



# Monterey Bay Aquarium Seafood Watch

## **Atlantic and Lake sturgeon**

*Acipenser oxyrinchus*, *Acipenser fulvescens*



### **Canada: Inland Waters**

### **Gillnets and entangling nets (unspecified)**

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Seafood Watch Standard used in this assessment: Fisheries Standard v4

#### **Disclaimer**

All Seafood Watch fishery assessments are reviewed for accuracy by external experts in ecology, fisheries science, and aquaculture. Scientific review does not constitute an endorsement of the Seafood Watch program or its ratings on the part of the reviewing scientists. Seafood Watch is solely responsible for the conclusions reached in this assessment.

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## **About Seafood Watch**

Monterey Bay Aquarium's Seafood Watch program evaluates the environmental sustainability of wild-caught and farmed seafood commonly found in the United States marketplace. Seafood Watch defines sustainable seafood as originating from sources, whether wild-caught or farmed, which can maintain or increase production in the long-term without jeopardizing the structure or function of affected ecosystems. The program's goals are to raise awareness of important ocean conservation issues and empower seafood consumers and businesses to make choices for healthy oceans.

Seafood Watch's science-based ratings are available at [www.SeafoodWatch.org](http://www.SeafoodWatch.org). Each rating is supported by a Seafood Watch assessment, in which the fishery or aquaculture operation is evaluated using the Seafood Watch standard.

Seafood Watch standards are built on our guiding principles, which outline the necessary environmental sustainability elements for fisheries and aquaculture operations. The guiding principles differ across standards, reflecting the different impacts of fisheries and aquaculture.

- Seafood rated Best Choice comes from sources that operate in a manner that's consistent with our guiding principles. The seafood is caught or farmed in ways that cause little or no harm to other wildlife or the environment.
- Seafood rated Good Alternative comes from sources that align with most of our guiding principles. However, one issue needs substantial improvement, or there's significant uncertainty about the impacts on wildlife or the environment.
- Seafood rated Avoid comes from sources that don't align with our guiding principles. The seafood is caught or farmed in ways that have a high risk of causing harm to wildlife or the environment. There's a critical conservation concern or many issues need substantial improvement.

Each assessment follows an eight-step process, which prioritizes rigor, impartiality, transparency and accessibility. They are conducted by Seafood Watch scientists, in collaboration with scientific, government, industry and conservation experts and are open for public comment prior to publication. Conditions in wild capture fisheries and aquaculture operations can change over time; as such assessments and ratings are updated regularly to reflect current practice.

More information on Seafood Watch guiding principles, standards, assessments and ratings are available at [www.SeafoodWatch.org](http://www.SeafoodWatch.org).

## **Guiding Principles**

Seafood Watch defines sustainable seafood as originating from sources, whether fished<sup>1</sup> or farmed, that can maintain or increase production in the long term without jeopardizing the structure or function of affected ecosystems.

The following guiding principles illustrate the qualities that fisheries must possess to be considered sustainable by the Seafood Watch program (these are explained further in the Seafood Watch Standard for Fisheries):

- Follow the principles of ecosystem-based fisheries management.
- Ensure all affected stocks are healthy and abundant.
- Fish all affected stocks at sustainable levels.
- Minimize bycatch.
- Have no more than a negligible impact on any threatened, endangered, or protected species.
- Managed to sustain the long-term productivity of all affected species.
- Avoid negative impacts on the structure, function, or associated biota of aquatic habitats where fishing occurs.
- Maintain the trophic role of all aquatic life.
- Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts.
- Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks.

These guiding principles are operationalized in the four criteria in this standard. Each criterion includes:

- Factors to evaluate and score
- Guidelines for integrating these factors to produce a numerical score and rating

Once a rating has been assigned to each criterion, Seafood Watch develops an overall recommendation. Criteria ratings and the overall recommendation are color coded to correspond to the categories on the Seafood Watch pocket guides and online guide:

**Best Choice/Green:** Buy first; they're well managed and caught or farmed responsibly.

**Good Alternative/Yellow:** Buy, but be aware there are concerns with how they're caught, farmed or managed.

**Avoid/Red:** Take a pass on these for now; they're caught or farmed in ways that harm other marine life or the environment.

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<sup>1</sup> "Fish" is used throughout this document to refer to finfish, shellfish and other invertebrates

## **Summary**

This report provides recommendations for fisheries for Atlantic sturgeon and lake sturgeon in the St. Lawrence River, Québec, Canada. Both sturgeon species are large bodied, slow growing, and late maturing, and are particularly susceptible to overexploitation.

Lake sturgeon in Canadian territory ranges from the Saskatchewan Rivers in Alberta to the St. Lawrence River and Estuary in the east. The lake sturgeon populations in Canada declined abruptly, although some information indicates that some populations are rebounding. But, because of the limited amount of information and lake sturgeon's classification as "Threatened" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), the stock status was scored a high concern. Similarly, Atlantic sturgeon in the St. Lawrence River and Estuary is considered "Threatened" by COSEWIC and a high concern in this recommendation. Considering their ecology, both sturgeon species are extremely susceptible to overexploitation. They have been the subject of intense regulations in 1998, 1999, and 2002 across the various fisheries, as a consequence of intense exploitation. The large gillnet size and restriction to riverine habitats greatly eliminate the chance of by-catch, and the only by-catch are the undersized or oversized individuals of the targeted species. It has been largely assumed that discarded individuals have quite high survival rates and thus do not add appreciable impacts to fishery practices.

The management regulations in place include gear restrictions, season closures (and short fishing seasons), total allowable catch quotas, and enforcement actions that focus on number, sizes, and catch registration. The effectiveness of these regulations is generally unknown, although some research shows signs of effectiveness, such as increases in CPUE and juvenile abundance in some areas. The combination of authorized gear, fishing technique, and substrates encountered (sand and mud benthic substrate) seems to have limited impacts on the habitat. But, other activities have been identified that have negative affects on sturgeon species, such as dams or dredging activities that cause habitat destruction or modification.

