MANAGEMENT PLAN FOR LAKE STURGEON IN BLACK LAKE 2016

MANAGEMENT PLAN FOR LAKE STURGEON IN BLACK LAKE

by

David Borgeson, Northern Lake Huron Management Unit Supervisor, Fisheries Division, Michigan Department of Natural Resources

Ed Baker, Marquette Fisheries Research Station Manager, Fisheries Division, Michigan Department of Natural Resources

Nathan Barton, Great Lakes Fisheries Biologist, Grand Traverse Band of Ottawa and Chippewa Indians

David Caroffino, Tribal Coordination Unit Biologist, Fisheries Division, Michigan Department of Natural Resources

Tim Cwalinski, Senior Fisheries Biologist, Fisheries Division, Michigan Department of Natural Resources

Kevin Donner, Great Lakes Fisheries Biologist, Little Traverse Bay Band of Odawa Indians

Brett Fessell, Restoration Section Leader – River Ecologist, Grand Traverse Band of Ottawa and Chippewa Indians

Maxwell Field, Inland Fisheries Biologist, Little Traverse Bay Band of Odawa Indians

James Garavaglia, Inland Fish and Wildlife Biologist, Grand Traverse Band of Ottawa and Chippewa Indians

Patrick Hanchin, Tribal Coordination Unit Supervisor, Fisheries Division, Michigan Department of Natural Resources

Marty Holtgren, Tribal Coordination Unit Biologist, Fisheries Division, Michigan Department of Natural Resources

Corey Jerome, Fisheries Biologist, Little River Band of Ottawa Indians

Emily Martin, Inland Fish and Wildlife Biologist, Bay Mills Indian Community

James Osga, Fisheries Biologist, Bay Mills Indian Community

Bill Parsons, Inland Fisheries Biologist, Little Traverse Bay Band of Odawa Indians

John Powell, Assessment Biologist, Sault Ste. Marie Tribe of Chippewa Indians

MANAGEMENT PLAN FOR LAKE STURGEON IN BLACK LAKE

Introduction and Background

Management plans for Lake Sturgeon populations in Michigan are developed using the guidance provided in Michigan's Lake Sturgeon Rehabilitation Strategy (Hayes and Caroffino 2012). The rehabilitation strategy describes the goals for Lake Sturgeon management, and these goals are reflected in the objectives outlined in this plan. The rehabilitation strategy should be used as a companion document to this plan.

Black Lake and watershed

Black Lake (Cheboygan and Presque Isle counties) is the third largest inland lake in the Cheboygan River watershed which encompasses 1,493 square miles and drains into Lake Huron (Figure 1). At 10,131 acres, it is the tenth largest inland lake in the State of Michigan. The Black Lake watershed includes more than 350,000 acres and has 18 miles of shoreline, making up 38% of the entire Cheboygan River watershed. Black Lake has a much higher watershed size to surface acre ratio and is relatively shallow when compared to neighboring Mullett and Burt lakes. It is considered a mesotrophic lake (moderate amount of nutrients) with a maximum depth of 50 feet and an average depth of 25 feet. The water is lightly brown-stained and typically stratifies thermally in the summer. Bottom substrate types are mainly sand, marl, and organic with few gravel and cobble areas present. The immediate lake shoreline is mostly developed.

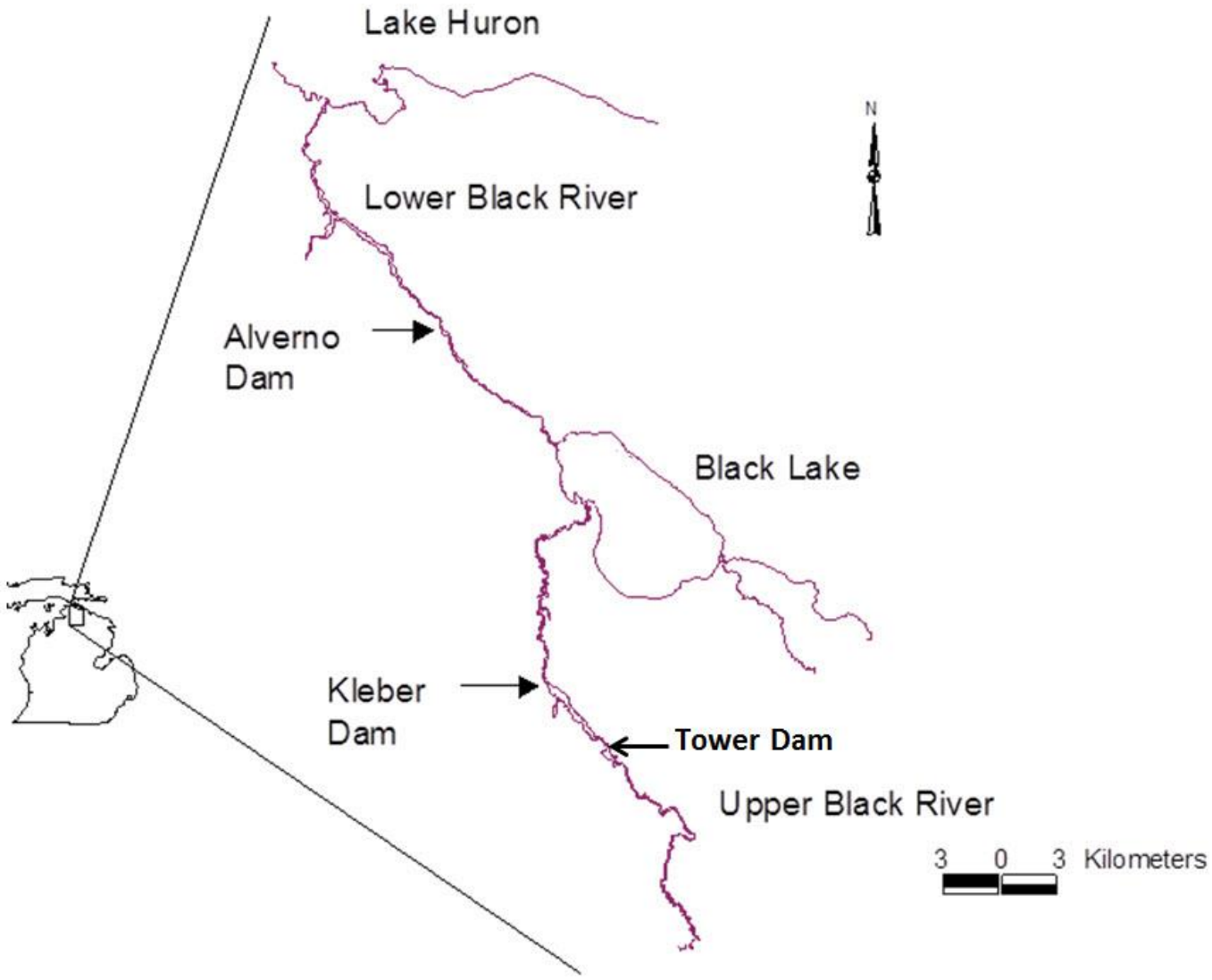

Figure 1. Black Lake area map

Major tributaries of Black Lake include the Upper Black and Rainy rivers, as well as Stewart, Mud, and Stony creeks. The 9.5 mile section of the Upper Black River currently accessible to fish from Black Lake is a warm transitional river which is separated from the rest of the Upper Black River by Tower and Kleber dams. This reach flows through a forested corridor with steep valley walls paralleling the river for many miles. Riparian ownership is almost completely public. Gradient is moderate to fast in the four river miles directly below Kleber

