintained by Science Branch indicate that landings may have been under-reported until 1996 when return of the logbooks to the DFO became a condition of licence. No logbooks were issued for the 2008 fishing season; however, there was only one participant in the fishery that year and direct consultation with the licence holder resulted in the gathering of detailed records of daily catch, daily effort, and fishing locations.

Since 2009, all commercial fishers holding a licence to fish a diadromous fish species have been required by condition of licence to submit their logbooks to a Dockside Monitoring Company for data entry. A 'Freshwater Fisheries Logbook' was developed to allow for the gathering of data across fisheries in a standard manner. However, it became clear during the 2009 CITIES NDF (DFO 2009) that additional information would be required -- namely the body size and sex of the individual fish harvested. As well, a means to verify that each fish landed was counted against the annual quota was required. The current logbook, therefore, allows for the reporting of:

- a unique harvest number stamped on a tag that is attached to each fish before being landed,
- date and location of capture,
- the total length and sex of each landed fish, and
- information on number of gillnets fished daily.

A change in the tracking and recording of catches from landed weight to number of fish landed by sex began in 2007 as an industry initiative. Catches have been converted from number of fish, to weight, using the average weight of processed fish (head off, gutted, tail removed – the bullet weight) for the year multiplied by a standard conversion factor of 1.3 (DFO Unpublished Data). Since 2010, progress towards reaching the harvest quota of 175 males and 175 females (350 fish total) has also been based upon the number of fish landed. Average processed fish weight estimates supplied by industry have been used to convert the catch to landed weight.

Recreational Angling Fishery

Atlantic Sturgeon recreational anglers are not required to report catches.

Aboriginal Fisheries

Combined landings under the two licences have been minimal (< 5 fish per year) in the past five years. Two Atlantic Sturgeon were reported in 2012.

DFO Surveys/Programs

Saint John River Littoral Zone Surveys

Beach seine surveys of the shallow (approximately 1 m depth or less) littoral habitats were conducted by DFO-Science from late July to early September during the years 2000, 2001, and 2009 to help characterize fish assemblages. The surveys occurred throughout both the tidal and non-tidal portions of the lower Saint John River, lying between Mactaquac Dam and Reversing Falls (including sub-drainages; Figure 4). Briefly, two sweeps, each approximately 50 m in length, with a 30 m in length (mesh size 1 cm) beach seine were conducted at each site. Total catch per fish species was recorded for each sweep and site.

Research Vessel Surveys

The Maritimes Virtual Data Centre maintains a database of DFO research vessel (RV) surveys conducted since 1970 by Maritimes Region Science Branch. The data base was queried for all recorded catches of Atlantic Sturgeon, for all years and for all surveys. No attempt was made to assess the frequency of captures of Atlantic Sturgeon in the surveys. The information reported in this document, therefore, represents only the records of reported catches.

Fishery Observer Programs

The Maritimes Virtual Data Centre also maintains a database of fisheries observer records acquired since 1977, concerning the composition of catches in commercial fisheries for groundfish, pelagic fishes, and invertebrates. The data base was specifically queried for information on the fishery, gear type, year, date, and quantity of captured Atlantic Sturgeon. No attempt was made to assess the frequency of incidental captures of Atlantic Sturgeon in the observed fisheries; the information reported in this document, therefore, represents only the records of reported catches.

Acoustic Tracking Studies

Minas Passage

In order to assess the use of the Minas Channel (Figure 5) as a migration corridor by migrant Atlantic Sturgeon, 30 sturgeon >100 cm FL were obtained locally during June-September 2010, surgically implanted with individually identifiable acoustic transmitters, and returned to the wild as described by Beardsall et al. 2013. Each transmitter had an expected functional life of four years. A linear array of hydrophones, maintained across the 4 km in width (maximum depth about 120 m) Minas Channel, provided the platform for detections of individual fish from June 2010 to June 2012.

POPULATION ESTIMATES

Spawner Abundances from Mark-Recapture Experiments

Daily records of tags applied and recaptured were used to estimate annual spawner abundance for the 2009, 2010, 2011, and 2012 fishing seasons. Estimates were of the ‘Peterson type’ generated using the Bayes algorithm developed by Gazey and Staley (1986). Briefly, traditional approaches to sequential mark-recapture experiments (Petersen- and Schnabel-type) yield population estimates with significant negative bias and large confidence intervals where the number of animals marked and examined is generally low. Recasting the analysis into a Bayesian framework using a "non-informative" discrete uniform improper prior (a priori theoretical) distribution can alleviate these biases (Gazey and Staley 1986).

Several estimates were generated for each fishing year where possible. These included:

- Single estimates for total spawner abundance via the pooling of all marks, all recaptures and the total catch for the year.
- Single estimates for female spawner abundance via the pooling of all marks, all recaptures and the total catch of females for the year.
- Sequential total spawner abundance estimates using marks available, reported recaptures and reported catch for sequential 5-day intervals.
- Sequential female spawner abundance estimates using marks available, reported recaptures and reported catch for sequential 5-day intervals.
- Sequential ‘pre-fishery’ estimates of total spawner abundance derived from records of July-August catches and recaptures of tags applied during the month of May.
- Sequential ‘pre-fishery’ estimates of female spawner abundance derived from records of July-August catches and recaptures of tags applied during the month of May.

The method assumes the following:

1. The population is closed, so the population size does not change over the period of the experiment.
2. The probability of capturing a marked individual at any given time is equal to the proportion of marked members in the population at that time.
3. Animals do not lose their marks over the period of the study.
4. All marks are reported on recovery (Gazey and Staley 1986).

In practice, valid estimates can be generated when population size changes with time, where:

1. There is neither recruitment nor immigration, but death and emigration affect marked and unmarked individuals equally.
2. There is recruitment and/or immigration but neither death nor emigration.
3. Knowledge is available from other sources such that adjustments can be made for migration, recruitment, and death prior to analysis of the data (Gazey and Staley 1986).

Population Homogeneity and Effective Population Size

Commercial Catch Samples

Measurement and sampling of the commercial catches occurred during the years 1998 and 1999 and has occurred annually since 2007. Body length and sex data acquired from the 1998 and 1999 samples have been previously summarized in DFO (2009).

Data on Total Length (cm), Dressed Weight (kg) (minus the head, guts and tail) sex, and the date and location of capture were acquired for the years 2007 and 2008. Sex determinations were performed on live fish with a biopsy probe. Since 2009, tissue samples and pectoral fin spines as sources of DNA and for use in age determination, respectively, have been excised from Atlantic Sturgeon selected for harvest. Samples of both materials were assigned unique sample ID numbers to allow them to be related to the source fish. Tissue samples were placed in small vials topped with 95%ETOH. The alcohol was replaced after 24 hours to maintain the quality of the DNA. Pectoral fin spines were stored frozen until prepared for use in age determination.

Since 2009, external Floy tags and/or internal PIT tags have been applied to fish returned to the wild.

Age Validation, Ageing and Growth

Widespread atmospheric testing of atomic bombs in the 1950s and 1960s resulted in the release of radiocarbon (14C or carbon-14), in the form of carbon dioxide gas, into the atmosphere. Rain and atmosphere-ocean gas exchange quickly introduced the radiocarbon into the surface layer of the world's oceans and fresh water environs. Many organisms, including some fish species (Kalish 1993; Campana 1999), have been shown to have incorporated carbon-14, in proportion to its concentration in the environment, into calcareous body parts while the fish grow. The record of carbon-14 contained within the calcareous tissues of animals alive prior to the onset of atmospheric atomic explosions can, therefore, potentially be used to validate fish ages derived by counting the number of rings (annuli) observed in hard body parts such as otoliths and spines.

Validation of ages derived from the reading of annuli recorded in Atlantic Sturgeon pectoral fin spines does not appear to have been previously attempted. Therefore, exploratory assays of carbon-14 in pectoral fin spines were initiated to 1) determine if this species uptakes carbon-14 and 2) whether assigned ages are consistent with the time horizon defined by the appearance and subsequent depletion of carbon-14 into aquatic environments. Two pectoral fin spines excised from fish sampled in 1998 were selected for assay, one from a 231 cm TL (70.2 kg TW) female and one from a 216 cm TL (48.5 kg TW) male. Readings of the spines suggested spawning years (formation of the core) of 1964 and 1968 for the female and male, respectively. Preparation, assay, and interpretation carbon-14 data was as described in Campana (1999).

Pectoral fin spines collected during the 2010 and 2011 fishing seasons were thawed and dried at 23ºC prior to sectioning with an Isomet saw. Ages (Years) were estimated from digital images of the spine sections.

CAVIAR AND MEAT PRODUCTION UNDER QUOTA MANAGEMENT

Dressed weights (kg) are available for 491 male and 257 female Saint John River Atlantic Sturgeon for the years 2008 to 2012. Caviar yields (kg) are available for 239 females captured in 2011 and 2012. Estimates of the 5%, 50%, 75%, 95%, 97.5% and 99% quantile annual yield were generated from 5,000 samples consisting of the summed weight of caviar for 150 caviar weights (the annual quota of females) drawn at random. Meat yields were similarly derived using the summed dressed weights for 150 males and 150 females.

RESULTS AND DISCUSSION

DISTRIBUTION AND ABUNDANCE

Intensive commercial Atlantic Sturgeon fishing beginning in 1880 resulted in the reported removal of over 700 metric tons of fish over 7 years (Table 1; Figure 6). Year over year declines in landings ranged between 25% to nearly 60%. The fishery closed after the 1886 season and did not re-open until 1897. The time series of landings for the Saint John River fishery indicated that spawner abundance never recovered to pre-fishery levels at any time (Figure 6) although a re-building of the stock may have been underway by the mid-1970s (Figure 6). However, the absence of Catch per Effort information limits speculation on this matter. With the exception of occasional low (approximately 0.1t) landings from the southern Gulf of St. Lawrence, Atlantic Sturgeon fishing outside of the Saint John River did not develop until 1910 (Tables 2-4).

The Saint John River fishery has been the dominant Atlantic Sturgeon fishery in the Maritime Provinces since 1880 (Figure 7). However, landings from sea fisheries, in particular the fisheries occurring within the Bay of Fundy, have contributed significantly to the annual total catch in some years. It is unclear if the landings from the sea fisheries were the result of directed fishing or retention of bycatch, or a combination of both. It is not clear as to the extent that the sea fisheries for Atlantic Sturgeon were regulated and subject to the conditions developed with time for the Saint John River fishery.

No landings were reported for the 2005 and 2006 fishing years[1] (Table 4). The inter-annual increase in landings following resumption of fishing in 2007 (Table 5) reflects increased fishing activity as markets developed. Total annual catch since implementation of quota management (maximum 350 fish per year) in 2010 has been 190, 340, and 323 fish per year for the 2010, 2011, and 2012 fishing seasons, respectively. The 2011 fishery was closed after the 175 female quota was reached.

The number of licences and gear (gillnets, fathoms) under licence for the Saint John River fishery have declined significantly since 1996 when 10 licence holders were authorized to set 1,830 fathoms (about 3,350 m) of gillnets (Figure 8). There are presently three active licences,

[1] The years 1932 and 1933 are the only other years in the time series when no landings have been reported, other than for when the fishery was closed between 1887 and 1897.

and 270 fathoms (495 m) of gillnet under licence for the river (Figure 8). The single licence, for 60 fathoms (110 m) of gillnet, for the Shubenacadie River, Nova Scotia remains active (Figure 8).

The large number of FSD's (Tables 1 and 2; Figure 3) wherein Atlantic Sturgeon landings have been reported indicate that the species range includes all of the Bay of Fundy and the Atlantic Coast of Nova Scotia. Reported landings from Cape Breton Island waters have been rare. Reported landings are also rare in the tidal waters of Prince Edward Island, as well as the areas of New Brunswick and Nova Scotia that border the southern Gulf of St. Lawrence (Tables 2 and 3). The inter-annual regularity of reported landings from the Passamaquoddy Bay, Chignecto Bay, Minas Basin, and Digby Neck (including Annapolis Basin and St. Mary's Bay) areas of the Bay of Fundy (Tables 1 and 2) indicate these may be areas of regular seasonal occupation by Atlantic Sturgeon.

The distribution of landings among the FSD's located within the lower Saint John River (Table 1) indicate that the amount of freshwater habitat located in the main stem of the river, used by the fish, is not extensive. Landings from FSD 58, which represent the stretch of river lying within Sunbury County and upstream of its border with York County (a few kilometers below the City of Fredericton), were infrequent and generally low even during the first years of the fishery (Table 1). The distribution of landings may, therefore, indicate that the presence of the Mactaquac Dam may not have significantly reduced the total amount of freshwater habitat that was used historically by the adult (fishable) population. However, confirmed Atlantic Sturgeon occurrences in the headpond created by the dam (DFO Unpublished data) do indicate that riverine habitat upstream of Fredericton was used by the population to some extent.

DFO Surveys/Programs

Saint John River Littoral Zone Surveys

No Atlantic Sturgeon were captured during the extensive beach seine surveys of the lower Saint John River during the years 2000, 2001, and 2009. The shallow (approximately 1 m depth and less) shoreline areas of the river, therefore, do not appear to be used extensively by the species irrespective of substrate type, vegetation, salinity, or tidal amplitude.

Research Vessel Surveys

Few Atlantic Sturgeon have been captured during DFO RV surveys. All have occurred either near the entrance to Saint John Harbour or further into the Bay of Fundy (Figure 9). The infrequency of the catches, in low numbers, indicates that waters greater than 100 m in depth are not used extensively within the Bay of Fundy. The absence of catches from any of the Shelf (e.g., submarine banks) and Shelf Slope ecosystems adjacent to the Canadian Maritime Provinces indicates that these ecosystems may not represent important habitat for Atlantic Sturgeon.

Fishery Observer Programs

Compilation of all by-caught Atlantic Sturgeon recorded by fishery observers indicates that the species is generally of low susceptibility to capture in commercial fisheries and mostly only within commercial fisheries occurring at relatively shallow depths near shore. Susceptibility to incidental capture is apparently greatest in trawl fisheries targeting groundfish in the areas of Scots Bay and the inner Bay of Fundy; and Longhorn Sculpin (*Myoxocephalus octodecemspinosus*) in St. Mary's Bay (Comeau et al. 2009); and the outer Bay of Fundy (Figure 10).

The Longhorn Sculpin fishery began in 1999 and was stopped after the 2006 fishery, pending review. The fishery took place over a six week period in April-May, and was limited to four licence holders (vessels). Observer coverage was required and varied by year from 25% to

100% coverage. While fishing for sculpin, vessels were permitted to use a 90 mm diamond mesh codend (Comeau et al. 2009). The habitat where the directed sculpin fishery took place was an area that is highly tidally energetic and of low bottom complexity (Comeau et al. 2009). Table 6 shows that Atlantic Sturgeon was captured during seven of the eight years of observer coverage and in as many as 2.2% of the tows.

The bycatch rates in the St. Mary's Bay fishery are broadly comparable to Atlantic Sturgeon catch rates during winter tagging surveys conducted from 1988 to 2006 off the coasts of Virginia and North Carolina (Wilson Laney et al. 2007). Numbers of Atlantic Sturgeon captured during the surveys ranged from 0 (1993, 1995) to 29 (2006). They were encountered in 4.2% of tows, with the percentage varying from 0% in 1993 and 1995 to 12.6% in 1988. These data have been interpreted as an indication that juvenile Atlantic Sturgeon aggregate during the winter months to some degree (Wilson Laney et al. 2007).

Acoustic Tracking Studies

Minas Passage

Tagged Atlantic Sturgeon were present within the Minas Passage during the spring, summer, and autumn months (Figure 11), with the majority of detections occurring along the southern half of the array (Figures 5 and 11). Atlantic Sturgeon did not exhibit fidelity to the bottom when present in the Passage. The median depth of the fish at time of detection was less than the mean bottom depth at Mean Low Water at eight of the ten receiver locations (Figure 12).

POPULATION ESTIMATES

Mark-Recapture Experiments

Census Population Size (N_C)

Estimates of spawner abundance (Tables 7, 8, and 9) vary between the single and multiple (sequential) estimation procedures and vary between sample populations developed using all marked fish versus only those marked during the month of May (years 2010 and 2012). Nonetheless, all estimates yield mutually consistent estimates of low modest population abundances in the range of 1,000 to 3,000 spawners. All but one series of estimates indicated that spawner abundance has declined every year since 2009; the extent of the decline; however, varies with method. The time series of single census median estimates the following numbers of spawners: (Data per year is pooled) 3,050 (2009); 2,505 (2010); 1,825 (2011); 950 (2012), (Table 9). The two estimates that were possible by tracking recaptures of May tagged fish through the July-August fishing period yielded estimates of 2,450 (2010) and 2,125 (2012) (Table 9). The highest 5-day interval median seasonal estimates (Table 8) were as follows: 1,950 (2009); 1,550 (2010); 1,760 (2011); 1,020 (2012).

The highest 5-day interval median seasonal estimates of female spawner abundance (Table 8) were as follows: 600 (2009); 825 (2010); 740 (2011); 400 (2012). These estimates, when compared to the estimates for pooled sex estimates, imply sex ratios are in the range of two to three in favour of males, which differs significantly from the maximum observed 1.5:1 male:female ratio calculated from the sampled commercial catches in the years 2009 to 2012 (Table 7).

Estimates, especially those that included marks applied during July-August, are probably biased by incomplete reporting of marked and unmarked fish during the 2011 and 2012 fishing seasons. The proportion of the landed catch not represented in the mark-recapture experiment was higher in 2012 (66 of 323) than 2011 (40 of 340). Incomplete information is possibly a contributing factor to the large difference in median spawner abundance estimates obtained in 2012 using only May tagged fish (2,125) versus all tagged fish (950) (Table 9). The two methods yielded similar median spawner abundance estimates during 2010 (May tagged fish = 2,450; All tags = 2,505) when the record for recaptures within the fishery was complete (Table 9).

Population Homogeneity and Effective Population Size

Effective Population Size (Ne)

Analyses were carried out on 232 samples that yielded clear genotypes at the great majority of loci; for these samples, the mean number of loci scored was 20.3. The extent of polymorphism varied considerably among loci (Table 10). The number of alleles per locus varied from 3 to 22 (mean = 8.5) and He was 0.04-0.89 (mean = 0.57). The results of tests of departure from Hardy-Weinberg Equilibrium (HWE) were significant following sequential Bonferroni correction for 21 tests for four loci: LS-62, Aox45, AoxD297 and Aod_AS9WM. For each of these loci, inbreeding coefficient (Fis) values were positive (0.075-0.323), indicative of fewer than expected heterozygotes. A possible cause of heterozygote deficits is null alleles; alleles that fail to amplify, presumably because of mutations in Polymerase Chain Reaction (PCR) primer binding sites for those alleles. Consistent with this possibility, MicroChecker identified the presence of null alleles at these loci. MicroChecker also indicated the presence of null alleles at a fifth locus, AoxD64. Because the presence of null alleles might bias Ne estimates, Ne estimation was carried out on both the full 21 locus data set, and a reduced data set of 16 loci that excluded the five problematic loci.

Ne estimates produced by the two methods, and the 21- and 16 locus data sets were all similar and showed relatively narrow confidence intervals (Table 3). Estimated Ne ranged from 95 (sibship method, 16 locus data set) to 118 (LDNe method, 21 locus data set). The lower 95% confidence bound for the various Ne estimates was 73-96, and the upper 95% confidence bound was 127-159.

The Colony sibship analyses inferred the presence of 13 full-sib families comprising a total of 31 individuals for the 16 locus data set, and 15 full-sib families comprising 36 individuals for the 21 locus data set. The two analyses agreed on the full-sib relationships of 21 individuals. Both analyses identified a large number of putative half-sib relationships; for example, in the 21 locus analysis, all individuals were assigned membership in a half-sib family with at least one other fish in the data set (Figure 14).

