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The Lake Sturgeon in Ontario

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Executive Summary

Lake sturgeon (*Acipenser fulvescens*) are the largest and most long-lived fish in Ontario. The existence of lake sturgeon dates back to the time of dinosaurs over two hundred million years ago. Lake sturgeon are an important and highly revered fish to First Nations communities. In the late 1800s, lake sturgeon were heavily exploited for their meat and roe (caviar). Pollution and alteration of their habitat, including construction of dams and hydroelectric generating facilities, in conjunction with exploitation were responsible for a dramatic decline in sturgeon stocks throughout Ontario. The biological characteristics of the lake sturgeon (i.e., late maturity, spawning periodicity, spawning site fidelity) contribute to their vulnerability to anthropogenic stressors. Most lake sturgeon populations in the province have not recovered more than one hundred years after their decline.

The status of lake sturgeon in Canada has been recognized by the Committee on the Status of Endangered Species in Canada (COSEWIC), the Committee on the Status of Species at Risk in Ontario (COSSARO) and the Convention on the International Trade on Endangered Species (CITES). COSEWIC has proposed eight designatable units for lake sturgeon in Canada under Canada's Species at Risk Act. Under this proposal Ontario has two designatable units listed as endangered, two units listed as special concern and one unit listed as threatened. COSSARO recently designated lake sturgeon as a species of special concern in northeastern Ontario and as a threatened species in northwestern Ontario and the Great Lakes-upper St. Lawrence River basin. All species of sturgeon have been listed under CITES Appendix II.

The recent collapse of the sturgeon fishery in the former Soviet Union and the worldwide demand for sturgeon meat and caviar has resulted in increased pressure on remaining sturgeon stocks elsewhere in the world including North America. Recognizing the threat to native sturgeon stocks, the Ontario Ministry of Natural Resources implemented a zero harvest quota for the recreational fishery in July 2008 and for the commercial fishery in July 2009 pending a review of population status, consultation with clients, and the development of a lake sturgeon management strategy or recovery plan.

This document has been prepared to assemble and consolidate existing information on lake sturgeon in Ontario as a background reference document for the development of a provincial lake sturgeon management strategy or recovery plan. It outlines the biology, life history, habitat requirements and status of lake sturgeon. Current and future threats to the sustainability of lake sturgeon are also discussed.

Actions need to be taken to promote the recovery and ensure the sustainability of lake sturgeon in Ontario. In several instances this will involve cooperative measures by jurisdictions sharing boundary waters. Depending on the actions taken recovery may be slow and any lake sturgeon recovery strategy should be viewed as a long term initiative.

Sommaire

L'esturgeon jaune (*Acipenser fulvescens*) est le plus grand poisson d'eau douce de l'Ontario et celui dont la durée de vie est la plus longue. Son existence remonte au temps de dinosaures, il y a plus de deux cents millions d'années. C'est un poisson très prisé par les Premières nations. Vers la fin des années 1800, l'esturgeon jaune était très recherché pour sa chair et ses œufs que l'on transformait en caviar. La pollution et l'altération de son habitat, notamment par la construction de digues et de barrages hydroélectriques, et sa surexploitation ont causé une diminution importante de sa population en Ontario. Les caractéristiques biologiques de l'esturgeon jaune (maturité lente, périodicité de la ponte et fidélité au lieu de ponte) contribuent à sa vulnérabilité et à l'augmentation des agresseurs anthropiques. La plupart des populations d'esturgeons jaunes de nos lacs ne se sont pas rétablies, plus de cent ans après le début de leur déclin.

Le statut de l'esturgeon jaune au Canada a été établi par le Comité sur la situation des espèces en péril au Canada (COSEPAC), le Comité de détermination du statut des espèces en péril de l'Ontario (CDSEPO) et la Convention sur le commerce international des espèces de faune et de flore sauvages menacées d'extinction (CITES). Le COSEPAC a proposé huit unités désignables pour l'esturgeon jaune au Canada, aux termes de la *Loi sur les espèces en péril* du Canada. Selon la proposition, l'Ontario possède deux unités désignables jugées espèces en voie de disparition, deux unités jugées espèces préoccupantes et une unité considérée comme menacée. Le CDSEPO a récemment désigné l'esturgeon jaune comme une espèce préoccupante dans le Nord-Est de l'Ontario et comme une espèce menacée dans les Grands Lacs et le haut Saint-Laurent. Toutes les espèces d'esturgeons sont inscrites à l'annexe II de la CITES.

La récente fermeture de la pêche à l'esturgeon dans l'ex-Union soviétique et la demande mondiale de chair et de caviar d'esturgeon ont entraîné une augmentation de la pression sur les populations d'esturgeon ailleurs dans le monde, notamment en Amérique du Nord. Conscient de la menace pesant sur nos esturgeons, le ministre des Ressources naturelles de l'Ontario a imposé un quota complet sur la pêche récréative en juillet 2008 et sur la pêche commerciale en juillet 2009, en attendant les résultats d'un examen des populations d'esturgeon jaune, une consultation des clients et l'élaboration d'une stratégie de rétablissement de l'esturgeon jaune.

Le présent document contient des renseignements sur l'esturgeon jaune de l'Ontario et il servira de base à l'élaboration d'une stratégie provinciale de rétablissement de l'esturgeon jaune. Il définit la biologie, le cycle évolutif, les exigences de l'habitat et le statut de l'esturgeon jaune. On y aborde également la question des menaces actuelles et futures à sa viabilité.

Des mesures s'imposent pour promouvoir le rétablissement et assurer la viabilité de l'esturgeon jaune de l'Ontario. Dans bien des cas, il faudra mettre en place des mesures similaires pour les administrations qui bordent les mêmes eaux frontalières. Selon les plans d'action, le rétablissement pourrait être lent et une stratégie de rétablissement de l'esturgeon jaune doit être considérée comme une initiative à long terme.

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Introduction

Lake sturgeon (*Acipenser fulvescens*) are Ontario's largest and longest-lived fish with ancestral ties from over 200 million years ago. Several features, including a cartilaginous skeleton, a heterocercal tail, large bony plates or scutes along the body (instead of scales) and a swim bladder which was derived from a lung-like air sac, bear evidence to its origin.

Lake sturgeon is one of 27 species from the Order: *Acipenseriformes* endemic to the northern hemisphere worldwide (Billard and Lecointre 2001); with 10 species found in North America; and 5 of these species within Canada (Pitkitch et al. 2005). Polyploidization (see Glossary) is believed to have played a significant role in the speciation of *Acipenser* (Birstein et al. 1997). Most sturgeon species are benthivores, live long, mature late and are periodic spawners (Billard and Lecointre 2001). Sturgeon are a highly migratory group, most being diadromous whereas lake sturgeon are potamodromous, migrating in excess of 200 km for spawning (Auer 1999, Kempinger 1988, Rusak and Mosindy 1997). As such, many of the same threats are common among sturgeon and, subsequently, all species are considered periled (Billard and Lecointre 2001) despite their historical abundance. The need to fulfill the insatiable desire for caviar accompanied by the collapse of the Soviet Union in the early 1990s caused the precipitous decline of Caspian Sea sturgeon populations. Subsequently, pressure increased on other sturgeon species as their value dramatically increased. This, coupled with dam construction, hydroelectric development, pollution and habitat alteration on many large rivers, has contributed to sturgeon declines worldwide.

This document has been prepared to assemble and consolidate information on Ontario's lake sturgeon as a background document to be used for the development of a provincial lake sturgeon management plan or recovery strategy.

Current Status of Lake Sturgeon in Ontario

Distribution of Lake Sturgeon

Lake sturgeon originally had a wide geographic range in North America encompassing the Mississippi, Great Lakes and Hudson Bay drainages (Figure 1). Lake sturgeon are the only species of sturgeon found in the Great Lakes basin although paddlefish (*Polyodon spathula*), a close relative, historically inhabited Lake Erie (Scott and Crossman 1973).

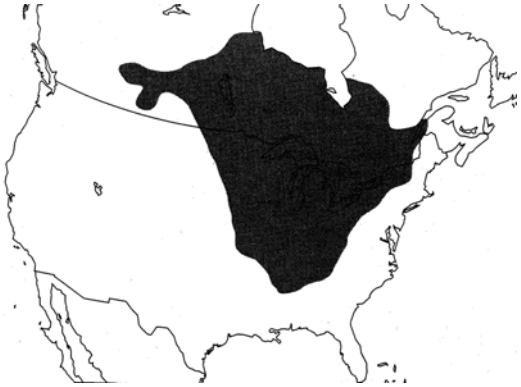

Figure 1. Distribution of lake sturgeon in North America (from Williamson 2003).

There are at least 229 waters (128 lakes and reservoirs and 101 rivers) in Ontario which support lake sturgeon (Kerr 2002). Lake sturgeon are present in all of the Great Lakes and major connecting waterways. Although their distribution is somewhat sporadic throughout the province, their inland distribution is concentrated in northern

Ontario. Lake sturgeon are potamodromous (i.e., live strictly within freshwater) but have some tolerance for brackish water.

Designated Status

Lake sturgeon are rare in many parts of their historic North American range. Existing populations in the Great Lakes are estimated to be only 1% of their original size (Tody 1974, Peterson et al. 2002).

Lake sturgeon have been extirpated from many former Ontario waters in their range including twenty-seven Great Lake tributaries (Tables 1 and 2). Inland waters which formerly supported lake sturgeon included Ottawa River tributaries in Lanark and Renfrew counties as well as Lakes Simcoe and Couchiching.

Table 1. Lake sturgeon spawning populations in the Ontario waters of the Great Lakes which are believed to have been extirpated.

Great Lake	Tributary
Superior	Gravel River, Harmony River, Pigeon River, Prairie River, Stokely Creek, White River, Wolf River
Huron	Ausable River, Blind River, Echo River, Go Home River, Key River, Manitou River, Root River, Sauble River, Saugeen River, Sequin River, Serpent River, Sturgeon River, Thessalon River
Erie	Grand River
Ontario	Amherst Island Shoal, Don River, Ganaraska River, Napanee River, Salmon River, Trent River

Table 2. Status of lake sturgeon in the Canadian waters of the Great Lakes basin (from Pratt 2008).

	Sturgeon Population Status		
Lake/River	Extant	Extirpated	Total
Lake Superior	10	5	15
Lake Nipigon	1	0	1
Lake Nipissing	1	0	1
Lake Huron	16	9	25
Lake Erie	4	0	4
Lake Ontario	2	3	5
St. Lawrence River	1	0	1
Ottawa River	10	0	10
Summary	45	17	62

Nationally, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has proposed eight designatable units (DU) for lake sturgeon based on genetic and biogeographical distinction (Table 3). Four of these designatable units fall within Ontario. The Red-Assiniboine Rivers-Lake Winnipeg (DU4) and Winnipeg River-English River (DU 5) populations are both considered "Endangered". The Lake of the Woods - Rainy River (DU6) and southern Hudson Bay-James Bay populations (DU7) are designated as "Special Concern" and the Great Lakes-Upper St. Lawrence River population (DU8) is designated as "Threatened".

Under the COSEWIC designation, "Endangered" indicates a species facing imminent extirpation or extinction, "Threatened" is a species likely to become endangered if nothing is done to reverse the factors which threaten it, and "Special Concern" indicates that a species may become a threatened or endangered species because of a combination of biological characteristics and identified threats.

Table 3. Proposed status of various lake sturgeon populations in Canada.

Designatable Unit (DU)	Proposed Status
Western Hudson Bay (DU 1)	Endangered
Saskatchewan River (DU 2)	Endangered
Nelson River (DU 3)	Endangered
Red-Assiniboine Rivers – Lake Winnipeg (DU 4)	Endangered
Winnipeg River – English River (DU 5)	Endangered
Lake of the Woods – Rainy River (DU 6)	Special Concern
Southern Hudson Bay – James Bay (DU 7)	Special Concern
Great Lakes – Upper St. Lawrence (DU 8)	Threatened

The Committee on the Status of Species at Risk in Ontario (COSSARO) has recently proposed a change in status for lake sturgeon populations in three regions of Ontario. The northwestern population of lake sturgeon will be revised to "Threatened" (formerly Special Concern), the Great Lakes-Upper St. Lawrence River population will be revised to "Threatened" (formerly Special Concern) and Hudson Bay-James Bay population will remain with "Special Concern" status (Figure 2). These designations will become effective by September 2009.

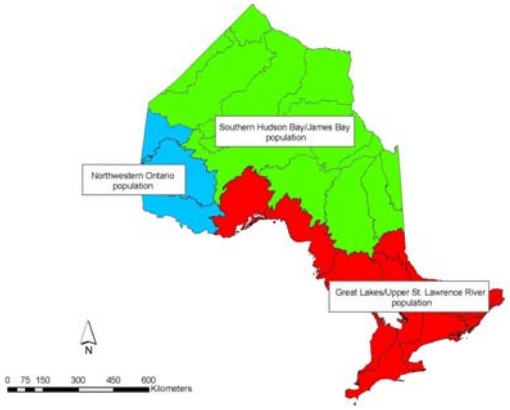

Figure 2. COSSARO classification of lake sturgeon populations in Ontario.

Once established, Ontario's Species at Risk Act prohibits damaging or destroying the habitat of any species designated as threatened or endangered. Killing, capturing and possessing a threatened species is prohibited. The Act also requires that a recovery strategy be prepared for that species.

Internationally, the special status of lake sturgeon had recognition under the Convention on the International Trade of Endangered Species (CITES) but was delisted in 1983 when Canada and the United States both agreed that the species was not endangered (Houston 1987). More recently, international concern over the collapse of Caspian Sea sturgeon populations prompted listing of all *Acipenseriform* species under CITES Appendix II in June 1997 (Williamson 2003). As a result a permit is required to export lake sturgeon, their parts or derivatives from Canada.

In the United States, lake sturgeon are designated as "Threatened" in the states of Michigan, New York and Nebraska. They have been designated as "Endangered" in Iowa, Indiana, Illinois, Ohio, Vermont, Pennsylvania, Missouri, Kentucky and Tennessee. They are listed as "Extirpated" in Alabama, West Virginia and Georgia and of "Special Concern" in Minnesota, North Carolina and Wisconsin. Lake sturgeon are currently not listed by the U.S. Fish and Wildlife Service, the agency responsible for federal listings in the United States.

Historical Significance of Lake Sturgeon to First Nations

Within Ontario and the Great Lakes watershed there are many aboriginal names for lake sturgeon. These include Name (Ojibwe), Namay Namaeu (Cree), Nme (Ottawa), Numae and Hahma to name a few. This fish was and continues to be significant to many First Nations not only as a source of food but as an integral part of their spiritual and cultural identity. Sturgeon were called "buffalo of the water" and were considered analogous to the relationship between bison and tribes of the western plains.

Subsistence fishing for lake sturgeon was a long standing tradition for many First Nations communities (Hopper and Power 1991). Families would gather at traditional lake sturgeon spawning sites in the spring for ceremonies and to capture fish for food (Michalenko et al. 1991). Sturgeon were harvested using hook and lines, weirs, spears and harpoons. Spearing was often done from wooden platforms constructed to extend over rapids (Holtzkamm et al. 1988). Individual fish were sometimes tethered and kept alive for several weeks.

Lake sturgeon were an important food source to First Nations communities for much of the year. Due to their large size, a single sturgeon yielded more meat than dozens of smaller fish species. Nearly every part of the sturgeon was utilized. Caviar was consumed and the flesh could be pounded, mixed with other ingredients and dried to make pemmican. Soup was often made from the cartilaginous "backbone" (Waddell undated). Sturgeon oil, extracted from the head, viscera and gonads was considered a valuable, high energy product (Holzkamm 1987). The skin was used as a container (known as numay-wayan) for liquids (MNR 2008). Their rough bony plates (scutes) were used as rasps and grates (Glover 1961) and pointed bones from the fish's back were used as arrowheads (MNR 2008).

Sturgeon products also served as valuable trade items. Swim bladders were sold to the Hudson Bay Company for isinglass, a form of gelatine obtained from the inner lining of the sturgeon's swim bladder. Although considered a delicacy by some, its primary use was to clarify wine, beer and other liquids. Based on the sale of isinglass between 1823 and 1885, the annual sturgeon harvest in the Lac de Pluies district (Rainy River, Lake of the Woods, Rainy Lake, Namakan Lake and Seine River) was estimated at 141,210 kg per year (Holzkamm and Wilson 1988). Fur traders would also purchase fresh, dried or smoked sturgeon as well as oil and isinglass (Lytwyn 1990).

For many First Nations sturgeon hold a certain spiritual and cultural significance and, to those who follow the clan system, members of the sturgeon clan are considered to be mediators and teachers (Abraham 2008). They represent wisdom and their role is to help children develop skills and healthy spirits and to solve disputes amongst other clans. Some believe the decline of the sturgeon has corresponded with the decline in the sturgeon clan families (Little River Band of Ottawa Indians 2008).

In many communities sturgeon were considered a sacred animal which was acknowledged in special ceremonies (Dick et al. 2006). There are also many sacred stories and legends regarding sturgeon. For example, an Anishinaabe story tells of a giant sturgeon associated

with the spiritual power controlling fish and fisheries (Holtzkamm and Wilson 1988, Hannibal-Paci 1998). Another tells us of how the maria (see Glossary) came to be. In this story there was a sturgeon which ate some sturgeon eggs and was turned into the ugliest fish possible as punishment and, thus, became a maria.

Tribal gatherings, involving many bands from a wide geographical area, were regularly held at well known lake sturgeon spawning sites during the spawning run. One of the more popular gathering places was at Manitou Rapids on the Rainy River. Anishinaabe came from as far away as Lac Seul to the north, Lake Winnipeg to the west and Lake Superior to the east. In some years, up to 1,500 Anishinaabe attended these gatherings (Rainy River First Nations 2002). Such large gatherings, fed by sturgeon, facilitated the renewal of friendships and social ties, the discussion of military and political affairs, and the holding of religious ceremonies (Holtzkamm and Waisberg 2004). Nearby, Namakan Lake and the Namakan River were known as “place of sturgeon”, or a place where sturgeon were dried (Darryl McLeod, Ontario Ministry of Natural Resources, Fort Frances. personal communication).

Lake sturgeon continue to be highly valued by many First Nations communities today. For example, elders of the Namaygoosisagagun First Nation, near Armstrong, make the journey to Smoothrock Lake each spring to capture and bring back some lake sturgeon to share with the community (A/OFRC 2007). Sturgeon are so significant to the Rainy River First Nation that they still harvest sturgeon to smoke for food and to provide a source of wild gametes. They consider themselves stewards of the river and believe their responsibility is to share their accumulated knowledge with present and future generations. Today, they operate a sturgeon hatchery, a historical interpretive centre (Kay-Nah-Chi-Wah-Nung) and have initiated the Rainy River Watershed Program for environmental protection, rehabilitation and awareness.

Lake Sturgeon Life History and Biology

Age and Growth

Growth of lake sturgeon is relatively rapid during the first 5-10 years of life (Harkness 1923) and then slows from that point onward (Magnin 1977, Scott and Crossman 1973, Threader and Brousseau 1986). Friday (2006b) reported young-of-the-year growth rates were approximately 1.7 mm per day between June and August. Male and female sturgeon grow at similar rates until approximately 20 years of age after which female growth generally exceeds that of male fish (Bruch 1999). There is, however, considerable geographical variation in growth across the species range, much of which is explained by latitudinal variation (Beamish et al. 1996, Fortin et al. 1996, Noakes et al. 1999, Royer et al. 1968,) (Figure 3).

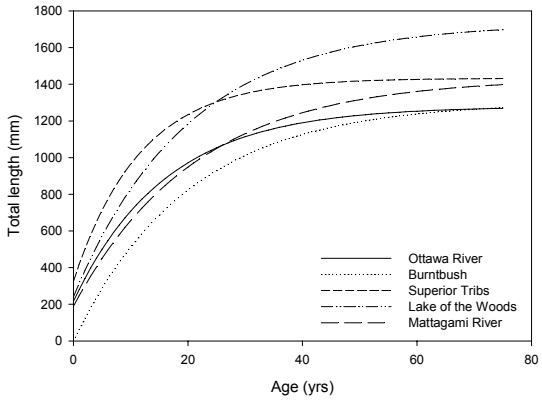

Figure 3. Von Bertalanffy growth curves for selected lake sturgeon populations in Ontario.

With sufficient food, lake sturgeon can sustain active growth at temperatures of 5ºC - 22ºC. Growth rates generally peak at temperatures of approximately 15ºC (Wehrly 1995). Variation in growth across Ontario may not necessarily conform to latitudinal variation but may be linked to growth energetics under different temperature regimes (Power and McKinley 1997).

Lake sturgeon are Canada's largest freshwater fish and can grow to extremely large sizes (Figure 4 and Table 4). Sturgeon as large as 140.7 kg (310 lb.) have been taken in commercial fisheries of both Lakes Erie and Superior. The largest lake sturgeon ever angled from Ontario is believed to be a 76.2 kg (168 lb.) fish caught in Georgian Bay in 1982 (IGFA 2008).

Figure 4. A 106 kg (234 lb.) male sturgeon captured from Lake of the Woods (Ontario Department of Lands and Forests photo).

Lake sturgeon are also a long-lived species. One of the oldest sturgeon on record is a 152 year old fish caught in Lake of the Woods in 1953 (MacKay 1963). This fish may indeed have been much older as pectoral spine aging underestimates ages of lake sturgeon older than 14 years (Bruch et al. 2009).

Table 4. Large (> 97 kg) lake sturgeon captured from Ontario waters (from Macins 1972 and Szabo 2004).

Waterbody	Date	Size of Fish
Lake Superior	1922	140.7 kg (310 lb.)
Lake Erie	1955	140.7 kg (310 lb.)
Georgian Bay	1901	113.5 kg (250 lb.)
Prince Edward Bay	1905	112.1 kg (247 lb.)
Lake Huron	1948	106.7 kg (235 lb.)
Lake of the Woods	1954	106.4 kg (234 lb.)
Eel Bay	1926	102.2 kg (225 lb.)
Georgian Bay	1951	102.2 kg (225 lb.)
Ottawa River	1931	98.5 kg (217 lb.)
Lake Erie	1934	97.6 kg (215 lb.)

Casselman (2004) reported lake sturgeon of 155 and 129 years of age being captured from Lake Huron and Lake Erie, respectively, in the mid 1980s. The oldest lake sturgeon captured in Lake Nipissing was estimated to be 97 years of age (Kaufman 2008). Typically in unexploited populations, the lifespan of a sturgeon is believed to be 50-60 years for males and 80-150 years for females (Dick et al. 2006). The average ages of lake sturgeon populations today are usually less than half of historic ages.