Dam, and decreases significantly as the river approaches Black Lake. Bottom substrate in the upper reaches is primarily sand, gravel, cobble, boulder, and bedrock, while sand dominates the downstream section. The Rainy River is a smaller stream which enters Black Lake on the southeast shore. It is a warm transitional stream with low summer base flows.

The outlet of Black Lake is commonly referred to as the Lower Black River and is 11 miles long. The Lower Black River is a warm water river with variable gradient and habitat types. It is sluggish in reaches directly upstream of Alverno Dam, and fairly fast in Smith Rapids. Both Alverno Dam and Smith Rapids act as water level controls for Black Lake, and Alverno Dam is a barrier between Black Lake and the rest of the Cheboygan River watershed. Further downstream, the Cheboygan lock and dam separates Lake Huron from the Cheboygan River watershed.

The Federal Energy Regulatory Commission, with assistance from the State of Michigan, regulates all four dams (Cheboygan Dam, Alverno Dam, Kleber Dam, Tower Dam) (Godby et al. 2015). Alverno Dam was built in 1904, and has a head of 16 feet. It is owned by Black River Limited Partnership and its 40-year license was updated in 2001. Tower and Kleber dams are owned by Tower-Kleber Limited Partnership and were built in 1918 and 1949, respectively. Tower Dam has a head of 20 feet, while Kleber Dam has a head of 42 feet. The 30-year license for these dams was renewed in 1994 (while projects were owned by Wolverine Power) and has articles which provide specific direction to the licensee regarding assistance as mitigation to the Michigan Department of Natural Resources' efforts to protect and enhance Lake Sturgeon in the Black River downstream of the projects. The license requires the owner to operate the project in run-of-river mode, and to work with the MDNR to construct a Lake Sturgeon rearing facility when deemed necessary.

The MDNR determined stocking was necessary to help rehabilitate the Black Lake population of Lake Sturgeon. In 2001 larval fish were collected and transported to Wolf Lake State Fish Hatchery, and 890 fall fingerlings were stocked in the Black River. This practice continued in 2003 and 2004. In 2005, a temporary streamside rearing facility was constructed near the mouth of the Upper Black River, and research concentrating on the relative fitness of Lake Sturgeon rearing in the streamside rearing facility versus those reared in a traditional hatchery was conducted. The results of this research (Crossman et al. 2014) revealed that streamside facilities were preferable to traditional hatcheries. Consequently, Tower-Kleber Limited Partnership, in consultation with the MDNR, constructed the current streamside Black River Lake Sturgeon rearing facility adjacent to Kleber Dam in time for production to begin in 2009.

Aquatic communities, management, stakeholders

The fish communities of Black Lake and its rivers are best described in Cwalinski and Hanchin (2011). The lake is known for its relatively abundant population of Lake Sturgeon, as intensive management and research effort has been focused on this species since the 1970s. Both cool and warm water fish species are present in Black Lake. Popular game species include Walleye, Northern Pike, Muskellunge, Smallmouth Bass, and Yellow Perch.

Invasive species have also entered the Black Lake ecosystem. Most notable are zebra mussels, rusty crayfish, and Eurasian water milfoil. These species can directly and indirectly impact ecological health. It has been hypothesized that zebra mussels have negatively altered the productivity of Black Lake. Volunteer lake monitoring efforts from the late 1980s to recent years have demonstrated a general decline in phosphorus, nitrogen, and chlorophyll-a levels, and

increased water clarity (Tip of the Mitt Watershed Council 2014), typical consequences of zebra mussel invasion.

The fish community and fisheries of Black Lake are managed cooperatively by the State of Michigan and five tribal governments (Bay Mills Indian Community [BMIC], Sault Ste. Marie Tribe of Chippewa Indians [SSMT], Grand Traverse Band of Ottawa and Chippewa Indians [GTB], Little River Band of Ottawa Indians [LRB], and Little Traverse Bay Bands of Odawa Indians [LTBB]). The tribal governments operate independently within the 1836 Ceded Territory as defined by the 2007 Inland Consent Decree (United States v. Michigan 2007) (hereafter 07 Decree). Fishing activities of state licensed anglers are regulated by laws established by the State of Michigan Department of Natural Resources. While guided by provisions of the 07 Decree, the tribes independently establish fishing regulations and management for their members by virtue of tribal sovereignty and longstanding cultural traditions. Lake Sturgeon management within each tribe is guided by varying documents and traditional philosophies. An example is that LRB has a tribally approved nmé (Lake Sturgeon) stewardship plan for the Big Manistee River and 1836 Reservation that guides management actions for the restoration and management of nmé within the Great Lakes. It is known that nmé are a clan animal of Midwest tribes and it is a common traditional belief of Michigan tribes that nmé is the King of all fish. Nmé have been harvested historically by Midwest tribes as a subsistence food source. The oil contained within nmé parts was used as cooking oil, lamp fuel, to water proofing clothing, and cattails soaked in nmé oil became torches that would last a very long time (Anthony 2009).

Tribal regulatory approaches are often grounded in potentially differing contexts based on generations of accumulated traditional ecological knowledge (TEK) related to methods,

location and timing most practical and appropriate for subsistence harvest purposes. Accordingly, fishing regulations for tribal members are governed by a mixture of contemporary and ancestral laws tempered with cultural and spiritual principles and teachings passed down and honored by their respective tribal governments (BMIC, SSMT, GTB, LRB, or LTBB). Two fisheries resources within Black Lake are regulated through specific provisions in the 07 Decree; Lake Sturgeon (Section XVII, Paragraph 17.3) and Walleye (Appendix B1). Under the 07 Decree, the MDNR and the five tribes coordinate research and assessment activities, cooperate in restoration, reclamation, and enhancement projects, and exchange information on an annual basis. Cooperative efforts and information sharing among the State of Michigan and the five tribes has led to a higher degree of transparency and understanding, guiding future resource allocation decisions and individual species management and/or recovery efforts.