Overall, even though both species are considered threatened, strong management is in place and some signs show that these measures are effective. Considering that impacts on habitat and the ecosystem remain low, this report scored the products from the Canadian sturgeon commercial fishery as a Good Alternative.

## **Final Seafood Recommendations**

| SPECIES   FISHERY                                                                                         | CRITERION 1<br>TARGET<br>SPECIES | CRITERION 2<br>OTHER<br>SPECIES | CRITERION 3<br>MANAGEMENT | CRITERION 4<br>HABITAT | OVERALL<br>RECOMMENDATION           |
|-----------------------------------------------------------------------------------------------------------|----------------------------------|---------------------------------|---------------------------|------------------------|-------------------------------------|
| Atlantic sturgeon   Saint Lawrence River Estuary   America, North - Inland Waters   Set gillnets   Canada | 1.732                            | 5.000                           | 3.000                     | 4.000                  | <b>Good Alternative<br/>(3.193)</b> |
| Lake sturgeon   Saint Lawrence River   America, North - Inland Waters   Set gillnets   Canada             | 1.732                            | 5.000                           | 3.000                     | 4.000                  | <b>Good Alternative<br/>(3.193)</b> |

### **Summary**

Atlantic sturgeon and lake sturgeon caught in Canada using bottom gillnets are rated a Good Alternative. The main factors in the rating are the uncertainties over the assessment of the stocks' statuses, and that it is unclear if the recovery strategy is effective, even though management measures are in place.

## Scoring Guide

Scores range from zero to five where zero indicates very poor performance and five indicates the fishing operations have no significant impact.

Final Score = geometric mean of the four Scores (Criterion 1, Criterion 2, Criterion 3, Criterion 4).

**Best Choice/Green** = Final Score  $>3.2$ , and no Red Criteria, and no Critical scores

**Good Alternative/Yellow** = Final score  $>2.2$ - $3.2$ , and neither Harvest Strategy (Factor 3.1) nor Bycatch Management Strategy (Factor 3.2) are Very High Concern<sup>2</sup>, and no more than one Red Criterion, and no Critical scores

**Avoid/Red** = Final Score  $\leq 2.2$ , or either Harvest Strategy (Factor 3.1) or Bycatch Management Strategy (Factor 3.2) is Very High Concern or two or more Red Criteria, or one or more Critical scores.

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<sup>2</sup> Because effective management is an essential component of sustainable fisheries, Seafood Watch issues an Avoid recommendation for any fishery scored as a Very High Concern for either factor under Management (Criterion 3).

# **Introduction**

## **Scope of the analysis and ensuing recommendation**

This recommendation focuses on two sturgeon species in Canada: Atlantic sturgeon (*Acipenser oxyrinchus*) and lake sturgeon (*Acipenser fulvescens*) that are captured within a commercial fishery in the St. Lawrence River, particularly the lower St. Lawrence River that stretches approximately 350 km from Lac St. Louis to the St. Lawrence Estuary downstream of Québec City {Mailhot Y., Dumont P., Vachon N. 2011}. The commercial fishery has operated for decades {Dumont P., D'Amours J., Thibodeau S., Dubuc N., Verdon R., Garceau S., Bilodeau P., Mailhot Y., Fortin R 2011} {Mailhot Y., Dumont P., Vachon N. 2011}. Because of signs of overexploitation, a management plan was developed and implemented to control the fishing effort, protect spawning adults, and strengthen enforcement {Mailhot Y., Dumont P., Vachon N. 2011}. The gear type is 19–20.3 cm bottom gillnet; commercial fishers that use bottom gillnets to target the species must follow gear restrictions, season closures, limits on size, and a total allowable catch (TAC). Lake sturgeon is caught commercially only in the Upper St. Lawrence River in Québec. Lake sturgeon distribution overlaps with Atlantic sturgeon distribution in some sections of the St. Lawrence River.

## **Species Overview**

Lake sturgeon is a potamodromous, fluvial-dependent species from the family Acipenseridae. Its distribution extends from the Great Lakes to the Mississippi River and the Hudson Bay drainages. The populations along its distribution suffered mass declines from extensive overexploitation and habitat loss and alteration. Reproduction spawning occurs during spring when eggs are broadcast into the water column; those that are fertilized develop a sticky exterior and adhere to the substrate. The age at maturity ranges from 12 to 20 years for males and 15 to 30 years for females. Dispersal movement patterns of lake sturgeon are driven by the physical separation of habitats needed to complete its life processes.

Atlantic sturgeon is a large-bodied, slow-growing, and late-maturing anadromous fish that lives and grows in brackish salty water, but spawns in fresh water. The largest Atlantic sturgeon captured in the St. Lawrence River, at 160 kg (350 lb), was estimated to be about 60 years old (COSEWIC 2011). Males reach sexual maturity between ages 16 and 26, and females at age 27 or 28. Tagging and telemetry studies conducted in the St. Lawrence Estuary concluded that a large number of Atlantic sturgeon occur in small localized sites, which makes them vulnerable to fishing and to any intervention (e.g., filling or dredging) in these local habitats {Paradis, Y., Pépino, M., Bernatchez, S., Fournier, D., L'Italien, L. and J. Doucet-Caron 2021}.

## **Production Statistics**

The commercial Canadian fishery is developed in two regions: the St. Lawrence River and the St. John River fishery (>3,000 and 350 fish, respectively) (COSEWIC 2011) (Verreault G., Trenchia G. 2011). According to the available data on the Fisheries and Oceans Canada (DFO) website, landings for “sturgeon” are only reported in Québec Province and range from 116 tons in 2015 to 124 tons in 2019 (L'Italien, L., Doucet-Caron, J., Bernatchez, S. and Y. Paradis 2021).

| Year | Landings (t)  |                   |
|------|---------------|-------------------|
|      | Lake Sturgeon | Atlantic Sturgeon |
| 2015 | 74            | 42                |
| 2016 | 83            | 43                |
| 2017 | 83            | 40                |
| 2018 | 72            | 45                |
| 2019 | 78            | 45                |

### **Importance to the US/North American market.**

The commercial interest in the United States and Canada for sturgeon is mostly for its meat as smoked flesh. According to the data from NOAA foreign trade data, from 2016 to 2019, sturgeon products have been imported from Canada in different presentations and variable amounts. In 2016, a little more than 1,000 kg of roe (cured) were reported. In 2017, more than 6,000 kg were imported as frozen and fresh presentations. Similarly, in 2019, more than 4,000 kg of frozen sturgeon were imported but the amount was reduced to 684 kg in 2019 (NOAA 2021). Aquaculture practices have been in place for several years in the region, mostly focused on producing caviar for export to Europe.