Maturity and Spawning

Sexual maturity of lake sturgeon is

generally attained between the ages of 12 and 20 years for male fish and 14 to 33 years for female fish (Scott and Crossman 1973)(Table 5). Egg production is correlated with weight and can range from 8,744 - 12,264 eggs per kg of fish (Bruch et al. 2006). Although egg production generally increases with size of fish, it can be variable in fish of the same weight.

Spawning does not necessarily correspond with maturity. Under natural conditions, spawning is periodic: males spawn every 2 - 3 years whereas females may only spawn every 4 - 9 years (Kempinger 1988, Mosindy and Rusak 1991, Roussow 1957, Scott and Crossman 1973). In Lake Nipissing, Love (1972) reported that male sturgeon spawned every 6 - 7.5 years and females spawned every 5 - 7.1 years.

Spawning occurs in the spring and in Canada often occurs from early May to late June at water temperatures between 13ºC - 18ºC (Harkness 1923, Scott and Crossman 1973, Nichols et al. 2003) (Table 6). Peak spawning temperatures have been reported between 10ºC and 15ºC in southerly populations (Kempinger 1988, Auer 1996a, Peterson et al. 2002); 12ºC - 15ºC in the St. Lawrence River (LaHaye et al. 1992); and between 11.5ºC - 16ºC in Wisconsin (Bruch and Binkowski 2002).

Lake sturgeon exhibit complex polygamous mating behaviour which may serve to enhance genetic diversity (Bruch and Binkowski 2002). Female sturgeon are typically surrounded by multiple male fish during spawning. They broadcast adhesive eggs over rock and rubble substrate (Bruch and Binkowski 2002). The eggs incubate for approximately 5 -14 days depending on temperature (Johnson et al. 2006, Kempinger 1988, Scott and Crossman 1973, Smith 2003). No parental care is provided to the eggs.

Egg mortality is high with a natural hatch rate estimated to be <1% (Nichols et al. 2003). Poor egg survival is often attributed to unfavourable water temperatures since optimal survival and development of lake sturgeon eggs occurs between 14ºC and 17ºC. Total egg mortality occurs at water temperatures greater than 20ºC (Wang et al. 1985).

Two separate spawning periods may sometimes occur in a single season (Auer and Baker 2002, LaPan et al. 2000, Nichols et al. 2003). This behaviour appears to be linked with water temperature. Two distinct upstream migrations of spawning fish were observed in the Rainy River and were attributed to differences in the temporal response of river and lake populations to increasing water temperatures (Rusak and Mosindy 1997).

In the Kaministiqua River, two separate bouts of spawning activity were recorded at water temperatures of 13.6ºC -15.2ºC, respectively (Friday 2006a). In that system, separate spawning events ranged from 3 to 37 days apart (May 21 and June 27). Fish involved in the first spawning period were described as being larger, on average, than those during the second peak (Fortin et al. 2002). Both spawning events were considered important for natural recruitment. There is no evidence of reproductive senescence in lake sturgeon (Dick et al. 2006).

Early Life History

Newly hatched lake sturgeon larvae are pelagic and negatively phototactic (see

Table 5. Lake sturgeon maturation in selected Ontario waters (see citations in References and in Appendix 14).

	Length (cm)		Age (years)		
Waterbody	**Male**	**Female**	**Male**	**Female**	**Information Source**
Groundhog River	110.0 (fork length)	119.0	19	22	Nowak & Jessop (1987)
Groundhog River	82.0 – 157.0 (fork length, sexes combined)		7 – 56 (sexes combined)		Golder Associates Ltd. (2008)
Kenogami River	82.0	105.0	20-25	25-31	Ecologistics Ltd. (1987)
Lake Huron	-	-	18.3 (mean)	21.4 (mean)	Mohr (2000)
	98.9	134.3	-	21	J. Speers (unpublished data)
Lake Nipigon	94.0 – 96.5 (sexes combined)		22 (sexes combined)		Harkness (1923)
Lake Nipissing	-	-	10-20 (mean 14.8)	12-22 (mean 16.5)	Love (1972)
Lake of the Woods	-	-	17	23	Macins (1972)
	123.8	140.9	11-28 (mean 16.8)	20-32 (mean 25.8)	Mosindy and Rusak (1991)
Mattagami River	76.0-96.5	84.0-96.5	14-22	17-22	Saunders (1981)
Moose River	123.2 (fork length)	118.5	14+	20+	Threader (1981)
North Channel (L. Huron)	-	-	15.0 (mean)	19.7 (mean)	Mohr (2000)
	99.4	110.8	10	14	J. Speers (unpublished data)
Ottawa River (Lac Deschênes)	76.2-78.7	83.8-86.4	19-20	26	Dubreuil & Cuerrier (1950)
Ottawa River	106.7 (total length)	112.2	20.4	25.4	Haxton (2008)

Table 6. Dates and water temperatures recorded for lake sturgeon spawning in selected Ontario waters (see citations in References and in Appendix 14).

Waterbody	Spawning Dates	Water Temperatures (ºC)	Source of Information
Canadian waters	-	13 - 18	Scott and Crossman (1973)
Groundhog River	-	13	Phoenix (1991)
Groundhog River	May 8-12	-	Rich (1987)
Groundhog River	May 4-29 (peak spawning, 1994-2004)	-	Hendry (unpublished data)
Groundhog River (Six Mile Rapids)	May 8-21 (2004-2008)	10 - 13	C. Hendry (pers. comm.)
Groundhog River (Camus Rapids)	May 4-24 (1994-2006)	-	C. Hendry (pers. comm.)
Groundhog/Mattagami Rivers	May	10 - 13	Seyler et al. 1996
Kaministiquia River	May 19 – June 27	13.4 - 17.2	Friday (2004, 2005, 2006a)
Lake Nipissing	May 27-June 15	-	Love (1972)
Lake of the Woods	May 7 – June 10	12.8 - 15.6	Macins (1972), Mosindy and Rusak (1991)
Ottawa River	June 4-July 9	16 - 20	Haxton (2008a)
St. Clair River	May 20-June 14	12 - 13	Thomas and Haas (2004)
St. Lawrence River	June 17-28	15 - 16	LaPan et al. (1997)
Trent River	May 3 – 10	17 - 18	Mathers (2000)

Glossary). Yolk sac larvae exhibit diurnal behaviour: they tend to hide in the interstices of gravel during the day and emerge at night when light levels are diminished (Harkness and Dymond 1961, Kempinger 1988).

As with incubation, larval emergence is temperature dependent (LaHaye et al. 1992, Smith 2003, Smith and King 2005a). Shortly after emergence they begin a “swim-up” phase which is important for larval drift. Larval drift seems to be temperature dependent with 15ºC being the cue for initiating drift (Smith 2003).

Nocturnal (2100 to 0200 hours) drifting downstream typically peaks between 8 and 14 days post-hatch but can occur up to 28 days post-spawn (Kempinger 1988).

Larval drift is passive and dependent on water velocity and discharge (D’Amours et al. 2001). Depending upon the length of interval between separate spawning episodes, there can be more than one larval drift period (Auer and Baker 2002). For example, Friday (2004, 2005) documented two distinct periods of larval drift in the Kaministiquia River.

Once larval lake sturgeon drift downstream from their spawning grounds, it becomes unclear whether they display specific habitat preferences. Some literature suggests that larval drift is not uniform in a river and that larvae are distributed unevenly within the water column and across a river reach (Johnston et al. 1995, Smith and King 2005b). However there is speculation that larval lake sturgeon may actually select a particular habitat rather than simply being dispersed into areas where water velocity is reduced (D’Amours et al. 2001, Smith and King 2005b).

Scheidegger and Bain (1995) suggested that 8.4 cm sec^{-1} was the maximum water velocity that a 12 mm larvae

could sustain without drifting downstream. This represents a velocity which is substantially less than that found at spawning grounds.

From the perspective of predation, the most vulnerable period is from the egg stage to a fish up to 250 mm in length (Auer and Baker 2002) (Figure 5). Predators of lake sturgeon eggs include silver redhorse (*Moxostoma anisurum*), logperch (*Percina caprodes*) and other lake sturgeon (LaPan et al. 1997). Crayfish (*Orconectes* spp.) can also be important predators during the first summer of life (Scribner and Baker 2008).

Figure 5. Larval lake sturgeon (top) from the Ottawa River (T. Haxton photo) and a yearling lake sturgeon (bottom) from the Kamisitiquia River (M. Friday photo).

In Black Lake, Michigan, yearling lake sturgeon differed in substrate preferences compared to older juvenile lake sturgeon (Smith and King 2005b). Juvenile lake sturgeon may mature in their natal river or drift downstream into lakes to forage in deep water (Holtgren and Auer 2004). Some studies suggest limited range movement of juvenile lake sturgeon (Hay-Chmielewski 1987, Lyons and Kempinger 1992, Sandilands 1987, Thuemler 1988,) while others have demonstrated that juvenile lake sturgeon can move a substantial distance from their origin (Holtgren and Auer 2004, Mosindy and Rusak 1991).

Habitat Requirements

Spawning Habitat – Spawning habitat is well documented and is defined typically by hydrography and substrate type in large rivers. Lake sturgeon spawn at relatively shallow depths (e.g., between 0.6 and 4.5 m) in areas of fast flowing water (generally greater than 0.6 m/s) typically over clean, coarse substrates such as gravel, rubble and broken angular rock (Johnson et al. 2006, Kempinger 1988, Seyler 1997)(Figure 6). Large debris, which can serve as refuge and resting areas, is also believed to be important. In many Ontario rivers, spawning occurs at the base of dams or impassable barriers (Friday 2003, Haxton and Findlay 2008, Seyler 2003). In the Great Lakes, lake sturgeon have been known to spawn in high energy (i.e., wave exposed), rocky areas (Scott and Crossman 1973) but they may also spawn in deep (9-12 m) water (Caswell et al. 2004, Manny and Kennedy 2002).

There is a considerable amount of evidence to suggest a relatively high degree of spawning site fidelity in lake sturgeon (DeHaan et al. 2006, Golder Associates Ltd. 2008). Adult sturgeon typically move downstream shortly after spawning.

Figure 6. Spawning lake sturgeon in a northern Ontario river (D. Barbour photo).

Lake spawning has been documented in several larger waters including Lake Erie and Lake Nipigon. It is suspected to occur in Lake of the Woods but has yet to be confirmed (Tom Mosindy, Ontario Ministry of Natural Resources, Kenora. personal communication). In lakes, spawning usually occurs over well oxygenated rocky shoals and ledges at depths of 1-1.5 m. Lake spawning is often later than rivers due to the slower warming of water temperatures in a lentic environment.

Nursery/Juvenile Habitat

Benson et al. (2005) described the habitat of young-of-year (i.e., age-0) lake sturgeon as shallow, riverine areas with sand substrates, low current velocity and an abundance of dipteran larvae. In the Kaministiquia River, Friday (2006b) captured young-of-the-year lake sturgeon along river margins at depths of 20 - 55 cm and river flows of 21 - 32.5 m^3 sec^{-1}. He reported that nursery habitat was in shallow, low velocity areas dominated by coarse sand substrate.

In Wisconsin rivers, age-0 lake sturgeon were found in close contact with substrates of sand and gravel devoid of aquatic vegetation (Kempinger 1996). They were never captured over fine detritus substrates. These findings are similar to experiments in aquaria where larval lake sturgeon showed a clear preference for sandy substrates and open spaces as opposed to vegetated areas and those having uneven bottom substrates (Peake 1999, Sbikin and Bibikov 1988).

The diet of juvenile lake sturgeon is very diversified (Dumont et al. 2004, Nilo et al. 2006) and consists of benthic organisms including insects, molluscs and annelids. While juvenile lake sturgeon habitat preferences may be unclear, there is evidence that it may be correlated with prey abundance (Chiasson et al. 1997) which is often associated with deep runs and pools in river systems. In northern Ontario rivers, juvenile lake sturgeon were found in greatest abundance over clay substratum compared to habitats dominated by larger-sized particles. Their presence was also correlated with a high abundance of benthic invertebrate prey species (Chaisson et al. 1997). In a study involving Lake Superior tributaries, juvenile sturgeon were found in greater abundance over pea gravel/sand substrates than pure sand alone (Holtgren and Auer 2004). This study did not find a correlation between juvenile sturgeon and benthic invertebrate abundance however.

There is some evidence of habitat partitioning between juvenile/subadult and adult lake sturgeon. Adult lake sturgeon tend to inhabit shallower depths of rivers and lakes over heterogenous substrates while juveniles and subadults are commonly found at greater depths, occasionally exceeding

9 m, often having expanses of silt (Harkness and Dymond 1961, Hayes 2000, Holtgren and Auer 2004, Lord 2007).

Adult Habitat

Adult lake sturgeon require large areas of suitable habitat. Depending on body size, Randall (2008) concluded that lake sturgeon required individual areas of 0.05 - 0.15 ha in rivers and 0.15 -0.47 ha in lakes. Individual home ranges were believed to range from 0.4 -16.1 ha in rivers and be up to 20 times larger in lakes.

Lake sturgeon are opportunistic feeders consuming virtually any organism living on the substrate. This includes molluscs, small fish, benthic insects, gastropods, algae, and plants. Crayfish and small fish become a more frequent diet item in larger sturgeon. There are reports of lake sturgeon feeding heavily on alewife that had died during winterkills (Casselman 2004). Sturgeon forage most actively at night and feed predominantly over flat areas with sand, gravel or detritus substrates. There does not seem to be any dietary portioning with other species of fish.

Prey abundance has been considered a predominant factor in determining habitat selection of adult sturgeon (Chiasson et al. 1997). Rusak and Mosindy (1997) concluded that habitat preferences during different times of the year were probably related to foraging behaviour.

Generally, adult lake sturgeon prefer relatively shallow (< 2-3 m) habitats with a moderate flow (< 0.6 m/sec) of water (Benson et al. 2005). Seyler (1997) concluded that water velocity (< 60 cm sec^{-1}), food availability and water depth (2-6 m) were the primary factors influencing adult sturgeon habitat selection in the Groundhog River. Rusak and Mosindy (1997) found most lake sturgeon in Lake of the Woods at water depths of 6 m or greater, oriented along island and mainland shorelines that provided increased water movement. Lake sturgeon are seldom, if ever, associated with the presence of aquatic vegetation.

Movements

Like all *Acipensiformes*, lake sturgeon can be highly migratory but restrict movements to freshwater (i.e., potamodromous). Lake sturgeon display two types of movement: upstream migrations to reach spawning grounds and downstream movements to deeper water during the summer. Lake sturgeon will migrate from lakes or downstream reaches of rivers into shallower, faster waters upstream (Holtgren and Auer 2004, Smith 2003, Smith and King 2005b). Spawning migrations can be quite extensive. Some adult populations can travel 200 - 400 km upstream (Auer 1999, Kempinger 1988, Rusak and Mosindy 1997, Scott and Crossman 1973). Migrations to spawning areas vary. Some populations migrate during the fall preceeding the spawning period and stage in the river (Bruch 1999) whereas others migrate immediately prior to spawning. Borkholder et al. (2002) associated upstream movements during increased discharge and downstream movements during periods of decreasing discharge in the Kettle River, Minnesota.

Haxton and Findlay (2008) reported minimal movements in large rivers. In the Ottawa River, Haxton (2003) reported that lake sturgeon displayed high fidelity to a basin and did not move extensive distances. Similarly, Dumont

et al. (2004) reported that, with the exception of spawning migrations, movement in the Québec waters of the St. Lawrence River were restricted. In the contiguous Lake of the Woods-Rainy River system, Rusak and Mosindy (1997) observed basin-wide movement patterns during the ice free season while movements were relatively limited during winter months in both the lake and river.

Lake Sturgeon Fisheries

Commercial Fishery

Prior to the mid 1800s, sturgeon had limited value and were considered a nuisance by commercial fishers for tearing nets targetting other fish species. At that time, sturgeon meat was considered the food of inferior people such as servants and slaves (Harkness and Dymond 1961). When captured they were usually disposed of or left to spoil. There are also accounts of the carcasses being used as fuel for steamboats.

In 1860, lake sturgeon were sold for ten cents each with fish over four feet in length selling for twenty-five cents (Cusson 1972). Between 1860 and1870 their value as food, for both meat and caviar, and as a source of isinglass rose substantially and commercial fisheries developed quickly. In 1880, 3.4 million kg of sturgeon was harvested from the Ontario waters of the Great Lakes (Ontario Game and Fisheries Commission 1912). Commercial harvest on the Great Lakes peaked at 4,901 metric tons in 1885 (Baldwin et al. 2002). At the time it was not uncommon for fishers to keep sturgeon alive in pens while awaiting an increase in market value (Kerr 1981). By 1890, the provincial sturgeon harvest was 514,368 kg (Table 7) with meat selling for 6 cents per pound.

As commercial fisheries became established a similar trend occurred in almost all Ontario fisheries. Peaks in harvest occurred within 5 -10 years of commercial exploitation followed by a steep decline to negligible levels within the next 15 - 20 year period.

Lake sturgeon declined to commercially insignificant levels by the turn of the 20th century. These population declines were attributed to unregulated harvest, habitat degradation, and to loss of access to traditional spawning areas in tributaries due to dam construction. In Lake Superior, the maximum lake sturgeon harvest was recorded in 1885 at 101,696 kg. By 1920, the yield had declined to less than 4,500 kg (Lawrie and Rahrer 1972).

Table 7. Lake sturgeon harvests from various Ontario waters in 1890 (from Ontario Game and Fisheries Commission, 1892).

Location	Amount (kg) of Sturgeon Harvested
Lake Superior	44,220
Lake Huron	101,583
Georgian Bay	9,534
Manitoulin (North Channel)	48,147
Lake St. Clair (and St. Clair River)	5,448
Detroit River	15,481
Lake Erie	263,597
Lake Ontario	11,078
Bay of Quinte	409
Kingston/Wolfe Island	2,860
St. Lawrence River	1,816
Lower Ottawa River	1,816
Ottawa River Tributaries (Renfrew County)	209
Lake Nipissing	2,724

In Lake Huron, a commercial fishery for lake sturgeon began in the 1860s. The harvest declined from 250 metric tonnes in 1889 to insignificant levels by 1909. The near extirpation of the species was attributed to overexploitation (Berst and Spangler 1973).

The first recorded commercial harvest of lake sturgeon in Lake Erie was in 1879 (Figure 7). Catches peaked shortly thereafter (mid 1880s) and quickly declined to relative insignificance.

In Lake Ontario, the commercial harvest of lake sturgeon peaked at over 250,000 kg in 1890 before declining to insignificant levels by the early 1900s. The dramatic decline in lake sturgeon abundance in Lake Ontario was attributed largely to overfishing (Christie 1973).

Figure 7. An early commercial catch of lake sturgeon from Lake Erie (MNR photo).

Commercial fisheries for lake sturgeon were also established on several larger inland waters. Commercial harvest on Lake Nipissing began in 1888. The harvest peaked at 86,000 kg in 1903 but, within a few short years, was negligible. Nonetheless, a small commercial fishery persisted. Between 1971 and 1982 sturgeon catches averaged 4,725 kg (111-7,540 kg) annually.

On the Ottawa River, a commercial fishery for lake sturgeon became established in 1881 and landings peaked at 28,780 kg by 1898 (Figure 8).

Figure 8. Lake sturgeon harvested from a 1974 commercial fishery on the Ottawa River (P. McGwire photo).

Sturgeon harvest from the Canadian waters of Lake of the Woods peaked at 245,265 kg in 1895 but had fallen to only 8,805 kg in 1911 (Evermann and Latimer 1910, Macins 1972, Mosindy 1987). Within one decade (1893-1903) the sturgeon catch from Lake of the Woods declined by 95% and, by 1930, the fishery was virtually non-existent (Mosindy 1987). With the exception of one licence held in moratorium by the Rainy River First Nation, commercial fishing on Lake of the Woods has been closed since 1995.

Based on annual commercial returns, there are records of the sale of almost 62,000 kg from Lake Simcoe between 1881 and 1888 (MacCrimmon and Skobe 1970). Catches declined rapidly after 1894 to the point where sturgeon were subsequently considered extirpated from that waterbody.

Commercial fishing, using baited hook lines, was permitted for lake sturgeon on the upper St. Lawrence River until 1984 when the last licence was retired. At that point, reported sturgeon harvests had declined from 11-16 fish per week in the 1940s to only a few fish per year (MNR and NYDEC 2008).

Commercial harvest of lake sturgeon in Lake Nipigon peaked at approximately 37,706 kg in 1924 and 36,962 kg in 1925 (Rick Salmon, Ontario Ministry of Natural Resources, Nipigon. personal communication). The sturgeon population in Lake Nipigon collapsed shortly thereafter (Swainson 2001).

Commercial harvest continued to push to inland waters as populations in the Great Lakes and large inland lakes collapsed. Several large rivers in northern Ontario sustained commercial fisheries for a period of time. The Abitibi River was fished commercially for almost fifty years (1935-1982). Sturgeon harvests were as high as 0.96 kg ha^{-1} (mean of 0.24 kg ha^{-1}). An average of 0.64 kg ha^{-1} of sturgeon was harvested by commercial hook and line fisheries on the Mattagami River between 1927 and 1963 (Duckworth et al. 1992). By the early 1980s sturgeon quotas on these northern rivers were based on an allocation of 0.20 kg ha^{-1} $year^{-1}$. Only a few years later, Payne (1987) recommended the cessation of commercial fishing on the Mattagami River, adjustment of the commercial quota on the Abitibi River, and the reallocation of the commercial quota on the Frederick House River.

Presently, small commercial fisheries exist in a few locations such as the North Channel and southern Lake Huron. Lake sturgeon are targeted by fisherman using gill nets in the North Channel. Conversely, sturgeon are largely an incidental catch in trap nets set in southern Lake Huron for walleye and lake whitefish. There are 44 licences issued for the Ontario waters of Lake Huron with an annual sturgeon quota of 12,042 kg. Approximately 46% (5,200 kg) of the assigned quota is harvested each year. The value of the sturgeon catch is estimated at approximately $35,000. Lake St. Clair currently has an annual commercial sturgeon quota of 1,542 kg of which approximately 50% (772 kg) is harvested annually.