In addition to the State of Michigan and tribes, other groups and stakeholders share a direct interest in the aquatic communities of Black Lake and its watershed. These include, but are not limited to, Black Lake Chapter of Sturgeon for Tomorrow (SFT), Michigan State University, Black Lake Association, Huron Pines, Tip of the Mitt Watershed Council, the Northern Inland Lakes Citizens Advisory Committee, and Tower-Kleber Limited Partnership. The mission of SFT is to assist fisheries managers in Lake Sturgeon rehabilitation, to advance education, to further other charitable, educational, and scientific objectives, and to engage in and facilitate scientific research. This group has direct interest and involvement in the current and future sturgeon fishery, rehabilitation of the population through the streamside hatchery program and efforts to restore river function, outreach and educational activities, and the Sturgeon Guarding Program. Michigan State University has worked cooperatively to secure grants and conduct research on various aspects of Lake Sturgeon life history traits while also rearing Lake

Sturgeon for recovery efforts. Tower-Kleber Limited Partnership, under Article 406 of its current license agreement, cooperates with the MDNR in implementing sturgeon recovery through the establishment of the Upper Black River streamside hatchery. The Black Lake Association works cooperatively with the agencies to maintain the high quality cool water fisheries of Black Lake, whether through additional stocking efforts, habitat enhancement, or information exchange. Tip of the Mitt Watershed Council organizes the volunteer lake monitoring studies crucial to understanding the changing limnological parameters of Black Lake. The charge of the Northern Inland Lakes Citizens Advisory Committee is "to review, understand, and provide recommendations and direction into the fishery goals, objectives and management plans for lakes in the Inland Waterway and connecting waters." It is a platform for information sharing between interested citizens and managing agencies.

Hayes and Caroffino (2012) identify the Lake Sturgeon population in Black Lake as large and stable and above the minimum viable population. Lake Sturgeon stocking initiated in 1982 has resulted in expansion, though as of 2015 the population is still below historical levels. Goals of the Lake Sturgeon statewide rehabilitation strategy (Hayes and Caroffino 2012) are:

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.
2. Maintain some populations of sufficient size to provide fisheries that support the recreational and cultural desires of state and tribal fishers.

Lake Sturgeon fishery in Black Lake

Michigan legislature prohibited the taking of Lake Sturgeon statewide in 1928 (Vondett 1957). Twenty-years later, it was believed that the statewide population had increased to an

extent that with strict regulations a fishing season for Lake Sturgeon could be permitted. Beginning in 1948, a limited sport fishery for Lake Sturgeon was allowed on inland lakes open to spearing, which included Black Lake. Regulations allowed an annual two-month (January and February) spearing season permitting each fisherman two sturgeon of at least 36 inches in length per season. The minimum legal length was increased to 42 inches in 1952 (Vondett 1957). During the last half of the 20th century, the popularity of the Black Lake fishery grew and became deeply embedded in the culture of the local community, as demonstrated by the genesis of the Black Lake Sturgeon Shivaree, a local festival held during the sturgeon season which honors and celebrates the importance of Lake Sturgeon to the community. Accurate reports of the number of sturgeon harvested in Black Lake prior to 1974 are generally unavailable, although angler surveys documented effort and harvest of Lake Sturgeon in Black Lake in 1956-1958 (Table 1) (Vondett 1957, Vondett and Williams 1961).

Table 1. Lake Sturgeon angler effort and harvest in Black Lake, 1956-1958

Year	Angler Days	Harvest
1956	469	18
1957	354	5
1958	363	12

Reported harvest of Lake Sturgeon in Black Lake from 1974 through 1999 was 461 fish. In the late 1990s, concerns arose among DNR fisheries managers and the public regarding the apparent decline in the Black Lake population as evidenced by declining harvest (Figure 2.) (Baker and Borgeson 1999).