### **Common and market names.**

Other common names for lake sturgeon are rock sturgeon, common sturgeon, rubberrnose, and esturgeon jaune (in French).

Atlantic sturgeon is also known as American Atlantic sturgeon (in the UK) and esturgeon noir (in French) (Froese R. Pauly D 2021).

### **Primary product forms**

Both lake and Atlantic sturgeon are marketed in North America in two forms: smoked flesh and caviar. In Canada, there is no caviar fishery in Québec because mature females are protected; however, caviar can be retained if a mature female is landed that is within the landing size limits.

## Assessment

This section assesses the sustainability of the fishery(s) relative to the Seafood Watch Standard for Fisheries, available at [www.seafoodwatch.org](http://www.seafoodwatch.org). The specific standard used is referenced on the title page of all Seafood Watch assessments.

### Criterion 1: Impacts on the species under assessment

*This criterion evaluates the impact of fishing mortality on the species, given its current abundance. When abundance is unknown, abundance is scored based on the species' inherent vulnerability, which is calculated using a Productivity-Susceptibility Analysis. 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.*

#### Guiding principles

- *Ensure all affected stocks are healthy and abundant.*
- *Fish all affected stocks at sustainable level*

## Criterion 1 Summary

| ATLANTIC STURGEON                                                                     |                     |                         |             |
|---------------------------------------------------------------------------------------|---------------------|-------------------------|-------------|
| REGION / METHOD                                                                       | ABUNDANCE           | FISHING MORTALITY       | SCORE       |
| Saint Lawrence River Estuary   America, North - Inland Waters   Set gillnets   Canada | 1.000: High Concern | 3.000: Moderate Concern | Red (1.732) |

| LAKE STURGEON                                                                 |                     |                         |             |
|-------------------------------------------------------------------------------|---------------------|-------------------------|-------------|
| REGION / METHOD                                                               | ABUNDANCE           | FISHING MORTALITY       | SCORE       |
| Saint Lawrence River   America, North - Inland Waters   Set gillnets   Canada | 1.000: High Concern | 3.000: Moderate Concern | Red (1.732) |

## Criterion 1 Assessments

### SCORING GUIDELINES

Factor 1.1 - Abundance

Goal: Stock abundance and size structure of native species is maintained at a level that does not impair recruitment or productivity.

- *5 (Very Low Concern) — Strong evidence exists that the population is above an appropriate target abundance level (given the species' ecological role), or near virgin biomass.*
- *3.67 (Low Concern) — Population may be below target abundance level, but is at least 75% of the target level, OR data-limited assessments suggest population is healthy and species is not highly vulnerable.*
- *2.33 (Moderate Concern) — Population is not overfished but may be below 75% of the target abundance level, OR abundance is unknown and the species is not highly vulnerable.*
- *1 (High Concern) — Population is considered overfished/depleted, a species of concern, threatened or endangered, OR abundance is unknown and species is highly vulnerable.*

#### Factor 1.2 - Fishing Mortality

Goal: Fishing mortality is appropriate for current state of the stock.

- *5 (Low Concern) — Probable (>50%) that fishing mortality from all sources is at or below a sustainable level, given the species ecological role, OR fishery does not target species and fishing mortality is low enough to not adversely affect its population.*
- *3 (Moderate Concern) — Fishing mortality is fluctuating around sustainable levels, OR fishing mortality relative to a sustainable level is uncertain.*
- *1 (High Concern) — Probable that fishing mortality from all source is above a sustainable level.*

## **Atlantic sturgeon**

### **Factor 1.1 - Abundance**

#### **Saint Lawrence River Estuary | America, North - Inland Waters | Set gillnets | Canada**

##### **High Concern**

The most recent assessment of Atlantic sturgeon (*Acipenser oxyrinchus*) in the St. Lawrence River by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) was developed in 2011 and concluded that the population was threatened (COSEWIC 2011). Also, the Québec provincial government considers the St. Lawrence River population as susceptible under the act concerning threatened or vulnerable species (Loi sur les espèces menacées ou vulnérables du Québec [LEMV]). The criteria used by COSEWIC to include the species within the threatened category are reserved for "[a] Canadian population with a very restricted index of area of occupancy (typically  $<20 \text{ km}^2$ ) or number of locations (typically  $\leq 5$ ) such that it is prone to the effects of human activities or stochastic events within a very short time period (1–2 generations) in an uncertain future, and is thus capable of becoming extinct, extirpated or critically endangered in a very short period of time" (Category D2 of the COSEWIC wildlife species assessment: quantitative criteria and guidelines).

The 2011 COSEWIC report stated that, due to the lack of detailed fisheries' data, population estimates and trends in abundance are "limited to nonexistent" in Canada (COSEWIC 2011). Even though breeding populations are known in the St. Lawrence River, these are small and breed within a small range (which is the reason for their threatened designation). In addition, no older population estimates exist before the St. Lawrence work, so only commercial landing information is available to determine population trends.

An up-to-date report on the status of Atlantic sturgeon in Canada is in preparation by COSEWIC. This report will contain the results of many new studies and information on Atlantic sturgeon in the St. Lawrence River (pers. comm., Bernatche & Paradis, DEFA 2021). Because the stock has been considered "Threatened" by COSEWIC since 2011 and no more recent information has been publicly released, stock status scores a high concern.

