Proposed

Species at Risk Act
Management Plan Series

Management Plan for the Shortnose Sturgeon (*Acipenser brevirostrum*) in Canada

Shortnose Sturgeon

2015

Canada

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Preface

Under the *Species at Risk Act* (S.C. 2002, c.29) (SARA), the federal competent ministers are responsible for the preparation of Management Plans for listed species of Special Concern and are required to report on progress within five years. The federal, provincial, and territorial government signatories under the Accord for the Protection of Species at Risk (1996) agreed to establish complementary legislation and programs that provide for effective protection of species at risk throughout Canada.

The Minister of Fisheries and Oceans is the competent minister under SARA for the Shortnose Sturgeon and has prepared this Management Plan as per section 65 of SARA. It has been prepared in cooperation with: government departments, First Nations, Aboriginal organizations, academia and industry as per subsection 66(1) of SARA (Appendix B).

Success in the management of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this plan and will not be achieved by Fisheries and Oceans Canada, or any other jurisdiction alone. All Canadians are invited to join in supporting and implementing this Management Plan for the benefit of the Shortnose Sturgeon and Canadian society as a whole.

Implementation of this plan is subject to appropriations, priorities, and budgetary constraints of the participating jurisdictions and organizations.

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Acknowledgments

Fisheries and Oceans Canada (DFO) would like to acknowledge the many individuals who provided information and advice early in the document development process. In particular, DFO wishes to acknowledge the valuable input provided by those who participated in the Shortnose Sturgeon Management Plan Workshop and subsequently reviewed the draft plan, as well as the broader interested public who participated in the consultation process (Appendix B).

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Executive Summary

Shortnose Sturgeon (*Acipenser brevirostrum*) is an aquatic species listed as Special Concern under the *Species at Risk Act* (SARA). This listing triggers the requirement for a management plan, which aims to identify the measures needed to ensure the species does not become further at risk. The general prohibitions of SARA do not apply to species of Special Concern, and there is no requirement to identify or protect critical habitat.

Populations of Shortnose Sturgeon are found in large rivers along the entire east coast of North America. The only known population of Shortnose Sturgeon in Canada is in the Saint John River, in southwest New Brunswick, which flows into the Bay of Fundy. This Canadian population is the most northerly of the species and is genetically different from other populations in the United States.

The species in Canada holds historical, Aboriginal, commercial, and ecological significance and currently two aquaculture operators raise and produce Saint John River Shortnose Sturgeon products in land-based facilities. Sturgeons also have a special role in biodiversity. They represent a 100 million year lineage of a long-lived bottom dwelling fish that consume prey living in the sediment, and have limited breeding and feeding ranges which makes them an important indicator of habitat quality.

The Saint John River population of Shortnose Sturgeon is considered amphidromous, that is fish which generally remain in its natal river and estuary. The population in the Saint John River is limited to the lower river below the Mactaquac Dam and its tributaries. Two important habitat areas are acknowledged in this Management Plan: a spawning area located below the Mactaquac Dam and an overwintering area near the confluence of two of the river's large tributaries, the Hammond and Kennebecasis Rivers.

Threats of highest concern to the Canadian population of Shortnose Sturgeon include bycatch in commercial fisheries (particularly in set gillnets), and habitat availability and suitability (flow rates) resulting from hydroelectric facilities (Mactaquac Dam), followed by directed recreational fishing. Filling knowledge gaps related to population abundance, habitat suitability and use, and impacts from identified threats may represent the greatest opportunity to inform the species' management.

The overall objective of this Management Plan is to: *Maintain sustainable population levels and the current distribution of Shortnose Sturgeon in Canada*. To achieve this objective, conservation measures are outlined and organized under three broad strategies: 1-Research, monitoring, and assessment, 2-Protection and management, and, 3-Stewardship, outreach and communication. Conservation measures aimed at addressing identified knowledge gaps and addressing those threats identified as highest concern are given the highest priority.

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Success in the management of Shortnose Sturgeon requires the commitment and cooperation of many different constituencies that will be involved in implementing the actions set out in this Management Plan. Accordingly, this Management Plan contains an Implementation Schedule which identifies leads, partners, and timelines for each outlined conservation measure. Others can become involved by contacting the Species at Risk Maritimes Region office by email at xmarsara@mar.dfo-mpo.gc.ca or by phone at 1-866-891-0771.

Performance indicators are also included to provide a way to monitor and assess progress toward achieving the Management Plan objective. DFO will continue to work cooperatively with other jurisdictions, stakeholders, First Nations and other Aboriginal organizations, and interested parties on the conservation of Shortnose Sturgeon.

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1. COSEWIC[1] Species Assessment Information

Date of Assessment: May 2005

Common Name (population): Shortnose Sturgeon

Scientific Name: *Acipenser brevirostrum*

COSEWIC Status: Special Concern[2]

Reason for Designation: This is an anadromous species restricted to a single river system in Canada where spawning fish require unhindered access to freshwater spawning sites; but the population may have been divided since 1967 by the Mactaquac Dam. These large, slow growing, late maturing fish are conservation dependent. There is some risk to the species through mortality from hydroelectric facilities, by-catch in alewife and shad fisheries, and poaching. However, there is no immediate threat that would lead to elimination of the population in a very short period of time.

Canadian Occurrence: New Brunswick

COSEWIC Status History: Designated Special Concern in April 1980. Status re-examined and confirmed in May 2005. Last assessment based on an updated status report.

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2. Species Status Information

Extensive fishing and industrial development over the past century have contributed to the decline of Shortnose Sturgeon populations in portions of the species' North American range. The species has accordingly been assigned various domestic and international at-risk status designations, which are summarized below and in Table 1.

2.1. Canadian Designations

In Canada, Shortnose Sturgeon (*Acipenser brevirostrum*) was first assessed as Special Concern by COSEWIC in 1980. A reassessment of the species in 2005 confirmed its Special Concern status (COSEWIC 2005) due to their distribution being limited to a single river in Canada. A Special Concern designation signifies that a wildlife species may become threatened or endangered because of a combination of biological characteristics and identified threats. Despite this Special Concern designation,

[1]COSEWIC: Committee on the Status of Endangered Wildlife in Canada.

[2]Species meets the COSEWIC criterion for Threatened with a code of D2 (i.e., very small population or restricted distribution) because it is present in only one location (in only one river), but is designated Special Concern because there are no immediate threats (COSEWIC 2005).

COSEWIC acknowledges that there is no immediate threat that would lead to elimination of this population in a very short period of time (COSEWIC 2005). In 2009, Shortnose Sturgeon was listed as Special Concern under Schedule 1 of the *Species at Risk Act* (S.C. 2002, c.29) (SARA), which triggered the requirement for a management plan. This Management Plan was prepared in accordance with section 65 of SARA, and aims to identify the conservation measures needed to ensure, at a minimum, that Shortnose Sturgeon does not become further at risk. The automatic prohibitions of SARA (sections 32 and 33) do not apply to species of Special Concern, and there is no requirement to identify or protect critical habitat. The species is scheduled for reassessment by COSEWIC in April 2015.

Nationally, Shortnose Sturgeon is also listed in Schedule I of the *Wild Animal and Plant Trade Regulations* (SOR/96-263), made pursuant to section 21 of the *Wild Animal and Plant Protection and Regulation of the International and Interprovincial Trade Act* (S.C. 1992, c.52) (WAPPRIITA). The purpose of this Act is to protect certain species by regulating their international and interprovincial trade.

In the Province of NB, the Minister of Natural Resources contributes to "The General Status of Wild Species"; a national report which is developed every five years under the *Accord for the Protection of Species at Risk* (e.g. Canadian Endangered Species Conservation Council [CESCC] 2011). This report provides an overview of occurrence and general status of various wildlife species in Canada. The Shortnose Sturgeon is assessed and included in the report as Sensitive[3]. Furthermore, the Shortnose Sturgeon is included as Special Concern under Schedule A of the *List of Species at Risk Regulations* of the *New Brunswick Species at Risk Act* (S.N.B. 2012, c. 6), which came into force in June 2013.

2.2. United States Designation

In the United States (US), Shortnose Sturgeon has been listed as Endangered[4] since March 1967, and remained on the endangered species list with the enactment of the *Endangered Species Act of 1973*. The National Marine Fisheries Service (NMFS) recognizes 19 distinct population segments occurring along the east coast of North America from NB south to Florida. Although Shortnose Sturgeon remains listed as an endangered species throughout all of its range along the US east coast, the "Final Recovery Plan for the Shortnose Sturgeon", prepared for NMFS in 1998, noted evidence of recovery in some population segments (NMFS 1998). A more recent population assessment by the Shortnose Sturgeon Status Review Team (SSSRT) concluded that some of the more northern river populations are relatively healthy with stable or increasing trends in abundance and a number of other populations are moderately healthy (SSSRT 2010).

[3]Species which are not believed to be at risk of immediate extirpation or extinction, but which may require special attention or protection to prevent them from becoming at risk.
[4]Section 3.6 of the *Endangered Species Act of 1973* defines an endangered species as "[…] any species which is in danger of extinction throughout all or a significant portion of its range […]".

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2.3. International Designations

Internationally, Shortnose Sturgeon was assessed as Vulnerable[5] by the International Union for Conservation of Nature (IUCN) in 1996, and added to the Red List (IUCN 2014). This status was reconfirmed in 2004 (Friedland and Kynard 2004). Although stocks in a number of river systems were increasing and a recovery plan had been implemented in the US, Shortnose Sturgeon remained seriously depleted in other systems at the time of the update.

As a potentially valuable commercial species, and due to the severe overharvesting of sturgeons in the Caspian Sea for caviar, Shortnose Sturgeon has been listed in Appendix I of the *Convention on the International Trade Endangered Species of Wild Fauna and Flora* (CITES) since 1975. Appendix I of CITES includes those species that are presently threatened with extinction and trade is only authorized in exceptional circumstances. Commercial trade of wild specimens is strictly prohibited, but the commercial trade of captive-bred specimens from CITES-registered aquaculture facilities is possible.

NatureServe, an international network of biological data inventories, has developed a species status assessment procedure in which at-risk species are assigned a global national, and/or subnational "Conservation Status Rank" (Faber-Langendoen et al. 2009, 2012). Under this system, Shortnose Sturgeon has been assigned a global ranking of G3-Vulnerable[6], and a subnational (NB) ranking of S2-Imperiled[7], however the subnational ranking (as reflected on NatureServe Explorer; NatureServe 2004) has not been reviewed in over 10 years and may no longer be accurate (Ormes pers. comm. 2014).

Table 1. Summary of existing protection or other status designations assigned to Shortnose Sturgeon.

Country	Authority/Organization	Year(s) Assessed and/or Listed	Status/Description	Designation Level
Canada	NBSARA	2013	Schedule A: Special Concern	Canadian Population
Canada	SARA	2009	Schedule 1: Special Concern	Canadian Population

[5]A species is considered Vulnerable when the best available evidence indicates that it meets any of the vulnerability criteria outlined in IUCN (2012), and it is therefore considered to be facing a high risk of extinction in the wild.
[6]Vulnerable species are considered at moderate risk of extinction or elimination due to a fairly restricted range, relatively few populations or occurrences, recent and widespread declines, threats, or other factors.
[7]Imperiled species are considered at high risk of extirpation in the jurisdiction due to restricted range, few populations or occurrences, steep declines, severe threats, or other factors.

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Country	Authority/Organization	Year(s) Assessed and/or Listed	Status/Description	Designation Level
Canada (NB)	The General Status of Wild Species in New Brunswick	2006	Sensitive	Canadian Population
Canada	COSEWIC	1998, 2005	Special Concern	Canadian Population
Canada	WAPPRIITA	1992	Schedule I of the Wild Animal and Plant Trade Regulations	Species
United States	Endangered Species Act	1967	Endangered	Species
International	CITES	1975	Appendix I	Species
International	IUCN	1996, 2004	Vulnerable	Species
International	NatureServe	2011	Global: G3-Vulnerable	Species
			Regional (NB): S2-Imperiled[8]	Canadian Population

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3. Species Information

In addition to the papers cited in the following text, further details on the Shortnose Sturgeon, including its general biology, population and distribution, habitat needs, and threats can be found in the "COSEWIC Assessment and Update Status Report on the Shortnose Sturgeon *Acipenser brevirostrum* in Canada*"* (COSEWIC 2005) which draws on the earlier work of Dadswell (1976, 1979, 1984), Dadswell et al. (1984), and others. The information presented in this Management Plan is further updated where appropriate using more recent publications, including Li et al. (2007), Deslauriers and Kieffer (2012), Usvyatsov et al. (2012a, b, c and 2013a, b).

Taxonomy
Class: Actinopterygii
Order: Acipenseriformes
Family: Acipenseridae
Genus: *Acipenser*
Species : A. brevirostrum (LeSueur 1818)

[8] NatureServe ranking methodology and calculator has been recently updated and used to update global rankings however subnational rankings have not been reviewed in over 10 years and may no longer be accurate.

Common names
English: Shortnose Sturgeon
French: Esturgeon à museau court
Maliseet: Pasokas (Atwin pers. comm. 2014)
Mik'maq: Apsisquna't Kumkatamuj (Hunka et al. 2010)
Other names: Little Sturgeon (local name, Saint John River, NB)

3.1. Species Description

3.1.1. Genetic Distinctiveness

Globally, 19 distinct populations of Shortnose Sturgeon have been recognized along the east coast of North America from NB (i.e., the Saint John River population) south to Florida (NMFS 1998; Figure 2). Since the publication of the National Marine Fisheries Service (NMFS) report, more recent reports have presented opinions on the number of 'discrete population segments' of Shortnose Sturgeon across the species' range based on genetic data. A recent species assessment prepared by the Shortnose Sturgeon Status Review Team (SSSRT) for the NMFS reviewed additional information including results of available genetic analysis and concluded that there are five genetically distinct population groupings or clusters across the species' US geographic range and at least one genetically distinct population in Canada, in the Saint John River (SSSRT 2010). Other recent genetic studies also confirmed the greater genetic distinctiveness of the Saint John River population from other river population segments (Wirgin et al. 2010, King et al. 2014). In August 2014, a Regional Science Response Process was held in the DFO Maritimes Region to review the population status and genetic distinctiveness of the Saint John River population of Shortnose Sturgeon more specifically (DFO 2014). Several genetic studies were examined during this process, including the above noted studies by Wirgin et al. (2010) and King et al. (2014), and it was concluded that a strong argument can be made for recognizing the Saint John River population of Shortnose Sturgeon as sufficiently genetically distinct from all other populations of Shortnose Sturgeon within the species' range.

Additional unpublished genetic work undertaken in 2013 and 2014 on both wild-caught fish from the Saint John River and fish obtained from the aquaculture farm discovered a new haplotype (a group of genes, which is inherited together by an organism from a single parent) previously unreported across the species' range (Wilson and Kerr pers. comm. 2014). This finding would lend further support to the distinction of the Saint John River Shortnose Sturgeon population from those in the US.

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3.1.2. Special Significance of the Species

Shortnose Sturgeon is one of approximately 25 surviving species in the Family Acipenseridae[9], a group of primitive ray-finned fishes known to have occurred over 100 million years ago during the Upper Cretaceous Period. Some sturgeon fossil records date as far back as 225 million years ago (Hilton and Grande 2006). Of the 17 *Acipenser* species assessed by IUCN, all but four are listed as being at-risk (IUCN 2014). Shortnose Sturgeon is one among five sturgeon species in Canada and only occurs in one location, the Saint John River, NB. This particular population, which co-exists in the Saint John River with the Atlantic Sturgeon (*Acipenser oxyrinchus*), is genetically distinct, and represents the most northerly occurrence of this species (COSEWIC 2005; Wirgin et al. 2010, SSSRT 2010).