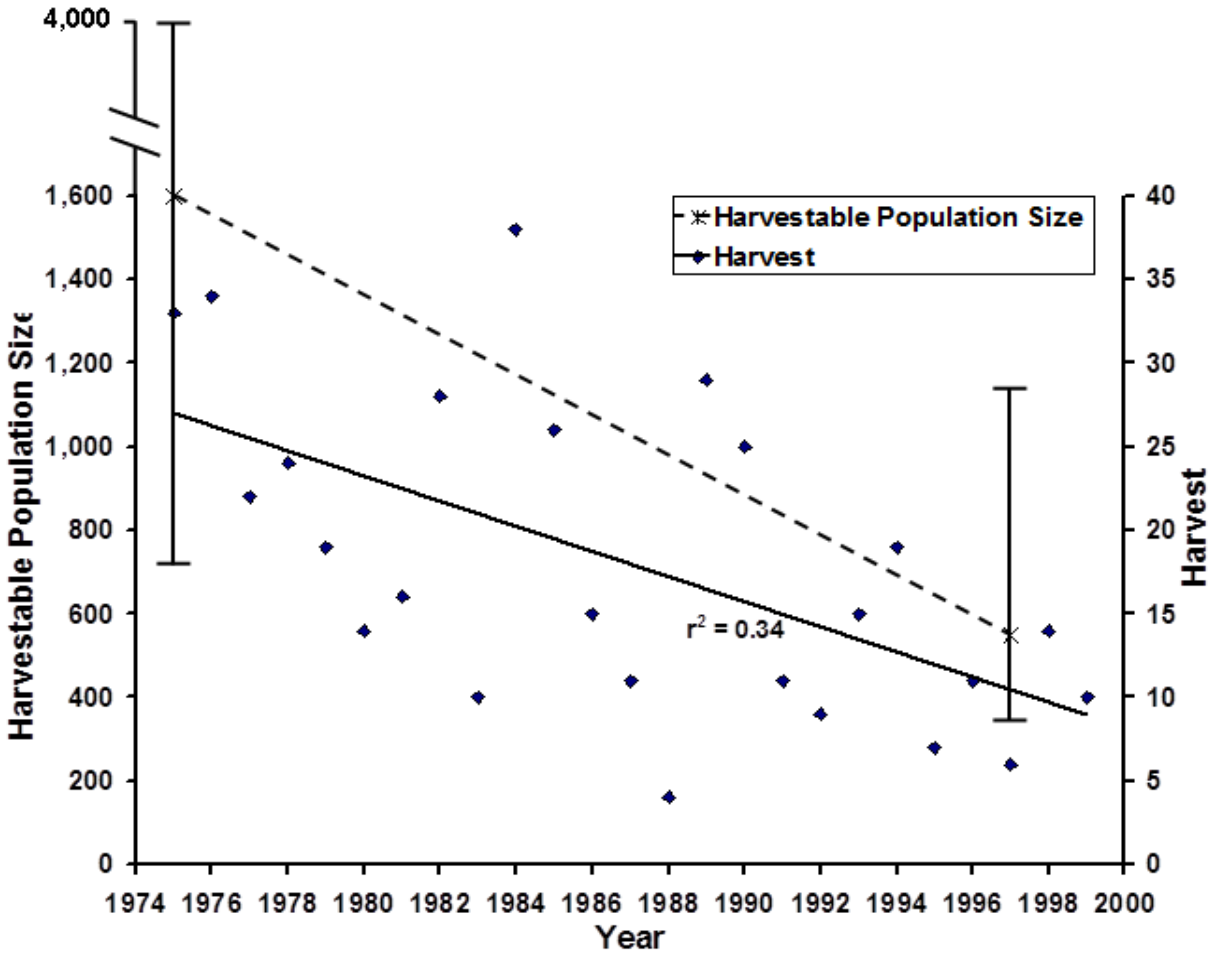

Figure 2. Lake Sturgeon harvest 1975-1999, population estimates for 1975 and 1997

In 2000, highly restrictive Lake Sturgeon harvest regulations were placed on Black Lake. From 2000-2009 the fishery was regulated by implementing a limited entry fishery that could last nine days or until the five fish quota was met. The minimum size of Lake sturgeon that could be harvested was 36 inches. Harvest during this period (2000-2009) was at, slightly above, or below the quota of five fish (Appendix A). Angler registration for the limited entry fishery during these years ranged from 213-1,447. Special State of Michigan fishing regulations were enacted for the upper section of the Upper Black River to protect spawning Lake Sturgeon, closing the river to fishing between Kleber Dam and Red Bridge.

The 07 Decree established the entry of tribal harvest once the adult (fish capable of breeding) Lake Sturgeon population was estimated to exceed 750 individuals with an equal allocation of Lake Sturgeon harvest between the State and five tribes. In 2010 the parties agreed that the population was estimated to exceed 750 mature fish and a joint fishery was established as the tribes authorized harvest through a limited permit system. A protective exploitation rate of 1.2% of the estimated adult population was initially established based on doubling the State of Michigan allocation of 6 fish to 12 fish (6 for the State of Michigan, 6 for the tribes). The annual tribal allocation of Lake Sturgeon is divided each year among the five tribal governments, however not all tribes chose to open harvest to its members. Fishing methods and seasons for subsistence harvest in Black Lake were established by each independent tribal government. Since 2010, total Lake Sturgeon harvest in Black Lake by the tribes (collectively) has ranged from 2-5 fish per year. Further, since implementation of the joint fishery, the tribes have annually harvested below the annual tribal allocation of Lake Sturgeon regardless of differing methods and seasons employed among the tribes.

In 2010, through detailed consultation between MDNR and SFT, it was determined that an unlimited entry fishery could be employed in Black Lake. Season length would be five days or until the State quota was met. Though harvest quotas remained low, response to the unlimited entry season was overwhelmingly positive in 2010. During the 2011 harvest season, however, state anglers harvested 11 Lake Sturgeon, exceeding the State's allocation by four fish. Realizing the inherent risk and difficulties in managing an unlimited entry fishery, MDNR and SFT cooperators started employing several safeguards in 2012 to ensure that Lake Sturgeon harvest remained at or below the quota. Increased on-ice personnel and improved communication would be tools managers would use to help reduce the risk of harvest beyond the annual State quota.

The MDNR implemented a harvest regulation model which incorporated a mechanism to reduce the number of Lake Sturgeon allocated to state anglers in subsequent years if the quota was exceeded. Since the inception of the unlimited entry fishery in 2010, angler participation on the ice at Black Lake has ranged from 197-330 anglers. The size limit for Lake Sturgeon was also removed to increase the likelihood of harvest of male and immature Lake Sturgeon and to reduce the harvest of mature female Lake Sturgeon.

Lake Sturgeon population estimates in Black Lake

Population estimates of adult Lake Sturgeon were made for Black Lake in 1975, 1997, 2002, and 2007. Juvenile Lake Sturgeon abundance was estimated in Black Lake with gill nets in 2013 (Appendix B). The abundance of harvestable fish (50 inch minimum size limit in the 1970s) was estimated in 1975 (Baker 1980) and calculated using annual tagging and spear harvest data spanning several years. This assessment used different methods from subsequent surveys and yielded a much larger population estimate. More recent (1997, 2002 and 2007) in-lake population estimates have employed the use of large mesh gill-nets monitored regularly during the day. Captured fish were marked, released, and allowed time to mix with the remaining unmarked population. Marking occurred over a two-month period in 1997, and was accomplished in less than two-weeks in both 2002 and 2007. In 2007, a separate estimate was calculated using the spring spawning run of Lake Sturgeon as the marking run. In each period, the Schnabel method (Schnabel 1938), as presented in Sutherland (2006), was used to estimate Lake Sturgeon vulnerable to the gill-nets. Proportional length-frequencies of the catches were used to estimate the total number of fish 50 inches and larger. Wide confidence intervals around some estimates were caused by low sample sizes.

Adult Lake Sturgeon population estimates in Black River

From 2001 through 2015 male and female adult Lake Sturgeon were captured and tagged during the spring spawning migration from Black Lake into the Upper Black River. Pledger et al. (2013) used these data to develop an appropriate population model for the Black Lake Sturgeon population. This model included spawning periodicity of fish in a closed system, sex-specific survival, and breeding return time probabilities as parameters to generate adult population estimates for Lake Sturgeon in Black Lake. However, because it takes a number of years for this model to account for all individuals currently in the population (Pledger et al. 2013), initial apparent increases in abundance are artifacts of the accounting process used by the model.

These annual abundance estimates indicate the sexually mature portion of the population has been increasing for both males and females likely due to the stocking that took place in the 1980's. As of 2016, the model estimates 486 females and 627 males in the adult population.

Young of the year and juvenile Lake Sturgeon surveys in Black Lake and the Upper Black River

Production of wild fish in the Upper Black River is assessed with standardized methods using larval drift collection efforts (Auer and Baker 2002), and by spotlighting for summer or fall fingerlings (Mann et al. 2011). Cooperative management has allowed the annual sampling of drifting Lake Sturgeon larvae using D-frame drift nets. Five drift nets are deployed across a transect 1 mile downstream of the Upper Black River spawning habitat. Larval sampling begins 10-14 days after the first observed spawning activity, and before larvae have begun to disperse from the spawning habitat. Larval sampling is done for five hours nightly until spawning has

concluded and larval drift has ceased. These methods have been standardized across years to allow inter-annual comparisons of larval abundance. The 2013 juvenile Lake Sturgeon survey in Black Lake indicated the abundance of larvae sampled during drift, which varies greatly from year to year, is not strongly correlated with wild fish recruitment to the juvenile population.