### **Factor 1.2 - Fishing Mortality**

#### **Saint Lawrence River Estuary | America, North - Inland Waters | Set gillnets | Canada**

##### **Moderate Concern**

According to the available information, fishing mortality has been identified as the biggest cause of mortality for the Atlantic sturgeon population, with an unregulated fishery in place for decades since the 1960s (Verreault G., Trencia G. 2011). In addition, habitat degradation and the loss of

preferred habitat have been recognized as threats. A quota system was set for the species in 2011 {CSAS 2016} and it has been strictly controlled by authorities since then. Verreault and Trenchia analyzed some evidence and determined that regulations were working (Verreault G., Trenchia G. 2011). COSEWIC is currently working on an update of the Assessment and Status Report on Atlantic sturgeon in Canada, but recent information about fishing mortality was unavailable.

Because the current level of fishing mortality is supporting the current total allowable catch (TAC), and positive population structure modification is ongoing, fishing mortality scores a moderate concern.

## **Lake sturgeon**

### **Factor 1.1 - Abundance**

#### **Saint Lawrence River | America, North - Inland Waters | Set gillnets | Canada**

##### **High Concern**

Lake sturgeon was considered a single unit and designated "Not at Risk" in April 1986 (COSEWIC 2017), but in 2005, the species was split into separate units. Subsequently, the "Great Lakes–Upper St. Lawrence population," labeled as unit 4 (DU4), was designated "Threatened" in November 2006 by COSEWIC, and this was confirmed in April 2017 (COSEWIC 2017). Similarly to that for Atlantic sturgeon, this designation was a suggestion by COSEWIC, but lake sturgeon is currently not listed under the Species at Risk Act (SARA).

Within DU4, several populations can be found; in the COSEWIC assessment, managers reported that the lake sturgeon population was believed to comprise >100,000 individuals and was increasing (COSEWIC 2017), which differs from other DU4 populations. In relation to this, in 2011, Mailhot, Dumont, and Vachon reported an increase in the number of juveniles observed throughout the St. Lawrence River, as well as an increase in the catch per unit effort (CPUE) information (Mailhot Y., Dumont P., Vachon N. 2011).

Although evidence exists that suggests an improvement in the species' abundance (Mailhot Y., Dumont P., Vachon N. 2011), more recent data were unavailable to be considered at the time of this assessment. Because of the 2017 COSEWIC "Threatened" designation and the susceptible status according to the Québec act concerning threatened or vulnerable species (Loi sur les espèces menacées ou vulnérables du Québec [LEMV]), this factor is scored a high concern.

### **Factor 1.2 - Fishing Mortality**

#### **Saint Lawrence River | America, North - Inland Waters | Set gillnets | Canada**

##### **Moderate Concern**

In the past, the St. Lawrence River lake sturgeon fishery declared annual catches of 150 tonnes, and the fishery was considered overexploited. Since then, a strong management plan was implemented in 2000 that reduced the commercial catch by 60%, and a set of regulations were put in place that included stronger fishing measures, such as a brief fishing season (Bruch, R.M., Haxton, T.J., Koenings, R., Welsh, A., Kerr, S.J. 2016). Dumont et al. supported maintaining the commercial fishery because of the low total allowable catch (TAC) quota (80 tonnes), the effective control systems in place, and the increase in levels of abundance of juvenile lake sturgeon {Dumont P., D'Amours J., Thibodeau S., Dubuc N., Verdon R., Garceau S., Bilodeau P., Mailhot Y., Fortin R. 2011}.

Because harvest has been reduced, a quota is strictly monitored, and there are some signs of recovery of the population, but fishing mortality relative to a sustainable level is unknown, this factor is scored a moderate concern.

## **Criterion 2: Impacts on Other Species**

*All main retained and bycatch species in the fishery are evaluated under Criterion 2. 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. Species are evaluated using the same guidelines as in Criterion 1. When information on other species caught in the fishery is unavailable, the fishery's potential impacts on other species is scored according to the Unknown Bycatch Matrices, which are based on a synthesis of peer-reviewed literature and expert opinion on the bycatch impacts of each gear type. The fishery is also scored for the amount of non-retained catch (discards) and bait use relative to the retained catch. To determine the final Criterion 2 score, the score for the lowest scoring retained/bycatch species is multiplied by the discard/bait 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 is Critical if Factor 2.3 (Fishing Mortality) is Critical*

### **Guiding principles**

- *Ensure all affected stocks are healthy and abundant.*
- *Fish all affected stocks at sustainable level.*
- *Minimize bycatch.*

## Criterion 2 Summary

### Criterion 2 score(s) overview

This table(s) provides an overview of the Criterion 2 subscore, discards+bait modifier, and final Criterion 2 score for each fishery. A separate table is provided for each species/stock that we want an overall rating for.

| ATLANTIC STURGEON                                                                     |           |                       |               |
|---------------------------------------------------------------------------------------|-----------|-----------------------|---------------|
| REGION / METHOD                                                                       | SUB SCORE | DISCARD RATE/LANDINGS | SCORE         |
| Saint Lawrence River Estuary   America, North - Inland Waters   Set gillnets   Canada | 5.000     | 1.000: < 100%         | Green (5.000) |

| LAKE STURGEON                                                                 |           |                       |               |
|-------------------------------------------------------------------------------|-----------|-----------------------|---------------|
| REGION / METHOD                                                               | SUB SCORE | DISCARD RATE/LANDINGS | SCORE         |
| Saint Lawrence River   America, North - Inland Waters   Set gillnets   Canada | 5.000     | 1.000: < 100%         | Green (5.000) |

### Criterion 2 main assessed species/stocks table(s)

This table(s) provides a list of all species/stocks included in this assessment for each 'fishery' (as defined by a region/method combination). The text following this table(s) provides an explanation of the reasons the listed species were selected for inclusion in the assessment.