Shortnose Sturgeon holds historical significance for the Aboriginal Peoples of Canada. Evidence suggests the Mi'kmaq were fishing for sturgeon as early as 5,000 years ago (MAPC 2011). A variety of traditional fishing techniques were employed, including one known as "saksegwa", which involved the use of torchlight to lure the naturally curious sturgeon to the surface. For years, coastal Aboriginal communities relied on both Atlantic and Shortnose Sturgeon as a source of meat, oil, roe, and leather. These species would later become a staple for European colonists, as well. Aboriginal Traditional Knowledge (ATK) of the Saint John River and Shortnose Sturgeon, as well as Aboriginal peoples' worldview that all life forms are interconnected and interdependent, are important considerations for the Management Plan.

Shortnose Sturgeon in Canada was part of a commercial sturgeon fishery until a minimum size limit of 120 cm on the capture and retention of sturgeons was introduced in 1978, which effectively excluded Shortnose Sturgeon from the fishery. In the late 1990s, work began on evaluating whether Saint John River Shortnose Sturgeon could be captive-bred and possibly used in commercial aquaculture. A commercial Shortnose Sturgeon aquaculture industry emerged and began production of Shortnose Sturgeon meat and caviar in 2011. Two aquaculture operators with established broodstock currently exist in New Brunswick that raise and produce Saint John River Shortnose Sturgeon products in land-based facilities.

Sturgeons have a special role in biodiversity. They represent a 100 million year lineage of a long-lived bottom dwelling fish that consume prey living in the sediment. They have limited breeding and feeding ranges which makes them an important indicator of habitat quality and contaminants levels in both sediment and prey items.

3.1.3. Physical Characteristics

Shortnose Sturgeon is a heavily armoured fish with five rows of bony plates or "scutes" along the length of their body which cover their tough leathery skin. Additionally, rather than scales, sturgeon species have minute denticles (tooth-like projections) similar to

[9] From FishBase, an online global species database of fish species.

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those found on sharks and rays. These denticles give the skin its roughness when rubbed in one direction, and smoothness when rubbed in the other. Although grouped taxonomically with the bony fishes, other physical attributes of sturgeons, such as their mostly cartilaginous skeleton and their spiral intestinal valve, are more similar to those of sharks and rays (Class Chondrichthyes). Sturgeon species also have a heterocercal tail fin much like that of sharks; that is a tail in which the backbone turns upwards and extends into the upper, larger lobe of the tail fin. The Shortnose Sturgeon has a wide, protrusible siphon-like toothless mouth on the underside and near the rear of its elongated V-shaped snout. Four fleshy whisker-like sensory organs known as barbels are found in front of the mouth and are used for locating food on the bottom (Figure 1).

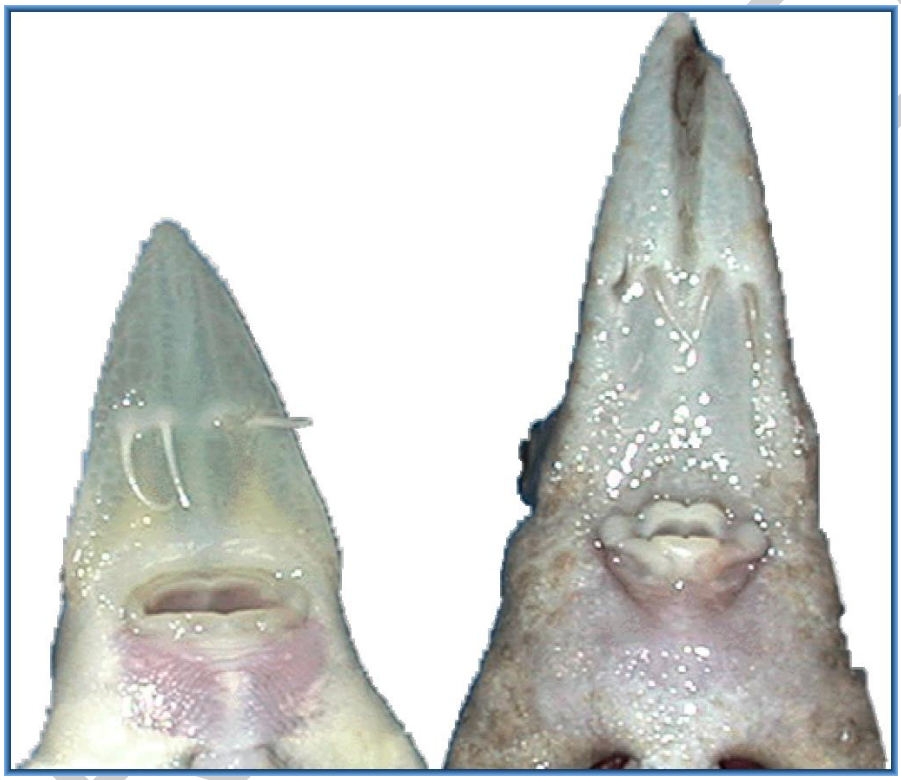

Figure 1. Ventral view of the mouths and snouts of juvenile Shortnose (left) and Atlantic (right) Sturgeon (COSEWIC 2005).

Shortnose Sturgeon is a small North American sturgeon. In the Saint John River, it co-exists with the Atlantic Sturgeon. A mature Shortnose Sturgeon can be distinguished from a mature Atlantic Sturgeon by size, as Shortnose Sturgeon mature at a much smaller size than Atlantic Sturgeon. Recorded fork lengths[10] (FL) for Shortnose Sturgeon captured in the Saint John River range from 50 to 150 cm, with the most frequent length class being approximately 80 cm. Rarely do they exceed 120 cm. In contrast, Atlantic Sturgeon has been known to reach lengths in excess of 400 cm. It is

[10]Fork length (FL) is the length of a fish as measured from the tip of the snout to the fork in the tail.

more difficult to differentiate between juvenile sturgeons; however, they can often be distinguished using the characteristics outlined in Table 2.

Table 2. Distinguishing features of the Shortnose and Atlantic Sturgeons, as derived from information provided in COSEWIC (2005) and references therein.

Characteristic	Shortnose Sturgeon	Atlantic Sturgeon
Adult body length	Relatively shorter (50-150 cm FL but rarely over 120 cm)	Relatively longer (can exceed 400 cm FL)
Nose length	Relatively shorter	Relatively longer
Mouth size	Relatively larger; greater than 63% of distance between eyes	Relatively smaller; less 55% of distance between eyes
Number of anal fin rays	19-22 rays	26-28 rays
Number of dorsal fin rays	38-42 rays	38-46 rays
Position of dorsal fin relative to anal fin	Dorsal fin above and in line with anal fin	Dorsal fin origin in advance of anal fin origin
Number of plates behind dorsal fin	Two plates	Six-nine plates, mostly in pairs
Number of plates behind anal fin	One or two plates	Four plates in pairs

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3.1.4. Biology

The biology of the Saint John River population of Shortnose Sturgeon is relatively well known despite some remaining gaps. A number of studies were initiated in the 1970s (partly in response to the species listing under the US *Endangered Species Act* in 1973) that increased the species general knowledge base across its range, including that for the Saint John River population. This knowledge base has further increased in recent years due primarily to contributions from collaborations between researchers and the aquaculture industry on both wild and captive-bred populations. Given that this Management Plan is for the wild population of Shortnose Sturgeon in the Saint John River, this section is focused on the current state of knowledge on the biology of the wild population. However, some limited information on the species' biology in captivity is also included.

Feeding and growth

The Shortnose Sturgeon is a bottom feeder, sucking its prey from sediments. Juveniles feed mainly on crustaceans and insects while adults eat mainly molluscs, particularly the soft-shelled clam, *Mya arenaria*. Both past and recent (Usvyatsov et al. (2012a)),

studies found that stomachs of Shortnose Sturgeon from freshwater sites contained mainly gastropods (e.g. snails), freshwater bivalves (e.g. mussels), chironomids (e.g. midge larvae), and amphipods. Fish stomachs from saline and brackish environments contained mostly amphipods, soft-shell clams, isopods, and chironomids. Females in the Saint John River fast for approximately eight months before spawning, whereas males continue feeding. There is potential for competition for food between Shortnose and Atlantic Sturgeon, particularly during the juvenile stages.

Like other sturgeons, the Shortnose Sturgeon is long-lived. The oldest female fish caught from the Saint John River population was 67 years old, and the oldest male was 32 years old (COSEWIC 2005). Generation time is estimated to be 30 years for Shortnose Sturgeon in US rivers (NMFS 1998). Dadswell (1979) calculated growth curves for female and male Shortnose Sturgeon (Saint John River population) based on adult fork length and age. The results suggested that growth rates differ slightly between males and females. Young males (<15 years) were generally longer and heavier than females of the same age; however, male growth rates decelerated faster than the females. In captivity, females generally tend to be larger at age and faster growing than males (Barry pers. comm. 2014). During the period 1998-2002, annual mean weight gain for the Saint John River population was estimated at 540 g (Litvak pers. comm. 2013). Growth rates have been found to vary inversely with latitude; that is, fish from northerly populations grow more slowly than fish from the south (NMFS 1998). Cooler northern conditions result in slower growth. Based on the sampling from 1998-2002, the size distribution of Shortnose Sturgeon remains similar to that in the 1970s and the average growth rates of the Saint-John River Shortnose Sturgeon are similar or have increased (DFO 2014).

Sex ratio

Historic adult sex ratio within the Shortnose Sturgeon population of the Saint John River was approximately 2:1, females to males (Dadswell 1979). This finding, in conjunction with samples of juveniles indicating a 1:1 ratio of females to males, suggests that males do not live as long as females.

Reproduction and spawning

The Shortnose Sturgeon is a highly fecund, iteroparous fish (meaning it reproduces multiple times in its lifetime). The age of first spawning for Shortnose Sturgeon in the Saint John River is later than for southern populations. Age at first spawning for female Shortnose Sturgeon in the Saint John River is 13 years, while for males it is typically 11 years (Dadswell 1984). The minimum elapsed time between spawning for females is three years, and for males it is every one to two years (Dadswell 1979). Information from work on Saint John River Shortnose Sturgeon in captivity shows that, at similar seasonal water temperatures to those in the river, females spawn every 20-28 months and can spawn as early as five years old (Barry pers. comm. 2014).

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Depending on its size, a female may produce 27,000-208,000 demersal adhesive eggs (Dadswell 1979). Early research suggested that Shortnose Sturgeon spawn from mid-May to mid-June in the Saint John River (Dadswell 1979). More recent research by Usvyatsov et al. (2012b) suggested that mean spawning events occur in late April to early May at water temperatures of 9°C and mid to late May at 13°C, with hatching peaking in late May. In captivity, optimal temperatures for spawning are 12°C-16°C and there are no indications of egg development at temperatures below 10°C (Barry pers. comm. 2014).

In the Saint John River, Shortnose Sturgeon lay eggs that sink and adhere to the rocks and gravel in the fast flowing current below the Mactaquac Dam. After hatching, the larvae drift downstream. By 9-12 days, larvae develop into juveniles capable of swimming in the water column at which time they begin feeding and are believed to migrate downstream (Richmond and Kynard 1995). No eggs and larvae have been caught downriver in the lower reaches of the Kennebecasis River where Shortnose Sturgeon are known to overwinter (Usvyatsov et al. 2012c).

Mortality rates

Sturgeon population dynamics are most sensitive to changes in survival during the first few years of development. Even though a relatively large number of eggs are produced in the Saint John River each year (e.g. Dadswell (1979) estimated an annual production of 3.76×10^9 eggs), juveniles appear to be rare. This observation may result from difficulty in capturing older juveniles due to their preference for deep waters. Sturgeon larvae are known to experience a high rate of mortality, suggesting that the major bottleneck to recruitment occurs during the early life stages. This observation led Usvyatsov et al. (2013a) to study Shortnose Sturgeon larval dispersal in a stretch of the Saint John River immediately downstream of the Mactaquac Dam, a known spawning site. Estimates of annual upstream larval abundance between 2008 and 2011 ranged from approximately 21,000 to 245,000; however, abundances 4.5 km downriver were 49-76% lower. Usvyatsov et al. (2013b) suggested environment-related mortality accounted for at least 4-25% of the observed larval mortality in a study which attempted to differentiate between mortality from sampling and environmental sources.

Dadswell (1979) determined mortality rates for Shortnose Sturgeon aged 14 to 55 years in the Saint John River and found that adult mortality was low and was approximately equal to the natural mortality expected for a slow-growing species. Mortality was found to be relatively high among younger year classes, declining with age. At the time of the study, incidental fishing mortality was thought to account for 7% of total mortality.

3.2. Population and Distribution

3.2.1. Distribution

Globally, populations of Shortnose Sturgeon are found along the entire east coast of North America from NB, Canada south to Florida, USA (NMFS 1998; Figure 2). The

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only known population in Canada is found in Atlantic Canada's longest river: the Saint John River, in southwest NB, which flows into the Bay of Fundy (Figure 3). Shortnose Sturgeon distribution within this river system includes its largest tributary, the Kennebecasis River (Figure 3). The first published record of Shortnose Sturgeon in the Saint John River was in 1957. As was the case in many river systems, prior to this Shortnose Sturgeon were not distinguished from Atlantic Sturgeon (likely misidentified as juvenile Atlantics) and were classified simply as "sturgeon" in fishery statistics.

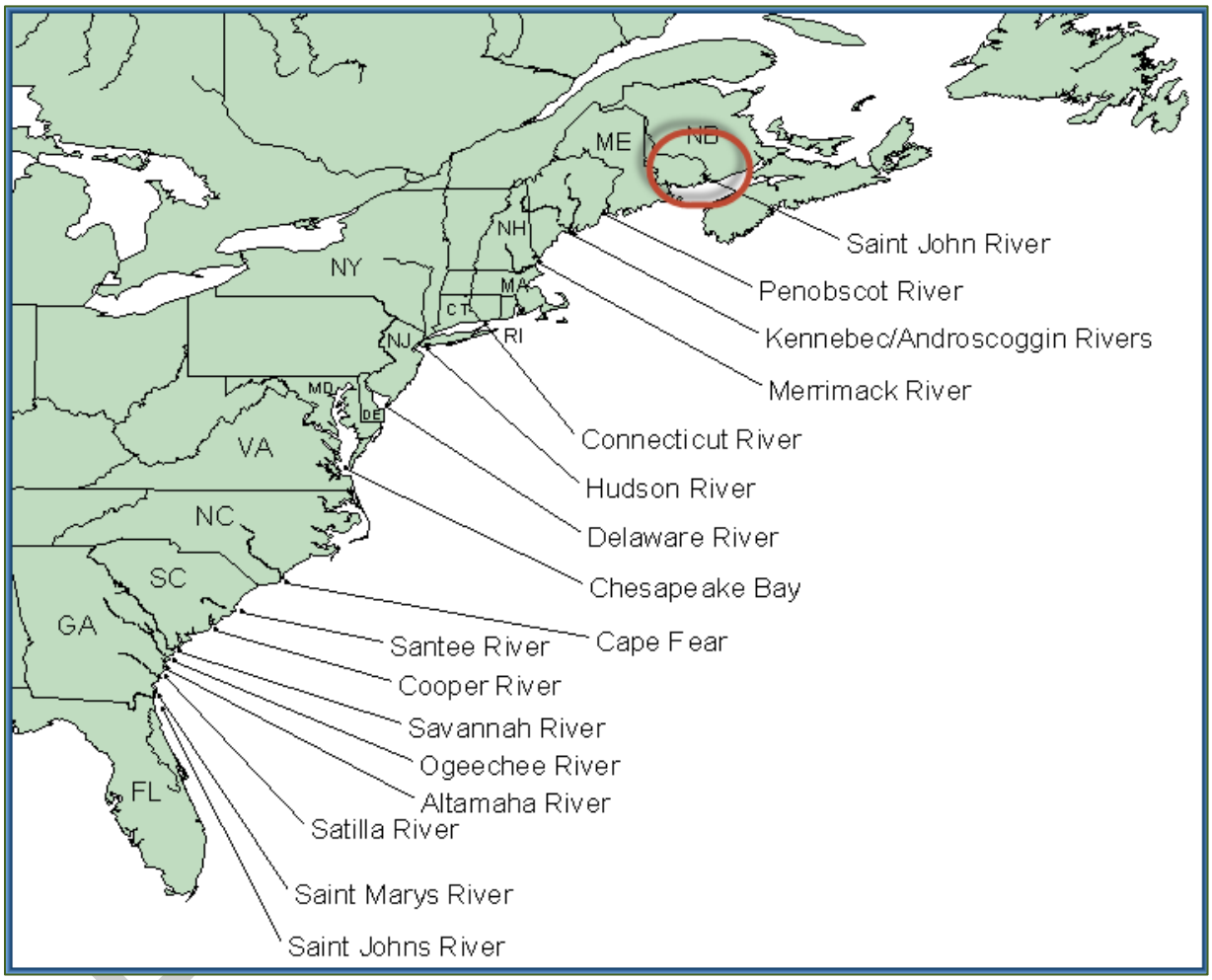

Figure 2. Global distribution of Shortnose Sturgeon showing 17 of 19 natal rivers (Winyah Bay and the Ashepoo, Combahee and Edisto (ACE) Basin populations in South Carolina are not shown). The Canadian portion of the Shortnose Sturgeon distribution is restricted to the Saint John River system, circled (after COSEWIC 2005).

