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EVALUATION OF ATLANTIC STURGEON (*ACIPENSER OXYRINCHUS*) FROM THE BAY OF FUNDY POPULATION TO INFORM A CITES NON-DETRIMENT FINDING

Edmonson and Chrisp

Figure 1. Bay of Fundy location map. The approximate locations of the Saint John River and the Minas Basin are also shown.

Context

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) is a legally binding multilateral environmental agreement that aims to ensure that international trade of species does not threaten their survival in the wild. Under the Convention, evaluations must be conducted to determine if the export of a species will be detrimental to its survival in the wild (i.e. a non-detriment finding; NDF). Fisheries and Oceans Canada (DFO) is responsible for the issuance of CITES export permits for Canadian aquatic species, which must be accompanied by a positive NDF.

DFO has received an application to export specimens and products of wild Atlantic Sturgeon (Acipenser oxyrinchus) captured from the Saint John River, New Brunswick. Atlantic Sturgeon is listed on Appendix II of CITES and an evaluation of the sustainability of the total removals of Atlantic Sturgeon from the Bay of Fundy and its associated estuaries is necessary to inform the non-detriment finding (NDF). The St. Lawrence River population of Atlantic Sturgeon is not discussed in this document as it is considered distinct from the Bay of Fundy population.

SUMMARY

- Estimates of Atlantic Sturgeon spawner abundance in the Saint John River indicate low to modest population abundance, in the range of 1,000 to 3,000 spawners per year. Current recruitment of Atlantic Sturgeon is unknown but is suspected based on the ongoing presence of juvenile fish in the Saint John River and the broad size structure of the exploitable population (at least 20 age classes).

- There is an abundance of migrant foraging juveniles, sub-adults, and adults in the Minas Basin (~ 10,000, c.v. 6,000-14,000). Based on recent genetic analyses of these individuals, 62% are of Saint John River origin with the remainder comprised of fish with origins in the United States.

- The primary source of human-induced mortality to this population is the Saint John River commercial fishery. This fishery has been closely regulated since 2010 and is subject to harvest quotas, gear restrictions, mandatory reporting, and temporal closures. The one experimental licence that was previously authorized for the Shubenacadie River and Minas Basin was moved to the commercial fishery in the Saint John River in 2013.

- A maximum commercial harvest of 350 Atlantic Sturgeon from the Bay of Fundy population is considered to be sustainable over the short-term (up to five years). Management measures and harvest rules currently in place should be maintained until the next assessment.

- Quantile values of Atlantic Sturgeon meat and caviar yields were estimated from 5,000 samples of the data drawn at random based on the Saint John River commercial fishery. Estimated mean total dressed weight of 350 adults = 10,485kg ± 145kg and the estimated mean caviar (kg) yield from 175 female Saint John River = 528 ± 29 kg.

BACKGROUND

Rationale for Assessment

Atlantic Sturgeon is listed on Appendix II of the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES) and is considered by CITES to be a shared stock with the United States. A review of the sustainability of the total removals of Atlantic Sturgeon in Canada, and the related estimated caviar and meat yields from the commercial fishery, must be evaluated prior to the issuance of a non-detriment finding (NDF). The St. Lawrence River population of Atlantic Sturgeon is not discussed in this document as it is considered distinct from the Bay of Fundy population.

The Fishery

In Canada, licenced fisheries for Atlantic Sturgeon are authorised for the Bay of Fundy and the Saint Lawrence River populations. As Atlantic Sturgeon from the St. Lawrence River are considered a discrete population, and fish caught in the St. Lawrence River are not being requested for export, only the Bay of Fundy population and the related Saint John River fishery will be described in this report.

Commercial Fishery

Four licences are currently 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. These licences include the one exploratory licence that was previously valid in Nova Scotia (Shubenacadie River located at the head of the Minas Basin) as it was moved to the Saint John River/Harbour fishery in 2013. 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 gillnets having a minimum mesh size of 330 mm (13 inches), which has been implemented to reduce the catch of juvenile sturgeons and prevent bycatch of other species. In 2011, a harvest quota of 350 individuals with a 50:50 sex ratio was implemented; once 175 individuals of either sex are landed, the fishery is closed. Regulations currently prohibit the retention or possession of Atlantic Sturgeon <120 cm in total length, which is the presumed length at first maturity. The commercial fishing season is 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).

Retention of incidentally caught Atlantic Sturgeon in other river and coastal commercial fisheries is prohibited by regulations. However, the rates of incidental capture and mortality of Atlantic Sturgeon as bycatch are not well known. Some fisheries, notably set gillnet fisheries for Gaspereau (*Alosa pseudoharengus* and *A. aestivalis*) and American Shad (*A. sapidissima*) do carry a potentially high risk of mortality for Atlantic Sturgeon. The level of incidental mortality in these fisheries is not known, but there are indications that it is potentially high relative to other sources of mortality, particularly in the Saint John River/Harbour fisheries.

Recreational Fishery

There is a recreational fishery for Atlantic Sturgeon in New Brunswick and there are annual sturgeon angling tournaments on the Saint John River. Tournament entry rules require live release of all angled sturgeons. Non-tournament angling also occurs with a 120 cm minimum size limit for retention of fish. Recreational angling for Atlantic Sturgeon is permitted with an open season (except for the closure in June to protect spawning adults). Although there is currently no bag or possession limit for this species, the release rate is approximately 98% and survival of Atlantic Sturgeon that are released alive is considered very high.

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, but these licences have reported minimal annual landings (< 5 total) in the past five years; two Atlantic Sturgeon were reported in 2012.

Aquaculture

There is one active Atlantic Sturgeon aquaculture facility in New Brunswick. DFO has authorised the capture and spawning in captivity of wild-caught Atlantic Sturgeon (Table 1). All fish captured for aquaculture purposes are required to be released alive. Beginning in 2011, all removals for aquaculture purposes have been counted against the 350 fish quota, even though they were subsequently returned to the wild.

ASSESSMENT

Status and Trends

Status and trends information for Atlantic Sturgeon from the Bay of Fundy population is primarily based on monitoring and sampling of fish captured in the Saint John River commercial fishery for this species.

Table 1. Annual landings of male and female Saint John River Atlantic Sturgeon and estimated total landed weight for the years 2007 to 2012. The average weight of processed fish for the year was multiplied by 1.3 and catch in numbers to estimate landed weight. The fishery has been under quota management (350 fish with a 50:50 sex ratio) since 2011.

Year	Average Weight (kg)	Number Sturgeons Harvested				Total Catch	
		Males		Females			
		Processed	Hatchery	Processed	Hatchery	Weight (t)	n
2007	44.8	3	0	15	0	2.9	18
2008	49	61	18	84	13	5.9	145
2009	33	148	10	137	6	801	285
2010	36.5	79	18	111	17	9	190
2011	37.5	164	12	176	8	11.8	340
2012	35.1	162	4	161	21	10.9	323

Commercial fishing for Atlantic Sturgeon began on the Saint John River in 1880 when an intensive and largely unregulated gillnet-based fishery removed 273 t (Fig. 2). A precipitous year-over-year decline in annual landings, to a low of 7.4 t in 1886, resulted in a 10-year closure of the fishery beginning in 1887. Estimates of the virgin population abundance are not possible because of uncertainty in the annual levels of fishing effort. However, the cumulative reported fishery removals from 1880 to 1886 of approximately 700 t indicate a minimum of 7,000 to 14,000 adults were removed assuming average individual biomasses of 50-100 kg. Annual commercial landings from the Saint John River fishery have not exceeded 41 t (i.e. 400-800 fish/year at average weights of 50 kg and 100 kg, respectively) in any year since the re-opening of the fishery in 1897. No landings were reported for the years 1932, 1933, 2005, and 2006.

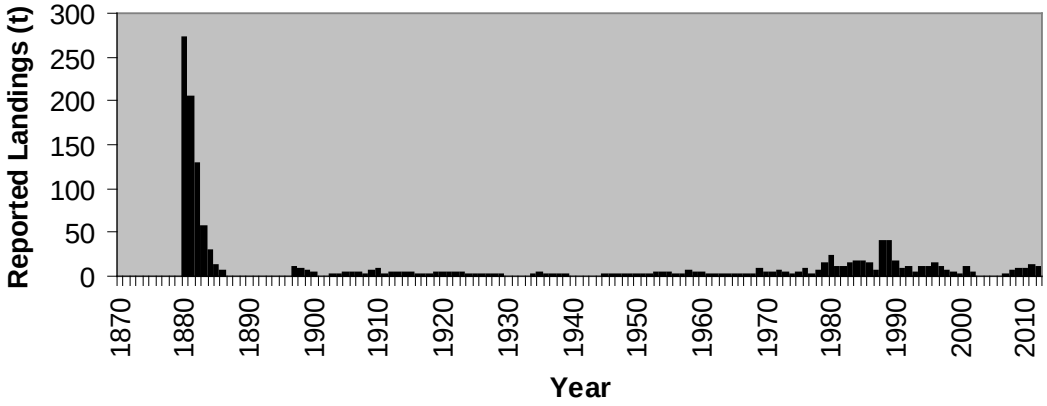

Figure 2. Annual reported landings from the Atlantic Sturgeon commercial fishery in the Saint John River. The fishery began in 1880 and was closed between 1887 and 1897. No landings were reported for the years 1932, 1933, 2005, and 2006.

Fishing resumed in 2007 (3 t) on an exploratory basis to assess the potential for locally-produced value-added products (i.e. meat and caviar) derived from both wild-caught and cultured fish (Table 1).

Current estimates of annual Atlantic Sturgeon spawner abundance in the Saint John River are in the range of 1,000-3,000 spawners per year. While the spawning frequency of this population has not been established, it is expected to be in the order of 3-4 years for females, and 1-3 years for males. Given that not all adults enter the river to reproduce each year, coupled with the preferential gear selectivity for smaller (and presumably younger) females, the number of Atlantic Sturgeon in the Bay of Fundy population is likely greater than the aforementioned estimate.

Recent studies conducted in the Minas Basin indicate that there is a recurring, summering aggregation of foraging Atlantic Sturgeon, primarily of juveniles and sub-adults (ages 3-29), in the order of 10,000 (c.v. 6,000-14,000). Genetic analyses indicate that approximately 62% of these fish are of Saint John River origin with the remaining fish originating from United States of America (USA) populations. However, no Atlantic Sturgeon of USA origin have been detected in the Saint John River fishery and no adult fish tagged and released from the commercial Saint John River fishery have been reported in another river known to support a spawning population.

A population model for Atlantic Sturgeon continues to be developed and thus it is not possible to project future biomass with any certainty at the current time. However, given the broad age composition of the population and the large number of Saint John River juveniles and sub-adults that have been observed in the Minas Basin, under current conditions, it is expected that the population will continue to persist at approximately current levels in the short to medium term (5-10 years) and is not considered to be at risk of extinction within the next generation.

In 2011, the *Committee on the Status of Endangered Wildlife in Canada* (COSEWIC) assessed Atlantic Sturgeon as 'Threatened' on the basis of a single spawning location within the lower Saint John River, a relatively small breeding population, and uncertainty of the population effects of the commercial and recreational fisheries.

Life History Parameters

Information on the life history parameters of Atlantic Sturgeon in Canada is provided in COSEWIC (2011) and DFO (2013).

Threats

The primary source of human-induced mortality of Bay of Fundy Atlantic Sturgeon is from the Saint John River commercial fishery. Although commercial harvest rates are considered sustainable, the number of Atlantic Sturgeon taken as bycatch is unknown.

The recreational and Aboriginal fisheries are not considered a threat to this population of Atlantic Sturgeon, nor are illegal harvests as enforcement is considered effective.

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); 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 are anecdotal reports of Atlantic Sturgeon becoming trapped in the gate wells located at the base of the dam.

Natural mortality of Atlantic Sturgeon in the Bay of Fundy is not known. The broad range of age (size) classes and the presence of older mature individuals suggest that natural mortality is low.

Estimated Sustainable Harvest Level

In 2009, it was determined that the exploitable portion of Atlantic Sturgeon in the Saint John River appear to have a healthy age structure and has supported a commercial harvest in the order of 400 fish per year over the past 50 years of fishing activity. There continues to be no evidence that this harvest level has resulted in any substantial changes to the observed relative abundance, size structure, or estimated age structure of Atlantic Sturgeon in the Bay of Fundy or the Saint John River.

From 2009-2012, the average annual reported landings have been 9.9 mt ± 1.7 mt, consisting of approximately equal numbers of males and females (Tables 1 and 2). From 2009-2012, the average weight (± 1 Standard Deviation) of fish has been 35.5 kg ± 1.9 kg (30.6 kg ± 6.7kg for males and 41.6 kg ± 10.0 kg for females).

Given existing information, total removals that are within the average historical levels are expected to be sustainable for the short term (i.e. five years). If annual removals from recreational fisheries, Aboriginal fisheries, and incidental mortality combined are assumed to be no more than 50 fish, this would suggest a sustainable commercial harvest level of 350 fish (maximum) for the commercial fishery on the Saint John River. The sex ratio of this harvest should remain at 50:50 to minimise potential conservation concerns.

This proposed commercial harvest limit is based on a number of assumptions that should be re-evaluated as new information is made available.

Estimated Sustainable Caviar and Meat Production

As shown in figures 3 and 4, Atlantic Sturgeon meat and caviar production exhibit significant ($p>0.001$) increasing trends with increasing body size but neither relation is strong (Meat-TL r^2 =0.68; Caviar-TL r^2 =0.19).

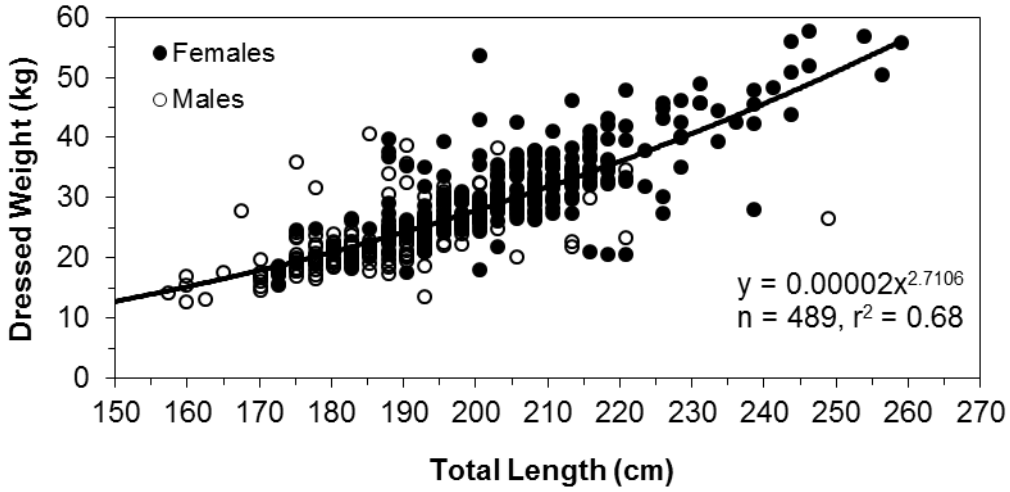

Figure 3. Dressed weight, minus head and tail and gutted, (kg) versus total length (cm) for male (open circles) and female (closed circles) Saint John River Atlantic Sturgeon. The regression line has been calculated with the sexes combined.

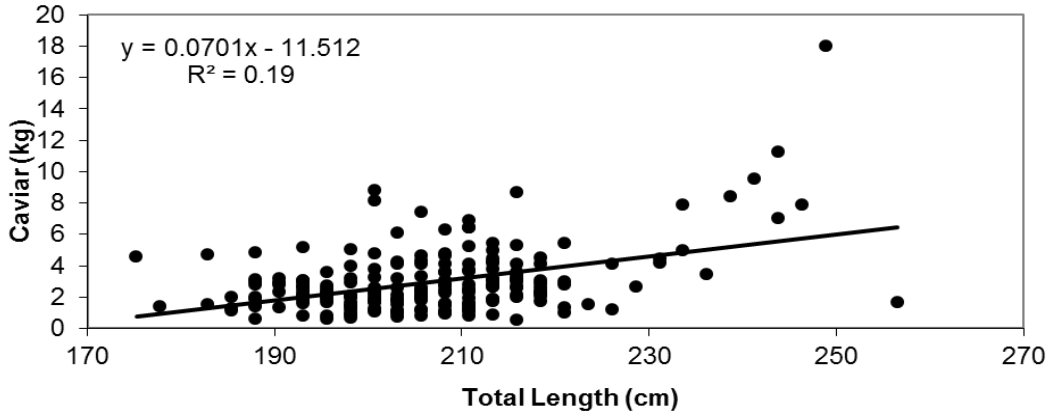

Figure 4. Caviar production (kg) versus total length (cm) for female Saint John River Atlantic Sturgeon.