Another method for examining Lake Sturgeon fingerlings in the Upper Black River involves spotlighting in the late summer or early fall. Lake Sturgeon are revealed by glowing eyes and mottled pattern underwater and captured with dip nets. Fish are scanned for PIT tags and biodata is collected. Up to three river kilometers were sampled each year between 2010 and 2013 and the number of unique age-0 wild Lake Sturgeon captured was 22, 0, 2, and 0 in each year, respectively (Michigan DNR unpublished data). Although survey efforts to date have been limited, an expansion may assist managers in better understanding recruitment dynamics in this system.

A juvenile Lake Sturgeon survey was completed with 6 and 8 inch mesh gill nets in Black Lake in the summer of 2013. It was a cooperative effort between the MDNR, Michigan State University, and LTBB. This assessment came following more than a decade of fingerling stocking efforts in Black Lake and the Upper Black River. The results of this survey suggest that natural reproduction is limited and unlikely to allow the population to reach established goals (Figure 3). This finding is consistent with previous survey efforts in the lake and river that indicated a pulse of juvenile Lake Sturgeon coincidental with the stocking events in the 1980s.

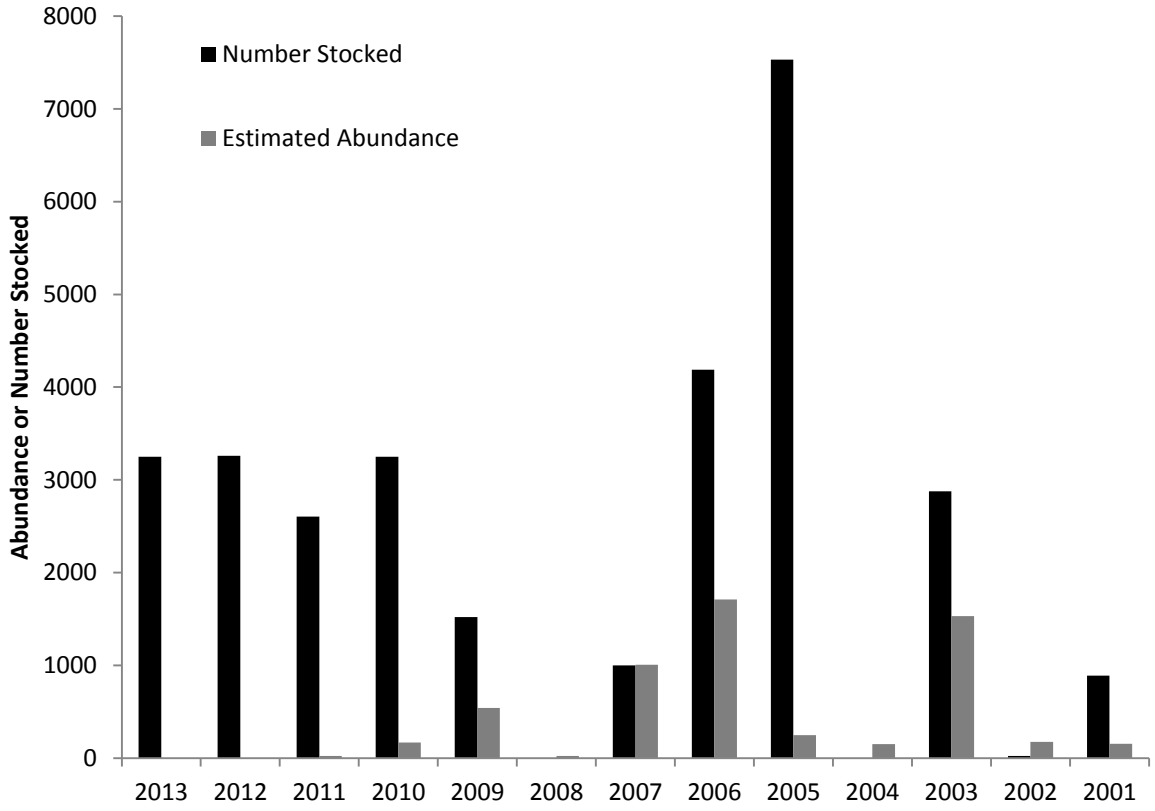

Figure 3. Numbers of stocked fish by year-class and year-class specific abundance estimates for juvenile Lake Sturgeon in Black Lake. Abundance estimates are for August 2013 and based on the mark-recapture gillnet survey (Schnabel multiple mark-multiple recapture estimate).

Lake Sturgeon stocking efforts in Black Lake

Black Lake stocking efforts for Lake Sturgeon began in the 1980s, were discontinued after 1988, and resumed in 2001. The stocking efforts of the 1980s were done using low numbers of adults from the Black Lake system. Fish produced from the gametes of these limited pairings are highly related, and have begun to enter the spawning population. Fingerling Lake Sturgeon of varying sizes were stocked nearly every year between 2001 and 2015 (Table 2).

Table 2. Lake Sturgeon stocked in Black Lake 1982- 2015.

Year	Number Stocked	Length (inches)	Mark
1982	40		none
1983	1187		none
1984	6698	5.1	none
1988	3587	3.9	none
2001	890	5.8	CWT
2002	23	12.0	none
2003	2,878	8.7	CWT
2004			
2005	7,533	3.3	none
2006	4,188	6.3	CWT
2007	1,000	6.2	CWT
2008			
2009	1,520	6.1	CWT
2010	3,250	4.8	CWT
2011	2,604	3.9	CWT
2012	3,261	4.6	CWT
2013	3,250	4.2	CWT
2014	500	5.1	CWT/PIT
2015	523	7.6	PIT

Stocked fingerlings were either captured as larvae during a larval drift survey or produced from gametes taken from spawning Lake Sturgeon in the Upper Black River. Fish were raised at the Wolf Lake State Fish Hatchery from 2001 through 2003, at a temporary streamside hatchery on the Upper Black River from 2005 through 2007, and at the current streamside hatchery near Kleber Dam since 2009. Fish were implanted with a coded wire tag in most years, and pit tagged since 2014. The initial stocking rate was 3,250 summer fingerlings annually. Results from the 2013 Black Lake gill netting survey demonstrated much higher post-stocking survival than anticipated and better survival when larger fingerlings were stocked (Figure 5).