In the Saint John River, adult Shortnose Sturgeon are found both in freshwater and in areas under tidal influence. Generally, Shortnose Sturgeon overwinter in the lower tidal reaches of the Saint John River and in the spring migrate upstream as far as the Mactaquac Dam to spawn in freshwater. Although adult Atlantic Sturgeon are commonly captured in the Bay of Fundy, unconfirmed records of Shortnose Sturgeon capture are comparatively rare (one to two per year over the past decade) (Dadswell et al. 2013). The first confirmed capture of a Shortnose Sturgeon in the Bay of Fundy occurred on

June 29, 2013, in an intertidal Atlantic herring (*Clupea harengus*) weir in the Minas Basin near Economy, a distance of approximately 165 km from the mouth of the Saint John River (Dadswell et al. 2013). This individual's population of origin is unknown. Recent acoustic telemetry work conducted in Maine revealed that up to 70% of adult Shortnose Sturgeon make regular coastal migrations of approximately 130 km between the Kennebec and Penobscot Rivers (Zydlewski et al. 2011; Dionne et al. 2013). It is not known whether migrations of this or lesser scale can be normally expected of the Saint John River population; however, the genetic distinction between the Saint John River population and the nearest U.S. population (i.e. Penobscot River) suggests little mixing (Wirgin et al. 2010). Overall, it is widely believed that Shortnose Sturgeon generally remain in their natal river and estuary as is commonly observed in other parts of its range. Occurrences outside of these areas are relatively rare.

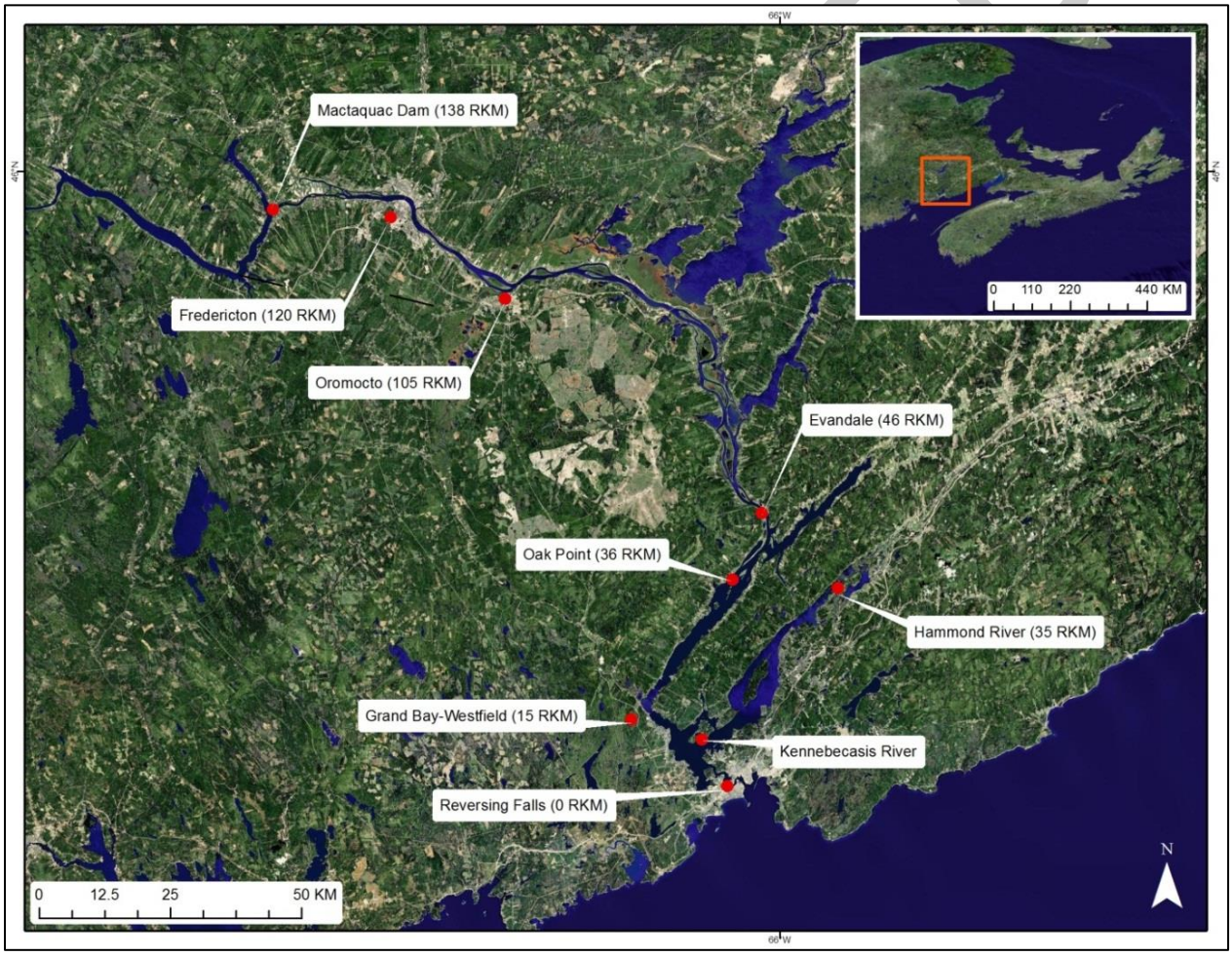

Figure 3. Saint John River from the Reversing Falls at its mouth to Mactaquac Dam. RKM refers to river kilometers, i.e. distance in km from the mouth of the river. This map was created by the Oceans and Coastal Management Division of Fisheries and Oceans Canada based on a map in COSEWIC (2005).

The Saint John River, from its headwaters to the Reversing Falls at its mouth, is 673 river kilometers (RKM; distance in km from the mouth of the river) (Figure 3). Of that

total, 138 RKM is below the Mactaquac Dam and includes five large tributary rivers (Nashwaak, Oromocto, Jemseg, Canaan, and Kennebecasis). The drainage area below the dam is approximately 15,000 km^2, or 27% of the entire Saint John River drainage system. A detailed description of the river can be found in Kidd et al. (2011). It is unknown precisely what proportion of the area below the dam is used by Shortnose Sturgeon; however, various life stages have been captured at the river mouth, including Saint John Harbour, as well as upriver close to the Mactaquac Dam. It has been suggested that Shortnose Sturgeon adults in reproductive condition are geographically separated from those adults that will not spawn the following spring. However, both reproductive and non-reproductive fish have been found together in the Saint John River (M. Litvak pers. comm. 2014).

The Mactaquac Dam was constructed in 1967. Although there is no existing effective mechanism to allow passage of a bottom dwelling species like Shortnose Sturgeon over this dam, there is also no published scientific evidence of Shortnose Sturgeon being observed above the dam before or after it was constructed. However, a paper on the Old Meductic Fort (located at about 200 RKM near the small village of Meductic, south of Woodstock) that was read before the NB Historical Society by Rev. W. O. Raymond, M. A. (1897) reported: “The hunting in the vicinity was excellent; the rivers abounded with salmon, sturgeon, bass, trout and other fish...”. In addition, anecdotal observations of sturgeon were made in the Saint John River near Woodstock in the 1940s and 1950s (LaBillois pers. comm. 2013). This information indicates that sturgeon occurred above the Mactaquac Dam prior to its construction; however, it is unclear whether these were Shortnose or Atlantic Sturgeon, how far upriver the population may have ranged, and whether a landlocked portion of the population continues to reside above the dam.

3.2.2. Population Abundance

There has been only a single complete census of the Shortnose Sturgeon population occupying the entire Saint John River below Mactaquac Dam and this was conducted in the 1970s. There is no information on the population’s status prior to the construction of the Mactaquac Dam built in the mid-1960s. Dadswell (1979) estimated an adult population size of 18,000+/-30% in the lower Saint John River during the period 1973-1977, with an estimated total Canadian population size of 100,000 through extrapolation of the mortality relationship. At the time of the study, the Saint John River population was believed to be one of the largest in North America. Several more recent partial population estimates have been attempted. A mark-recapture study was conducted on migrating fish captured from the annual fall Sturgeon Derby in the Kennebecasis River 1998 to 2004 and estimated an abundance of 2,068 fish (COSEWIC 2005; Litvak pers. comm. 2014). This population estimate however has high interannual variability (801-11,277) likely due to the variable immigration and emigration of individuals from other tributaries of the Saint John River. Therefore, despite indications of a persisting population given the long-term annual catches in the Sturgeon Derby, this population estimate is not precise enough to track population abundance changes over time. Other studies, although primarily intended to locate and describe overwintering habitat sites, also provided an opportunity to obtain an estimate when the population was aggregated

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and sedentary. These single location studies focused on overwintering sturgeon at the confluence of the Kennebecasis and Hammond Rivers and resulted in local abundance estimates of 4,836 fish in 2005, 3,852 in 2009, and 5,222 in 2011 (Li et al. 2007; Usvyatsov et al. 2012c). These more recent estimates are thought to represent an unknown portion of the total population, and one of several possible overwintering aggregations. While these partial estimates are informative, they are not readily comparable to the historic estimates because of differences in the location, methodology, and timing of the surveys, and make the tracking of population changes over time difficult. Therefore, there is no current Shortnose Sturgeon population estimate for the complete lower estuary of the Saint John River since 1979, however there is also no indication that the general population status (size and distribution) has changed since the 1970s. A current comprehensive summary of these studies on the status of the Saint John River population of Shortnose Sturgeon can be found in DFO (2014).

3.3. Needs of the Shortnose Sturgeon

3.3.1. Habitat

Shortnose Sturgeon has been described as an anadromous or amphidromous species. An anadromous species typically migrate from the marine environment to freshwater for spawning purposes. An amphidromous species however, migrates from fresh water to the marine environment, or vice versa, but not necessarily for the purpose of breeding. Shortnose Sturgeon populations across the species range tend to remain within their natal watersheds with short, but limited seaward migrations. The Saint John River population of Shortnose Sturgeon (as other northern US populations) is more correctly described as amphidromous given it tends to reside mainly in the river and estuary, and is rarely observed in the marine environment of the Bay of Fundy.

Tidal influence and extensive spring flooding in the Saint John River combine to create the largest wetland complex in Atlantic Canada, including backwaters, creeks, and marshes that extend up to the Mactaquac Dam, and 2 to 5 km beyond the main Saint John River riverbanks. Leavitt (1995) states that there was a location called “Aukpaque” 5 km upstream of Fredericton, and that this location name is a Maliseet word meaning “location where tide stops coming in”. The location of the tidal boundary on the Saint John River is currently defined in fishery regulations as the Crocks Point area which is approximately 20 km upstream of Fredericton. This location is near the historical McKinley Ferry, an iron cable car ferry that used to join the communities on either side of the river.

Aquatic habitat in the Saint John River has not been quantified (Kidd et al. 2011); nonetheless, some information on Shortnose Sturgeon habitat does exist. In the Saint John River, Shortnose Sturgeon adults are found both in freshwater and in areas under tidal influence. Although the extensive seasonally flooded shoreline habitat is available to Shortnose Sturgeon, it is not known whether they use it (DFO 2009).

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Overall, it appears that Shortnose Sturgeon habitat mainly encompasses the lower Saint John River and its tributaries, with an important spawning habitat area located near the Mactaquac Dam and an important overwintering habitat area located near the confluence of the Hammond and Kennebecasis Rivers. Other important habitat areas (e.g. migration corridors, spawning, overwintering, and feeding areas) likely exist in the Saint John River but these require further study. It is currently unknown whether important habitat areas exist in the Bay of Fundy. More detailed information on Shortnose Sturgeon habitat and important habitat areas acknowledged in this Management Plan is provided below.

Juvenile habitat

Juvenile (i.e. <45 cm in length) Shortnose Sturgeon habitat is largely confined to the freshwater/riverine portion of the lower Saint John River, with concentrations occurring between Evandale (46 RKM) and Oromocto (105 RKM) (Dadswell 1979; Figure 3).

Adult spawning habitat

Adult Shortnose Sturgeon spring spawning migration starts when the river temperature reaches 8-9°C. Spawning has been documented in areas with high flow rates near the Mactaquac Dam as evidenced by the presence of large numbers of eggs and larvae (Usvyatsov et al. 2012b). Spawning typically occurs over gravel and/or boulder substrate where salinity is low (near-freshwater conditions), at temperatures of 8°C-13°C and flow rates between 0.4-1.0 m^3/s (Usvyatsov et al. 2012b). The eggs are laid in gravel beds, and once hatched the larvae are carried downriver by the flow from the Mactaquac Dam. These gravel and boulder substrate areas where spawning occurs below the Mactaquac Dam are therefore considered important habitat areas for Shortnose Sturgeon. Spawning may also occur at other locations on the Saint John River system but there is no documented evidence to substantiate this at this time.

Overwintering habitat

Shortnose Sturgeon overwinter in the lower reaches of the Saint John River system where salinity is as high as 20 parts per thousand (ppt). Concentrations of overwintering Shortnose Sturgeon have been confirmed in a small area at the confluence of the Kennebecasis and Hammond Rivers where the water salinity is close to zero even at high tide (Li et al. 2007; Usvyatsov et al. 2012c) (Figure 4). The tidal nature of the river at this location and nearly level bottom with extensive sand bars appears to offer optimal overwintering conditions for Shortnose Sturgeon. Shortnose Sturgeon aggregated on the sandy substrate in this area at depths of 3.1-6.9 m, with a preference for the deeper portions of this area. This overwintering area may be an important habitat area for Shortnose Sturgeon and any disturbance that alters the substrate composition may adversely affect this habitat and its use by Shortnose Sturgeon. Although several other overwintering sites have been reported in past research (Dadswell 1979, 1984), none of these were confirmed during recent tagging studies (Li et al. 2007).