Caviar yields of ≤ 1 kg per female are common across much of the length range. 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.

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.

Similarly, caviar yields are available for 239 females captured in 2011 and 2012 with an estimated mean (±1 Standard Deviation) caviar yield (kg) from 175 female Saint John River of 528 ± 29 kg (Table 2).

Table 2. *Quantile values of Saint John River Atlantic Sturgeon meat and caviar yields estimated from 5,000 samples of the data drawn at random.*

Yield (kg)	**Quantile 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

Sources of Uncertainty

Limited biological information is available for Atlantic Sturgeon from the Saint John River, particularly at times when the fishery is closed. Of particular interest would be estimates of abundance across all age classes, as well as age and growth data for males and females.

The habitats of the life history stages in the river are unknown beyond the favoured location for commercial fishers. For example, spawning in the river has not been confirmed and movements/migrations from and into the river are not presently well described.

There may have been changes in the productivity of the Saint John River since the construction of the Mactaquac Dam.

Rates of incidental capture and mortality of Atlantic Sturgeon as bycatch, particularly in set gillnet fisheries for Gaspereau and American Shad, are not well known and should be quantified as soon as possible.

CONCLUSIONS AND ADVICE

The exploitable population of Atlantic Sturgeon in the Saint John River appears to have a healthy age structure and has supported a commercial harvest in the order of 400 fish per year over the past 50 years of fishing activity. Other sources of human-induced mortality on Atlantic Sturgeon in the Bay of Fundy are thought to be low and in the order of approximately 50 fish per year. Non-fishery sources of human-induced mortality are not expected to change from present levels during the next five years.

Based on the information available, a maximum commercial harvest of 350 Atlantic Sturgeon from the Saint John River is considered to be sustainable over the short-term (i.e. up to five years). This harvest level is based on a number of assumptions that should be re-evaluated as new information becomes available. The sex ratio of this harvest should also be taken into consideration, with a suggested male to female ratio of 50:50.

A maximum mesh size limit could be imposed through regulations as a means to increase escapement of larger-bodied mature females if benefits to conservation could be demonstrated. Similarly, an increase in the minimum legal size could be implemented to afford protection to a larger component of (younger, smaller-bodied) adults. The present seasonal closure (during the month of June) could be varied, if necessary, to protect a greater proportion of the spawning biomass.

Mandatory reporting (i.e. quantity and sex) of Atlantic Sturgeon caught as bycatch, particularly in the Gaspereau and American Shad fisheries, and independent verification of bycatch and bycatch mortality rates are necessary in order to determine the potential severity of this threat.

SOURCES OF INFORMATION

This Science Advisory Report is from the January 17, 2013 National Peer Review on the Evaluation of the Saint John River population of Atlantic Sturgeon (*Acipenser oxyrinchus*) to Inform a CITES Non-Detriment Finding. Additional publications from this meeting will be posted on the Fisheries and Oceans Canada (DFO) Science Advisory Schedule as they become available.

COSEWIC. 2011. COSEWIC assessment and status report on the Atlantic Sturgeon *Acipenser oxyrinchus* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xlvii + 136 pp. [Accessed 7 May 2013]

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Wirgin, I., L. Maceda, J.R. Waldman, S. Wehrell, M. Dadswell and T. King 2012. Stock origin of migratory Atlantic Sturgeon in Minas Basin, inner Bay of Fundy, Canada, determined by microsatellite and mitochondrial DNA analyses, Trans. Am. Fish. Soc.141: 1389-1398.

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MPO. 2013. Évaluation de la population d'esturgeon noir (Acipenser oxyrinchus) dans la baie de Fundy pour documenter un avis de commerce non préjudiciable de la CITES. Secr. can. de consult. sci. du MPO, Avis sci. 2013/047.