NEW YORK STATE OF OPPORTUNITY. Department of Environmental Conservation

LAKE STURGEON RECOVERY PLAN 2018-2024

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Conserve and enhance New York State's abundant and diverse population of freshwater fishes while providing the public with quality recreational angling opportunities.

NEW YORK STATE LAKE STURGEON RECOVERY PLAN

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DATE 02/24/2018

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Executive Summary

Lake sturgeon are long lived, large bodied, late to sexually mature, and spawn only intermittently. These characteristics make this species especially vulnerable to overfishing, and slow to recover from the severe declines they experienced in the past. In New York State, overfishing and habitat degradation led to severe declines in many of the state's lake sturgeon spawning populations, resulting in listing as a state threatened species in 1983. While much research has been conducted on lake sturgeon in the past twenty years, we still lack sufficient knowledge of specific spawning locations for some populations, as well as population abundances and age structure for many of the populations. To change the New York State listed status of this species from Threatened to Special Concern, or to remove it from the list altogether, there needs to be sufficient self-sustaining populations in the state to warrant that change. Defining these populations and an accompanying target number for recovery proved challenging since lake sturgeon occupy wide ranging and variable habitats across New York. In many cases, smaller spawning aggregations may be part of a larger metapopulation. To accommodate these variances, we defined Management Units across New York as a descriptor of these metapopulations. Self-sustaining populations of lake sturgeon are defined in this plan as having an estimate of at least 750 spawning adults across all spawning aggregations within a Management Unit and detection of at least three years of wild reproduction in a five-year period. A stocking program by New York State Department of Environmental Conservation (NYSDEC) and the United States Fish and Wildlife Service (USFWS) has been in place since 1993 to achieve these goals. Lake sturgeon have been re-established across the state and current stocking is seeking to enhance the genetic diversity of the stocked populations. Naturally recovering populations are also being monitored in several Great Lakes locations. Spawning habitat enhancement is taking place at several locations in the St. Lawrence River, and the Seneca River. NYSDEC, USFWS, US Geological Survey (USGS), Cornell University, Saint Regis Mohawk Tribe (SRMT), many local governments, non-governmental organizations, and utilities are working toward these goals. Contributions from all will be necessary to accomplish recovery of this species.

Introduction

Lake sturgeon (*Acipenser fulvescens*) is the largest and longest lived freshwater fish species in New York State. It was historically an abundant and widely distributed species in the Great Lakes drainage, but by the early 20th century overharvest and habitat degradation resulted in drastic population declines. Severely depleted stocks ultimately led to the closure of the State's lake sturgeon fishery in 1976. In 1983, lake sturgeon was listed as a Threatened Species in New York State, and populations were considered absent, sparse or declining in six of the nine watersheds where they historically occurred (Carlson 1995).

Lake sturgeon is considered a priority species for recovery in New York State by inclusion as a Species of Greatest Conservation Need (NYSDEC 2015) and by virtue of its listing as a Threatened Species. It has been listed as a species of primary restoration concern by the US Environmental Protection Agency Great Lakes Restoration Initiative (GLRI), and lake sturgeon restoration is identified among the bi-national fish community objectives of the fisheries management agencies for both Lake Erie (Ryan *et al* 2003) and Lake Ontario (Stewart *et al* 2017). A New York recovery plan was first developed in 1994 (Bouton 1994) and revised in 2000 and 2005 (Carlson 2000, 2005). The initial recovery goal was to establish five lake sturgeon populations in individual waters (Bouton 1994). This was later expanded to maintain populations in five waters and restore populations in three other areas (Carlson 1995, 2000). These previous plans specified that the species would be eligible for removal from the Threatened Species list, or down-listed to a Species of Special Concern (as defined in NY Codes Rules and Regulations Title 6, Part 182) if self-sustaining populations were documented in these eight populations. A self-sustaining population was defined at that time as the presence of at least three year classes of sexually mature adult females, and evidence of natural recruitment in at least three years (Carlson 2005).

Since the 2005 plan revision, new guidance that defines a viable spawning population at 750 sexually mature fish has been published (Welsh *et al*. 2010). Recent research cited throughout this document has also provided insights on spawning populations, distribution, and stocking survival among other things. This iteration of the New York recovery plan partitions the historic range of lake sturgeon into seven Management Units based on distribution of known sturgeon populations, movement within and among populations, and the genetic structure of lake sturgeon populations across the state. The Management Units are described beginning on page 25 of this document and within the individual sections for each Management Unit. Based on our knowledge of sturgeon movement, each Management Unit may contain more than one spawning population.

The draft Lake Sturgeon Recovery Plan was released for public comment on October 11, 2017 and notification provided through a press release on October and publication in the Environmental Notice Bulletin on October 11, 2017. Comments were accepted in writing via email and US mail through November 25, 2017. Comments on the plan were received from 28 persons or organizations. Comments are summarized in Appendix 1. and their disposition is described in the agency responses.

The purpose of this recovery plan is to ensure perpetuation of the species in this State, restore self-sustaining populations, and remove the species from the Threatened Species list in New York. To achieve that goal, recovery metrics are defined that must be achieved in six of the seven Management Units to support removing lake sturgeon from the list of threatened species in New York. At a minimum, 750 sexually mature fish must be present in each Management Unit and there must be evidence of ongoing recruitment, measured by detection of three year classes of wild reproduction in a 5-year period, to consider that unit recovered.

Recovery Goal

Establish or maintain sufficient self-sustaining populations of lake sturgeon within six of the seven Management Units to warrant removal of lake sturgeon from the list of Threatened Species in New York.

Success metrics for self-sustaining populations of lake sturgeon are:

- Evidence of at least 750 sexually mature lake sturgeon in a Management Unit. This may be determined by actual census numbers, or by acceptable scientific methods to estimate populations. In the case of population estimates, the lower limit of the 95% confidence interval should be no less than 500 animals and;
- Where smaller spawning aggregations are measured and collectively used to meet the 750 sexually mature lake sturgeon per Management Unit target, each spawning aggregate should include 150 sexually mature adults. In the case of population estimates, the lower limit of the 95% confidence interval should be no less than 80 animals.
- Evidence of natural recruitment in at least 3 years of a 5-year period within the last 20 calendar years in a Management Unit.

Welsh *et al.* (2010) recommend 750 sexually mature adults because it "represents the minimum number thought to be present in Great Lakes populations that are considered to be either stable or increasing in abundance…" Each Management Unit is delineated as a metapopulation that has a reasonable potential for interbreeding. Seven hundred and fifty adults in each Management Unit should represent a stable population for a geographic portion of the species range in New York. Further, the target of 750 mature adults in each of multiple Management Units provides a robust buffer against large mortality events like botulism or viral hemorrhagic septicemia (VHS) outbreaks.

How 750 sexually mature adults is measured will vary from Management Unit to Management Unit. Measuring the number of individuals in a population by census means that at least 750 unique individual fish have been captured and recorded from a Management Unit. Populations may also be estimated by other methods such as statistical mark-recapture, estimation of survival of stocked fingerlings, or counts conducted during video surveillance of spawning adults. In the case of statistically calculated populations, the lower limit of the population estimate range should be no fewer than 500 animals at the 95% confidence interval.

Additionally, individual rivers and shoals within a Management Unit have varied carrying capacity for juvenile sturgeon and spawning adults. Individual spawning aggregations that are sampled within a Management Unit may contain fewer than 750 sexually mature adults. However, if all the spawning aggregations sampled in that Management Unit add up to 750 sexually mature adults, then the target population will have been achieved. To define what constitutes a viable spawning aggregation for inclusion in the metapopulation of a Management Unit, NYS DEC reviewed modelling done by Schueller and Hayes (2011), which found the presence of 80 to 150 post-young-of year lake sturgeon represents a low probability of extinction over 250 years. Based on that model, the recovery target may incorporate any smaller spawning aggregation of at least 150 sexually mature adults. If the population is calculated via mark-recapture or other similar sampling methods, the lower range of the population estimate should be no less than 80 sexually mature individuals at the 95% confidence interval. This should insure that any smaller spawning aggregation will continue to contribute to the desired healthy metapopulation within a Management Unit for the foreseeable future.

Detecting evidence of recruitment is also a difficult process. Sampling for both larvae and juveniles is labor intensive and unpredictable. However, gill netting techniques used to sample adult spawning aggregations in New York have picked up sturgeon that aged as young as eight years old. If lake sturgeon in the youngest year classes are captured consistently every year, that can serve as evidence of consistent recruitment. Alternatively, if netting in spawning tributaries proves feasible, recruitment may be indicated by the capture of three year classes of juvenile fish that can be attributed to natural reproduction in a five-year period. Due to annual variability in spawning success and difficulties in consistently capturing juvenile lake sturgeon, three out of five years was chosen to demonstrate that recruitment was not dependent on a single year class of adults in which the females only spawn every three to nine years. Keeping the detection period to within the last 20 calendar years ensures recruitment within an approximate generation for lake sturgeon.

Timeline for Recovery Action Implementation

The New York State Department of Environmental Conservation seeks to gather enough evidence of recovery of lake sturgeon to initiate removal from the list of Threatened Species in New York by 2024. This is intended to be an adaptive management process with concurrent actions and monitoring, and with adjustments made annually to achieve recovery of lake sturgeon. The Lake Sturgeon Working Group and NYSDEC staff will determine the sampling specifics and review data for each Management Unit. Their recommendations and findings will be incorporated into annual work plans and an annual species status report. Determination of recovery will be based on information in the annual species status report, and once species recovery is achieved, management plans will be developed to address ongoing needs within each Management Unit. At a minimum, monitoring of stocks will need to continue to ensure long term viability of recovering populations.

Additional information and resources will be needed if a limited fishery is to be considered for lake sturgeon in the future. Options for any kind of fishery can only be weighed following recovery and removal from the list of Threatened Species under 6 NYCRR Part 182. Once six of the seven Management Units reach the recovery targets, the process to remove lake sturgeon from the list of Threatened Species in New York will begin.

Natural History

Lake sturgeon is a member of one of the oldest groups of fishes, the order Acipenseriformes, and modern forms appeared in the fossil record 100 million years ago. Sturgeons have a largely cartilaginous skeleton, a heterocercal tail (asymmetrical with top longer than bottom), a spiral valve intestine, and their jaw does not articulate with the cranium (Moyle and Cech 1988). The sturgeons are distinct from the paddlefish by having five rows of bony plates, or scutes, on the body which are remnants of ganoid scales, and are also distinguished by their protrusible, bottom-oriented mouth (similar to suckers) with four barbels (Moyle and Cech 1988). The lake sturgeon is one of three sturgeon species present in New York, along with the shortnose sturgeon (*Acipenser brevirostrum*) and the Atlantic sturgeon (*Acipenser oxyrhynchus*). The lake sturgeon is the largest completely freshwater fish in New York, averaging about 5 feet in length, but reaching over 7 feet for older specimens in the Great Lakes. Females generally grow larger than males after sexual maturity (Bruch 1999).

Lake sturgeon grow quickly and mature late compared to other fish species. They typically reach sexual maturity between the ages of 14 and 33 years and 12 and 20 years for females and males respectively, though mature males as young as eight have been captured in Oneida Lake (R. Jackson, Cornell University, personal communication). Females do not spawn annually and the period ranges from every third year to as infrequently as every ninth year (Scott and Crossman 1973, Auer 1999, Billard and Lecointre 2001). Males spawn typically every other year, but sometimes every year (Auer 1999, Klindt 2014) to as infrequently as every 5th year (Billard and Lecointre 2001). Male lake sturgeon typically live to 55 years and females from 80 to 150 years. High fecundity of mature females and complex age structure of populations help buffer populations against short term environmental perturbations (Peterson *et al.* 2007).

Lake sturgeon generally live in lakes and larger rivers and migrate to tributaries in the spring to spawn when water temperatures reach 53-55° F (LaHaye *et al.* 1992). Females are typically surrounded by multiple male fish during spawning and broadcast adhesive eggs over rock and rubble substrate (Kempinger 1988). Lake sturgeon abandon spawning locations immediately after spawning (Auer 1999, Bruch and Binkowski 2002; Peterson, *et al*. 2007). Eggs incubate for 3 to 8 days before hatching without parental care (LaHaye *et al.*, 1992).

Lake sturgeon are opportunistic benthic feeders and their diet is dominated by what is available to them and their body size. Lake sturgeon juveniles and adults have been documented to use sand and muck substrates, feeding on a wide variety of invertebrates including Chironomids, worms, snails, isopods, amphipods, crayfish and Dreissenid mussels (Harkness and Dymond 1961). Some have also been found to have fish in their gut including round gobies and sculpins. In Oneida Lake, lake sturgeon have been found to opportunistically feed on winter kills of gizzard shad (R. Jackson, Cornell University, personal communication).