Discussion of Genetic analyses

The two methods for estimating Ne produced remarkably similar results, with relatively narrow confidence intervals. We begin by considering possible sources of error or bias in our Ne estimates.

Both methods of estimating Ne used here make the same assumptions, some of which may be violated to some degree. These assumptions are as follows:

i. the population is closed;
ii. population size is stable;
iii. the population has discrete generations; and
iv. the genetic loci used are unlinked.

Each of these assumptions is considered in turn below:

i. **The population is closed**. As for any other diadromous fish, the Saint John River population of Atlantic Sturgeon is surely subject to some degree of in and out migration and, therefore, is not closed. The rate of immigration of Atlantic Sturgeon into the Saint John River is not known, but available genetic evidence indicates that for Atlantic Sturgeon, each river that supports breeding represents a genetically distinguishable population. For example, King et al. (2001) reported that the F_{ST} values between the Saint John River and other populations were 0.065-0.145 (all values were highly significantly > 0), implying that migration rates between rivers are likely to be relatively low. Unfortunately, the King et al. (2001) study did not include the population most likely to contribute migrants to the Saint John River and the Kennebec River. A recent study (Wirgin et al. 2012) did include the Kennebec River, but did not report F_{ST} estimates; however, it did suggest that Kennebec is probably the population that is most closely related to the Saint John River. Hence, if our sample of Saint John River sturgeon did include any immigrants, they were most likely to have come from the Kennebec River. Nonetheless, other considerations suggest that regardless of immigration levels, the true value of Ne in the Saint John River is unlikely to be greater than our estimates. A recent simulation study by Waples and England (2011) showed that the Linkage Disequilibrium (LD) method was relatively insensitive to moderate levels of immigration of up to about 5-10 percent per generation. At higher rates of migration in the simulation, the Ne estimates converged to the global metapopulation value. No similar evaluation of the effect of migration rates on Ne estimates derived from the kinship method are available, but Waples and England (2011) suggested that the presence of immigrants in the sample would increase (therefore, upwardly bias) Ne estimates based on the kinship method, because the immigrants would have parents unrelated to individuals in the focal population. Thus, low -moderate migration (<10%) might be expected to have little effect on the LD Ne estimate, and might cause an upward bias in the estimate derived from the kinship method. Greater levels of immigration would cause upward bias in the Ne estimates derived by both methods, because the Ne estimates would start to reflect metapopulation values (which might include the Kennebec River, and possibly other populations), but would, therefore, over-estimate the value of Ne for the local Saint John River stock. In any case, the two methods produced closely similar results in our study, and to reiterate, are likely either to be accurate (the low-modest immigration scenario) or over-estimates (high immigration scenario).

ii. **The population size is stable.** Both methods estimate the effective number of parents that produced the current sample; if the population size is unstable, this could in theory lead to a poor estimate of Ne. However, the long lifespan of Atlantic Sturgeon, coupled with the fact that our samples likely represent multiple year classes, suggest that this formal assumption is unlikely to have significantly biased our results.

iii. **The population has discrete generations.** Both methods assume that there are no parent-offspring relationships among the sampled individuals. In the absence of age data for our samples, this assumption cannot be confirmed. The degree of relatedness between parents and offspring is similar to the relatedness of full-sibs, so it is possible that some of the dyads interpreted as full-sibs in the kinship analysis are really parent-offspring pairs. It is unclear how such errors of kinship interpretation might affect the Ne estimates; however, the general implications of observing parent-offspring pairs in a sample of adult sturgeon are similar to those associated with detecting full-sib pairs. In our study, at least 13% of sampled individuals were inferred to belong to full-sib families represented by at least one other individual in the data set. If some of these individuals are related to each other through a parent-offspring relationship, the general conclusion remains the same: there are many closely related individuals within the population sample.

iv. **The genetic loci are unlinked.** The LDNe method assumes that statistical associations between alleles at different loci are driven by relatedness among individuals, not by physical linkage. The chromosomal locations of the microsatellites used in this study are not known; however, the large number of chromosomes in Atlantic Sturgeon (120; Ludwig et al. 2001) and the relatively large size of the Atlantic Sturgeon genome (>2B base pairs; Hardie and Hebert 2003), suggests that the loci used in this study are unlikely to be physically linked.

Other sources of error, such as genotyping error, could have influenced the Ne estimates. However, the loci chosen for this study were all either tri- or (mostly) tetranucleotide repeat microsatellites, which are easy to score, and, therefore, tend to result in low levels of genotyping error. Further, genotyping error, if random, would tend to degrade signals of linkage disequilibrium or kinship that these methods depend on, which would likely lead to larger estimates of Ne. Therefore, the overall conclusion is that our estimates of Ne are likely either to be accurate or, possibly, over-estimates of local Ne. They are unlikely to represent under-estimates.

Our estimates of Ne averaged 110 across both methods and both combinations of loci. The lowest lower limit 95%CI was 73 (sibship method, 16 loci), and the highest upper limit 95% CI was 159 (LDNe method, 16 loci). The overall conclusion, that Ne for the Saint John River Atlantic Sturgeon population is quite small, is reinforced by the detection of at least 13 full-families among the 232 sturgeon that were genotyped.

Although estimates of Ne are of interest in their own right, they gain the most relevance when placed in the context of the associated census values, Nc, for the population. Recent mark-recapture work on the Saint John River population carried out by DFO has produced a variety of Nc estimates, which are generally in the very low thousands. Median estimates of Nc that have been suggested to be reasonably reliable include: 2,450 (May 2010) and 2,125 (May 2012) (R. Bradford, DFO, pers. comm.). Using Ne = 110, these estimates suggest Ne/Nc ratios of 0.04-0.05. Overall, the recent estimates of Nc suggest a downward trend in abundance. For example the median seasonal estimates of Nc were 3,050 and 950 in 2009 and 2012, respectively (R. Bradford, DFO, pers. comm.) These suggest Ne/Nc ratios of 0.04 and 0.12, respectively. Finally, we can ask what are the extreme possible ratios for Ne/Nc (i.e., lowest lower CI Ne/highest upper CI Nc ; highest upper CI Ne/lowest lower CI Nc). These values correspond to 95/4855 = 0.02 (for May 2012 upper CI of Nc) and 147/690 = 0.21 (for seasonal 2012 lower CI of Nc). Hence, the extreme range of possible Ne/Nc ratios for Atlantic Sturgeon range from 0.02 to 0.21, and the most credible ratios are approximately 0.04-0.05.

All but the highest possible Ne/Nc ratios quoted above rank towards the low end of the range of Ne/Nc ratios that have been previously reported. For example, in a recent review of 83 studies, Palstra and Ruzzante (2008) reported a median Ne/Nc ratio of 0.14 across all taxonomic groups. Furthermore, they found that ratios tended to be higher in small populations, and suggested that mechanisms, such as reduced variance in reproductive success at low population levels, might act to buffer the effects of lower Nc on Ne. The factors underlying the relatively low Ne/Nc ratio for Saint John River Atlantic Sturgeon deserve further investigation, since such a low ratio suggests the possibility that reproductive success in the population is highly skewed, a somewhat surprising finding for a species that is very long-lived and presumably has many opportunities for reproduction.

Our mean estimate of Ne (approximately 110) for Saint John River sturgeon is above the 50 (Ne) threshold that is suggested to be critical for immediate risk of inbreeding (Franklin 1980). The risk of inbreeding is further mitigated by the possibility of immigration from other populations, such as the Kennebec River. Nonetheless, an Ne of 110 can only be considered very low for a population that continues to be subject to commercial exploitation. Further, populations in the U.S. are also at low abundance, suggesting that potential for genetic rescue from other populations may be limited, and that demographic rescue is even less likely.

To conclude, Ne, Nc and Ne/Nc values for the Saint John River population of Atlantic Sturgeon are all relatively low. Taken in the context of ongoing commercial exploitation of this population and poor conservation status of populations across the remainder of the range, these results strongly suggest the need for further investigation of demographic and genetic trends for this population.

BIOLOGICAL TRAITS

Sex Ratio

The fishery in recent years has included a component of real time assessments of fish sex and level of gonad development. Many fish are, therefore, not landed the first time they are observed in the catch. The potential for individual fish to be represented in more than one daily catch can, therefore, bias estimates of the male:female ratio. The sex ratio was, therefore, estimated using the sex determination information acquired the first time a fish appeared in the catch in a given year. Estimates varied between 0.9 to 1.5 males per female between 2009 and 2012 (Table 11). Males were proportionally a lower component of the landed catch in all years (Table 11). The male:female ratio of the landed catch has been near 1, and slightly in favour females in all four years (Table 11).

Length

The females intercepted in the fishery are on average longer bodied by about 20 cm TL than the males (Table 11). Average Total Body Length (cm) varied little among years for either sex (for First Capture Fish: males, 177 - 182 cm TL; females, 200 – 205 cm TL; Table 11). The landed catch of male and female Atlantic Sturgeon tends to be larger bodied by a few centimetres than the general population of spawners (Table 11; Figure 14), assuming the data collected from fish the first time they appear in the fishery is representative of the fishable population.

Age Validation

Carbon-14 exhibits strong gradients across the spine growth sequence for the two fish sampled (Figure 15). Pectoral fin spines are, therefore, well suited to application of carbon-14 assays to validate fish ages.

One of the samples (female) possessed a pre-bomb signature less than zero indicating that the age assigned from annulus counts underestimated true fish age by perhaps five to seven years. Figure 15 shows the carbon-14 value of the samples plotted against the expected year (based on conventional age determination) that the assayed materials were deposited in the spine. Carbon-14 began to increase in freshwater systems around 1956, plus or minus 1 or 2 years (Steven Campana, DFO, Dartmouth, personal communication). However, this preliminary assessment is not sufficient to determine the initial year of increase among Atlantic Sturgeon.

The preliminary results are consistent with previous observations that fin spines underestimate sturgeon age in old fish. Further investigation will require additional assays of spines, including spines possessing annuli formed before 1960 in order to complete carbon-14 chronology so as to include pre-bomb values.

Age

Average age (years) for commercially captured adult female Atlantic Sturgeon (28 ± 5 years in 2010, 29 ± 6 years in 2011) were on average about three years older than for commercially captured adult male Atlantic Sturgeon (26 ± 5 years in 2010, 25 ± 3 years in 2011) in the Saint John River (Table 12). Both estimates are older than modal ages of 15 years for males and 22 years for females reported by Kahnle et al. (2007) for adults captured in the Hudson River estuary commercial gillnet fishery between 1993 and 1995. Based upon available samples, males and females were estimated to first appear in the fishery at the ages of 17 years and 16 years, respectively (Table 12, Figure 16). These are older than for male (10 years) and female (10 years) Hudson River Atlantic Sturgeon. However, the Saint John River minimum ages at maturity may be overestimates because fish smaller than those represented in the age analysis are intercepted in the fishery as shown by the presence of males and females as small as

127 cm TL and 147 cm TL in the fishery (Table 11). The minimum lengths represented in the ageing samples were 160 cm TL and 175 cm TL for males and females, respectively (Table 11). Ages of between 8-10 years and 10-12 years could be expected for 127 cm TL males and 147 cm females based upon the predicted length at age (see Growth below).

Both sexes exhibit broad estimated age distributions, 17-39 years for males and 16-44 years for females (Table 12; Figure 16). The actual age distribution of spawners may be broader for both sexes in light of the indications that ages derived from counting visible annuli in pectoral fin spines may underestimate the true age of older Atlantic Sturgeon by 5-7 years (see Age Validation). Observed age distributions for neither sex varied appreciably between the two years (Table 12). Examples of sectioned pectoral fins are shown in Figure 17.

Growth

Estimation of all three of the von Bertalanffy growth parameters was not possible with the available data because the lack of immature, smaller-bodied specimens in the sample pool likely resulted in over-inflated estimates of t0 (which yield predicted lengths at t0 of <100 cm TL, data not shown). Nonetheless, growth relations generated by forcing through the origin generally fit the age versus length scatterplots for the male and female sturgeon sampled from the Saint John River (Figure 18). The theoretical maximum lengths (Linf) for male (201 ± 7.5 cm TL) and female (222 ± 6.9 cm TL) Saint John River fish (Table 13) are lower than those estimated for the Hudson River population (male 234±15 cm, female 278±7.5 cm; Kahnle et al. 2007). Estimates of the growth coefficient (k) indicate that both male (k = 0.11 ± 0.02) and female (k = 0.095 ± 0.015) Saint John River fish grow at a faster rate than male (k = 0.093 ± 0.016) and female (k = 0.074 ± 0.006) Hudson River fish.

Neither the Hudson River fish nor the Saint John River fish are predicted to grow as large as St. Lawrence River fish, which have been estimated to possess a theoretical maximum length of 315 cm (Table 12).

CAVIAR AND MEAT PRODUCTION UNDER QUOTA MANAGEMENT

Atlantic Sturgeon caviar and meat production exhibit significant ($p>0.001$) increasing trends with increasing body size but neither relation is strong (Caviar-TL $r^2 = 0.19$; Meat-TL $r^2 = 0.68$).

Caviar yields of ≤ 1 kg per female are common across much of the length range (Figure 19). Males tend to yield less meat than females because they are on average smaller bodied than females. However, meat production from both sexes exhibits the same general trend; the relative wide range in meat weights relative to body length likely reflect within-fish differences or variability in the method of processing more so than between-sex differences (Figure 20).

Estimation of the maximum potential annual yield of caviar and meat from the Saint John River commercial fishery for Atlantic Sturgeon must consider that the harvest is capped at 350 fish per year with no more than 175 males and 175 females comprising the catch in any given year.

Dressed weights are available for 491 male and 257 female Atlantic Sturgeon from the Saint John River commercial fishery that were processed in 2008-2012. The estimated mean (±1 Standard Deviation) Total Dressed Weight per 350 adult Saint John River Atlantic Sturgeon is 10,485 kg ± 145 kg (Table 14).

Similarly, caviar yields are available for 239 females captured in 2011 and 2012 with an estimated mean (±1 Standard Deviation) caviar (kg) yield from 175 female Saint John River of 528 ± 29 kg.

RECOVERY TARGETS

Recovery targets are typically set with an abundance and a distribution component; however, other population characteristics may also be considered (DFO 2005; DFO 2011).

Given the lack of accurate information on the current and historical spawning stock biomass in the Saint John River, including potential changes over time, it is not possible to establish definitive recovery targets for this DU.

However, a potential medium-term recovery target could be, at a minimum, to maintain the current annual spawner abundance in the lower Saint John River of approximately 1,000-3,000 spawners, while supporting a population with a broad body size and age distribution for both sexes, and improving upon the understanding of the genetic diversity within the population. Development of more accurate estimates of spawner abundance, spawning frequency, ages and the size-dependency of catchability of adult sturgeons with gill nets will greatly facilitate assessment of both progress toward and achievement of the recovery target.

A potential distribution target would be that all life history stages should be found in the Saint John River, with interannual appearances of multiple age classes within known marine foraging areas (e.g. the Minas Basin). A further consideration, contingent on the outcomes of future research, may be range expansion of spawning activity within the Maritime Provinces via introductions into areas where prior presence of spawning can be demonstrated (the Miramichi River, for example).

HABITAT CONSIDERATIONS (FROM DFO 2013)

The Canadian *Species at Risk Act* (*SARA*) requires that Critical Habitat be identified to the extent possible based on the best information available in the Recovery Strategy for all 'Threatened', 'Endangered' or 'Extirpated' species, or a schedule of studies be included that, when completed, would allow the species' Critical Habitat to be identified. The *SARA* defines Critical Habitat as, "… the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in the recovery strategy or in an action plan for the species." National Guidance suggests that the identification of Critical Habitat is comprised of several components: biophysical functions, features and attributes, and geographic location.

Functions – Critical Habitat serves a biological function, which is the capacity to support a life-cycle process requirement of the listed species. A function is the result of a biophysical feature and its attributes**,** which together provide the capacity for the function to occur.

Features – Features are the biophysical components of the habitat (e.g., eelgrass beds, macrophytes, riffles, pools, and acoustic environment). Features are the aspects of the habitat that support the functional capacity for life-cycle processes necessary for survival or recovery. Features must be described in terms of their temporal use and/or availability.

Attributes – Every feature is comprised of many attributes, such as temperature, water depth, velocity, gravel size and oxygen level, that operate within optimal ranges and together provide the functional capacity of the feature to support a life-cycle process. Attributes are measurable and indicate why one feature is essential whereas another similar feature is not. Only those attributes deemed essential to a feature and the function it supports should be described.

Geographic location – Can be identified through a variety of approaches, including the Bounding Box Approach, in which the function and features of the habitat can be described but their exact location cannot.

While Critical Habitat was not identified by this RPA, there is information to support the identification of Critical Habitat. DFO will consider Science advice, the requirements of *SARA*, and National policies and guidance on Critical Habitat identification to complete the identification of Critical Habitat in the Recovery Strategy.

Atlantic Sturgeon are anadromous, meaning they spawn in rivers and spend a portion of their lives at sea. Based on presence of larvae, spent and gravid females, and spermeating (ripe and running) males, Atlantic Sturgeon are known to spawn somewhere below Mactaquac on the Lower Saint John River (above the Reversing Falls), including tributaries, and, thus, the lower Saint John River between Mactaquac and the Reversing Falls, including tributaries, is considered to be important habitat for the Maritimes DU of Atlantic Sturgeon. There is a possibility that other spawning locations exist within rivers of the Maritimes DU, but this has not been substantiated to date.

Adults can begin to ascend the Saint John River as early as May. Some adults may reside within the river throughout the winter prior to spawning in the spring. Spawning is thought to extend into late August. Neither the exact historical (i.e. prior to construction of the Mactaquac Dam in 1968) nor current spawning locations have been reported. Eggs are thought to be deposited on firm substrate where they adhere until hatching. Juveniles reportedly remain in the river for at least their first summer before migrating to estuaries in winter. The Saint John River Estuary (below the Reversing Falls) is considered to be important habitat for the Maritimes DU of Atlantic Sturgeon for its role as a migration route in and out of the Saint John River. By three to five years of age, juvenile Atlantic Sturgeon move into the marine environment where they are thought to migrate along the coast following temperature gradients until maturity. Migrant, foraging juvenile (as young as three years), sub-adult and adult Atlantic Sturgeon are abundant in the Minas Basin during the summer months, and this is also considered to be important habitat for the Maritimes DU of Atlantic Sturgeon. The Minas Passage is considered important habitat for the migration of Atlantic Sturgeon in and out of the Minas Basin.

No Atlantic Sturgeon were captured during the extensive beach seine surveys of the lower Saint John River during the years 2000, 2001, and 2009. The shallow shoreline areas (< 2 m depth) of the river, therefore, do not appear to be used extensively by the species irrespective of substrate type, vegetation, salinity, or tidal amplitude. There have not been significant catches of Atlantic Sturgeon reported from Research Vessel surveys or Observer records in waters greater than 50 m depth within the Bay of Fundy, or from any of the Shelf (e.g., submarine banks) and Shelf Slope ecosystems adjacent to the Canadian Maritime Provinces, though tagging suggests that there may be use of some areas outside of Bay of Fundy, possibly for overwintering. Aggregations of Atlantic Sturgeon detected in Scott's Bay and St. Mary's Bay, Nova Scotia need further investigation to determine their genetic origin and habitat use within those areas.

RESIDENCE REQUIREMENTS

Residence is defined in *SARA* as a, “dwelling-place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating”.

Current knowledge does not indicate any particular residence requirements for Atlantic Sturgeon.

THREATS

THREATS TO INDIVIDUALS

The primary source of human-induced mortality of Saint John River Atlantic Sturgeon is the commercial fishery. Three licences are valid for the Saint John River/Harbour, and licence conditions restrict fishing to tidal waters of the counties through which the Saint John River flows. One licence is valid in Nova Scotia (Shubenacadie River). Removals via the fishery have been capped at 350 (175 males and 175 females) fish per year since 2011.

