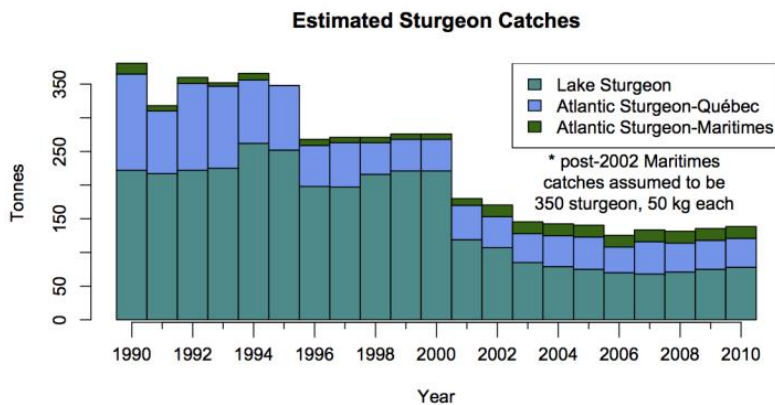


Production Statistics

The Atlantic sturgeon fishery existed throughout this species range, from Georgia, US to the St. Lawrence River, Canada but following precipitous declines throughout the US stocks, all US fisheries were closed. Currently, fisheries for this species only occur in Canada, and are dominated by the St. Lawrence River fishery, which is ten times larger than the St. John River fishery ($\gg 3000$ vs. 350 fish) (COSEWIC 2011)(DFO 2013)(Verreault & Trenchia 2011). Landings have declined following intensive regulations of both fisheries in the late 1990s, now around 2000-4000 fish in the St. Lawrence River and capped at 350 fish in the St. John River, though rarely met with a 50:50 sex ratio regulation (COSEWIC 2011)(DFO 2013b)(Verreault & Trenchia 2011).

The Lake sturgeon fishery is limited to the contiguous US and Canada. Insignificant Lake sturgeon fisheries existed throughout the US and the majority of current production occurs in Canada's Great Lakes-Upper St. Lawrence River area. Production has declined following intensive regulations and is capped at 80 tonnes (approximately 12,000 fish). There has been a reduction in effort in recent years, as commodity price has fallen (COSEWIC 2006)(Mailhot et al. 2011).



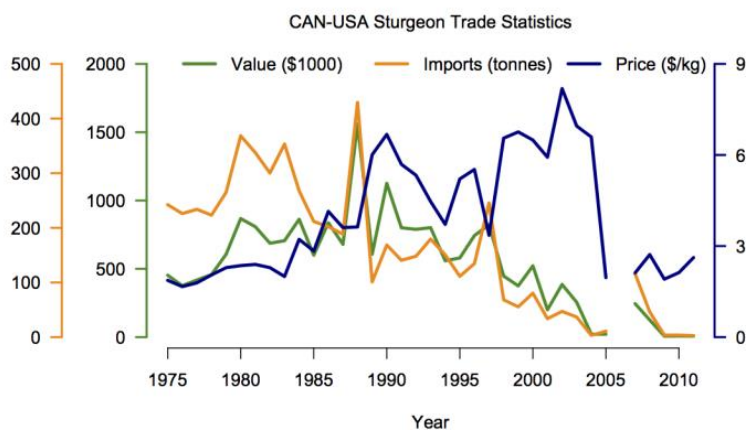
Production of Lake Sturgeon from Québec and Atlantic Sturgeon from Québec and Maritimes from 1990 to 2010. Production of Atlantic Sturgeon from the Maritimes was assumed to be 350 fish per annum at 50 kg each, following COSEWIC (2011) and DFO (2013).

Importance to the US/North American market.

The market for wild capture sturgeon fishery products, comprising both Canadian Atlantic and Lake sturgeon fishery products, is in smoked flesh and represents \$19,363,608 since 1975 in imports to the US (5736 tonnes of product). On average this has represented \$537,878 per annum but wide variation exists based on the market price and import quantity. In recent years (2008-onwards), a decreasing market share in US exports has been from smoked flesh and subsequently the export importance of fisheries for sturgeon within Canada. The

increasingly dominant market share is from caviar aquaculture facilities in Canada (NOAA NMFS FSED 2014). In the most recent year, production was close to 150 tonnes with an approximate availability on the market of 90-100 tonnes of smoked flesh and 528 kg of caviar (from the Canadian Maritimes) [estimated as 60% of the total production following, dressed weight values of the Maritimes fishery, (DFO 2013c)].

The availability of Atlantic sturgeon to the North American market is limited to Canada as it is listed in the United States as an Endangered Species but is a local product within Canada. Lake sturgeon are exported to the United States typically to Northern United States and a local product within Canada. Sturgeon, make up approximately 100-120 tonnes of product per annum. This comprises the dominant share of the market for smoked flesh with some small quantities available from recreational fisheries and caviar from aquaculture productions, though considerable amounts of caviar are imported from aquaculture facilities in Europe.



Records of exports from Canada to the United States of America from 1975 to 2011 of "Sturgeon". This encompasses both Lake and Atlantic Sturgeon from Québec and the Maritimes. The relative contribution of each fishery is unknown but is suspected to be close to the proportion of the allocated catch of each fishery of the total available for "Sturgeon" in Canada.

Common and market names.

Lake sturgeon and Atlantic sturgeon are marketed generically as sturgeon in the USA.

Primary product forms

Atlantic and Lake sturgeon are marketed in North America in two forms, smoked flesh and caviar. Lake and Atlantic sturgeon fisheries in Québec only produce smoked flesh (Mailhot et al. 2011)(Verreault & Trencia 2011) and the Maritimes fishery produces both smoked flesh and caviar (DFO 2013c), though caviar is primarily produced from aquaculture operations. Infrequently and not recently, isinglass is marketed but production from Canada has not been documented in many years.

Assessment

This section assesses the sustainability of the fishery(s) relative to the Seafood Watch Criteria for Fisheries, available at <http://www.seafoodwatch.org>.