Distribution

The lake sturgeon is native to large lakes and rivers throughout the Great Lakes Basin and from the Hudson Bay south into the Mississippi drainage to Alabama and northern Mississippi, from Lakes Winnipeg and Manitoba to Lake Champlain and the St. Lawrence River (Figure 1.). In New York, they are native to the Great Lakes, the St. Lawrence River and Lake Champlain, including connecting waters and major tributaries to these waters (Figure 2). Historic records of lake sturgeon catches from the mid-1800s in Oneida and Cayuga Lakes are likely the result of migrants from Lake Ontario through the barge canal and locks (Carlson 1995). Therefore, it is not certain that these lakes were part of their native range. Lake sturgeon were historically recorded as occurring in the Allegheny River as far upstream as Warren, PA, only 20 miles south of the New York border (PGC-PFBC 2015).

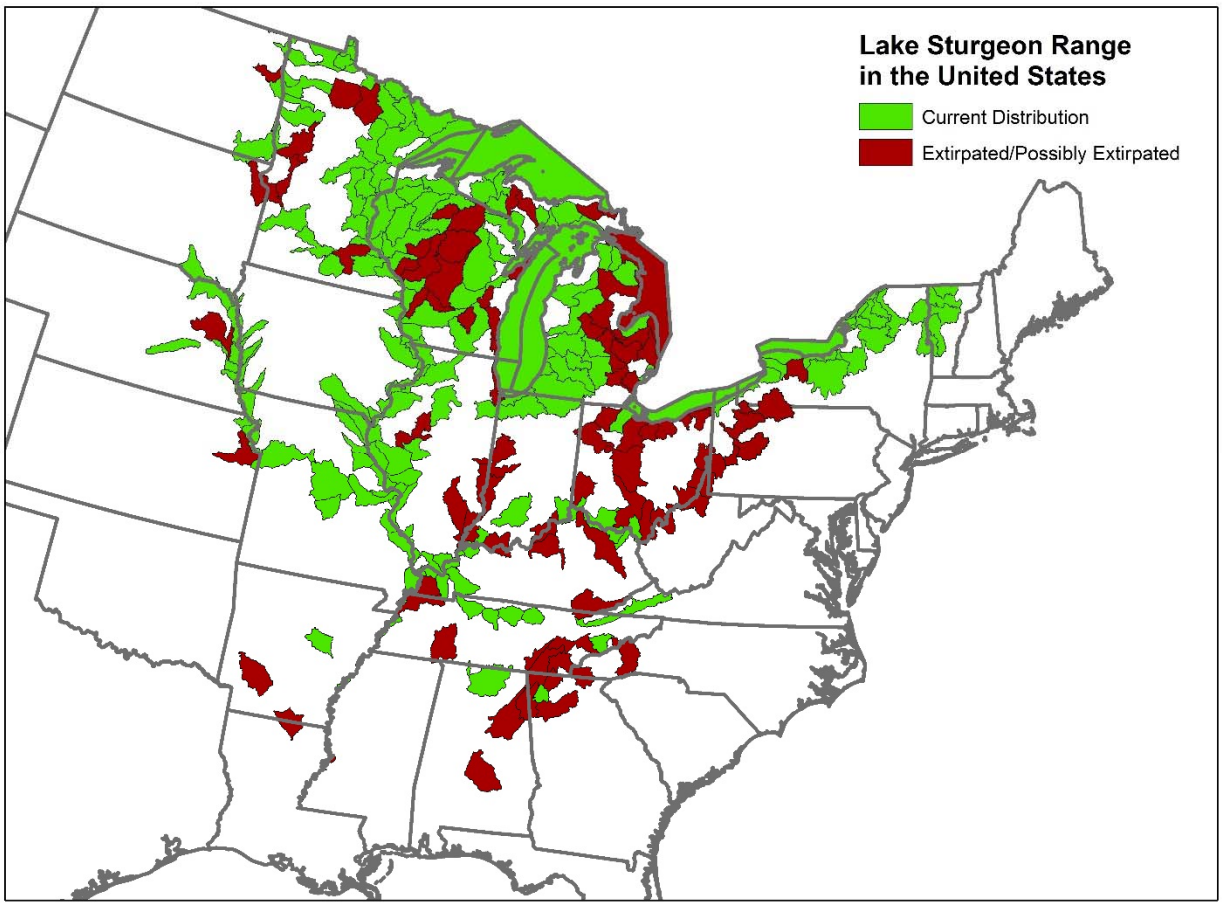

Figure 1. Historic and current distribution of lake sturgeon by watershed in the United States modified from NatureServe map (NatureServe.org 2013) to include range information from the Pennsylvania State Wildlife Action Plan (PGC-PFBC 2015).

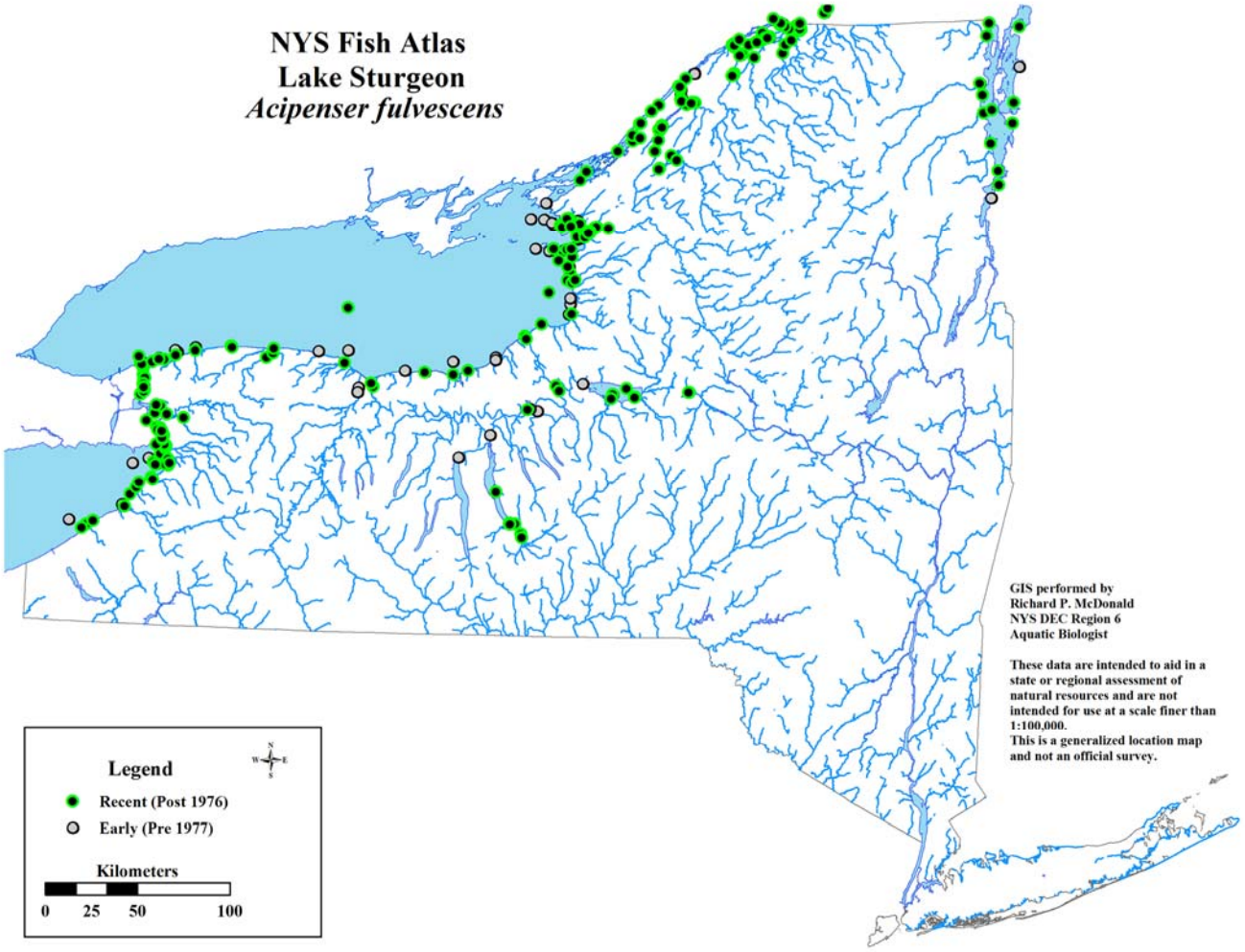

Figure 2. Historic and recent collection locations of lake sturgeon in New York, 1884-2013 (NYSDEC, 2014b).

Population Status History

- Pre-industrial to 1860s

Prior to European contact, lake sturgeon were commonly found in New York waters of Lake Ontario, Lake Erie and the St. Lawrence River and its tributaries. Abundant spawning occurred in tributaries near rapids and along the rocky shores of Lakes Ontario and Erie (Carlson 1995). Indigenous lake sturgeon subsistence fisheries existed for thousands of years before European contact. Usages varied among tribes and nations, but most (if not all) depended on sturgeon as an early spring source of meat. Lake sturgeon were also used for medicinal, ceremonial, and functional uses (e.g. the skins of sturgeon were used to make jars for storing oil, swim bladders provided isinglass, the base for glue, paint, and gelatin). Lake sturgeon isinglass became a prominent trade item for indigenous communities on the Canadian side of the Great Lakes after contact with European fur traders. Throughout their range, the industrial revolution and building of mill dams and mills near rivers resulted in habitat fragmentation as well as degradation of water quality, and in some cases even smothering of feeding or spawning habitat by mill wastes (Harkness and Dymond 1961).

- 1860s to 1976

Early in this period lake sturgeon were killed as a nuisance species for destroying the gill nets of herring fisherman. Subsequently, lake sturgeon roe was discovered as a suitable substitute for beluga caviar once Russian stocks were depleted. By the 1870s the Great Lakes became the hub of the US commercial sturgeon fishery. Between 1879 and 1900 the total Great Lakes commercial harvest of lake sturgeon averaged over 4 million pounds annually. The fishery peaked in 1885 at 8.6 million pounds across the entire Great Lakes fishery, and 5.2 million pounds of that was harvested in Lake Erie (US Fish and Wildlife Service 2014b). In a review of Great Lakes fisheries of 1885 (Smith and Snell 1890), the authors noted “The most extensive fishery for sturgeon is at Buffalo. Considerable quantities occur throughout the lake, except in Chautauqua County, New York, west of Irving, and in Maumee Bay and River, where the catch is small.” The gill net and set line fisheries in Buffalo and Erie County alone harvested 3.66 million pounds of lake sturgeon that year. By contrast, the fishery for lake sturgeon in Lake Ontario was much more modest. Commercial landings reported in 1885 were 386,974 pounds (Smith and Snell 1890).

Lake sturgeon were commercially harvested until the fishery collapsed, in many places in less than ten years (Harkness and Dymond 1961). In New York waters, the decline took longer, but the fisheries were reduced to minimum levels by the 1950s and 1960s (Carlson 1995). Jolliff and Eckert (1971) concluded that the St. Lawrence River lake sturgeon population below the Moses Saunders Dam at Massena, NY was the only remaining fishery and probably the only sustainable population in the St. Lawrence River with enough individuals not considered in danger of being extirpated. This section of the St. Lawrence River includes the Akwesasne Territory that straddles the US – Canadian border and has included an uninterrupted indigenous fishery. New York’s portion of Lake Erie retained a very small commercial fishery until 1976, and there were lake sturgeon present in both the Upper and Lower Niagara rivers at that time (C. Legard, NYSDEC, personal communication). Lake Champlain also supported a commercial fishery primarily on the Vermont side of the lake in the Missisquoi, Lamoille, and Winooski rivers during spring spawning. No record of spawning exists on the New York side of the lake. Vermont closed their commercial fishery in 1967 and listed lake sturgeon as endangered in 1972. The New York fishery statewide was officially closed in 1976.

- 1976 to 1995

At the time of the fishery closure in 1976, only two spawning populations were known in New York. They were in the lower St. Lawrence River near Massena (below the Moses-Saunders Dam) and in the Grasse River at Madrid. Some subsistence harvest by Mohawks of Akwesasne continued during this time in Mohawk waters in the St. Lawrence River. In subsequent years, little to no recovery of lake sturgeon was observed throughout the state and the species was listed as threatened in NY in 1983 (Bouton 1994). In 1992 and 1993, NYSDEC and multiple federal, provincial, university and industry partners experimented with egg takes from the Rivière des Prairies in Montreal, Canada. The 1992 egg take attempts failed due to vandalism, but six adult sturgeon were released into the middle Oswegatchie River (Figure 3.). The egg take in 1993 was successful and two to four inch fingerlings were stocked in the Oswegatchie, Grasse and Oswego rivers. The first recovery plan was written in 1994 (Bouton 1994) and recommended continued stocking in the Oswegatchie and Grasse rivers for three more years to establish populations in those systems. It also recommended the selection of 6 to 8 waterbodies for lake sturgeon restoration or population enhancement. Stocking in the Grasse River occurred once in 1993, but was discontinued when it was determined it had an existing spawning population (Carlson 1999).

Figure 3. Stocking locations and numbers of lake sturgeon stocked by year taken from NYSDEC records. Numbers in bold and italics indicate small fish that were not expected to survive in appreciable numbers.