There is a recreational fishery for Atlantic Sturgeon in New Brunswick, and there are annual sturgeon angling tournaments on the Saint John River. The recreational fishery has a release rate of approximately 98%, and survival of Atlantic Sturgeon that are released live is considered to be very high. Few (one to two per year) Atlantic Sturgeon are captured in the angling tournaments.

There are currently two Aboriginal fishing licences (Food, Social, and Ceremonial) that authorize Atlantic Sturgeon harvest in the Maritimes Region (Oromocto First Nation and the New Brunswick Aboriginal Peoples Council, NBAPC). There is a negotiated daily allocation of ten Atlantic Sturgeon per day per person for NBAPC, but these licences have reported minimal landings (< 5 in total) of Atlantic Sturgeons in the past five years. Two Atlantic Sturgeon were reported landed in 2012.

There is one active Atlantic Sturgeon aquaculture facility in New Brunswick. Some Atlantic Sturgeon have been authorized by DFO to be caught and retained for aquaculture purposes (i.e. breeding). Removals were 16 fish in 2002 and 20 fish in 2003. The number of wild Atlantic Sturgeon spawned for aquaculture purposes was 30, 31, 24, and 32 for the years 2007 to 2010. All fish were returned to the wild after having been spawned. Removals for aquaculture purposes since 2011 have been counted against the annual harvest limit of 350 fish, even if the fish were subsequently returned to the wild after having been spawned. In total, 7 females and 12 males captured under a commercial licence were returned to the wild in 2011. One female and 4 males were removed for aquaculture purposes in 2012 and then returned to the wild.

It is prohibited to retain Atlantic Sturgeon captured as bycatch in other fisheries, but rates of incidental capture and mortality are not well known. Some fisheries, notably set gillnet fisheries (for gaspereau and shad), do carry a relatively high risk of mortality for incidentally captured Atlantic Sturgeon as they occur in Atlantic Sturgeon habitat. The level of incidental capture and mortality in these fisheries is not known, but there are indications that it is potentially high, particularly within the Saint John River and Harbour, relative to other sources of mortality. Mandatory reporting of Atlantic Sturgeon (quantity and sex) caught as bycatch in these fisheries, and independent verification of bycatch and bycatch mortality rates are necessary in order to determine the potential severity of this threat to the species.

Illegal harvest of Atlantic Sturgeon is not considered to be a threat. Enforcement is considered to be effective at minimizing retention of bycatch and illegal harvest.

The Annapolis Tidal Generating Station is known to be a source of mortality for Atlantic Sturgeon in the Bay of Fundy; however, the number of individuals reported to be killed each year is low (< 5) with 11 mortalities having been reported since about 1985. The proportion of these that are from the Saint John River is not known.

There are no reports of Atlantic Sturgeon mortalities from the Mactaquac Dam hydroelectric facility on the Saint John River. However, there have been anecdotal reports of Atlantic Sturgeon becoming trapped in gate wells located at the base of the dam.

Oil and gas development proposed for the Gulf of St. Lawrence was identified as a potential threat in the COSEWIC report. However, because catches from this area are infrequent and low when reported, oil and gas developments are not considered to be a threat to Maritimes DU Atlantic Sturgeon at this time.

THREATS TO HABITAT

Water quality in the lower Saint John River is considered to be sufficient for Atlantic Sturgeon use, and it is not considered to have changed significantly in the last 20 years. A concern for entrapment of alewife and blueback herring in human-made ponds along the wetlands of the lower Saint John River (e.g. impoundments for waterfowl during spring and fall flooding and subsequent water level recessions) may also be relevant to other species such as Atlantic Sturgeon.

Atlantic Sturgeon are known to feed extensively on marine worms; thus, any fisheries on food supplies, such as the commercial fisheries within the Bay of Fundy for bloodworms, may have a potential impact on the prey of Atlantic Sturgeon and may be destructive to Atlantic Sturgeon habitat.

MITIGATION AND ALTERNATIVES

A maximum of 350 Atlantic Sturgeon (50:50 sex ratio) can be taken annually in the commercial fishery in the Bay of Fundy; the fishery is subject to gear and effort restrictions. There are presently four commercial licence holders for this area. Three licences are valid for the Saint John River/Harbour, and licence conditions restrict fishing to tidal waters of the counties through which the Saint John River in New Brunswick flows. One licence is valid for one county in the Province of Nova Scotia through which the Shubenacadie River flows. All sturgeon licences are terminal (i.e. they cannot be transferred to another individual), and the licences cease to exist if/once the licence holders leave the fishery.

Atlantic Sturgeon may only be fished commercially with gill nets having a minimum mesh size of 330 mm (13 inches), which has been implemented to reduce the catch of juvenile sturgeon and prevent bycatch of other species. A complementary maximum mesh size limit could increase escapement of larger bodied mature females. In addition, an increase in the minimum legal size could be implemented.

The commercial fishing season is presently closed during the month of June to protect spawning adults. This represents about one third of the spawning season (which typically occurs annually from the end of May to August). This seasonal closure could be modified, if necessary, to protect a greater proportion of the spawning biomass.

Regulations prohibit the retention or possession of Atlantic Sturgeon <120 cm in total length, which is the presumed length at first maturity, in both commercial and recreational fisheries. Retention of incidentally caught sturgeon in other river and coastal commercial fisheries is prohibited by regulations.

SOURCES OF UNCERTAINTY

- Catchability may differ between male and female spawners (e.g.,Caron et al. (2002)).
- Incomplete reporting of marked and unmarked fish in some years.
- Gillnet selectivity may result in unequal catchability of male and female spawners.
- Abundance and biological traits of males and females intercepted in the commercial fishery are assumed to be representative of the spawning population.
- The spawning frequency for male and female sturgeon is not known.
- There is potential for unequal catchability resulting from behavioral (social) factors intrinsic to Atlantic Sturgeon.

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TABLES

Table 1. Reported landings of Atlantic Sturgeon within the Saint John River (SJR) and Bay of Fundy (BoF) portions of New Brunswick (NB) by year and Fishery Statistical District (FSD). A dash (-) indicates no landings were reported.

	Saint John River						Bay of Fundy						
Year	Harbour FSD49	Kings FSD55	Queens FSD56	Sunbury FSD57	York FSD58	SJR[1] total	FSD48	FSD51	FSD52	FSD53	FSD79	FSD80B	NB-BoF[1] Total
1868							-	-	-	-	-	-	0
1869							-	-	-	-	-	-	0
1870							-	-	-	-	-	-	0
1871							-	-	-	-	-	-	0
1872			No fishery				-	-	-	-	-	-	0
1873							-	-	-	-	-	-	0
1874							-	-	-	-	-	-	0
1875							-	-	-	-	-	-	0
1876							-	-	-	-	-	-	0
1877							-	-	-	-	-	-	0
1878	Reference to sturgeon being lightly fished, see notes						-	-	-	-	-	-	0
1879	Reference to increased interest in fishery, see notes						-	-	-	-	-	-	0
1880	-	90.72	146.69	-	-	273.29-	-	-	-	-	-	-	0
1881	0.91	146.06	52.25	-	-	205.68	-	-	-	-	-	-	0
1882	0.91	120.09	7.99	-	-	128.98	-	-	-	-	-	-	0
1883	-	56.83	-	-	-	56.83	-	-	-	-	-	-	0
1884	-	29.11	-	-	-	29.11	-	-	-	-	-	-	0
1885	-	11.9	-	-	-	11.90	-	-	-	-	-	-	0
1886	-	7.38	-	-	-	7.38	-	-	-	-	-	-	0
1887							-	-	-	-	-	-	0
1888							-	-	-	-	-	-	0
1889							-	-	-	-	-	-	0
1890							-	-	-	-	-	-	0
1891			Fishery closed				-	-	-	-	-	-	0
1892							-	-	-	-	-	-	0
1893							-	-	-	-	-	-	0
1894							-	-	-	-	-	-	0
1895							-	-	-	-	-	-	0
1896							-	-	-	-	-	-	0
1897	-	11.34	-	-	-	11.34	-	-	-	-	-	-	0
1898	-	9.07	-	-	-	9.07	-	-	-	-	-	-	0
1899	-	5.44	-	-	-	5.44	-	-	-	-	-	-	0
1900	-	4.54	-	-	-	4.54	-	-	-	-	-	-	0
1901	-	0.91	-	-	-	0.91	-	-	-	-	-	-	0
1902	-	0.45	-	-	-	0.45	-	-	-	-	-	-	0
1903	-	2.72	-	-	-	2.72	-	-	-	-	-	-	0
1904	-	2.72	-	-	-	2.72	-	-	-	-	-	-	0
1905	-	4.38	-	-	-	4.38	-	-	-	-	-	-	0
1906	-	-	-	-	-	4.9	-	-	-	-	-	-	0
1907	-	-	-	-	-	4.31	-	-	-	-	-	-	0
1908	-	2.27	-	-	-	2.27	-	-	-	-	-	-	0
1909	-	5.17	0.25	0.16	-	5.58	-	-	-	-	-	-	0
1910	-	4.08	2.72	0.68	-	7.48	-	-	-	-	-	1.81	1.81
1911	-	1.18	-	1	-	2.18	-	-	-	-	-	-	0.91
1912	-	3.63	-	0.54	-	4.17	-	-	-	-	0.14	2.49	2.63
1913	-	2.72	-	0.45	-	3.18	-	-	-	-	-	4.76	4.76
1914	-	4.54	-	0.36	-	4.9	-	-	-	-	-	2.72	2.72
1915	-	3.63	-	0.32	-	3.95	-	-	-	-	-	-	0
1916	-	2.18	-	0.27	-	2.45	-	-	-	-	-	0.91	0.91
1917	-	1.41	-	-	-	1.41	-	-	-	-	-	0.68	0.68
1918	-	2.09	-	-	-	2.09	-	-	-	-	-	0.91	0.91
1919	-	3.18	-	-	-	3.18	-	-	-	-	-	0.91	0.91
1920	-	3.63	-	-	-	3.63	-	-	-	-	-	-	0
1921	-	4.49	-	-	-	4.49	-	-	-	-		-	0
1922	-	4.81	0.23	-	-	5.03	-	-	-	-		-	0
1923	-	3.63	0.91	-	-	4.54	-	-	-	-		-	0
1924	-	2.86	0.14	-	-	2.99	-	-	-	-		-	0
1925	-	1.91	-	-	-	1.91	-	-	-	-		-	0
1926	-	2.36	0.23	-	-	2.59	-	-	-	-		-	0
1927	-	0.86	0.23	-	-	1.09	-	-	-	-		-	0
1928	-	2.95	0.09	-	-	3.04	-	-	-	-		-	0
1929	-	1.22	0.09	-	-	1.32	-	-	-	-		-	0
1930	-	0.68	-	-	-	0.68	-	-	-	-		-	0
1931	-	0.23	-	-	-	0.23	-	-	-	-		-	0
1932	-	-	-	-	-	0	-	-	-			0.95	0.95
1933	-	-	-	-	-	0	-	-	-	-		-	0
1934	-	1.81	0.91	-	-	2.72	-	-	-	-		-	0
1935	-	2.27	1.36	-	-	3.63	-	-	-	-		-	0
1936	-	1.81	1.13	-	-	2.95	-	-	-	-		-	0
1937	-	1.36	0.95	-	-	2.31	-	-	-	-		-	0

	Saint John River						Bay of Fundy						
Year	Harbour FSD49	Kings FSD55	Queens FSD56	Sunbury FSD57	York FSD58	SJR[1] total	FSD48	FSD51	FSD52	FSD53	FSD79	FSD80B	NB-BoF[1] Total
1938	-	1.13	0.5	-	-	1.63	-	-	-	-		-	0
1939	-	0.91	0.32	-	-	1.22	-	-	-	-		-	0
1940	-	0.36	0.18	-	-	0.54	-	-	-	-		-	0
1941	-	0.41	0.14	-	-	0.54	-	-	-	-		-	0
1942	-	0.59	0.23	-	-	0.82	-			0.59	-		0.59
1943	-	0.54	0.27	-	-	0.82	-	-	-	-	-	-	0
1944	-	0.5	0.23	-	-	0.73	-	0.05	1.18	0.14	-		1.36
1945	0.86	0.5	0.23	-	-	1.59	0.09	-	0.45	0.05	-	0.18	0.77
1946	1.13	1.13	0.54	-	-	2.81	-	-	-	-	-	-	1.36
1947	-	1.36	-	-	-	1.81	-	-	-	-	-	-	0.45
1948	-	0.91	-	-	-	1.36	-	-	-	-	-	-	1.36
1949	-	0.91	-	-	-	1.81	-	-	-	-	-	-	0.91
1950	-	1.36	-	-	-	1.81	-	-	-	-	-	-	0
1951	-	0.91	-	-	-	1.36	-	-	-	-	-		0.45
1952	-	1.81	-	-	-	1.81	-	-	-	-	-	-	0
1953	0.91	1.81	0.45	-	-	3.17	-	0.45	-	-	-	-	0.45
1954	-	2.27	0.91	0.45	-	3.63	-	1.81	-	-	-	-	1.81
1955	-	3.18	0.91	-	-	4.09	-	0.45	-	-	-	-	0.45
1956	-	2.27	-	-	-	2.27	-	0	-	-	-	-	0
1957	-	2.72	-	-	-	2.72	-	3.18	-	-	-	-	3.18
1958	0.45	5.44	-	-	-	5.89	-	3.18	-	-	-	-	3.18
1959	-	3.63	-	-	-	3.63	-	1.81	-	-	-	-	1.81
1960	0.91	4.08	-	-	-	4.99	-	1.36	-	-	-	0.91	2.27
1961	-	1.81	-	-	-	1.81	-	1.36	-	-	-	0.45	3.17
1962	-	1.81	-	-	-	1.81	-	-	-	-	-	-	0.91
1963	-	1.81	-	-	-	1.81	-	-	-	-	-	-	0.45
1964	-	1.36	-	-	-	1.36	-	-	-	-	-	-	0
1965	-	2.27	-	-	-	2.27	-	2.27	-	-	-	-	2.27
1966	-	2.72	-	-	-	2.72	-	-	-	-	-	-	0
1967	-	1.81	-	-	-	1.81	-	-	-	-	-	-	0
1968	-	1.36	-	-	-	1.36	-	3.63	-	-	-	0.45	4.08
1969	-	8.16	-	-	-	8.16	-	-	-	-	-	-	0
1970	-		-	-	-	4.99	-	-	-	-	-	-	0.91
1971	-	3.63	-	-	-	3.63	-	-	-	-	-	-	0
1972	-	7.26	-	-	-	7.26	-	-	-	-	-	-	0.45
1973	-	-	-	-	-	4.08	-	-	-	-	-	-	0.91
1974	-	-	-	-	-	2.72	-	-	-	-	-	-	1.81
1975	-	-	-	-	-	3.18	-	-	-	-	-	-	1.36
1976	-	8.98	-	-	-	8.98	-	1.12	-	-	-	-	1.35
1977	-	-	1.09	-	-	1.09	-	0.11	-	-	-	-	0.11
1978	-	7.19	-	-	-	7.19	-	0.05	-	-	-	-	0.05
1979	-	14.57	-	-	-	14.57	-		-	-	-	-	0
1980	-	23.06	-	-	-	23.06	-		-	-	-	-	0
1981	0.02	11.17	-	-	-	11.19	-	1.57	-	-	-	-	1.57
1982	0.33	10.84	-	-	-	11.17	-		-	-	-	-	0.03
1983	0.08	13.8	-	-	-	13.88	-	0.04	0.26	0.02	-	-	0.32
1984	0.41	16.55	-	-	-	16.96	0.02	0.19	-	-	-	-	0.21
1985	0.21	15.8	0.01	-	-	16.02	-	2.21	0.05	-	3.26	-	14.03
1986	0.31	13.78	-	-	-	14.09	-	1.88	-	-	-	-	3.46
1987	-	7.08	-	-	-	7.08	-	1.09	-	1.19	0.79	-	3.07
1988	10.01	30.94	-	-	-	40.95	0.03	0.07	-	0.13	3	-	3.23
1989	-	40.46	-	-	-	40.46	0.1	0	-	-	-	-	0.1
1990	0.76	15.65	-	-	-	16.41	-	0.1	-	0.2	-	-	0.91
1991	1.8	7.67	-	-	-	9.47	-	0.08	-	-	-	-	0.08
1992	0.44	9.18	-	-	-	9.62	-	0.3	-	-	-	-	0.3
1993	0.58	4.35	-	-	-	4.93	0.04	0.05	-	-	-	-	0.09
1994	0.21	10	-	-	-	10.21	0.04	0.02	-	-	-	-	0.06
1995	-	10.57	-	-	-	10.57	0.03	0.01	-	0.13	-	-	0.19
1996	0.03	13.74	-	-	-	13.77	0.06	0.02	-	-	-	-	0.08
1997	-	11.27	-	-	-	11.27	0.01	0.04	-	0.02	-	-	0.07
1998	-	6.16	-	-	-	6.16	0	-	-	-	-	-	0
1999	-	3.23	-	-	-	3.23	-	-	-	-	-	-	0
2000	0.13	0.63	0.85	0.92	-	2.53	-	-	-	-	-	-	0
2001	-	10.34	-	-	-	10.34	-	-	-	-	-	-	0
2002	-	5.07	-	-	-	5.07	-	-	-	-	-	-	0
2003	-	0.13	-	-	-	0.13	-	-	-	-	-	-	0
2004	-	0.19	-	-	-	0.19	-	-	-	-	-	-	0
2005	-	-	-	-	-	0	-	-	-	-	-	-	0
2006	-	-	-	-	-	0	-	-	-	-	-	-	0
2007	-	-	-	-	-	0	-	-	-	-	-	-	0
2008	-	-	-	-	-	0	-	-	-	-	-	-	0
2009	-	-	-	-	-	0	-	-	-	-	-	-	0
2010	-	-	-	-	-	0	-	-	-	-	-	-	0
2011	-	-	-	-	-	0	-	-	-	-	-	-	0
2012	-	-	-	-	-	0	-	-	-	-	-	-	0

Note:
[1]. Total includes landings not attributed to a particular Fishery Statistic District.

Table 2. Reported landings (t) of Atlantic Sturgeon within the Bay of Fundy and Atlantic coastal (including eastern Cape Breton Island) portions of Nova Scotia by year and Fishery Statistical District (FSD) The FSD numbers appearing in brackets represent a change in numbering with time (e.g., FSD44B was previously FSD24) or addition of a new district (e.g., FSD39A). A dash (-) indicates no landings were reported.