| SAINT LAWRENCE RIVER   AMERICA, NORTH - INLAND WATERS   SET GILLNETS   CANADA |                     |                         |              |
|-------------------------------------------------------------------------------|---------------------|-------------------------|--------------|
| SUB SCORE: 5.000                                                              |                     | DISCARD RATE: 1.000     | SCORE: 5.000 |
| SPECIES                                                                       | ABUNDANCE           | FISHING MORTALITY       | SCORE        |
| Lake sturgeon                                                                 | 1.000: High Concern | 3.000: Moderate Concern | Red (1.732)  |

| SAINT LAWRENCE RIVER ESTUARY   AMERICA, NORTH - INLAND WATERS   SET GILLNETS   CANADA |                     |                         |              |
|---------------------------------------------------------------------------------------|---------------------|-------------------------|--------------|
| SUB SCORE: 5.000                                                                      |                     | DISCARD RATE: 1.000     | SCORE: 5.000 |
| SPECIES                                                                               | ABUNDANCE           | FISHING MORTALITY       | SCORE        |
| Atlantic sturgeon                                                                     | 1.000: High Concern | 3.000: Moderate Concern | Red (1.732)  |

The commercial sturgeon fisheries in Canada are considered highly selective. The gillnet mesh size used in the fishery, combined with restricting the fishery to riverine habitats, greatly eliminate the chance of by-catch, and the only affected species are the undersized or oversized individuals of the target species. It has largely been assumed that discarded individuals have quite high survival rates and thus do not add appreciable impacts to fishery practices; however, more evidence is needed. In 2020, Mullen et al. studied the effects of recreational catch-and-release (C&R) fisheries targeting lake sturgeon {Mullen, E., Schoen, A., Hauger, M., Murray, L., and Anderson, G. 2020}. The authors evaluated the physiological

and behavioral impairment of lake sturgeon after C&R angling, and reported physiological stress response but observed a recovery in acid-base balance, ion balance, and reflex impairment within 24 hours. The authors concluded there was an apparent resilience of lake sturgeon to C&R by anglers {Mullen, E., Schoen, A., Hauger, M., Murray, L., and Anderson, G. 2020}. But, more details about the commercial fishing impacts are needed to inform the management strategies.

## Criterion 2 Assessment

### SCORING GUIDELINES

Factor 2.1 - Abundance

*(same as Factor 1.1 above)*

Factor 2.2 - Fishing Mortality

*(same as Factor 1.2 above)*

Factor 2.3 - Modifying Factor: Discards and Bait Use

Goal: Fishery optimizes the utilization of marine and freshwater resources by minimizing post-harvest loss. For fisheries that use bait, bait is used efficiently.

*Scoring Guidelines: The discard rate is the sum of all dead discards (i.e. non-retained catch) plus bait use divided by the total retained catch.*

| Ratio of bait + discards/landings Factor 2.3 score |      |
|----------------------------------------------------|------|
| <100%                                              | 1    |
| >=100                                              | 0.75 |

### Factor 2.3 - Discard Rate/Landings

**Saint Lawrence River Estuary | America, North - Inland Waters | Set gillnets | Canada**  
**Saint Lawrence River | America, North - Inland Waters | Set gillnets | Canada**

#### **< 100%**

The commercial sturgeon fishery uses gillnets with a 19 to 20.3 cm mesh size, which significantly reduces the catch of species other than sturgeon {L'Italien, L., Doucet-Caron, J., Bernatchez, S. & Y. Paradis 2021}. In addition, these nets have proved to target large reproductive individuals (Mailhot Y., Dumont P., Vachon N. 2011). Non-selected lake sturgeon individuals are assumed to be released alive, because limits are strict, but the survival rate is unavailable for this fishery. Finally, because bait is not used in this fishery, the discard rate/landings is believed to be <100%.

### Criterion 3: Management Effectiveness

Five factors are evaluated in Criterion 3: Management Strategy and Implementation, Bycatch Strategy, Scientific Research/Monitoring, Enforcement of Regulations, and Inclusion of Stakeholders. Each is scored as either 'highly effective', 'moderately effective', 'ineffective,' or 'critical'. The final Criterion 3 score is determined as follows:

- 5 (Very Low Concern) — Meets the standards of 'highly effective' for all five factors considered.
- 4 (Low Concern) — Meets the standards of 'highly effective' for 'management strategy and implementation' and at least 'moderately effective' for all other factors.
- 3 (Moderate Concern) — Meets the standards for at least 'moderately effective' for all five factors.
- 2 (High Concern) — At a minimum, meets standards for 'moderately effective' for Management Strategy and Implementation and Bycatch Strategy, but at least one other factor is rated 'ineffective.'
- 1 (Very High Concern) — Management Strategy and Implementation and/or Bycatch Management are 'ineffective.'
- 0 (Critical) — Management Strategy and Implementation is 'critical'.

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 = Red or High Concern**

Rating is Critical if Management Strategy and Implementation is Critical.

#### Guiding principle

- The fishery is managed to sustain the long-term productivity of all impacted species.

Five factors are evaluated in Criterion 3: Management Strategy and Implementation, Bycatch Strategy, Scientific Research/Monitoring, Enforcement of Regulations, and Inclusion of Stakeholders. Each is scored as either 'highly effective', 'moderately effective', 'ineffective,' or 'critical'. The final Criterion 3 score is determined as follows:

### Criterion 3 Summary

| FISHERY                                                                       | MANAGEMENT STRATEGY  | BYCATCH STRATEGY | DATA COLLECTION AND ANALYSIS | ENFORCEMENT      | INCLUSION        | SCORE                 |
|-------------------------------------------------------------------------------|----------------------|------------------|------------------------------|------------------|------------------|-----------------------|
| Saint Lawrence River   America, North - Inland Waters   Set gillnets   Canada | Moderately Effective | Highly effective | Moderately Effective         | Highly effective | Highly effective | <b>Yellow (3.000)</b> |

|                                                                                       |                      |                  |                      |                  |                  |                       |
|---------------------------------------------------------------------------------------|----------------------|------------------|----------------------|------------------|------------------|-----------------------|
| Saint Lawrence River Estuary   America, North - Inland Waters   Set gillnets   Canada | Moderately Effective | Highly effective | Moderately Effective | Highly effective | Highly effective | <b>Yellow (3.000)</b> |
|---------------------------------------------------------------------------------------|----------------------|------------------|----------------------|------------------|------------------|-----------------------|