	Stocking Locations													
Year	Lake Ontario - Chaumont Bay	Genesee River	Oswego River/ Seneca River/ Barge Canal	Cayuga Lake	Oneida Lake	St. Lawrence River - Middle Corridor	St. Lawrence River- Lake St. Lawrence	St. Lawrence River - Lake St. Francis	Black Lake/Lower Oswegat-chie River (rkm 8-18)	MiddleOswegat-chie River (rkm 18-95)	Grasse River	Raquette River	St. Regis River	Salmon River (Franklin County)
1992														
1993			***35***						10,000		2,000			
1994									3,600	3,100				
1995				2,800	5,000				2,750	2,250				
1996					550	250	250	250		2,528				
1997						250	250	250		2,987				
1998				370	387	300		300	1,500	1,500			1,100	
1999					320	520		300	1,200				1,200	
2000				412	300	300	200	200	1,030				1,027	
2001														
2002														
2003		900			369			102	420				820	
2004		1,000		109	1,200			200	2,210	1,530		860	1,200	
2005														
2006						500								
2007														
2008														
2009														
2010														
2011														
2012														837
2013		1,047		2,500		***7,000***		500				1,000	1,000	1,000
2014	3,250	500		1,000	500	5,250		2,500	3,000	1,000		500	1,000	1,000
2015	***7,500***	1,000		2,500	500	***2,500***		300	2,000	1,700		500	1,000	1,000
2016		506		659	510			500	1,000	500		500	500	500

- 1995 to Present

Throughout their total current range, researchers have shown that lake sturgeon populations seem to be stable or increasing (US Fish and Wildlife Service 2014a), although not yet close to historical abundances. As of 1997 lake sturgeon abundance was estimated at 1% of historical levels across their native range (Hay-Chmielewski and Whelan 1997). Lake sturgeon were formerly abundant from southern Canada to the southeastern U.S. They are absent in some of the southern portions of its range, such as Alabama, and inhabit a reduced range in Illinois, Indiana, and Kentucky (St. Pierre and Runstrom 2004).

Despite extra protections conveyed by its listing as a threatened species in New York, lake sturgeon showed little natural recovery between the fishery closure and 1994, when the first recovery plan was written. Since that time a combination of active interventions through stocking, habitat enhancement, and observed natural recovery have resulted in slow and steady progress in reestablishing populations throughout the historic range in New York State.

New York State Department of Environmental Conservation stocked sturgeon in 13 locations from 1995 to 2004, using gametes taken from the population below the Moses-Saunders Dam in Massena (Figure 3). From this egg source, populations were established in 7 waters: the Genesee River, Cayuga Lake, Oneida Lake, the Oswegatchie River, Black Lake, the Raquette River, and the St. Regis River. Stockings during that same period also enhanced existing populations in the St. Lawrence River.

In the late 1990s the US Fish and Wildlife Service (USFWS) began sampling the Lower Niagara River to evaluate lake sturgeon populations. Both adult and juvenile lake sturgeon were captured in 1998 (Hughes *et al*. 2005) and numerous reports came in from the public, showing sturgeon using most of the lower Niagara River. A robust population is recovering in that part of Lake Ontario based on continuing sampling.

In the early 2000s, periodic outbreaks of Type-E botulism resulted in mortalities of lake sturgeon in both Lake Erie and Lake Ontario and posed a setback for recovering populations. Those mortalities were tracked intermittently (Carlson *et al*. 2002). In 2005, Viral Hemhorragic Septicemia (VHS) was detected in Lake Ontario, and sturgeon egg takes were suspended until a risk assessment for transmission of the virus could be completed. Successful egg takes and stocking resumed in 2012 when staff from the USFWS's Genoa National Fish Hatchery joined DEC in a cooperative effort to improve the success of egg takes and fingerling production levels.

In response to increasingly frequent lake sturgeon sightings reported by anglers near Buffalo, NY, in 2012, NYSDEC biologists conducted a small pilot netting program which captured two adult lake sturgeon near Buffalo Harbor. Since 2012, NYSDEC and USFWS have collaborated on a more comprehensive annual assessment which is revealing a natural recovery in eastern Lake Erie (Legard 2015; Neuenhoff *et al*. 2017).

From 2013 to 2016 lake sturgeon fingerlings were stocked in nine locations. In the same time period, young fish spawned by stocked populations were detected in Oneida Lake (Jackson *et al*. 2016) and the Oswegatchie River (NYSDEC and USFWS unpublished data). Ripe females have been captured in the Seneca River since 2013 and ripe males from previous stockings were captured in the Genesee River in 2016 (Dawn Dittman, USGS, personal communication). See the individual Management Unit sections for more detailed information on known reproduction. The population levels and evidence of natural recruitment in each Management Unit varies, but this variation is consistent throughout the range of the species.

Lake sturgeon is still a species of cultural significance to Indigenous Nations such as the Seneca, Tuscarora, Cayuga, Onondaga, Oneida, and Mohawks (also known collectively as the Iroquois or Haudenosaunee Confederacy). Cultural revitalization and use of this species is highly desired, especially in waters that do not have sufficient sturgeon populations for subsistence harvest. Some Mohawks of Akwesasne still practice subsistence fishery in Mohawk waters, albeit at reduced numbers due to loss of traditional knowledge with the passing of elders in the community. However, cultural restoration programs have been working towards restored cultural uses of the land and waters by younger generations in the community, including sustainable lake sturgeon harvest. For example, in 2016, SRMT published a bilingual (Mohawk and English) publication to be used as an educational outreach material on Teiokién:taron (sturgeon) in Akwesasne.

- Next Steps

The NYSDEC will strive to document current population levels and natural recruitment over the next several years to support a finding of recovery sufficient to warrant delisting the species. Based on the data already gathered, a separate species status assessment for lake sturgeon will be prepared in 2018, and will be updated annually to incorporate new data as it is collected. NYSDEC seeks to have partners and the public objectively evaluate the recovery goals prior to NYSDEC assessing progress toward a set of goals that may change. Upon adoption of the current iteration of the Lake Sturgeon Recovery Plan, NYSDEC will convene the NYS Lake Sturgeon Working Group to evaluate the best data available and reach consensus on recovery status of the species.

Statewide Recovery Actions

Some recovery actions are broad or administrative in nature and are included here. Other location specific tasks are outlined in each of the Management Units. Recovery actions will be conducted and/or coordinated by NYSDEC, with assistance from USFWS, USGS, Cornell University, Saint Regis Mohawk Tribe and other partners under the auspices of the New York Lake Sturgeon Working Group.

Protection

- Continue to protect lake sturgeon from harvest by enforcing fishing regulations.
- Minimize angling mortality through public education.
- Continue to protect water quality by reviewing pesticide applications, SPDES discharges, and other large environmental disturbance projects.
- Work with hydropower agencies to bring about any hydrological changes necessary to ensure spawning habitat suitability in spawning rivers.

Management

- Continue propagation of lake sturgeon as needed for recovery and future management targets.
- Enhance or restore spawning habitat where appropriate, including restoration of fish passage.

Consultation with Indigenous Nations

- Strengthen State/Indigenous nation partnerships in management units associated with lake sturgeon recovery goals and acceptance.
- Strive to share science based information and incorporate Traditional Environmental Knowledge into management goals to support indigenous use of lake sturgeon.
- Collaborate with indigenous nations for monitoring and assessment when feasible.

Monitoring and Assessment

- Sample known spawning populations each spring for a minimum of 5 consecutive years to estimate population via mark-recapture or other credible method.
- Long-term monitoring of spawning populations at least once every five years once population goals are achieved.
- Sampling juvenile congregation areas at least once every five years as those areas are identified, by either acoustic bathymetry surveys, netting, or other means.
- Assess existing spawning habitat for enhancement opportunities.

Statewide Research Needs

- Develop methods to estimate recruitment rates of lake sturgeon within Management Units.
- Develop robust sampling methods for juvenile (age 2 to 10) lake sturgeon.
- Identify spawning locations for Management Units where they are unknown.
- Investigate spawning tributaries for areas of juvenile aggregation.
- Develop non-lethal methods for contaminant load assessment of lake sturgeon flesh and eggs.
- Continue to search for additional active spawning locations.

Outreach

- Educate anglers about longevity of lake sturgeon and late-age at first spawning, past over-exploitation to support compliance with regulations.
- Increase public awareness of the cultural significance and importance of restoring lake sturgeon populations for indigenous peoples.
- Produce pamphlets and handouts and develop attention-getting displays for use at Sportsmen’s shows, fairs, and environmental days.
- Support the production of educational materials conveying Traditional Environmental Knowledge regarding lake sturgeon for indigenous nations and non-indigenous populations.
- Educate anglers about the need to let lake sturgeon spawn without harassment, and the need to report illegal fishing.

- Engage statewide sportsman organizations, zoos, aquariums and volunteer groups to deliver messages on lake sturgeon protection.
- Consider initiating volunteer spawning-watch and reporting programs following similar efforts in Wisconsin and Michigan.
- Develop child-appropriate messages about lake sturgeon; what lake sturgeon are, what role they played in the past, what caused them to decline.
- Do in-school presentations about sturgeon.
- Invite schools to attend stocking events.
- Support zoo and aquarium displays about sturgeon.
- Develop web and social media content about lake sturgeon recovery and management activity.
- Share technical findings with partners and stakeholders, including habitat restoration needs in a timely manner.

Reporting

- Annual progress summaries will be produced by all parties involved in lake sturgeon recovery and management activities. Biological data, tagging information, and relevant environmental variables will be reported in a standardized format to the regional fisheries manager.
- A Species Status Assessment Report will be produced annually by NYSDEC containing data and analysis within each Management Unit that includes lake sturgeon size, age, population structure, and trends.

Management Unit Status and Recovery Actions

To further clarify the recovery actions for lake sturgeon in New York, this recovery plan has divided the range of lake sturgeon into seven Management Units (Figure 4.). Management Units are physiographically connected, though partial barriers to free passage of the fish exist in the form of dams and locks in the riverine portions of the management units. They are named and described in the boxes below. Geographically significant features are listed within each management unit are either known current or historic spawning locations, significant habitat features, or areas where restoration activities have been identified. The current status and needed recovery actions are outlined for each Management Unit. Each Management Unit section within this plan includes a map depicting the general boundaries and the significant features. Symbols indicating major cities and indigenous sovereign territories are included as landmarks, along with features like dams that affect lake sturgeon movement.

Figure 4. Lake Sturgeon Management Units and short description.

1. Lake Erie • Cattaraugus Creek • Lake Erie outlet (Buffalo and vicinity) • Upper Niagara River	**2. Western Lake Ontario** • Lower Niagara River • Niagara Bar • Lower Genesee River
3. Central New York • Oswego River • Oneida River • Seneca River • Oneida Lake/Fish Creek • Cayuga Lake • Onondaga Lake	**4. Eastern Lake Ontario** • Chaumont Bay • Black River • Oswego River mouth • Salmon River (Oswego County)
5. Upper St. Lawrence River • St. Lawrence River- Cape Vincent to Morristown • St. Lawrence River – Morristown to Moses Saunders Dam (Lake St. Lawrence reach) • Iroquois Dam • Oswegatchie River mouth • Oswegatchie River from Ogdensburg to rkm 95 at Natural Dam • Black Lake/Indian River	**6. Lower St. Lawrence River** • St. Lawrence River from the Moses Saunders Dam downstream to the US border (Lake St. Francis reach) • Grasse River • St. Regis River • Raquette River • Salmon River • Akwesasne Territory
7. Lake Champlain* • Missisquoi River, VT • Lamoille River, VT • Winooski River, VT • Otter Creek, VT *No known historic spawning areas in New York	This Management Unit is not currently part of New York's recovery for lake sturgeon. All spawning is on the Vermont side of Lake Champlain and the Vermont Fish and Wildlife Department is currently monitoring natural recovery in Lake Champlain tributaries in their state. However, future participation by NYDEC may be needed.

Management Unit 1: Lake Erie

Description and Status

The Lake Erie Management Unit encompasses New York's portion of eastern Lake Erie and its tributaries.

Significant geographic areas within the Management Unit include:

- Cattaraugus Creek – possible spawning habitat, no observations
- Lake Erie outlet (Buffalo vicinity) – spawning and staging area, historic fishery and spawning on Bird Island Reef near Buffalo Harbor
- Upper Niagara River – adult concentration area

Figure 5. Lake Erie Management Unit

This Management Unit is experiencing recovery of the lake sturgeon population following depletion through the historic fishery. New York State does not stock in its portion of Lake Erie waters or tributaries. The nearshore eastern basin waters of the lake provide excellent feeding habitat and recent studies show lake sturgeon appear to remain in this part of the lake (Withers *et al*. 2017). In the New York portion of Lake Erie, NYSDEC and USFWS have been monitoring a congregation of young adult lake sturgeon at the head of the Upper Niagara River at spawning time. USFWS staff captured lake sturgeon eggs on Bird Island Reef in 2017 (Jonah Withers, USFWS, unpublished data) and natural reproduction in Buffalo Harbor has been documented (Legard 2015; Neuenhoff *et al*. 2017). The eggs from Bird Island

Reef were genetically similar to lake sturgeon sampled in the Lake St. Clair-Detroit River portion of western Lake Erie. The states of Michigan and Ohio have spawning habitat enhancement programs underway in the St. Clair River system and western basin of the lake. However, ages of sturgeon captured in Buffalo Harbor indicates that at least some adults survive from prior to the restoration programs (NYSDEC, unpublished data).