	Nova Scotia (Bay of Fundy)										Atlantic Coast																
Year	FSD 24 (44B)	FSD 36	FSD 37	FSD 38	FSD 39A	FSD 40	FSD 41 (40B)	FSD 42	FSD 43A	NS-BoF Total	FSD 1	FSD 8	FSD 15	FSD 18	FSD 19	FSD 20	FSD 21-22	FSD 23	FSD 25	FSD 26	FSD 27	FSD 28	FSD 31	FSD 32	FSD 33	FSD 34	NS-AC Total
1868	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1869	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1870	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1871	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1872	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1873	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1874	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1875	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1876	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1877	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1878	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1879	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1880	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1881	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1882	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1883	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1884	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1885	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1886	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1887	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1888	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1889	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1890	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1891	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1892	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1893	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1894	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1895	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1896	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1897	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1898	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1899	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1900	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1901	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1902	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1903	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1904	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1905	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1906	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1907	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1908	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1909	-	-	-	-	-	-	-	-	-	0.00																	
1910	-	-	-		-	-	-	-	0.23	0.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1911	-	-	-	0.23	-	-	-	-	-	0.23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1912	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1913	-	-	-	-	1.54	-	-	-	-	1.54	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1914	-	-	-	-	1.18	-	-	-	-	1.18	-	-	-	-	-	-	-	-	-	-	-	-	0.09	-	-	-	0.09

Year	FSD 24 (44B)	FSD 36	FSD 37	FSD 38	FSD 39A	FSD 40	FSD 41 (40B)	FSD 42	FSD 43A	NS-BoF Total
	Nova Scotia (Bay of Fundy)									
1915	-	-	-	-	0.50	-	-	-	-	0.50
1916	-	-	-	-	-	-	-	-	-	0.00
1917	-	-	-	-	-	-	-	-	-	0.00
1918	-	-	-	-	-	-	-	-	-	0.00
1919	-	-	-	-	-	-	-	-	-	0.00
1920	-	-	-	-	0.27	-	-	-	-	0.27
1921	-	-	1.22	-	-	-	-	-	0.05	1.27
1922	-	-	0.14	-	-	-	-	-	-	0.14
1923	-	-	0.23	-	-	-	-	-	-	0.23
1924	-	-	0.14	-	-	-	-	-	-	0.14
1925	-	-	0.68	-	-	-	-	-	-	0.68
1926	-	-	0.18	-	-	-	-	-	-	0.18
1927	-	-	0.23	-	-	-	-	-	-	0.23
1928	-	-		-	-	-	-	-	-	0.00
1929	-	-		-	-	-	-	-	-	0.00
1930	-	-		-	-	-	-	10.21	-	10.21
1931	-	-		-	-	-	-	-	-	0.00
1932	-	-		-	-	-	-	0.68	-	0.68
1933	-	-	-	-	-	-	-	-	-	0.00
1934	-	-	-	-	-	-	-	-	-	0.00
1935	-	-	-	-	-	-	-	-	-	0.00
1936	-	-	-	-	-	-	-	-	-	0.00
1937	-	-	-	-	-	-	-	-	-	0.00
1938	-	-	-	-	-	-	-	-	-	0.00
1939	-	-	-	-	-	-	-	-	-	0.00
1940	-	-	-	-	-	-	-	-	-	0.00
1941	-	-	-	-	-	-	-	-	-	0.00
1942	-	-	-	-	-	-	-	-	-	0.00
1943	-	-	-	-	-	-	-	-	-	0.00
1944	-	-		0.14	-	-	-	-	-	0.14
1945	-	-	-	-	-	-	-	-	-	0.00
1946	-	-	-	-	-	-	-	-	-	0.00
1947	-	-	-	-	-	-	-	-	-	0.00
1948	-	-	-	-	-	-	-	-	-	0.00
1949	-	-	-	-	-	-	-	-	-	0.00
1950	-	-	-	-	-	-	-	-	-	0.00
1951	-	-	-	-	-	-	-	-	-	0.00
1952	-	0.45	-	-	-	-	-	-	0.45	0.91
1953	-	-	-	-	-	0.45	-	-	-	0.45
1954	-	-	-	-	-	-	-	-	-	0.00
1955	-	-	-	-	-	0.45	-	-	-	0.45
1956	-	-	-	-	-	-	-	-	0.45	0.45
1957	-	-	-	-	-	-	-	-	-	0.00
1958	-	-	-	-	-	-	-	-	-	0.00
1959	-	-	-	-	-	-	-	-	-	0.00
1960	-	-	-	-	-	-	-	-	-	0.00
1961	-	-	-	-	-	-	-	-	-	0.00
1962	-	-	-	-	-	-	-	-	-	0.00
1963	-	-	-	-	-	-	-	-	-	0.00
1964	-	-	-	-	-	-	-	-	-	0.00
1965	-	-	-	-	-	-	-	-	-	0.00
1966	-	-	-	-	-	-	-	-	-	0.00
1967	-	-	-	-	-	-	-	-	-	0.00

Year	FSD 1	FSD 8	FSD 15	FSD 18	FSD 19	FSD 20	FSD 21-22	FSD 23	FSD 25	FSD 26	FSD 27	FSD 28	FSD 31	FSD 32	FSD 33	FSD 34	NS-AC Total
	Atlantic Coast																
1915	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1916	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1917	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1918	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1919	-	0.14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.14
1920	-	0.27	-	-	-	-	0.14	-	-	-	-	-	-	-	-	-	0.41
1921	-	-	-	-	-	-	0.59	-	-	-	-	-	-	-	-	-	0.59
1922	-	-	-	-	-	-	0.23	-	-	-	-	-	0.14	-	-	-	0.36
1923	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1924	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1925	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1926	-	-	-	-	-	-	0.09	-	-	-	-	-	-	-	-	-	0.09
1927	-	-	-	-	-	-	0.23	-	-	-	-	-	-	-	-	-	0.23
1928	-	-	-	-	-	-	0.09	-	-	-	-	-	-	-	-	-	0.09
1929	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1930	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1931	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1932	-	-	-	-	-	-	0.09	-	-	-	-	-	-	-	-	-	0.09
1933	-	-	-	-	-	-	0.05	-	-	-	-	-	-	-	-	-	0.05
1934	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1935	-	-	-	-	-	-	0.09	-	-	-	-	-	-	-	-	-	0.09
1936	-	-	-	-	-	-	0.05	-	-	-	-	-	-	-	-	-	0.05
1937	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1938	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1939	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1940	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1941	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1942	0.05	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.05
1943	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1944	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1945	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1946	-	-	-	-	-	-	0.05	-	-	-	-	-	-	-	-	-	0.05
1947	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1948	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1949	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1950	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1951	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1952	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1953	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1954	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1955	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1956	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1957	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1958	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1959	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1960	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1961	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1962	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1963	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1964	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1965	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1966	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1967	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00

Year	Nova Scotia (Bay of Fundy)										Atlantic Coast																
	FSD 24 (44B)	FSD 36	FSD 37	FSD 38	FSD 39A	FSD 40	FSD 41 (40B)	FSD 42	FSD 43A	NS-BoF Total	FSD 1	FSD 8	FSD 15	FSD 18	FSD 19	FSD 20	FSD 21-22	FSD 23	FSD 25	FSD 26	FSD 27	FSD 28	FSD 31	FSD 32	FSD 33	FSD 34	NS-AC Total
1968	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1969	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1970	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1971	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1972	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1973	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1974	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1975	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1976	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	0.05		0.06	-	0.11	0.39	-	-	-	-	0.62
1977	0.11	-		0.06	-	-	-	-	-	0.17	-	-	-	-	-	-	0.03	-	-	-	0.02	0.13	-	-	-	-	0.18
1978	0.07	-	-	-	-	-	-	-	0.59	0.66	-	-	-	-	-	-	0.02	-	-	-	0.16	0.15	-	-	-	-	0.33
1979	-	-	-	-	-	-	3.41	0.09	1.25	4.75	-			0.03	-	-	-	-	-	-	1.32	0.22	-	-	-	-	1.57
1980	-	-	-	-	0.21	0.19	3.84	-	2.36	6.60	-	0.07	-	-	-	-	0.07	-	-	-	0.60	1.27	-	-	-	-	2.01
1981	-	0.41	0.13	1.02	4.50		0.57	-	0.38	7.02	-	-	-	-	-	-	0.01	-	0.05	-	1.21	1.47	0.27	-	-	-	3.00
1982	-	0.05		0.03	1.55		0.91	-		2.53	-	-	-	-	-	-	-	-	0.02	-	0.34	0.49	0.09	-	-	-	0.95
1983	-	0.03		0.16	0.93		0.53	-	0.23	1.88	-	-		0.04	-	-	0.05	-	-	-	0.07	0.23	0.07	-	-	-	0.46
1984	-	0.14		1.43	0.02		1.05	-		2.64	-	-		0.01	0.05	0.04	0.05	-	-	-	0.50	0.72	-	-	0.16	-	1.53
1985	-	0.30		1.68			1.18	-	0.81	3.97	-	-		0.07	-	-	0.05	-	0.06	-	0.25	0.00	-	-	-	-	0.42
1986	-	0.24	0.02	1.13	0.04	0.27	0.45	-	0.91	3.05	-	-		0.01	-	0.04	0.08	-	0.01	-	0.02	0.02	-	-	-	-	0.17
1987	-	-		0.41	0.42	1.22	2.91	-	0.91	5.87	-	-	0.04	0.01	0.03	-	0.05	-	-	-		0.05	-	-	0.03	-	0.21
1988	-	0.08	0.11	2.72		2.48	3.90	-	-	9.29	-	-	0.01	0.01	-	0.02	0.06	-	-	0.02	0.14	0.17	-	-	-	-	0.43
1989	-	0.08	0.02	2.60		1.51	3.99	-	-	8.20	-	-	0.02	0.01	-	0.03	0.04	-	-	0.02	0.83	0.11	-	0.02	-	-	1.07
1990	-	0.43		0.93		0.85	0.84	-	-	3.05	-	-		0.00	0.01	-	0.01	-	-	-	0.09	0.11	0.03	-	-	-	0.26
1991	-	0.11	0.04	1.48	0.61	5.35	0.49	-	0.53	8.60	-	-	0.03	-	-	-		-	-	-		0.25	-	-	-	-	0.28
1992	-	0.15		1.18		3.06	0.45	-	0.72	5.56	-	-	-	-	-	-	0.02	-	-	-	0.04	0.48	-	-	-	-	0.54
1993	-	0.06	0.75	2.39		3.75	0.88	-	1.04	8.86	-	-	-	0.02	-	-	0.01	-	-	-	0.14	0.31	-	-	-	-	0.49
1994	-	0.27		1.75		3.24	0.32	-	0.47	6.04	-	-	-	-	-	-	0.04	-	-	-	-	-	-	-	-	0.03	0.07
1995	-	0.30	0.31	0.18		0.14		-	0.82	1.74	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
1996	-	0.47		-	-	-	-	-	-	0.47	-	-	-	-	-	-	0.01	-	0.05	-	-	-	-	0.02	0.08	-	0.16
1997	-	0.07	0.05	-	-	-	-	-	-	0.13	-	-	-	-	-	-	0.04	0.09	-	-	0.02	-	-	-	-	-	0.15
1998	-	-	4.19	-	-	-	-	-	-	4.19	-	-	-	-	-	-	-	-	-		-	0.03	-	-	-	-	0.03
1999	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	0.04	-	-	-	-	-	-	0.04
2000	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
2001	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
2002	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
2003	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
2004	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
2005	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
2006	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
2007	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
2008	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
2009	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
2010	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
2011	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00
2012	-	-	-	-	-	-	-	-	-	0.00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.00

Table 3. Reported landings (t) of Atlantic Sturgeon within the New Brunswick and Nova Scotia portions of the southern Gulf of St. Lawrence by year and Fishery Statistical District (FSD). A dash (-) indicates no landings were reported.

	Gulf NS	Gulf NB			
Year	FSD 2	FSD 68	FSD 71	FSD 77	Total
1868	-	-	-	-	0.00
1869	-	-	-	-	0.00
1870	-	-	-	-	0.00
1871	-	-	-	-	0.00
1872	-	-	-	-	0.00
1873	-	-	-	-	0.00
1874	-	-	-	-	0.00
1875	-	-	-	-	0.00
1876	-	-	-	-	0.00
1877	-	-	-	-	0.00
1878	-	-	-	-	0.00
1879	-	-	-	-	0.00
1880	-	-	-	-	0.00
1881	-	-	-	-	0.00
1882	-	-	-	-	0.00
1883	-	-	-	-	0.00
1884	-	-	0.11	-	0.11
1885	-	-	-	-	0.00
1886	-	-	-	-	0.00
1887	-	-	-	-	0.00
1888	-	-	-	-	0.00
1889	-	-	-	-	0.00
1890	-	-	-	-	0.00
1891	-	0.11	-	-	0.11
1892	-	-	-	-	0.00
1893	-	-	-	-	0.00
1894	-	-	-	-	0.00
1895	-	-	-	-	0.00
1896	-	-	-	-	0.00
1897	-	-	-	-	0.00
1898	-	-	-	-	0.00
1899	-	-	-	-	0.00
1900	-	-	-	-	0.00
1901	-	-	-	-	0.00
1902	-	-	-	-	0.00
1903	-	-	-	-	0.00
1904	-	-	-	-	0.00
1905	-	-	-	-	0.00
1906	-	-	-	-	0.00
1907	-	-	-	-	0.00
1908	-	-	-	-	0.00
1909	-	-	-	-	0.00
1910	-	-		0.59	0.59
1911	-	-	-	-	0.00
1912	-	-	-	-	0.00
1913	-	-	-	-	0.00
1914	-	-	-	-	0.00
1915	-	-	-	-	0.00
1916	-	-	-	-	0.00
1917	-	-	-	-	0.00
1918	-	-	-	-	0.00
1919	-	-	-	-	0.00
1920	-	-	-	-	0.00
1921	-	-	-	-	0.00
1922	-	-	-	-	0.00
1923	-	-	-	-	0.00
1924	-	-	-	-	0.00
1925	-	-	-	-	0.00
1926	-	-	-	-	0.00
1927	-	-	-	-	0.00
1928	0.09	-	-	-	0.09
1929	-	-	-	-	0.00
1930	-	-	-	-	0.00
1931	-	-	-	-	0.00
1932	-	-	-	-	0.00
1933	-	-	-	-	0.00
1934	-	-	-	-	0.00
1935	-	-	-	-	0.00
1936	-	-	-	-	0.00
1937	-	-	-	-	0.00
1938	-	-	-	-	0.00
1939	-	-	-	-	0.00
1940	-	-	-	-	0.00
1941	-	-	-	-	0.00

	Gulf NS	Gulf NB			
Year	FSD 2	FSD 68	FSD 71	FSD 77	Total
1942	-	-	-	-	0.00
1943	-	-	-	-	0.00
1944	-	-	-	-	0.00
1945	-	-	-	-	0.00
1946	-	-	-	-	0.00
1947	-	-	-	-	0.00
1948	-	-	-	-	0.00
1949	-	-	-	-	0.00
1950	-	-	-	-	0.00
1951	-	-	-	-	0.00
1952	-	-	-	-	0.00
1953	-	-	-	-	0.00
1954	-	-	-	-	0.00
1955	-	-	-	-	0.00
1956	-	-	-	-	0.00
1957	-	-	-	-	0.00
1958	-	-	-	-	0.00
1959	-	-	-	-	0.00
1960	-	-	-	-	0.00
1961	-	-	-	-	0.00
1962	-	-	-	-	0.00
1963	-	-	-	-	0.00
1964	-	-	-	-	0.00
1965	-	-	-	-	0.00
1966	-	-	-	-	0.00
1967	-	-	-	-	0.00
1968	-	-	-	-	0.00
1969	-	-	-	-	0.00
1970	-	-	-	-	0.00
1971	-	-	-	-	0.00
1972	-	-	-	-	0.00
1973	-	-	-	-	0.00
1974	-	-	-	-	0.00
1975	-	-	-	-	0.00
1976	-	-	-	-	0.00
1977	-	-	-	-	0.00
1978	-	-	-	-	0.00
1979	-	-	-	-	0.00
1980	-	-	-	-	0.00
1981	-	-	-	-	0.00
1982	-	-	-	-	0.00
1983	-	-	-	-	0.00
1984	-	-	-	-	0.00
1985	-	-	-	-	0.00
1986	-	-	-	-	0.00
1987	-	-	-	-	0.00
1988	-	-	-	-	0.00
1989	-	-	-	-	0.00
1990	-	-	-	-	0.00
1991	-	-	-	-	0.00
1992	-	-	-	-	0.00
1993	-	-	-	-	0.00
1994	-	-	-	-	0.00
1995	-	-	-	-	0.00
1996	-	-	-	-	0.00
1997	-	-	-	-	0.00
1998	-	-	-	-	0.00
1999	-	-	-	-	0.00
2000	-	-	-	-	0.00
2001	-	-	-	-	0.00
2002	-	-	-	-	0.00
2003	-	-	-	-	0.00
2004	-	-	-	-	0.00
2005	-	-	-	-	0.00
2006	-	-	-	-	0.00
2007	-	-	-	-	0.00
2008	-	-	-	-	0.00
2009	-	-	-	-	0.00
2010	-	-	-	-	0.00
2011	-	-	-	-	0.00
2012	-	-	-	-	0.00

Table 4. Reported landings (t) of Atlantic Sturgeon by Sub-Area and Province by year. A dash (-) indicates no landings were reported.

	Southwest New Brunswick			Nova Scotia			NB, NS	
Year	Saint John River	Bay of Fundy	Total	Bay of Fundy	Atlantic Coast	Total	Southern Gulf	All Maritimes Total
1868	-	-	-	-	-	-	-	-
1869	-	-	-	-	-	-	-	-
1870	-	-	-	-	-	-	-	-
1871	-	-	-	-	-	-	-	-
1872	-	-	-	-	-	-	-	-
1873	-	-	-	-	-	-	-	-
1874	-	-	-	-	-	-	-	-
1875	-	-	-	-	-	-	-	-
1876	-	-	-	-	-	-	-	-
1877	-	-	-	-	-	-	-	-
1878	-	-	-	-	-	-	-	-
1879	-	-	-	-	-	-	-	-
1880	273.29	0.00	273.29	0.00	0.00	0.00	-	273.29
1881	205.68	0.00	205.68	0.00	0.00	0.00	-	205.68
1882	128.98	0.00	128.98	0.00	0.00	0.00	-	128.98
1883	56.83	0.00	56.83	0.00	0.00	0.00	-	56.83
1884	29.11	0.00	29.11	0.00	0.00	0.00	0.11	29.22
1885	11.90	0.00	11.90	0.00	0.00	0.00	-	11.90
1886	7.38	0.00	7.38	0.00	0.00	0.00	-	7.38
1887	-	0.00	0.00	0.00	0.00	0.00	-	0.00
1888	-	0.00	0.00	0.00	0.00	0.00	-	0.00
1889	-	0.00	0.00	0.00	0.00	0.00	-	0.00
1890	-	0.00	0.00	0.00	0.00	0.00	-	0.00
1891	-	0.00	0.00	0.00	0.00	0.00	0.11	0.11
1892	-	0.00	0.00	0.00	0.00	0.00	-	0.00
1893	-	0.00	0.00	0.00	0.00	0.00	-	0.00
1894	-	0.00	0.00	0.00	0.00	0.00	-	0.00
1895	-	0.00	0.00	0.00	0.00	0.00	-	0.00
1896	-	0.00	0.00	0.00	0.00	0.00	-	0.00
1897	11.34	0.00	11.34	0.00	0.00	0.00	-	11.34
1898	9.07	0.00	9.07	0.00	0.00	0.00	-	9.07
1899	5.44	0.00	5.44	0.00	0.00	0.00	-	5.44
1900	4.54	0.00	4.54	0.00	0.00	0.00	-	4.54
1901	0.91	0.00	0.91	0.00	0.00	0.00	-	0.91
1902	0.45	0.00	0.45	0.00	0.00	0.00	-	0.45
1903	2.72	0.00	2.72	0.00	0.00	0.00	-	2.72
1904	2.72	0.00	2.72	0.00	0.00	0.00	-	2.72
1905	4.38	0.00	4.38	0.00	0.00	0.00	-	4.38
1906	4.90	0.00	4.90	0.00	0.00	0.00	-	4.90
1907	4.31	0.00	4.31	0.00	0.00	0.00	-	4.31
1908	2.27	0.00	2.27	0.00	0.00	0.00	-	2.27
1909	5.58	0.00	5.58	0.00	0.00	0.00	-	5.58
1910	7.48	1.81	9.30	0.23	0.00	0.23	0.59	10.12
1911	2.18	0.91	3.08	0.23	0.00	0.23	-	3.31
1912	4.17	2.63	6.80	0.00	0.00	0.00	-	6.80
1913	3.18	4.76	7.94	1.54	0.00	1.54	-	9.48
1914	4.90	2.72	7.62	1.18	0.09	1.27	-	8.89
1915	3.95	0.00	3.95	0.50	0.00	0.50	-	4.45
1916	2.45	0.91	3.36	0.00	0.00	0.00	-	3.36
1917	1.41	0.68	2.09	0.00	0.00	0.00	-	2.09
1918	2.09	0.91	2.99	0.00	0.00	0.00	-	2.99
1919	3.18	0.91	4.08	0.00	0.14	0.14	-	4.22
1920	3.63	0.00	3.63	0.27	0.41	0.68	-	4.31
1921	4.49	0.00	4.49	1.27	0.59	1.86	-	6.35
1922	5.03	0.00	5.03	0.14	0.36	0.50	-	5.53
1923	4.54	0.00	4.54	0.23	0.00	0.23	-	4.76
1924	2.99	0.00	2.99	0.14	0.00	0.14	-	3.13
1925	1.91	0.00	1.91	0.68	0.00	0.68	-	2.59
1926	2.59	0.00	2.59	0.18	0.09	0.27	-	2.86
1927	1.09	0.00	1.09	0.23	0.23	0.45	-	1.54
1928	3.04	0.00	3.04	0.00	0.09	0.09	0.09	3.22
1929	1.32	0.00	1.32	0.00	0.00	0.00	-	1.32
1930	0.68	0.00	0.68	10.21	0.00	10.21	-	10.89
1931	0.23	0.00	0.23	0.00	0.00	0.00	-	0.23
1932	0.00	0.95	0.95	0.68	0.09	0.77	-	1.72
1933	0.00	0.00	0.00	0.00	0.05	0.05	-	0.05
1934	2.72	0.00	2.72	0.00	0.00	0.00	-	2.72
1935	3.63	0.00	3.63	0.00	0.09	0.09	-	3.72
1936	2.95	0.00	2.95	0.00	0.05	0.05	-	2.99
1937	2.31	0.00	2.31	0.00	0.00	0.00	-	2.31
1938	1.63	0.00	1.63	0.00	0.00	0.00	-	1.63
1939	1.22	0.00	1.22	0.00	0.00	0.00	-	1.22
1940	0.54	0.00	0.54	0.00	0.00	0.00	-	0.54
1941	0.54	0.00	0.54	0.00	0.00	0.00	-	0.54