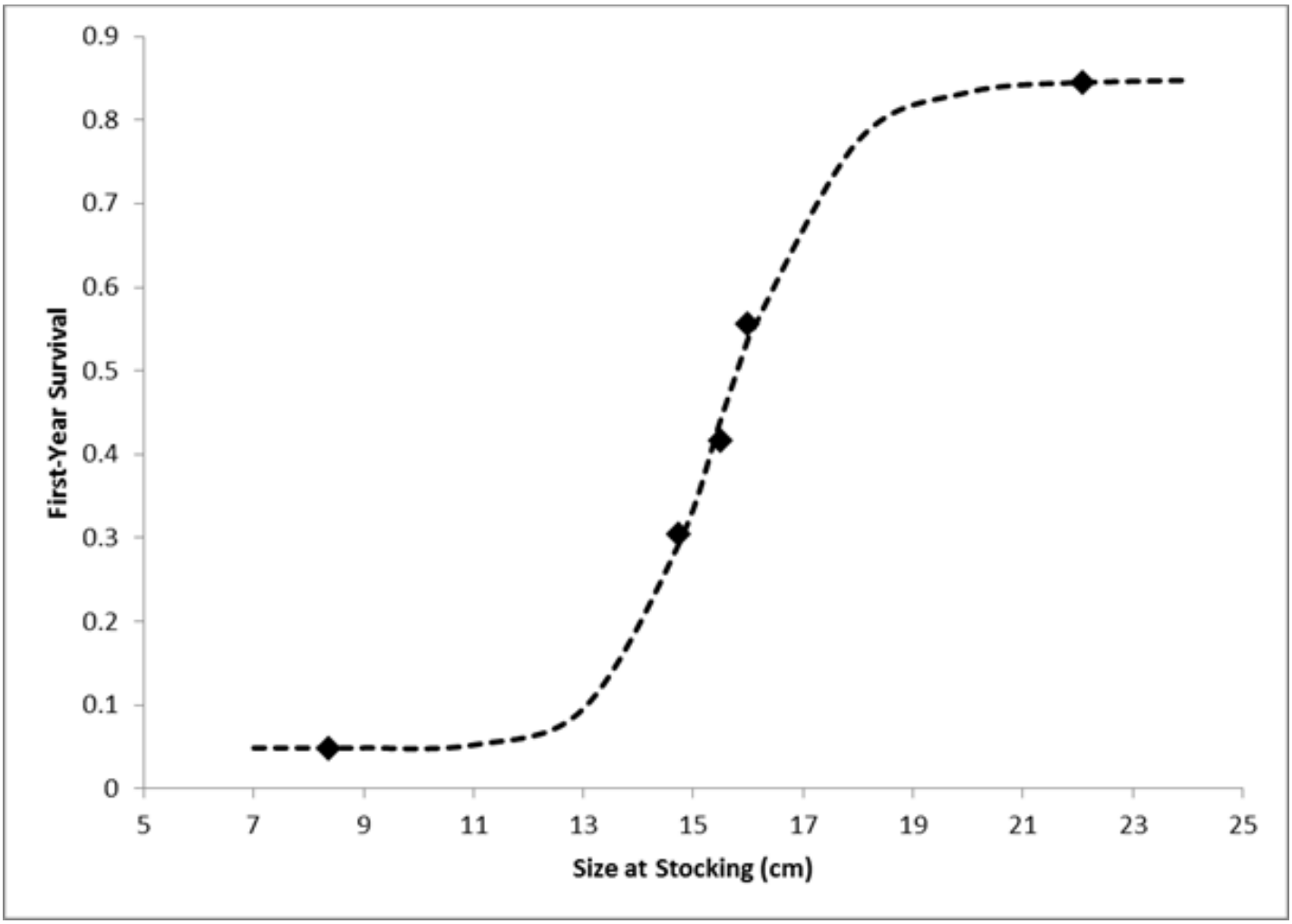

Figure 5. Post stocking survival of Lake Sturgeon in Black Lake related to size at stocking.

A reduced stocking prescription of 500 individuals began in 2014. The resulting lower density in the rearing facility should provide a better probability of stocking Lake Sturgeon averaging greater than 6 inches in length, and enable the population to reach target levels. In addition, LTBB has successfully raised and stocked Lake Sturgeon summer fingerlings in nearby Burt Lake from gametes collected cooperatively in the Upper Black River since 2013.

Specific Objectives for Lake Sturgeon in Black Lake

To achieve the goals outlined in Michigan's Lake Sturgeon Rehabilitation Strategy (Hayes and Caroffino 2012), five objectives have been identified for Lake Sturgeon in Black Lake.

Objective 1. Develop a population of 1600 to 2000 adult Lake Sturgeon by 2030

The 1975 estimate of 1599 Lake Sturgeon 50 inch or larger (Baker 1980) was chosen as the lower limit to a target adult population size. With legal, and significant illegal (Baker and Borgeson 1999), harvest occurring in Black Lake since 1948 it is likely that the adult population was depressed prior to the 1975 estimate.

The upper level of 2000 adults is consistent with a population goal greater than the depressed level of abundance of 1975, as well as an analysis of suitable Lake Sturgeon habitat in Black Lake. Using summer limnological profiles, temperatures and dissolved oxygen levels suitable to Lake Sturgeon were determined to exist from 5-40 feet. Black Lake has 5,917 surface acres in this depth range. This estimate of suitable lake habitat correlates well with other studies. Hay-Chmielewski (1987) found that the preferred depth ranges of adult Lake Sturgeon in Black Lake were 20-40 feet deep. Data from Bruch (1999) found that adult Lake Sturgeon in Lake Winnebago used water less than 20 feet deep. Bruch (1999) also determined the adult densities at 0.313/acre in Lake Winnebago, which is considered a healthy Lake Sturgeon waterbody. A population goal of 2,000 adult Lake Sturgeon in Black Lake will yield a similar density of approximately one adult sturgeon per three acres of suitable summer habitat.

Adult Lake Sturgeon population estimates are annually determined from the tagging and recovery assessments from the spawning run. Current population models for Lake Sturgeon in Black Lake forecast the population to exceed 2000 adults by year 2030, perhaps by over 500

individuals. Assessment efforts will provide data related to growth and condition of the sturgeon population, which will help evaluate the appropriateness of this population objective.

Objective 2. Achieve a natural recruitment level that will sustain an adult Lake Sturgeon population of 1600-2000 adults.

Recovery of Lake Sturgeon populations across the Great Lakes are hindered by historic effects of habitat destruction and discontinuity, barriers to migration, overharvest, invasive species, and a changing food web (Auer 1999). It is likely recruitment within the Black Lake population is impacted to some extent by all of these factors. The goal for Black Lake is for Lake Sturgeon population recovery to be sustained by natural processes. If this is to occur, the current factors limiting natural recruitment need to be identified, understood, and addressed. Some bottlenecks are known, such as first year survival and the presence of dams degrading and limiting access to habitat and impacting natural food webs (Hammad 1972, Ligon et al. 1995, Shuman 1995, Petts 1980, Cushman 1985, Doppelt 1993, Benke 1990, Bain et al. 1988, and Ward and Stanford 1989); however, implementing feasible, corrective management actions remains difficult.