## Criterion 3 Assessment

### SCORING GUIDELINES

#### Factor 3.1 - 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? Do managers follow scientific advice? To achieve a highly effective rating, there must be appropriately defined management goals, precautionary policies that are based on scientific advice, and evidence that the measures in place have been successful at maintaining/rebuilding species.*

#### Factor 3.2 - Bycatch Strategy

*Considerations: What type of management strategy/measures are in place to reduce the impacts of the fishery on bycatch species and when applicable, to minimize ghost fishing? How successful are these management measures? To achieve a Highly Effective rating, the fishery must have no or low bycatch, or if there are bycatch or ghost fishing concerns, there must be effective measures in place to minimize impacts.*

#### Factor 3.3 - Scientific Research and Monitoring

*Considerations: How much and what types of data are collected to evaluate the fishery's impact on the species? Is there adequate monitoring of bycatch? To achieve a Highly Effective rating, regular, robust population assessments must be conducted for target or retained species, and an adequate bycatch data collection program must be in place to ensure bycatch management goals are met.*

#### Factor 3.4 - 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.*

#### Factor 3.5 - 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, if high participation by all stakeholders is encouraged, and if there is a mechanism to effectively address user conflicts.*

### Factor 3.1 - Management Strategy And Implementation

**Saint Lawrence River | America, North - Inland Waters | Set gillnets | Canada**

### **Moderately Effective**

The lake sturgeon fishery in the St. Lawrence River has several management measures in place, including seasonal closures (limited to two annual 2-month periods), size limits (between 80 cm and 130 cm inclusive), fish registration, license reductions, catch monitoring, gear restrictions, and limited market opportunities for processing. Although the stock is far below historic levels, there is evidence of improvement. According to Mailhot, Dumont, and Vachon, signs of improvement in the stock were shown, juvenile abundance increased, and the fishery CPUE doubled in one fishing sector (Mailhot Y., Dumont P., Vachon N. 2011). Overall, the measures in place seem to be appropriate and conservation targets appear adequate. But, the species' "Threatened" status was confirmed by COSEWIC in 2017 (COSEWIC 2017), although the species has not been included under the Species at Risk Act (SARA). There is still uncertainty about the level of recovery occurring in the lake sturgeon St. Lawrence River population. It is estimated that the population will reach the recovery target within one to three generations (COSEWIC 2017), although a recovery plan for this population was not found.

The "Great Lakes–Upper St. Lawrence populations" DU4 includes the Great Lakes, where the status of lake sturgeon populations is completely different from those in the lower St. Lawrence River, where the commercial fishery operates. The Great Lakes and the lower St. Lawrence River are separated by several dams, and there is virtually no exchange between these populations (pers. comm., Simon Bernatchez 2021). Only the lower St. Lawrence populations, which are considered the most abundant lake sturgeon populations, are exploited as part of the commercial fishery.

Finally, similar to Atlantic sturgeon, limitations exist for estimating the lake sturgeon population status, because of underlying uncertainty in the fishing mortality rate of the stock. Although lake sturgeon is considered a species of concern, best management practices that are believed to be effective are in place to minimize mortality of "stocks of concern," so this factor is scored moderately effective.

## **Saint Lawrence River Estuary | America, North - Inland Waters | Set gillnets | Canada**

### **Moderately Effective**

According to the 2011 COSEWIC report, the commercial fishery for Atlantic sturgeon in the St. Lawrence River DU has been restricted to a catch between 4,400 and 4,800 fish/year (about 60 t) since 1997 (COSEWIC 2011)(Verreault G., Trencia G. 2011). Among the regulations in place, there is a maximum size limit of 150 cm fork length (FL) to protect the large, mature fish in the population (Verreault G., Trencia G. 2011). In addition, Québec Province has set the fishing season from May 1 to October 15 except for waters where the temperature becomes too high in summer, which are closed between July 1 and August 15 to prevent sturgeon mortality in the nets. In the two zones downstream, where water temperature is not a factor, the fishing season runs from May 15 to August 15 (L'Italien, L., Doucet-Caron, J., Bernatchez, S. and Y. Paradis 2021). Regulations limit mesh size at 19 to 20.3 cm stretched (L'Italien, L., Doucet-Caron, J., Bernatchez, S. & Y. Paradis 2021)(COSEWIC 2011), and strict management measures are in place that are expected to be effective. But, based on the most recent recovery potential assessment for the Atlantic sturgeon

St. Lawrence population (released in 2013), the authors recognized that the abundance of this population has never been formally established.

In addition, the population size that would ensure the species' survival for 500 years (the minimum viable population [MVP]) was estimated (through different studies) to be between 5,000 and 6,000 Atlantic sturgeon adults. This has not been confirmed because of the level of uncertainties related to demographic parameters of the species {DFO 2013}, so there is a need for increased precaution based on these uncertainties. But, because best management practices to minimize mortality of "stocks of concern" are implemented and are believed to be effective, and managers are currently working on modeling to determine the dynamics of the Atlantic sturgeon population and evaluate the need for new management regulations (pers. comm., Simon Bernatchez 2021), this factor is scored moderately effective.

### **Factor 3.2 - Bycatch Strategy**

**Saint Lawrence River Estuary | America, North - Inland Waters | Set gillnets | Canada**  
**Saint Lawrence River | America, North - Inland Waters | Set gillnets | Canada**

#### **Highly effective**

Because the only recorded species is the target species and a management strategy is in place, there is no need for a by-catch strategy. This factor is scored highly effective.