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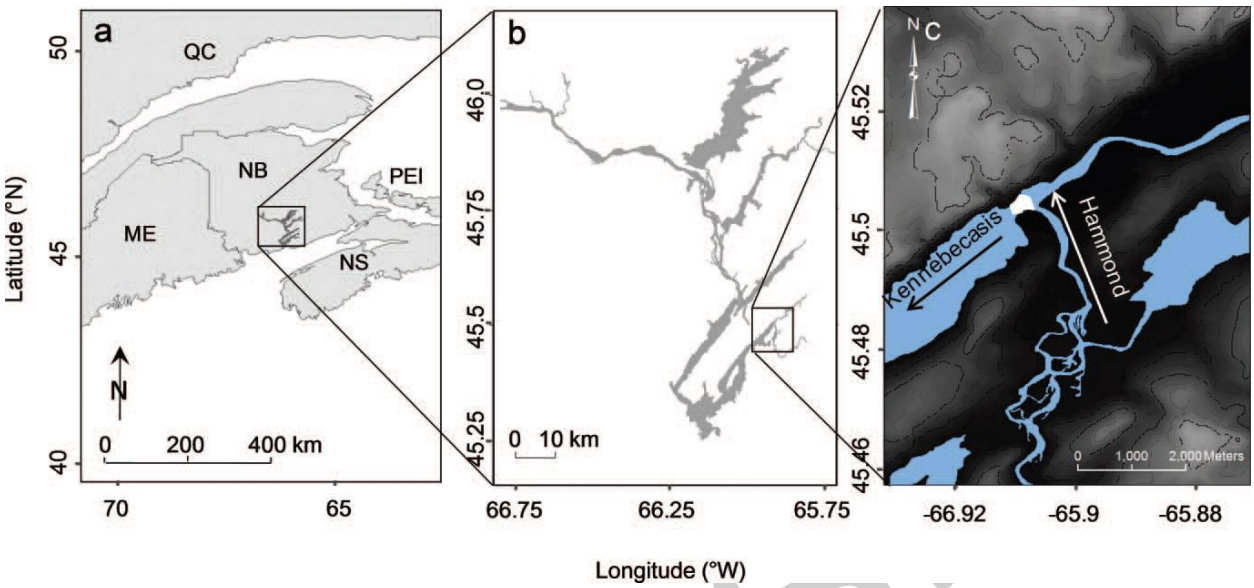

Figure 4. The Kennebecasis-Hammond River confluence, where overwintering Shortnose Sturgeon were sampled by Usvyatsov et al. (2012c)[11]. Arrows = direction of river flow. White polygon = sampling site).

3.3.2. Water Quality

Salinity

Shortnose Sturgeon in the Saint John River can be found in a wide range of salinities at different times of the year and during different life stages. They spawn near the Mactaquac Dam where salinity is near zero, suggesting that eggs and larvae require freshwater conditions for survival. They overwinter in the lower reaches of the river where salinity is as high as 20 ppt and also in the Kennebecasis River where salinity is near 0 ppt. Shortnose Sturgeon have also been recorded in the Saint John Harbour below the Reversing Falls where salinity is even higher. The recent confirmed Shortnose Sturgeon observation from the Minas Basin also demonstrates that this species can tolerate higher salinity waters, although these occurrences are rare. Studies on the effect of salinity on Shortnose Sturgeon growth have shown that young of this species grow best in freshwater conditions. This supports observations that smaller juveniles show a preference for low salinity conditions.

Temperature

[11] Figure credit: Usvyatsov, S., J. Watmough, and M.K.Litvak. 2012a. Age and population size estimates of overwintering shortnose sturgeon in the Saint John River, New Brunswick, Canada. Canadian Journal of Fisheries and Aquatic Sciences 141(4):1126-1136 © Canadian Science Publishing or its licensors.

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As noted in Section 3.3.1, adult Shortnose Sturgeon spawning migration starts when spring river temperature reaches 8-9°C. Additionally, spawning typically occurs at temperatures of 8°C-13°C (Usvyatsov et al. 2012b). Laboratory studies have demonstrated that Shortnose Sturgeon tolerate a wide range of temperatures and show few differences between swimming performance levels at colder or warmer water conditions (Deslauriers and Kieffer 2012). Shortnose Sturgeon swimming performance diminished below 10°C, plateauing between 15°C and 25°C. Observations suggest that 25°C may be an upper tolerance limit, as individuals are seldom found in water exceeding that temperature.

Dissolved oxygen

Little is known about the effects of oxygen concentration on Canadian Shortnose Sturgeon but studies in the US have shown sturgeons are sensitive to low oxygen conditions (Secor and Niklitschek 2002). Although not specific to Sturgeon, the lowest acceptable dissolved oxygen concentration for fish in early life stages is 9.5 mg/L in cold water and 6 mg/L in warm water (Canadian Council of Ministers of the Environment [CCME] 1999). Kidd et al. (2011) found that oxygen levels in the Saint John River below the Mactaquac Dam were approximately 9 to 10 mg/L in recent years, which are much higher than levels observed in the 1960s (~7 mg/L). This is largely attributed to improvements in waste management at industrial facilities and municipal wastewater treatment. Studies in captivity have demonstrated that Shortnose Sturgeon are capable of surviving for at least short periods of time (hours or days) at low oxygen concentrations of 4 mg/L or lower in warm water 15-19°C (Barry pers. comm. 2014).

4. Threats and Limitations

4.1. Threat Assessment

An assessment of potential and ongoing threats to the Shortnose Sturgeon population in the Saint John River is presented in Table 3, and discussed further in Section 4.2. This assessment was informed by COSEWIC's review of the species' status (COSEWIC 2005) and through subsequent discussion with Shortnose Sturgeon experts. As previously noted, the prohibitions of SARA and the need to identify and protect critical habitat do not apply to Special Concern species. As well, COSEWIC (2005) stated that there is no immediate threat that would lead to the elimination of the species in a very short period of time and a recent review of the population status concludes that there is no indication that the general status (population size and distribution) of the Saint John River Shortnose Sturgeon has changed since the 1970s (DFO 2014). Therefore, the identified threats are those where appropriate management of the species and its habitat may be needed to ensure that Shortnose Sturgeon does not become threatened or endangered. The level of concern ranks assigned to the various threats are relative to each other, and reflect management priority based on our current limited knowledge of these threats and their impact on the population. With this in mind, bycatch in commercial fisheries (particularly in set gillnets) and habitat availability and suitability resulting from hydroelectric facilities (Mactaquac Dam) are

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identified as being of highest concern, followed by directed recreational fishing. The level of knowledge (i.e. degree of evidence) associated with a particular threat is reflected in its associated causal certainty (see column heading definitions in the footnotes below Table 3 for further details on these ranking criteria). Although not a direct threat to the species, knowledge gaps were identified as an important limitation in the management of Shortnose Sturgeon, since many of the threats are still poorly understood despite improved understanding of the species' biology. By assessing the threats to the population, recommended management measures can be prioritized accordingly.

Table 3. Threat assessment for Shortnose Sturgeon.

Threat	Level of Concern[1]	Extent[2]	Occurrence[3]	Frequency[4]	Severity[5]	Causal Certainty[6]
Threat to habitat						
Hydroelectric facilities (Mactaquac Dam)	High	Localized	Current	Seasonal	Unknown	Medium
Agriculture runoff	Low	Widespread	Current	Seasonal	Unknown	Low
Industrial activity	Low	Widespread	Current	Continuous	Unknown	Low
Forestry	Low	Localized	Current	Continuous	Unknown	Low
Urban development	Low	Localized	Current	Continuous	Unknown	Low
Threat of direct mortality and removals						
Bycatch in commercial fisheries	High	Widespread	Current	Seasonal	Unknown	Medium
Directed recreational fishery	Medium	Localized	Current	Seasonal	Unknown	Low
Bycatch in recreational fisheries	Low	Widespread	Current	Seasonal	Unknown	Low

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Threat	Level of Concern[1]	Extent[2]	Occurrence[3]	Frequency[4]	Severity[5]	Causal Certainty[6]
Aboriginal fisheries	Low	Localized	Current	Seasonal	Unknown	Low
Aquaculture removals	Low	Localized	Current	Seasonal	Unknown	Low
Removals for scientific or other purposes	Low	Widespread	Anticipated	Unknown	Low	Low
Illegal harvest	Low	Unknown	Current	Unknown	Unknown	Low
Other threats						
Escape of hybrids	Low	Localized	Unknown	Unknown	Unknown	Low
Non-native invasive species	Low	Widespread	Current	Unknown	Unknown	Low
Disease	Low	Unknown	Unknown	Unknown	Unknown	Low

[1] Level of concern: signifies that managing the threat is of High, Medium or Low concern (relative ranking) for the conservation of the species. This criterion considers the assessment of all the information in the table.
[2] Extent: refers to whether threat information relates to a specific site or narrow portion of the species' range (Localized) or whether it relates to the whole distribution or large portion of the species' range (Widespread).
[3] Occurrence: indicates whether the threat is Historic (contributed to decline but no longer affecting the species), Current (affecting the species now), Imminent (is expected to affect the species very soon), Anticipated (may affect the species in the future), or Unknown (it is not known whether the threat is currently occurring, but it is a viable threat).
[4] Frequency: describes the temporal extent of the threat over the course of the year (Seasonal: either because the species' presence is seasonal or the threat only occurs at certain times of the year, Recurrent, Continuous).
[5] Severity: reflects the population-level effect (High: very large population-level effect, Moderate, Low, Unknown).
[6] Causal certainty: reflects the degree of evidence that is known for the threat and how it affects the population (High: there is substantial scientific evidence of a causal link where the impact to populations is understood qualitatively; Medium: there is scientific evidence linking the threat to stresses on the population Low: there is a plausible link with limited evidence that the threat has stressed the population).

4.2. Description of Threats and Limitations

4.2.1. Habitat

Hydroelectric facilities: Mactaquac Dam

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The Mactaquac Dam's effect on Shortnose Sturgeon habitat is one of the highest ranked threats to this species. The dam may be limiting Shortnose Sturgeon's access to upriver habitat, and the dam's water management regime may be affecting spawning and early life history survival. More detailed information on these impacts is described below. The dam is assigned a high level of concern, because of the uncertainty associated with this threat. Scientific studies related to assessing the potential impacts of the Mactaquac Dam have been identified as high-priority conservation measures (Section 6.3). Currently, no plans are in place to manage or restore environmental flows[12] on the Saint John River, but a large aquatic ecosystem study is underway to inform a decision by 2017 on the future of the Mactaquac Generating Station. The results of these scientific studies may also inform the development of threat mitigation options for Shortnose Sturgeon. See Actions Completed or Underway in Section 6.1 of this document for further details on this aquatic ecosystem study.

Habitat availability: The damming of major rivers in North America is known to have had negative impacts on anadromous species. On the Saint John River, the construction of the Mactaquac Hydroelectric Dam, which took place between 1964 and 1968, limited access to habitat above the dam for many fish species. Although many other hydroelectric dams exist on the Saint John River, the Mactaquac Dam is the lowermost dam on the river and limits access to approximately 75% of the river system (Figure 5). Anecdotal evidence suggests that sturgeon were present above the Mactaquac Dam site prior to its construction; however, because sturgeon species were not differentiated in fishery records between Shortnose and Atlantic prior to 1957, it is unclear whether these observations included Shortnose Sturgeon. Since its construction, there have been no recorded observations of Shortnose Sturgeon above the Mactaquac Dam. A fish lift has been in place throughout the lifetime of the dam but, has never caught a Shortnose Sturgeon. This is perhaps not surprising given that the fish lift is actually a collection facility designed specifically to intercept Atlantic Salmon (*Salmo salar*), not bottom feeders like sturgeon. It seems plausible that Shortnose Sturgeon would have used the river above the dam prior to its construction. If so, the dam would represent a barrier to an area of suitable habitat between the Mactaquac Dam and the next unpassable dam on the Saint John River (Figure 5).

Flow rates: A river's flow affects its speed, depth, width, temperature, oxygen levels, channel shape, and sediment movement (Kidd et al. 2011). Therefore, flow is an important indicator of habitat suitability for fish. Flow rates on the Saint John River are described in Kidd et al. (2011), particularly in relation to the effects of the Mactaquac Dam. Given that Shortnose Sturgeon spawn in close proximity to the dam, early life stages may be vulnerable to changes in river conditions controlled by dam operations that alter flow rates. Changes in flow rates and temperature may reduce habitat important for spawning and egg incubation. High turbulence, as well as fluctuating flow regimes and water levels, may pose a risk to fish larvae (Caroffino et al. 2010).

[12] Environmental flows are the seasonally and annually varying water flows and levels that support ecosystems and human livelihoods while providing for other uses such as hydropower, irrigation, and water supply.

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Usvyatsov et al. (2012b) found that dam operations could result in large fluctuations in water flow just below the Mactaquac Dam in the Shortnose Sturgeon spawning area. The degree to which temperature, flow regimes, and water level fluctuations may affect Shortnose Sturgeon spawning and early life history survival in the Saint John River is, however, unknown. In captivity, larval Saint John River Shortnose Sturgeon are highly susceptible to flow changes, temperature changes of 2-5^{o}C and to the addition of particulate to the water (Barry pers. comm. 2014). Shortnose Sturgeon have however continued to spawn successfully just below the Mactaquac Dam since its construction. The bell-shaped curve size distribution of Shortnose Sturgeon caught during 1998-2002 provides evidence of successful spawning and recruitment over the last few decades.

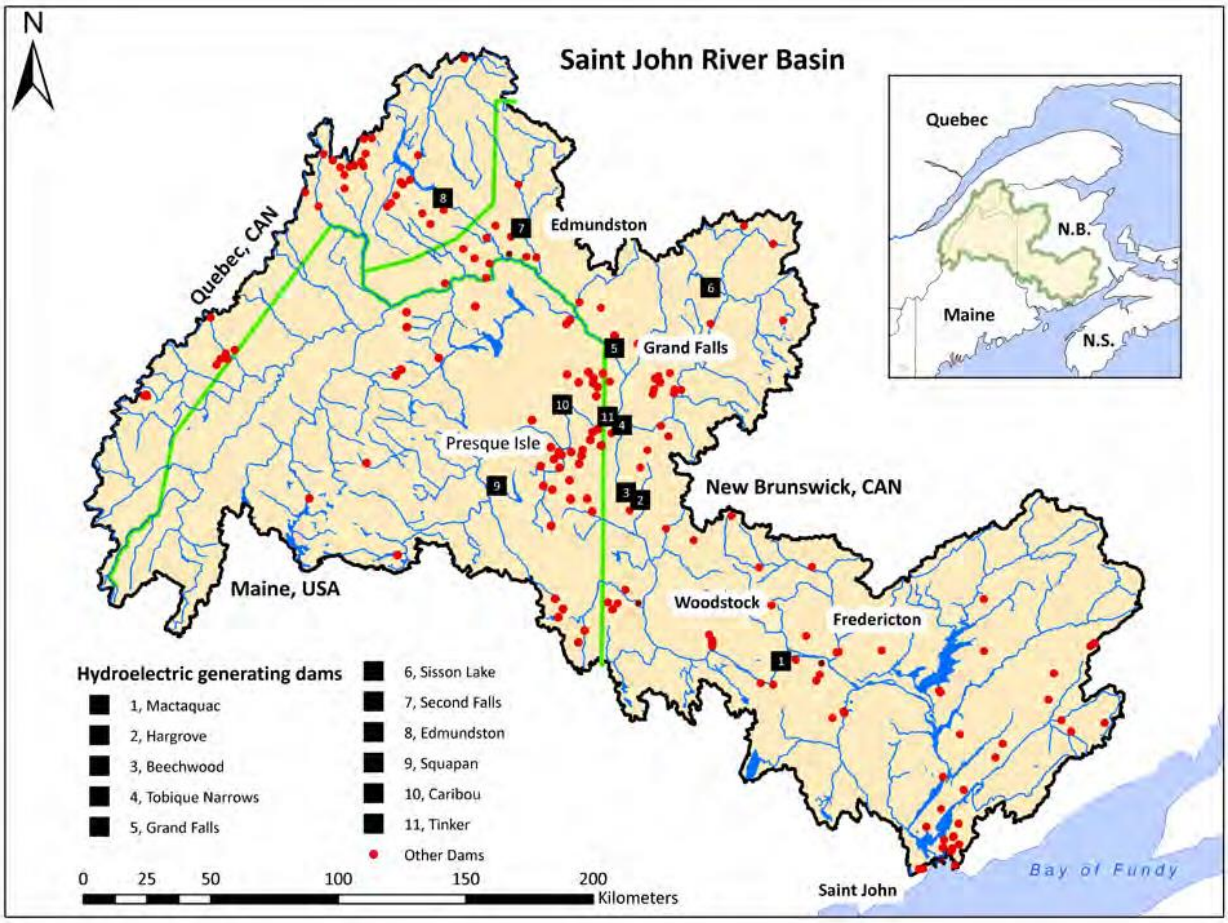

Figure 5. Hydroelectric and other dams in the Saint John River basin (Kidd et al. 2011).