Stocking is a temporary, but necessary, solution to supplement the sporadic and low levels of natural recruitment currently observed. The purpose of stocking is to maintain sufficient spawning stock biomass, such that when the barriers to natural recruitment are removed or overcome the population will immediately be able to produce recruits. Stocking also allows the adult population to persist, supporting a fishery for state and tribal fishers. The prescribed rate of stocking must be sufficient to maintain an adult population, support a fishery, and not create unrealistic expectations for exploitation, such that reductions in harvest would be

difficult to achieve when a self-sustaining population is established. Stocked fish must be tagged so that natural recruitment can be quantified.

To fully realize the Black River's potential to sustain the Lake Sturgeon population through natural recruitment, restoring a free-flowing, barrier free system is recommended. Many Lake Sturgeon management plans such as the Michigan's Lake Sturgeon Rehabilitation Plan by Hayes and Carroffino (2012) list dams as one of the leading impediments to Lake Sturgeon populations. A free-flowing system will allow for habitat connectivity, as well as restoration of in-stream processes necessary to maintain key spawning and nursery habitats. In addition to the benefits of access and increased spatial distribution of adult spawners, by opening the river above Tower and Kleber dams, this same spatial expansion may be beneficial to drifting larval sturgeon by extending residence times in the productive higher gradient habitats of the system and to young-of-year Lake Sturgeon found to use lower gradient river habitats during summer and fall (Mann et al. 2011, Benson et al. 2006, Holtgren and Auer 2004). Increasing residence time can increase overall physiological fitness of young Lake Sturgeon improving their probability of survival and recruitment into the lake population. In summary, reconnection of the Black River above Tower and Kleber dams would increase the abundance of suitable spawning, nursery and escape cover upwards of 5 fold over existing conditions. The restoration of colder instream temperatures below Tower and Kleber dams may also benefit Lake Sturgeon spawning, survival and recruitment by potentially shifting run and drift times to coincide with the inherent (fully natural) flow and thermal regimes as well as other physicochemical cues known, or unknown, that could have been altered by these dams.

Objective 3. Support a fishery with a maximum exploitation rate appropriate for the classification status as defined in the Rehabilitation Strategy.

The Lake Sturgeon population in Black Lake is listed in the rehabilitation strategy as a large, stable population (Hayes and Caroffino 2012). Accordingly, the strategy states that "harvest may be considered, up to 2% of the adult population each year." The current exploitation rate used to manage this fishery is 1.2% of the estimated adult population. The adult population is currently below historic and target levels. While the population is building and bottlenecks to higher levels of natural recruitment are being investigated, the exploitation rate should not exceed the rehabilitation strategy recommendations.

The proper management of the Lake Sturgeon fishery in Lake Winnebago, Wisconsin by using a sex-based exploitation rate is well documented. Because male Lake Sturgeon mature at a younger age than female Lake Sturgeon (Bruch 2008), the effects of recent supplementation efforts in Black Lake will initially be seen in the form of additional male fish entering the fishery. This increase in the number of harvestable males increases the risk of over-harvesting the female component of the population when exploitation rates are set based on the overall adult abundance. In the early stages of recovery of the Black Lake population, therefore, it is important to protect the large, naturally produced females that remain in the population. To accomplish this we recommend annual harvest to not exceed 2% of the estimated abundance of adult females, and to not exceed 2% of the overall adult abundance estimate.

Objective 4. Determine habitat limitations of the Upper Black River and Black Lake by 2025

Lake Sturgeon populations in Michigan have been hindered by habitat degradation, and addressing habitat limitations has been identified as a critical long-term goal (Hayes and Caroffino 2012). Inaccessible, or degraded, spawning or nursery habitats remain primary causes of recruitment problems for Lake Sturgeon populations (Auer 1999). In Black Lake the Tower, Kleber, Alverno, and Cheboygan dams have altered habitat conditions and greatly reduced the

spawning habitat accessible to Lake Sturgeon. It is suspected that one or more habitat suitability factors are limiting survival of larval Lake Sturgeon. This limitation is a major impediment to the goal of a self-sustaining Lake Sturgeon population. The quantity and survival of larval fish may be reduced by the presence of dams truncating, and possibly altering, the spawning habitat and larval drift zone of Black Lake. The mechanism for low survival of larval fish is poorly understood and is a primary focus for further investigation.

Objective 5. Maintain and encourage annual public involvement in Lake Sturgeon management efforts in Black Lake.

Stakeholder involvement has been critical to the progress already made toward rehabilitation of Lake Sturgeon in Black Lake. Continued stakeholder engagement is a necessity if the goals and objectives of this plan are to be achieved. The DNR Fisheries Division has a Memorandum of Agreement with the SFT that outlines responsibilities of each organization. The organizations meet annually to discuss Lake Sturgeon related activities, including the harvest season, the research and management field season, and any resources that these efforts may require. SFT typically provides funding to assist in the identified areas of need, including purchasing Lake Sturgeon food and field and hatchery equipment. SFT also organizes the Sturgeon Guarding program, which is a key component of the overall rehabilitation effort. The organizations are charged to work together on outreach and education opportunities led by SFT, develop press releases, and identify and resolve any outstanding issues. SFT also oversees the Sturgeon in the Classroom program, which allows schools to integrate Lake Sturgeon outreach and educational materials into their curriculum while caring for a young Lake Sturgeon.

A Sturgeon Advisory Council was formed to provide a platform for many groups within the Cheboygan watershed to become familiar with, and participate in, Lake Sturgeon

management within the watershed, and make management recommendations to the DNR. The Sturgeon Advisory Council actively seeks Tribal participation in these annual meetings.

Evaluation and Assessment Plan

Tracking progress toward achieving objectives requires identifying and conducting standard assessment methods specific to each objective.

Adult population assessment

Annual population estimates are produced by surveying the adult fish entering the spawning grounds for the duration of the spawning period. This protocol should be maintained until at least 2025-2030, as the population increases and the fishery expands. The current methodology using hand nets to capture adults has an acceptable capture efficiency of over 75% of the adults entering the river. Each adult is implanted with a PIT tag, if one is not detected at time of capture. Information on all Lake Sturgeon captured will be entered into a database, with tag numbers recorded along with the biological data (length, weight, sex). Population estimates for the adult population will be conducted using the model developed by Pledger et al. (2013). Annual estimates will be generated for both adult males and adult females separately. These estimates will be used to determine the number of Lake Sturgeon of each sex available for the fishery and to track progress toward the population goal.