Several First Nations bands currently have small commercial lake sturgeon quotas ranging from 50 – 5,000 kg. In northwestern Ontario there are 33 licences, with a total sturgeon quota of 21,920 kg, issued to First Nations. Fifteen of these licences are inactive and harvest from the remaining licences is minimal. In most cases, only a few sturgeon are harvested annually and sold locally within the community. In northeastern Ontario, a commercial fishing licence, with a 200 kg sturgeon quota, is issued to First Nations for the Moose River. This licence is believed to have been inactive since 1996.

Commercial fisheries for lake sturgeon in the U.S. waters of the Great Lakes were closed in 1977 (Baker and Borgeson 1999). There are currently no commercial fisheries for lake sturgeon in the United States (Pikitch et al. 2005).

In Canada, Alberta had closed all commercial fisheries for lake sturgeon by 1968; Manitoba by 1995; and Saskatchewan by 1996. There is still a regulated commercial fishery for lake sturgeon in Québec including a quota of 286 fish per year on Lake Timiskaming, a border water in northeastern Ontario (Greg Deyne, Ontario Ministry of Natural Resources, Timmins. personal

communication). Similarly, there is still a small commercial fishery, consisting of two licences, in the Québec waters of the Ottawa River (Haxton and Findlay 2008).

Recreational Fishery

Traditionally, lake sturgeon have not been heavily exploited by the recreational fishery and few fisheries have been evaluated. Brousseau (1987) estimated the provincial angler harvest of sturgeon in 1984 was only 9,185 kg. Duckworth et al. (1992) estimated that the recreational harvest of lake sturgeon in 1988 was 7,450 kg.

Recreational angling for lake sturgeon is a popular activity in some locations however. A creel survey conducted on the Groundhog and Mattagami rivers from 1982-84 indicated that sturgeon harvests ranged from 2,945 - 5,262 kg annually (Nowak and Jessop 1987). This recreational harvest of lake sturgeon from the Groundhog River was believed to have exceeded natural annual production (Nowak and Jessop 1987).

Brousseau and Goodchild (1989) estimated that, in 1984, 12,000 angler hours of effort was exerted on a 45 km stretch of the Groundhog River to harvest 4,600 kg of lake sturgeon, 300 kg of northern pike and 25 kg of walleye. Over one-half of the sturgeon harvest came from a small portion of the river known locally as “the Pot”.

A 1991 creel survey estimated the recreational harvest of lake sturgeon from Rainy River-Lake of the Woods was only 500-750 kg (Mosindy and Rusak 1991) but recent sport harvest estimates range from 2,000-7,000 kg per year, most of which is taken from the U.S. portion of the Rainy River. These estimates may be conservative because, in most years, creel surveys were conducted in the spring and fall but not during the summer (Barry Corbett, Ontario Ministry of Natural Resources, Kenora. personal communication). In some years the sturgeon harvest has exceeded the estimated potential yield of this area (5,300 kg) and, in most years, exceeded the management objective of 3,400 kg. In an effort to reduce harvest, the state of Minnesota has implemented a number of angling regulations (Talmage et al. 2009).

Recreational fisheries for lake sturgeon exist on some Great Lakes tributaries including large rivers in northern Lake Huron and the Detroit and St. Clair rivers (Lloyd Mohr. Ontario Ministry of Natural Resources, Owen Sound. personal communication). No estimates of exploitation are available for these fisheries.

Since 1980 there were large minimum size limits in place for sturgeon for the recreational fishery in some parts of northwestern Ontario. Prior to July 2008, the catch limit for most recreational fisheries in Ontario was one fish per day. Since then, only catch-and-release fishing (0 quota) has been allowed. It is believed that angling mortality has been minimized based on the assumption that mortality associated with catch-and-release fishing practices is insignificant.

Only two known studies have evaluated the response of lake sturgeon to capture and handling. Baker et al. (2008) analyzed haematological (blood) variables from mark-and-recapture tagging activities on lake sturgeon which were shown to initiate primary and secondary physiological stress responses. In the study, blood samples were taken from fish after mark-

recapture stressors were applied and again after the fish had rested in a holding tank for a period of three days. The mark-recapture activities involved multiple stressors including gill net capture, handling out of water and insertion of radio tags. There were no known mortalities during the study and all lake sturgeon had recovered to a non-stressed state within 72 hours.

Thomas and Haas (1999) reported that lake sturgeon were resilient to stressors such as setline capture and release activities. They tested the use of setlines for the scientific collection of lake sturgeon. The majority (80%) of the captured sturgeon were hooked in the mouth but some fish were also snagged. A total of 84 lake sturgeon were hooked on a setline and handled for the collection of biological data. All fish were released alive with no mortalities noted.

The results from these two studies suggest that human induced stressors, including capture, air exposure, tagging and handling, do not pose a significant threat to lake sturgeon survival. These conclusions are supported by numerous observations of lake sturgeon captured by the commercial fishery (L. Mohr. Ontario Ministry of Natural Resources, Owen Sound. personal communication). Although angling-induced mortality rates have yet to be quantified for lake sturgeon, it would appear that this is not a significant factor.

Subsistence Fishery

First Nations subsistence fisheries have existed for thousands of years. Archaelogical sites along the Rainy River confirm sturgeon fishing occurred over 2,500 years ago (Holzhamm and Waisberg (2004). The annual harvest of sturgeon by the Ojibway from the Hudson Bay area between 1823 and 1885 was 141,210 kg (Holzkamm and McCarthy 1988). Based on isinglass returns recorded in Hudson Bay Company journals, the average annual harvest of edible sturgeon meat by Ojibway fishermen in the Rainy River between 1823 and 1885 was estimated at 125,038 kg (Holzkamm 1987).

Hopper and Power (1991) describe a multi-species subsistence fishery on the Winisk River in northern Ontario. Between October 1987 and September 1988, forty lake sturgeon (350 kg) were harvested.

There are no accurate estimates for the harvest associated with the current subsistence fishery in Ontario although it is believed to be relatively low in terms of absolute numbers of fish.

Sturgeon Management in Ontario

Regulations

Open and closed seasons, catch and possession limits, size limits and fish sanctuaries, have traditionally been used to manage lake sturgeon fisheries in Ontario (Appendix 1).

In 1903, regulations were introduced to close the fishing season for lake sturgeon during the spawning period. In 1912, recognizing the collapse of many lake sturgeon populations, the Ontario Game and Fisheries Commission recommended major penalties for the commercial or illegal sale of sturgeon meat and caviar (Ontario Game and Fisheries Commission 1912). Minimum size limit regulations were introduced for lake sturgeon on several waterbodies in the 1920s. In 1927, the closed season in Ontario waters other than the Great Lakes was changed from June 1 to June 30. In 1954, the closed season dates

were changed to May 15 - June 14. On Lake Ontario, the commercial and recreational fisheries for lake sturgeon were closed in 1984 and 1990, respectively. The lake sturgeon fishery (commercial and recreational) has been closed on Lake Nipissing since 1991.

Table 8 outlines the recreational angling regulations for lake sturgeon that were in place in 2008. With some exceptions, regulations were applied on the basis of individual Fisheries Management Zones (Figure 9).

Midway through 2008, the Ontario Ministry of Natural Resources closed the sturgeon fishery and announced that it would be consulting with stakeholders and First Nations to develop a provincial management strategy or recovery plan that would address issues affecting the sustainability of lake sturgeon populations. It was also announced that commercial quotas for lake sturgeon on the Great Lakes would be reduced to zero in 2009. Aboriginal harvest of lake sturgeon by First Nations for subsistence, cultural and ceremonial purposes was not affected.

There are differences in the regulations for lake sturgeon on shared waters including Lake St. Clair and the St. Clair River (Michigan), Ottawa River (Québec), Rainy River and Lake of the Woods (Minnesota), Lake Superior (Wisconsin) and the Winnipeg River (Manitoba). These jurisdictions currently allow the harvest of lake sturgeon. Resource management agencies need to work cooperatively on shared waters to develop recovery plans and adopt appropriate regulations to ensure recovery plans are successful in meeting their objectives.

Biological Studies

In Ontario, there have been numerous studies and surveys involving lake sturgeon over the years (Table 9). These include projects to study movements, document distribution, describe habitat requirements, understand basic life history and identify factors responsible for the decline of lake sturgeon in Ontario (Figure 10). In February 1987, a lake sturgeon workshop (Olver 1987) was held in Timmins, Ontario. The workshop proceedings from that event have provided a useful reference to fisheries managers.

As a follow-up to the lake sturgeon workshop, a provincial lake sturgeon management review was conducted in 1992 (Duckworth et al. 1992). Recommendations included implementation of harvest control measures, habitat protection and rehabilitation, reintroduction of sturgeon into former waters and programs to increase public awareness. Unfortunately, many of these recommendations were not implemented on a provincial scale.

An increased interest in lake sturgeon is evident by a number of formalized workshops and meetings in recent years.

In June, 2000 a workshop on lake sturgeon restoration in the Great Lakes was sponsored by the Great Lakes Trust Fund (Holey et al. 2000). A Great Lakes Lake Sturgeon Coordination Group, comprised of various Great Lakes management agencies, was formed as a result of the workshop. This group, meets every two years to share information and coordinate activities.

In addition to the Coordination Group, a Central Great Lakes Lake Sturgeon

Table 8. Existing (pre July 1, 2008) recreational angling regulations for lake sturgeon in Ontario.

Regulation	Details	Fisheries Management Zones
Open Season	• January 1 - April 30; July 1 - December 31	1,2,4,5,6,7,8,9,10,11,13,14,15,16,18,19
	• January 1 - April 15; July 1 - December 31	3
	• June 15 - October 31	12
	• Closed all year	17,20
Catch Limits	• Sport – 1; Conservation – 0	1,2,3,4,5,7,8,10,11,12,13,14,15,16,18
	• Sport – 0; Conservation – 0	6,9,19
Size Limits	• Must be greater than 190 cm (74.8 inches)	4,5
	• Must be less than 105 cm (41.3 inches)	12

Figure 9. Fisheries management zones in Ontario.

bi-national work group was also formed. This group, which meets annually, is focused on lake sturgeon activities on Lake Huron, Lake St. Clair and Lake Erie.

Figure 10. Obtaining measurements from lake sturgeon captured in the Mattagami River near Kapuskasing, October, 1948 (Ontario Department of Lands and Forests photo).

In September, 2004, a lake sturgeon workshop was held in Cornwall. This event focused on lake sturgeon in Lake St. Francis and involved representatives from Ontario, Québec, New York, Mohawks of Akwesasne, and Ontario Power Generation (OPG et al. 2004). At the workshop participants developed a series of management actions for Lake St. Francis.

In March, 2005, a federal-provincial workshop was held in Sault Ste. Marie to develop a framework for monitoring and reporting on the status of lake sturgeon in Ontario (MNR 2005).

In November 2007, over thirty researchers, biologists and key stakeholders met in Sault Ste. Marie, Ontario, to evaluate recovery potential for lake sturgeon populations in the Great Lakes basin. It was estimated that, without any actions taken to reduce exploitation and address the presence of barriers, it could take up to 300 years to meet recovery targets (Pratt and O'Connor 2008).

On border waters there are a number of inter-jurisdictional groups to address fisheries management concerns. For example, there is a Border Waters Lake Sturgeon Technical Committee within the Ontario-Minnesota Fisheries Management Committee. The Technical Committee established short and long term goals for the continued recovery of lake sturgeon populations in Lake of the Woods and Rainy Lake. Similar committees have also been established to address issues on the Ottawa River, shared by the provinces of Ontario and Québec and Lake Ontario-St. Lawrence River, shared by the province of Ontario and New York state.

Due to the importance of lake sturgeon to many First Nations communities, several projects involving lake sturgeon have been initiated by the Anishinabek/Ontario Fisheries Resource Center (Table 10).

Stocking and Transfers

Sturgeon were cultured in Russia as early as 1869 (Smith 2009) but did not begin in North America until the 1960s.

Historically, lake sturgeon stocking has not been done in Ontario. This was primarily due to difficulties associated with egg collection. "Experience has demonstrated the great difficulty of securing ripe spawn and ripe milt at the same time, where hatchery operations are contemplated or attempted" (Ontario Game and Fish Commission 1912).

Table 9. A summary of biological studies involving lake sturgeon from various Ontario waters (see citations in References and in Appendix 14).

Population Assessment	Adams et al. (2006a), Easton (1968), ESC International (2003), Friday (2002), Friday and Chase (2005), Gillies and Desson (2002), Haxton (2003a), Maraldo (1997), McLeod (1999, 2007, 2008), Mohr (1995, 1997b, 2000, 2002), Mosindy and Rusak (1991), Nowak and Hortiquela (1986), Payne (1987), Seyler (2002), Young and Love (1970)
Tagging/Movement	Adams et al. (2006b), Friday (2004, 2005, 2006a), Haxton (2003b), McKinley (1993), McKinley et al. (1990, 1991, 1998), Phoenix (1991), Rusak and Mosindy (1997), Sheehan and McKinley (1992)
Spawning Assessment	Belfry (2003), Friday (2004, 2006), Garvey (2001), Golder Associates Ltd. (2008), Haxton (2006a, 2006b), Nichols et al. (2003), Power et al. (1998), Rich (1987), Seyler (1996, 2003),
Larval/Juvenile Assessment	Desson (1993), Friday (2004, 2005, 2006a), Preston (1994)
Aging	Mohr (1997a), Rossiter et al. (1995), Wilson (1987)
Inventory/Distribution	Carbone (1985), Ferguson and Duckworth (1997), German (1968), Hendry and Chang (2001), Kerr (2002), McLeod and Chepil (1999), Nowak and MacRitchie (1984)
Habitat Utilization	Chiasson et al. (1997), Haxton (2005a), Phoenix and Rich (1988), Seyler (1997b), Threader et al. (1998)
Impact Assessments	Carson et al. (1991), Chubbick and Evans (1982), Evans (1990), Haxton (2007), Niblett Environmental Associates (1993), Stokes et al. (1999)
Growth	Gibson et al. (1984), Goddard (1963), Harkness (1923), Haxton and Findlay (2008), Johnson et al. (1998), Lawson (1983), LeBreton et al. (1999), Love (1972), Power and McKinley (1997), Threader (1981)
Production and Yields	Ecologistics (1985, 1987)
Culture	Environmental Applications Ltd. (1988), Kerr (2006), Perron (1983), Rodd (1924), Smith (2009)
Genetics	Ferguson et al. (1993a, 1993b), McQuown et al. (2002, 2003), Welsh et al. (2008)

Ontario`s only efforts to culture lake sturgeon occurred in the 1920s by the Ontario Fisheries Research Laboratory at the University of Toronto (Kerr 2006). Many difficulties were encountered and the project was discontinued.

Sturgeon culture has been used for both conservation and commercial purposes.

Stocking programs have recently been initiated in several U.S. jurisdictions, including Michigan, Minnesota,

Table 10. Lake sturgeon projects conducted by Ontario First Nations communities.

Project	Waterbody (Year)
Spawning surveys	Mississagi River (1998-2003), Pickerel River (2002), Rainy River (2002), Serpent River (2003-2005), Spanish River (2003, 2005, 2006), Lake Nipigon (2006), Black River (2007), Pic River (2006, 2007), Smoothrock Lake (2006, 2007, 2008), Sturgeon River (2003), Whalesback Channel (2004)
Radio telemetry	Pic River (2008)
Population assessment	Key and Magnetewan Rivers (2000), Lake Nipissing (1997, 2002, 2003), Lake Nipigon (2007, 2008), Lake Superior (2008), Spanish River (2008)
Juvenile assessment	Lake Nipigon (2006)
Artificial propagation	Manitou rapids (1992)

Wisconsin, New York, Georgia and Tennessee. All have involved the restoration or reintroduction of lake sturgeon. In Canada, there have been small scale sturgeon culture and stocking efforts in both Manitoba and Saskatchewan.

Since 1993, a small culture facility in northwestern Ontario has been operated by the Rainy River First Nations at Manitou Rapids. Brood stock are collected from the Rainy River and, over the past decade, an average of 40,000 lake sturgeon fry have been released back into the Rainy River at Manitou Rapids to supplement and improve local sturgeon stocks. Over 100,000 fry from this hatchery have also been stocked into the upper Winnipeg River, just downstream of Kenora, by the MNR and the Dalles First Nation (Tom Mosindy, Ontario Ministry of Natural Resources, Kenora. personal communication).

Smith (2009) provides a review of lake sturgeon culture and stocking techniques. Three types of artificial propagation have been attempted. Traditional hatchery propagation involves the collection of gametes from wild spawning stocks and the progeny are reared under artificial conditions until their release as fry or juveniles. Increases in lake sturgeon abundance in the St. Louis River, Wisconsin, were attributed to this type of stocking program (Schram et al. 1999). While this technique improves early survival, there are often problems in obtaining sufficient numbers of eggs (captive brood stocks are impractical). There are also concerns regarding hatchery imprinting and outbreeding depression (see Glossary)(Kjartanson 2008).

A similar propagation technique involves the collection of gametes from wild spawning stocks but eggs are incubated in a streamside incubation unit where they are believed to imprint to their natal river.

A third, more recent, technique is known as `head start`. This procedure involves the collection of naturally spawned lake sturgeon larvae which are then transferred to a hatchery environment for several months before being released back into their natal waterbody.

This technique has been used with some success on the Black, Sturgeon and Pigeon Rivers in Michigan (Peterson et al. 2007).

In a few isolated instances, adult transfers of live fish have been conducted. For example, in 2003, 50 adult lake sturgeon were transferred from the Lower Mattagami River, at Little Long Reservoir, and reintroduced to the Upper Mattagami River near Timmins. Prior to this, sturgeon had been extirpated from that section of river. In 2007, recruitment was documented in the Tatachikapkia River, a tributary of the Upper Mattagami River (Charles Hendry, Ontario Ministry of Natural Resources, Timmins. personal communication).

Restoration of remnant or extirpated Ontario lake sturgeon stocks may require stocking or transfers. Any future stocking program will need to be carefully evaluated to ensure that it properly addresses the problem, does not deplete or impact the genetic integrity of wild spawning stocks, and is cost-effective.

Habitat Enhancement

Most habitat enhancement for lake sturgeon in North America has focused on providing access over small, low head barriers (i.e., fishways), creating or enhancing spawning areas, and working with water management agencies to ensure suitable flow regime (see Kerr *In Prep.*).

The large size, swimming ability and behaviour of lake sturgeon complicates the design of multi species fishways (Peake et al. 1997). Fish passages need to provide sufficient flow to attract sturgeon to the entrance and must have adequate depth of water for movement and access (Kynard and Pugh 2003). Since small sturgeon are poor swimmers, consideration must also be given to enhancing downstream drift over the dam (Bruch 2008).

There have been several fishways constructed, on low head barriers, to facilitate upstream access for lake sturgeon. On the Upper Fox River, Wisconsin, a three step plunge pool fishway, 30 m in length, provides upstream access for both walleye and lake sturgeon over a low head dam (Bruch 2008). Several dam removal and modification projects on the Red River, in Minnesota, have been successful in improving upstream access for sturgeon (Abraham 2008). More recently, a fish pass was constructed on the Richelieu River, Québec, to accommodate several fish species including lake sturgeon (Paradis 2003). This structure had a 5 m^3 sec^{-1} attractant flow, a 1 m^3 sec^{-1} flow through the structure and a 150 cm height change between 16 successive chambers. Recent observations indicate that lake sturgeon are successfully using this fishway. Despite these successes, the effectiveness of fish pass technology remains relatively unproven and requires more research.

Downstream migration through hydroelectric facilities has also been a problem in the past. In recent years, physical screening devices and behavioural deterrent technologies have been developed to reduce entrainment and guide fish to alternative downstream passage routes (Amaral 2004). New turbine designs, which reduce mortality, have also been developed.

Attempts have been made to create artificial spawning grounds in the Saint-Francois River, St. Lawrence River and Chaudiere River (Dick et al. 2006). On the St. Lawrence River site, lake

sturgeon spawning activity has been observed for three consecutive years (Johnson et al. 2006). Lapan et al. (1997) also reported lake sturgeon spawning activity on an artificial shoal constructed on a St. Lawrence River tributary. Dumont et al. (2004) reported improved egg-larval survival after spawning bed enhancement on the Des Prairies and L'Assomption rivers in Québec. More recently, several large spawning beds for lake sturgeon were constructed in the Detroit River (Manny et al. 2005).

Criteria for constructing a suitable spawning site includes the use of rock-rubble substrate with interstitial depth from 0.5 - 1.0 m, selecting a site with water velocity in the range of 0.6 - 1.0 $m^3 sec^{-1}$ and a depth of 4 - 8 m of water which is accessible to adult sturgeon. The absence of aquatic vegetation is also important.

Most habitat enhancement efforts have been directed at improving existing sturgeon spawning habitat. The size and quality of two lake sturgeon spawning areas were enhanced on the Des Prairies and Saint Maurice rivers in Québec. These efforts resulted in increased egg to larval survival as well as larval production (Dick et al. 2006).

A critical feature of lake sturgeon spawning habitat is the presence of a natural flow regime. Flow patterns have been altered in many large river systems by the construction and operation of hydroelectric generating facilities. Fluctuating and peaking water flows affect spawning migrations and spawning activity by disrupting natural environmental cues, dewatering spawning shoals, altering thermal regimes, and entraining adult sturgeon. Fluctuations of water flows can also affect the downstream drift of larval fish.

Although hydroelectric facilities cause habitat fragmentation resulting in isolated stocks, these populations can often remain viable if the facilities are operated on a run-of-the-river discharge (see Glossary) basis and there is suitable spawning habitat available.

There is the need for habitat enhancement programs to improve larval and juvenile habitat. Bark and woody debris, often associated with pulp and paper mills, are a significant detriment to both spawning and larval/juvenile habitat (Chiasson et al. 1997, Harkness and Dymond 1961). Much of this debris still exists today particularly in many of the larger Great Lakes tributaries. Several river deltas are totally covered in decaying wood chips and mats of bark (Lloyd Mohr, Ontario Ministry of Natural Resources, Owen Sound. personal communication).

In some cases, other sources of pollution have also been addressed. For example, improved watershed management and the construction of sewage treatment facilities was found to improve lake sturgeon larval production in the L'Assomption River, Québec (Dumas et al. 2003).

Current and Future Threats to Lake Sturgeon in Ontario

There are numerous species of sturgeon and paddlefishes in the world and all are in a threatened state. A number of factors have contributed to the current decline of lake sturgeon throughout its range. These include exploitation, illegal harvest, habitat alteration and fragmentation, and pollution (Birstein et al. 1997, Rochard et al. 1990). Climate change and the introduction of non-native species may also negatively impact lake sturgeon although the level

of their potential effect are not known.