Forestry, agricultural runoff, industrial activity, and urban development

The 1900s to 1960s was a period of high industrialization on the Saint John River with increases in urban development, forestry, agricultural, and industrial practices. These types of human activities and developments contributed to siltation, eutrophication, and contaminant loads and led to a highly polluted state of some stretches of the Saint John River (Kidd et al. 2011). Although, water quality has greatly improved in the Saint John River system since the 1970s as a result of more stringent enforcement of pollution

regulations by government, and investments in wastewater treatment by municipalities and industries (COSEWIC 2005; Kidd et al. 2011), these same types of activities are ongoing and they have the potential to affect the Shortnose Sturgeon and its management.

There is a large forestry industry with five pulp and paper mills at various locations along the river. The Saint John River valley is also a productive agricultural region that includes four potato-processing plants. There are two cities on the Saint John River below the Mactaquac Dam: the City of Fredericton, population of 56,000, and the City of Saint John, population of 70,000 (Statistics Canada 2011) (Figure 5). A number of smaller towns are located along the Saint John River and all of them have some level of sewage treatment. These treatment plants have overflow mechanisms, but they have rarely been used. A percentage of the sewage from the city of Saint John is released into the mouth of the estuary without treatment, but this is below where most Shortnose Sturgeon occur. Kidd et al. (2011) noted that most of the remaining issues (siltation, agricultural runoff) on the Saint John River occur in areas above the Mactaquac Dam. Downstream effects are unknown and Kidd et al (2011) did not directly relate the evaluation of the Saint John River system to the status of Shortnose Sturgeon. The following is a description of threats associated with the activities described above. Given the current state of improved water quality and regulations, and their potential impact to Shortnose Sturgeon, these threats are currently assessed as being of low concern.

Eutrophication: Discharge from pulp mills, silviculture, agriculture, and municipal sewage can cause eutrophication and lead to low oxygen levels. In the US, Collins et al. (2000) suggested that deterioration in water quality affects nursery production of juvenile Shortnose Sturgeon and low oxygen levels, in particular, may lead to a recruitment bottleneck. In the Saint John River in the 1970s, late summer die-offs of sturgeon and other species were noted in eutrophic areas of the estuary that were choked with vegetation. These events have been attributed to oxygen depletion brought on by elevated nutrient loads and vegetative blooms. Increased water temperatures can exacerbate the eutrophication process; however, the Saint John River is at the northernmost extent of the Shortnose Sturgeon range where water temperatures are typically cooler and oxygen levels higher than in other parts of their range.

As indicated above, since the 1970s, Saint John River water quality has greatly improved. In their state of the environment assessment of the Saint John River system, Kidd et al. (2011) found that since most of the Saint John River is undeveloped (83% forested and 5% wetlands), urban effects are relatively minor (Figure 6). Low oxygen concentrations are not as significant an issue compared to other river systems supporting sturgeon populations. In fact, oxygen levels on the lower reaches of the Saint John River have improved in recent years (Kidd et al. 2011).

Contaminants: Contaminant loads in the Saint John River are influenced by industrial practices (e.g. pulp mills), urban activity, agriculture and forestry. The Shortnose Sturgeon's long lifespan and benthic feeding habits may make it vulnerable to harmful effects from the bioaccumulation of heavy metals and other toxicants, such as Mercury,

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DDT (dichlorodiphenyltrichloroethane) and PCB (polychlorinated biphenyl) (see Dadswell 1976b for specific content levels in Shortnose Sturgeon at that time). Kocan et al. (1996) studied the effects of coal tar leachate (polycyclic aromatic hydrocarbons [PAHs]) on the embryonic and larval development of Shortnose Sturgeon, and found that exposure resulted in extremely high mortality within 18 days. Such effects have not been observed in the Saint John River system. Water quality downstream of Fredericton is thought to be generally higher than elsewhere along the river due to the lack of dams and less intensive industry and agriculture (Kidd et al. 2011). However, there are areas above the Mactaquac Dam, specifically, Edmundston-Grand Falls and Florenceville-Woodstock, that have been noted for their relatively poor water quality (Kidd et al. 2011). The potential impacts of these areas on downstream water quality are unknown. Accidental discharges of toxins or other pollutants could have negative impacts on the Saint John River Shortnose Sturgeon population, but there is no documented evidence of high contaminant loads harming Shortnose Sturgeon or their habitat at this time.

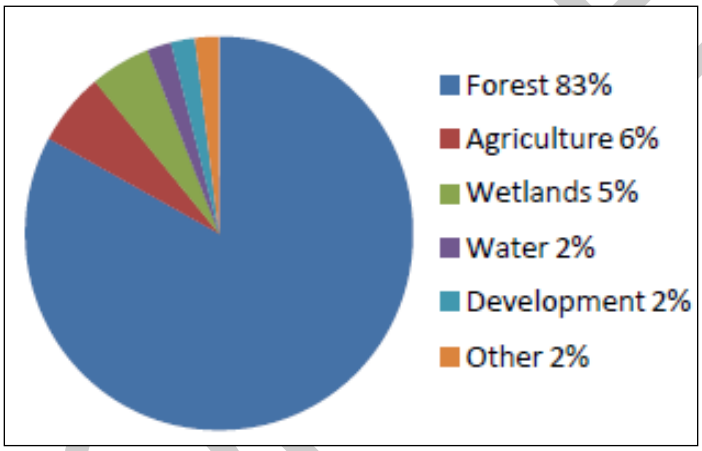

Figure 6. Land use in the Saint John River basin, New Brunswick (Kidd et al. 2011; data from the New Brunswick Department of Environment 2007).

New development activities: New development projects may cause serious harm to fish and fish habitat (e.g., spawning and overwintering areas can be harmed by altering substrate composition). These types of projects are typically reviewed under current provincial and federal legislation (e.g., the federal *Fisheries Act*, the NB *Clean Water Act* and the NB *Crown Lands and Forest Act*). The preferred outcome of these project reviews is to avoid serious harm to fish and fish habitat by implementing mitigation measures. This may involve undertaking the work at a time, in a location, or in a manner that minimizes the risk of impacts. Examples of mitigation measures that could reduce impacts to Shortnose Sturgeon include: restricting the work window to the summer months after spawning has occurred, minimize in-stream footprints, relocate in-stream footprints through design modifications, and prevent the release of contaminants and silt into the water column by installing and maintaining sediment erosion control structures.

4.2.2. Direct Mortality and Removals

Bycatch in commercial fisheries

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Bycatch in commercial fisheries (particularly in set gillnets) is considered of high concern and is among the highest ranked threat to Shortnose Sturgeon. There are a number of commercial fisheries in the Saint John River that can capture Shortnose Sturgeon as bycatch. Although Shortnose Sturgeon are a resilient fish and most are released alive, bycatch impacts can include either direct mortality and/or indirect effects, including behavioural changes, post-release mortality or injury.

There is currently no commercial fishery in the Saint John River for Shortnose Sturgeon and it is for the most part protected by a federal regulation that limits retention of all sturgeon (Shortnose and Atlantic) in the Saint John River to individuals over 120 cm in total length (TL). Nonetheless, unknown levels of Shortnose Sturgeon bycatch in commercial fisheries for Atlantic Sturgeon, American Eel (*Anguilla rostrata*), and alosids (i.e. gaspereau [*Alosa* spp.] and American Shad [*Alosa sapidissima*]) may result in some mortality. Commercial fishing for several of these species occurs through the use of gillnets. Gillnetting is a method of catching fish by suspending a net in the water. Fish are caught when they swim into the net and become entangled by their gills or by their body in the webbing. Currently, gillnets that are set in certain locations, such as the area both upstream and downstream from the Reversing Falls, are the main concern because they may result in direct mortality of Shortnose Sturgeon.

Atlantic Sturgeon fishery: Commercial fishing for Atlantic Sturgeon by gillnets began on the Saint John River in 1880 (DFO 2013). There are currently four commercial licence holders for Atlantic Sturgeon in the Saint John River and all four are active. These licences are currently non-transferable and, without a policy change, will expire when the licence holder retires. Atlantic Sturgeon can only be fished commercially with gillnets that have a minimum mesh size of 330 mm (13 inches). This regulation was implemented to reduce the catch of juvenile sturgeon and to prevent bycatch of other species such as Shortnose Sturgeon. Shortnose Sturgeon, which rarely exceed 120 cm, are generally small enough to swim through 330 mm mesh gillnets.

Alosid fisheries: DFO has issued 85 commercial licences to fish for gaspereau and 74 licences for American Shad in the Saint John River (DFO Maritimes Region, Licensing Division); 38 and 37 licences respectively are in the County of Saint John (i.e., area of Saint John Harbour upstream and downstream of the Reversing Falls), although, except for 5 licences, both shad and gaspereau licences in this area are held by the same individuals. Bycatch of Shortnose Sturgeon in these commercial alosid fisheries has not been rigorously reported (e.g. DFO logbooks). There are unconfirmed reports that Shortnose Sturgeon are incidentally caught in the fixed and drift gillnets employed in these fisheries. Fishermen have indicated that they do capture Atlantic Sturgeon on occasion (DFO unpublished data). Some of these captures may have been Shortnose Sturgeon as they are particularly vulnerable to capture during their spring spawning migration, which coincides with gaspereau spawning runs. Although it has been reported that Shortnose Sturgeon captured in these alosid fisheries are most often released unharmed, captures in set (i.e. anchored or fixed) gillnets located in areas with high currents, such as the area both upstream and downstream from the Reversing

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Falls, may result in interruptions of the spawning run or higher direct mortality than drift gillnets (Atlantic Sturgeon Status Review Team [ASSRT] 2007). American Shad and gaspereau fisheries in Saint John Harbour are mostly set gillnets.

American Eel fishery: The commercial American Eel fishery on the Saint John River is conducted with both fyke nets and baited eel pots. Both methods permit live release of bycatch. There are indications from commercial fishers that juvenile Shortnose Sturgeon are occasionally captured as bycatch in this fishery. The evidence for interception of adults is less clear, but given the size and location of the fyke nets deployed, it is possible for adult Shortnose Sturgeon to be caught. Actual bycatch numbers, however, have gone unreported. Measures taken to determine how many individuals are caught as bycatch and released, and how many encounters result in mortality each year, will help inform future management decisions.

In addition to direct mortality of individuals in commercial fisheries, Shortnose Sturgeon caught and released in commercial fisheries may also be subject to indirect effects including stress, behavioural changes, post-release mortality or injury. Shortnose Sturgeon exhibit less exhaustion following gillnet capture than other fish species. This suggests that the species is more tolerant to capture and has a better chance of survival upon release. Evidence however suggests that in some US rivers, capture and release during spawning migrations may have secondary effects by interrupting spawning and causing abandonment of migrations (NMFS 1998), but such effects on Shortnose Sturgeon in the Saint John River have not been studied. Baker et al. (2008) examined physiological consequences associated with gillnet capture and handling of a closely related species, the Lake Sturgeon (*Acipenser fulvescens*). During tagging experiments, elevated blood chemistry was observed in the captured fish indicating stress; however, values returned to normal over three days indicating recovery. These results cannot be directly related to Shortnose Sturgeon but do indicate that a closely related species is able to tolerate capture in gillnets and removal from the water for short periods.

Shortnose Sturgeon bycatch rates or mortality estimates in the Saint John River have not been calculated recently, but a historical estimate by Dadswell (1979) indicated 7% of Shortnose Sturgeon bycatch mortality occurred in existing commercial gillnet fisheries at the time. In the US, Atlantic Sturgeon bycatch mortality has been estimated for different gear and target fisheries (ASSRT 2007), providing an indication of the extent of bycatch mortality typically observed in sturgeon fisheries, albeit for a different species and in different habitat. Bycatch mortality estimates in the US American Shad gillnet fishery (a fishery which also occurs in the Saint John River) ranged from 4 -16%.

Bycatch in recreational fisheries

Bycatch of Shortnose Sturgeon in recreational sturgeon and Striped Bass (*Morone saxatilis*) fisheries is considered a threat of low concern because Atlantic Sturgeon are typically the target species in the Sturgeon fishery and retention by anglers in both fisheries is not thought to be an issue. The gear used in the recreational fishery allows for greater chances of live releases and reduced indirect effects. Furthermore, bottom

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lures, which would be required to catch sturgeon, are not often employed in the Striped Bass recreational fishery. A seasonal recreational fishery for Atlantic Sturgeon on the Saint John River attracts anglers who must release all Sturgeon under 120 cm TL. The season for this fishery runs from Jan. 1-May 31 and July 1-Dec. 31. In accordance with the *Maritime Provinces Fishery Regulations,* this fishery has no daily bag limit or possession limit and only sturgeon over 120 cm TL can be retained. Shortnose Sturgeon are occasionally captured in this fishery as well as in the recreational angling fishery for Striped Bass. Although bycatch is likely low, it is possible that some Shortnose Sturgeon can be lawfully retained if caught. Size distribution information is recorded in fork length (FL) and the fishing regulations reference total length (TL). Since the fork length of a fish is less than its total length, a restriction on keeping sturgeon less than 120 cm TL will allow the retention of some Shortnose Sturgeon. The size distribution of the species caught during 1998-2002 sampling of the Sturgeon Derby (Litvak pers. comm. 2013) also suggests that some Shortnose Sturgeon will exceed this total length restriction.

Directed recreational fishery (derby)

In addition to the recreational sturgeon angling, the Pickwauket Lions Club of Hampton, NB hosts an annual catch-and-release sturgeon fishing derby ("The Great Sturgeon Hunt"). This derby takes place during October on the Kennebecasis River, an area where Shortnose Sturgeon are known to aggregate over the winter. Given the timing and location of the derby, it principally targets Shortnose Sturgeon. Well over 100 anglers have been known to participate in the derby, and annual catches range from 40-60 fish (based on 2011 and 2012 data; Pickwauket Lions Club 2014). This annual event has been ongoing for nearly three decades without any reported evidence of direct mortality, however direct and post-release mortality and injury have never been quantified. This activity is considered a threat of medium level of concern, since the interactions with the fish are direct (e.g., hooking and handling), numerous, and with the potential for indirect or post-release effects.