Recruitment assessment

Until the population can be maintained by natural reproduction, assessment of naturally produced larval Lake Sturgeon will coincide with procurement of drifting larval fish for production purposes. The magnitude of each larval drift event associated with specific spawning

episodes will be annually monitored by deploying drift nets downstream from the spawning grounds. If larval drift assessments indicate successful spawning, late summer age-0 assessments, perhaps spotlight surveys, will be conducted. The goal of these assessments is to develop a reliable index of annual natural recruitment of age-0 Lake Sturgeon in fall. Production of acceptable estimates of recruitment requires targeting juvenile Lake Sturgeon by deploying gill nets in the lake every 5-10 years. Using this assessment method necessitates marking all stocked Lake Sturgeon with PIT tags so that each stocked fish can be individually identified and differentiated from naturally produced fish.

Fishery assessment

Achieving the objective of regulating the fishery, potentially using a sex-based exploitation rate, will require accurate and timely reporting of all harvested Lake Sturgeon. Information collected from all harvested fish will include; sex, maturity, size, presence of PIT or coded wire tag, and tag number. Fishing effort, in terms of angler days and angler hours, will also be recorded.

Habitat assessment

Past assessment activities suggest a bottleneck to natural recruitment may occur when larval Lake Sturgeon are drifting downstream from the spawning area (Scribner and Baker, unpublished data). Future habitat assessment activities should initially focus on factors in the Black River that are likely to contribute to reduced survival during this time frame. Factors influencing the quantity and suitability of nursery habitat should be assessed, including; predator impacts, food availability for larval Lake Sturgeon, and preferred physical habitat quality and availability (substrate, cover, depth, etc.). Suitability and abundance of available, and currently

inaccessible, spawning habitat should also be assessed to determine the level of current impairment and if larval production can be increased.

Additional habitat assessments in the Upper Black River, above Tower and Kleber dams will help agencies estimate potential larval production if fish passage or dam removal is achieved. Specifically, data collection efforts should focus on floodplain and channel geometry, dimensions, and grain size distributions in the active channel and within the impoundments. Such efforts will facilitate sediment wedge volume estimates and extents, as well as depth of refusal sampling for mapping relic channel and floodplains beneath these wedges. Data collection efforts in the active channel should occur at various key points in the valley where changes in slope, valley and channel classification or other geomorphic shifts occur in order to develop hydraulic models that characterize and predict the hydraulic, hydrologic and geomorphic processes and functions under various conditions.

Prescribed Management Actions

Several management actions will be required to achieve the objectives identified for Lake Sturgeon in Black Lake. Some actions will address multiple objectives (objective addressed in parentheses).

1. Stock over a 5-year average, 500 PIT tagged age-0 juvenile Lake Sturgeon collected via larval drift and reared in the streamside hatchery (objective 1, 2).
    a. Conduct juvenile (age 5-10) assessments every 5 to 10 years to monitor stocking survival rate and wild to hatchery ratio (objective 1, 2).
    b. Develop criteria for stocking reductions and ultimately cessation if natural recruitment increases (objective 1, 2).
2. Implement research to identify factors causing early-life mortality (objective 2, 4).

a. Examine food items available and assess forage base within the context of other sturgeon systems with natural recruitment (objective 2, 4).
b. Develop a recruitment index including sites, timing, methods for assessment, and benchmarks (objective 2).
c. Assess whether nursery habitats are of sufficient quality and quantity to allow for recruitment (objective 2, 4).

3. Annually set harvest quota for Black Lake based on estimates of adult females and all adult Lake Sturgeon and generate harvest regulations designed to stay within quota (objective 1, 3).
    a. Continue estimating adult abundance using spawning run mark-recapture, unless another assessment of the fishery is developed and agreed upon by the 07 Decree parties (objective 1, 3).
    b. Evaluate the effects of exploitation on the adult Lake Sturgeon population every 3 years and adjust, if necessary (objective 1, 3).
    c. Periodically survey anglers to enumerate Lake Sturgeon wounded and not recovered during spear fishery (objective 1, 3).
4. Understand, mitigate or eliminate negative impacts of Tower and Kleber dams on Lake Sturgeon (objective 2, 4, 5).
    a. Determine relative abundance of spawning habitat above and below dams (objective 2, 4).
    b. Collect data necessary to assess feasibility of dam removal to contribute to removal/retention design alternatives that explicitly address how existing

conditions may or may not be negatively affecting Lake Sturgeon life histories (objective 2, 4).

c. Determine impact of altered temperature regime, nutrient levels, and trophic dynamics below dams (objective 4).

d. Conduct assessment of potential futures of Tower and Kleber dams.

5. Cooperate among the 07 Decree parties, and with interested citizen groups (e.g., SFT) to conduct outreach activities related to the history, cultural importance, and fisheries for Lake Sturgeon in Black Lake (objective 5).

    a. Work with SFT and State and Tribal Law Enforcement to annually protect vulnerable sturgeon in the spawning run by continuing the Sturgeon Guarding program (objective 1, 2, 3, 5).

    b. Annually provide sturgeon and educational materials to participants in the Sturgeon in the Classroom program (objective 5).

    c. Ensure all assessment data continues to be shared among the 07 Decree parties (objective 1, 2, 3, 4, 5).

Literature Cited

Anthony, G. A. 2009. The Elders Speak: Reflections on Native American culture and life. Beaver Island Historical Society.

Auer, N.A. 1999. Lake sturgeon: A unique and imperiled species in the Great Lakes. Pages 515-536 *in* Taylor W.T., and C.P. Ferreri, editors. Great Lakes Fisheries Policy and Management: A Binational Perspective. Michigan State University Press, Lansing, Michigan.

Auer, N. A., and E. A. Baker. 2002. Duration and drift of larval lake sturgeon in the Sturgeon River, Michigan. Journal of Applied Ichthyology 18:557–564.

Bain, M. B., J. T. Finn, and H. E. Booke. 1988. Stream flow regulation and fish community structure. Ecology 69(2):382-392.

Baker, E., and D. Borgeson. 1999. Lake sturgeon abundance and harvest in Black Lake, Michigan 1975-1999. North American Journal of Fisheries Management 19:1080-1088.

Baker, J. P. 1980. The distribution, ecology, and management of the lake sturgeon (*Acipenser fulvescens* Rafinesque) in Michigan. Michigan Department of Natural Resources, Fisheries Research Report 1883, Ann Arbor.

Benke, A. C. 1990. A perspective on America's vanishing streams. Journal of the North American Benthological Society 9(1):77-88.

Benson, A. C., T. M. