Literature Review on Lake Sturgeon Life History and Suggested Rehabilitation Strategies in the Great Lakes Basin

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The Lake Sturgeon population in both Mullet and Burt Lake have been reported to be a mere shadow of their earlier population sizes since the early 1900s, whereas the Black Lake sturgeon have been reported to have a higher rate of reproduction. To understand the issues surrounding the Lake Sturgeon populations, the following article is a compilation of several different research articles and reports. The main questions voiced have been:

What may be causing the low reproductive rates of the Burt and Mullet Lake sturgeon populations?

- Lack of natural spawning habitat
- Spawning site fidelity (natal homing) movement or inability to move freely
- Presence of dams preventing site fidelity movement or causing varying water levels that may not be conducive to spawning.
- Are Burt and Mullet Lake sturgeon a remnant population or has the genetics of the population been altered due to fishery implants?

Studies were done all the way back to the mid-1950s, showing that Mullett and Burt Lake had few young sturgeon and much lower numbers of adult sturgeon compared to the original population size. Black Lake was found to have much higher numbers, and had an availability of age groups from young, through adult sturgeon. The study stated that sturgeon prefer spawning in approximately 10 feet of water over stony or gravelly lake bottom near rapids or waterfalls, however, sturgeon may also spawn occasionally in shallow water along lake shores. In the study, residents along the eastern shore of Burt Lake reported the rolling and jumping of sturgeon along that shore in the spring, which would indicate that this area might be the spawning ground of the Burt Lake population. However, since the lake shore sites are probably not a preferred type of spawning area, this may be a factor causing the apparent wide difference in numbers of sturgeon in Black Lake as compared to Burt and Mullett lakes (Vondett and Williams, 1957-58).
In a Great Lakes Fish Communication publication in 2010, researchers also found that sturgeon populations throughout the Great Lakes basin are remnants of their historical numbers. They go on to suggest that the reduced numbers are due to overfishing, habitat deterioration (including the construction and operation of dams), and that poor water quality contributed to lake sturgeon extirpation in many Great Lakes locations and drastically reduced the size of the remaining populations (Smith 1972). Lake sturgeon may also have suffered some level of mortality from sea lamprey (*Petromyzon marinus*) predation (Patrick 2007). Although conditions for lake sturgeon have improved in many ways, recovery has been slow or absent, and few efforts have

been directed specifically towards sturgeon recovery. Lake sturgeon do not reach sexual maturity until 14-33 years of age (Harkness and Dymond 1961), and evidence exists for spawning-site fidelity (Auer 1999; DeHaan et al. 2006). Therefore, because lake sturgeon take a long time to mature, recovery in population size and natural recolonization of vacant spawning sites by lake sturgeon often may not meet the recovery time frame desired by the public, fisheries stakeholders, and management agencies.

Fish-management agencies use stocking (placement of artificially propagated fish or naturally developing eggs or the translocation of post-larval fish into water bodies) to accomplish a variety of purposes. Stocked fish or fertilized eggs can be used to supplement and rehabilitate existing marginal populations, develop new populations, or reintroduce fish to a location where they have been extirpated. Stocking can potentially speed the recovery of lake sturgeon populations by reducing the dependency on the slow process of natural recolonization. Hatchery-reared fish also have been used by state natural-resource agencies to supplement naturally reproducing lake sturgeon populations in Black Lake. Rearing facilities also have been employed to improve survival by bringing larval fish collected from the wild into a culture facility for several months before releasing them back into the wild. The Michigan Department of Natural Resources and Environment and Michigan State University have employed this technique on the Black River using a streamside facility and a traditional off-site hatchery (Crossman 2008). Although stocking and artificial rearing can be an important part of sturgeon management, it was suggested that caution must always be exercised to avoid potential negative genetic consequences on both reintroduced and persisting lake sturgeon populations.

The 2012 Michigan's Lake Sturgeon Rehabilitation Strategy Report states that the primary goals for lake sturgeon management are to:
(1) develop self-sustaining populations across Michigan's jurisdictional waters of the Great Lakes and its tributaries to a level which would allow lake sturgeon to be removed from the list of state threatened species, and (2) maintain some populations of sufficient size to provide fisheries that support the recreational and cultural desires of state and tribal fishers.
Although lake sturgeon are listed as threatened statewide, the status of each individual population varies widely. As a result of this, the strategy report states the overall goal of developing self-sustaining populations can be broken down into three subgoals, which are to:
(1) conserve and maintain populations that are currently self-sustaining, (2) rehabilitate depressed populations so they become self-sustaining at a higher abundance, and (3) reintroduce lake sturgeon to suitable, vacant habitat.
The strategy report continues to state that whenever possible, rehabilitation strategies to increase sturgeon populations and move them towards self-sufficiency should be implemented. Candidate waters for reintroduction include those where appropriate habitat exists for self-sustaining or artificially-supported populations. Rationales for reintroductions include but are not limited to, native species rehabilitation, gene banking, fishery creation, and establishment of populations for

social and cultural reasons. The goals and subgoals presented above provide a long-term vision for guiding lake sturgeon management. However, given the species' life history attributes, realizing these goals will take decades (Hayes and Caroffino, 2012).

The status and trajectory of all known lake sturgeon populations in Michigan were compiled for a starting reference (Table 1)(Hayes and Caroffino, 2012).

Table 1.–Size and category for known lake sturgeon populations in Michigan. MVP = Minimum Viable Population, MDNR = Michigan Department of Natural Resources, LRBOI = Little River Band of Ottawa Indians, LSSU = Lake Superior State University, USFWS = U.S. Fish and Wildlife Service.

Watershed Population	Estimated adult population size	Category	Source, Affiliation
Lake Superior			
Ontonagon River [a, b]	<25	Below MVP	Ed Baker, MDNR
Sturgeon River [c]	1,808	Large stable	Ed Baker, MDNR
Lake Michigan			
Cedar River [a, b]	<25	Below MVP	Ed Baker, MDNR
Grand River [c]	103	Small declining	Kregg Smith, MDNR
Indian Lake [a]	60	Below MVP	Dave Caroffino, MDNR
Kalamazoo River [c]	88	Small declining	Kregg Smith, MDNR
Manistee River [a, c]	400	Medium stable	Marty Holtgren, LRBOI
Manistique River [a]	<25	Below MVP	Steve Scott, MDNR
Big Manistique Lake [a]	<25	Below MVP	Steve Scott, MDNR
Menominee River [c, d]	5,272	Large stable	Ed Baker, MDNR
Millecoquins Lake [a]	<25	Below MVP	Steve Scott, MDNR
Muskegon River [c]	166	Small increasing	Kregg Smith, MDNR
St. Joseph River [a]	<25	Below MVP	Kregg Smith, MDNR
Lake Huron			
Au Sable River [a]	<25	Below MVP	Steve Sendek, MDNR
Black Lake [c]	1,125	Large stable	Ed Baker, MDNR
Burt Lake [b]	100	Small stable	Ed Baker, MDNR
Carp River [a]	<25	Below MVP	Roger Greil, LSSU
Mullett Lake [b]	<25	Below MVP	Ed Baker, MDNR
Otsego Lake [a, e]	500	Medium stable	Tim Cwalinski, MDNR
Rifle River [a]	<25	Below MVP	Jim Baker, MDNR
St. Marys River [c]	354	Medium stable	Bauman et al. 2011
Saginaw River [a]	<25	Below MVP	Jim Baker, MDNR
Lake Erie			
St. Clair River/Lake St. Clair [c]	15,882	Large stable	Mike Thomas, MDNR
Detroit River [c]	4,838	Large stable	Justin Chiotti/Jim Boase, USFWS

[a] Estimate is based on public reports, observation, bycatch, and professional judgment. For consistency, all areas where estimates were well below MVP, abundance was considered to be <25 adults.
[b] Populations that were either extinct or below MVP but are anticipated to increase as a result of recent stocking.
[c] Estimate is based on mark-recapture analysis.
[d] Menominee River estimate includes all river segments, which are currently fragmented by dams.
[e] Otsego Lake's population is nonnative and was created through stocking experiments, which provide fishing opportunities regardless of population size.

Major obstacles to achieving a self-sustaining sturgeon population include excess mortality rates caused by fishing or other sources, reduced spawning habitat as a result of physical barriers, and general degradation of habitat required by each life stage (Rochard et al. 1990). The following discusses the effects of these and other threats to the sturgeon populations.

Lake sturgeon populations are highly sensitive to changes in rates of adult mortality (Velez-Espino and Koops 2009; Schueller and Hayes 2010).

Fishery regulation - The MDNR works cooperatively with tribes signatory to the 1836 Treaty of Washington Consent Decree regarding lake sturgeon harvest opportunities; however, the state does not regulate tribal fishing of lake sturgeon, and individual tribes throughout the 1836 and 1842 Treaty-ceded waters set regulations for their members.

Catch and release fisheries allow anglers to target a specific species of fish, then upon landing the fish it must be immediately released back into the water unharmed. Direct estimates of hooking and handling mortality are unavailable for lake sturgeon. Even though sturgeon are a hardy fish, evidence for white sturgeon suggests that hooking mortality may range between 2 and 4% (Jager et al 2002; Jager 2005).

Illegal harvest can rapidly reduce sturgeon populations, and can seriously undermine rehabilitation efforts. Illegal harvest is of particular concern for sturgeon populations that visibly spawn in shallow water, but it can negatively affect any population. Success has been shown with MDNR and citizens reporting any illegal harvest activity.

Degradation of spawning and nursery habitat, as well as barriers reducing access to these habitats are the primary causes of recruitment limitations leading to population decline (Auer 1999). Thus, protecting currently occupied lake sturgeon habitats and providing access to previously inaccessible habitats through enhanced fish passage is crucial to maintaining the status of healthy sturgeon populations.

Some strategic solutions to achieve sturgeon sustainability:

Stocking - Stocking is one of the key tools of fisheries management and has a role in lake sturgeon rehabilitation. Stocking is an appropriate management tool for increasing abundance because of lake sturgeon's naturally slow life cycle.

Education – Education is key to increasing interest in lake sturgeon and will promote the species, encourage wise use of the resource, and discourage illegal harvest. Fisheries professionals and the general public alike are fascinated by lake sturgeon because of their longevity, size, prehistoric nature, and historical and cultural significance throughout Michigan and the Great Lakes. As more people become aware of the species and the threats it continually faces, they will be more likely to join the rehabilitation efforts or report those who attempt to stall them.

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