Aboriginal fisheries

Sturgeon, both Shortnose and Atlantic, are Aboriginal Food, Social and Ceremonial (FSC) species. The Aboriginal FSC fishery is managed through licences issued under the *Aboriginal Communal Fishing Licences Regulations* (SOR/93-322). Additionally, some projects funded under both the Aboriginal Fisheries Strategy and the Aboriginal Fund for Species at Risk programs may contribute to the management of these species. Two Aboriginal organizations in NB have FSC allocations for Atlantic Sturgeon and Shortnose Sturgeon on the Saint John River, which are negotiated on an annual basis. Conditions include certain restrictions on gear type, methods of fishing, and seasons. Additionally, individual daily bag limits for each Sturgeon species are specified, although reporting by species is not always provided. The level of concern associated with FSC removals is considered low since annual retentions of Shortnose Sturgeon for FSC purposes are not currently substantial.

Aquaculture removals

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The two aquaculture operators in NB that grow Shortnose Sturgeon for commercial sale previously obtained wild Shortnose Sturgeon under written permissions or licences issued under the *Fisheries Act* or the *Fishery (General) Regulations* (SOR/93-53). These companies have now established their own broodstock using those fish previously collected from the wild, and DFO is not aware of any immediate new wild collection needs. Consequently, the threat is considered of low concern at this time, but would be reconsidered should new requests for wild removals be received.

Removals for scientific or other purposes

DFO is not aware of any immediate wild collection needs for either experimental, scientific, educational or public display purposes, but any collections of individuals from the wild would require a licence under section 52 of the *Fishery (General) Regulations*. Consequently, the threat is considered of low concern at this time, but request for wild removals should be reviewed in light of the objectives of this Management Plan should any be received.

Illegal harvest

Illegal harvest of Shortnose Sturgeon has been reported in US rivers (e.g. Kynard 1997). To date, there is only anecdotal information regarding illegal harvest of sturgeon in the Saint John River. The degree to which Shortnose Sturgeon are retained in this activity is unknown and there is no evidence to substantiate such removals. Accordingly, the number of Shortnose Sturgeon lost to illegal harvest is unknown but likely low.

4.2.3. Other Threats

Escape of hybrids

Interspecific Shortnose/Atlantic Sturgeon hybrids (i.e. offspring of different species within the same genus) are currently being raised in a land-based aquaculture facility in NB within the Saint John River watershed. It is currently unknown whether these hybrids are fertile and what the consequence could be for existing wild sturgeon populations if hybrids were to escape into the Saint John River (e.g. interbreeding, competition). Because hybrids are currently housed in a land-based facility under strict containment practices, the risk of escape is currently considered very low.

Non-native invasive species

The Saint John River is located primarily in the Province of NB but is also in, and arising from, the province of Quebec and the US state of Maine. Muskellunge (*Esox masquinongy*) is a non-native predatory fish species that was introduced in a Quebec headwater lake on the Saint John River in the 1970s and has since established self-sustaining local populations in the river (Stocek et al. 1999; Curry et al. 2007). This species now appears to be common in the upper basin. Yoder et al. (2005) reported

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adults and juveniles in 8 of 13 sites in Maine waters, and Kidd et al. (2011) collected adults at various locations and juveniles in Glazier Lake, a Saint John River headwater lake located in Maine. Adults and sub-adults (individuals greater than 40 cm long) are now regularly caught by anglers downstream to Fredericton and one adult was captured in the Otnabog River near Gagetown in 2010 (Kidd et al. 2011). The Muskellunge is a voracious predator, placing added pressure on many species in the Saint John River. Its primary diet consists of Yellow Perch (*Perca flavescens*), White Sucker (*Catostomus commersonii*), and cyprinids[13] but it likely feeds on most fish species depending on opportunity and habitat overlap (Stocek et al. 1999). Like Shortnose Sturgeon, Muskellunge are known to inhabit slow river stretches with submergent and emergent vegetation (Scott and Crossman 1973). Although there is some habitat overlap between species, Muskellunge predation on adult Shortnose Sturgeon is highly unlikely given the latter's size and robustness. However, juvenile Shortnose Sturgeon may be at risk of such predation. The overall severity of the predation threat that Muskellunge poses to Shortnose Sturgeon is currently unknown, but this threat is currently considered to be of low concern.

Other non-native invasive species such as Smallmouth Bass (*Micropterus dolomieu*) and Chain Pickerel (*Esox niger*) are also present in the Saint John River, but unlike Muskellunge, they have been present in the system for a long time, since the late 1800's (Cox 1896; Catt 1949), and are not considered to represent an emerging threat to Shortnose Sturgeon.

Disease

Little work has been done on disease vectors and effects on Shortnose Sturgeon and no studies have been done on the Saint John River population specifically. However, the introduction of pathogens and disease is a potential threat to Shortnose Sturgeon. One potential source of disease transfer could be from the sturgeon aquaculture facility on the Saint John River which releases its effluent through streams prior to release into the river. Aquaculture facilities are however regulated by federal and provincial legislation including the *Fish Health Protection Regulations* of the *Fisheries Act*, and the *Water Quality Regulations* of the *NB Clean Environment Act* and *Aquaculture Act* that require measures to monitor and control disease within the facility and to minimize the risk of releasing contaminated effluent into the surrounding natural environment. These regulations and the existing level of mitigation currently in place is considered effective in preventing the spread of disease to the wild population of Shortnose Sturgeon, This threat is therefore currently considered to be of low concern.

4.2.4. Limitations: Knowledge Gaps

Although not a direct threat to the survival of the species, perhaps the greatest opportunity to improve the evaluation and understanding of the threats to the Saint John

[13]Cyprinids: any of numerous often small freshwater fishes of the family *Cyprinidae*, which includes the minnows, carps, and shiners.

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River Shortnose Sturgeon population is improving our knowledge of population abundance, habitat quality and use, and identified threats. This improvement in knowledge may also represent the greatest opportunity to inform and improve the management of this species and its habitat. These and other gaps in knowledge are further described below.

Population abundance: No complete modern population abundance estimate exists for Shortnose Sturgeon. There is only a single complete population abundance estimate provided for Saint John River Shortnose Sturgeon, Dadswell's historical 1979 estimate. Although several partial adult population abundance estimates have been attempted in more recent years (see Population abundance in Section 3.2.2 of this document), these are not easily comparable nor do they allow tracking population abundance changes over time. Therefore, given the lack of a comparable time series of population abundance, and despite ongoing consistent annual catches in the Sturgeon Derby, the abundance of the population over time is unknown. Furthermore, these more recent past estimates do not include juvenile abundance estimates.

Extent of occurrence and important habitat: Questions remain about the extent of occurrence of the Saint John River Shortnose Sturgeon population, particularly above the Mactaquac Dam, in the tributaries below the dam, and in the Bay of Fundy. Although an important spawning habitat area below the Mactaquac Dam and an important overwintering habitat area near the confluence of the Hammond and Kennebecasis Rivers have been confirmed and are acknowledged in this Management Plan, other spawning and overwintering habitat, migration corridors, and feeding areas remain to be confirmed.

Habitat conditions due to Mactaquac Dam operating regime: Oxygen levels below Mactaquac Dam have improved in recent years; however, little is known about the condition of sturgeon habitat below the dam and whether it has changed over time. The effects of the Mactaquac Dam operating regime (e.g. downstream flow rates, temperature changes) on early life stages of Shortnose Sturgeon have not been evaluated and remain unknown.

Bycatch and mortality rates: Bycatch and mortality rates in various commercial and recreational fisheries in the Saint John River are unquantified. Monitoring and reporting could be improved.

Aboriginal Traditional Knowledge: ATK holders have shared some contemporary and traditional knowledge of the species in the development of this Management Plan. The gathering and sharing of more ATK regarding Shortnose Sturgeon and its habitat would be welcomed.

5. Management Objective

This Management Plan aims to ensure that Shortnose Sturgeon does not become threatened or endangered. The geographic scale for managing the species is the Saint

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John River system in the Province of NB, primarily between the Mactaquac Dam and Saint John Harbour. There is no current need or rationale to provide for the expansion of Shortnose Sturgeon range in Canada.

Accordingly, the overall objective of this Management Plan is to:

> *Maintain sustainable population levels and the current distribution of Shortnose Sturgeon in Canada.*

A numerical population objective cannot be established at this time because there are no recent and complete abundance estimates for the Saint John River Shortnose Sturgeon population. Sustainable population levels may be defined once a modern population size is determined. However, a recent review by Stokesbury et al. (2014) suggests that a minimum viable population size of 5,000 adults is appropriate for Shortnose Sturgeon on the east coast of North America, given their life-history characteristics and assumed low mortality (natural and fisheries-related).

6. Broad Strategies and Conservation Measures

This Management Plan includes broad strategies and related conservation measures to maintain the Canadian Shortnose Sturgeon population. These strategies and measures recognize that Shortnose Sturgeon holds biological and ecological significance, but also social, cultural, and economic value to local First Nations and Aboriginal organizations, industry, and the Canadian public as a whole for education, research, and sustainable use.

Conservation measures for Shortnose Sturgeon are organized under three Broad Strategies:

Broad Strategy 1: Research, monitoring, and assessment.

Broad Strategy 2: Protection and management.

Broad Strategy 3: Stewardship, outreach and communication.

Implementation of these conservation measures will help achieve the overall management objective of this plan. Sections 6.1 and 6.2 provide an overview of those conservation actions currently underway and those that are yet to be implemented, respectively. Conservation measures to be implemented are summarized in an Implementation Schedule in Section 6.3. The schedule prioritizes the conservation measures, and identifies leads, partners, and timelines, to the extent possible at this time.

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6.1. Actions Already Completed or Currently Underway

6.1.1. Broad Strategy 1: Research, Monitoring, and Assessment

Biological studies on the wild population

Prior to 2010, published information on Shortnose Sturgeon in the Saint John River was limited mainly to studies carried out in the 1970s and 1980s (e.g. Dadswell 1976a, 1979, 1984). In recent years, research scientists at Mount Allison University, Acadia University, and the University of New Brunswick have studied a range of topics including: effects of gillnet capture; temperature, growth, survival and swimming performance; feeding and growth; water velocity effects on physiology and behavior; overwintering habitat; timing of spawning and hatching; population and age estimates; larval drift; feeding ecology; and environmental mortality. Information from these recent studies has been incorporated into this Management Plan as appropriate.

Biological studies on the species in captivity

The Shortnose Sturgeon aquaculture industry in New Brunswick has also conducted a range of studies related to captive-breeding Shortnose Sturgeon including studies on: dissolved oxygen, growth and feed rates, spawning intervals, vitellogenesis (egg yolk formation), water temperature, larval growth, larval impacts from temperature, flows, oxygen levels and silt/substrate shocks, etc. Much of this research has been shared and contributed to the work of academic researchers.

Mactaquac Aquatic Ecosystem Study

By 2017, NB Power will be making a decision to rebuild or remove the Mactaquac Generating Station on the Saint John River, which is expected to reach the end of its service life by 2030. To make an informed, science-based decision on preferred options, NB Power has engaged the Canadian Rivers Institute (CRI) to design a large multidisciplinary aquatic ecosystem study to support their decision making process and subsequent regulatory requirements. The Mactaquac Aquatic Ecosystem Study (MAES) is a multi-year, planned, whole-river ecosystem study and dam manipulation (flow, sediment load and thermal regime) which includes a number of separate project components organized under three themes: 1- whole river ecosystem, 2- fish passage, and 3- environmental flows. One of the projects (scheduled for 2014-2017) aims to determine the location of spawning grounds for both Atlantic and Shortnose Sturgeon, improve the understanding of seasonal habitats of adults of both species in the Saint John River, and identify flow regime scenarios for either the dam renewal or removal. Another project (scheduled for 2014) is focused on fish passage for multiple species to inform the conceptualization of engineering design options for fish passage at a future Mactaquac Dam. Further information on the MAES and the various separate study themes and projects can be found on the CRI website.

Gathering of Aboriginal Traditional Knowledge

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Some ATK has been gathered in recent years by local Aboriginal organizations. The Maliseet Nation Conservation Council (MNCC) has recently concluded a traditional knowledge study in six NB Maliseet First Nation communities to collect ATK about several fish species of relevance to the Maliseet First Nation, including the Shortnose Sturgeon. A report on the study was produced by MNCC in 2012 (MNCC 2012). The ATK gathered included information on the species' biology, food and feeding, traditional significance of the species to First Nations, current locations of Shortnose Sturgeon in the river and threats to long term existence of the species. In 2014, MNCC will undertake a study to evaluate the efficacy of different ATK data collection mechanisms (i.e., questionnaires, facilitated discussions and storytelling) and to investigate social and cultural significance of species at risk, including the Shortnose Sturgeon, to First Nations. The ATK gathered during both studies will be presented on Geographic Information System (GIS) maps.

6.1.2. Broad Strategy 2: Protection and Management

Several mechanisms are in place to manage activities to protect both Shortnose Sturgeon and its habitat.

Management of fishing and transfer activities

Several pieces of legislation are used to manage fishing for Shortnose Sturgeon, their transfer to rearing facilities, and their release into fish habitat:

- For commercial and recreational fisheries on the Saint John River, Shortnose Sturgeon is for the most part protected by a retention size limit of 120 cm minimum total length, which is near the species' maximum size. This size limit was first introduced in the *New Brunswick Fishery Regulations* (C.R.C. 1978, c.844). In 1993, the NB regulations were replaced by the *Maritime Provinces Fishery Regulations* (SOR/93-55) made under the authority of the federal *Fisheries Act* (R.S.C. 1985, c.F-14). Section 97 of these regulations maintains the 120 cm length restriction for sturgeons. The regulations also provide for gear and seasonal closures. For inland waters, a recreational angling licence is required under the *New Brunswick Fish and Wildlife Act* (SNB 1980, c.F-14.1). However, only a very small section of the Saint John River below Mactaquac Dam is considered inland waters; from the Dam downriver approximately 2 km to Crocks Point. The rest of the river to Saint John Harbour is considered tidal waters.
- A written permission is required under section 4 of the *Fisheries Act* to obtain Shortnose Sturgeon for purposes of artificial breeding (aquaculture).
- A licence is required under section 52 of the *Fishery (General) Regulations* to fish for Shortnose Sturgeon for scientific, educational, research, or public display purposes (the only reasons for which direct removals are permitted).
- A licence is required under section 56 of the *Fishery (General) Regulations* to transfer Shortnose Sturgeon to rearing facilities (e.g. aquaculture); or to release them into fish habitat.

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Current aquaculture operations have an established Shortnose Sturgeon broodstock. Should there be a request in the future to obtain additional wild broodstock, it would be handled in accordance with the relevant statutory requirements listed above. The objectives of this Management Plan would also be considered. Written permissions and licences carry strict terms and conditions with respect to where fishing can occur, the gear that is permitted to be used, the number of fish (including the sex of those fish) that can be retained, and the mandatory reporting of all activities carried out under that written permission or licence. Fishery officers, in the normal course of their duties, carry out compliance monitoring for all types of written permissions and licences. In addition, up-to-date reports on the number of written permissions and licences, by species, are available to DFO for tracking purposes and for monitoring the potential number of fish authorized to be removed from the wild.

Management of commercial trade

Shortnose Sturgeon is listed in Appendix I of CITES and therefore trade of Shortnose Sturgeon is only authorized in exceptional circumstances. Commercial trade of wild specimens is strictly prohibited, but the commercial trade of captive-bred specimens from CITES-registered aquaculture facilities is possible. CITES is responsible for regulating the export, re-export, import, and introduction of live and dead animals and plants listed under CITES, as well as their parts and derivatives, through a system of permits and certificates. For species listed in Appendix I, permits or certificates may only be issued if international trade is not detrimental to their survival in the wild (CITES 2010).

Management of habitat quality

Shortnose Sturgeon habitat quality in the Saint John River is managed under existing provincial and federal legislation and regulations. Water quality of the Saint John River has improved since the first serious concerns were raised in the 1950s and 1960s. This is the result of improved enforcement of pollution regulations by government and better wastewater treatment by municipalities and industries along the river.

The New Brunswick Department of Agriculture, Aquaculture and Fisheries (DAAF) have trained staff within the Saint John River watershed, and provide substantial financial assistance, to assist agriculture producers in selecting and implementing environmental Beneficial Management Practices to reduce agricultural contamination of the watershed by soil particles, chemical fertilizers, pesticides, and livestock manure. The DAAF also undertakes environmental research with the objective of reducing impacts from agriculture.

New development projects, as well as the ongoing operation, maintenance, and modification of existing facilities, are typically reviewed under current provincial and federal legislation (e.g. the federal *Fisheries Act*, the NB *Clean Water Act*, and the NB *Crown Lands and Forest Act*) to ensure that impacts are acceptable. As stated in

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Section 4.2.1 "*New Development Activities"*, the preferred outcome of these project reviews is to avoid serious harm to fish and fish habitat by implementing mitigation measures. This may involve undertaking the work at a time, in a location, or in a manner that minimizes the risk of impacts.

6.1.3. Broad Strategy 3: Stewardship, Outreach, and Communication

Community education and awareness programs that provide members of the public, local residents, and other stakeholders with the information, skills, and tools to reduce and mitigate threats to Shortnose Sturgeon on the Saint John River can contribute to the conservation and management of the species.

The Maritime Aboriginal Peoples Council (MAPC) has produced and distributed a number of informational posters and pamphlets that focus on the anatomy, life cycle, threats, and Aboriginal significance of the Atlantic Sturgeon and Shortnose Sturgeon (MAPC 2011). DFO has created and distributed posters on Shortnose Sturgeon in Atlantic Canada for Oceans Day events. Various provincial and federal government employees involved in the conservation of Shortnose Sturgeon provide information (pamphlets, posters, emails, meetings) to stakeholders to raise awareness and promote best practices for industrial, agricultural, and municipal pollution prevention. Federal and provincial governments support education programs and stewardship initiatives as well as restoration projects led by watershed groups and other non-government organizations. The Habitat Stewardship Program (HSP) and the Aboriginal Fund for Species at Risk (AFSAR) are examples of federal programs designed to help Canadians protect species at risk and their habitats. The 2012 and current (2014) MNCC projects were funded through AFSAR. These programs foster land and resource use practices that maintain the habitat necessary for the survival and recovery of species at risk, enhancing existing conservation activities and encouraging new ones. These programs provide an ongoing potential resource for parties interested in species at risk conservation and recovery efforts. The Recreational Fisheries Conservation Partnerships Program (RFCPP) may also provide funding opportunities to those interested in undertaking activities to restore fisheries habitat.

These actions provide a starting point for raising public awareness of the species and engaging First Nations, Aboriginal organizations, other local communities, stakeholders, and the general public in the conservation of Shortnose Sturgeon.

6.2. Additional Actions to be Implemented

6.2.1. Broad Strategy 1: Research, Monitoring, and Assessment

As outlined elsewhere in the Management Plan, many knowledge gaps need to be addressed to ensure the successful management and conservation of Shortnose Sturgeon in the Saint John River. Given this, knowledge acquisition is a primary focus of

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the Management Plan. Research, monitoring, and assessment should focus on increasing knowledge of the species, particularly early life history (biology, ecology, and mortality, including the vulnerability of juvenile sturgeon to predation by invasive predators such as Muskellunge), adult population abundance, species' extent of occurrence and identification of additional important habitat areas, bycatch mortality, impacts of the Mactaquac Dam, and the gathering of ATK. The acquisition of this information is important in informing the other conservation measures required to meet the Management Plan objective.

Determine population abundance

Determining the current and ongoing population abundance is a high priority measure. A modern quantitative adult population estimate that can be compared to the 1979 baseline should be completed, and the adult population size should be re-assessed every 10 years. This information is needed to determine the current stability of the population and to evaluate whether the abundance objective to maintain the current population numbers is adequate or whether population abundance needs to increase. One method to accomplish this could be to undertake additional efforts to locate and characterize all winter aggregation sites for Shortnose Sturgeon in the Saint John River (DFO 2014). Determining the juvenile population size is also important but of lower (medium) priority.

Collect, archive, and analyze genetic tissue

Genetic samples have been taken and analyzed from the Saint John River and other populations (see "Genetic Distinctiveness" Section 3.1.1 for details). Evidence suggests that genetic bottlenecking has not occurred in the Saint John River Shortnose Sturgeon population; however, it would be prudent to develop an archive of Shortnose Sturgeon tissue should genetic bottlenecking become a concern in the future, or if such information is needed to set an abundance target for maintaining genetic health.

Furthermore, given the potential for coastal migrations and the proximity of the Maine Shortnose Sturgeon populations to the Bay of Fundy, the origin of Shortnose Sturgeon found in the Bay of Fundy can only be assumed until genetic analysis provides confirmation. Genotyping Shortnose Sturgeon specimens found outside of the Saint John River in the Bay of Fundy could help to confirm if and how this population uses the marine environment.

Confirm extent of occurrence

The extent of occurrence of the Saint John River Shortnose Sturgeon population may be more extensive than currently thought. The presence or absence of Shortnose Sturgeon above the Mactaquac Dam, in the tributaries below the Mactaquac Dam, and in the Bay of Fundy should be confirmed.

Monitor use and identify additional important habitat areas

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Two important habitat areas have been confirmed for Shortnose Sturgeon in the Saint John River and are acknowledged in this Management Plan, including a spawning area just below the Mactaquac Dam and an overwintering area near the confluence of the Kennebecasis and Hammond Rivers. Other important habitat areas have been previously reported and still other likely exist. A monitoring and research program should be initiated to a) monitor the use of these two important habitat areas for key Shortnose Sturgeon life processes, and b) confirm whether other important habitat areas exist, such as migration corridors, staging areas and other spawning and overwintering sites, in particular those overwintering sites previously reported by Dadswell (1979 and 1984).

Evaluate effects of identified threats

Threats arising from human activities and their effects on the population are poorly understood. There are known issues in terms of habitat quality, but the effects on Shortnose Sturgeon are unknown. For example, the effect of the Mactaquac Dam flow rates and water quality on spawning activity and larval transport are poorly understood. Therefore, a conservation measure aimed at evaluating what effects the Mactaquac Dam operating regime may have on early Shortnose Sturgeon life stages is included as a high priority. Although historic commercial fishing mortality was estimated to contribute approximately 7% of total mortality, there are no recent estimates for Shortnose Sturgeon mortality as bycatch in commercial fisheries in the Saint John River, and no estimates of mortality have been determined for recreational fisheries. Given the level of concern associated with bycatch mortality, the numbers of Shortnose Sturgeon taken as bycatch in commercial fisheries should be estimated and the associated mortality should be quantified. Similarly, the rates of direct and post-release mortality or effects (e.g., injury, behavioural changes) associated with directed recreational fishing for Shortnose Sturgeon should also be quantified.

Gather additional Aboriginal Traditional Knowledge

ATK is an important source of local and experiential knowledge about the current state of Shortnose Sturgeon and its threats. ATK holders have shared some contemporary and traditional knowledge, including historic extent of occurrence, in the development of this Management Plan. Building on this, an ATK study to gather additional traditional knowledge on Shortnose Sturgeon habitat use, extent of occurrence, and threats should be undertaken and shared.

6.2.2. Broad Strategy 2: Protection and Management

Minimize impacts on important habitat and explore management and protection options

As previously mentioned, development projects are typically reviewed under current provincial (i.e. NB *Clean Water Act* and the NB *Crown Lands and Forest Act)* and

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federal legislation (i.e. the fisheries protection provisions of the *Fisheries Act*), and the preferred outcome of these reviews is to avoid serious harm to fish and fish habitat. To ensure that important Shortnose Sturgeon habitats are considered appropriately in these reviews, a map of these areas should be developed and shared with regulators. This will allow regulators to take these areas into consideration when reviewing future developments along the Saint John River. Further to this, the outcomes of the Mactaquac Aquatic Ecosystem Study and selection options for the Mactaquac Generating Station (renewal or removal) should be discussed between relevant parties (i.e., industry, regulators, scientific experts) to inform the development of subsequent water manipulation (flow, sediment load, and temperature) and management regimes appropriate for important Shortnose Sturgeon habitat. Options to ensure that additional protection is applied to these areas should also be explored and implemented.

Consider Shortnose Sturgeon in fish passage design options

Pending the outcomes of the decision on the future of the Mactaquac Dam and research on the presence/absence of Shortnose Sturgeon above the Mactaquac Dam, the need to provide Shortnose Sturgeon with access to upstream habitat should be evaluated. If the Dam is to be rebuilt and there is value in providing upstream passage to Shortnose Sturgeon, this species should be included in engineering design for fish passage.

Revisit minimal size retention length

Shortnose Sturgeon bycatch in recreational and commercial fisheries for other species is known to occur occasionally but specific levels of bycatch are not well known. Given the earlier noted discrepancy between total and fork length measurements for Shortnose Sturgeon and associated size restrictions (see Section 4.2.2) management measures that would reduce the risk that Shortnose Sturgeon could be legally retained in the recreational fishery for other species, or as a bycatch in commercial fisheries for other species including the directed Atlantic Sturgeon fishery, should be considered.

Improve bycatch/catch monitoring and reporting

Although there is mandatory reporting of bycatch in the Freshwater Fishery Logbook Report for the commercial Atlantic Sturgeon, American Shad, Gaspereau, and American Eel fisheries (for example), compliance with the bycatch recording as well as with logbook submission remains a concern. To ensure greater compliance with mandatory reporting, additional measures to promote compliance should be explored and implemented. Improved logbook submissions, including increased reporting by sturgeon species (i.e., Shortnose or Atlantic Sturgeon) in all fisheries, including the Aboriginal FSC fishery, and increased monitoring should help determine more accurate bycatch/catch levels. If the bycatch of Shortnose Sturgeon in one or more of these fisheries is of more significant concern than currently thought, additional management measures should be explored such as time, area, and/or gear changes to help reduce Shortnose Sturgeon bycatch. Validation of reported bycatch rates by fisheries officers

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also contributes to improved compliance and monitoring. Possible methods for monitoring recreational bycatch/catch of Shortnose Sturgeon should also be explored.

Evaluate extent of illegal harvest

Although anecdotal information regarding targeted illegal harvest has been received, the target sturgeon species and degree of retention from this activity are unknown. Efforts should be made to evaluate the extent to which this is occurring and implement measures to discourage this activity.

Review requests for removals

Any future request for wild broodstock removals (e.g. for expansion of existing aquaculture facilities, establishment of new facilities, or response to a catastrophic loss) would be reviewed according to the DFO Access to Wild Aquatic Resources Policy, to ensure that numbers removed from the wild would not impact sustainable population levels or the objectives of this Management Plan. Any future request for wild removals for scientific or other purposes (e.g. educational, public display) would also be reviewed in light of the objectives of this Management Plan and licence requirement under section 52 of the *Fishery (General) Regulations.*

6.2.3. Broad Strategy 3: Stewardship, Outreach, and Communication

Raise awareness

Raising awareness about this ancient fish species, its existence in the Saint John River as the sole Canadian population, and its importance to the ecosystem, with the local fishing industry, municipalities, and other stakeholders located along the lower Saint John River watershed will help to promote and support conservation measures. One example of how this could be achieved among recreational anglers is the creation of a species' profile page in the New Brunswick angling guide, similar to that found in the Nova Scotia Anglers' Handbook for the Endangered Atlantic Whitefish.

Engage groups in reducing threats

Efforts by First Nations, Aboriginal organizations, stakeholders, and other interest groups to reduce threats to Shortnose Sturgeon and its habitat will be important in the conservation of this species. These efforts may include expanding existing education programs and stewardship initiatives, or adding new ones as appropriate. The development and distribution of information (pamphlets, posters, emails) aimed at preventing industrial, agricultural, and municipal pollution in the Saint John River and its tributaries, particularly in important Shortnose Sturgeon habitat areas, is a potential area of focus. Existing materials may be useful (e.g. Province of NB & Agriculture Canada stewardship material on best management practices). Efforts should be made to ensure that those engaged in relevant fisheries are able to readily distinguish between a Shortnose Sturgeon and an Atlantic Sturgeon. Additionally, best practices in handling

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and live release of catch/bycatch in commercial and recreational fisheries should continue to be promoted. Federal and provincial governments should continue to support existing education programs, stewardship initiatives, and restoration projects led by external parties through programs such as HSP, AFSAR and RFCPP.

6.3. Conservation Measures and Implementation Schedule

To help meet the management objective for Shortnose Sturgeon, a Conservation Measures and Implementation Schedule has been developed (Table 4). This schedule outlines the prioritized conservation measures necessary to maintain a sustainable population level and current distribution of Shortnose Sturgeon in Canada. Leads, partners, status, and timelines necessary for successful implementation are also included to the extent possible. Successful management of this species is not solely dependent on the actions of any single jurisdiction; rather, it requires the commitment and cooperation of many different constituencies. DFO strongly encourages other agencies, organisations and all Canadians to participate in the conservation of Shortnose Sturgeon by participating in the conservation measures outlined in this Management Plan. While DFO has already commenced efforts to implement the plan, the performance of activities that have been included in Table 4, but which have not yet been implemented, will be subject to the availability of funding and other resources. Where appropriate, partnerships with specific organizations and sectors will provide the necessary expertise and capacity to carry out the listed measures. If your agency or organisation is interested in participating in any of the outlined conservation measures, please contact the Species at Risk Maritimes Region office at xmarsara@mar.dfo-mpo.gc.ca; or by phone (toll-free) at 1-866-891-0771.

Explanation of column headings in Table 4

Table 4 is laid out so that each conservation measure listed in the table is first grouped under one of the three broad strategies highlighted in this Management Plan. These measures are then further sub-grouped under the specific threat category/limitation being addressed. Additional columns outline the conservation measures, priority, status, responsibility, and timeline.

Conservation measures: The activities or actions that should be taken to implement the Management Plan are summarized and organized according to the three broad strategies outlined above. Further details related to each measure are provided in Section 6.2.

Priority: Priority levels (low, medium, or high) are assigned to reflect the direct contribution a conservation measure will make toward addressing the stated threat or limitation, and thus the degree to which the activity is expected to contribute to achieving the management objective for Shortnose Sturgeon. It does not take into account the priorities and budgetary constraints of the participating jurisdictions and organizations, but may be used to inform decisions on funding as well as departmental and conservation priorities.

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- High priority measures are those considered most likely to have an immediate and/or direct influence on meeting the management objective for Shortnose Sturgeon and are thus considered to be most urgently needed. In some cases, a high priority action may be an essential precursor to a measure that contributes to the management of the species.
- Medium priority measures may have a less immediate or less direct influence on reaching the management objective, but are still important for the management of Shortnose Sturgeon populations.
- Low priority measures will likely have an indirect or gradual influence on reaching the management objective, but are considered important contributions to the knowledge base and/or public involvement in, and acceptance of, measures required for Shortnose Sturgeon management.

Status: The Status column reflects whether an activity has been initiated, with two status categories: Not started or Underway.

Responsibility: The Lead and Partner columns list the jurisdictions, organizations, and other parties currently or potentially involved in completing the stated conservation measures. This Management Plan is also intended to encourage other groups to become involved, and these future partnerships may not be completely captured within this document at this time. In some cases, the organizations or parties that may become involved have yet to be determined. Below is a list of acronyms used in these two columns of the table.

AOs: Aboriginal Organizations
CRI: Canadian Rivers Institute
DFO: Fisheries and Oceans Canada
EC: Environment Canada
MAARS: Maritime Aboriginal Aquatic Resources Secretariat
MAPC: Maritime Aboriginal Peoples Council
MNCC: Maliseet Nation Conservation Council
N/A: Not Applicable
NB DELG: New Brunswick Department of Environment and Local Government
NB DAFF: New Brunswick Department of Agriculture, Aquaculture and Fisheries
NB DNR: New Brunswick Department of Natural Resources
NGOs: Non-Government Organizations
TBD: To Be Determined

Timelines: The Timeline column indicates the estimated timeline for completion of the conservation measure from the date of publication of this Management Plan. The timeline may reflect a specific time interval (<2 years; 2-5 years; >5 years), or may be continuous (i.e. the activity will be ongoing over an indefinite time period). TBD is used if the timeline is unknown or undetermined at the time of Management Plan publication.

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Table 4. Conservation measures and implementation schedule.

Conservation measure	Priority	Current status	Responsibility		Timeline
			Lead	Partner	
Broad strategy 1 – Research, monitoring, and assessment					
A. Threat to habitat					
Quantify mortality during early life stages (eggs, larvae, juveniles) in important habitat in the Saint John River that may be used for spawning and nursery areas.	High	Underway	Academia	AOs, Communities, Industry	Continuous
Determine the effects of the Mactaquac Dam operating regime (flow) on early life stages	High	Underway	CRI	DFO, AOs, Communities, Industry	2-5 years
B. Threat of direct mortality and removals					
Quantify bycatch and mortality in commercial shad, gaspereau, and eel fisheries	High	Not started	DFO	AOs, Academia, Industry	2-5 years
Quantify adult mortality from directed recreational fishing	High	Not started	DFO	Academia, NGOs, Recreational fishers	2-5 years
Quantify adult bycatch and mortality from other recreational fisheries	Medium	Not started	Academia	AOs, DFO, Recreational fishers	2-5 years
C. Other threats					
Quantify juvenile mortality related to predation by invasive species	Medium	Not started	TBD	TBD	TBD
D. Limitation to be addressed: Knowledge gaps					
Determine current adult population abundance	High	Underway	Academia	AOs, DFO	2-5 years
Develop protocol and implement program to assess adult population abundance (one estimate per decade)	High	Underway	Academia	AOs, DFO	2-5 years (development)

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Conservation measure	Priority	Current status	Responsibility		Timeline
			Lead	Partner	
Confirm location of spawning grounds and improve understanding of adult seasonal habitats	High	Underway	CRI	Industry (e.g., Acadian Sturgeon and Caviar Inc.)	2-5 years
Monitor the use of important habitat areas for key life processes: spawning, overwintering and learn more about known habitats	High	Underway	Academia, AOs, Communities	DFO	Continuous
Confirm presence/absence in areas beyond known extent of occurrence (focus above the Mactaquac Dam, tributaries below Mactaquac Dam and Bay of Fundy)	High	Underway	Academia, AOs	DFO	2-5 years
Gather and share Aboriginal Traditional Knowledge (ATK) on Shortnose Sturgeon habitat use and extent of occurrence	High	Not started	First Nations, AOs	DFO, Academia, Communities	TBD
Confirm existence of any additional important habitat areas and monitor life processes	Medium	Underway	Academia, AOs, Communities	DFO	Continuous
Determine juvenile population size	Medium	Underway	Academia	AOs, DFO	2-5 years
Quantify mortality related to predation on early life stages	Low	Not started	Academia	AOs, Industry, DFO	> 5 years
Establish a tissue archive for use in genetic evaluations as needed	Low	Not started	Academia	TBD	2-5 years
Broad strategy 2 – Protection and management					
A. Threat to habitat					
Minimize impacts on important habitat (e.g., known spawning and overwintering areas)	High	Underway	DFO, EC, NB DELG, Industry	N/A	Continuous

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Conservation measure	Priority	Current status	Responsibility		Timeline
			Lead	Partner	
Develop map of important habitat areas within the Saint John River for Shortnose Sturgeon and share with other regulators	Medium	Not started	DFO	Academia	<2 years
Explore and implement protection options for important habitat areas	Medium	Not started	DFO, others (TBD)	TBD	2-5 years
Consider Shortnose Sturgeon in fish passage design options at a future Mactaquac Dam	Low	Not started	CRI, NB Power	DFO	2-5 years
B. Threat of direct mortality and removals					
Monitor bycatch in commercial fisheries (Shad, gaspereau, eel)	High	Underway	DFO	Industry	<2 years
Improve compliance with mandatory reporting	High	Underway	DFO	Industry	<2 years
Evaluate extent of illegal harvesting and implement measures to reduce as necessary	High	Not started	Regulatory Agencies (DFO/NBDNR)	N/A	Continuous
Revisit current regulations to reduce the risk of Shortnose Sturgeon retention (fork length vs. total length)	Low	Underway	DFO	N/A	<2 years
Determine and implement best approach to monitor recreational catches of Shortnose Sturgeon.	Medium	Not started (mandatory reporting does not currently exist)	DFO, NBDNR	N/A	2-5 years
Limit total removal for aquaculture or other purposes if necessary	Low	Underway (Permitted only under DFO licence)	DFO	N/A	Continuous
Improve reporting in Aboriginal Fisheries	Low	Underway	DFO	AOs	Continuous
Broad strategy 3 – Stewardship, outreach, and communications					

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Conservation measure	Priority	Current status	Responsibility		Timeline
			Lead	Partner	
Engage First Nations and Aboriginal organizations and local interest groups in efforts to reduce threats to the species and its habitat	Medium	Not started	DFO	AOs, NGOs	TBD
Develop and distribute outreach materials of information about important habitat locations and related threats to habitat users and regulators	Medium	Not started	DFO	TBD	TBD
Promote water quality best practices to reduce industrial, agricultural and municipal pollution	Medium	Not started	NBDELG, EC, NBDAAF	DFO, Industry	TBD
Continue and expand existing awareness and education programs, and stewardship initiatives as well as restoration projects	Medium	Underway	AOs (e.g. MAARS, MAPC, MNCC) NGOs	All	Continuous

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7. Measuring Progress

Reporting on implementation of the Management Plan under section 72 of SARA will be done by assessing progress towards implementing the broad strategies and conservation measures. The implementation of this Management Plan will be monitored on an on-going basis and will be assessed within five years after the plan has been posted to the Public Registry.

The performance indicators below provide a way to monitor and assess progress toward achieving the overall objective of this Management Plan. These indicators are also used to evaluate whether the conservation measures identified in Table 4 are adequate for their purpose.

Broad Strategy 1: Research, monitoring and assessment

- Have quantitative estimates of all sources of adult and juvenile mortality been obtained?
- Have the effects of the Mactaquac Dam on habitat use and early life stage survival been determined?
- Has bycatch in commercial and recreational fisheries been quantified?

- Has adult population size been determined?
- Has an adult abundance monitoring program been developed and implemented?
- Has the location of spawning grounds been confirmed and understanding of seasonal habitats of adults been extended?
- Have studies been undertaken to confirm the existence of additional important habitat areas?
- Is the use of confirmed important habitat being monitored?
- Has the species' extent of occurrence been better defined?
- Has additional Aboriginal Traditional Knowledge about the historical and current Shortnose Sturgeon distribution and habitat use been gathered?
- Has juvenile population size been determined?
- Have tissue samples been archived?

Broad Strategy 2: Protection and management

- Have impacts to known important habitat areas been minimized and protection options been explored?
- Have important habitat areas been mapped and this information shared with regulators?
- Has Shortnose Sturgeon been considered in fish passage design options for a potential future Mactaquac Dam?
- Are systems in place to effectively monitor bycatch in relevant commercial fisheries and bycatch/catch in recreational fisheries in the Saint John River?
- Has there been increased compliance with mandatory reporting in relevant fisheries in the Saint John River (e.g., Atlantic Sturgeon, American Shad, Gaspereau, American Eel)?
- Are illegal harvesting levels better understood and has illegal harvest been reduced as needed?
- Have fishing regulations related to the minimum size of retention been reviewed and clarified?
- Have removals for aquaculture or other purposes been limited if necessary?
- Have reporting requirements in Aboriginal fisheries been improved?

Broad Strategy 3: Stewardship, outreach, and communications

- Have First Nations, Aboriginal organizations, and local interest groups been engaged in Shortnose Sturgeon conservation?
- Have stakeholders received information on the species, its habitat, and the threats it faces?
- Have educational materials aimed at preventing industrial, agricultural, and municipal pollution in the Saint John River and its tributaries, particularly in important Shortnose Sturgeon habitat areas, been developed?
- Are there awareness and education programs, stewardship and outreach initiatives, and restoration projects in place?

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Appendix A: Effects on the Environment and Other Species

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally sound decision-making.

Management planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that plans may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts upon non-target species or habitats. The results of the SEA are incorporated directly into the plan itself, but are also summarized below.

The potential for the Shortnose Sturgeon Management Plan to inadvertently lead to adverse effects on the environment or other species was considered. Since the recommended conservation measures are limited to non-intrusive measures such as monitoring the population and conducting awareness activities, we may conclude that the Management Plan will not entail any significant adverse effects.

In all likelihood, some of the measures proposed in this Management Plan will contribute to the conservation of other species. Atlantic Sturgeon, a similar species that coexists with Shortnose Sturgeon in the Saint John River, was designated as Threatened by COSEWIC in 2011 and is being considered for addition to Schedule 1 of SARA. Given their overlapping geographic distribution and the similarity of these two species, when implemented, the conservation measures developed for Shortnose Sturgeon would likely also benefit the conservation of Atlantic Sturgeon. Striped Bass (Bay of Fundy population), another species that inhabits the Saint John River, was re-assessed as Endangered by COSEWIC in 2012 and is also being considered for addition to Schedule 1 of SARA. Given that Striped Bass may also spawn just below the Mactaquac Dam, conservation measures related to determining the effect of the dam's operating regime on early life stages of Shortnose Sturgeon may also provide useful information related to Striped Bass spawning.

The lower Saint John River is thought to possess the highest freshwater fish diversity east of the Province of Quebec. In addition to those mentioned above, many other fish species occur in the Saint John River, including Atlantic Salmon, American Eel, American Shad, Blueback Herring (*Alosa aestivalis*), Alewife (*Alosa pseudoharengus*), White Perch (*Morone Americana*) and Rainbow Smelt (*Osmerus mordax*). Two of these species are assessed at risk and under SARA listing consideration (i.e. Atlantic Salmon and American Eel). The lower Saint John River also represents the bulk of the known Canadian range for the Redbreast Sunfish (*Lepomis auritus*), a species that was assessed by COSEWIC in 2008 and placed in the Data Deficient category. Although the habitat needs and preferences of these species may differ from those of Shortnose Sturgeon, efforts to ensure the conservation and long-term viability of Shortnose

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Sturgeon may also enhance conservation and awareness efforts focused on these other species.

Shortnose Sturgeon is suggested as a potential predator and host species to the Yellow Lampmussel (*Lampsilis cariosa*), which is a freshwater bivalve mussel also found in the lower Saint John River and listed under SARA as Special Concern. The Management Plan for the Yellow Lampmussel includes a conservation measure aimed at determining potential predator-prey and host-parasite interactions between the two species (DFO 2010). Should interactions be determined, it will be important to manage both species in a manner that supports the management objective of each.

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Appendix B: Record of Cooperation and Consultation

An early draft of the Shortnose Sturgeon Management Plan was developed in March 2013 with input from a number of targeted internal and external Shortnose Sturgeon experts and interested parties. A one-day workshop was subsequently held in Saint John, NB on July 4th, 2013 to review key sections of the early draft plan and seek additional input and advice on the conservation measures required for Shortnose Sturgeon. Attendees of the one-day workshop included representatives from relevant DFO sectors, First Nations and other Aboriginal organizations, the aquaculture industry, academia, and NB provincial government departments (Table 5).

The Mi'kmaq and Maliseet Peoples are seen as important partners in the management of the Shortnose Sturgeon. Aboriginal knowledge can provide commentary, experience, local knowledge and another worldview about the current state of sturgeon and its threats. Aboriginal Peoples were engaged in providing input into the early draft during bi-lateral meetings and participation in the workshop. Aboriginal knowledge holders have freely shared some traditional knowledge in the development of this Management Plan.

Table 5. Shortnose Sturgeon Management Plan workshop attendee list, 4 July, 2013.

Attendee	Affiliation
Fisheries and Oceans Canada	
Bradford, Rod (Dr.)	DFO Maritimes / Science
Floyd, Trevor	DFO Maritimes / Species at Risk Management Division
Gaudet, Odette	DFO Maritimes / Conservation & Protection
Kesselring-Cheney, Sarah	DFO Maritimes / Resource Management (St. George)
Robichaud-Leblanc, Kimberly	DFO Maritimes / Species at Risk Management Division
Savoie, Fernand	DFO Gulf / Fisheries Protection Program
Stevens, Greg	DFO Maritimes / Resource Management
Themelis, Daphne	DFO Maritimes / Science
Academia	
Dadswell, Mike (Dr.)	Acadia University
Litvak, Matthew (Dr.)	Mount Allison University
Province of New Brunswick	
Collet, Kathryn	NB Department of Natural Resources
McEachreon, Tom	NB Department of Agriculture, Aquaculture and Fisheries
Sabine, Mary	NB Department of Natural Resources
Industry	
Barry, Jonathan	Breviro Caviar (President)
Ceapa, Cornel (Dr.)	Acadian Sturgeon & Caviar
Labadie, Holly	Breviro Caviar/ Mount Allison University
Aboriginal Organizations	
Atwin, Phil	Maliseet Nation Conservation Council (MNCC)
Augustine, Trenton	North Shore Micmac District Council

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Attendee	Affiliation
Francis-Kennedy, Julia	Assembly of First Nations Chiefs in New Brunswick
Stuart, Brian	Maliseet Nation Conservation Council (MNCC)
LaBillois, Barry	MAARS Secretariat / NB Aboriginal Peoples Council (NBAPC)
Ward, Devon	North Shore Micmac District Council

The draft Management Plan was also reviewed by relevant DFO representatives in the National Capital Region, Maritimes Region, and Gulf Region. The draft document was also shared with other relevant federal departments (e.g., Department of National Defence, Canadian Forces Base Gagetown), and relevant NB provincial government representatives from the Department of Natural Resources, the Department of Agriculture, Aquaculture and Fisheries, and the Department of Environment and Local Government. All comments received during this review were considered and addressed as appropriate in this version of the document.

The draft document was also circulated in March 2014 to relevant First Nations and other Aboriginal organizations, as well as stakeholder organizations, NGOs, academics, and industry groups in NB to provide an opportunity for any additional input into this Management Plan. All comments received during this review were considered for incorporation into the document. Additionally, meetings were held with the Assembly of First Nations Chiefs in New Brunswick and the New Brunswick Aboriginal Peoples Council on May 21 and 22, 2014 to discuss the draft Management Plan.

All comments received on the proposed Management Plan during the 60-day Public Registry comment period (month day 2014 to month day 2014) will be considered and addressed as appropriate in the final version of the document.

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