### **Factor 3.3 - Scientific Data Collection and Analysis**

**Saint Lawrence River Estuary | America, North - Inland Waters | Set gillnets | Canada**  
**Saint Lawrence River | America, North - Inland Waters | Set gillnets | Canada**

#### **Moderately Effective**

Atlantic sturgeon is considered a threatened species partly because of the limited monitoring that is in place, which has capped the managers' ability to be certain about the species' status (COSEWIC 2011). In the past, a partnership of fishers, government agencies, and universities enabled the gathering of data on several subjects, such as genetics, length, weight, mark and recapture, acoustic tracking, and the assessment of dredging activities on distribution and food availability. Managers are currently working on a modeling, to determine the dynamics of the Atlantic sturgeon population and evaluate the need for new management regulations. In addition, the Ministère des Forêts, de la Faune et des Parcs (MFFP), in partnership with Atlantic sturgeon fishers, is conducting a complementary survey each year, which measures and records all sturgeon (for the complete fishing season) that are caught in the nets, kept, or released. These data allow the MFFP to obtain

information (i.e., released fish) that is not part of the landings data. This information is quite valuable and allows managers to evaluate the trends in different segments of the population, such as juveniles that are usually released and adults (over 150 cm FL). Managers are currently working to update the federal status (COSEWIC) (COSEWIC 2011) but the timeframe is uncertain. Currently, management relies on the implementation of a strategy that requires only minimal monitoring (e.g., short closures, total allowable catch, and size limits) and there is no high risk of ghost fishing. Therefore, this factor is scored moderately effective.

#### **Factor 3.4 - Enforcement of and Compliance with Management Regulations**

**Saint Lawrence River Estuary | America, North - Inland Waters | Set gillnets | Canada**  
**Saint Lawrence River | America, North - Inland Waters | Set gillnets | Canada**

##### **Highly effective**

The Ministry of Forests, Wildlife and Parks (Ministère des Forêts, de la Faune e des Parcs) is the agency in charge of enforcing the commercial fishery regulations, in particular those related to the total allowable catch (TAC), as well as the gear restrictions and seasonal closures. These actions have helped stabilize the landings and increase the abundance of the species (Verreault G., Trencia G. 2011). In addition, inspections related to the appropriate permits/licenses are regularly enforced and measures in place seem appropriate to the fishery, considering the limited area and the short timeframe. For these reasons, this factor is scored highly effective.

#### **Factor 3.5 - Stakeholder Inclusion**

**Saint Lawrence River | America, North - Inland Waters | Set gillnets | Canada**

##### **Highly effective**

The DFO and the Ministère des Forêts, de la Faune e des Parcs have provisions within the management strategy for consultation during Recovery Potential Assessments (DFO 2004). The process includes guidelines for transparency and for stakeholders to actively engage with managers to contribute to the implementation and design of management (Mailhot Y., Dumont P., Vachon N. 2011). Therefore, this factor is scored highly effective.

**Saint Lawrence River Estuary | America, North - Inland Waters | Set gillnets | Canada**

##### **Highly effective**

According to Verreault and Trencia, during the implementation of regulations for the Atlantic

sturgeon fishery, fishers were involved in the decision-making process (Verreault G., Trenchia G. 2011). Also, the most recent update to the Canadian Fisheries Act (2019) included that, “when making a decision under this Act, the Minister may consider, among other things, Indigenous knowledge of the Indigenous peoples of Canada that has been provided to the Minister as well as community knowledge and cooperation with any government of a province, any Indigenous governing body and anybody—including a co-management body—established under a land claims agreement” (Fisheries Act 2019). Finally, the system in place encourages participation in management, and decisions are made in a transparent process. Therefore, this factor is scored highly effective.

## 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 (factor 4.1 + factor 4.2) and the Ecosystem Based Fishery Management score. The Criterion 4 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**

### Guiding principles

- Avoid negative impacts on the structure, function or associated biota of marine habitats where fishing occurs.
- Maintain the trophic role of all aquatic life.
- Do not result in harmful ecological changes such as reduction of dependent predator populations, trophic cascades, or phase shifts.
- Ensure that any enhancement activities and fishing activities on enhanced stocks do not negatively affect the diversity, abundance, productivity, or genetic integrity of wild stocks.
- Follow the principles of ecosystem-based fisheries management.

*Rating cannot be Critical for Criterion 4.*

## Criterion 4 Summary

| FISHERY                                                                                     | FISHING GEAR<br>ON THE<br>SUBSTRATE | MITIGATION<br>OF GEAR<br>IMPACTS | ECOSYSTEM-<br>BASED<br>FISHERIES MGMT | FORAGE<br>SPECIES? | SCORE                    |
|---------------------------------------------------------------------------------------------|-------------------------------------|----------------------------------|---------------------------------------|--------------------|--------------------------|
| Saint Lawrence River   America, North<br>- Inland Waters   Set gillnets   Canada            | 3                                   | +1                               | Low Concern                           |                    | <b>Green<br/>(4.000)</b> |
| Saint Lawrence River Estuary  <br>America, North - Inland Waters   Set<br>gillnets   Canada | 3                                   | +1                               | Low Concern                           |                    | <b>Green<br/>(4.000)</b> |

### Criterion 4 Assessment

#### SCORING GUIDELINES

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

Goal: The fishery does not adversely impact the physical structure of the ocean habitat, seafloor or associated biological communities.

- *5 - Fishing gear does not contact the bottom*

- 4 - Vertical line gear
  - 3 - 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. Or bottom seine on resilient mud/sand habitats. Or midwater trawl that is known to contact bottom occasionally. Or purse seine known to commonly contact the bottom.
  - 2 - Bottom dragging gears (dredge, trawl) fished on resilient mud/sand habitats. Or gillnet, trap, or bottom longline fished on sensitive boulder or coral reef habitat. Or bottom seine except on mud/sand. Or there is known trampling of coral reef habitat.
  - 1 - Hydraulic clam dredge. Or dredge or trawl gear fished on moderately sensitive habitats (e.g., cobble or boulder)
  - 0 - 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 - Modifying Factor: Mitigation of Gear Impacts

Goal: Damage to the seafloor is mitigated through protection of sensitive or vulnerable seafloor habitats, and limits on the spatial footprint of fishing on fishing effort.

- +1 —>50% of the habitat is protected from fishing with the gear type. Or fishing intensity is very low/limited and for trawled fisheries, expansion of fishery's footprint is prohibited. Or gear is specifically modified to reduce damage to seafloor and modifications have been shown to be effective at reducing damage. Or there is an effective combination of 'moderate' mitigation measures.
- +0.5 —At least 20% of all representative habitats are protected from fishing with the gear type and for trawl fisheries, expansion of the fishery's footprint is prohibited. Or gear modification measures or other measures are in place to limit fishing effort, fishing intensity, and spatial footprint of damage caused from fishing that are expected to be effective.
- 0 —No effective measures are in place to limit gear impacts on habitats or not applicable because gear used is benign and received a score of 5 in factor 4.1

#### Factor 4.3 - Ecosystem-Based Fisheries Management

Goal: All stocks are maintained at levels that allow them to fulfill their ecological role and to maintain a functioning ecosystem and food web. Fishing activities should not seriously reduce ecosystem services provided by any retained species or result in harmful changes such as trophic cascades, phase shifts or reduction of genetic diversity. Even non-native species should be considered with respect to ecosystem impacts. If a fishery is managed in order to eradicate a non-native, the potential impacts of that strategy on native species in the ecosystem should be considered and rated below.

- 5 — Policies that have been shown to be effective are in place to protect species' ecological roles and ecosystem functioning (e.g. catch limits that ensure species' abundance is maintained at sufficient levels to provide food to predators) and effective spatial management is used to protect spawning and foraging areas, and prevent localized depletion. Or it has been scientifically demonstrated that fishing practices do not have negative ecological effects.
- 4 — Policies are in place to protect species' ecological roles and ecosystem functioning but have

*not proven to be effective and at least some spatial management is used.*

- *3 — Policies are not in place to protect species' ecological roles and ecosystem functioning but detrimental food web impacts are not likely or policies in place may not be sufficient to protect species' ecological roles and ecosystem functioning.*
- *2 — Policies are not in place to protect species' ecological roles and ecosystem functioning and the likelihood of detrimental food impacts are likely (e.g. trophic cascades, alternate stable states, etc.), but conclusive scientific evidence is not available for this fishery.*
- *1 — Scientifically demonstrated trophic cascades, alternate stable states or other detrimental food web impact are resulting from this fishery.*

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

**Saint Lawrence River Estuary | America, North - Inland Waters | Set gillnets | Canada**  
**Saint Lawrence River | America, North - Inland Waters | Set gillnets | Canada**

**3**

The commercial fishery operates with bottom gillnets that have limited impacts on the substrate. In addition, the fishery operates on either sand, mud, and/or gravel bottoms {Caron F., Hatin D., Fortin R. 2002}{Hatin D., Lachance S., Fournier D. 2007}{Verreault G., Trenchia G. 2011}. Per the Seafood Watch standard, and the combination of gear and habitat encountered by the fishery, this factor is scored 3.

#### **Factor 4.2 - Modifying Factor: Mitigation of Gear Impacts**

**Saint Lawrence River Estuary | America, North - Inland Waters | Set gillnets | Canada**  
**Saint Lawrence River | America, North - Inland Waters | Set gillnets | Canada**

**+1**

Controls on fishing effort are strict and limited to two important fishing areas. In addition, there are limits on the fishing season and on intensity through the implementation of total allowable catch (TAC) quotas {Caron F., Hatin D., Fortin R. 2002}{Trenchia G., Verreault G., Georges S., Pettigrew P. 2002}{Verreault G., Trenchia G. 2011}. Because these measures allow at least 50% of the representative habitat to be protected from the gear type used, a score of +1 is assigned to the fishery.

#### **Factor 4.3 - Ecosystem-based Fisheries Management**

**Saint Lawrence River Estuary | America, North - Inland Waters | Set gillnets | Canada**  
**Saint Lawrence River | America, North - Inland Waters | Set gillnets | Canada**

**Low Concern**

Neither Atlantic sturgeon nor lake sturgeon is considered an “exceptional species” of the ecosystems. Both have a low trophic position within the food web (3.4 score; consumers of benthic invertebrates {Froese & Pauly 2014}) and do not represent a substantial link to upper trophic levels (low levels of natural mortality). Temporal closures are in place for both species. For Atlantic sturgeon, the season runs May 1–October 15, except in waters where the temperature becomes too high in summer, which are closed July 1–August 15 to prevent mortality of sturgeon in the nets. In the two zones downstream, where the water temperature is not a problem, the season runs May 15–August 15. For lake sturgeon, the season runs May 14–October 15, with a closure July 1–August 15 to prevent mortality of sturgeon in the nets (L’Italien, L., Doucet-Caron, J., Bernatchez, S. and Y. Paradis 2021). There are no spatial closures in place, although several spawning sites have been identified and closures are meant to protect spawning periods. In addition, areas of ecological importance have been identified.

For Atlantic sturgeon, the recovery potential assessment reported that at least six areas of adult concentration were identified, including four in the river estuary, and three or four areas in the river estuary were identified as potential spawning grounds {DFO 2013}. Similarly, important habitats for the breeding and feeding of juveniles were identified, as well as two main areas with high concentrations of juveniles.

For lake sturgeon, in 2018, Barth et al. reported that the abundance of subadult and adult lake sturgeon are high and stable, with significant recruitment occurring annually (Barth, C., Burnett, D., McDougall, C. and Nelson, P. 2018). The authors also reported that the number of known spawning sites has increased over the years. According to Valiquette, at least four spawning grounds are used by more than 1,000 spawners annually (Valiquette E. 2016). Data also have shown that abundance of juveniles and sub-adults is increasing, as well as the frequency of occurrence at different sampling locations (Barth, C., Burnett, D., McDougall, C. and Nelson, P. 2018). Finally, these authors reported that commercial fishers who target Atlantic sturgeon in the St. Lawrence Estuary have reported a higher abundance of lake sturgeon in their catch in recent years.

Considering the management in place, it is likely that the number of targeted and retained sturgeons allows for maintaining ecosystem function and that the temporal management protects those ecosystem interactions; also, increases in abundance have been reported for both species. Therefore, this factor is scored a low concern.

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