The 2016 population estimate using the Schnabel method (Schnabel 1938) for this Buffalo Harbor breeding aggregation is 806 with a range of 457 to 1515 at the 95% confidence interval. The sampled population is predominantly male and less than 30 years old (NYSDEC unpublished data). Few juvenile lake sturgeon are captured from year to year, making determination of recent recruitment difficult. However, sturgeon as young as eight years old have recruited to the gill nets used to assess spawning adults in this location (NYSDEC unpublished data). Over time these young sturgeon may provide adequate evidence of recruitment.

This management zone borders the Province of Ontario, where fishing for lake sturgeon is also prohibited.

Recovery Actions

Stocking

- Not recommended at this time. Natural recovery appears to be underway, but if future stocking is warranted, an egg source from within the same genetic unit as delineated in Welsh *et al*. (2010) should be used.

Habitat improvement

- None identified at this time, however, see Research section below.

Monitoring

- Annually use spring gill netting of spawning adults to update the population estimates for Buffalo Harbor, until the population estimate range at the 95% confidence interval is no lower than 500 fish.
- Where possible, verification of ongoing successful spawning should be completed (see recruitment concerns in narrative above).
- Lake sturgeon size, age, and population structure will be analyzed for trends.
- Place egg mats and conduct larval tows in the vicinity of known or suspected spawning areas annually.

Research

- Historic spawning areas need to be investigated to determine current suitability for spawning, and monitored for use by lake sturgeon. More research is needed in this area to track population recovery and identify useful management actions (such as spawning habitat enhancement), which may improve population resilience into the future.
- Identify current spawning areas within New York's portion of Lake Erie, and identify specific area protection needs, particularly within the Buffalo River Area of Concern.
- Identify habitat use by juvenile lake sturgeon.

Ongoing Implementation

- The NYSDEC Lake Erie Fisheries and Region 9 Fisheries Units, along with the USFWS, conduct and coordinate monitoring tasks for Lake Erie and the Upper Niagara River. This work should continue.
- Annual reporting of progress and recovery actions for this management unit will be prepared for NYSDEC's Lake Erie annual report published each March.

Management Unit 2: Western Lake Ontario

Description and Status

The Western Lake Ontario Management Unit encompasses the New York Portion of Lake Ontario and its tributaries from the Niagara River downstream of Niagara Falls east to Sodus Bay.

Significant features within the Management Unit include:

- Lower Niagara River - spawning habitat in the gorge
- Niagara Bar - congregation and feeding area
- Lower Genesee River – historic spawning area

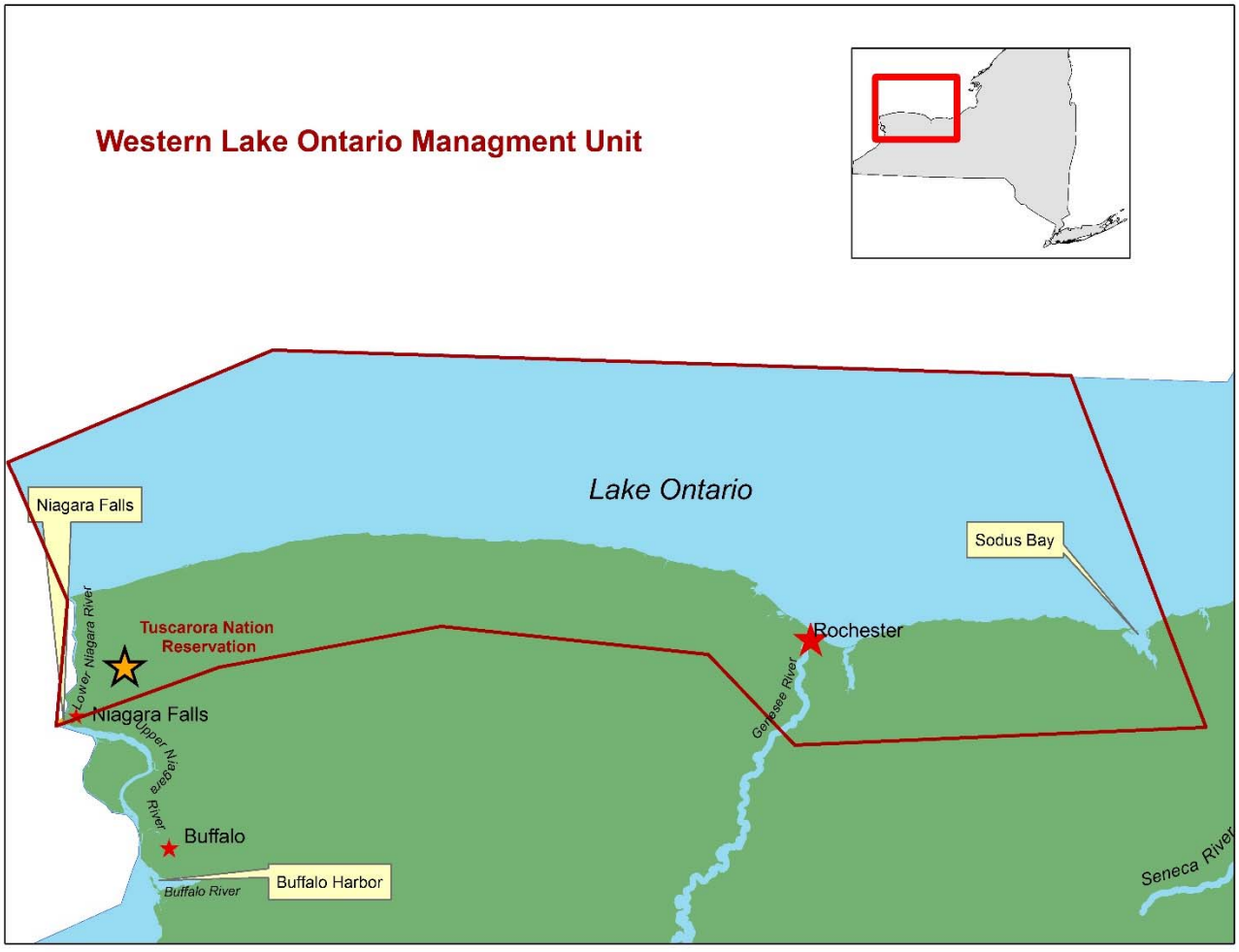

Figure 6. Western Lake Ontario Management Unit

This Management Unit is experiencing natural recovery of the lake sturgeon population in the Niagara River and a historic spawning and nursery area is being stocked for recovery in the lower Genesee River. The lower Genesee River population is regularly sampled by USGS staff via gill netting and shows good survival and growth rates. Western Lake Ontario is excellent adult sturgeon habitat.

Reproduction is likely occurring in the lower Niagara River, with several young adult year classes documented over time (Biesinger et al. 2014). The annual survival using a Cormack Jolly-Seber estimator calculated by USFWS in 2016 for the

lower Niagara River is 88% with a capture probability of 3%. This estimator likely underestimates survival, because lake sturgeon often leave spawning river systems for long periods of time making them unavailable for recapture. Using these values, USFWS calculated a Jolly-Seber population estimate of 7,600 individuals with a range of 5,900 and 9,800 individuals at the 95% confidence interval (Dimitry Gorsky, USFWS, personal communication).

Age estimates of sampled lake sturgeon show that 92% of sturgeon captured originated from the 1992-2004 year classes with little to no recruitment being detected from other years. This was inspected for a sampling bias of certain aged fish and was found not significant (Dimitry Gorsky, USFWS, personal communication). Possible explanations for the failure to detect younger year classes of lake sturgeon are habitat changes in the sampling area making it less attractive to juvenile sturgeon, or a lack of appreciable recruitment in recent years.

The 1,900 lake sturgeon stocked in the Genesee River in 2003 and 2004 are estimated to have an overall survival rate of 26%, resulting in a population estimate of about 494 for those two year classes. Additional stocking has continued annually from 2013 and is expected to have a similar survival rate. Based on that survival rate and the numbers of stocked fish, the overall population is estimated to be 1,288 sturgeon ranging in age from 1 to 14 in 6 cohorts as of 2016.

By 2015, few of the 2003 and 2004 stocked sturgeon remained resident in the Genesee River (Dittman 2017). However, as previously noted, ripe males from those cohorts were captured in spring of 2016 in the river. The stocked females from those cohorts in the Genesee River will reach the age of maturity by 2020 and evidence of successful spawning is not expected until then.

This management zone borders the Province of Ontario, where fishing for lake sturgeon is also prohibited.

Recovery Actions

Stocking

- No stocking is recommended in the lower Niagara River at this time.
- Continue low level stocking to expand year class structure and genetic variation in the Genesee River. Stocking goal of 1,000 lake sturgeon per year in Genesee River until 2024 or recovery goals are met.

Habitat improvement

- None identified at this time.

Monitoring

- Continue standard set line surveys by USFWS to assess the population of sturgeon in the Lower Niagara River. Lake sturgeon size, sex, age, and population structure will be assessed.
- Continue gill net surveys of juvenile sturgeon in the Genesee River to refine survival and population estimates until the population estimate range at the 95% confidence interval is no lower than 500 adult lake sturgeon.
- New monitoring of spawning activity in the Genesee River should be initiated no later than spring 2020.

Research

- Investigate where sturgeon are spawning in the lower Niagara River and
- Investigate if juvenile sturgeon are using habitat outside the lower Niagara River to explain the decline in juvenile captures in the river.

Ongoing Implementation

- The USFWS is researching the Lower Niagara River lake sturgeon population. Further research to determine spawning locations and continued assessments of recruitment from those locations is necessary.

- USGS is currently monitoring the Genesee River lake sturgeon population. The monitoring of the population, seasonal use of the river, growth, and survival after stocking should continue.
- USFWS and USGS staff will submit annual findings to NYSDEC Region 8 staff for annual reporting.

Management Unit 3: Central New York

Description and Status

The Central New York Management Unit includes the inland waters of Central New York draining to Lake Ontario.

Significant geographic features within the Management Unit include:

- Oswego River/Oneida River/Seneca River – spawning suspected at Mud Locks in Montezuma NWR and Caughdenoy Dam
- Oneida Lake/Fish Creek – stocked population; spawning suspected in Fish Creek; wild recruit fish captured
- Cayuga Lake/Fall Creek – stocked population; survival of stocked fish documented through annual fall netting of adults; observed spawning activity in Fall Creek

Figure 7. Central NY Management Unit.

These waters were historically separated from Lake Ontario by natural barriers until the opening of the Erie Canal in 1825. There are reputable reports of lake sturgeon from Cayuga Lake and Oneida Lake after this time. The waters of this Management Unit have been stocked to take advantage of highly productive lakes that support a metapopulation of lake sturgeon. Sturgeon have been documented to migrate from Oneida Lake to the Oneida/Seneca/Oswego River system and Onondaga and Cross lakes. Oneida Lake received 9,636 stocked sturgeon fingerlings in 10 year classes between 1995 and 2016. Cayuga Lake received 10,431 fingerlings in the same time period from 8 year classes. Stocked resident fish are now present in Oneida Lake, Cayuga Lake, and the Seneca River and canal system upstream and downstream throughout the Oswego River (Chalupnicki et al. 2011). The outlets to Oneida and Cayuga lakes are dammed, but as with the canal and rivers in the Management Unit, lake sturgeon can move through locks to re-enter the lakes.

High growth and survival rates in Oneida Lake make this population an excellent species stronghold in the overall recovery of lake sturgeon (Jackson *et al*. 2002). Mark-recapture studies conducted by Cornell Field Station staff at Shackleton Point resulted in an estimated 1,790 fish surviving from the 1995 stocking cohort (95% confidence interval 1114-2970). This corresponds to an approximately 30% overall survival rate after 7 years. Extrapolation of the 30% survival rate to all stocked fish would result in an overall population estimate of 2,891 sturgeon between the ages of 1 and 22 years old. The majority of the population are 22-year-old fish from the 1995 stocking of lake sturgeon originating from Riviére des Prairies, Quebec brood stock.

Annual fall gill netting near Taughannock State Park has shown survival to maturity of some of the stocked sturgeon in Cayuga Lake. Eighty lake sturgeon have been handled over 16 years of netting (NYSDEC unpublished data). Abundant sea lamprey populations in Cayuga Lake are thought to have hampered survival of fish stocked there, though efforts at sea lamprey control have resumed (Emily Zollweg-Horan, NYSDEC, personal communication). Spawning adults were observed in Fall Creek in Ithaca, NY in spring of 2017.

This management unit has documented reproduction occurring in the Oneida Lake system (Jackson et al. 2010), and Cornell University researchers have captured wild produced fish from the 2011, 2012, 2014 year classes in Oneida Lake (Jackson *et al*. 2017). Spawning is also suspected within Oneida/Seneca/Oswego River system at Fulton, Cayuga outlet, and Caughdenoy Dam. Spawning beds built in Montezuma National Wildlife Refuge attracted spawning adults in 2016.

This management zone borders the Province of Ontario, where fishing for lake sturgeon is also prohibited.

Recovery Actions

Stocking

- Continue low level stocking to expand year class structure and genetic variation in Cayuga Lake and Oneida Lake.
    - 2000 lake sturgeon per year in Cayuga Lake until recovery is achieved.
    - 500 lake sturgeon per year in Oneida Lake until recovery is achieved.

Habitat improvement

- Create spawning habitat structures in order to facilitate natural reproduction where spawning habitat is limiting and construction is feasible. If lake sturgeon use the new spawning beds at Mud Locks, then other suitable locations in the Seneca River/Cross Lake/Oswego River system should be identified and spawning beds built there as well.
- Continue lamprey treatments in Cayuga Lake to enhance survival and fitness of lake sturgeon.

Monitoring

- Use large mesh gill nets in fall at Taughannock Point and Salmon Creek Delta to assess lake sturgeon population in Cayuga Lake.
- Use large mesh gill nets to assess lake sturgeon spawning at Cayuga Inlet and Fall Creek.
- Use gill nets to assess lake sturgeon in the Seneca River/Cross Lake/Oswego River system.
- In Oneida Lake, PIT tag gateways should be used (rather than gill nets) for monitoring spawning activity in Fish Creek and other tributaries to avoid conflicts with anglers in the spring.
- Verification of successful spawning should be completed in Fish Creek.
- Verification of successful spawning should be completed in Fall Creek.
- Monitor toxic substances within legacy contaminant areas of the Management Unit, such as Onondaga Lake, where possible, by sending sturgeon tissue and/or blood samples from this management unit for analysis.

Research

- Track population recovery, determine any impediments to that recovery (such as migration barriers), and identify potential management actions which may improve resilience of these populations into the future.
- Estimate recruitment rates in Oneida Lake.
- Investigate the suitability of Oneida Lake's sturgeon population as an egg source for future propagation needs.
- Examine lamprey treatment streams in this Management Unit for use by juvenile sturgeon at risk of adverse effects from TFM. Specifically:
    - Fish Creek tributary to Oneida Lake

Ongoing Implementation

- The USGS is monitoring the Oneida/Seneca/Oswego rivers system, and this work should continue.
- NYSDEC Region 7 Fisheries is monitoring the Cayuga Lake population of lake sturgeon, and this work should continue.
- Cornell University is monitoring the lake sturgeon population by standard gill netting in Oneida Lake and this monitoring should continue.
- USGS, USFWS, and Cornell University staff will submit annual findings to NYSDEC Region 7 staff for annual reporting.

Management Unit 4: Eastern Lake Ontario

Description and Status

The Eastern Lake Ontario Recovery Unit includes the New York portion of Lake Ontario and its tributaries from Sodus Bay to Cape Vincent, NY.

Significant features within the Management Unit include:

- Chaumont Bay – nursery habitat
- Black River – spawning area
- Oswego River mouth – historic spawning area
- Salmon River – large tributary

Figure 8. Eastern Lake Ontario Management Unit.

Lake sturgeon were known historically from the Oswego River mouth and the Black River (Carlson 1994 and 1996). There is a naturally recovering population in this management unit, though it is likely benefitting from stockings in the Central New York Management Unit. Lake sturgeon tagged in Oneida Lake have been recovered in the Black River, and sturgeon are known to migrate out of the Central NY Management Unit regularly. Fish have been captured in the mouth of the Oswego River below the dam at the power station (NYSDEC 2010). Potential spawning area may exist in the lower Oswego River, but needs to be investigated. Spawning has been documented in the Black River (Klindt and Adams, 2006) with a single egg captured in an egg trap, capture of ripe running individuals, and video footage of spawning

behavior. NYSDEC has tagged 152 individual fish in the Black River between 2009 and 2016 (Rodger Klindt, NYSDEC, personal communication).

Current practices at Oneida Hatchery in New York include the early release of lake sturgeon fry that are not thriving in the hatchery environment. Chaumont Bay is one location designated for early release of lake sturgeon fry. Surplus fingerling sturgeon from Genoa National Fish Hatchery and Oneida Hatchery are also stocked in Chaumont Bay.

This management zone borders the Province of Ontario, where fishing for lake sturgeon is also prohibited.

Recovery Actions

Stocking

- No stocking in this Management Unit is recommended at this time (see note about hatchery release above).

Habitat Improvement

- Add cobble and gravel substrate in the lower Black River to increase the available spawning habitat for lake sturgeon and other species.

Monitoring

- Continue to use gill netting to assess lake sturgeon in the Black River.
- Additional verification of successful spawning should be completed.
- Sampling for spawning adults should be initiated in the mouth of the Oswego River.
- Survey Chaumont Bay for usage by juvenile sturgeon.

Research

- Research survival estimates for early release lake sturgeon fry in Chaumont Bay.
- Examine lamprey treatment streams in this Management Unit for use by juvenile sturgeon at risk of adverse effects from TFM. Specifically:
    - Black River in Jefferson County
    - Salmon River in Oswego County

Implementation

- NYSDEC Region 6 is monitoring the Black River spawning aggregation and this work should continue.
- NYSDEC Region 6 will prepare annual report of findings.

Management Unit 5: Upper St. Lawrence River

Description and Status

The St. Lawrence River Management Unit includes the New York portion of the St. Lawrence River and its tributaries from Cape Vincent, NY to the Moses-Saunders Dam.

Significant features within the Management Unit include:

- St. Lawrence River reach from Cape Vincent to Morristown – historic habitat and fishery
- Iroquois Dam – documented spawning on the NYPA constructed beds at the dam
- St. Lawrence River reach from Morristown to the Moses-Saunders Dam
- Oswegatchie River mouth – historic habitat and fishery
- Lower Oswegatchie River reach from rkm 8 at Ogdensburg to rkm 18 at Heuvelton including Black Lake and Indian River to Rossie – stocked population
- Middle Oswegatchie River reach from rkm 18 at Heuvelton to to rkm 95 at Natural Dam – stocked population; wild recruit juveniles captured

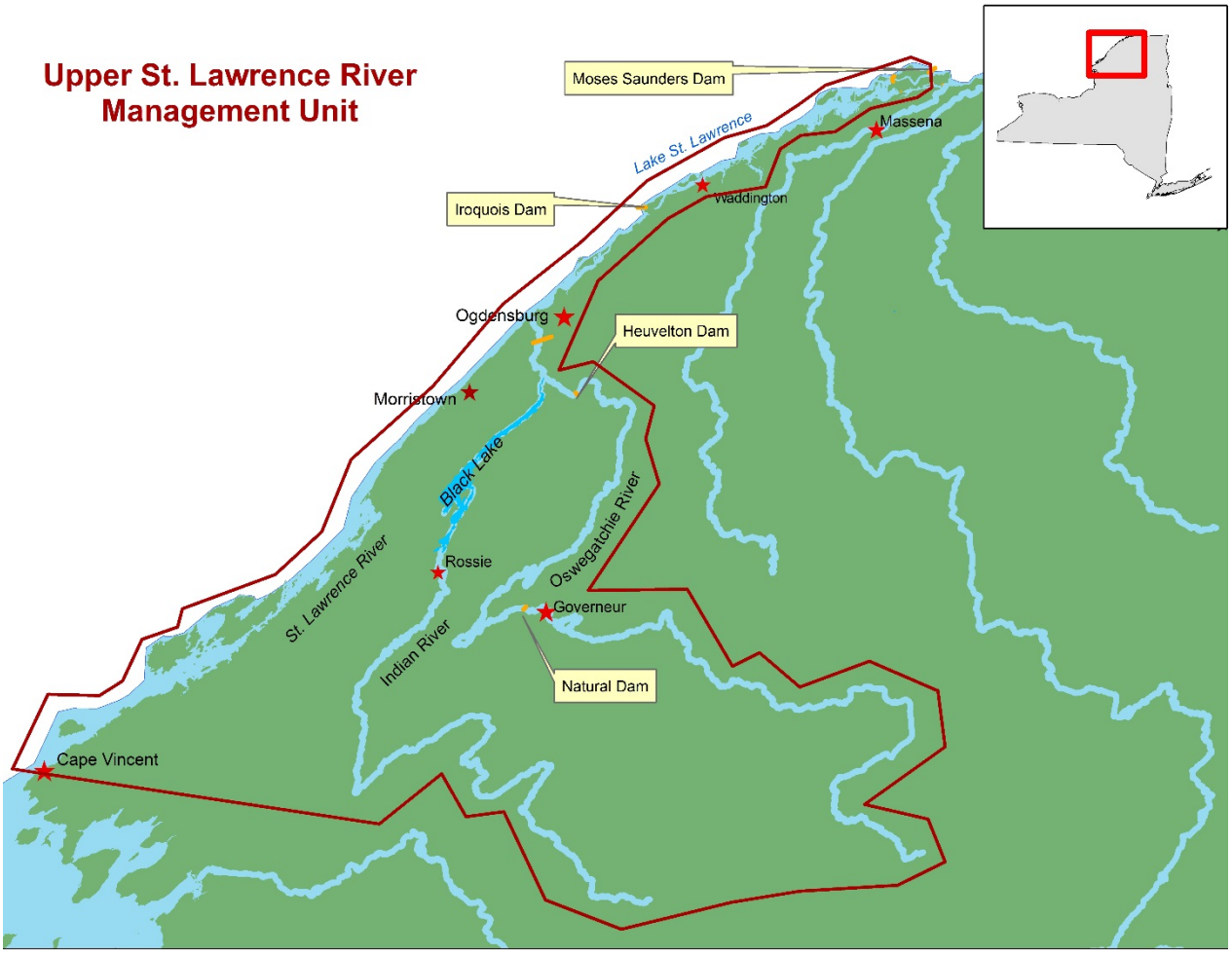

Figure 9. Upper St. Lawrence Management Unit.

Lake sturgeon were known historically throughout the St. Lawrence River and in the Oswegatchie River mouth. Lake sturgeon are currently known to spawn on the created beds up- and downstream of the Iroquois Dam. Lake sturgeon are also consistently caught via netting at the mouth of the Oswegatchie River at Ogdensburg, including ripe males.

While suitable spawning habitat is known to exist in the mouth of the Oswegatchie, no spawning behavior has been observed. Current stocking practices in this Management Unit include the stocking of surplus fish from the NYS Oneida Hatchery and USFWS federal hatchery in Genoa, WI at the mouth of the Oswegatchie River. The Oswegatchie River mouth is also one location designated for early release of lake sturgeon fry that fail to thrive at NYS Oneida Hatchery. The middle Oswegatchie River reach has been stocked since 1993 and received 13 stockings as of 2013 (Figure 3.). In 1992, six adult lake sturgeon were trapped in the St. Lawrence River and transferred to just below the dam at Heuvelton (Douglas Carlson, NYSDEC, personal communication).

The New York Power Authority built two spawning beds in 2007, one upstream and one downstream of the Iroquois Power Dam in the St. Lawrence River. In spring 2008, video monitoring confirmed the presence of spawning sturgeon. Egg mats and larval drift nets further confirmed that spawning was successful. Data from continued monitoring in 2009 revealed a calculated population of 709 (249 to 1,230; 95% confidence interval) adults on the upstream spawning bed on June 8 during the spawning peak (Environnement Illimite, Inc, 2010). Later reporting by DEC on the same beds in 2013 showed “[b]etween 120-400 sturgeon have been observed on the spawning beds on the peak days during each of the five years (2008-2012) monitored to date” (NYSDEC, 2013). Later NYSDEC reports show that numbers of spawning sturgeon continue to vary from year to year (NYSDEC 2014a, 2015b, 2016).

NYSDEC, USFWS, and USGS all have sampled the middle Oswegatchie River from Heuvelton Dam upstream to Natural Dam. In 2016, NYSDEC and USFWS staff captured 16 suspected wild reproduced sturgeon from the Oswegatchie River above Heuvelton. Fin rays were collected from 12 of these juveniles and sectioned for age calculation. The 12 juveniles were assigned to six year classes between 2002 and 2011, indicating successful wild reproduction.

A dam at Ogdensburg, NY separates the Oswegatchie River from the St. Lawrence River, but fish passage has been created at two barriers upstream of Ogdensburg. A nature-like fishway was completed at Eel Weir in 2015. Fish passage is under construction at Heuvelton and will likely be completed in 2018.

This management zone borders the Province of Ontario, where fishing for lake sturgeon is also prohibited.

Recovery Actions

Stocking

- Continue low level stocking to expand year class structure and genetic variation in Oswegatchie River and Black Lake.
    - 1000 lake sturgeon per year in Lower Oswegatchie River until recovery goal is met.
    - 1000 lake sturgeon per year in Black Lake until recovery goal is met.
    - 1000 lake sturgeon per year in Middle Oswegatchie River until recovery goal is met.

Habitat improvement

- Pursue passage at Ogdensburg Dam to restore sturgeon migration from the St. Lawrence River to the lower Oswegatchie River.

Monitoring

- Use video monitoring or other appropriate method to estimate the spawning population of lake sturgeon using the Iroquois Dam spawning beds annually.
- Track annual abundance and recruitment with larval drift nets at the Iroquois Dam.
- Adult populations in the middle Oswegatchie and Black Lake system should be further evaluated to assess stocking survival. Parameters should include age structure and mark-recapture population estimates.
- Use gill netting to assess lake sturgeon in the Oswegatchie River and Black Lake.
- Verification of successful spawning should be completed in the Middle and Lower Oswegatchie River and Indian River.

- Movement studies should be used to evaluate the success of the restored fish passage on the Oswegatchie River.

Research

- Identify spawning locations within the Oswegatchie River System.

Ongoing Implementation

- NYSDEC and partners are annually monitoring spring use of the artificial spawning beds at the Iroquois Dam. This monitoring should continue.
- NYSDEC Region 6 will prepare an annual report of findings.

Management Unit 6: Lower St. Lawrence River

Description and Status

The Lower St. Lawrence Management Unit extends from the Moses-Saunders dam downstream to the New York State/US border and includes the NY portion of the Lake St. Francis reach of the St. Lawrence River.

Significant features within the Management Unit include:

- Moses Saunders Dam – upstream boundary of Lake St. Francis and site of annual egg take for sturgeon propagation
- Lake St. Francis – large impoundment of the St. Lawrence that connects spawning tributaries to open water habitat
- Grasse River – site of a naturally recovering spawning population both above and below the Massena Weir
- Raquette River – historic spawning habitat; stocked population
- St. Regis River – historic spawning habitat; stocked population
- Salmon River – historic spawning habitat; stocked population
- Akwesasne, including Saint Regis Mohawk Tribal Nation Territory and Jurisdiction
- Existing subsistence harvest by Mohawks in Akwesasne Territory

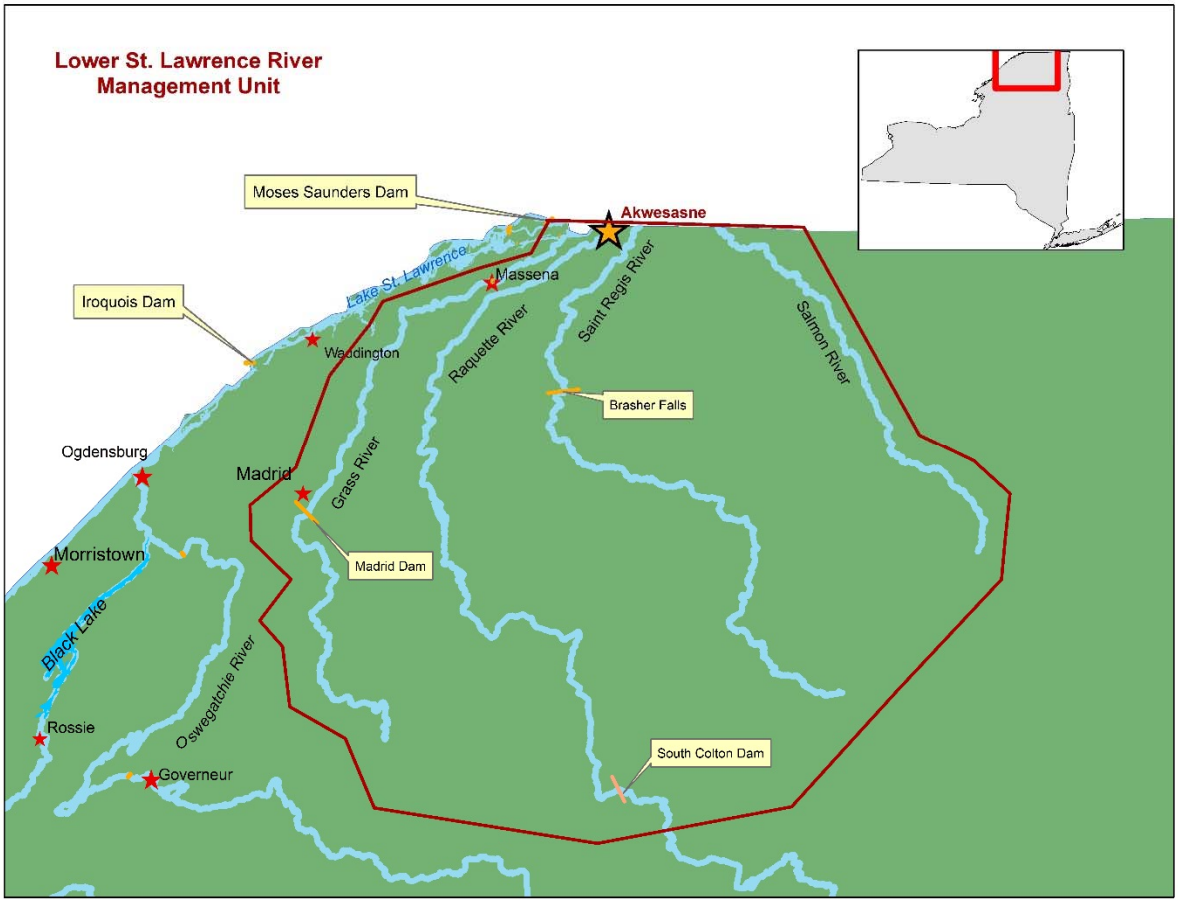

Figure 10. Lower St. Lawrence Management Unit.

This management unit is experiencing natural recovery of its lake sturgeon population immediately downstream of the Moses Saunders Dam and is the source of mature adults captured for egg takes that support the NY stocking program. The Grasse River is also home to a naturally recovering and mostly resident lake sturgeon population in both the upper and lower reaches, separated by the breached weir and rapids in Massena. Jolliff and Eckert (1971) hinted at the nature of the historic population in the Grasse River in their report in a discussion of the efficacy of trap lines used in the Grasse River sturgeon fishery, which said “three fisherman using this gear severely depleted a population of sturgeon within three years.” They further discuss a recreational fishery that was anecdotally reported to consist of taking sturgeon with spears and grapples during the spawning run (Jolliff and Eckert 1971)

While the largest remaining population of lake sturgeon occurs in the St. Lawrence River downstream of the Moses Saunders Dam at Massena, even this population is much reduced due to water quality and habitat degradation and over fishing (LaPan et al 1998). There is documented natural reproduction of lake sturgeon above and below the Moses Saunders Dam, as well as in the Grasse River (Carlson 1999, Trested at al. 2011a and 2011b). The Raquette River has some indication of natural reproduction by direct observation of spawning fish, or capture of fish too young to have been stocked (Dawn Dittman, USGS personal communication). It has received five sturgeon stockings since 2004. The Salmon River in Franklin County has also been stocked with lake sturgeon since 2012.

The population of lake sturgeon downstream of the Moses Saunders Dam has been recovering since the closure of the NY commercial fishery in 1976 and 1178 unique fish have been handled by DEC staff in this area between 1992 and 2016. The length frequency data for the fish captured here during the spring egg takes show a bell curve age structure indicative of a healthy population.

The Grasse River population has been reconnected from the St. Lawrence River to the dam in Madrid by a breach in the weir at Massena. Trested *et al*. (2011a and 2011b) estimated the population at 739 (range of 337-1249 @ 95% CI in MARK) for the Grasse River. The age structure was 0 to 32 years based on 196 individuals sampled and the annual mortality of 7 to 14-year olds was 16.8% (Trested *et al*. 2011a and 2011b). Carlson (1999) documented several years of spawning in the Grasse River in the 1990s and the studies by Normandeau Associates (2009) and Kleinschmidt (2016) indicate that spawning continues here.

The St. Regis River has been reconnected with the St. Lawrence upstream to Brasher Falls by the removal of the Hogansburg Dam in 2016. Sampling by USGS in 2004 and 2005 captured 121 juvenile sturgeon that represented all the stocked year classes of the 4,977 fingerlings stocked from 1998 to 2004 in that river. The Salmon River has been reconnected to the St. Lawrence River by removal of the Fort Covington Dam in 2009.

There is an ongoing tribal fishery within the sovereign territory of Akwesasne as governed by the Saint Regis Mohawk Tribe (SRMT) and Mohawk Council of Akwesasne (MCA). Akwesasne Territory includes portions of the St. Lawrence, Salmon, St. Regis, and Raquette Rivers with Treaty Rights to the lower Grasse River and mile square on both the Grasse and Salmon Rivers (i.e. first river rapids from confluence with St. Lawrence River).

This management zone borders the Province of Quebec, where fishing for lake sturgeon is permitted.

Recovery Actions

Stocking

- Evaluate benefit of low level stocking to expand year class structure and genetic variation in Grasse River, once remediation of PCB contaminated sediments is completed.
- Continue stocking in Raquette River, St. Regis River, Salmon River, and St. Lawrence River.
    - 1000 lake sturgeon per year in Raquette River until the recovery goal is met.
    - 1000 lake sturgeon per year in St. Regis River until the recovery goal is met.
    - 1000 lake sturgeon per year in Salmon River (Franklin County) until the recovery goal is met.

Habitat improvement

- Clean and suitable habitat replacement in lower Grasse River during and after Superfund remedy construction for all lake sturgeon life stages, including but not limited to foraging, larval nursery habitat, juvenile rearing, over wintering, etc.

Monitoring

- Use standard netting protocol to assess lake sturgeon in the Grasse River. Lake sturgeon size and age, population structure, distribution, and use of available spawning habitat should be assessed. Where possible, verification of successful spawning should be completed.
- Use standard netting protocol to assess stocked lake sturgeon survival in the Salmon River.
- Use standard netting protocol to assess lake sturgeon in the St. Regis River. Lake sturgeon size and age, population structure, distribution, and use of available spawning habitat will all be assessed. Where possible, verification of successful spawning should be completed.
- Use standard netting protocol to assess lake sturgeon in the Raquette River. Lake sturgeon size and age, population structure, distribution, and use of available spawning habitat will all be assessed. Where possible, verification of successful spawning should be completed.
- Work with partners to use standard netting protocol to assess lake sturgeon in the Lake St. Francis reach of the St. Lawrence River. Lake sturgeon size and age, population structure, distribution, and use of available spawning habitat will all be assessed. Where possible, verification of successful spawning should be completed.
- Monitor toxic substances where possible by collecting lake sturgeon tissue samples for analysis. Coordinate with the state Department of Health and USEPA regarding the results of these analyses, especially within the St. Lawrence Area of Concern.

Research

- Work with partners to conduct movement studies to better understand how the Lower St. Lawrence Management Unit functions as a metapopulation.
- Identify active spawning locations within the Management Unit.
- Investigate use of spawning tributaries by both stocked fish and wild fish over time to see if stocking juvenile lake sturgeon into spawning tributaries attracts nearby adult lake sturgeon to appropriate spawning habitat.
- Support cultural use of the sturgeon resource in Akwesasne territory by providing technical support and data to assist SRMT determination of sustainable harvest levels and safe consumption levels.

Implementation

- USGS has researched the tributaries to the St. Lawrence River, but more effort is needed to document population levels in the St. Regis, Raquette and Salmon rivers.
- The Saint Regis Mohawk Tribe is investigating suitable spawning habitat in the Grasse, Raquette, St. Regis, and St. Lawrence Rivers and monitoring contaminant levels in lake sturgeon consumed by Mohawks of Akwesasne. This work should continue. Results of this work should be used to evaluate future habitat enhancement project or improvements needs.
- NYSDEC Region 6 and USFWS are working together to collect eggs from fish caught near Massena in the St. Lawrence River, to raise in NYSDEC and USFWS hatcheries, and stock them back into waters of New York state.
- NYSDEC Region 6 will prepare an annual report of findings.

Management Unit 7: Lake Champlain*

Description and Status

New York, Vermont and the Province of Quebec all border Lake Champlain. The management unit includes New York's waters of Lake Champlain and direct tributaries.

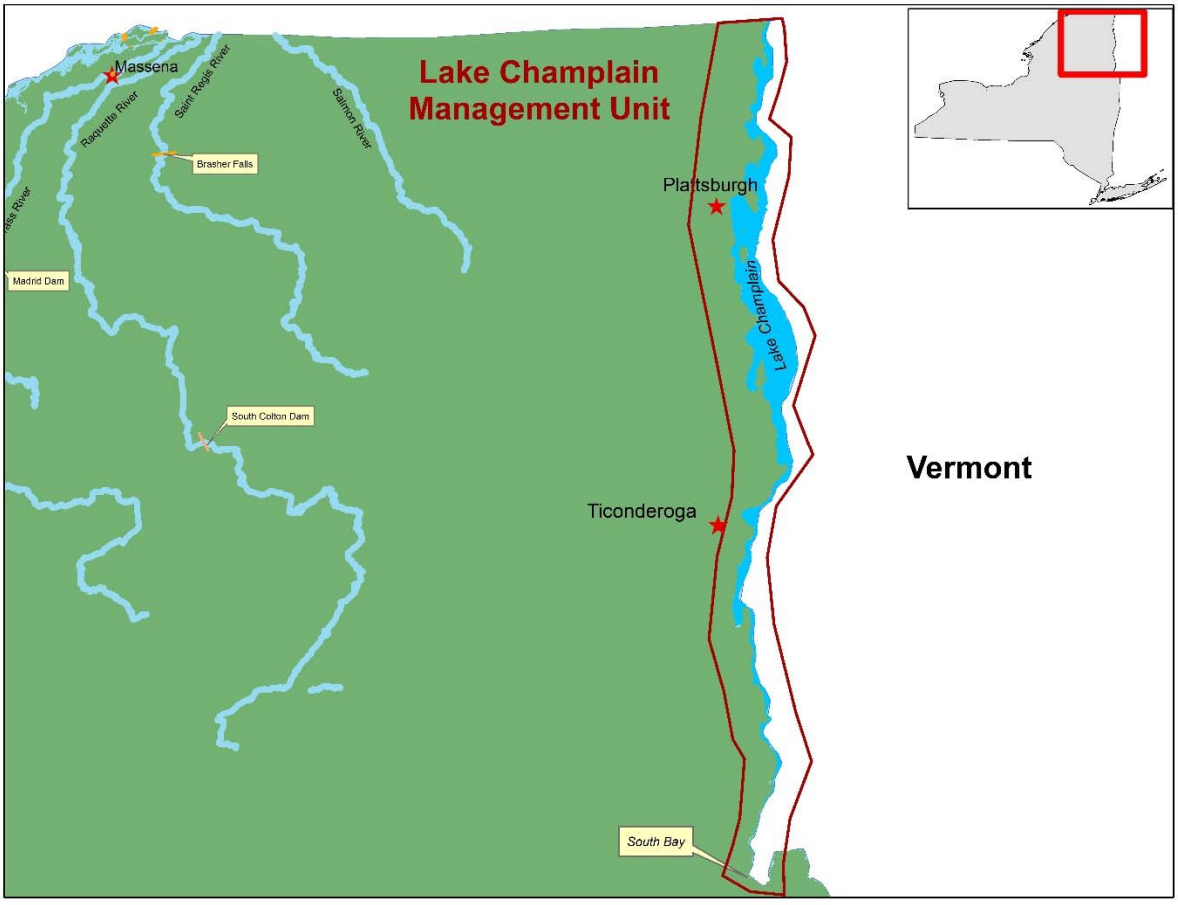

Figure 11. Lake Champlain Management Unit.

Lake sturgeon were commercially fished in Lake Champlain on a small scale from the 1800s to the closure of the fishery by Vermont and NY in 1967 and 1976 respectively. Historic records only document lake sturgeon spawning in tributaries on the Vermont side of Lake Champlain. The Vermont Fish and Wildlife Department has released a recovery plan for lake sturgeon that calls for natural recovery and no stocking at this time. New York does not have an active role in recovering lake sturgeon in Lake Champlain at this time, but will support the ongoing recovery monitoring by Vermont Fish and Wildlife Department.

Documentation of natural recovery in Lake Champlain is based on the State of Vermont's Lake Champlain Lake Sturgeon Recovery Plan dated February 2016 and based on the following metrics:

- Index netting yields a total population estimate of at least 200 spawning adults in each of the Mississquoi, Lamoille, and Winooski rivers.
- The lake-wide population estimate of lake sturgeon is 1000 individuals or greater.

Significant features within the Management Unit include:

- Missisquoi River (VT)
- Lamoille River (VT)
- Winooski River (VT)
- Otter Creek (VT)

This management zone borders the Province of Quebec, where fishing for lake sturgeon is permitted.

*No known historic spawning areas in New York

Recovery Actions

Stocking

- No stocking is recommended at this time.

Habitat improvement

- None identified at this time.

Monitoring

- VT DFW monitors tributaries for spawning activity and fish passage attempts.

Research

- None identified at this time.

Implementation

- NYSDEC Region 5 is coordinating with Vermont Fish and Wildlife staff to track recovery of lake sturgeon in Lake Champlain. New York will continue to implement regulatory protection for lake sturgeon in coordination with the state of Vermont.

Next Steps

Upon adoption of this plan, NYS DEC will continue to work with its partners via the New York State Lake Sturgeon Working Group. Partner organizations currently include:

- US Fish and Wildlife Service (multiple offices)
- US Geological Survey
- Saint Regis Mohawk Tribe
- Tuscarora Nation
- Cornell University
- SUNY Environmental Science & Forestry
- NY Sea Grant
- Aquarium of Niagara

The working group will meet annually to evaluate recovery metrics, available data, and recommend adjustments to ongoing management actions accordingly. The working group will recommend annual tasks to be undertaken by involved partners, or seek new partners to accomplish the recovery and management goals for lake sturgeon. Specific tasks to be accomplished include:

- Review existing data on lake sturgeon populations within each Management Unit.
    - Examine existing data on population abundance for conformance with the recovery metrics and assign confidence to the results.
    - Refine and expand known information on each Management Unit's physiographic characteristics, including critical habitat areas for spawning, migration, and feeding.
    - Develop or refine sampling methods and data calculations for population estimates.
    - Refine needed habitat management recommendations.
    - Refine research questions and develop scopes of work suitable to support funding requests.
- Develop a Lake Sturgeon Species Status Assessment Document by January 2019.
    - Update the Lake Sturgeon Species Status Assessment Document annually.
- Develop a public outreach and education strategy. Message development should include the following targets:
    - reducing incidental mortalities and poaching
    - informing the public of progress in the species' recovery
    - basic life history information for lake sturgeon in New York

Once recovery metrics are achieved in six of the seven Management Units, NYSDEC will initiate the regulatory process to remove lake sturgeon from the list of Threatened Species under 6 NYCRR Part 182. The recovery determination is based, in part, on the likelihood of the species remaining healthy and stable in New York without the specific protections conveyed by 6NYCRR Part 182. Future management actions, including potential establishment of a fishery, can only be initiated once the species is removed from the list of Threatened Species.

Literature Cited

Auer, N. A. 1999. Population characteristics and movements of lake sturgeon in the Sturgeon River and Lake Superior. Journal of Great Lakes Research, 25: 282–293.

Biesinger, Z., D. Gorsky, G. R. Jacobs, J. A. Sweka, M. A. H. Webb, and M. Talbott. 2014. Population Assessment of Lake Sturgeon in the Lower Niagara River *in* 2013 Annual Report of the Bureau of Fisheries Lake Ontario Unit and St. Lawrence River Unit to the Great Lake Fishery Commission's Lake Ontario Committee. NYSDEC. Albany, NY.

Billard, R. and G. Lecointre. 2001. Biology and conservation of sturgeon and paddlefish. Reviews in Fish Biology and Fisheries, 10: 355–392.

Bouton, D. 1994. A recovery plan for the lake sturgeon in New York. New York State Department of Environmental Conservation, Albany, NY.

Bruch, R. M. 1999. Management of lake sturgeon on the Winnebago System – long term impacts of harvest and regulations on population structure. Journal of Applied Ichthyology, 15:142–152.

Bruch, R.M. and F.P. Binkowski. 2002. Spawning behaviour of lake sturgeon (Acipenser fulvescens). Journal of Applied Ichthyology 18:570-579.

Carlson, D.M. 1994. Historic Lake Sturgeon Waters and Fisheries in New York. New York State Department of Environmental Conservation. Watertown, New York. 13pp.

Carlson, D.M. 1995. Lake sturgeon waters and fisheries in New York State. Journal of Great Lakes Research 21: 35-41.

Carlson, D.M. 1996. Black River Fisheries Survey, 1992-93. New York State Department of Environmental Conservation. Watertown, New York. 77pp.

Carlson, D.M. 1999. Fish Survey of the Grasse River. Data Summary. New York State Department of Environmental Conservation. Watertown, New York. 14 pp.

Carlson, D.M. 2000. A recovery plan for the lake sturgeon (*Acipenser fulvescens*) in New York. New York State Department of Environmental Conservation. Albany, New York. 12pp.

Carlson, D.M. 2005. The next ten years of planning for the management of lake sturgeon in New York. New York State Department of Environmental Conservation, Albany, New York.

Carlson, D.M., R. Colesante, J.S. Hayes, and S.L. Schlueter. 2002. Lake Sturgeon (Acipenser fulvescens) and its recovery programs in New York State. New York State Department of Environmental Conservation, Albany, New York. 15pp.

Chalupnicki, M.A., D.E. Dittman, and D.M. Carlson. 2011. Distribution of Lake Sturgeon in New York: 11 years of restoration management. American Midland Naturalist. 165:364-371.

Dittman, D. 2017. "Lake Sturgeon Restoration Progress in the Genesee and Seneca-Oswego Rivers, NY." Presentation at the New York Chapter of the American Fisheries Society annual meeting. Abstract available

http://newyork.fisheries.org/wp-content/uploads/2017/01/2017-NYCAFS-Mtg-Abstracts.pdf. Video available https://www.youtube.com/watch?v=m2IQBWRwrk8&t=351s.

Environnement Illimité inc. 2010. Investigation of Lake Sturgeon Spawning Activities at Iroquois Dam on the St. Lawrence River in 2009. Final Report prepared for New York Power Authority. White Plains, New York. 39 pp.

Harkness, W.J.K., and J.R. Dymond. 1961. The Lake Sturgeon: The history of its fishery and problems of conservation. Ontario Department of Lands, Forests. Fish and Wildlife Branch. 121 pp.

Hay-Chmielewski, E. and G. Whelan. 1997. Lake sturgeon rehabilitation strategy. Fisheries Division, Michigan Department of Natural Resources, Special Report Number 18, Ann Arbor, MI, pp. 51.

Hughes, T.C., C.E. Lowie, and J.M. Haynes. 2005. Age, growth, relative abundance and SCUBA capture of a new or recovering spawning population of lake sturgeon in the lower Niagara River, New York. North American Journal of Fisheries Management 25:1263-1272.

Jackson, J.R., A.J. VanDeValk, T.E. Brooking, O.A. van Veeken, and L.G. Rudstam. 2002. Growth and feeding dynamics of lake sturgeon, *Acipenser fulvescens*, in Oneida Lake, New York: results from the first five years of a restoration program. Journal of Applied Ichthyology 18:439-443.

Jackson, J. R., L.G. Rudstam, S.D. Krueger, T.E. Brooking, J.L. Forney, K.T. Holeck, C. Hotaling, R.L. DeBruyne, and W.W. Fetzer. 2010. Fisheries and Limnology of Oneida Lake 2000-2009. NYS DEC, Albany, NY. 46 pp.

Jackson, J.R., A.J. VanDeValk, T.E. Brooking, K.T. Holeck, C. Hotaling, and L.G. Rudstam. 2016. The fisheries and limnology of Oneida Lake 2016. NYS DEC, Albany, NY. 91 pp.

Jolliff, T. M. and T. H. Eckert. 1971. Evaluation of Present and Potential Sturgeon Fisheries of the St.Lawrence River and Adjacent Waters. Report. New York Department of Environmental Conservation, Cape Vincent Fisheries Station, Cape Vincent, New York.

Kempinger, J. J. 1988. Spawning and early life history of lake sturgeon in the Lake Winnebago system, Wisconsin. In Am. Fish. Soc. Symp. 5(1):12-122.

Kleinschmidt. 2015. A Mesohabitat Assessment of Lake Sturgeon Usage of The Lower Grasse River, New York. Report to Alcoa Inc. Pittsfield, ME. 71 pp.

Klindt, R. K. 2014. Lake Sturgeon PIT Tagging 2014. Report to the Fisheries Advisory Committee of the Fish Enhancement, Mitigation and Research Fund. NYSDEC Region 6, Watertown NY 13601. 19 pp.

Klindt, R.K. and R. Adams. 2006. Lake Sturgeon spawning activity in the lower Black River. Section 21 *in* 2005 NYSDEC Annual Report, Bureau of Fisheries Lake Ontario Unit and St. Lawrence River Unit to the Great Lakes Fishery Commission's Lake Ontario Committee.

LaHaye, M., A. Branchaud, M. Gendron, R. Verdon, and R. Fortin. 1992. Reproduction, early life history, and characteristics of spawning grounds of the lake sturgeon (*Acipenser fulvescens*) in Des Prairies and L'Assomption rivers, near Montreal, Quebec. Canadian Journal of Zoology 70:1681-1689.

LaPan, S.R., A. Schiavone, R.M. Klindt, and R.T. Colesante. 1998. 1997 Lake Sturgeon Restoration Activities, in NYSDEC Lake Ontario Annual Report 1997 (St. Lawrence River Unit). NYSDEC, Albany, NY.

Legard, C. 2015. Lake Sturgeon Monitoring in Buffalo Harbor. Section M in NYSDEC 2015, Lake Erie 2014 Annual Report. New York State Department of Environmental Conservation, Albany, New York. 3 pp.

Moyle, P.B. and J. C. Cech, Jr. 1988. Fishes: an introduction to ichthyology, 2nd Edition. Prentice-Hall.

NatureServe.org. 2010. Lake Sturgeon Distribution and Status map. Downloaded 2013.

Neuenhoff, R., L. Davis, J. Withers, and J. Sweka. 2017. Lake sturgeon catch and abundance proximate to Buffalo Harbor, NY USA. Section O in NYSDEC 2017, Lake Erie 2016 Annual Report. New York State Department of Environmental Conservation, Albany, New York. 86 pp.

Normandeau Associates, Inc. 2009. Lake Sturgeon (Acipenser Ful Vescens) Abundance, Seasonal Movements, and Spawning Behavior in The Grasse River, St. Lawrence County, New York; Updated Study Report. Report to Town of Massena Electric Department. Bedford, NH. 47 pp.

NYSDEC. 2010. Annual Progress Report for State Wildlife Grant T-14 Project 4: Management and Restoration of Species of Greatest Conservation Need and their Critical Habitats in New York State. New York State Department of Environmental Conservation, Albany, New York. 19pp.

NYSDEC. 2013. Lake Sturgeon Spawning Beds Habitat Improvement Project: 2012 Monitoring Activities at the Iroquois Dam and Results. Report to the New York Power Authority and the Technical Advisory Council for St. Lawrence–FDR Power Project: FERC NO. 2000. New York State Department of Environmental Conservation, Chase Mills, New York. 25pp.

NYSDEC. 2014a. Lake Sturgeon Spawning Beds Habitat Improvement Project: 2013 Monitoring of Spawning Beds at Iroquois Dam and Moses-Saunders Power Dam. Report to the New York Power Authority and the Technical Advisory Council for St. Lawrence–FDR Power Project: FERC NO. 2000. 32 pp.

NYSDEC. 2014b. Fish Atlas Maps of New York, Lake Sturgeon. http://www.dec.ny.gov/animals/85721.html. Downloaded 2017.

NYSDEC. 2015a. New York State Wildlife Action Plan. NYSDEC, Albany, NY. 102pp.

NYSDEC. 2015b. Lake Sturgeon Spawning Beds Habitat Improvement Project: 2014 Monitoring Activities at the Iroquois Dam and Results. Report to the New York Power Authority and the Technical Advisory Council for St. Lawrence–FDR Power Project: FERC NO. 2000. New York State Department of Environmental Conservation, Chase Mills, New York. 36pp.

NYSDEC. 2016. Lake Sturgeon Spawning Beds Habitat Improvement Project: 2015 Monitoring of Spawning Beds at Iroquois Dam and Moses-Saunders Power Dam. New York State Department of Environmental Conservation, Chase Mills, New York. 28pp.

PGC-PFBC (Pennsylvania Game Commission and Pennsylvania Fish & Boat Commission). 2015. Pennsylvania Wildlife Action Plan, 2015-2025. C. Haffner and D. Day, editors. Pennsylvania Game Commission and Pennsylvania Fish & Boat Commission, Harrisburg, Pennsylvania.

Peterson, D.L., P. Vecsei, and C.A. Jennings. 2007. Ecology and biology of the lake sturgeon: a synthesis of current knowledge of a threatened North American *Acipenseridae*. Reviews in Fish Biology and Fisheries. 17:59-76.

Ryan, P., Knight, R., MacGregor, R., Towns, G., Hoopes, R., and Culligan, W. 2003. Fish-Community Goals and Objectives of Lake Erie. Great Lakes Fishery Commission Special Publication. 03-02. 56 pp.

Schnabel, Z.E. 1938. The estimation of the total fish population in a lake. American Mathematical Monographs 45:348-352.

Schueller, A.M. and D.B. Hayes. 2011. Minimum population size for lake sturgeon (*Acipenser fulvescens*) using an individual-based model of demographics and genetics. Canadian Journal of Fisheries and Aquatic Science. 68:62-73.

Scott, W.B. and E. J. Crossman. 1973. Freshwater Fishes of Canada. Bulletin 184. Fisheries Research Board of Canada, Ottawa.

Smith, H.M. and M.M. Snell. 1890. Review of the Fisheries of the Great Lakes in 1885. US Government Printing Office, Washington. 333pp.

Stewart, T.J. Todd, A., and LaPan, S. 2017. Fish community objectives for Lake Ontario [online]. Available from: www.glfc.org/pubs/FisheryMgmtDocs/Fmd17-01.pdf [accessed 10 Aug 2017].

St. Pierre, R. and A. Runstrom. 2004. *Acipenser fulvescens*. The IUCN Red List of Threatened Species 2004: e.T223A13036599. Available from: http://dx.doi.org/10.2305/IUCN.UK.2004.RLTS.T223A13036599.en [accessed 24 August 2017]

Trested, D.G., M.D. Chan, W.C. Bridges, and J.J Isely. 2011a. Seasonal movement and mesohabitat usage of adult and juvenile Lake Sturgeon in the Grasse River, New York. Transactions of the American Fisheries Society. 140:4 pp. 1006-1014.

Trested, D.G., and J.J. Isely. 2011b. Age, growth, mortality, and abundance of lake sturgeon in the Grasse River, New York, U.S.A. Journal of Applied Ichthyology. 27:13–19.

U.S. Fish and Wildlife Service. 2014a. Great Lakes Lake Sturgeon Collaboration. http://www.fws.gov/midwest/sturgeon/index.htm [accessed 01 June 2017]

U.S. Fish and Wildlife Service. 2014b. Lake Sturgeon Biology and Population History in The Great Lakes. https://www.fws.gov/midwest/sturgeon/biology.htm [accessed 01 June 2017]

Welsh, A.B., R.F. Elliott, K.T. Scribner, H.R. Quinlan, E.A. Baker, B.T. Eggold, J.M. Holtgren, C.C. Kreuger, and B. May. 2010. Genetic guidelines for the stocking of lake sturgeon (*Acipenser fulvescens*) in the Great Lakes basin. Great Lakes Fishery Commission Miscellaneous Publication 2010-01. 54 pp.

Withers, J.L., R.D. Neuenhoff, L.A. Davis, and J. Sweka. 2017. Assessing Lake Sturgeon Movement in Eastern Lake Erie. Presentation given at New York Chapter of the American Fisheries Society Annual Meeting. Cooperstown, New York. February 2, 2017.

Appendix 1: Public Comments on the Plan and Responses

The draft Lake Sturgeon Recovery Plan was released for public comment on October 11, 2017 and notification provided through a press release on October and publication in the Environmental Notice Bulletin on October 11, 2017. Comments were accepted in writing via email and US mail through November 25, 2017. Comments on the plan were received from 28 persons or organizations. Comments by organizations are attributed. Comments by individuals are not, since in most cases a person's name was not provided with their emailed comments.

The comments are characterized below with responses as appropriate.

Comment: Fourteen commenters were generally in favor of the plan with no substantive comments.
Response: No response necessary

Comment: Seven commenters felt money spent on lake sturgeon should be spent elsewhere, either on people in need, or other fish species.
Response: The dollars spent on lake sturgeon recovery come from funding sources governed by rules that prevent their use for non-fish and wildlife purposes. Further, some of the funding is explicitly to be used to recover species in greatest need of conservation which would make species like trout, salmon and walleye (as suggested by the commenter) ineligible to receive the funds.

Comment: Fish raised in hatcheries will not survive to adulthood and reproduce, so the program will fail.
Response: The lake sturgeon raised in hatcheries have already survived to adulthood and reproduced in several locations.

Comment: Effort on lake sturgeon should be redirected to "save" the St. Lawrence River from invasive round goby.
Response: Lake sturgeon have been found to eat round goby, so their restoration will, in fact, help reduce the impact of round gobies wherever the two species occur together.

Comment: NY Sturgeon for Tomorrow were generally in favor but expressed concern about down listing sturgeon too soon, support for continuation or expansion of stocking, and support for establishing a fishery for lake sturgeon.
Response: The recovery goals established in the plan are intended to be protective of lake sturgeon. If populations are demonstrated to reach levels identified by the recovery goals, we expect they will continue to increase in abundance as long as protective measures regarding their harvest and habitat remain in place. Stocking will be used as a recovery tool only as long as it meaningfully contributes to the recovery of the species. Stocking may be further evaluated as a tool to support a fishery if a fishery is established. However, the long lifespan and late maturity of lake sturgeon make stocking a less effective means of direct fishery support than it is for other species such as trout and walleye. Establishment of a lake sturgeon fishery will have to be carefully evaluated and managed to prevent relapses in population levels. Even in long-established and heavily managed fisheries like the one at Lake Winnebago, WI, managers discovered that the population structure of lake sturgeon has been adversely impacted by the fishery (Bruch 1999).

Comment: Buffalo Niagara Waterkeeper commented in support of the plan but recommended that clearly stated methods for egg and milt takes be included in the final draft.
Response: The recovery document does not go into methods for specific recovery activities or methods for obtaining metrics. NYSDEC felt it would not be appropriate to go into that level of detail for the egg takes. Additionally, NYSDEC and the USFWS are the only entities involved in egg takes in New York. No plans exist to expand egg takes to other partners at this time, so the utility of sharing this information is limited. NYSDEC staff reached out to Buffalo Niagara Waterkeeper to discuss this comment and reached consensus to leave the egg take methods out of this document.

Comment: Buffalo Niagara Waterkeeper recommended a research priority to investigate sublethal effects of lampricide on young-of-the-year sturgeon.
Response: This comment was addressed in the final document.

Comment: Buffalo Niagara Waterkeeper recommended that the State share identified habitat needs and research results as they become apparent.
Response: This comment was addressed in the final document.

Comment: The Finger Lakes Conservation Council commented in support of the plan, specifically the following: support for the monitoring of the native Niagara River population of sturgeon that was done in cooperation with the US Fish and Wildlife Service; support for stocking and monitoring in the Genesee River with emphasis on the survival of juvenile fish and seasonal use of the river by sturgeon; and research to find spawning sites in Lake Ontario so they can be protected.
Response: All of these comments are addressed in the final document.

Comment: One commenter expressed support of the plan and provided additional technical information regarding spawning in Lake Erie, the genetics of the sturgeon captured in New York's waters of Lake Erie and information gaps related to larval, juvenile and sub-adult life stages in Lake Erie.
Response: All of these comments have been addressed in the final version of the plan.

Comment: Two commenters asked for clarification of the three out of five year criteria.
Response: Given the difficulty in many areas of the state to detect juvenile sturgeon at all, we feel that detection of even one individual from a year class is significant. At our currently level of understanding, effort to detect additional young of year to age seven lake sturgeon would be extremely high to gain minimal additional information on juvenile abundance. We are also able to age adult and sub-adult lake sturgeon in spawning aggregations to infer recruitment to the spawning population. This is arguably a more conservative measure of true recruitment to the spawning population. The language in the plan was clarified to better explain this concept.

Comment: In the state's effort to monitor legacy contaminants in lake sturgeon tissue, will lake sturgeon be selectively harvested for the study, or will a non-lethal tissue removal method be used?
Response: We will seek to coordinate tissue and blood collection from animals harvested in Akwesasne by St. Regis Mohawk Tribe members, with blood or tissue plug samples taken in other areas of known contamination. We do not intend to sacrificially sample additional sturgeon for this purpose. Indeed, since fish harvested in Akwesasne are destined for human consumption, measurement of contaminants there is a priority.

Comment: Is tagging going to be part of the protocol when wild recruits are caught to easier identify in the future?
Response: Yes, NYSDEC and partners routinely apply PIT tags and dangler tags to most sturgeon they handle. Additionally, all lake sturgeon reared in the Oneida and Genoa hatcheries to be stocked in New York receive a coded wire tag prior to stocking.

Comment: One commenter requested confirmation of the recovery status in each management unit to be included in the recovery plan and stated a preference not to wait on a separate status assessment document.
Response: This document was purposely limited to defining recovery targets and metrics so that consensus could be reached on our goals. Measuring success toward those goals will require the use of data provided by partners, and evaluation of confidence in that data, not all of which is published. Defining an endpoint for the recovery program need not be delayed while data is compiled, peer reviewed and interpreted.

Comment: One commenter requested that we demonstrate that lake sturgeon are still a threatened species.
Response: The species appears in 6 NYCRR Part 182.5(b) Threatened species.

Comment: One commenter asked why we shouldn't declare lake sturgeon no longer threatened after demonstrating success in five recovery units.
Response: The recovery team determined six of seven units to be resilient in the face of known environmental stressors, such as disease outbreaks, flow variations and temperature anomalies that may inhibit successful spawning and recruitment, and incidental mortality from human activities. Some of the recovery units do not show sustained, detectable recruitment, and others have not yet achieved the number of spawning adults thought to demonstrate a stable or growing population. Because of these factors, NYSDEC is taking a conservative approach to ensure lake sturgeon remains off the threatened species list.