	Southwest New Brunswick			Nova Scotia			NB, NS	
	Saint John				Atlantic		Southern	All Maritimes
Year	River	Bay of Fundy	Total	Bay of Fundy	Coast	Total	Gulf	Total
1942	0.82	0.59	1.41	0.00	0.05	0.05	-	1.45
1943	0.82	0.00	0.82	0.00	0.00	0.00	-	0.82
1944	0.73	1.36	2.09	0.14	0.00	0.14	-	2.22
1945	1.59	0.77	2.36	0.00	0.00	0.00	-	2.36
1946	2.81	1.36	4.17	0.00	0.05	0.05	-	4.22
1947	1.81	0.45	2.27	0.00	0.00	0.00	-	2.27
1948	1.36	1.36	2.72	0.00	0.00	0.00	-	2.72
1949	1.81	0.91	2.72	0.00	0.00	0.00	-	2.72
1950	1.81	0.00	1.81	0.00	0.00	0.00	-	1.81
1951	1.36	0.45	1.81	0.00	0.00	0.00	-	1.81
1952	1.81	0.00	1.81	0.91	0.00	0.91	-	2.72
1953	3.18	0.45	3.63	0.45	0.00	0.45	-	4.08
1954	3.63	1.81	5.44	0.00	0.00	0.00	-	5.44
1955	4.08	0.45	4.54	0.45	0.00	0.45	-	4.99
1956	2.27	0.00	2.27	0.45	0.00	0.45	-	2.72
1957	2.72	3.18	5.90	0.00	0.00	0.00	-	5.90
1958	5.90	3.18	9.07	0.00	0.00	0.00	-	9.07
1959	3.63	1.81	5.44	0.00	0.00	0.00	-	5.44
1960	4.99	2.27	7.26	0.00	0.00	0.00	-	7.26
1961	1.81	3.18	4.99	0.00	0.00	0.00	-	4.99
1962	1.81	0.91	2.72	0.00	0.00	0.00	-	2.72
1963	1.81	0.45	2.27	0.00	0.00	0.00	-	2.27
1964	1.36	0.91	2.27	0.00	0.00	0.00	-	2.27
1965	2.27	2.27	4.54	0.00	0.00	0.00	-	4.54
1966	2.72	0.00	2.72	0.00	0.00	0.00	-	2.72
1967	1.81	0.00	1.81	0.00	0.00	0.00	-	1.81
1968	1.36	4.08	5.44	0.00	0.00	0.00	-	5.44
1969	8.16	0.00	8.16	-	-	0.00	-	8.16
1970	4.99	0.91	5.90	-	-	0.00	-	5.90
1971	3.63	0.00	3.63	-	-	0.00	-	3.63
1972	7.26	0.45	7.71	-	-	0.00	-	7.71
1973	4.08	0.91	4.99	-	-	0.00	-	4.99
1974	2.72	1.81	4.54	-	-	0.00	-	4.54
1975	3.18	1.36	4.54	-	-	0.00	-	4.54
1976	8.98	1.34	10.33	0.00	0.62	0.62	-	10.95
1977	1.09	0.11	1.20	0.17	0.18	0.35	-	1.54
1978	7.19	0.05	7.24	0.66	0.33	0.98	-	8.22
1979	14.57	0.00	14.57	4.75	1.57	6.32	-	20.88
1980	23.06	0.00	23.06	6.60	2.01	8.61	-	31.67
1981	11.19	1.57	12.76	7.02	3.00	10.02	-	22.78
1982	11.16	0.03	11.19	2.53	0.95	3.48	-	14.67
1983	13.88	0.32	14.19	1.88	0.46	2.33	-	16.53
1984	16.96	0.21	17.16	2.64	1.53	4.17	-	21.33
1985	16.02	14.03	30.05	3.97	0.42	4.40	-	34.45
1986	14.09	3.45	17.54	3.05	0.17	3.22	-	20.76
1987	7.08	3.07	10.15	5.87	0.21	6.08	-	16.23
1988	40.94	3.24	44.18	9.29	0.43	9.73	-	53.90
1989	40.46	0.11	40.57	8.20	1.07	9.27	-	49.83
1990	16.40	0.92	17.32	3.05	0.26	3.30	-	20.62
1991	9.46	0.08	9.55	8.60	0.28	8.88	-	18.42
1992	9.62	0.30	9.92	5.56	0.54	6.10	-	16.01
1993	4.93	0.09	5.02	8.86	0.49	9.35	-	14.37
1994	10.21	0.06	10.27	6.04	0.07	6.11	-	16.37
1995	10.57	0.19	10.76	1.74	0.00	1.74	-	12.50
1996	13.77	0.08	13.85	0.47	0.16	0.63	-	14.48
1997	11.27	0.07	11.34	0.13	0.15	0.28	-	11.62
1998	6.16	0.00	6.16	4.19	0.03	4.21	-	10.37
1999	3.23	0.00	3.23	0.00	0.04	0.04	-	3.27
2000	2.52	-	2.52	-	-	-	-	2.52
2001	10.34	-	10.34	-	-	-	-	10.34
2002	5.07	-	5.07	-	-	-	-	5.07
2003	0.13	-	0.13	-	-	-	-	0.13
2004	0.19	-	0.19	-	-	-	-	0.19
2005	-	-	-	-	-	-	-	-
2006	-	-	-	-	-	-	-	-
2007	2.87	-	2.87	-	-	-	-	2.87
2008	5.88	-	5.88	-	-	-	-	5.88
2009	8.12	-	8.12	-	-	-	-	8.12
2010	8.98	-	8.98	0.00	-	0.00	-	8.98
2011	11.76	-	11.76	-	-	-	-	11.76
2012	10.89	-	10.89	-	-	-	-	10.89

Table 5. Annual landings of male and female Saint John River Atlantic Sturgeon and estimated total landed weight for the years 2007 – 2012. The average weight of processed fish for the year was multiplied by 1.3 and catch in numbers to estimate landed weight. A dash (-) indicates no data.

Year	Average weight (kg)	Males		Females		Catch	
		Processed	Hatchery	Processed	Hatchery	Tons	Numbers
2007	44.8	3	-	15	-	2.9	18
2008	49.0	61	18	84	13	5.9	145
2009	33.0	148	10	137	6	8.1	285
2010	36.5	79	18	111	17	9.0	190
2011	37.5	164	12	176	8	11.8	340
2012	35.1	162	4	161	21	10.9	323

Table 6. Numbers of observed sets capturing Atlantic Sturgeon during the Longhorn sculpin fishery in St. Mary's Bay, NS, from 1999-2006. n/a indicates not applicable.

	Year							
Variable	1999	2000	2001	2002	2003	2004	2005	2006
Number Tows Sampled	193	290	576	152	147	185	273	370
Percent sets with Sturgeon	0.5	1.4	1.6	2.0	0.0	0.5	2.2	0.5
Weight (kg)	130	193	175	0	30	255	86	729

Table 7. The marks available, the catch and the number of recaptures per 5-day intervals of the 2009 to 2012 fishing seasons for female Saint John River Atlantic Sturgeon, and females only. n/a indicates not applicable.

Year	Sample Population	Start Date[1]	Start of five day sampling interval									
			06-Jul	11-Jul	16-Jul	21-Jul	26-Jul	31-Jul	05-Aug	10-Aug	15-Aug	20-Aug
2009	Females	Marks	9	20	25	30	29	30	32	32	37	40
		Catch	44	21	30	21	14	19	9	12	9	9
		Recaptures	0	1	3	2	1	1	0	0	0	2
	All	Marks	26	80	107	131	142	153	160	160	173	193
		Catch	146	94	99	55	52	43	40	47	31	39
		Recaptures	2	5	8	7	5	1	2	0	6	9
2010	Females	Start date[1]	02-Jul	07-Jul	12-Jul	17-Jul	22-Jul	27-Jul	01-Aug	06-Aug	11-Aug	16-Aug
		Marks	44	52	53	60	60	58	61	61	63	71
		Catch	42	16	30	12	23	16	8	13	13	12
		Recaptures	3	1	3	0	5	1	2	3	5	4
	All	Marks	120	144	156	171	174	171	176	179	184	198
		Catch	83	40	51	27	46	20	16	25	23	26
		Recaptures	8	3	7	1	7	0	2	3	7	6
2011	Females	Start date[1]	01-Jul	06-Jul	11-Jul	16-Jul	21-Jul	26-Jul	31-Jul	05-Aug	10-Aug	15-Aug
		Marks	15	25	44	54	61	68	72	76	77	80
		Catch	44	50	40	22	29	19	18	12	12	13
		Recaptures	1	2	3	1	8	7	4	5	4	3
	All	Marks	21	37	70	94	112	131	147	157	163	171
		Catch	56	80	76	45	60	59	32	27	31	19
		Recaptures	0	3	4	1	10	9	6	5	5	3
2012	Females	Start date[1]	01-Jul	06-Jul	11-Jul	16-Jul	21-Jul	26-Jul	31-Jul	05-Aug	10-Aug	
		Marks	44	43	45	48	50	51	53	55	56	n/a
		Catch	40	19	22	17	11	14	7	9	13	
		Recaptures	3	3	4	3	1	3	1	2	2	
	All	Marks	48	65	74	76	84	88	92	94	93	
		Catch	65	44	42	41	35	29	21	27	25	n/a
		Recaptures	2	4	4	3	5	4	3	5	3	

Note:
1. Start date is first day of five day interval.

Table 8. Estimated modal and median and upper and lower 95% Credibility Intervals for female and total spawner abundances for Saint John River Atlantic Sturgeon as estimated using the Gazey and Staley (1986) Bayes algoritmn for sequential estimates of population size. The intervals with the highest predicted abundances (Max) and end-of-season (End) abundance estimates are shown.

Population Sampled	2009				2010				2011				2012			
	Females		All		Females		All		Females		All		Females		All	
Value	Max	End	Max	End	Max	End	Max	End	Max	End	Max	End	Max	End	Max	End
Interval	15-Aug	20-Aug	10-Aug	20-Aug	17-Jul	16-Aug	06-Aug	16-Aug	16-Jul	15-Aug	16-Jul	15-Aug	11-Jul	10-Aug	16-Jul	10-Aug
Mode	520	460	1,875	1,575	720	375	1,515	1,270	700	310	1,720	980	360	330	940	740
Median	600	500	1,950	1,500	825	375	1,550	1,270	740	310	1,760	980	400	340	1,020	740
Lower 95% Confidence limit	300	280	1,350	1,125	420	270	1,130	990	400	230	1,000	760	220	230	620	540
Upper 95% Confidence limit	1,400	1,060	2,850	2,100	1,515	570	2,250	1,725	1,110	430	2,420	1,320	810	530	1,860	1,080

Table 9. Single sample population estimates for Saint John River Atlantic Sturgeon for the years 2009 to 2012 as estimated using all data pooled across the fishing season and using only tags applied in May and subsequent recaptures during the months of July and August. A dash (-) indicates no data.

	2009		2010		2011		2012	
Variable	May	Season	May	Season	May	Season	May	Season
Marks	-	193	110	236	-	171	44	93
Catch	-	702	357	502	-	485	338	329
Recaptures	-	45	17	48	-	46	8	33

	2009		2010		2011		2012	
Abundance Estimates	May	Season	May	Season	May	Season	May	Season
Mode	-	3,010	2,300	2,470	-	1,800	1,800	930
Median	-	3,050	2,450	2,505	-	1,825	2,125	950
Lower 95% Confidence limit	-	2,330	1,550	1,910	-	1,400	1,020	690
Upper 95% Confidence limit	-	4,170	4,150	3,345	-	2,475	4,855	1,350

Table 10. Summary of microsatellite markers.

Locus	Repeat Motif	Primer Sequence	Ta (°C)	Size Range (bases)	GenBank accession no.	Source Study	Source Species
LS-19	$(TTG)_9$	F: CATCTTAGCCGTCTGTGGTAC R: CAGGTCCCTAATACAATGGC	55	133	U72730	1	*A. fulvescens*
LS-54	$(GATA)_6(GACA)_7$	F: CTCTAGTCTTTGTTGATTACAG R: CAAAGGACTTGAAACTAGG	55	177	U72735	1	*A. fulvescens*
LS-62	$(GACA)_7$	F: GATCAGGAGGGCAGAGNAAC R: CCCTGGATTTGAATTAACAG	57	85	U72738	1	*A. fulvescens*
LS-68	$(GATA)_{13}$	F: TTATTGCATGGTGTAGCTAAAC R: AGCCCAACACAGACAATATC	55	120	U72739	1	*A. fulvescens*
Aox23	$(ATT)_2(ACT)_{10}$ $(AAT)_5$	F: CAGTGTGCTAGCTTCTCAATA R: GTTAGCTTAACCATGAATTGTG	50	91-133	AF067811	2	*A. oxyrinchus oxyrinchus*
Aox45	$(AAT)_{20}$	F: TTGTCCAATAGTTTCCAACGC R: TGTGCTCCTGCTTTTACTGTC	55	109-154	AF067813	2	*A. oxyrinchus oxyrinchus*
AoxB28	$(CAT)_7(CAC)_1$	F: CCTCGGCATCATCATAGTT R: GGCACACACATTTGTCTTG	55	165-171	AY093630	3	*A. oxyrinchus oxyrinchus*
AoxB34	$(CAT)_{13}$	F: GCATTCTCAATCCCATCAAC R: CTCCAAAGTAAATTCCGAAGTG	55	151-208	AY093628	3	*A. oxyrinchus oxyrinchus*
AoxC30	$(GGAT)_8(AGAT)_2$	F: TCTCTAAATTGCGCCTTAGTTG R: TTTTGGAATTGCTGTCTAACTG	55	265-321	AY093631	3	*A. oxyrinchus oxyrinchus*
AoxC45	$(GGAT)_8$	F: GCGACCCTGTAAAGGAGTAAG R: TATTAAACTTGGACCGGTTAGC	55	108-116	AT093632	3	*A. oxyrinchus oxyrinchus*
AoxC55	$(CATC)_8(CATT)_2$ ATCATT	F: GCAAGGTGTATTAAACTGGACC R: CGACCCTGTAAAGGAGTAAGC	55	114-122	AY093633	3	*A. oxyrinchus oxyrinchus*
AoxD32	$(TAGA)_{16}(CAGA)_2$ $(TAGA)_{10}$	F: CAGATTTAAGTAAGATAAGCATCAGC R: AAAGCAGCTTGACATAACGG	55	172-256	AY093634	3	*A. oxyrinchus oxyrinchus*
AoxD54	$(TAGA)_{18}$	F: GAGAACAACGTTTTACTGCAAAC R: GATCATAACTAAAGCTGGCAGG	55	174-225	AY093636	3	*A. oxyrinchus oxyrinchus*
AoxD64	$(TAGA)_{16}$	F: TTTGTGTAGGGAAATACCCTTG R: TGAGTGCAGCCCTACTGCTC	55	197-241	AY093637	3	*A. oxyrinchus oxyrinchus*
AoxD170	$(TAGA)_{16}$	F: GAACCATTTTATTGACATTCGAC R: CCCTGTCTCACGTACATTTTATG	56	138-167	ATY093641	3	*A. oxyrinchus oxyrinchus*
AoxD161	$(CTAT)_{15}$	F: GTTTGAAATGATTGAGAAAATGC R: TGAGACAGACACTCTAGTTAAACAGC	55	118-148	AY093639	3	*A. oxyrinchus oxyrinchus*
AoxD241	$(TAGA)_{36}$	F: TGTTCACAATATAGTCTTCCAGGTC R: CACAACAAATCAAAACAGAAGC	55	180-272	AY093646	3	*A. oxyrinchus oxyrinchus*
AoxD297	$(TAGA)_{20}$	F: TGCTTGTATTTTCTGTTTTAGCC R: CCACACTAGTGCATCCAGCTC	55	185-358	AY093648	3	*A. oxyrinchus oxyrinchus*
Aod_AS9WM	$(CTGT)_6$	F: CATGAAGCCACAGTGACCC R: CGCAAACAACTAAGTGTGCAG	55	265-269	JF699724	4	*A. oxyrinchus desotoi*
Aod_AIUU2	$(AAAT)_9$	F: CTTCCGGATGGAATCGCAC R: ACGGCCTAAATCAGAACTGC	55	326-354	JF699707	4	*A. oxyrinchus desotoi*
Aod_JDW4	$(ATCT)_{13}$	F: GCTAAAGGTGCGTCAACTAGC	55	361-389	JF699720	4	*A. oxyrinchus desotoi*

Notes:
1. May et al. 1997; 2. King et al. 2001; 3. Henderson-Arzapalo and King 2002; 4. Hargrove et al. 2011.

Table 11. Summary of body lengths (Total length in cm) of male and female Saint John River Atlantic Sturgeon when first captured in the fishery, when harvested, and those selected for age determination. Male to female (M:F) sex ratios are shown for the population at time of first capture and those harvested.

Population Portion sampled	Year	Males (M)				Females (F)				M:F Ratio
		N	Min	Max	Mean	N	Min	Max	Mean	
1st Capture	2009	278	150	227	179	185	164	253	200	1.5
	2010	174	145	234	177	192	147	249	202	0.9
	2011	203	127	218	180	231	168	257	203	0.8
	2012	192	142	221	182	161	163	259	205	1.6
Harvested	2009	142	152	227	185	136	164	253	200	1.1
	2010	77	150	234	182	99	168	249	205	0.7
	2011	133	152	218	187	150	175	257	207	0.9
	2012	126	150	221	186	128	173	259	208	1.0
Aged	2010	22	160	234	188	39	175	249	208	n/a
	2011	36	160	213	190	34	175	257	208	n/a

Table 12. Number (N) of male and female Saint John River Atlantic Sturgeon selected for age determination by year and the minimum, maximum, average (± 1 Standard Deviation (SD) ages determined.

Year	Males					Females				
	N	Min	Max	Mean	SD	N	Min	Max	Mean	SD
2010	22	17	39	26	5	39	19	40	29	5
2011	36	18	32	25	3	34	16	44	28	6

Table 13. Comparison of the Von Bertalanffy growth parameters among the Hudson River, St. Lawrence River, and Saint John River populations (Linf = Asymptotic length (cm), k = growth coefficient, to = theoretical time when L = 0).

Population (Source)	Sex	L_{inf}		k		t_o	
		Mean	StanDev	Mean	StanDev	Mean	StanDev
Hudson River (from Kahnle et al. 2007)	Males	234	15	0.093	0.016	-0.91	0.69
	Females	278	7.5	0.074	0.006	-0.73	0.5
	Combined	-	-	-	-	-	-
St. Lawrence River (from Magnin 1964)	Males	-	-	-	-	-	-
	Females	-	-	-	-	-	-
	Combined	315	-	0.032	-	-0.75	-
Saint John River	Males	201	7.5	0.11	0.02	-	-
	Females	222	6.9	0.095	0.015	-	-
	Combined	224	7	0.08	0.01	-	-

Table 14. Quantile values of Saint John River Atlantic Sturgeon meat and caviar yields estimated from 5,000 samples of the data drawn at random.

	Quantile Yield (kg)					
Yield (kg)	5%	50%	75%	95%	97.5%	99%
Caviar	485	528	547	575	586	598
Meat:						
Males	4,722	4,889	4,959	5,061	5,094	5,137
Females	5,430	5,594	5,664	5,764	5,802	5,839
Combined	10,250	10,484	10,584	10,723	10,772	10,828

FIGURES

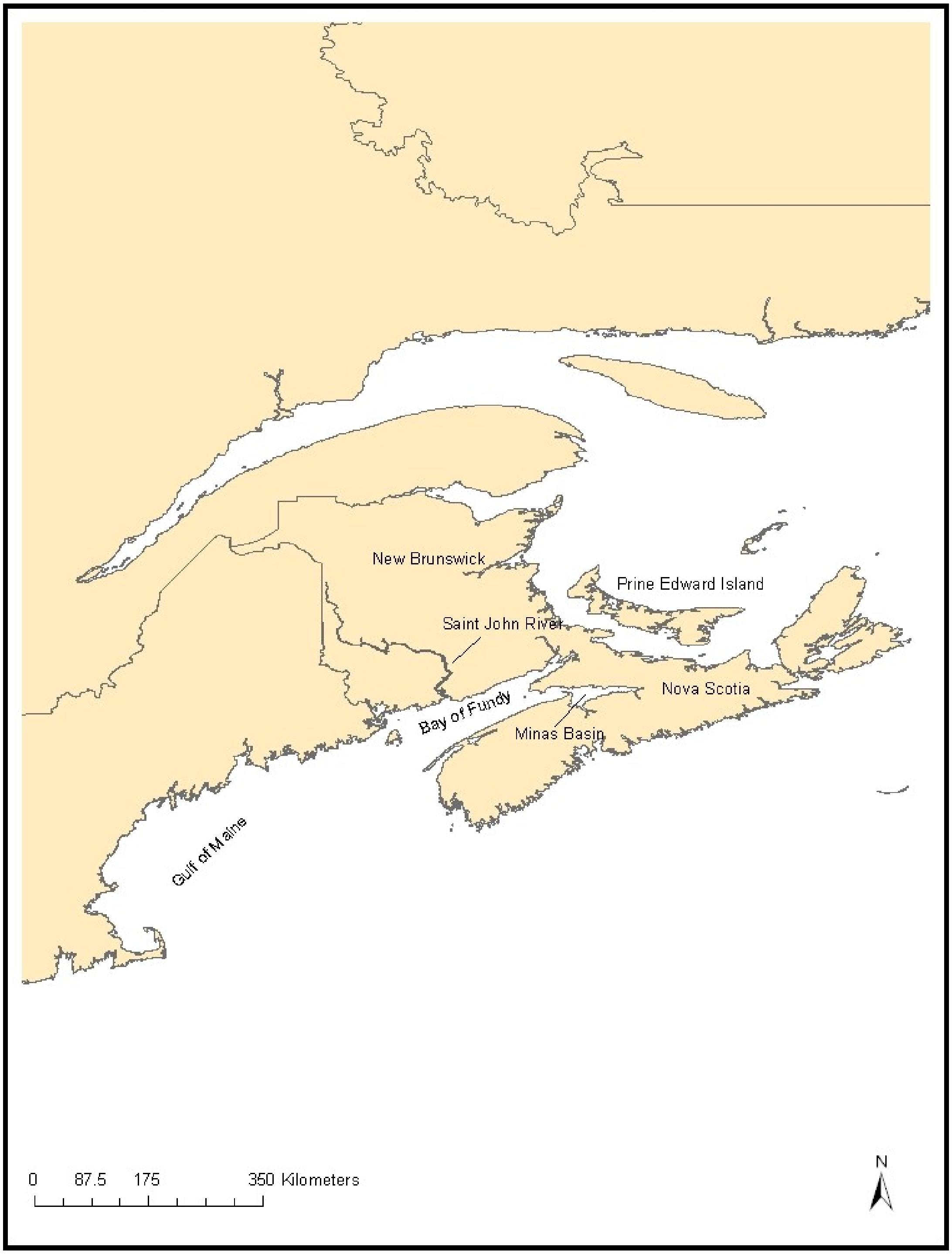


Figure 1. Map of the Maritime Provinces.

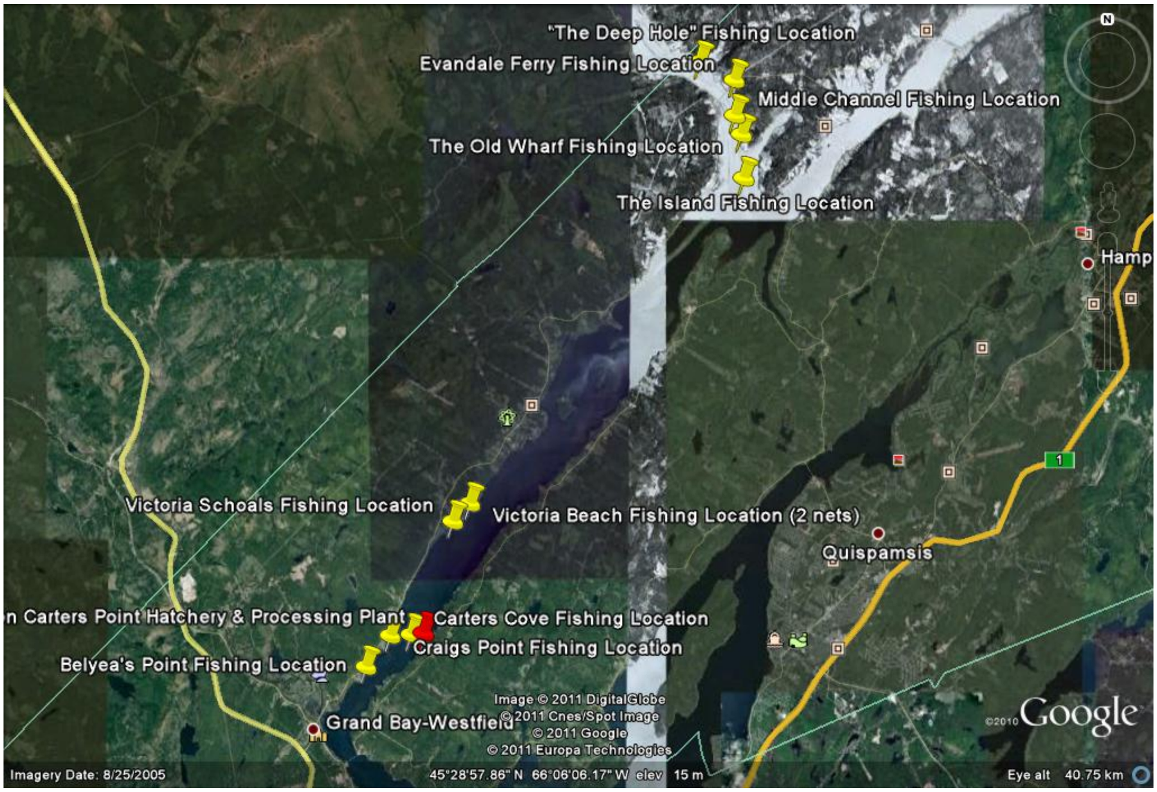


Figure 2. Google Earth image showing the approximate locations of Atlantic Sturgeon fishing areas within the lower Saint John River.

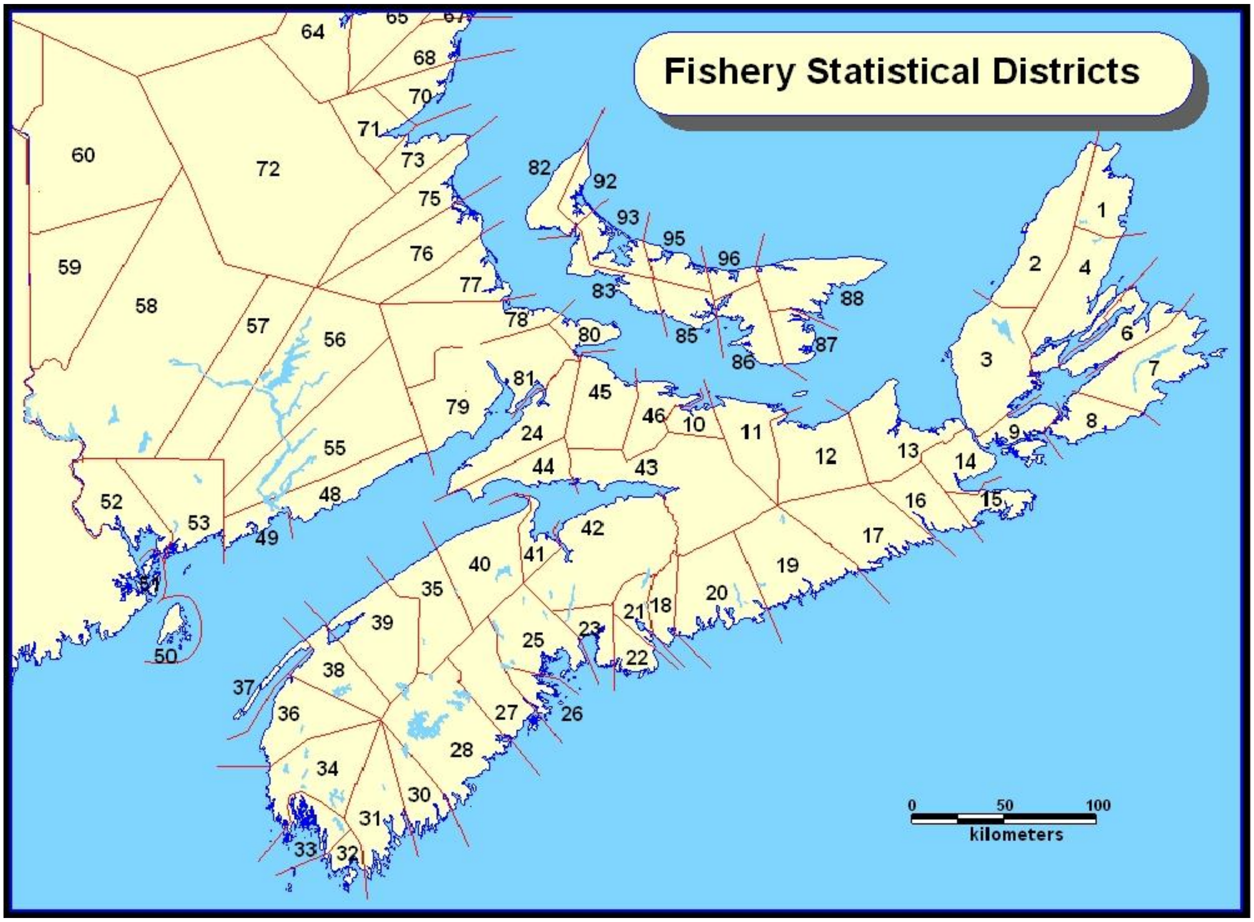


Figure 3. Fishery Statistical Districts within the Maritime Provinces.

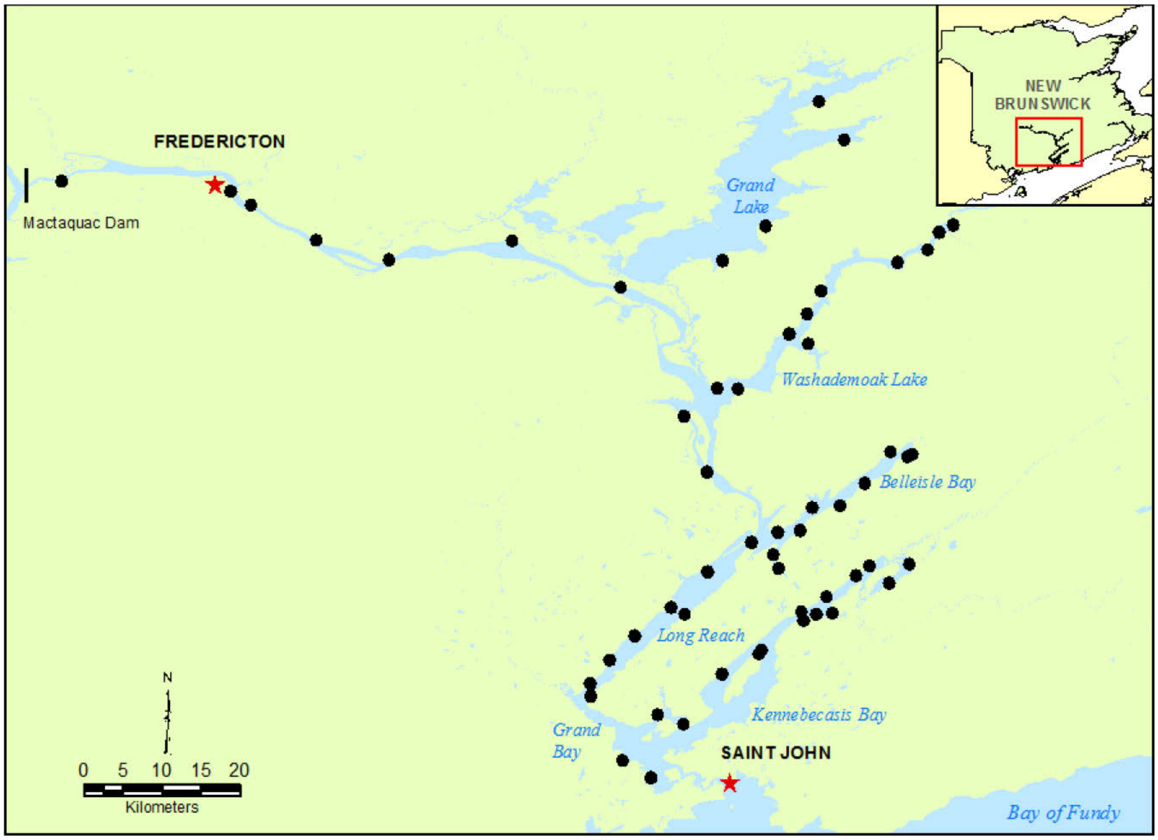


Figure 4. Map of Saint John River below Mactaquac Dam showing subdrainages and beach seining sites sampled in 2009.

Figure 5. Map of the Minas Passage are showing the location of hydrophones (yellow squares) deployed during 2010 and relative to the area (red box) reserved for testing in-stream tidal turbines.

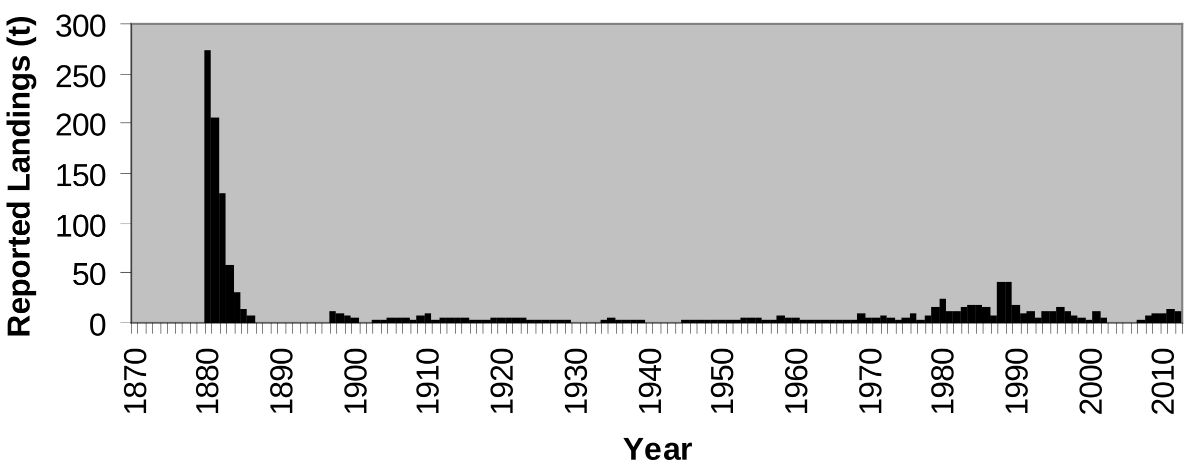


Figure 6. Annual reported landings from the Saint John River and Harbour Atlantic Sturgeon fishery. The fishery began in 1880 and was closed between 1887 and 1897. No landings were reported for the years 1932, 1933, 2005 and 2006.

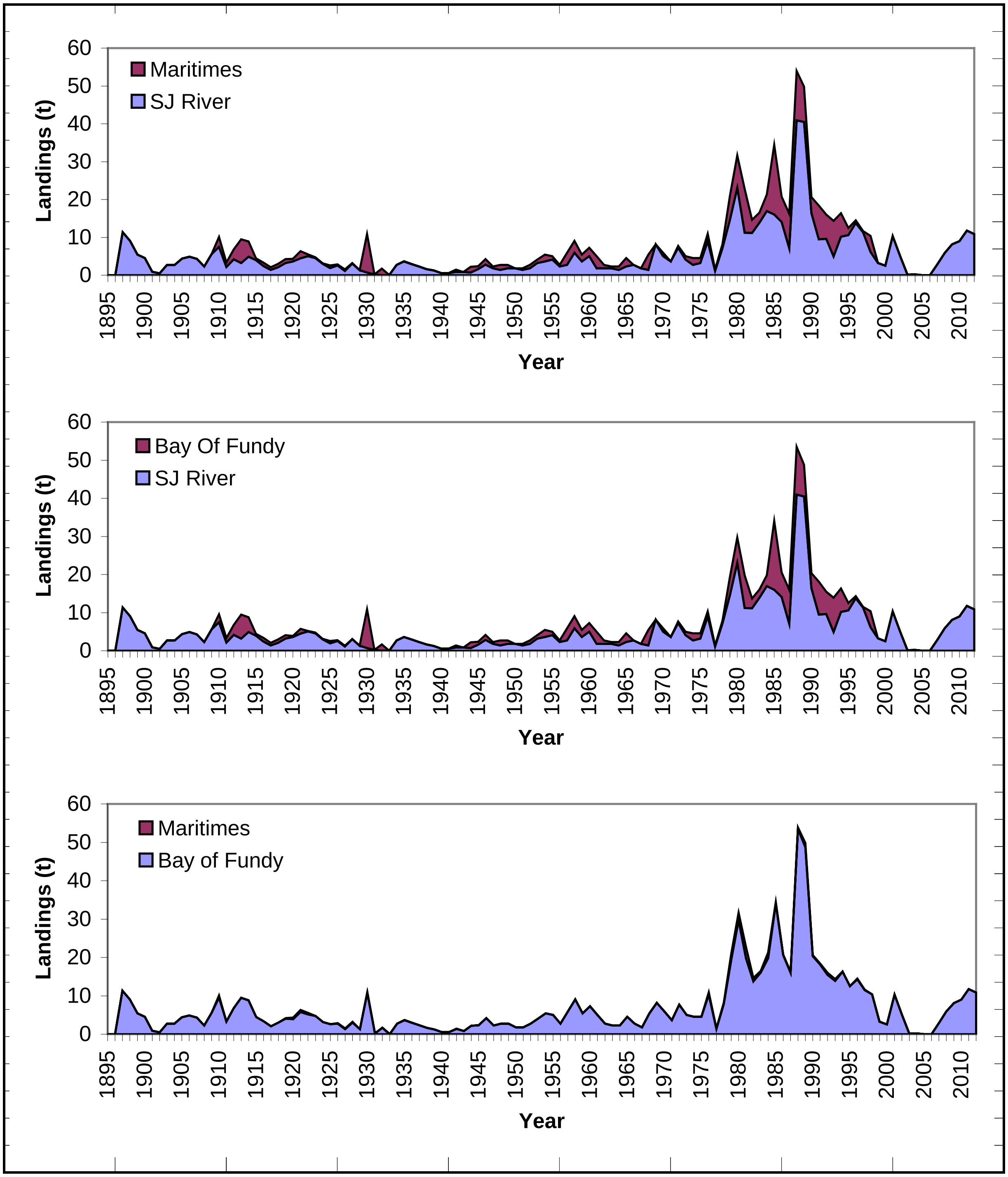


Figure 7. Proportion of reported landings (t) of Atlantic Sturgeon in (upper panel) the Maritime Provinces represented by the Saint John River fishery, (middle panel) the Bay of Fundy represented by the Saint John River fishery, and (lower panel) the Maritime Provinces represented by all Bay of Fundy fisheries including the Saint John River.

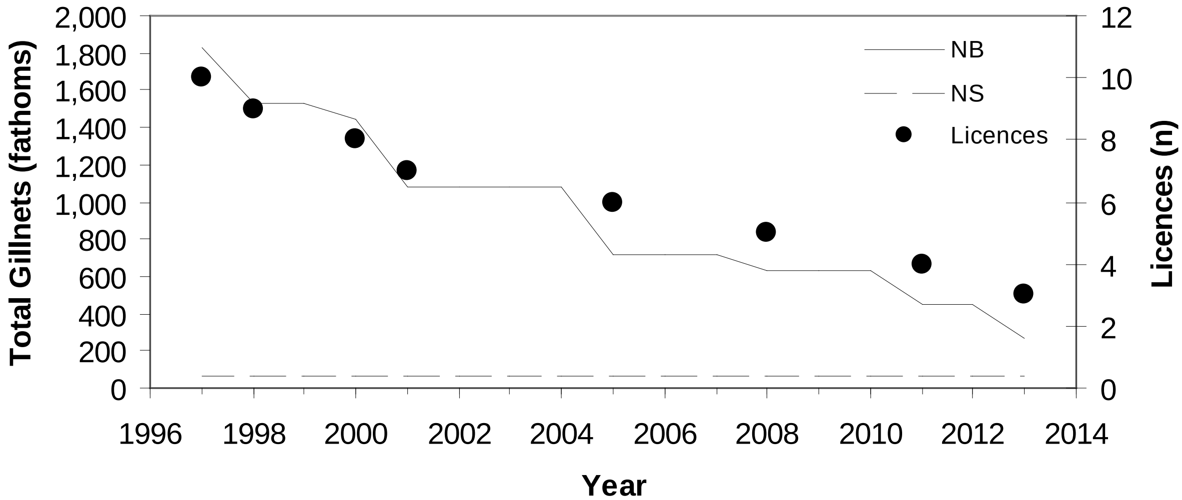


Figure 8. Number of licences and total amount of gear (gillnets; fathoms) under licence by year and province for the years 1996 to 2012.

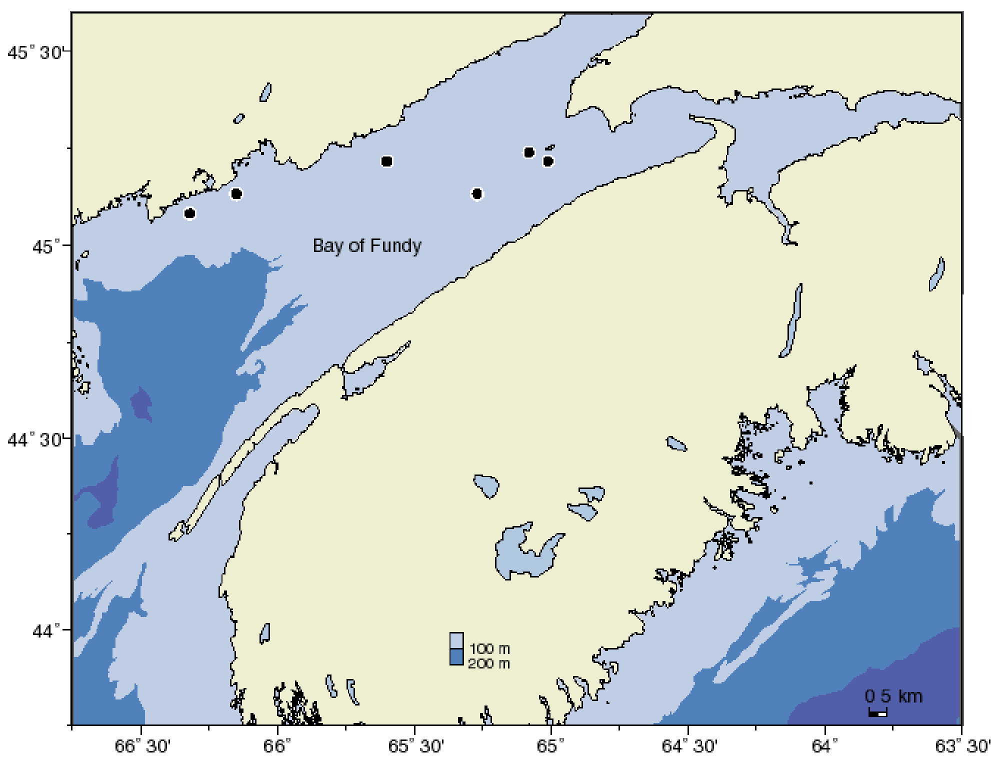


Figure 9. Set locations where Atlantic Sturgeon have been captured in DFO RV surveys.

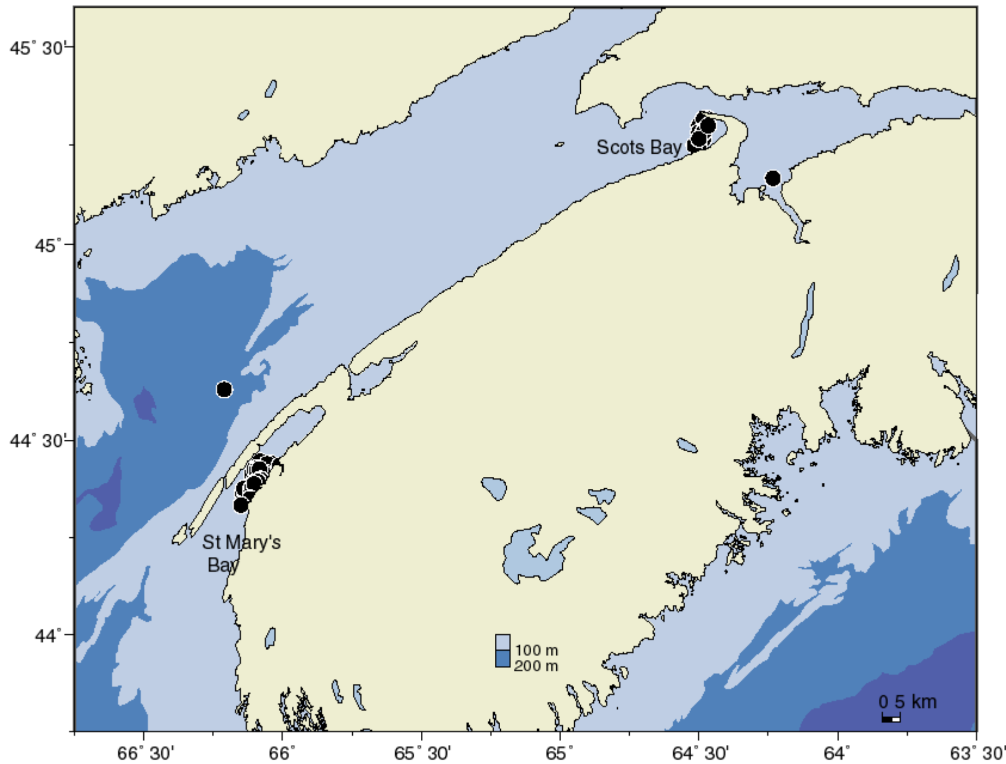


Figure 10. Set locations where Atlantic Sturgeon have been reported as a bycatch by fishery observers.

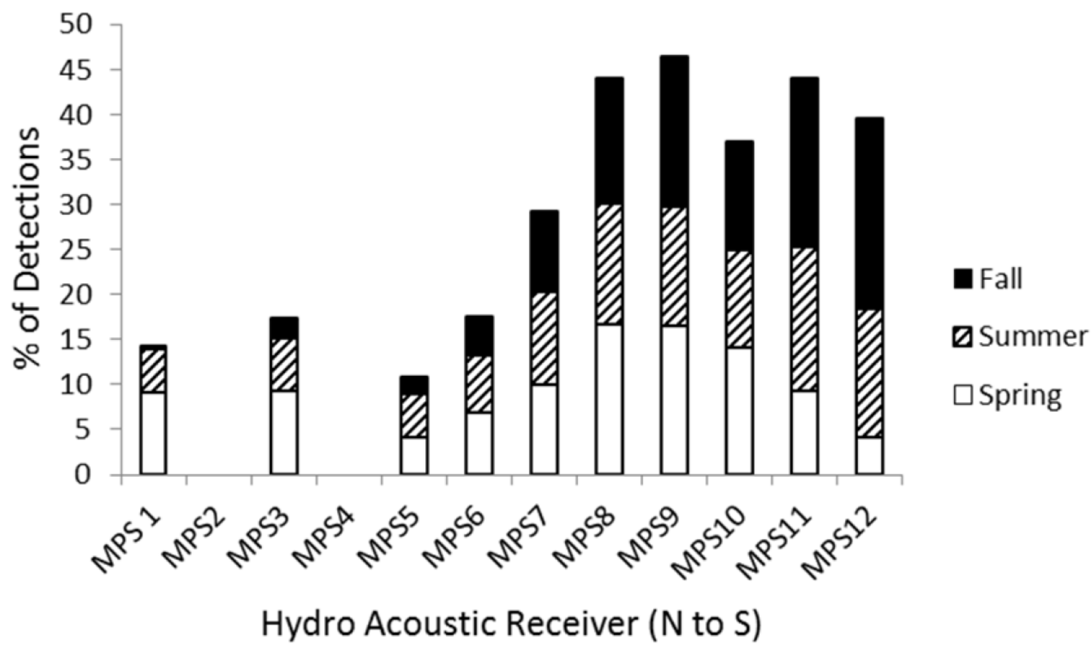


Figure 11. Relative frequency of 2010 detections within the Minas Passage by season (N = North, S = South).

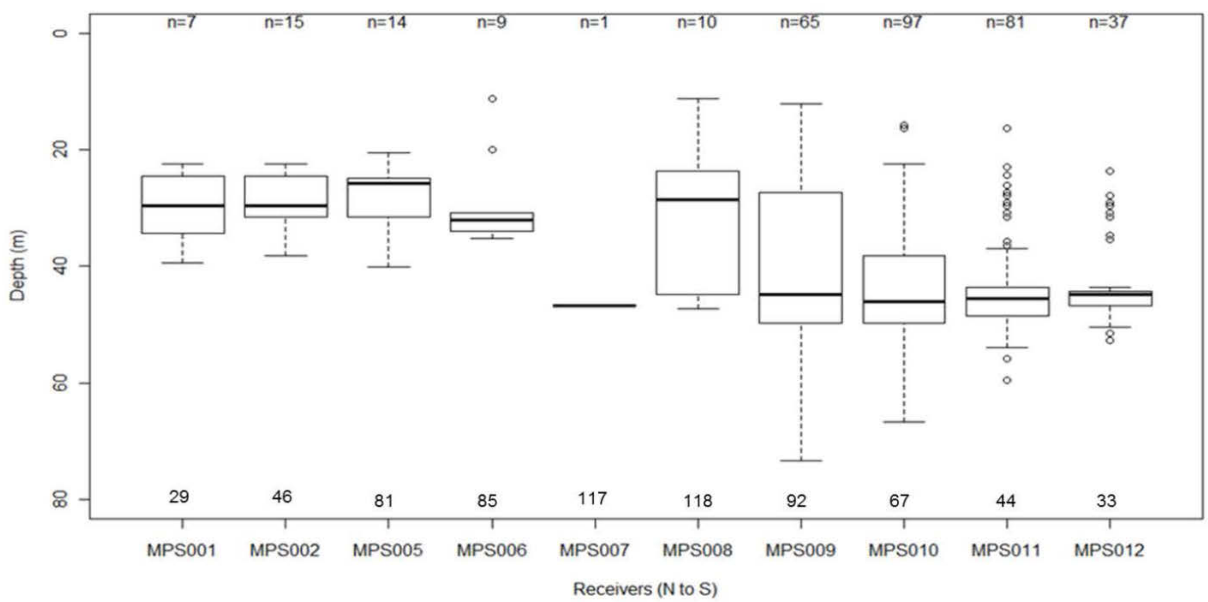


Figure 12. Depth of Atlantic Sturgeon surgically implanted with acoustic telemetry tags measuring pressure at time of detection through the hydrophone array deployed across Minas Passage during 2010. MP01 = Northern most receiver. MP12 = Southernmost Receiver. Receiver MP04 was not retrieved, and receiver MP07 contained no detection information. Box plots central line = Median; box = 25th and 75th percentile, whiskers = maximum value and minimum value.

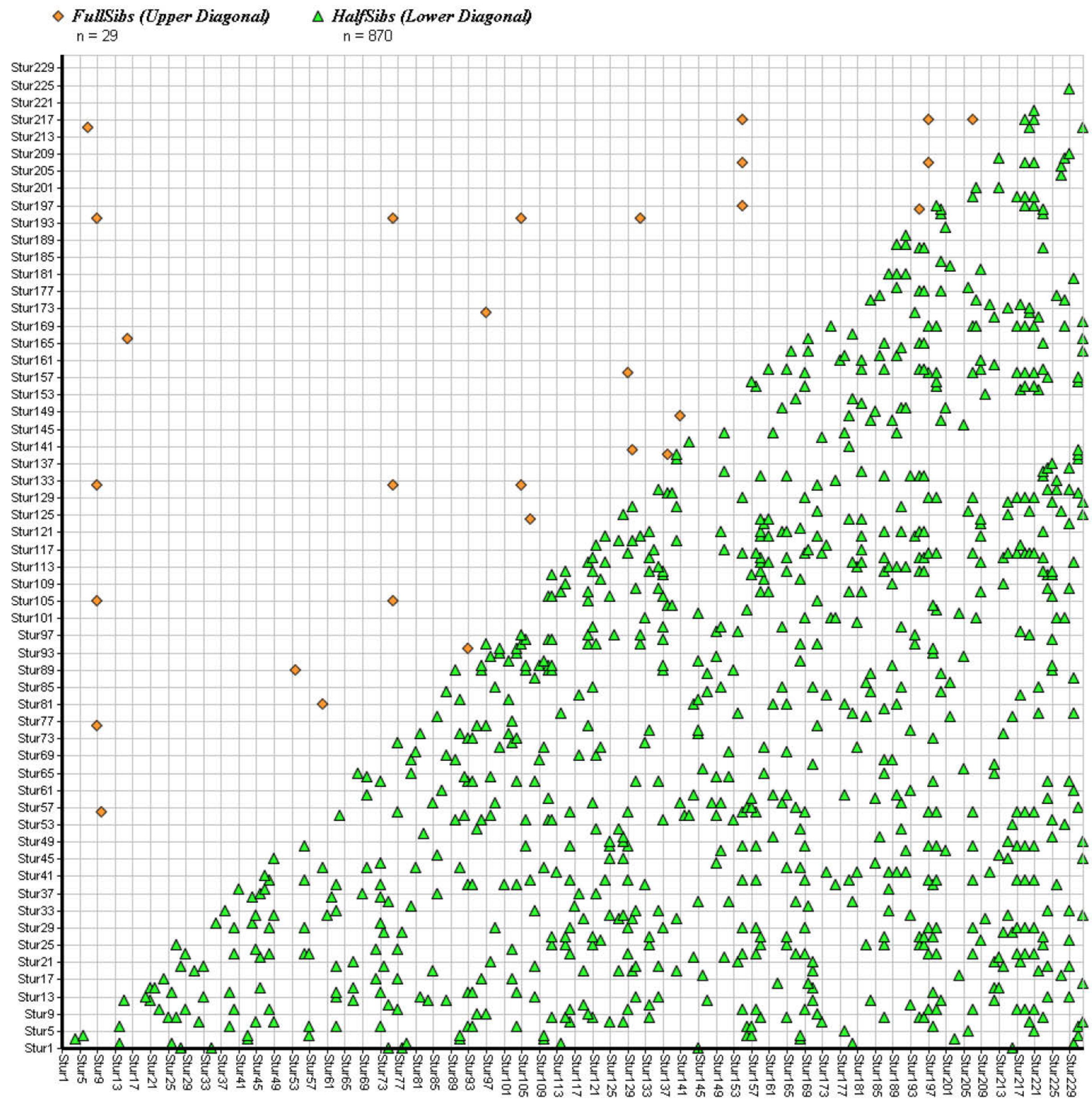


Figure 13. Plot showing full-sib (red diamonds) and half-sib relationships among Saint John River Atlantic Sturgeon inferred using the 21 locus data set.

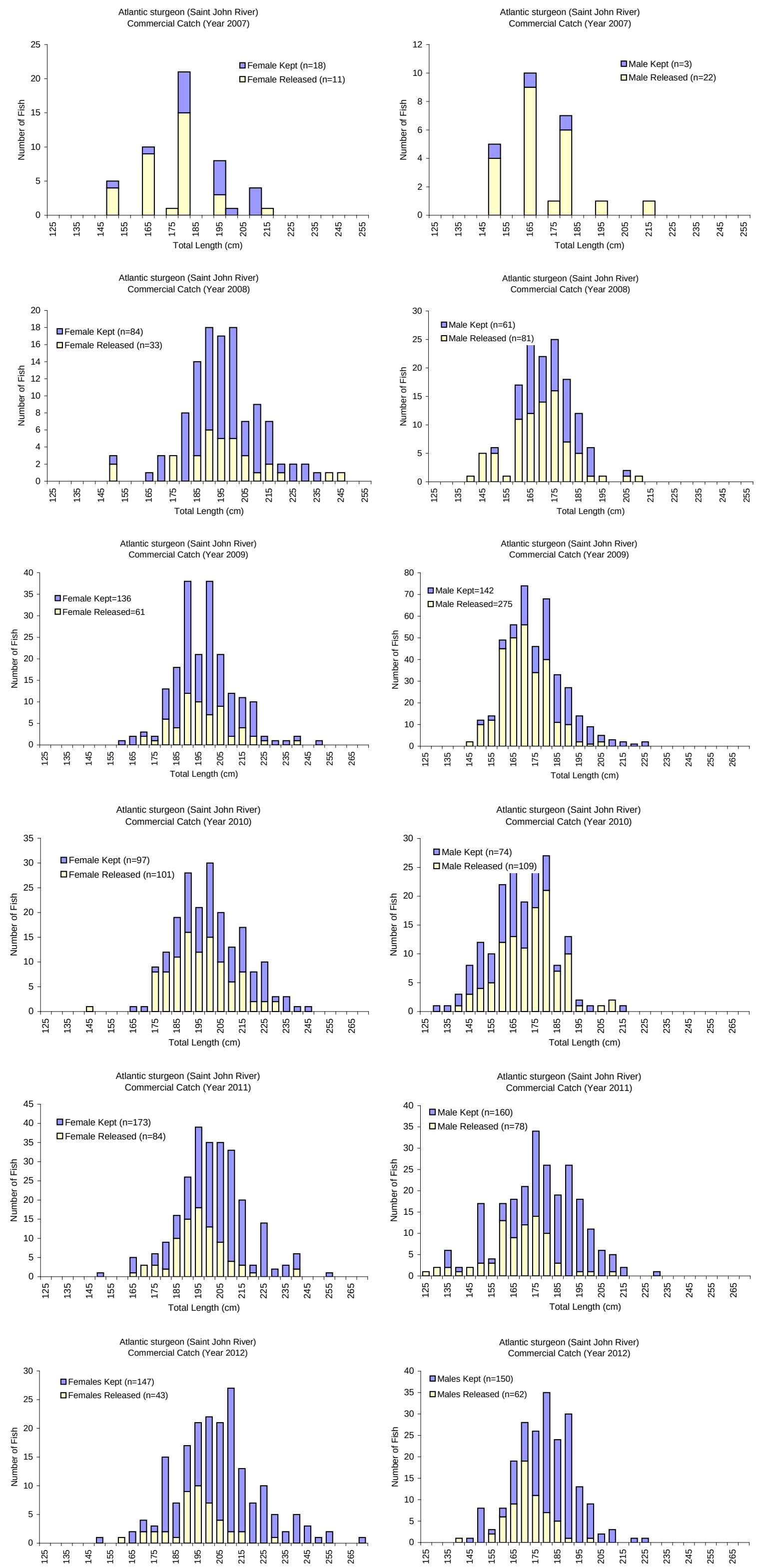


Figure 14. Length frequency distributions for Harvested (Yellow) and Released (Blue) Male and Female Atlantic Sturgeon for the years 2007 to 2012.

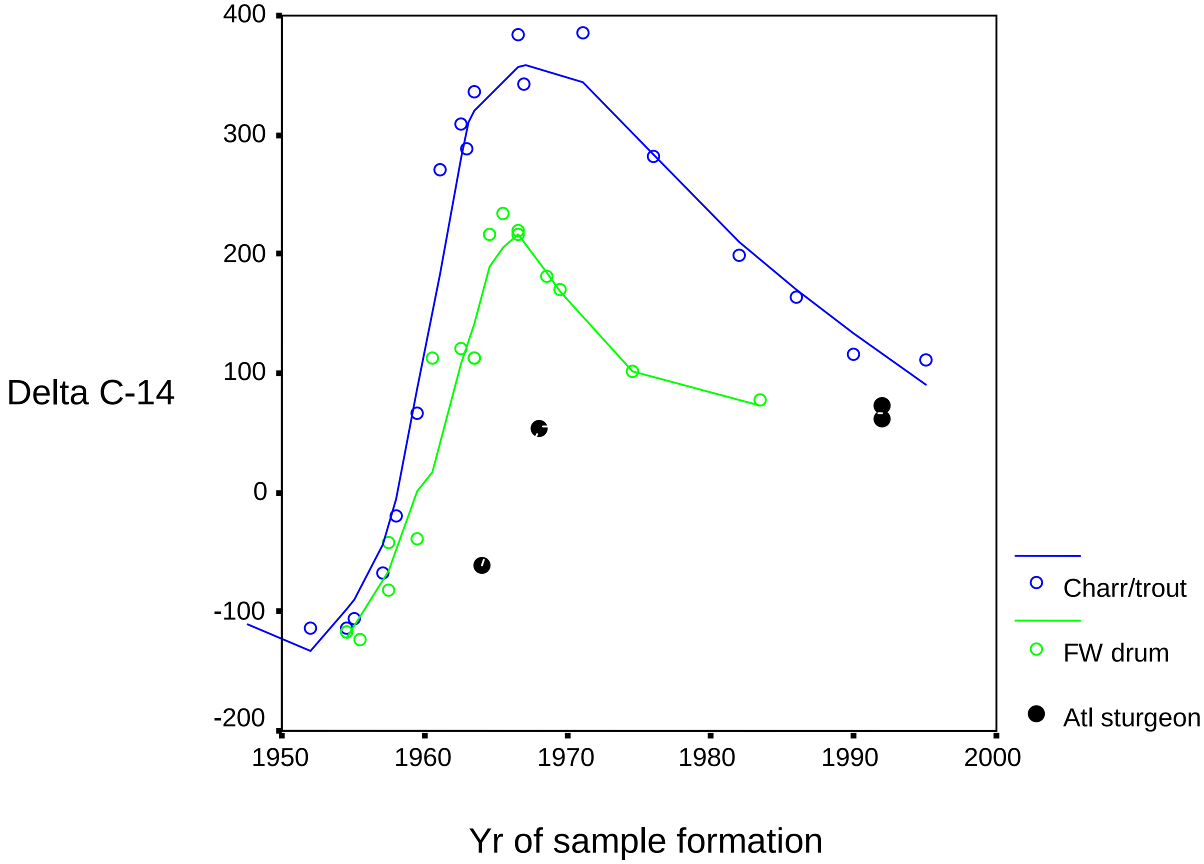


Figure 15. Carbon-14 concentration relative to carbon-12 versus estimated year of sample formation determined from reading spine annuli. The change in carbon-14 contained in the otoliths of freshwater salmonids and freshwater drum are presented for comparison. The shift to the right in the data points suggest that conventional methods of age determination estimate the true age of older Atlantic Sturgeon.

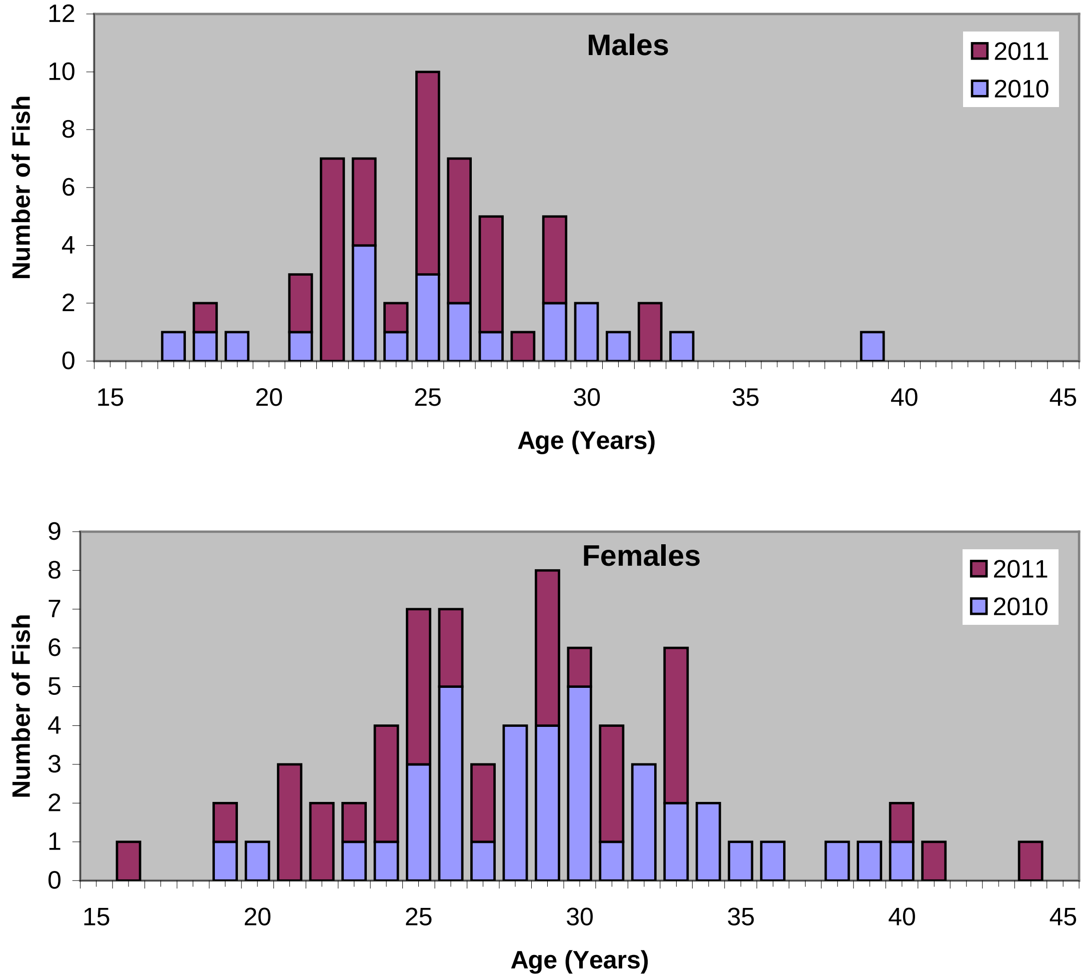
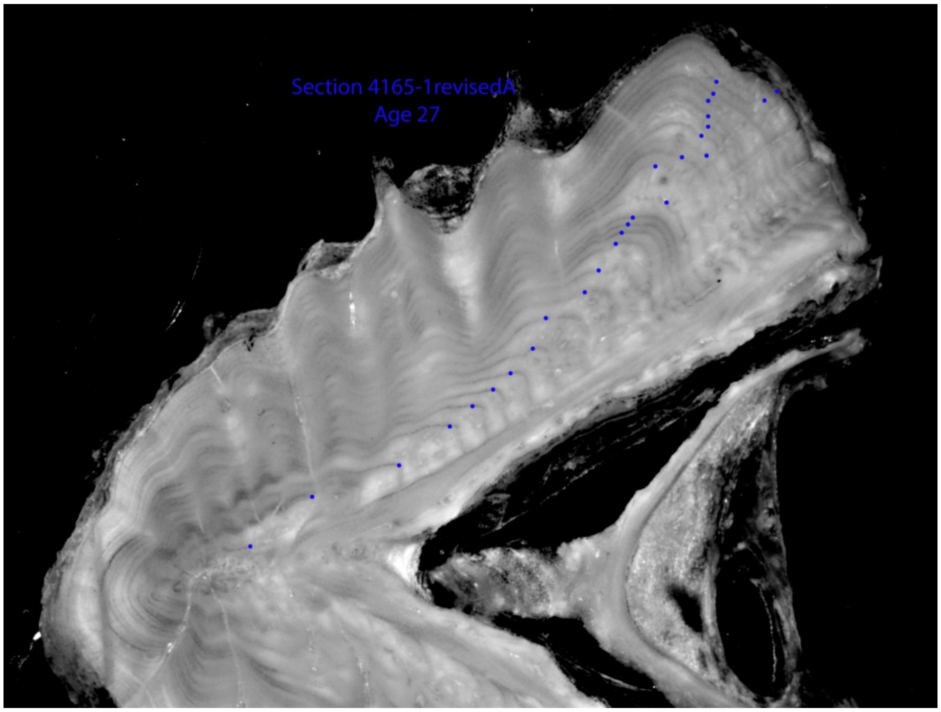


Figure 16. Age frequency distributions of adult male and female Saint John River Atlantic Sturgeon sampled during 2010 and 2011.



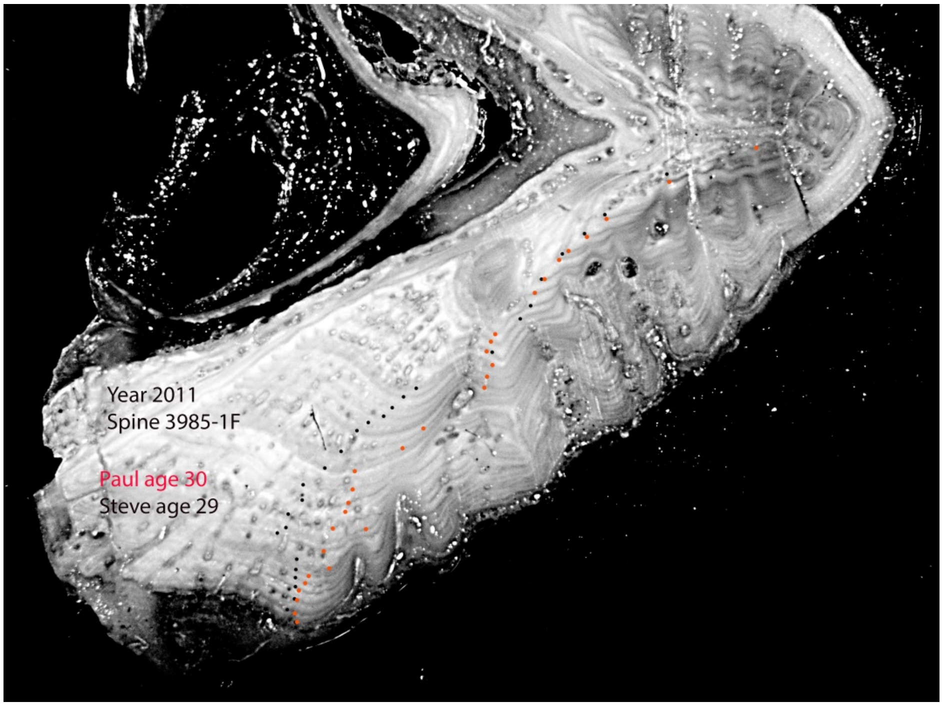


Figure 17. Images of pectoral fin spines (that have been sectioned and prepared for age determination). The position of annuli are represented by dots (upper panel). The lower panel shows the interpretations of annuli location and number from two independent readers.

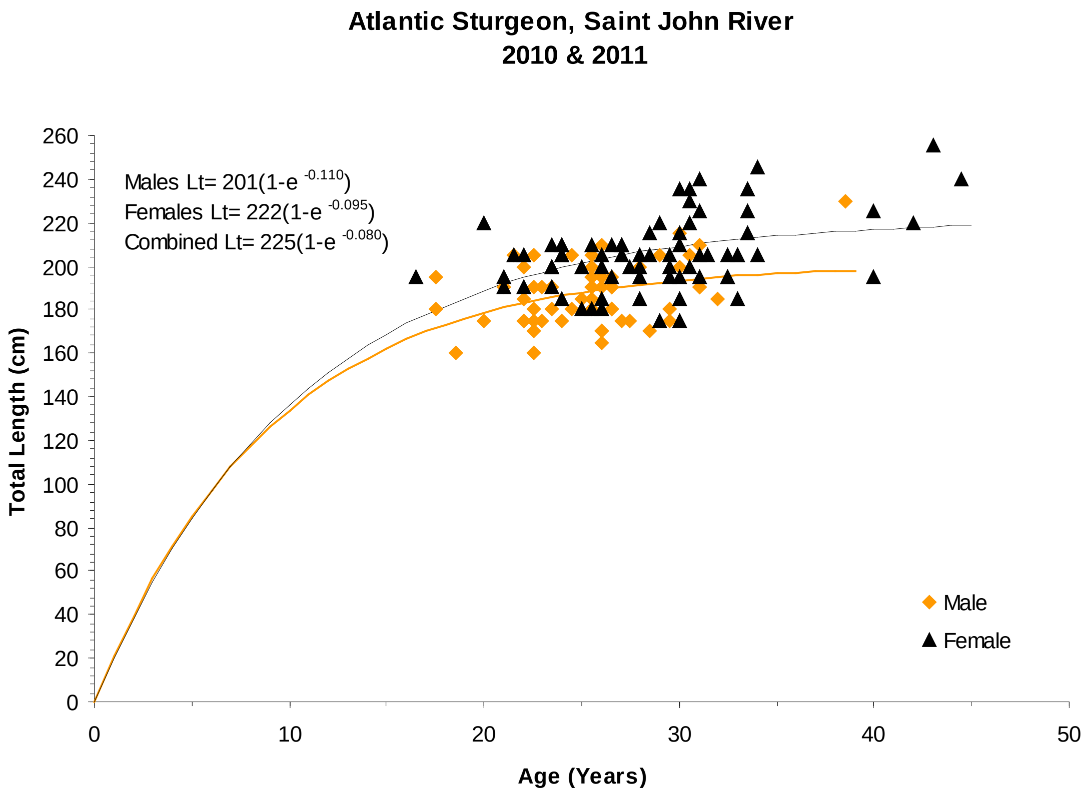


Figure 18. Scatterplots of Total Length (cm) versus estimated age (Years) for Male (diamonds) and Female (triangles) adult Atlantic Sturgeon sampled during the 2010 and 2011 fishing seasons. The von Bertalanffy growth functions have been calculated for each sex using the data pooled between years.

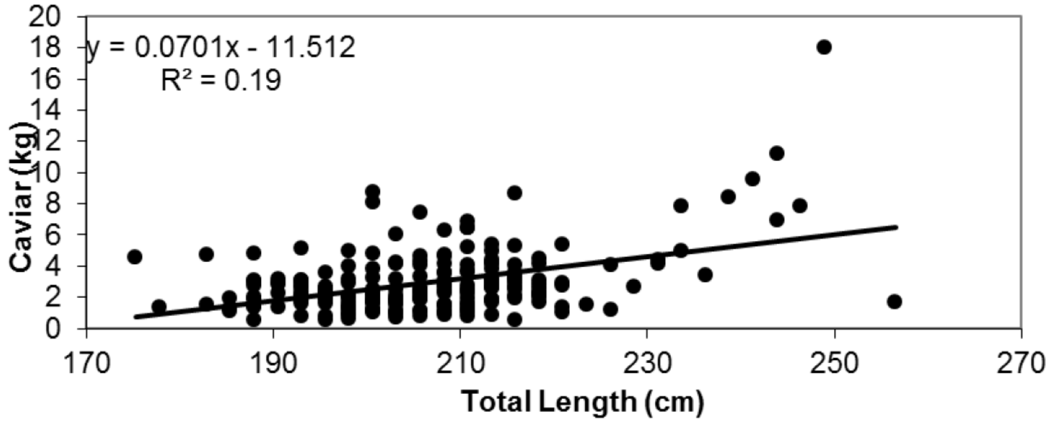


Figure 19.Caviar production (kg) versus total length (cm) for female Saint John River Atlantic Sturgeon.

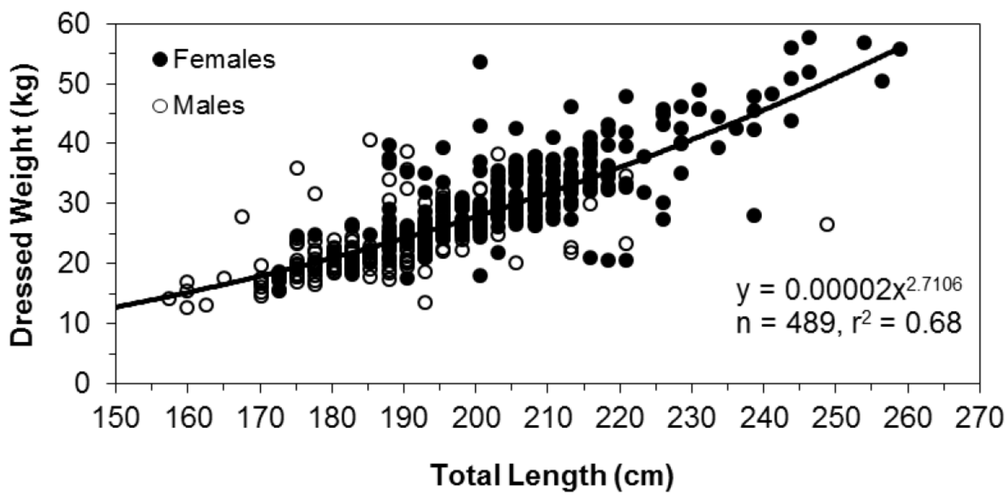


Figure 20. Dressed weight (minus head and tail and gutted) kg versus total length (cm) for male (open circles) and female (closed circles) Saint John River Atlantic Sturgeon. The regression line has been calculated with the sexes combined.