Criterion 1: Impacts on the species under assessment

This criterion evaluates the impact of fishing mortality on the species, given its current abundance. The inherent vulnerability to fishing rating influences how abundance is scored, when abundance is unknown.

The final Criterion 1 score is determined by taking the geometric mean of the abundance and fishing mortality scores. The Criterion 1 rating is determined as follows:

- Score >3.2=Green or Low Concern
- Score >2.2 and ≤3.2=Yellow or Moderate Concern
- Score ≤2.2=Red or High Concern

Rating is Critical if Factor 1.3 (Fishing Mortality) is Critical

Criterion 1 Summary

ATLANTIC STURGEON				
Region Method	Inherent Vulnerability	Abundance	Fishing Mortality	Score
Canada/St. Lawrence River Estuary Set gillnets Canada	1.00: High	1.00: Very High Concern	2.33: Moderate Concern	Red (1.53)

LAKE STURGEON				
Region Method	Inherent Vulnerability	Abundance	Fishing Mortality	Score
Canada/St. Lawrence River Set gillnets Canada	1.00: High	1.00: Very High Concern	1.00: High Concern	Red (1.00)

Criterion 1 Assessment

SCORING GUIDELINES

Factor 1.1 - Inherent Vulnerability

- *Low*—The FishBase vulnerability score for species is 0-35, OR species exhibits life history characteristics that make it resilient to fishing, (e.g., early maturing).
- *Medium*—The FishBase vulnerability score for species is 36-55, OR species exhibits life history characteristics that make it neither particularly vulnerable nor resilient to fishing, (e.g., moderate age at sexual maturity (5-15 years), moderate maximum age (10-25 years), moderate maximum size, and middle of food chain).
- *High*—The FishBase vulnerability score for species is 56-100, OR species exhibits life history characteristics

that make is particularly vulnerable to fishing, (e.g., long-lived (>25 years), late maturing (>15 years), low reproduction rate, large body size, and top-predator). Note: The FishBase vulnerability scores is an index of the inherent vulnerability of marine fishes to fishing based on life history parameters: maximum length, age at first maturity, longevity, growth rate, natural mortality rate, fecundity, spatial behaviors (e.g., schooling, aggregating for breeding, or consistently returning to the same sites for feeding or reproduction) and geographic range.

Factor 1.2 - Abundance

- 5 (Very Low Concern)—Strong evidence exists that the population is above target abundance level (e.g., biomass at maximum sustainable yield, BMSY) or near virgin biomass.
- 4 (Low Concern)—Population may be below target abundance level, but it is considered not overfished
- 3 (Moderate Concern) —Abundance level is unknown and the species has a low or medium inherent vulnerability to fishing.
- 2 (High Concern)—Population is overfished, depleted, or a species of concern, OR abundance is unknown and the species has a high inherent vulnerability to fishing.
- 1 (Very High Concern)—Population is listed as threatened or endangered.

Factor 1.3 - Fishing Mortality

- 5 (Very Low Concern)—Highly likely that fishing mortality is below a sustainable level (e.g., below fishing mortality at maximum sustainable yield, FMSY), OR fishery does not target species and its contribution to the mortality of species is negligible ($\leq 5\%$ of a sustainable level of fishing mortality).
- 3.67 (Low Concern)—Probable (>50%) chance that fishing mortality is at or below a sustainable level, but some uncertainty exists, OR fishery does not target species and does not adversely affect species, but its contribution to mortality is not negligible, OR fishing mortality is unknown, but the population is healthy and the species has a low susceptibility to the fishery (low chance of being caught).
- 2.33 (Moderate Concern)—Fishing mortality is fluctuating around sustainable levels, OR fishing mortality is unknown and species has a moderate-high susceptibility to the fishery and, if species is depleted, reasonable management is in place.
- 1 (High Concern)—Overfishing is occurring, but management is in place to curtail overfishing, OR fishing mortality is unknown, species is depleted, and no management is in place.
- 0 (Critical)—Overfishing is known to be occurring and no reasonable management is in place to curtail overfishing.

ATLANTIC STURGEON

Factor 1.1 - Inherent Vulnerability

CANADA/ST. LAWRENCE RIVER ESTUARY, SET GILLNETS, CANADA

High

Atlantic sturgeon have a very high inherent vulnerability (the FishBase score is 85 out of 100) (Froese & Pauly 2014). Atlantic sturgeon is long-lived (40-60 years) (Stevenson & Secor 1999), late maturing (16-24 years of age in males, 27-28 years of age in females) and once mature spawn every ~3 years (males) to 4-5 years (females) (COSEWIC 2011)(DFO 2013)(DFO 2013b)(Smith 1985)(Dadswell pers. comm. 2015).

Factor 1.2 - Abundance

Very High Concern

The St. Lawrence River populations of Atlantic sturgeon are evaluated as "Threatened" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2011). The spawning locations are unknown within the St. Lawrence River (though efforts are underway [(Verreault pers. comm. 2014)]), the breeding population is small and occurs within a relatively small area and there is uncertainty over the population effects of the commercial and recreational fisheries. The St. Lawrence populations are not listed under the Species At Risk Act (SARA), but scheduled for consideration under this act. The species is listed as "Near Threatened" by the IUCN (St. Pierre 2006), and "Endangered" under the US Endangered Species Act (ESA) (NOAA NMFS FSED 2014).

From (DFO 2013b): "The abundance of Atlantic sturgeon, St. Lawrence population, has never been formally established. The current size is unknown." There is a tenuous estimate (to be used with caution) that the population contains between 500 and 1000 individuals(DFO 2013b). The absence of an analytical model prevented estimating the size of the minimum viable population (MVP) for Atlantic Sturgeon in the St. Lawrence River but based on other MVP studies was indicated an MVP of 5,000 – 6,000 adults would ensure survival of the species for 500 years. *

Stock status scores as "very high concern" because the St Lawrence river populations of Atlantic sturgeon are evaluated as threatened by COSEWIC and is listed by the IUCN as Near Threatened (St. Pierre 2006).