The ecological and biological characteristics of *Acipenseriformes* present challenges for conservation. Lake sturgeon are generally unable to compensate for increased adult mortality. Most lake sturgeon populations have failed to recover from exploitation and habitat alterations which occurred in the late 1800s. At the same time, it is the lake sturgeon's unique life history strategy (e.g., benthic feeding habits and lack of natural predators) that may have prevented it from becoming extinct in some areas. In addition, periodicity in spawning with uneven male/female cycles has probably contributed to the preservation of genetic diversity.

Exploitation – The life history characteristics of lake sturgeon (slow growing, late maturity, spawning periodicity, longevity, etc.) make them extremely vulnerable to even low levels of exploitation (Baker and Borgeson 1999, Peterson et al. 2007). Anaylsis by Velez-Espino and Koops (2008) indicated that adult mortality (from fishing and other sources) had a substantial impact on population growth and recovery of lake sturgeon.

Traditionally, lake sturgeon in Ontario have been legally harvested by recreational, commercial and subsistence fisheries. The decline of many Ontario populations has been associated with overexploitation (Mosindy 1987). Many lake sturgeon populations in Ontario which were overexploited in the late 1800s and early 1900s have not recovered.

Lake sturgeon do not produce high yields on a sustainable basis and are known to be highly susceptible to fishing mortality (Boreman 1997). Brousseau (1987) postulated that unexploited populations in good habitat yielded only 0.20 kg ha^{-1}. MacRitchie (1983) estimated sturgeon yields from northern Ontario rivers were in the order of 0.20 - 0.28 kg ha^{-1}.

Fisheries can remove valuable brood stock and sturgeon harvest can easily exceed natural recruitment and sustainable yields. Beamesderfer and Farr (1997) reported that annual lake sturgeon harvest rates of more than 5 - 10% exceeded sustainable levels. Auer (2003) recommended that exploitation rates should be less than 5% for lake sturgeon. Similarly, Secor et al. (2002) concluded that sturgeon populations could not tolerate a fishing mortality in excess of 5%. In the Winnebago system, Wisconsin, Bruch (2008) concluded that annual exploitation rates of 3.2 - 4.7% were sustainable. Threader and Brousseau (1986) estimated that exploitation of lake sturgeon from the Moose River in northern Ontario should not exceed 1.8% of the population annually.

Illegal Harvest (Poaching) – Legal and illegal harvest of sturgeon in Ontario has been intensified by the increasing global demand for sturgeon flesh and caviar (Williamson 2003)(Figure 11).

International demand for caviar has been estimated at almost 2 million kg annually (World Wildlife Organization 2008). Until recently, the Caspian Sea was the single greatest source of caviar for the world market. As sturgeon stocks in the Caspian Sea collapse, there has been increasing demand for North American caviar as an alternate to the Caspian Sea product.

The price of caviar makes sturgeon poaching a very lucrative pursuit and poaching for sturgeon is a common

activity (Cohen 1997). In recent years there has been an increase in cases involving poaching and illegal trade in North America (TRAFFIC 2003). As more restrictive regulations are placed on legal fisheries, incidences of illegal harvest may increase (Williamson 2003).

Figure 11. The illegal harvest of sturgeon can have detrimental impacts on local populations (MNR photo).

Habitat Alteration – Sturgeon have been subjected to major habitat alterations throughout much of their range. These alterations have included dredging, channelization, flow/water level alterations and habitat fragmentation due to construction of dams.

Haxton and Findlay (2008) found that lake sturgeon were more abundant in the unimpounded reaches of the Ottawa River than the impounded reaches. Auer (1996a) recommended a barrier free 250-300 km combined river and lake range as a minimum distance to support self-sustaining lake sturgeon populations.

The construction of dams, many for hydroelectric power generation, restrict access to spawning, nursery and feeding habitats thereby fragmenting their natural habitat (Figure 12). Hydroelectric development was identified as the greatest problem for lake sturgeon rehabilitation at 12 of 21 historic Lake Superior spawning sites (Ebener 2007). The blockage of migration routes has been attributed as the cause for decline and a factor preventing recovery of lake sturgeon in many situations (Harkness and Dymond 1961, Haxton and Findlay 2008, Mohr and McClain 2001, Swainson 2001).

Hydroelectric power generation can have strong negative effects on sturgeon spawning downstream. Sturgeon recruitment is believed to be related to the volume of spring water flows. The artificial alteration of water levels and flows disrupts the natural environmental cues associated with movements, spawning and downstream drift of larval fish. Constant flows allow large fish migratory access and triggers reproduction resulting in less time spent on the spawning grounds (Auer 1996b). On the Kaministiquia River, Friday and Chase (2005) reported that adult sturgeon did not move to the spawning area at the base of Kakabeka Falls until flows reached 23 m^3 sec^{-1}. Water level fluctuations below dams can leave eggs susceptible to dessication (Brousseau and Goodchild 1989, Evans et al. 1993, Rosenberg et al. 1997). In some cases, sturgeon can become entrained and stranded in pools downstream of hydroelectric facilities (Seyler 1996).

Figure 12. Dams and hydroelectric facilities often represent a harmful alteration to lake sturgeon habitat (MNR photo).

Hydroelectric facilities also cause problems for downstream movements of adult and larval sturgeon. Injury and mortality can occur from passing through turbines or descending over spillways.

The impacts of dams and hydroelectric facilities appears to be the single largest impediment to the recovery of sturgeon in Ontario. Ironically, the threat to sturgeon as a result of the construction of large dams is expected to increase as the Province of Ontario looks to increase the number of new hydroelectric sites to meet future energy demands.

Dredging and channelization destroy critical spawning substrates and feeding habitat. Seven of nine historic lake sturgeon spawning sites in the Detroit River were altered through gravel removal and siltation (Manny et al. 2005). Blasting, dredging and underwater disposal of dredged material associated with the construction of the St. Lawrence Seaway is believed to have disrupted spawning, nursery and feeding habitats of lake sturgeon (MNR and NYDEC 2008).

Finally, the draining and filling of marshland is believed to have contributed to the decline of lake sturgeon in Lake Erie (Leach and Nepszy 1976) and Lake Ontario (Whillans 1979).

Pollution and Contaminants - In some areas the decline of lake sturgeon has been attributed to pollution in terms of water quality deterioration, contaminants, deposition of wood fibre and elevated water temperatures.

Sewage effluent was determined responsible for widespread mortality of lake sturgeon eggs in the L'Assomption River, Québec (Dumas et al. 2003).

Releases of chlorinated sewage upstream of a lake sturgeon spawning area on the Detroit River affected survival of offspring (Manny et al. 2005).

Discharges of wood fiber and chemical wastes from pulp and paper mills contributed to the collapse of sturgeon fisheries on Lake Superior (Lawrie and Raher 1972), Lake of the Woods (Mosindy 1987), Lake Nipissing (Harkness and Dymond 1961, Maraldo 1997) and the Spanish River (Dymond and Delaporte 1952).

Turbidity and water quality impairments affect the survival of benthos (see Glossary) upon which sturgeon depend for food. Sturgeon are bottom feeders and they may be exposed to high levels of contaminants and pollutants. The uptake of contaminants from the benthos can have deleterious effects including growth retardation, muscle degeneration, and reproductive impairment. Various compounds can accumulate in the fat tissues of lake sturgeon. Lake sturgeon are highly susceptible to contaminants such as mercury. With their long lifespan, larger older sturgeon tend to have high mercury concentrations. Although mercury concentrations were elevated in Ottawa River lake sturgeon, they were not believed to be sufficient to impede population recovery (Haxton and Findlay 2008). The effect of contaminant loading on survival and reproduction of lake sturgeon needs further research.

Lake sturgeon are also very sensitive to the lampricide trifluromethyl-4-nitrophenol (TFM) (Johnson et al. 1999, Boogaard et al. 2003). Young-of-the-year sturgeon, in the 15-100 mm length range, are most vulnerable to lampricide (Wisser and Weise 2003). Auer (1998) recommended that chemical treatments for sea lamprey must be adjusted and

carefully monitored in rivers used by lake sturgeon or an alternate control method needed to be considered. The Great Lakes Fishery Commission has developed protocols for treating streams in which young-of-the-year lake sturgeon are known to be present (Seelye et al. 1989).

Introduction of Non-Native Species – A large number of non-native aquatic species have been introduced to the Great Lakes basin. Many of these have had a profound impact on the aquatic community.

One exotic species that can impact lake sturgeon is the sea lamprey (*Petromyzon marinus*). There have been numerous observations of lamprey attack on lake sturgeon in the Great Lakes and there is evidence that they can kill small sturgeon (Sutton and Gaden 2007). Patrick (2008) concluded that a single sea lamprey attack was capable of inducing lethal levels of anemia on lake sturgeon, particularly younger individuals. Although sea lamprey may be capable of killing smaller lake sturgeon in the Great Lakes, larger individuals are probably not vulnerable to predation.

Lake sturgeon are believed to be most vulnerable to predation from egg stage to a fish of up to 250 mm in length (Auer and Baker 2002). Since they feed almost exclusively on small benthic organisms on the lake/river substrate, they could be sensitive to competition with other non-native organisms which have similar benthic feeding habits. For example, round gobies (*Neogobius melanostromous*) could compete for food with lake sturgeon. Gobies probably also predate sturgeon eggs.

Heavy infestations of zebra mussels (*Dreissena polymorpha*) can reduce the foraging activity of sturgeon. Lord (2007) found that juvenile lake sturgeon tended to avoid habitat colonized by zebra mussels. McCabe et al. (2006) concluded that the combined effect of zebra mussel avoidance and reduced foraging in the presence of zebra mussels could be detrimental to sturgeon stocking programs. In some instances heavy infestations of zebra mussels may also degrade spawning habitat.

Climate Change – As our climate changes, predictive models suggest that temperatures will become warmer. Consequently, it is believed that this will impact the hydrology cycle. Inland water levels may be lowered which could mean less habitat for lake sturgeon. Warmer water temperatures could possibly affect lake sturgeon distribution. Sturgeon are considered to be a coolwater species and are known to move from shallow waters when they warm. Some rivers may become unsuitable for sturgeon due to their homogeneous thermal properties. Disruption of the timing of peak flows due to variability in temperature and changes to ice cover, precipitation events, and length of the seasons could affect environmental cues for the phenology (see Glossary) of sturgeon. Changes in water levels and flows could impact early life history stages of lake sturgeon. A warming climate is expected to extend the northern range of several fish species some of which could compete for resources with lake sturgeon. Finally, increased environmental temperatures could have a similar effect on hydro demand leading to more development (hence fragmentation) and higher variability in use of existing aquatic resources.

Current Management Status of Ontario Sturgeon Populations

Three primary factors, namely unregulated commercial exploitation, habitat fragmentation and habitat degradation, caused the decline or collapse of Ontario lake sturgeon stocks. Many of these stocks have failed to recover from activities as long as one hundred years ago even though harvest has been strictly regulated or eliminated.

Although detailed assessments are not available in all instances, the current status of specific lake sturgeon populations in Ontario may be described as follows:

Lake of the Woods-Rainy Lake – Lake of the Woods was once known as "the greatest sturgeon pond in the world" (Ono et al. 1983). Assessment of lake sturgeon status has been conducted on a number of waters in the system and the evidence suggests that the population has improved steadily (Barry Corbett, Ontario Ministry of Natural Resources, Kenora. personal communication). Recent population assessments indicate that numbers of sturgeon greater than 100 cm in length have more than tripled from approximately 16,000 in 1990 (Mosindy and Rusak 1991) to almost 55,000 in 2004 (Stewig 2005). This improvement has been attributed to water quality improvements and controls on sport and commercial harvest especially in Lake of the Woods and the Rainy River. In spite of these improvements, lake sturgeon have not yet reached their full potential in these waters however.

Winnipeg-English Rivers – Only the upper portion of this drainage lies within Ontario. Although commercial harvest ended in the 1970s, estimated population growth rates indicate that sturgeon populations are still in decline (Velez-Espina and Koops 2008). Sturgeon are seldom captured in the recreational fishery or observed at traditional spawning sites. These populations have been tentatively ranked as endangered by COSEWIC.

Hudson-James Bay Drainage –This area includes a number of large rivers (e.g., Moose, Albany, Attawapiskat, Winisk and Severn) with drainage areas ranging from 56,000 to 136,000 km^2. The most southerly of these, the Moose River basin, has been impacted by extensive hydroelectric development, pollution and exploitation. All the river basins have sustained some level of commercial exploitation in the past and a few small First Nations commercial operations remain on the upper (inland) portions of the Albany and Winisk rivers. Populations of lake sturgeon in the vicinity of coastal communities and near reserves show signs of exploitation (Browne 2007) although they are relatively healthy overall.

Lake Superior - Lake sturgeon in Lake Superior have been impacted by overexploitation, pollution from sawmills, and construction of dams on tributary streams. As many as nine or ten tributaries (Canada and U.S.) still support self-sustaining populations although all are below historical levels.

Current assessment information exists for spawning populations associated with the Kaministiquia, Big Pic, Nipigon and Goulais rivers. Adult population size has been estimated for both the Kaminisitquia (~200) and Black Sturgeon (<100) rivers. Evidence of successful natural reproduction has been documented in both the Kaministiquia and Goulais rivers.

Although exploitation was not historically as intense on Lake Superior as in the other Great lakes, many populations were severely impacted and reduced to levels from which they have never recovered. Key issues in Lake Superior tributaries appear to be existing barriers, water flow regulation, and sea lamprey control (Mohr et al. 2008). The population status of all Lake Superior populations is considered to be critical with only one population (Kaministiquia River) identified as stable; the rest are unknown (Pratt 2008).

A lake sturgeon rehabilitation plan has been developed for Lake Superior (Auer 2003). The long term objective is to restore viable populations in each of the tributaries previously known to support lake sturgeon (Horns et al. 2003). Commercial fishing for sturgeon has been discontinued. Stocking has been conducted in four U.S. tributaries in an attempt to rehabilitate extirpated populations. In at least one instance (Kaministiqua River) efforts are being made to ensure adequate flows below a hydroelectric facility.

Lake Nipigon – The lake sturgeon population in Lake Nipigon crashed in the late 1920s. It is believed that lake sturgeon are still present in the lake but at very low levels of abundance (Rick Salmon, Ontario Ministry of Natural Resources, Nipigon. personal communication).

Lake Huron – Historic exploitation of lake sturgeon in Lake Huron was second only to Lake Erie suggesting that this activity likely played a large role in reducing lake sturgeon populations in the lake.

Issues impacting rehabilitation on Lake Huron include barriers, water level control, unregulated exploitation, and possibly sea lamprey control (Mohr et al. 2008). While several of the larger tributaries still provide access to larval and juvenile habitat, most have control structures located before the first major historical spawning location. Water level fluctuations during the spring spawning run have been identified as an issue on several tributaries (e.g., Moon River, Spanish River, Thessalon River). Sea lamprey treatment is a concern especially in the smaller tributaries.

Although lake sturgeon abundance remains well below historic estimates in Lake Huron, small commercial fisheries have been sustained in the Ontario waters of southern Lake Huron and the North Channel in areas where adult and juvenile habitat is abundant. Upstream access is a problem in some tributaries and spawning has been documented in only five rivers (Mississaugi, Nottawasaga, Spanish, Garden and St. Clair). Lakewide fish community objectives call for an increase in the abundance of lake sturgeon to the extent that the species is removed from threatened status (DesJardine et al. 1995). Restoration strategies include harvest control, habitat restoration, stocking, and law enforcement. A basinwide approach is required and the development of a recovery strategy has been recommended.

Lake St. Clair and connecting waterways – The lake sturgeon population of Lake St. Clair and connecting waters (Detroit and St. Clair rivers) appears to have remained stable for the past 40 years. These waters presently support a small commercial fishery for sturgeon.

Some of the issues in the Lake Erie-Huron corridor include habitat quality and quantity. The construction and use of the shipping channel in the corridor

continues to have an impact on lake sturgeon in the system. While overall water quality has been improving, contaminants continue to be an issue for lake sturgeon in this corridor.

Several large spawning beds have recently been created in the Detroit River. Sturgeon in Lake St. Clair and the St. Clair River are believed to be healthy with stable population trajectories (Pratt 2008).

Lake Erie – Based on commercial landings, it would appear that Lake Erie and its connecting waters historically had the largest lake sturgeon populations in the Great Lakes.

Lake sturgeon in Lake Erie have been severely reduced in abundance since the early 1900s. Five historic lake sturgeon spawning populations in the U.S. waters of Lake Erie are all considered extirpated. There currently are no known lake sturgeon spawning tributaries on the Ontario portion of Lake Erie.

Key issues on Lake Erie include habitat quality and quantity and water quality. While water quality has been improving, contaminants continue to be an issue for lake sturgeon.

Lakewide fish community objectives call for the protection and restoration of riverine and estuarine habitats to prevent the extirpation of sturgeon (Ryan et al. 2003). Although once on the edge of extirpation, sturgeon, particularly juvenile fish, have been more commonly seen in the western end of Lake Erie in recent years.

Lake Ontario – As in the other Great Lakes there is little doubt that exploitation at the end of the nineteenth century played a large role in the decline of lake sturgeon in Lake Ontario. The key issues on Lake Ontario today are the limitation of access to habitat due to barriers of various types and the degradation of the habitat that is available. Lakewide fish community objectives call for the recovery of sturgeon populations to the point where they can be removed from the `threatened` list (Stewart et al. 1999). Commercial fishing was closed in the late 1970s by both Ontario and New York. Based on incidental catches and spawning observations there are indications that lake sturgeon may be making a modest recovery in some parts of the lake.

Lake Nipissing – Lake Nipissing is believed to support stocks of lake sturgeon that spawn in the lake as well as three major tributaries (Figure 13). Water quality has improved at the Sturgeon River spawning site in recent years. Population assessments over the past two decades indicate successful natural recruitment suggesting the possibility of a modest recovery (Maraldo 1997). Pratt (2008) estimated the population trajectory of the Lake Nipissing sturgeon population was increasing.

Figure 13. An 82.6 kg (182 lb.) sturgeon captured in the Sturgeon River, a Lake Nipissing tributary (MNR photo).

Ottawa River – The Ottawa River has been highly fragmented by dams since European colonization. Lake sturgeon are found throughout the Ottawa River although there is significant variation in relative abundance between river reaches. Generally, their greatest abundance is in unimpounded reaches. Although many of the populations inhabiting tributaries have been extirpated, lake sturgeon in the Ottawa River appear relatively stable. Currently, exploitation rates are low and the system has yet to be colonized by many invasive species such as zebra mussels and round gobies.

St. Lawrence River – Commercial fisheries for lake sturgeon commenced later in the St. Lawrence River than many other parts of Ontario and stocks collapsed only in a few areas. There are presently only small remnant populations in the upper portion of the river. The Moses-Saunders hydroelectric facility continues to have a major impact on sturgeon populations in that part of the river. Another isolated population exists in Lake St. Francis between the Moses-Saunders and Beauharmois generating stations. Currently there is no commercial fishery. New York state has been stocking sturgeon in four tributaries to restore lake sturgeon on the U.S. portion of the river.

Summary of Key Considerations for Sturgeon Management

Habitat

- Lake sturgeon require a variety of specific habitat types during its life cycle. Identification, maintenance and restoration of habitat for all life stages of lake sturgeon is essential.
- Research is required to document key habitat and water quality requirements for different life stages of lake sturgeon.

Dams and Barriers

- The further development of rivers for hydroelectric purposes will probably be the greatest single impact on lake sturgeon in the future.
- Dams and barriers fragment lake sturgeon habitat, restrict gene flow, and block access to upstream spawning areas. The distribution of sturgeon populations should be identified in all waterbodies in Ontario. Higher priority should be given to protecting free-flowing rivers which support lake sturgeon.
- Altered water flows from hydroelectric generating facilities, particularly peaking operations, impact lake sturgeon movements and spawning activities. As a general principle, natural flow regimes (i.e., run-of-the-river) should be instituted wherever possible to accommodate sturgeon life history requirements.
- Lake sturgeon and hydroelectric development can co-exist. Best management practices should be adopted with new developments and a review should be conducted on operating regimes of existing facilities to accommodate sturgeon requirements at all life stages.
- There is the need to develop fish passage technology for lake sturgeon above high relief dams and hydroelectric generating facilities where dam removal is unlikely. This technology will be required to address concerns with regard to the construction of new dams and hydroelectric facilities in the future.

Exploitation

- As a result of their longevity and low reproductive rate, lake sturgeon are highly vulnerable to any type of

exploitation (i.e., increase in adult mortality). There is evidence to indicate that a fishery should not harvest more than a maximum of 5% of the population.

- With the recent collapse of the sturgeon fishery in the Caspian Sea, demand for sturgeon products has increased dramatically in North America encouraging harvest by both legal and illegal means.
- Although current legislation prohibits the harvest of lake sturgeon in Ontario (with the exception of subsistence fisheries), sustainable populations may be able to sustain a low level of harvest.
- Since mature female sturgeon represent the most vulnerable reproductive component in a population, size limits to protect larger, older fish should be established if harvest is to occur.
- Considering the variation of population responses and the uncertainty of estimates regarding life history variables for many lake sturgeon populations, a precautionary approach to future management is warranted.
- If harvest is being contemplated, consideration should be given to alternate harvest control techniques specifically those that provide information on the level of effort and harvest within Ontario.

Recovery and Restoration

- Recovery following overexploitation and collapse is very slow. Sturgeon recovery programs need to be considered a long term proposition. Depending on management actions taken, recovery time estimates to achieve lake sturgeon restoration objectives range up to 300 years.
- There is the need to develop short and long term objectives for any lake sturgeon recovery program. This includes defining what level of density/abundance, age structure and habitat use constitutes a viable/sustainable population. Monitoring and evaluation will be required to determine if management actions are meeting stated objectives.
- Identification of limiting factors is the first step in developing any recovery or restoration program for lake sturgeon.
- Survival during the first year of life is crucial in determining year class strength. Recovery plans for depressed lake sturgeon stocks should focus on improving survival rates during early life stages.

Artificial Propagation and Stocking

- Stocking programs have been used elsewhere in the world in cases involving collapsed stocks with little hope of natural recovery or for the purposes of reintroduction to a waterbody from which they were extirpated. Stocking programs should not be used to replace measures which address habitat alteration or overexploitation.
- Where populations have been extirpated, managers must first ensure that suitable habitat is still available and then develop innovative approaches to reintroduce and protect the stock as it is rebuilt over a period of many years or even decades.
- Artificial propagation projects must take into account considerations including inbreeding, genetic uniqueness, and the availability of donor stocks. Selection of source populations should consider population structure of donor stocks as well as genetic relationships among populations. For these reasons stocking projects for rehabilitation or re-introduction should proceed cautiously.

Cross Jurisdictional Issues

- Many lake sturgeon stocks exist in boundary waters shared with other provinces and the USA. Lake sturgeon move within and between jurisdictional boundaries and between lake basins. Recovery efforts and management activities require a coordinated approach.

Involvement of First Nations

- Due to their social and cultural significance as well as being an important food source, future activities and decisions regarding lake sturgeon should involve First Nation communities wherever possible.

Public Awareness

- There seems to be a general lack of understanding and awareness about the cultural and ecological importance of lake sturgeon. Future sturgeon management should include a public education component.

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Glossary of Terms

Benthos – organisms living on, or in, the bottom material of lakes and streams.

Benthic – refers to the bottom substrate and the species which inhabit that area.

Caviar – a highly valued delicacy comprised of salted, unfertilized eggs from female sturgeon or paddlefish.

Designatable unit – biologically-based unit that may be designated based on conservation status, guided by the general policy objective of preventing irreplaceable units of biodiversity from becoming extinct or extirpated from a jurisdiction in Canada.

Diadromous – fish which migrate between freshwater and saltwater environments.

Dietary portioning – sharing a common food resource with other resident fish species.

Extirpation – the elimination of a species of subspecies from a particular area but not from its entire range.

Heterocercal tail - In fish, a tail in which the tip of the vertebral column turns upward, extending into the dorsal lobe of the tail fin; the dorsal lobe is often larger than the ventral lobe. The heterocercal tail is present in many fossil fish, in the sharks (*Chondrichthyes),* and in the more primitive bony fish (e.g. the families *Acipenseridae* and *Polyodontidae*).

Juvenile – a young fish that has not reached sexual maturity.

Larval drift - an early life history stage of the sturgeon when they are being dispersed downstream from the spawning and incubation areas via currents while still absorbing their yolk sac.

Lentic – standing water such as a pond or a lake.

Maria – a term used by First Nations peoples to describe an outcast, the ugliest thing one could imagine and something of not much use to anyone.

Negatively phototactic – the movement of an organism away from a source of light.

Nocturnal – habits or activity which occurs during the night.

Omnivore – an organism which feeds on both plants and animals.

Opportunistic feeder – general feeding practice based on the abundance and availability of various food sources.

Outbreeding depression – reduced fitness, often measured as reproductive success, resulting from interbreeding between genetically distinct populations or species.

Phenology – timing of naturally recurring phenomena especially in relation to climate conditions.

Polygamous mating behaviour – spawning activity which involves more than one mate.

Polyploidization – a state where there are more than two homologous sets of chromosomes. The occurrence of polyploidy is a mechanism for speciation.

Potamodromous – fishes which live and move solely in freshwater to forage and breed.

Reproductive senescence - reduced reproductive capacity as an animal ages.

Run-of-the-river discharge – flows past hydroelectric facilities that are equivalent to flows being received from upstream (i.e., little of no storage of water).

Spawning periodicity – the act of spawning on an irregular basis.

Stock – a grouping of fish usually based on a genetic relationship, geographic distribution or movement pattern.

Swim-up – an early stage in the sturgeon`s life cycle when they begin to emerge from the spawning substrate where they had been incubating.

Appendix 1. Recreational angling regulations for lake sturgeon in the Province of Ontario, 1957 – 2008.

Year	Open Season	Catch (Possession) Limit	Size Limit
1957	• No closed season. • June 15 – May 15	1 fish per day	-
1958	• No closed season • June 15 – May 14	1 fish per day	-
1961	• No closed season • June 15 – May 14	1 fish per day	-
1962	• No closed season • June 15 – May 14	1 fish per day	-
1963	• No closed season • June 15 – May 14	1 fish per day	-
1964	• No closed season • June 13 – May 14	1 fish per day	-
1966	• No closed season • June 15 – May 14	1 fish per day	-
1967	• No closed season • June 15 – May 14	1 fish per day	-
1968	• No closed season • June 15 – May 14	1 fish per day	-
1969	• No closed season • June 15 – May 14	1 fish per day	-
1970	• No closed season • June 15 – May 14	1 fish per day	-

Year	Open Season	Catch (Possession) Limit	Size Limit
1971	• No closed season • June 15 – May 14	1 fish per day	-
1972	• No closed season • June 15 – May 14	1 fish per day	-
1973	• No closed season • June 15 – May 14	1 fish per day	-
1974	• No closed season • June 15 – May 14	1 fish per day	-
1975	• No closed season • June 15 – May 14	1 fish per day	-
1976	• No closed season • June 15 – May 14	1 fish per day	-
1977	• No closed season • June 15 – May 14	1 fish per day	
1978	• No closed season • June 15 – May 14	1 fish per day	-
1979	• No closed season (Divisions 1,2,8,11,16,17, 23 and 27) • June 30 – May 15 (Division 21 and 22) • June 15 – May 14 (All other Divisions)	1 fish per day	-
1980	• No closed season (Divisions 1,2,8,11,16,17,23 and 27) • June 30 – May 15 (Division 21 and 22) • June 15 – May 14 (All other waters)	1 fish per day	• Minimum total length of 114.3 cm (Divisions 21 and 22)
1981	• No closed season (Divisions 1,2,8,11,16, 17, 23 and 27) • June 30 – May 15 (Divisions 21 and 22) • June 15 – May 14 (All other waters)	1 fish per day	• Minimum total length of 114.3 cm (Divisions 21 and 22)

Year	Open Season	Catch (Possession) Limit	Size Limit
1982	• No closed season (Divisions 1,2,8,11,16,17 and 23) • June 30 – May 15 (Divisions 21 and 22) • July 1 – May 31 (Division 27) • June 15 – May 14 (All other waters)	1 fish per day	• Minimum total length of 114.3 cm (Divisions 21 and 22)
1983	• No closed season (Divisions 1,2,8, 11,16,17, 23) • June 30 – May 15 (Divisions 21 and 22) • July 1 - May 31 (Division 27) • June 15 – May 14 (All other waters)	1 fish per day	• Minimum total length of 114.3 cm (Divisions 21 and 22)
1984	• No closed season (Divisions 1,2,8,11,16,17,23) • June 30 – May 15 (Divisions 21,22) • July 1 – May 31 (Division 27) • June 15 – May 14 (All other waters)	1 fish per day	• Minimum total length of 114.3 cm (Divisions 21 and 22)
1985	• No closed season (Divisions 1,2,8,11,16,17,23) • June 30 – May 15 (Divisions 21,22) • July 1 – May 31 (Division 27) • June 15 – May 14 (All other waters)	1 fish per day	• Minimum total length of 114.3 cm (Divisions 21 and 22)
1986	• No closed season (Divisions 1,2,8,11,16,17,23) • June 30 – May 15 (Divisions 21,22) • July 1 – May 31 (Division 27) • June 15 – May 14 (All other waters)	1 fish per day	• Minimum total length of 114.3 cm (Divisions 21 and 22)
1987	• No closed season (Divisions 1,2,8,11,16,17, 23) • June 30 – May 15 (Divisions 21 and 22) • July 1 – May 31 (Division 27) • June 15 – May 14 (All other waters)	1 fish per day	• Minimum total length of 114.3 cm (Divisions 21 and 22)
1988	• No closed season (Divisions 1,2,8,11, 16, 17, 23) • June 30 – May 15 (Divisions 21 and 22) • July 1 – May 31 (Division 27) • June 15 – May 14 (All other waters)	1 fish per day	• Minimum total length of 114.3 cm (Divisions 21 and 22)

Year	Open Season	Catch (Possession) Limit	Size Limit
1989	• No closed season (Divisions 1,2,7, 9, 10, 12,15,16,17,23,29) • June 30 – May 15 (Divisions 21 and 22) • July 1 – May 31 (Division 27) • Last Saturday in April – May 14; June 15 – November 15 (Division 6 and 13) • June 15 – May 14 (All other waters)	1 fish per day	• Minimum total length of 114.3 cm (Divisions 21 and 22)
1990	• No closed season (Divisions 1,16,17,23) • Closed all year (Division 2,8,11,12) • June 30 – May 15 (Divisions 21 and 22) • July 1 – May 31 (Division 27) • Last Saturday in April – May 14; June 15 – November 15 (Divisions 6,13) • June 15 – May 14 (All other waters)	1 fish per day	• Minimum total length of 114.3 cm (Divisions 21 and 22)
1991	• No closed season (Divisions 1,16,17,23) • Closed all year (Divisions 2, 8, 11, 12) • June 30 – May 15 (Divisions 21 and 22) • July 31 – May 31 (Division 27) • Last Saturday in April – May 14; June 15 – November 15 (Division 6,13) • June 15 – May 14 (All other waters)	1 fish per day	• Minimum total length of 114.3 cm (Divisions 21 and 22)
1992	• No closed season (Divisions 1,16,17,23) • Closed all year (Divisions 2, 8, 11, 12) • June 30 – May 15 (Divisions 21 and 22) • July 31 – May 31 (Division 27) • Last Saturday in April – May 14; June 15 – November 15 (Division 6,13) • June 15 – May 14 (All other waters)	1 fish per day	• Minimum total length of 114.3 cm (Divisions 21 and 22)
1993	• No closed season (Divisions 1,16,17,23) • Closed all year (Divisions 2,8,11,12) • June 30 – May 15 (Divisions 21 and 22)	1 fish per day	Minimum total length of 114.3 cm (Divisions 21 and 22)

Year	Open Season	Catch (Possession) Limit	Size Limit
1993 (cont'd)	• July 1 – May 31 (Division 27) • Last Saturday in April – May 14; June 15 – November 15 (Divisions 6,13) • June 15 – May 14 (All other waters)		
1994	• No closed season (Divisions 1,16,17,23) • Closed all year (Division 2,8,11,12, 27 • June 30 – May 15 (Divisions 21 and 22, Eagle Lake) • Last Saturday in april – May 14; June 15 – November 15 (Divisions 6,13) • July 16 – April 30 (Groundhog River) • June 15 – May 15 (All other waters)	1 fish per day	• Minimum total length of 114.3 cm (Divisions 21 and 22)
1995	• No closed season (Division 1,16,17, 23, Simcoe County, French River) • Closed all year (Division 2, 8, 11, Lake St. Francis • Last Saturday in April – May 14; June 15 – November 15 (Division 6 • Last Saturday in april – May 14; June 15 - November 30 (Division 13) • Last Saturday in April – November 15 (Durham Region) • June 15 – October 31 (Division 12) • June 15 – December 31 (Huron County) • June 15 – March 15 (Lake Nosbonsing) • June 30 – May 15 (Divisions 21 and 22, Eagle Lake) • July 16 – April 30 (Groundhog River) • June 15 – May 14 (All other waters)	Sport – 1 fish per day Conservation – 0	• Minimum length of 114.3 cm (Divisions 21 and 22). Length refers to the distance measured from the rear most limit of the gill opening to the point where the rear edge of the dorsal fin joins the flesh of the body.
1996	• No closed season (Division 1, 8,11,16, 17,23, Simcoe County, Huron County, French River) • Closed all year (Division 2,27, Lake St. Francis) • Last Saturday in April – September 30 (Grey and Bruce Counties) • Last Saturday in April – November 15 (Durham Region)	Sport – 1 fish per day Conservation – 0	• Minimum length of 114.3 cm (Divisions 21 and 22). Length refers to the distance measured from the rear most limit of the gill opening to the point where the rear edge of the dorsal fin joins the flesh of the body.

Year	Open Season	Catch (Possession) Limit	Size Limit
1996 (cont'd)	• Last Saturday in April – May 14; June 15 – November 15 (Division 6, 13) • Closed all year (Division 2 • June 15 – October 31 (Division 12) • June 15 – March 15 (Lake Nosbonsing) • June 30 – May 15 (Divisions 21,22 and 32) • July 16 – April 30 (Groundhog River) • June 15 – May 14 (All other waters)		
1997	• No closed season (Divisions 1,16,17,23, Maitland River, French River) • Closed all year (Division 2, 8, 11,27) • January 1 – March 15; June 15 – December 31 (Lake Nosbonsing) • January 1 – May 15; June 30 – December 31 (Divisions 21 and 22) • January 1 – April 30; July 16 – December 31 (Groundhog River) • Last Saturday in April – November 15 (Durham Region) • Last Saturday in April – May 14; June 15 – November 15 (Division 6) • Last Saturday in April – May 14; June 15 – November 30 (Division 13) • June 15 – October 31 (Division 12) • June 15 – December 31 (Bayfield River) • June 15 – May 14 (All other waters)	Sport – 1 fish per day Conservation - 0	• Minimum length of 114.3 cm (Divisions 21 and 22). Length refers to the distance measured from the rear most limit of the gill opening to the point where the rear edge of the dorsal fin joins the flesh of the body.
1998	• No closed season (Division 1, 16, 17, 23, Maitland River, French River) • Closed all year (Division 2, 8, 11,27,Lake St. Francis) • January 1 - March 15; June 15 – December 31 (Lake Nosbonsing) • January 1 – May 15; June 30 – December 31 (Divisions 21, 22, 22A) • January 1 – April 30; July 16 – December 31 (Groundhog River)	Sport – 1 fish per day Conservation – 0	• Minimum length of 114.3 cm (Divisions 21, 22 and 22A). Length refers to the distance measured from the rear most limit of the gill opening to the point where the rear edge of the dorsal fin joins the flesh of the body.

Year	Open Season	Catch (Possession) Limit	Size Limit
1998 (cont'd)	• Last Saturday in April – May 14; June 15 – November 15 (Division 6) • Last Saturday in April – May 14; June 15 – November 39 (Division 13) • June 15 – October 31 (Division 12) • June 15 – December 31 (Nine Mile River) • June 15 – May 14 (All other waters)		
1999	• No closed season (Divisions 1,16,17,23, Maitland River, French River) • Closed all year (Divisions 2, 27, 12A) • January 1 – March 15; June 15 – December 31 (Lake Nosbonsing) • January 1 – May 14; June 15 – December 31 (Divisions 15 and 28) • January 1 – May 15; June 30 – December 31 (Divisions 21, 22, 22A) • Last Saturday in April – May 14; June 15 – November 15 (Division 6) • Last Saturday in April – May 14; June 15 – November 30 (Division 13) • June 15 – October 31 (Division 12) • June 15 – May 14 (All other waters) • June 30 – March 31 (Jackfish Creek, Ord River)	Sport – 1 fish per day Conservation – 0	• Minimum length of 114.3 cm (Divisions 21, 22 and 22A). Length refers to the distance measured from the rear most limit of the gill opening to the point where the rear edge of the dorsal fin joins the flesh of the body.
2000	• No closed season (Division 1, 16, 17, 23) • Closed all year (Division 2,8,11, 12A, 27) • January 1 – May 14; June 15 – December 31 (Divisions 20, 21,22,22A,24, 30, 31,33,34) • January 1 – May 15; June 30 – December 31 (Division 32) • Last Saturday in April – May 14; June 15 – November 15 (Division 6) • Last Saturday in April – May 14; June 15 – November 30 (Division 13) • June 15 – December 31 (Bayfield River, Nine Mile River)	Sport – 1 fish per day Conservation – 0	• Minimum length of 114.3 cm (Divisions 21, 22 and 22A).). Length refers to the distance measured from the rear most limit of the gill opening to the point where the rear edge of the dorsal fin joins the flesh of the body.

Year	Open Season	Catch (Possession) Limit	Size Limit
2000 (cont'd)	• June 15 – October 31 (Division 12) • June 15 – May 14 (All other waters)		
2001	• No closed season (Division 1, 16, 17, 23) • Closed all year (Divisions 2, 8,11, 12A,27) • January 1 – March 14; June 15 – December 31 (Lake Nosbonsing) • January 1 – May 14; June 15 – December 31 (Division 30, 31, 32,33,34) • January 1 – May 15: June 30 – December 31 (Division 21,22,22A) • Last Saturday in April – November 15 (Durham Region) • Last Saturday in April – May 14; June 15 – November 15 (Division 6) • Last Saturday in April – May 14; June 15 – November 30 (Division 13) • June 15 – October 31 (Division 12) • June 15 – December 31 (Nine Mile River) • June 15 – May 14 (All other waters)	Sport – 1 fish per day Conservation – 0	• Minimum length of 114.3 cm (Divisions 21, 22 and 22A). Length refers to the distance measured from the rear most limit of the gill opening to the point where the rear edge of the dorsal fin joins the flesh of the body.
2002	• No closed season (Divisions 1, 16, 17, 23) • Closed all year (Division 2, 8, 11, 12A, 27) • January 1 – May 15; June 30 – December 31 (Divisions 21,22,22A, 32) • Last Saturday in April – May 14; June 15 – November 15 (Division 6) • Last Saturday in April – May 15; June 15 – November 30 (Division 13) • June 15 – October 31 (Division 12) • June 15 – December 31 (Bayfield River, Maitland River) • June 15 – May 14 (All other waters)	Sport – 1 fish per day Conservation – 0	• Minimum length of 114.3 cm (Divisions 21, 22 and 22A). Length refers to the distance measured from the rear most limit of the gill opening to the point where the rear edge of the dorsal fin joins the flesh of the body.
2003	• No closed season (Divisions 1,10, 12A,16,17, 23, 29, 35) • Closed all year (Divisions 2, 8, 11,27)	Sport – 1 fish per day Conservation – 0	• Minimum length of 114.3 cm (Divisions 21, 22 and 22A). Length refers to the distance measured from the rear most limit of the gill opening to the point where the rear edge of the dorsal fin joins the flesh of the body.

Year	Open Season	Catch (Possession) Limit	Size Limit
2003 (cont'd)	• January 1 – March 15; June 15 – December 31 (Lake Nosbonsing) • January 1 – May 15; June 30 – December 31 (Division 32) • Last Saturday in April – May 14; June 15 – November 15 (Division 6, 13) • June 15 – October 31 (Division 12) • June 15 – December 31 (Maitland River, Nine Mile River) • June 15 – May 14 (All other waters)		
2004	• No season closure (Divisions 1, 11,12A, 16,17,23, 29,35) • Closed all year (Divisions 2, 8,27) • January 1 – March 15; June 15 – December 31 (Lake Nosbonsing) • January 1 – May 14; June 15 – December 31 (Division 10) • Last Saturday in April – May 14; June 15 – November 15 (Division 6) • Last Saturday in April – May 14; June 15 – November 30 (Division 13) • June 15 – October 31 (Division 12) • June 15 – December 31 ((Maitland River, Nine Mile River) • June 15 – May 14 (All other waters)	Sport – 1 fish per day Conservation – 0	• Minimum length of 114.3 cm (Divisions 21, 22 and 22A). Length refers to the distance measured from the rear most limit of the gill opening to the point where the rear edge of the dorsal fin joins the flesh of the body.
2005	• No season closure (Divisions 1,12, 12A,16,17,23, 29,35) • Closed all year (Divisions 2, 8,11,27) • January 1 – March 15; June 15 – December 31 (Lake Nosbonsing) • January 1 – May 15; June 30 – December 31 (Division 32) • Last Saturday in April – May 14; June 15 – November 15 (Division 6) • Last Saturday in April – May 14; June 15 – November 30 (Division 13) • June 15 – October 31 (Division 12)	Sport – 1 fish per day Conservation – 0	• Minimum length of 114.3 cm (Divisions 21, 22 and 22A). Length refers to the distance measured from the rear most limit of the gill opening to the point where the rear edge of the dorsal fin joins the flesh of the body.

Year	Open Season	Catch (Possession) Limit	Size Limit
2005 (cont'd)	• June 15 – December 31 (Maitland River, Nine Mile River) • June 15 – May 14 (All other waters)		
2006	• No season closure (Divisions 1,12, 12A,16,17,23, 29,35) • Closed all year (Divisions 2, 8,11,27) • January 1 – March 15; June 15 – December 31 (Lake Nosbonsing) • January 1 – May 15; June 30 – December 31 (Division 32) • Last Saturday in April – May 14; June 15 – November 15 (Division 6) • Last Saturday in April – May 14; June 15 – November 30 (Division 13) • June 15 – October 31 (Division 12) • June 15 – December 31 (Maitland River, Nine Mile River) • June 15 – May 14 (All other waters)	Sport – 1 fish per day Conservation – 0	• Minimum length of 114.3 cm (Divisions 21, 22 and 22A). Length refers to the distance measured from the rear most limit of the gill opening to the point where the rear edge of the dorsal fin joins the flesh of the body.
2007	• No season closure (Divisions 1,12, 12A,16,17,23, 29,35) • Closed all year (Divisions 2, 8,11,27) • January 1 – March 15; June 15 – December 31 (Lake Nosbonsing) • January 1 – May 15; June 30 – December 31 (Division 32) • Last Saturday in April – May 14; June 15 – November 15 (Division 6) • Last Saturday in April – May 14; June 15 – November 30 (Division 13) • June 15 – October 31 (Division 12) • June 15 – December 31 (Maitland River, Nine Mile River) June 15 – May 14 (All other waters)	Sport – 1 fish per day Conservation – 0	• Minimum length of 114.3 cm (Divisions 21, 22 and 22A). Length refers to the distance measured from the rear most limit of the gill opening to the point where the rear edge of the dorsal fin joins the flesh of the body.
2008	• No closed season • Closed all year (FMZ 17, 20, Lake Nipissing) • January 1 – April 15; July 1 – December 31 (FMZ 3 0	Sport – 1 fish per day; Conservation – 0 (FMZ 1,2,3,4,5,7, 10,11,12, 13,14, 15, 16, 18, 19	• Minimum total length of 190 cm in FMZ 4, 5 • Maximum size limit of 105 cm in FMZ 12

Year	Open Season	Catch (Possession) Limit	Size Limit
2008 (cont'd)	• January 1 – April 30; July 1 – December 31 (FMZ 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 18, 19, 20) • June 15 – October 31 (FMZ 12)	Sport – 0; Conservation – 0 (FMZ 6, 9, Lake Superior tributaries)	
2009	• No closed season • Closed all year (FMZ 17, 20, Lake Nipissing) • January 1 – April 15; July 1 – December 31 (FMZ 3 0 • January 1 – April 30; July 1 – December 31 (FMZ 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 18, 19 0 • June 15 – October 31 (FMZ 12)	Sport – 0* Conservation – 0*	NA

* Regulation became effective midway through 2008

Appendix 2. Designated status and associated regulations for lake sturgeon in selected North American jurisdictions.

Jurisdiction	Status Designation	Open Season	Catch Limit	Size Limit
Alabama	Extirpated	-	-	-
Alberta	Undetermined	Closed	Zero	N/A
Arkansas	Extirpated	Closed	Zero	N/A
Georgia	Extirpated	Closd	Zero	N/A
Illinois	Endangered	Closed	Zero	N/A
Indiana	Endangered	Closed	Zero	N/A
Iowa	Endangered (Mississippi R.)	Closed	Zero	N/A
Kentucky	Endangered	October 16 - May 14; June 1 - September 30	Zero	N/A
Manitoba	Unknown (Heritage species)	Unknown	Zero	N/A
Michigan	Threatened	• February 7 - 15 (spearing) • September 1 - 30 • July 16 - March 15 • July 16 - September 30 • July 16 - September 30	One One One One Zero	• 91.4 cm minimum • 152.4 cm minimum • 127.0 cm minimum • 106.7-127.0 cm harvest slot • N/A
Minnesota	Special Concern	• Closed • April 24 - May 7 and July 1 - September 30 • May 8 - May 15 and October 1 - April 23	Zero 1 (per year) Zero	• N/A • 114.3-127.0 harvest slot or 190.5 minimum • N/A
Missouri	Endangered	Closed	Zero	N/A
Nebraska	Threatened	Closed	Zero	N/A

Jurisdiction	Status Designation	Open Season	Catch Limit	Size Limit
New York	Threatened	Closed	Zero	N/A
North Carolina	Special Concern	Unknown	Unknown	Unknown
North Dakota	Unknown	Closed	Zero	N/A
Ohio	Endangered	Closed	Zero	N/A
Ontario	Special Concern	• No closed season	Zero	N/A
		• Closed all year (FMZ 17, 20, Lake Nipissing)	Zero	N/A
		• January 1 – April 15; July 1 – December 31 (FMZ 3)	1 fish*	None
		• January 1 - April 30; July 1 - December 31 (FMZ 1, 2, 4, 5, 6, 7, 8, 9, 10, 11, 13, 14, 15, 16, 18, 19;	1 fish*	105 cm minimum (FMZ 4, 5)
		• June 15 - October 31 (FMZ 12)	1 fish*	105 cm maximum
Pennsylvania	Endangered	Closed	Zero	N/A
Québec	Species at risk	June 15 - October 31	1	None
Saskatchewan	Unknown	Unknown	Zero	N/A
Tennessee	Endangered	Closed	Zero	N/A
Vermont	Endangered (L. Champlain)	Closed	Zero	N/A
West Virginia	Extirpated	Closed	Zero	N/A
Wisconsin	Special Concern	• September 8 - 30	1 (per year)	• 152.4 minimum
		• September 6 - October 15	1 (per year)	• 127.0 minimum
		• February 14 - March 1 (spearing)	1 (per year)	• 91.4 minimum

* Zero limit effective July 2008.

Appendix 3. A comparison of lake sturgeon population and density estimates for selected Ontario waterbodies to similar estimates for waters from other jurisdictions (from McLeod 2008).

Waterbody	Year	Jurisdiction	Method	Population Estimate (95% CI)	Density (fish/ha)	Density (fish/km)
Abitibi River	1984	Ontario	Schnabel	994 (830-1,213)	1.0	24.9
Black Lake	1997	Michigan	Schnabel	1,241 (> 900 mm)	0.3	-
Frederick House River	1984	Ontario	Modified Peterson	186 (spawning adults)	1.9	13.3
Kaministiquia River	1998	Ontario	Schymacher-Eschmeyer	140 (77-234)	1.2-5.0	3.0
	2001		Modified Schnabel	188 (127-289 adults)	-	4.0
Kenogami River	1985	Ontario	Schnabel	711 (660-767)	-	4.4
Kettle River	2002	Minnesota	Schnabel	346 (309-387)	-	-
Little Eva Lake	2007	Ontario	Adjusted Peterson	2,729 (1,218-6,824)	9.7	-
			Modified Schnabel	2,225 (908-5,563)	7.9	-
Lower Groundhog/ Mattagami River	1984	Ontario	Modified Schabel	8,428 (6,260-11,654) (fish ≥ age 9)	7.2	187.0
Manistee River	2001	Michigan	Modified Schnabel	46 (34-65) (spawning adults)	-	-
	2005			21-66	0.1	-
Mattagami River (Little Long head pond)	1991	Ontario	Modified Schnabel	24,772 (16,359-34,910)	3.5	-
	2001		Modified Schnabel	12,395 (10,292-14,924) (Mature adults)	1.7	-
Mattagamai River (head ponds)	1985	Ontario	Unknown	Unknown (Adults)	0.2-0.3	-
Moose River	1985	Ontario	Unknown	7,088 (5,774-8,919) (fish ≥ age 8)	-	-

Waterbody	Year	Jurisdiction	Method	Population Estimate (95% CI)	Density (fish/ha)	Density (fish/km)
Muskegon River	2002	Michigan	Modified Schnabel	17 (mature adults)	-	
Nelson River	2000	Manitoba	Modified Peterson	692 (adults)	-	-
North Saskatchewan River	2000	Saskatchewan	Jolly-Seber	200 (mature)	-	0.4
				1,360 (≥ age 3)	-	2.5
Ottawa River (Lac Deschenes)	2003	Ontario	Schnabel	202 (93-378 adults)	<0.1	0.2
Rainy River-Lake of the Woods	2004	Ontario	Simple Peterson	59,050 (30,736-121,372) (> 1,000 mm)	0.3	-
Round Lake	1998	Manitoba	Jolly-Seber	1,048 (562-2,553)	-	-
Saskatchewan River	2006	Manitoba	Jolly-Seber	1,639 (373-16,342) (adults)	-	-
South Saskatchewan River	1986	Saskatchewan	Jolly-Seber	510 (mature fish)	-	1.7
				2,058 (> age 3)	-	6.9
Winnebago Lake system	2008	Wisconsin	Modified Peterson	41,796 (35,536-52,320) (adults)	0.5	-
Winnipeg River	1997	Manitoba	Jolly-Seber	2,998 (1,143-13,101)	-	-
	1999			10,571	-	-

Appendix 4. Growth rates of lake sturgeon from various Ontario waterbodies.

Attawapiskat River (Environmental Applications Group Ltd. 1988)

Age	Sample Size (No. Fish)	Mean Fork Length (cm)	Mean Total Length (cm)	Mean Round Weight (gm)
5	4	43.2	48.4	440.0
6	2	45.9	51.9	620.0
7	5	53.1	58.0	854.0
8	2	54.1	61.9	875.0
9	3	53.0	59.9	880.0
10	15	58.5	67.3	1,242.7
11	9	61.4	70.1	1,507.8
12	7	62.7	70.8	1,571.4
13	10	63.4	72.7	1,483.0
14	9	64.1	71.9	1,874.4
15	5	63.7	69.6	1,376.0
16	6	66.6	75.3	2,295.0
17	3	70.2	77.9	2,126.7
18	3	69.6	79.1	2,296.7
19	3	75.1	85.0	2,716.7
20	8	79.1	90.5	3,456.3
21	8	75.0	84.4	2,793.8
22	3	77.1	84.4	3,300.0
23	4	76.4	86.7	2,750.0
24	8	78.3	86.9	3,106.3
25	4	95.5	104.0	5,025.0
26	11	89.2	100.4	5,013.6
27	11	86.6	96.9	4,686.4
28	6	91.4	98.3	5,491.7
29	8	93.4	104.2	5,450.0
30	7	94.4	105.6	5,857.1
31	7	92.3	102.8	5,592.9
32	7	96.6	107.7	6,614.3
33	7	96.7	107.3	6,178.6
34	4	99.6	109.7	7,237.5
35	5	101.0	111.7	7,500.0
36	5	106.6	119.0	8,840.0
37	4	100.0	110.5	7,200.0
38	5	101.1	112.6	7,370.0
39	4	101.9	112.7	8,025.0
40	1	114.0	124.0	9,600.0
41	1	107.4	119.4	9,100.0
42	1	104.5	115.4	8,200.0
43	1	115.0	125.0	12,100.0
44	1	123.0	138.0	18,500.0
45	5	111.1	120.8	11,210.0
46	3	117.3	128.2	12,283.3
47	1	117.0	127.0	11,250.0
48	1	112.5	121.9	11,400.0
49	2	129.6	142.0	13,700.0
50	1	135.1	150.5	15,500.0
52	2	125.3	136.0	14,150.0
56	2	123.5	130.5	13,625.0
57	1	144.5	161.0	21,750.0
63	1	138.0	153.0	20,000.0
65	1	136.0	153.0	21,400.0
68	1	150.0	158.0	22,250.0

Burntbush Lake (C. Hendry, published data)

Age	Sample Size (No. Fish)	Mean Fork Length (cm)	Mean Total Length (cm)	Mean Round Weight (gm)
13	-	-	65.3	-
14	-	-	69.9	-
16	-	-	71.8	-
17	-	-	74.3	-
18	-	-	79.0	-
19	-	-	81.7	-
20	-	-	78.5	-
21	-	-	89.0	-
22	-	-	89.0	-
24	-	-	79.5	-
26	-	-	93.3	-
27	-	-	106.5	-
28	-	-	94.9	-
29	-	-	100.3	-
30	-	-	106.5	-
31	-	-	98.9	-
32	-	-	111.3	-
33	-	-	109.0	-
34	-	-	108.3	-
35	-	-	113.5	-
36	-	-	106.0	-
38	-	-	119.5	-
39	-	-	116.9	-
40		-	112.4	-
41	-	-	127.5	-
42	-	-	124.0	-
43	-	-	114.0	-
44	-	-	124.0	-
45	-	-	111.0	-
46	-	-	120.0	-
49	-	-	109.3	-
50	-	-	114.5	-
51	-	-	109.5	-
56	-	-	124.0	-
59	-	-	129.0	-

Chipman Lake (Goddard 1963)

Age	Sample Size (No. Fish)	Mean Fork Length (cm)	Mean Total Length (cm)	Mean Round Weight (gm)
25	2	93.2	103.4	5,765.8
26	1	98.3	108.5	6,719.2
27	2	91.4	100.3	5,402.6
29	4	103.9	115.6	8,489.8
30	3	101.6	110.9	7,536.4
31	2	102.9	111.5	7,400.2
32	3	102.1	112.0	8,126.6
33	6	105.7	115.1	9,034.6
34	4	104.9	114.6	8,671.4
35	10	103.4	112.5	8,262.8
36	11	104.9	114.6	8,626.0
37	5	108.5	118.4	9,534.0
38	13	106.9	117.6	9,761.0
39	4	108.2	117.9	9,125.4
40	11	114.8	124.5	11,304.6
41	6	107.2	117.3	8,943.8
42	9	117.8	122.2	10,714.4
43	14	109.2	119.6	9,851.8
44	8	113.5	122.7	11,440.8
45	6	112.8	122.4	11,168.4
46	11	111.8	121.2	10,896.0
47	8	107.4	117.6	9,307.0
48	5	112.5	122.7	11,304.6
49	4	113.8	124.2	11,077.6
50	5	115.3	125.2	11,123.0
51	2	108.0	116.3	9,261.6
52	3	126.7	138.2	16,661.8
53	7	117.3	127.3	12,802.8
54	6	118.4	127.5	11,985.6
56	2	110.7	120.9	10,669.0
57	3	119.9	129.8	12,757.4
58	3	118.4	126.5	13,347.6
59	1	135.9	146.6	17,887.6
60	3	121.7	131.3	14,800.4
61	1	105.4	115.6	7,808.8
62	1	115.1	126.5	12,802.8
63	3	135.1	145.3	20,384.6
64	2	136.4	147.6	21,156.4
65	1	128.3	139.2	17,252.0
67	1	-	130.8	12,712.0
68	1	133.4	141.5	14,982.0
70	2	108.7	119.4	9,534.0
72	1	-	140.2	18,069.2
77	1	-	146.1	15,663.0
79	1	135.1	145.3	-
84	1	130.3	141.0	15,890.0
91	1	149.4	161.3	26,377.4

Groundhog and Mattagami Rivers (from Nowak and Jessop 1987).

Age	Sample Size (No. Fish)	Mean Fork Length (cm)	Mean Total Length (cm)	Mean Round Weight (gm)
9	5	53.8	-	1440
10	1	71.5	-	2800
11	2	58.0	-	1650
12	3	78.0	-	3900
13	11	78.4	-	3654
14	3	82.8	-	4883
15	8	89.9	-	6328
16	3	91.3	-	5667
17	5	97.6	-	8900
18	11	101.5	-	9155
19	16	95.9	-	7350
20	9	94.6	-	7311
21	12	102.5	-	9716
22	13	109.9	-	10,323
23	12	109.0	-	11,125
24	19	107.8	-	11,442
25	13	114.2	-	13,131
26	13	115.2	-	13,623
27	10	112.6	-	12,900
28	12	114.0	-	12,408
29	13	117.8	-	14,538
30	12	112.2	-	12,708
31	7	115.4	-	14,414
32	10	115.4	-	13,970
33	3	114.0	-	10,967
34	6	115.8	-	13,650
35	5	120.0	-	16,280
36	6	125.5	-	16,983
37	2	125.0	-	18,000
38	2	108.5	-	10,900
39	1	130.0	-	18,400
40	2	143.0	-	25,250
42	5	117.0	-	13,980
47	1	121.0	-	20,900
49	1	133.0	-	19,000

Groundhog River (Golder Associates Ltd. 2008).

Age	Sample Size (No. Fish)	Mean Fork Length (cm)	Mean Total Length (cm)	Mean Round Weight (gm)
7	1	82.0	-	2,500.0
8	1	101.0	-	5,000.0
9	1	99.5	-	6,500.0
10	1	110.0	-	8,500.0
12	2	97.9	-	6,800.0
13	1	97.5	-	7,500.0
14	3	103.0	-	7,666.7
15	1	105.0	-	10,000.0
16	1	97.0	-	6,375.0
17	3	113.8	-	9,500.0
18	2	112.3	-	6,250.0
19	4	105.1	-	8,125.0
20	2	112.5	-	11,500.0
21	4	103.9	-	7,785.0
22	2	115.5	-	15,250.0
23	2	107.5	-	11,500.0
24	4	108.2	-	10,625.0
25	4	98.9	-	7,750.0
26	1	108.0	-	11,500.0
27	1	127.0	-	18,000.0
28	3	121.8	-	11,500.0
29	2	120.5	-	18,500.0
30	2	121.2	-	14,250.0
31	3	111.7	-	11,833.3
32	1	97.5	-	8,000.0
33	1	104.0	-	9,500.0
34	1	106.0	-	7,500.0
35	1	104.5	-	7,500.0
36	2	114.8	-	11,250.0
37	1	110.0	-	10,000.0
38	1	121.5	-	16,000.0
39	1	126.5	-	15,500.0
41	2	118.3	-	11,750.0
42	1	112.0	-	11,500.0
43	1	110.0	-	8,500.0
44	1	115.5	-	10,000.0
45	1	116.0	-	18,500.0
46	1	107.0	-	10,000.0
48	1	111.1	-	13,000.0
51	1	110.5	-	11,500.0
54	1	123.0	-	13,500.0
55	1	118.0	-	14,000.0
56	1	157.0	-	42,000.0

Kenogami River (Ecologistics Ltd. 1987)

Age	Sample Size (No. Fish)	Mean Fork Length (cm)	Mean Total Length (cm)	Mean Round Weight (gm)
2	13	-	30.8	109.5
3	40	-	34.4	148.8
4	18	-	37.7	237.5
5	24	-	40.7	267.0
6	35	-	43.3	360.7
7	46	-	46.3	420.5
8	19	-	47.9	460.9
9	19	-	51.1	586.1
10	12	-	54.5	729.2
11	14	-	55.7	780.4
12	16	-	55.7	801.6
13	11	-	59.3	943.2
14	24	-	57.6	867.7
15	18	-	64.1	1,254.2
16	12	-	62.8	1,025.0
17	11	-	67.1	1,427.3
18	4	-	65.0	1,225.0
19	5	-	70.5	2,040.0
20	6	-	73.2	1,496.7
21	10	-	73.3	2,025.0
22	5	-	76.4	2,120.0
23	13	-	71.7	1,907.7
24	8	-	78.9	2,546.9
25	11	-	81.5	2,645.5
26	4	-	88.3	4,225.0
27	6	-	96.9	4,883.3
28	7	-	97.0	4,692.9
29	2	-	93.8	3,975.0
30	1	-	91.2	3,800.0
31	7	-	100.6	5,514.3
32	2	-	121.5	4,300.0
33	4	-	103.2	5,937.5
34	4	-	100.1	4,200.0
35	6	-	111.1	8,016.7
36	9	-	109.3	7,200.0
37	3	-	112.9	7,950.0
38	5	-	116.4	9,070.0
39	3	-	112.3	7,666.7
40	7	-	116.2	9,200.0
41	3	-	118.6	8,733.3
42	2	-	126.1	11,500.0
43	2	-	120.5	8,750.0
44	2	-	115.3	8,500.0
45	1	-	164.5	7,800.0
46	1	-	105.2	5,500.0
50	1	-	108.5	7,000.0
58	1	-	137.5	16,500.0

Lake Nipigon (Harkness 1923)

Age	Sample Size (No. Fish)	Mean Fork Length (cm)	Mean Total Length (cm)	Mean Round Weight (gm)
1	-	-	19.7-28.1	45.4-90.8
2	-	-	30.0	136.2
3	-	-	33.0-36.5	136.2-181.6
4	-	-	40.3-48.4	363.2-499.4
5	-	-	48.2-52.0	499.4-590.2
6	-	-	54.2-55.1	681.0-771.8
7	-	-	56.0-60.5	862.6-1,044.3
8	-	-	60.2-60.5	953.4-1,089.6
9	-	-	56.1-62.9	771.8-1,225.8
10	-	-	60.0-74.7	953.4-1,861.4
12	-	-	77.2	2,315.4
13	-	-	74.2	1,906.8
15	-	-	76.5-79.6	1,816.0-2,587.8
17	-	-	87.3	2,951.0
18	-	-	89.0	2,905.6
19	-	-	90.5	4,449.2
22	-	-	89.0	3,813.6
25	-	-	100.0	5.448.0
37	-	-	136.0	19,068.0
38	-	-	147.5	20,430.0
40	-	-	132.4	13,166.0
47	-	-	165.5	29,056.0
50	-	-	156.0	22,700.0

Lake Nipissing (Young and Love 1971)

Age	Sample Size (No. Fish)	Mean Fork Length (cm)	Mean Total Length (cm)	Mean Round Weight (gm)
13	1	-	104.1	8,626.0
15	2	-	113.1	9,534.0
16	2	-	109.9	9,307.0
17	5	-	120.1	10,804.0
18	3	-	121.1	11,955.3
19	2	-	121.3	10,896.0
21	3	-	119.4	10,139.3
22	1	-	129.5	14,982.0
23	1	-	147.3	21,792.0
24	2	-	141.0	20,657.0
27	2	-	152.4	26,559.0
29	1	-	154.9	31,326.0
31	3	-	159.2	29,358.6
33	1	-	135.9	20,884.0
35	1	-	165.1	41,768.0
48	1	-	154.9	24,516.0
50	1	-	167.6	30,418.0

Lake Nipissing/Sturgeon River (A/OFRC, unpublished data, 2002 and 2003 combined)

Age	Sample Size (No. Fish)	Mean Fork Length (cm)	Mean Total Length (cm)	Mean Round Weight (gm)
9	2	94.3	104.1	6,750.0
13	1	113.0	126.0	10,630.0
14	2	125.8	132.0	9,842.5
15	7	119.4	128.2	11,041.1
16	10	116.6	124.4	11,322.5
17	9	117.7	127.7	13,049.9
18	31	120.8	129.7	12,680.9
19	3	124.5	133.1	13,722.0
20	1	112.0	123.0	9,449.0
21	16	128.6	138.8	15,160.4
22	4	124.1	132.9	13,897.8
23	1	126.0	136.0	21,500.0
24	7	126.5	140,4	15,485.7 (N=6)
25	2	126.8	134.3	15,354.5
26	1	152.0	167.0	25,197.0
27	9	130.0	141.2	15,879.6
28	2	134.4	150.0	21,539.5
29	2	149.5	166.0	33,464.5
30	3	137.3	147.7	19,291.3
31	1	136.5	145.4	20,500.0
32	1	117.0	129.0	14,567.0
36	4	152.9	166.1	28,869.3
38	1	150.0	160.0	33,858.0
39	2	144.0	156.5	23,197.0
40	1	162.1	170.3	34,252.0
42	1	160.0	163.5	28,740.0
43	2	154.0	163.8	34,449.0
46	2	166.0	178.1	40,854.5
48	1	164.0	180.0	43,307.0
58	1	169.0	186.0	47,244.0
64	1	145.0	160.0	29,528.0
97	1	155.5	168.2	43,308.0

Lake of the Woods/Rainy River (Stewig 2004)

Age	Sample Size (No. Fish)	Mean Fork Length (cm)	Mean Total Length (cm)	Mean Round Weight (gm)
5	1	-	60.3	-
6	5	-	65.6	-
7	8	-	69.5	-
8	4	-	83.4	-
9	7	-	81.3	-
10	23	-	85.1	-
11	18	-	92.5	-
12	25	-	90.0	-
13	35	-	97.6	-
14	39	-	101.1	-
15	37	-	105.0	-
16	26	-	107.3	-
17	22	-	110.9	-
18	25	-	122.3	-
19	26	-	120.9	-
20	26	-	123.3	-
21	30	-	122.7	-
22	24	-	125.8	-
23	30	-	128.0	-
24	24	-	130.0	-
25	12	-	135.4	-
26	22	-	133.5	-
27	14	-	139.7	-
28	9	-	139.4	-
29	17	-	141.8	-
30	9	-	137.6	-
31	3	-	145.0	-
32	2	-	140.6	-
33	3	-	148.6	-
34	4	-	150.1	-
34	3	-	147.8	-
36	2	-	152.5	-
38	2	-	158.7	-

Lake St. Francis (Cuerrier and Roussow 1951)

Age	Sample Size (No. Fish)	Mean Fork Length (cm)	Mean Total Length (cm)	Mean Round Weight (gm)
3	2	-	41.9	454.0
4	9	-	51.1	953.4
5	16	-	56.9	1,225.8
6	27	-	60.5	1,589.0
7	34	-	62.7	1,725.2
8	36	-	67.1	2,043.0
9	31	-	69.6	2,451.6
10	25	-	74.2	2,860.2
11	25	-	76.5	3,223.4
12	23	-	78.7	3,450.4
13	21	-	83.3	4,267.6
14	17	-	87.4	5,266.4
15	14	-	88.9	5,675.0
16	19	-	88.4	5,084.8
17	10	-	95.5	7,127.8
18	3	-	96.5	6,219.8
19	2	-	106.7	9,080.0
20	7	-	101.6	8,580.6
21	3	-	101.6	7,854.2
22	2	-	95.3	6,583.0
23	3	-	125.2	17,115.8

Mattagami River (Ontario Power Generation unpublished data)

Age	Sample Size (No. Fish)	Mean Fork Length (cm)	Mean Total Length (cm)	Mean Round Weight (gm)
5	-	-	59.0	-
7	-	-	88.3	-
8	-	-	73.0	-
9	-	-	68.5	-
10	-	-	69.7	-
11	-	-	75.7	-
12	-	-	77.3	-
13	-	-	81.0	-
14	-	-	79.8	-
15	-	-	85.1	-
16	-	-	84.1	-
17	-	-	90.0	-
18	-	-	90.0	-
19	-	-	94.1	-
20	-	-	96.6	-
21	-	-	94.7	-
22	-	-	96.9	-
23	-	-	98.8	-
24	-	-	108.1	-
25	-	-	105.2	-
26	-	-	111.3	-
27	-	-	108.5	-
28	-	-	109.7	-
29	-	-	113.7	-
30	-	-	120.4	-
31	-	-	116.0	-
32	-	-	117.8	-
33	-	-	117.0	-
34	-	-	119.1	-
35	-	-	121.8	-
36	-	-	123.2	-
37	-	-	118.0	-
38	-	-	123.9	-
39	-	-	126.5	-
40	--	-	124.0	-
41	-	-	125.0	-
42	-	-	116.0	-
43	-	-	125.5	-
44	-	-	127.1	-
45	-	-	125.3	-
46	-	-	131.8	-
47	-	-	127.7	-
48	-	-	119.0	-
49	-	-	132.5	-
50	-	-	135.5	-
51	-	-	129.9	-
52	-	-	144.7	-
53	-	-	117.2	-
54	-	-	131.3	-
55	-	-	126.1	-
56	-	-	145.6	-
59	-	-	153.0	-
61	-	-	155.0	-
63	-	-	139.2	-

Mississagi River (A/OFRC, unpublished data, 2000-2003 combined)

Age	Sample Size (No. Fish)	Mean Fork Length (cm)	Mean Total Length (cm)	Mean Round Weight (gm)
6	1	85.5	96.0	6,000.0
8	3	93.3	102.0	6,500.0
9	1	105.0	115.0	7,000.0
10	5	107.0	115.9	11,180.0
11	5	105.8	114.6	12,050.0 (N=4)
12	9	106.9	116.9	12,822.2
13	13	106.7	117.0	12,523.1
14	21	111.5	122.1	11,411.1 (N=18)
15	16	112.5	122.7	12,425.0
16	20	112.1	122.2	14,140.0
17	12	114.5	124.4	12,666.7
18	11	113.2	123.1	12,660.0
19	9	116.7	125.3 (N=8)	12,933.3
20	11	123.1	135.5	13.511.2
21	7	124.7	137.6 (N=6)	17,171.4
22	5	118.2	128.0	11,499.2
23	9	130.8	142.4	18,955.6
24	5	125.9	134.9	21,100.0
25	3	138.0	151.7	22,333.0
26	14	141.0	153.3	24,357.1
27	9	140.2	150.7	23,244.4
28	10	137.6	148.2	22,860.0
29	5	137.7	148.8	22,440.0
30	11	143.5	152.8	24,854.5
31	3	133.0	143.9	16,833.3
32	5	149.5	162.2	26,440.0
33	2	139.0	150.3	25,600.0
34	3	148.8	160.7	34,000.0
35	1	143.0	150.0	29,000.0
36	4	148.3	164.6	30,250.0
39	1	152.0	162.0	31,000.0
40	1	150.0	171.0	34,200.0
41	1	163.0	177.0	36,200.0
42	2	131.0	148.0	17,100.0
60	1	170.5	182.0	38,000.0

Moose River (Threader 1981)

Age	Sample Size (No. Fish)	Mean Fork Length (cm)	Mean Total Length (cm)	Mean Round Weight (gm)
3	1	-	43.5	580.0
4	3	-	41.9	470.0
5	7	-	44.3	549.3
6	12	-	48.5	707.1
7	3	-	52.9	818.3
8	5	-	53.5	938.0
9	4	-	58.1	1,057.5
10	7	-	57.4	1,255.0
12	1	-	73.3	2,850.0
16	1	-	76.2	3,250.0
22	5	-	93.3	6,528.0
31	1	-	107.0	10,950.0

Moose River (C. Chenier unpublished data)

Age	Sample Size (No. Fish)	Mean Fork Length (cm)	Mean Total Length (cm)	Mean Round Weight (gm)
5	-	-	48.8	-
7	-	-	56.9	-
8	-	-	58.2	-
9	-	-	58.9	-
10	-	-	61.4	-
11	-	-	62.2	-
12	-	-	61.0	-
13	-	-	66.5	-
14	-	-	61.1	-
15	-	-	70.4	-
16	-	-	71.7	-
17	-	-	72.2	-
18	-	-	77.5	-
19	-	-	71.8	-
20	-	-	80.4	-
21	-	-	77.1	-
22	-	-	75.4	-
23	-	-	85.2	-
25	-	-	87.0	-
26	-	-	90.0	-
29	-	-	100.9	-
31	-	-	104.6	-
34	-	-	115.2	-
40	-	-	105.9	-
44	-	-	134.0	-
49	-	-	106.1	-
50	-	-	108.1	-
64	-	-	131.1	-

Namakan River (McLeod 2008)

Age	Sample Size (No. Fish)	Mean Fork Length (cm)	Mean Total Length (cm)	Mean Round Weight (gm)
7	1	-	60.5	1,250.0
11	2	-	75.3	2,100.0
12	1	-	96.2	4,500.0
13	3	-	101.5	5,500.0
14	6	-	107.7	7,175.0
15	4	-	115.4	9,625.0
16	15	-	110.2	7,960.0
17	16	-	111.3	8,931.0
18	4	-	114.5	7,963.0
19	17	-	116.4	9,997.0
20	13	-	109.6	7,988.0
21	25	-	116.3	11,096.0
22	19	-	121.6	12,134.0
23	22	-	113.7	10,045.0
24	20	-	120.2	10,877.0
25	11	-	125.4	11,918.0
26	15	-	116.3	9,603.0
27	18	-	124.4	12,986.0
28	17	-	121.4	11,547.0
29	16	-	117.8	9,944.0
30	6	-	119.9	10,425.0
31	12	-	134.4	16,000.0
32	15	-	126.7	14,307.0
33	19	-	125.0	12,092.0
34	10	-	128.9	14,775.0
35	7	-	122.7	11,786.0
36	7	-	135.1	13,107.0
37	2	-	162.3	30,300.0
38	3	-	147.9	14,883.0
39	3	-	146.9	18,233.0
40	4	-	141.7	17,988.0
41	3	-	134.4	18,283.0
42	4	-	142.2	16,938.0
43	1	-	125.4	11,600.0
44	2	-	155.2	23,300.0
45	2	-	152.5	24,975.0
47	1	-	166.2	30,800.0
50	2	-	147.3	22,600.0
61	1	-	142.8	20,450.0

Ottawa River (T. Haxton unpublished data)

Age	Sample Size (No. Fish)	Mean Fork Length (cm)	Mean Total Length (cm)	Mean Round Weight (gm)
4	-	-	45.0	-
5	-	-	52.3	-
6	-	-	56.0	-
7	-	-	63.7	-
8	-	-	76.1	-
9	-	-	66.8	-
10	-	-	69.6	-
11	-	-	76.1	-
12	-	-	81.0	-
13	-	-	82.1	-
14	-	-	81.9	-
15	-	-	83.3	-
16	-	-	88.4	-
17	-	-	86.7	-
18	-	-	88.8	-
19	-	-	89.5	-
20	-	-	90.8	-
21	-	-	96.5	-
22	-	-	93.3	-
23	-	-	97.8	-
24	-	-	93.7	-
25	-	-	106.9	-
26	-	-	94.0	-
27	-	-	100.7	-
28	-	-	93.0	-
29	-	-	112.0	-
30	-	-	116.5	-
36	-	-	121.0	-
37	-	-	116.0	-
44	-	-	113.0	-

Rainy Lake (Adams 2004)

Age	Sample Size (No. Fish)	Mean Fork Length (cm)	Mean Total Length (cm)	Mean Round Weight (gm)
8	1	-	86.5	-
9	1	-	83.8	-
11	1	-	92.5	-
12	1	-	109.0	-
13	5	-	114.8	-
14	5	-	118.1	-
15	6	-	116.5	-
16	5	-	128.7	-
17	7	-	115.6	-
18	12	-	124.5	-
19	12	-	124.9	-
20	8	-	123.3	-
21	12	-	130.6	-
22	5	-	134.7	-
23	1	-	130.4	-
24	10	-	125.0	-
25	10	-	127.3	-
26	11	-	132.2	-
27	13	-	129.8	-
28	7	-	131.3	-
29	16	-	128.6	-
30	6	-	133.4	-
31	10	-	129.1	-
32	12	-	132.9	-
33	7	-	140.2	-
34	3	-	128.1	-
35	7	-	144.2	-
36	2	-	128.5	-
37	2	-	130.2	-
38	5	-	135.1	-
39	5	-	140.6	-
40	1	-	143.3	-
41	2	-	140.0	-
42	2	-	134.9	-
43	2	-	131.2	-
44	2	-	153.6	-
47	3	-	153.4	-
50	2	-	139.9	-
55	1	-	150.6	-
57	1	-	139.6	-
59	1	-	140.3	-

Smoothrock Lake (A/OFRC, unpublished data, 2006, 2007, 2008 combined)

Age	Sample Size (No. Fish)	Mean Fork Length (cm)	Mean Total Length (cm)	Mean Total Length (cm)
8	1	112.4	-	121.7
9	3	86.6	-	92.9
10	2	103.8	-	114.2
11	2	106.8	-	116.3
12	3	96.8	-	106.5
13	5	109.3	-	118.0
14	3	110.9	-	120.5
15	7	101.6	-	111.3
16	3	114.2	-	123.2
17	8	113.5	-	121.6
18	8	107.8	-	116.1
19	4	104.6	-	112.6
20	8	112.1	-	122.5
21	9	111.0	-	120.9
22	9	105.4	-	115.6
23	10	112.9	-	122.1
24	4	117.3	-	126.4
25	7	105.6	-	114.6
26	7	117.8	-	126.5
27	4	111.0	-	120.3
28	7	115.3	-	124.0
29	2	120.7	-	133.6
30	3	106.4	-	115.7
31	2	121.4	-	132.5
32	2	121.2	-	129.9
33	1	123.3	-	124.2
34	1	124.0	-	135.0
36	2	123.5	-	136.7
38	1	133.6	-	145.7
39	1	116.5	-	126.0
42	1	123.0	-	136.7
43	1	105.7	-	115.8
48	1	144.5	-	158.8
51	1	144.2	-	159.3

Spanish River (A/OFRC, unpublished data, 2003, 2006, 2008 combined)

Age	Sample Size (No. Fish)	Mean Fork Length (cm)	Mean Total Length (cm)	Mean Round Weight (gm)
7	3	98.9	109.9	4,518.0 (N=2)
8	1	114.7	126.0	-
9	3	110.2	117.6	-
10	6	108.8	118.0	5,896.7 (N=3)
11	7	113.9	124.7	6,576.8 (N=6)
12	9	115.2	125.2	6,971.5 (N=2)
13	5	117.4	128.0	6,803.0 (N=4)
14	11	116.2	126.2	7,711.0 (N=8)
15	3	111.4	120.0	5,4433.0 (N=2)
16	3	116.0	125.4	-
18	2	125.7	135.4	7,711.0
19	1	126.4	134.9	-
21	1	132.2	137.5	-
24	1	116.8	126.6	15,422.0
31	1	125.0	132.8	17,690.0

Appendix 5. Characteristics of lake sturgeon captured from commercial fisheries in Lake Huron, North Channel and Georgian Bay, 1995-2003.

Year	Water	# Fish Sampled	Mean Total Length (cm)	Mean Weight (kg)	Mean (range) Age
1995	Lake Huron	103	106.7	-	14.4 (1 - 37)
	North Channel	114	78.8	1.92	8.1 (1 - 30)
1996	Lake Huron	58	104.7	7.66	13.7 (3 - 60)
	North Channel	125	77.7	1.79	7.2 (1 - 26)
1997	Lake Huron	486	106.6	7.96	13.8 (1 - 38)
	North Channel	131	90.1	1.61	9.7 (2 - 30)
1998	Lake Huron	507	110.6	9.00	15.2 (1 - 45)
	North Channel	79	83.7	3.74	7.5 (2 - 29)
1999	Lake Huron	359	116.1	10.17	14.0 (1 - 45)
	North Channel	151	81.1	9.93	6.0 (2 - 29)
2000	Lake Huron	423	113.4	9.49	14.7 (2 - 34)
	North Channel	140	81.4	1.81	7.2 (2 - 25)
	Georgian Bay	27	80.0	2.43	5.8 (3 - 14)
2001	Lake Huron	480	117.6	10.45	16.7 (2 - 42)
	North Channel	8	72.8	-	-
2002	Lake Huron	462	117.7	10.60	20.3 (6 - 45)
	North Channel	11	72.8	-	-
2003	Lake Huron	218	130.6	13.89	20.3 (6 - 45)
	North Channel	10	103.9	-	-

Appendix 6. Commercial landings (thousands of pounds) of lake sturgeon, by jurisdiction, from Lake St. Clair, 1879-2000 (from Baldwin et al. 2002). A blank indicates no catch report.

Year	Michigan	Ontario	Grand Total
1879	999	92	1091
1880		76	
1881		63	
1882		15	
1883		13	
1884		47	
1885	228	50	278
1886		89	
1887		73	
1888		34	
1889	97	34	131
1890	309	42	351
1891	76	35	111
1892	96	48	144
1893	101	46	147
1894	62	19	81
1895	30	43	73
1896	28	53	81
1897	33	22	55
1898	21	54	75
1899	19	75	94
1900	19	73	92
1901	9	67	76
1902	3	41	44
1903	0	42	42
1904	1	33	34
1905	6	25	31
1906	1	38	39
1907	11	41	52
1908	1	35	36
1909	0	28	28
1910	0	41	41
1911	0	47	47
1912	0	49	49
1913	0	60	60
1914	0	41	41
1915	0	34	34
1916	0	19	19
1917	0	14	14
1918	0	15	15
1919	0	11	11
1920	0	13	13
1921	0	12	12
1922	0	8	8

Year	Michigan	Ontario	Grand Total
1923	0	23	23
1924	0	19	19
1925	0	15	15
1926	0	16	16
1927	0	10	10
1928	0	12	12
1929	0	13	13
1930	0	20	20
1931	0	13	13
1932	0	14	14
1933	0	7	7
1934	0	9	9
1935	0	8	8
1936	0	7	7
1937	0	10	10
1938	0	9	9
1939	0	9	9
1940	0	8	8
1941	0	11	11
1942	0	3	3
1943	0	9	9
1944	0	4	4
1945	0	2	2
1946	0	4	4
1947	0	5	5
1948	0	6	6
1949	0	5	5
1950	0	7	7
1951	0	8	8
1952	0	7	7
1953	0	11	11
1954	0	11	11
1955	0	13	13
1956	0	12	12
1957	0	12	12
1958	0	17	17
1959	0	11	11
1960	0	13	13
1961	0	14	14
1962	0	13	13
1963	0	13	13
1964	0	9	9
1965	0	10	10
1966	0	11	11
1967	0	12	12
1968	0	13	13
1969	0	17	17

Year	Michigan	Ontario	Grand Total
1970	0	0	0
1971	0	0	0
1972	0	0	0
1973	0	0	0
1974	0	0	0
1975	0	0	0
1976	0	0	0
1977	0	0	0
1978	0	0	0
1979	0	0	0
1980	0	0	0
1981	0	0	0
1982	0	0	0
1983	0	0	0
1984	0	0	0
1985	0	0	0
1986	0	0	0
1987	0	1	1
1988	0	1	1
1989	0	1	1
1990	0	1	1
1991	0	1	1
1992	0	0	0
1993	0	1	1
1994	0	1	1
1995	0	1	1
1996	0	1	1
1997	0		
1998	0	2	2
1999	0	2	2
2000	0	1	1

Appendix 7. Commercial landings of lake sturgeon (thousands of pounds), by jurisdiction, from Lake Ontario, 1879-2000 (from Baldwin et al. 2002). A blank indicates no catch report.

Year	U.S. Total	Ontario	Grand Total
1879	545	1	546
1880		16	
1881		12	
1882		103	
1883		73	
1884		75	
1885	387	54	441
1886		22	
1887		20	
1888		23	
1889	201	58	259
1890	542	39	581
1891		36	
1892		29	
1893	125	35	160
1894		40	
1895		38	
1896		42	
1897	102	42	144
1898		47	
1899	139	33	172
1900		19	
1901		7	
1902		14	
1903	110	12	122
1904		4	
1905		14	
1906		13	
1907		7	
1908	37	2	39
1909		0	
1910		0	
1911		0	
1912		9	
1913	4	0	4
1914	7	0	7
1915	10	2	12
1916	5	3	8
1917	3	2	5
1918	12	2	14
1919	4		
1920	2	1	3
1921	3	2	5
1922	3	2	5

Year	U.S. Total	Ontario	Grand Total
1923	5	3	8
1924	12	2	14
1925	4	1	5
1926	19	0	19
1927	19	0	19
1928	20	1	21
1929	2	0	2
1930	24		24
1931	8	0	8
1932	12	0	12
1933	13	1	14
1934	16	0	16
1935	10	1	11
1936	13	2	15
1937	12	3	15
1938	11	2	13
1939	16	2	18
1940	10	1	11
1941	10	6	16
1942	2	6	8
1943	2	9	11
1944	2	11	13
1945	1	8	9
1946	0	7	7
1947	2	6	8
1948	3	5	8
1949	3	5	8
1950	1	8	9
1951	1	6	7
1952	2	8	10
1953	4	13	17
1954	1	10	11
1955	2	9	11
1956	1	9	10
1957	0	7	7
1958	1	9	10
1959	1	8	9
1960	1	9	10
1961	2	14	16
1962	0	9	9
1963	0	7	7
1964	0	6	6
1965	1	5	6
1966	0	2	2
1967	0	1	1
1968	0	2	2
1969	0	1	1

Year	U.S. Total	Ontario	Grand Total
1970	0	1	1
1971	0	0	0
1972	0	1	1
1973	0	1	1
1974	0	1	1
1975	0	1	1
1976	0	1	1
1977	0	4	4
1978	0	4	4
1979	0	0	0
1980	0	1	1
1981	0	0	0
1982	0	0	0
1983	0	0	0
1984	0	0	0
1985	0	0	0
1986	0	0	0
1987	0	0	0
1988	0	0	0
1989	0	0	0
1990	0	0	0
1991	0	0	0
1992	0	0	0
1993	0	0	0
1994	0	0	0
1995	0	0	0
1996	0	0	0
1997	0	0	0
1998	0	0	0
1999	0	0	0
2000	0	0	0

Appendix 8. Commercial landings (thousands of pounds) of lake sturgeon, by jurisdiction, from Lake Erie, 1879-2000 (from Baldwin et al. 2002). A blank indicates no catch report.

Year	Michigan	New York	Ohio	Pennsylvania	U.S. Total	Ontario	Grand Total
1879					1970	142	2112
1880						213	
1881						180	
1882						159	
1883						223	
1884						330	
1885	91	3723	522	392	4728	459	5187
1886						350	
1887						610	
1888						470	
1889	2	156	410	677	1245	412	1656
1890	33	1710	230	106	2079	581	2660
1891	22					388	
1892	14					362	
1893	17				794	357	1151
1894	13					391	
1895	13					320	
1896	56					218	
1897	46	133	84	35	298	251	549
1898	47					285	
1899	41	627	50	100	818	142	960
1900	48					169	
1901	27					168	
1902	17					145	
1903	17	223	8	61	310	135	444
1904	16					112	
1905	8					74	
1906	10					66	
1907	11					52	
1908	7	42	5	8	62	108	170
1909						47	
1910						61	
1911						68	
1912	2					52	
1913	1	4	1	8		48	
1914	0	9	6	6	21	56	77
1915	0	15	4	1	20	56	76
1916	5	21	10	1	37	68	106
1917	8	17	2	0	27	47	75
1918	3	8	3	1	15	52	68
1919	0	8	10	1	19	43	62
1920	1	8	1		10	0	10
1921		8	0		8		8
1922	0	14	0	1	15	36	52

Year	Michigan	New York	Ohio	Pennsylvania	U.S. Total	Ontario	Grand Total
1923	0		0	0	0	41	41
1924	0	6	0	1	7	44	51
1925					0	42	42
1926		5		2	7	50	57
1927		5		1	6	41	47
1928		7	0	1	8	42	50
1929		2	0	0	2	27	29
1930		14	0	2	16	27	43
1931		14	1	1	16	22	38
1932		16		1	17	27	44
1933		6		1	7	24	31
1934		7	10	1	18	25	43
1935		6	12	0	18	22	40
1936		5	6	1	12	13	25
1937		3	2	0	5	13	18
1938		8	12	0	20	17	37
1939		7	9	1	17	18	35
1940		5	6	1	12	16	28
1941		6	5	1	12	14	26
1942		2	4	0	6	15	21
1943		1	2	1	4	12	16
1944		0	2	1	3	15	18
1945		0	1	0	1	11	12
1946		0	4	0	4	13	17
1947		0	10	0	10	18	28
1948		0	22	0	22	14	36
1949		0	19	0	19	13	32
1950			7	0	7	11	18
1951		1	10	0	11	9	20
1952		0	6	0	6	8	14
1953		1	1	0	2	6	8
1954		0	3	0	3	7	10
1955			5	0	5	22	27
1956			2	9	11	17	28
1957		0	1	0	1	6	7
1958		0	1	0	1	5	6
1959		0	0	0	0	4	4
1960	0	0	0	0	0	5	5
1961	0	0	0	0	0	5	5
1962	0	0	0		0	2	2
1963	0	0	0		0	2	2
1964			0	0	0	1	1
1965		0	0		0	2	2
1966			0		0	1	1
1967			0		0	1	1
1968		0	0		0	1	1

Year	Michigan	New York	Ohio	Pennsylvania	U.S. Total	Ontario	Grand Total
1969					0	1	1
1970					0	0	0
1971							
1972					0	0	0
1973		0			0	0	0
1974					0	0	0
1975					0	0	0
1976					0	1	1
1977					0	5	5
1978	0	0	0	0	0	2	2
1979	0	0	0	0	0	0	0
1980	0	0	0	0	0	1	1
1981	0	0	0	0	0	1	1
1982	0	0	0	0	0	1	1
1983	0	0	0	0	0	2	2
1984	0	0	0	0	0	0	0
1985	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0
1988	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0
2000						0	0

Appendix 9. Commercial landings (thousands of pounds) of lake sturgeon by jurisdiction, from Lake Huron, 1879-2000 (from Baldwin et al. 2002). A blank indicates no catch report.

Year	Lake Huron proper (Michigan)	Saginaw Bay (Michigan)	U.S. Total	Lake Huron proper (Ontario)	Georgian Bay (Ontario)	North Channel (Ontario)	Canadian Total	Grand Total
1879			204				48	252
1880							5	
1881							138	
1882							1	
1883							207	
1884							372	
1885	135	81	216				826	1042
1886							834	
1887							376	
1888							453	
1889			559				281	840
1890			366				357	723
1891	344	54	398				338	736
1892	138	42	180				230	410
1893	175	27	202				705	907
1894	77	10	87				462	549
1895	84	8	92				614	706
1896	38	10	48				297	345
1897	27	9	36				416	452
1898	84	7	91				391	482
1899	78	7	85				344	429
1900	16	8	24				357	381
1901	15	7	22				126	148
1902	17	8	25				99	124
1903	27	7	34				79	113
1904	24	8	32				100	132
1905	20	4	24				62	86
1906	15	3	18				55	73
1907	22	3	25				38	63
1908	5	2	7				45	52
1909							40	
1910							33	
1911							28	
1912			3				72	75
1913			8				51	59
1914			7				52	59
1915			28				46	74
1916	6	0	6				29	35
1917	3	1	4				34	38
1918	1	2	3				34	37
1919	6	2	8				26	34

Year	Lake Huron proper (Michigan)	Saginaw Bay (Michigan)	U.S. Total	Lake Huron proper (Ontario)	Georgian Bay (Ontario)	North Channel (Ontario)	Canadian Total	Grand Total
1920	10	2	12				26	38
1921	2	2	4				24	28
1922	2	0	2	10	3	13	27	29
1923	2	0	2	12	5	8	25	27
1924	4	6	10	8	5	9	22	32
1925	1	2	3	3	9	3	22	25
1926	2	1	3	8	4	10	22	25
1927	1	1	2	11	4	10	25	27
1928	0	0	0	10	2	10	22	22
1929	0	0	0	10	2	12	24	24
1930	0	0	0	8	2	15	25	25
1931	0	0	0	7	2	7	16	16
1932	0	0	0	8	1	8	17	17
1933	0	0	0	7	2	13	22	22
1934	0	0	0	7	1	13	21	21
1935	0	0	0	5	1	11	17	17
1936	0	0	0	4	2	10	16	16
1937	0	0	0	7	1	9	17	17
1938	0	0	0	4	2	7	13	13
1939	0	0	0	3	1	4	8	8
1940	0	0	0	5	1	4	10	10
1941	0	0	0	5	1	3	9	9
1942	0	0	0	6		4	10	10
1943	0	0	0	3		3	6	6
1944	0	0	0	5	1	6	12	12
1945	0	0	0	4	1	6	11	11
1946	0	0	0	7	1	7	15	15
1947	0	0	0	8		4	12	12
1948	0	0	0	6	1	7	14	14
1949	0	0	0	8	1	7	16	16
1950	0	0	0	7	1	7	15	15
1951	1	0	1	8	2	5	15	16
1952	2	0	2	5	1	4	10	12
1953	1	0	1	5	1	15	21	22
1954	1	0	1	7	2	31	40	41
1955	1	0	1	6	4	15	25	26
1956	1	0	1	10	5	11	26	27
1957	0	0	0	45	4	7	56	56
1958	1	0	1	26	2	7	35	36
1959	1	0	1	11	3	5	19	20
1960	1	0	1	5	2	7	14	15
1961	1	0	1	8	1	8	17	18
1962	1	0	1	7	2	9	18	19
1963	1	0	1	6	2	11	19	20
1964	0	0	1	6	3	9	18	19
1965	0	0	0	4	2	11	17	17

Year	Lake Huron proper (Michigan)	Saginaw Bay (Michigan)	U.S. Total	Lake Huron proper (Ontario)	Georgian Bay (Ontario)	North Channel (Ontario)	Canadian Total	Grand Total
1966	0	0	0	3	1	16	20	20
1967	0	0	1	4	2	13	19	20
1968	0	0	0	6		14	20	20
1969	0	0	0	4	1	11	16	16
1970	0	0	0	1	1	11	13	13
1971	0	0	0	2	1	7	10	10
1972	0	0	0	2	1	6	9	9
1973	0	0	0	7	1	8	16	16
1974	0	0	0	4		7	11	11
1975	0	0	0	6	1	6	13	13
1976	0	0	0	8	1	4	13	13
1977	0	0	0	4	1	4	9	9
1978	0	0	0	3	1	4	8	8
1979	0	0	0	4	1	4	9	9
1980	0	0	0	4	1	9	14	14
1981	0	0	0	4	1	7	12	12
1982	0	0	0	4	1	5	10	10
1983	0	0	0	3	0	5	8	8
1984	0	0	0	3	0	0	3	3
1985	0	0	0	4	0	8	12	12
1986	0	0	0	3	0	7	10	10
1987	0	0	0	3	0	7	10	10
1988	0	0	0	6	1	2	9	9
1989	0	0	0	7	0	8	16	16
1990	0	0	0	8	0	2	10	10
1991	0	0	0	8	4	0	12	12
1992	0	0	0	7	0	0	7	7
1993	0	0	0	4	1	3	8	8
1994	0	0	0	6	1	3	10	10
1995	0	0	0	6	1	2	9	9
1996	0	0	0	8	3	1	12	12
1997	0	0	0	9	1	3	13	13
1998	0	0	0	8	1	4	13	13
1999	0	0	0	8	1	2	11	11
2000				8	1	3	12	

Appendix 10. Commercial landings (thousands of pounds) of lake sturgeon, by jurisdiction, from Lake Superior, 1884-2000 (from Baldwin et al. 2002). A blank indicates no catch report.

Year	Michigan	Wisconsin	Minnesota	U.S. Total	Ontario	Grand Total
1884					0	
1885	131	42	10	183	42	225
1886					42	
1887					121	
1888					55	
1889	83	1	0	84	71	155
1890	40	8	0	48	97	145
1891	75				44	
1892	40				50	
1893	31				35	
1894	21				40	
1895	6				34	
1896	10				37	
1897	8				33	
1898	9				45	
1899	9	0	0	9	12	21
1900	11				13	
1901	5				7	
1902	23				6	
1903	8	11	0	19	4	23
1904	6				1	
1905	5					
1906	7				0	
1907	3				3	
1908	5	9	0	14	4	18
1909		2			1	
1910		2			8	
1911	0	1	0	1	7	8
1912	2				4	
1913	1	2	0	3	3	6
1914	1	2	0	3	9	12
1915	2	3	0	5	16	21
1916	0	0	0	0	3	3
1917					5	
1918	0	0	0	0	2	2
1919	3	0	0	3	4	7
1920	0	0	0	0	10	10
1921	0	0	0	0	6	6
1922	1	0	0	1	10	11
1923	1	0	0	1	27	28
1924	4	0	0	4	4	8
1925	0	0	0	0	3	3
1926	0	0	0	0	1	1
1927	0	0	0	0	0	0

Year	Michigan	Wisconsin	Minnesota	U.S. Total	Ontario	Grand Total
1928	0	0	0	0	1	1
1929	0	0	0	0	1	1
1930	0	0	0	0	3	3
1931	0	0	0	0	5	5
1932	0	0	0	0	3	3
1933	0	0	0	0	4	4
1934	0	0	0	0	1	1
1935	0	0	0	0	0	0
1936	0	0	0	0	1	1
1937	0	0	0	0	2	2
1938	0	0	0	0	3	3
1939	0	0	0	0	3	3
1940	0	0	0	0	4	4
1941	0	0	0	0	2	2
1942	0	0	0	0	2	2
1943	0	0	0	0	2	2
1944	0	0	0	0	1	1
1945	0	0	0	0	1	1
1946	0	0	0	0	2	2
1947	0	0	0	0	1	1
1948	0	0	0	0	1	1
1949	0	0	0	0	1	1
1950	0	0	0	0	1	1
1951	0	0	0	0	2	2
1952	0	0	0	0	2	2
1953	0	0	0	0	4	4
1954	0	0	0	0	5	5
1955	0	0	0	0	6	6
1956	0	0	0	0	3	3
1957	0	0	0	0	6	6
1958	0	0	0	0	6	6
1959	0	0	0	0	5	5
1960	0	0	0	0	11	11
1961	0	0	0	0	8	8
1962	0	0	0	0	3	3
1963	0	0	0	0	2	2
1964	0	0	0	0	1	1
1965	0	0	0	0	2	2
1966	1	0	0	1	1	2
1967	0	0	0	0	3	3
1968	0	0	0	0	2	2
1969	0	0	0	0	3	3
1970	0	0	0	0	1	1
1971	0	0	0	0	1	1
1972	0	0	0	0	1	1
1973	0	0	0	0	1	1
1974	0	0	0	0	0	0

Year	Michigan	Wisconsin	Minnesota	U.S. Total	Ontario	Grand Total
1975	0	0	0	0	0	0
1976	0	0	0	0	1	1
1977	0	0	0	0	0	0
1978	0	0	0	0	1	1
1979	0	0	0	0	2	2
1981	0	0	0	0	0	0
1982	0	0	0	0	2	2
1983	0	0	0	0	0	0
1984	0	0	0	0	0	0
1985	0	0	0	0	0	0
1986	0	0	0	0	0	0
1987	0	0	0	0	0	0
1988	0	0	0	0	0	0
1989	0	0	0	0	0	0
1990	0	0	0	0	0	0
1991	0	0	0	0	0	0
1992	0	0	0	0	0	0
1993	0	0	0	0	0	0
1994	0	0	0	0	0	0
1995	0	0	0	0	0	0
1996	0	0	0	0	0	0
1997	0	0	0	0	0	0
1998	0	0	0	0	0	0
1999	0	0	0	0	0	0
2000	0	0	0	0	0	0

Appendix 11. Commercial landings (thousands of pounds) of lake sturgeon, by jurisdiction, from Lake Michigan, 1882-2000 (from Baldwin et al. 2002). A blank indicates no catch report.

Year	Green Bay (GB)	Michigan (MI)	Green Bay (GB)	Wisconsin (WI)	Illinois (IL)	Indiana (IN)	U.S. Total	Ontario	Grand Total
1882						3840		3840	
1883									
1884									
1885	0	925	0	202	103	177	1407		1407
1886									
1887									
1888									
1889	0	475	0	44	8	85	612		612
1890	0	733	0	127	16	71	947		947
1891	254								
1892	196								
1893	107					312		312	
1894	112								
1895	84								
1896	83								
1897	0	58	0	58	0	23	139		139
1898	68								
1899	0	64	0	15	0	18	97		97
1900	76								
1970	69								
1902	38								
1903	0	50	0	11	0	4	65		65
1904	46								
1905	38								
1906	40								
1907	44								
1908	0	48	0	15	0	35	98		98
1909			2						
1910			2						
1911	0	14	0	0	0	0	14		14
1912	0	14	0	0	0	0	14		14
1913	0	12	0	2	0	0	14		14
1914	0	11	0	3	0	0	14		14
1915	0	12	0	1	0	0	13		13
1916	0	7	0	0	0	0	7		7
1917	0	6	0	0	0	2	8		8
1918	0	26	0	0	0	0	26		26
1919	0	7	0	0	0	0	7		7
1920	0	13	0	0	0	0	13		13
1921	0	7	0	0	0	0	7		7
1922	0	8	0	0	0	2	10		10
1923	0	7	0	0	0	0	7		7
1924	0	4	0	0	0	0	4		4

Year	Green Bay (GB)	Michigan (MI)	Green Bay (GB)	Wisconsin (WI)	Illinois (IL)	Indiana (IN)	U.S. Total	Ontario	Grand Total
1925	0	6	0	3	0	0	9		9
1926	0	6	0	0	0	0	6		6
1927	0	3	0	1	0	0	4		4
1928	0	2	0	0	0	0	2		2
1929	0	0	0	0	0	0	0		0
1951	0	0	0	0	0	0	0		0
1952	0	3	0	0	0	0	3		3
1953	0	5	0	0	0	0	5		5
1954	0	2	0	0	0	0	2		2
1955	0	2	0	0	0	0	2		2
1956	0	1	0	0	0	0	1		1
1957	0	1	0	0	0	0	1		1
1958	0	1	0	0	0	0	1		1
1959	0	1	0	0	0	0	1		1
1960	0	1	0	0	0	0	1		1
1961	0	2	0	0	0	0	2		2
1962	0	1	0	0	0	0	1		1
1963	0	3	0	0	0	0	3		3
1964	0	3	0	0	0	0	3		3
1965	0	2	0	0	0	0	2		2
1966	0	2	0	0	0	0	2		2
1967	0	0	0	0	0	0	0		0
1968	0	2	0	0	0	0	2		2
1969	0	3	0	0	0	0	3		3
1970	0	0	0	0	0	0	0		0
1971	0	0	0	0	0	0	0		0
1972	0	0	0	0	0	0	0		0
1973	0	0	0	0	0	0	0		0
1974	0	0	0	0	0	0	0		0
1975	0	0	0	0	0	0	0		0
1976	0	0	0	0	0	0	0		0
1977	0	0	0	0	0	0	0		0
1978	0	0	0	0	0	0	0		0
1979	0	0	0	0	0	0	0		0
1980	0	0	0	0	0	0	0		0
1981	0	0	0	0	0	0	0		0
1982	0	0	0	0	0	0	0		0
1983	0	0	0	0	0	0	0		0
1984	0	0	0	0	0	0	0		0
1985	0	0	0	0	0	0	0		0
1986	0	0	0	0	0	0	0		0
1987	0	0	0	0	0	0	0		0
1988	0	0	0	0	0	0	0		0
1989	0	0	0	0	0	0	0		0
1990	0	0	0	0	0	0	0		0
1991	0	0	0	0	0	0	0		0
1992	0	0	0	0	0	0	0		0

Year	Green Bay (GB)	Michigan (MI)	Green Bay (GB)	Wisconsin (WI)	Illinois (IL)	Indiana (IN)	U.S. Total	Ontario	Grand Total
1993	0	0	0	0	0	0	0		0
1994	0	0	0	0	0	0	0		0
1995	0	0	0	0	0	0	0		0
1996	0	0	0	0	0	0	0		0
1997	0	0	0	0	0	0	0		
1998	0	0	0	0	0	0	0		
1999	0	0	0	0	0	0	0		
2000	0	0	0	0	0	0	0		0

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Appendix 13. Federal and provincial legislation associated with lake sturgeon in Ontario.

Canada *Fisheries Act*

- Fish habitat defined as "spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life history processes."
- No person shall carry on any work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat.
- No person shall deposit or permit the deposit of a deleterious substance in a water frequented by fish.
- Every obstruction across or in any stream where the Minister determines it to be necessary for the public interest that a fish pass should exist shall be provided by the owner or occupier with a durable and efficient fishway or canal around the obstruction which shall be maintained in a good and effective condition by the owner as will satisfactorily permit the free passage of fish through it. Where a fishway is not efficient or that the spawning area above the obstruction are destroyed, the Minister may require the owner of the obstruction to pay for a fish hatchery establishment to meet the requirements for maintaining the annual return of migratory fish.

Canada *Species at Risk Act*

- Creates a legislative base for the scientific body, The Committee on the Status of Endangered Wildlife in Canada (COSEWIC), that assesses the status of species at risk in Canada. Classifications include extinct, extirpated, endangered, threatened or of special concern. Alternatively, it could indicate that there was insufficient information to classify a species or that the species was not currently at risk. COSEWIC makes recommendations to government regarding classifications but government retains discretion regarding whether or not to list the species under SARA.
- Prohibits the killing of extirpated, endangered or threatened species and the destruction of their residences. By virtue of the *Interpretation Act*, attempted or incomplete offences would also be punishable under this bill.
- Provides authority to prohibit the damage or destruction of the residence of a listed endangered or threatened species, or a listed extirpated species if a recovery strategy had recommended that the species be reintroduced into the wild in Canada. Critical habitat is protected only after it has been identified in a recovery strategy or action plan and described in a subsequent Ministerial order.
- Requires the competent minister or ministers to prepare a recovery strategy for every species listed as extirpated, endangered or threatened. It also requires the preparation of management strategies for species listed as special concern.
- The competent Minister may enter into an agreement or issue a permit that authorizes a person to engage in an activity that otherwise would be prohibited.
- Provides emergency authority to protect species in imminent danger, including emergency authority to prohibit the destruction of the critical habitat of such species.
- Makes available funding and incentives for stewardship and conservation action.
- Enables the payment of compensation due to extraordinary impact of habitat protection measures.
- The Act is binding on the Crown.

Ontario *Fish and Wildlife Conservation Act*

- If a provision of this Act and the Species at Risk Act conflict with respect to any fish, the provision that give the fish the most protection prevails.

- An individual shall not engage in aquaculture unless the fish belong to a species described in regulations and are cultured under the authority of a licence and in accordance with the regulations.
- A person shall not buy or sell fish that belong to a species that exists in Ontario waters or fish prescribed by the regulations except under the authority of a licence and in accordance with the regulations.
- A person shall not list game wildlife, specially protected wildlife or fish on a menu or charge for serving it unless the person has the authorization of the Minister.

Ontario *Public Lands Act*

- The Minister of Natural Resources is identified as being responsible for the management, sale and disposition of public lands and forests. The Minister also has the authority to approve, modify or reject land use plans.
- A work permit must be issued for activities involving shorelands. The Minister also has the authority to approve, modify or reject land use plans.
- No person shall deposit any material on public lands, whether or not the lands are covered with water or ice, without consent of the Minister.
- A work permit must be issued for activities involving shorelands. Upon conviction for unauthorized works, the Minister may order rehabilitation measures.

Ontario Lakes and Rivers Improvement Act

- The purpose of this Act is "the management, perpetuation and use of the fish, wildlife and other natural resources dependant on the lakes and rivers."
- Under this Act, approval is required to construct, alter or decommission a dam, to channelize a river or stream, enclose a river or stream for more than twenty meters in length or constructing a water crossing over a stream draining an area of greater than five square kilometres.
- The Minister may order the owner of a dam that has been constructed without a fishway to provide one, within the time specified, that permits free and unobstructed passage of fish upstream and downstream at any season of the year.

Ontario Fishery Regulations

- Regulations create the need for a licence to harvest fish. They define what terms and conditions can be imposed on a commercial fishing licence.
- Regulations provide for the management of individual fish species by defining closed seasons, quotas and sanctuaries. They also create a listing of specially designated fish.
- The regulations require that all fish caught that cannot be harvested or possessed must be returned to the same water in a manner that causes the least harm to the fish.

Ontario Species at Risk Act (2007)

- Classification of a species at risk is determined by the Committee on the Status of Species at Risk in Ontario (COSSARO). COSSARO reports classification to the Minister of Natural Resources and these classifications must be regulated on the Species at Risk in Ontario list within 90 days of receipt of the COSSARO report.
- If a species is listed on the Species at Risk in Ontario list as extirpated, endangered or threatened, the Act prohibits killing, harming, harassing, capturing, taking, possessing, transporting, collecting, buying, selling, leasing, trading or offering to buy, sell, lease or trade a member of the species.
- No person shall damage or destroy the habitat of a species which is designated on the Species at Risk in Ontario list as endangered, threatened or extirpated if the species has prescribed habitat protection in regulation. This includes the provision for the Minister to make Habitat Protection Orders in emergency situations.
- The Minister of Natural Resources may issue a permit that authorizes a person to engage in an activity that otherwise would be prohibited.
- The Minister of Natural Resources is required to ensure that a recovery strategy is prepared for each species that is listed on the Species at Risk in Ontario list as an endangered or

threatened species. It also requires the preparation of management strategies for species listed as special concern if a management plan or recovery strategy is not required under SARA. In preparing recovery strategies, actions plans or management plans, the Minister must consider Canada's commitment to the conservation of biodiversity and to the precautionary principle.

- The Act is binding on the Crown but provisions are included enabling MNR to take measures for protection and recovery of listed species.

Convention on International Trade of Endangered Species

- CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.
- CITES is an agreement to which States (countries) adhere voluntarily. States that have agreed to be bound by the Convention ('joined' CITES) are known as Parties. Although CITES is legally binding on the Parties – in other words they have to implement the Convention – it does not take the place of national laws. Rather it provides a framework to be respected by each Party, which has to adopt its own domestic legislation to ensure that CITES is implemented at the national level.
- CITES works by subjecting international trade in specimens of selected species to certain controls. All import, export, re-export and introduction from the sea of species covered by the Convention has to be authorized through a licensing system. Each Party to the Convention must designate one or more Management Authorities in charge of administering that licensing system and one or more Scientific Authorities to advise them on the effects of trade on the status of the species.
- The species covered by CITES are listed in three Appendices, according to the degree of protection they need.Appendix I includes species threatened with extinction. Trade in specimens of these species is permitted only in exceptional circumstances. Appendix II includes species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible with their survival.

Appendix 14. Bibliography of Ontario lake sturgeon reports.

The following list of references is a collection of refereed journal articles as well as published and unpublished manuscripts that document studies (research, management and impact assessment) related to lake sturgeon in the Province of Ontario. Authors of these documents may include academic researchers, industry, environmental consultants and government agency staff.

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