Justification:

*Modeling the St. Lawrence population of Atlantic sturgeon has been regarded by managers as very tenuous, below is a quote from (Verreault pers. comm. 2014):

"The exercise was very risky given the weakness of available biological parameters (M, F, Z, growth, maturity, etc.). Depending the hypothesis used, we estimated the abundance for spawners over 36 years old, between approximately 2659 and 8019 individuals. This estimate needs to be validated and a mark-recapture analysis is being performed this year [2014]."

The RPA provides a tenuous population projection that there will be between 1,597 and 7,723 spawning adults in 40 years (DFO 2013b).

Factor 1.3 - Fishing Mortality**Moderate Concern**

Current fishing mortality is unknown as the current population size is unknown (COSEWIC 2011)(DFO 2013b). Population size is depleted. This was thought to be due to historical overexploitation in late 1800's and early 1900's (Limburg & Waldman 2009) but this did not occur (Dadswell pers. comm. 2015). The current population size is due to exploitation in the late 1900's (Dadswell 2006) (Dadswell pers. comm. 2015). There is evidence that management is rebuilding the stock's age structure; larger individuals are escaping the fishery and young recruits are appearing and filling the space left by larger fish (Verreault & Trencia 2011). However, because the population size is unknown, it is impossible to determine if management is effective in curtailing overfishing.

Fishing mortality is thought to be the highest cause of mortality to the population (habitat degradation and loss of preferred habitat are also major threats), but neither fishing mortality or these other sources, have been quantified.

Fishing mortality scores as "moderate concern" because the current level of fishing mortality is supporting the current TAC and positive population structure modification is ongoing.

Justification:

Fishing mortality from the commercial sector is estimated to be the highest cause of mortality to the population but numerous other threats exist within Quebec to the stock (from (COSEWIC 2011)(DFO 2013b)):

- 1) Dredging is a primary concern of fishery managers as it has been known to disrupt spawning, displace juveniles and subadults, and destroy macrobenthos assemblages of the primary Atlantic Sturgeon prey items. (McQuinn & Nellis 2007)(Nellis et al. 2007)(Nellis et al. 2007b)
- 2) Port development is a likely high level threat to Atlantic Sturgeon habitat (DFO 2013b)
- 3) Contamination is a likely low level threat to Atlantic Sturgeon populations (DFO 2013b)
- 4) Maritime accidents are an unlikely high level threat to Atlantic Sturgeon populations (DFO 2013b)
- 5) Climate change and variations in freshwater flow are a threat of unknown consequence to Atlantic Sturgeon populations (DFO 2013b)

LAKE STURGEON

Factor 1.1 - Inherent Vulnerability

CANADA/ST. LAWRENCE RIVER, SET GILLNETS, CANADA

High

Lake sturgeon have a very high inherent vulnerability (the FishBase score is 89 out of 100) (Froese & Pauly 2014). Lake sturgeon is long-lived (up to 150 years), late-maturing (13-33 years of age) and has a long generational time (33.4 years in the upper St. Lawrence population) (Vélez-Espino & Koops 2009).

Factor 1.2 - Abundance

CANADA/ST. LAWRENCE RIVER, SET GILLNETS, CANADA

Very High Concern

Lake sturgeon were evaluated as "Threatened" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in the upper St. Lawrence Designatable Unit 8 (COSEWIC 2006), and is listed as "Least Concern" by the IUCN (St. Pierre & Runstorm 2004). This stock is not listed under the Species at Risk Act in Canada, but it is scheduled for consideration under this Act. There is no evidence to suggest that the stock is either above or below reference points as the stock's abundance is unknown (DFO 2008)(Vélez-Espino & Koops 2009). The stock is thought to be severely depleted from a century of overexploitation and has not demonstrated full recovery (Mailhot et al. 2011). However, increased numbers of juveniles have been observed throughout the St. Lawrence River and catch-per-unit-effort (CPUE) has doubled in one of the fishing sectors (Mailhot et al. 2011).

Stock status scores as "very high concern" because the Lake sturgeon populations in the Upper St. Lawrence River are evaluated as threatened by COSEWIC.

Factor 1.3 - Fishing Mortality

High Concern

Current fishing mortality is unknown as the current population size is unknown (DFO 2008). Regulations intensified in 2000, but the stock has not recovered from historical overexploitation (Mailhot et al. 2011). Due to the lack of information about this stock, it is unknown whether the management in place facilitates recovery of this depleted stock so fishing mortality scores as "high concern".

Criterion 2: Impacts on other species

All main retained and bycatch species in the fishery are evaluated in the same way as the species under assessment were evaluated in Criterion 1. Seafood Watch® defines bycatch as all fisheries-related mortality or injury to species other than the retained catch. Examples include discards, endangered or threatened species catch, and ghost fishing.

To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard rate score (ranges from 0-1), which evaluates the amount of non-retained catch (discards) and bait use relative to the retained catch. The Criterion 2 rating is determined as follows:

- Score >3.2=Green or Low Concern
- Score >2.2 and ≤3.2=Yellow or Moderate Concern
- Score ≤2.2=Red or High Concern

Rating is Critical if Factor 2.3 (Fishing Mortality) is Critical

Criterion 2 Summary

Only the lowest scoring main species is/are listed in the table and text in this Criterion 2 section; a full list and assessment of the main species can be found in Appendix A.

ATLANTIC STURGEON - CANADA/ST. LAWRENCE RIVER ESTUARY - SET GILLNETS - CANADA					
Subscore:	5.00	Discard Rate:	1.00	C2 Rate:	5.00
Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore	
No other main species caught					

LAKE STURGEON - CANADA/ST. LAWRENCE RIVER - SET GILLNETS - CANADA					
Subscore:	5.00	Discard Rate:	1.00	C2 Rate:	5.00
Species	Inherent Vulnerability	Abundance	Fishing Mortality	Subscore	
No other main species caught					

2.4 - Discards + Bait / Landings

CANADA/ST. LAWRENCE RIVER ESTUARY, SET GILLNETS, CANADA
< 20%
The 20.4cm gillnet mesh size used in this fishery minimizes bycatch of all species (<1% of the catch) except for non-landed Atlantic sturgeon {Verreault & Trecia 2011}. This mesh size reduces landings of large reproductive individuals {Mailhot et al. 2011}. Atlantic sturgeon are selected for at the fishermen's discretion below the maximum size limit (> 150cm (fork length)). Individuals released by fishermen are assumed to be released alive and constitute 56.5% of the total catch {Verreault & Trecia 2011}. The dead discards+bait/landings score for the St. Lawrence population would be 0% {Verreault & Trecia 2011}, assuming 100% post-release survival.

Bait is not used in the Atlantic Sturgeon gillnet fishery.

CANADA/ST. LAWRENCE RIVER, SET GILLNETS, CANADA

< 20%

The 20.4cm gillnet mesh size used in this fishery minimizes bycatch of all species, except for non-landed Atlantic sturgeon. This mesh size reduces landings of large reproductive individuals {Mailhot et al. 2011}. Non-selected Lake sturgeon individuals are assumed to be released alive. A discard survival rate is not available for this fishery.

Bait is not used in this gillnet fishery.

Criterion 3: Management Effectiveness

Management is separated into management of retained species (harvest strategy) and management of non-retained species (bycatch strategy).

The final score for this criterion is the geometric mean of the two scores. The Criterion 3 rating is determined as follows:

- Score >3.2=Green or Low Concern
- Score >2.2 and ≤3.2=Yellow or Moderate Concern
- Score ≤2.2 or either the Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern = Red or High Concern

Rating is Critical if either or both of Harvest Strategy (Factor 3.1) and Bycatch Management Strategy (Factor 3.2) ratings are Critical.

Criterion 3 Summary

Region / Method	Harvest Strategy	Bycatch Strategy	Score
Canada / St. Lawrence River / Set gillnets / Canada	1.00	0.00	Red (1.00)
Canada / St. Lawrence River Estuary / Set gillnets / Canada	1.00	0.00	Red (1.00)

Criterion 3 Assessment

SCORING GUIDELINES

Factor 3.1 - Harvest Strategy

Seven subfactors are evaluated: Management Strategy, Recovery of Species of Concern, Scientific Research/Monitoring, Following of Scientific Advice, Enforcement of Regulations, Management Track Record, and Inclusion of Stakeholders. Each is rated as 'ineffective,' 'moderately effective,' or 'highly effective.'

- 5 (Very Low Concern)—Rated as 'highly effective' for all seven subfactors considered
- 4 (Low Concern)—Management Strategy and Recovery of Species of Concern rated 'highly effective' and all other subfactors rated at least 'moderately effective.'
- 3 (Moderate Concern)—All subfactors rated at least 'moderately effective.'
- 2 (High Concern)—At minimum, meets standards for 'moderately effective' for Management Strategy and Recovery of Species of Concern, but at least one other subfactor rated 'ineffective.'
- 1 (Very High Concern)—Management exists, but Management Strategy and/or Recovery of Species of Concern rated 'ineffective.'
- 0 (Critical)—No management exists when there is a clear need for management (i.e., fishery catches threatened, endangered, or high concern species), OR there is a high level of Illegal, unregulated, and unreported fishing occurring.

Factor 3.1 Summary

FACTOR 3.1 - MANAGEMENT OF FISHING IMPACTS ON RETAINED SPECIES							
Region / Method	Strategy	Recovery	Research	Advice	Enforce	Track	Inclusion
Canada / St. Lawrence River / Set gillnets / Canada	Moderately Effective	Ineffective	Moderately Effective	Highly Effective	Highly Effective	Moderately Effective	Highly Effective
Canada / St. Lawrence River Estuary / Set gillnets / Canada	Moderately Effective	Ineffective	Moderately Effective	Highly Effective	Highly Effective	Moderately Effective	Highly Effective

Subfactor 3.1.1 – Management Strategy and Implementation

Considerations: What type of management measures are in place? Are there appropriate management goals, and is there evidence that management goals are being met? To achieve a highly effective rating, there must be appropriate management goals, and evidence that the measures in place have been successful at maintaining/rebuilding species.

CANADA / ST. LAWRENCE RIVER, SET GILLNETS, CANADA

Moderately Effective

The Lake Sturgeon fishery in the St. Lawrence River is highly regulated with seasonal closures, size limits, fish registration, license reductions, catch monitoring, gear restrictions, and limited market opportunities for processing. The stock is highly depleted, but there is some evidence that the stock may be improving; the population has seen increased juvenile abundance and fishery CPUE has doubled in one fishing sector (Mailhot et al. 2011). However, because there is no stock assessment, it is uncertain whether the current management strategy will allow this threatened population to recover from depletion.

Harvest management strategy scores as "moderately effective" because is unknown whether current management is sufficiently precautionary.

Justification:

Current fishing restrictions are: (COSEWIC 2006)
 Total Allowable Catch Quotas set at 80 tonnes (~12,000 fish)
 Seasonal closures (June 14 to July 31 and September 13 to October 15 the fishery is open); the fishery does not encompass the spawning period of May and early June.
 Landed fish are required to be implanted with bar-code plastic tags and declared to wholesalers
 Gear restriction (20 cm mesh size gillnet) is chosen to actively select for smaller non-reproductive individuals. This allows escapement of large reproductive fish from the fishery and to contribute back to the stock (Mailhot et al. 2011).

CANADA / ST. LAWRENCE RIVER ESTUARY, SET GILLNETS, CANADA

Moderately Effective

The Atlantic Sturgeon fishery in the St. Lawrence River is highly regulated with seasonal closures, size limits, fish registration, license reductions, catch monitoring, gear restrictions, and limited market opportunities for processing. There is evidence the population is stable enough to support the current TAC as 34.1% of recruitment cohorts are escaping the fishery (Verreault & Trencia 2011), but due to the lack of stock

assessment, it is unknown if the current management strategy is allowing for the recovery of this depleted stock.

Harvest management strategy scores as "moderately effective" because the fishery is highly regulated, the population is stable at the current TAC and there is evidence that management is sufficiently precautionary. It was not scored as "highly effective" as the long-term recovery is uncertain due to the uncertainties in the stock's abundance.

Justification:

Gear restrictions (limited to 20.4 cm mesh size) (DFO 2013b), chosen to select for small non-reproductive individuals allowing escapement of large individuals to contribute back to the stock.

Harvestable quota is set annually at 60 mt (approximately 2000-4000 fish (Verreault & Trecia 2011)(Verreault pers. comm. 2014)

Size limit of < 150 cm in legal length, chosen to select for small non-reproductive individuals

Seasonal closures, May 1 to September 30 is open, except upstream of Québec City, where it is closed July 1 to August 15 (DFO 2013b)(Verreault pers. comm. 2014) to decrease mortality during summer months where water temperature may be > 20°C.

Tag enforcement, every fish retained is implanted with a non-destructable tag and reported weekly to an independent service along with the fish's length (Verreault pers. comm. 2014)

Fishermen are active stakeholders and two fishermen are employed by the Ministère des Forêts, de la Faune e des Parcs as index fishermen, catching 44% (by quantity) of annual landings since 2002. (Verreault & Trecia 2011)

Fishermen actively "choose" fish to retain (Verreault & Trecia 2011), resulting in 56.5% of the Atlantic Sturgeon caught in the fishery discarded alive.

Subfactor 3.1.2 – Recovery of Species of Concern

Considerations: When needed, are recovery strategies/management measures in place to rebuild overfished/threatened/ endangered species or to limit fishery's impact on these species and what is their likelihood of success? To achieve a rating of Highly Effective, rebuilding strategies that have a high likelihood of success in an appropriate timeframe must be in place when needed, as well as measures to minimize mortality for any overfished/threatened/endangered species.

CANADA / ST. LAWRENCE RIVER, SET GILLNETS, CANADA

Ineffective

Due to the lack of a stock assessment for this threatened population, it is uncertain whether recovery is occurring in the St. Lawrence River lake sturgeon population. There is evidence that management has reduced the population's decline; effort has stabilized, catch rates have doubled since the mid-2000s for one sector, and fishing regulations have limited the catch to 40% (80 tonnes) of pre-2002 levels (200 tonnes) (Mailhot et al. 2011). A recovery target was set of 1188 spawning females per year for all 12 Lake Sturgeon Designatable Units in Canada. In the St. Lawrence River, it is estimated that the population will reach the recovery target within 1-3 generations (Randall 2008)(Vélez-Espino & Koops 2009), but there is no recovery plan in place for this population. These estimates are uncertain due to underlying uncertainty in the fishing mortality rate on this stock.

Recovery of stocks of concern scores as "ineffective" because there is no recovery strategy in place and it is uncertain whether the the current management strategy will result in recovery of this threatened stock.

Ineffective

There is some evidence that after 16 years of active management and population monitoring, the Atlantic sturgeon population in the St. Lawrence river is on a trajectory towards recovery: 34.1% of recruitment cohorts are escaping the fishery (the fishery targets sub-adult fish)(Verreault & Trencia 2011) and annual adult abundances (based on the number of fish reaching age 19) projected 40 years into the future range from 1,597 to 7,723 individuals, an increase over the current but highly tenuous estimate of 500-1000 adults (DFO 2013b). Although this evidence exists, whether the population will recover and in what time frame this will occur, is highly uncertain; actual abundance is unknown and no stock assessment exists for this population. Due to the lack of accurate abundance information, it is not possible to determine a long term recovery trajectory necessary to create a formal recovery strategy (DFO 2013b).

The Recovery Potential Assessment (RPA) suggests a Minimum Viable Population (MVP) of between 5000-6000 Atlantic sturgeon to ensure the survival of this population for 500 years (DFO 2013b). Based on the 40 year projection, it is unclear whether this population will achieve the MVP in this time frame. The RPA suggests a reduction in fishing mortality (via a reduction in TAC) to decrease recovery time, but it is unclear whether managers have implemented this suggested reduction.

Lack of knowledge of precise spawning locations and juvenile feeding locations adds further uncertainty to the recovery of the St. Lawrence Atlantic sturgeon population due to habitat degradation and loss associated with dredging and other human activities which may occur in preferred Atlantic sturgeon habitats (DFO 2013b).

Recovery scores as "ineffective" because the evidence for recovery is tenuous and there no stock assessment by which to judge the extent of recovery.

Subfactor 3.1.3 – Scientific Research and Monitoring

Considerations: How much and what types of data are collected to evaluate the health of the population and the fishery's impact on the species? To achieve a Highly Effective rating, population assessments must be conducted regularly and they must be robust enough to reliably determine the population status.

Moderately Effective

A partnership of fishers, government agencies, and universities gather data on: (COSEWIC 2006)(DFO 2008) (Mailhot et al. 2011)

- 1) Genetics from some landed fish (Ferguson & Duckworth 1997)(McDermid et al. 2011)
- 2) Length and weight on captured fish
- 3) Sonar and trawl surveys of the distribution in relation to dredging spoils (Hatin et al. 2007b)(McQuinn & Nellis 2007)(Nellis et al. 2007)
- 4) Ageing of some landed fish
- 5) Daily monitoring of fishing effort and CPUE indices are in development
- 6) Monitoring of spawning sites and spawning aggregations in select areas (Dumont et al. 2011)(Johnson et al 2006)
- 7) Recruitment monitoring began in 1991 using experimental multi-mesh nets (LaHaye et al. 1992)(Nilo et al. 1997)
- 8) Juvenile and subadult monitoring (in numbers and mass) have been conducted 1995 (Fortin et al. 1993)

An independent robust stock assessment has not been completed due to the lack of abundance information.

CANADA / ST. LAWRENCE RIVER ESTUARY, SET GILLNETS, CANADA

Moderately Effective

A partnership of fishers, government agencies, and universities gather data on: (COSEWIC 2011)(DFO 2013b)

1) Genetics of all landed fish (Grunwald et al. 2008)(Wirgin et al. 2012)

2) Length, weight, age, and sex of both fishery-dependent and fishery-independent surveys (Caron & Tremblay 1999)(Caron et al. 2002)

3) Mark and recapture (PIT and t-bar tags) of some released fish (Caron et al. 2002)

4) Acoustic tracking of select individuals (Caron et al. 2002)

5) Index fishermen are selected to record fishing effort with CPUE recorded annually (Caron et al. 2002) (Verreault & Trenchia 2011)(Verreault pers. comm. 2014)

6) Fate and length of caught fish are recorded by index fishermen (Verreault & Trenchia 2011)

7) Every landed fish is registered and tagged recording data of capture, fishing zone, and legal length (Verreault & Trenchia 2011)(Verreault pers. comm. 2014)

8) Assessment of dredging activities on distribution and food availability (Hatin et al. 2007)(Hatin et al. 2007b) (McQuinn & Nellis 2007)(Nellis et al. 2007)(Nellis et al. 2007b)

An independent robust stock assessment has not been completed due to the lack of stock information (DFO 2013b)(Verreault pers. comm. 2014).

Subfactor 3.1.4 – Management Record of Following Scientific Advice

Considerations: How often (always, sometimes, rarely) do managers of the fishery follow scientific recommendations/advice (e.g. do they set catch limits at recommended levels)? A Highly Effective rating is given if managers nearly always follow scientific advice.

CANADA / ST. LAWRENCE RIVER, SET GILLNETS, CANADA

Highly Effective

Management set ineffective TAC quotas in 1987, with the declared catch increasing to over 250 tonnes. As a result of scientific evidence for stock declines, management instituted a quota reduction starting in 2000 to a TAC of 80 tonnes in 2002 and reduced the fishing season's length by two months (Mailhot et al. 2011). Due to evidence of poaching (COSEWIC 2006), fishermen were required to tag each sturgeon after landing the fish (Mailhot et al. 2011). In 2001, due to evidence of systematically choosing larger fish, management responded by implementing bar-code plastic tags and bar-coded declaration coupons to declare the weight of each fish landed (Mailhot et al. 2011).

CANADA / ST. LAWRENCE RIVER ESTUARY, SET GILLNETS, CANADA

Highly Effective

Management in the St. Lawrence Atlantic Sturgeon fishery followed a conservative approach starting in 1994 to counterbalance the lack of knowledge of population dynamics. Scientific review of historical records set the TAC to 60 tonnes and divided the harvest quota between the two fishing areas (Trenchia et al. 2002). Size limits were set and reduced to 150 cm (fork length) in 1996 to protect the reproductive individuals in the population. A quota was placed on the number of fish to incentivize the release of small fish based on fisher and gear selectivity as well as on life history characteristics (Trenchia et al. 2002). This quota is adjusted yearly

based on scientific monitoring of the stock through tagging and registration of landings to keep the TAC below 60 tonnes (Verreault & Trencia 2011).

Subfactor 3.1.5 – Enforcement of Management Regulations

Considerations: Do fishermen comply with regulations, and how is this monitored? To achieve a Highly Effective rating, there must be regular enforcement of regulations and verification of compliance.

CANADA / ST. LAWRENCE RIVER, SET GILLNETS, CANADA

Highly Effective

The Ministère des Forêts, de la Faune e des Parcs strongly enforces regulations in this fishery via heavy monitoring of TAC, gear restrictions, and seasonal closures (COSEWIC 2006)(DFO 2008). All fish landed are tagged with bar-code plastic tags, effectively tracking the TAC (Mailhot et al. 2011).

CANADA / ST. LAWRENCE RIVER ESTUARY, SET GILLNETS, CANADA

Highly Effective

The Ministère des Forêts, de la Faune e des Parcs strongly enforces regulations in this fishery via heavy monitoring of of TAC, gear restrictions, and seasonal closures. The processing market is limited and adds a layer of additional monitoring, reducing illegal take (Verreault & Trencia 2011)(Verreault pers. comm. 2014). TAC is monitored via individual fish registration and the reporting of weights of fish landed (Trencia et al. 2002).

Subfactor 3.1.6 – Management Track Record

Considerations: Does management have a history of successfully maintaining populations at sustainable levels or a history of failing to maintain populations at sustainable levels? A Highly Effective rating is given if measures enacted by management have been shown to result in the long-term maintenance of species overtime.

CANADA / ST. LAWRENCE RIVER, SET GILLNETS, CANADA

Moderately Effective

Prior to 2000, management had a poor track record on responding quickly to stock declines, which resulted in very low stock sizes. After 2000, management instituted rigorous catch and effort restrictions to aid in sturgeon recovery. Management's track record has since been very responsive with intensive fishery-independent monitoring of annual recruitment, juvenile and subadult relative abundance, and spawning aggregations. Fishermen are required to use bar-code plastic tags and managers utilize this information to track changes in fishery effort and landings (Mailhot et al. 2011).

Track record scores as "moderately effective" because measures enacted by management have not been in place long enough to know whether they will result in the recovery of this highly vulnerable stock.

CANADA / ST. LAWRENCE RIVER ESTUARY, SET GILLNETS, CANADA

Moderately Effective

Prior to 1996, there was a poor track record of responding quickly to stock declines (the fishery was non-regulated), resulting in very low stock sizes. Since 1996, management instituted rigorous restrictions and a

conservation strategy. This strategy includes: annual monitoring of the sturgeon population and the fishery, measuring key population dynamics parameters and regulations to conserve and protect the fishery resource (Verreault & Trencia 2011). These regulations have evolved into seasonal closures, size limits, spatial limits, annual monitoring programs, registration of all landings, and gear restrictions (DFO 2013b) (Verreault & Trencia 2011)(Verreault pers. comm. 2014).

Track record scores as "moderately effective" because although the size and age structure are improving, it is unknown whether the management in place has yet to recover the stock to appropriate levels (we cannot say that appropriate levels have been achieved if there is no stock assessment and there is high uncertainty over the abundance of this stock).

Subfactor 3.1.7 – Stakeholder Inclusion

Considerations: Are stakeholders involved/included in the decision-making process? Stakeholders are individuals/groups/organizations that have an interest in the fishery or that may be affected by the management of the fishery (e.g., fishermen, conservation groups, etc.). A Highly Effective rating is given if the management process is transparent and includes stakeholder input.

CANADA / ST. LAWRENCE RIVER, SET GILLNETS, CANADA

Highly Effective

DFO and Ministère des Forêts, de la Faune e des Parcs has provisions in their management strategy for consultation during Recovery Potential Assessments (DFO 2004). The process has guidelines for transparency and stakeholders to actively engage with managers to contribute to the implementation and design of management (DFO 2004)(DFO 2008)(Mailhot et al. 2011).

CANADA / ST. LAWRENCE RIVER ESTUARY, SET GILLNETS, CANADA

Highly Effective

DFO and Ministère des Forêts, de la Faune e des Parcs has provisions in their management strategy for consultation (DFO 2004). The process has guidelines for transparency and stakeholders actively engage with managers to contribute to the implementation and design of management (DFO 2004)(DFO 2013b)(Verreault pers. comm. 2014). Fishers were involved in the decision-making process annually to find suitable restrictions and compliance in response to management objectives (Verreault & Trencia 2011)(Verreault pers. comm. 2014).

Factor 3.2 - Bycatch Strategy

SCORING GUIDELINES

Four subfactors are evaluated: Management Strategy and Implementation, Scientific Research and Monitoring, Record of Following Scientific Advice, and Enforcement of Regulations. Each is rated as 'ineffective,' 'moderately effective,' or 'highly effective.' Unless reason exists to rate Scientific Research and Monitoring, Record of Following Scientific Advice, and Enforcement of Regulations differently, these rating are the same as in 3.1.

- 5 (Very Low Concern)—Rated as 'highly effective' for all four subfactors considered
- 4 (Low Concern)—Management Strategy rated 'highly effective' and all other subfactors rated at least 'moderately effective.'

- 3 (Moderate Concern)—All subfactors rated at least 'moderately effective.'
- 2 (High Concern)—At minimum, meets standards for 'moderately effective' for Management Strategy but some other factors rated 'ineffective.'
- 1 (Very High Concern)—Management exists, but Management Strategy rated 'ineffective.'
- 0 (Critical)—No bycatch management even when overfished, depleted, endangered or threatened species are known to be regular components of bycatch and are substantially impacted by the fishery

FACTOR 3.2 - BYCATCH STRATEGY					
Region / Method	All Kept	Critical	Strategy	Research	Advice Enforce
Canada / St. Lawrence River / Set gillnets / Canada	Yes	All Species Retained			
Canada / St. Lawrence River Estuary / Set gillnets / Canada	Yes	All Species Retained			

Subfactor 3.2.3 – Scientific Research and Monitoring

Considerations: Is bycatch in the fishery recorded/documented and is there adequate monitoring of bycatch to measure fishery's impact on bycatch species? To achieve a Highly Effective rating, assessments must be conducted to determine the impact of the fishery on species of concern, and an adequate bycatch data collection program must be in place to ensure bycatch management goals are being met

Subfactor 3.2.4 – Management Record of Following Scientific Advice

Considerations: How often (always, sometimes, rarely) do managers of the fishery follow scientific recommendations/advice (e.g., do they set catch limits at recommended levels)? A Highly Effective rating is given if managers nearly always follow scientific advice.

Subfactor 3.2.5 – Enforcement of Management Regulations

Considerations: Is there a monitoring/enforcement system in place to ensure fishermen follow management regulations and what is the level of fishermen's compliance with regulations? To achieve a Highly Effective rating, there must be consistent enforcement of regulations and verification of compliance.

Criterion 4: Impacts on the habitat and ecosystem

This Criterion assesses the impact of the fishery on seafloor habitats, and increases that base score if there are measures in place to mitigate any impacts. The fishery's overall impact on the ecosystem and food web and the use of ecosystem-based fisheries management (EBFM) principles is also evaluated. Ecosystem Based Fisheries Management aims to consider the interconnections among species and all natural and human stressors on the environment.

The final score is the geometric mean of the impact of fishing gear on habitat score (plus the mitigation of gear impacts score) and the Ecosystem Based Fishery Management score. The Criterion 2 rating is determined as follows:

- *Score >3.2=Green or Low Concern*
- *Score >2.2 and ≤3.2=Yellow or Moderate Concern*
- *Score ≤2.2=Red or High Concern*

Rating cannot be Critical for Criterion 4.

Criterion 4 Summary

Region / Method	Gear Type and Substrate	Mitigation of Gear Impacts	EBFM	Score
Canada / St. Lawrence River / Set gillnets / Canada	3.00: Low Concern	1.00: Strong Mitigation	3.00: Moderate Concern	Green (3.46)
Canada / St. Lawrence River Estuary / Set gillnets / Canada	3.00: Low Concern	1.00: Strong Mitigation	3.00: Moderate Concern	Green (3.46)

Criterion 4 Assessment

SCORING GUIDELINES

Factor 4.1 - Impact of Fishing Gear on the Habitat/Substrate

- *5 (None) - Fishing gear does not contact the bottom*
- *4 (Very Low) - Vertical line gear*
- *3 (Low)—Gears that contacts the bottom, but is not dragged along the bottom (e.g. gillnet, bottom longline, trap) and is not fished on sensitive habitats. Bottom seine on resilient mud/sand habitats. Midwater trawl that is known to contact bottom occasionally (*
- *2 (Moderate)—Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Bottom seine except on mud/sand*
- *1 (High)—Hydraulic clam dredge. Dredge or trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)*
- *0 (Very High)—Dredge or trawl fished on biogenic habitat, (e.g., deep-sea corals, eelgrass and maerl)*
Note: When multiple habitat types are commonly encountered, and/or the habitat classification is uncertain, the score will be based on the most sensitive, plausible habitat type.

Factor 4.2 - Mitigation of Gear Impacts

- *+1 (Strong Mitigation)—Examples include large proportion of habitat protected from fishing (>50%) with gear, fishing intensity low/limited, gear specifically modified to reduce damage to seafloor and modifications*

shown to be effective at reducing damage, or an effective combination of 'moderate' mitigation measures.

- *+0.5 (Moderate Mitigation)—20% of habitat protected from fishing with gear or other measures in place to limit fishing effort, fishing intensity, and spatial footprint of damage caused from fishing.*
- *+0.25 (Low Mitigation)—A few measures are in place (e.g., vulnerable habitats protected but other habitats not protected); there are some limits on fishing effort/intensity, but not actively being reduced*
- *0 (No Mitigation)—No effective measures are in place to limit gear impacts on habitats*

Factor 4.3 - Ecosystem-Based Fisheries Management

- *5 (Very Low Concern)—Substantial efforts have been made to protect species' ecological roles and ensure fishing practices do not have negative ecological effects (e.g., large proportion of fishery area is protected with marine reserves, and abundance is maintained at sufficient levels to provide food to predators)*
- *4 (Low Concern)—Studies are underway to assess the ecological role of species and measures are in place to protect the ecological role of any species that plays an exceptionally large role in the ecosystem. Measures are in place to minimize potentially negative ecological effect if hatchery supplementation or fish aggregating devices (FADs) are used.*
- *3 (Moderate Concern)—Fishery does not catch species that play an exceptionally large role in the ecosystem, or if it does, studies are underway to determine how to protect the ecological role of these species, OR negative ecological effects from hatchery supplementation or FADs are possible and management is not in place to mitigate these impacts*
- *2 (High Concern)—Fishery catches species that play an exceptionally large role in the ecosystem and no efforts are being made to incorporate their ecological role into management.*
- *1 (Very High Concern)—Use of hatchery supplementation or fish aggregating devices (FADs) in the fishery is having serious negative ecological or genetic consequences, OR fishery has resulted in trophic cascades or other detrimental impacts to the food web.*

Factor 4.1 - Impact of Fishing Gear on the Habitat/Substrate

CANADA / ST. LAWRENCE RIVER, SET GILLNETS, CANADA

Low Concern

The large mesh bottom gillnets used in this fishery have low impacts on benthic substrates; the gillnet is fished over sand, mud, and a mix of gravel (DFO 2008)(Fortin et al. 1993)(Hatin et al. 2007b)(Mailhot et al. 2011), warranting a score of "low concern".

CANADA / ST. LAWRENCE RIVER ESTUARY, SET GILLNETS, CANADA

Low Concern

The large mesh bottom gillnets used in this fishery have low impacts on benthic substrates; the gillnet is fished over sand, mud, and a mix of gravel of mixed sizes (Caron et al. 2002)(Hatin et al. 2007)(Hatin et al. 2007b)(McQuinn & Nellis 2007)(Trencia et al. 2002)(Verreault & Trencia 2011), warranting a score of "low concern".

Factor 4.2 - Mitigation of Gear Impacts

CANADA / ST. LAWRENCE RIVER, SET GILLNETS, CANADA

Strong Mitigation

Fishing effort is highly restricted in spatial footprint, temporal extent, and intensity (COSEWIC 2006)(DFO

2008)(Mailhot et al. 2011)(Randall 2008). See Criterion 1 for all restrictions on fishing mortality. Because it is likely that at least 50% of the representative habitat is protected from the gear used in this fishery, mitigation of gear impacts scores as "strong".

CANADA / ST. LAWRENCE RIVER ESTUARY, SET GILLNETS, CANADA

Strong Mitigation

Fishing effort is highly restricted in spatial extent (limited to two key areas), temporal extent, and intensity through TAC quotas and gear restrictions (Caron et al. 2002)(Trencia et al. 2002)(Verreault & Trencia 2011) (Verreault pers. comm. 2014). See Criterion 1 for full description on regulations of fishing mortality. Because it is likely that at least 50% of the representative habitat is protected from the gear used in this fishery, mitigation of gear impacts scores as "strong".

Factor 4.3 - Ecosystem-Based Fisheries Management

CANADA / ST. LAWRENCE RIVER, SET GILLNETS, CANADA

Moderate Concern

Lake sturgeon is not considered to be an "exceptional species"; this species occupies a low trophic position within the food web (3.3 score, consumers of benthic invertebrates (Froese & Pauly 2014)) and does not represent a substantial link to upper trophic levels (low levels of natural mortality). EBFM scores as "moderate concern" because the fishery does not catch "exceptional species" and scientific assessment and management of ecosystem impacts are not yet underway.

CANADA / ST. LAWRENCE RIVER ESTUARY, SET GILLNETS, CANADA

Moderate Concern

Atlantic sturgeon is not considered to be an "exceptional species"; this species occupies a low trophic position within the food web (3.4 score, consumers of benthic invertebrates (Froese & Pauly 2014)) and does not represent a substantial link to upper trophic levels (low levels of natural mortality). EBFM scores as "moderate concern" because the fishery does not catch "exceptional species" and scientific assessment and management of ecosystem impacts are not yet underway.

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Appendix A: Review Schedule

The next COSEWIC review will be in 2016 on Lake Sturgeon and in 2021 on Atlantic Sturgeon (COSEWIC reviews occur every 10 years).

Public consultations regarding the addition of the Atlantic sturgeon population in the St. Lawrence River (as well as the Maritimes population) to the List of Wildlife Species at Risk under SARA were held from November 17, 2014 to February 27, 2015.

Annual analysis of stock status is expected to continue in the Atlantic Sturgeon fisheries.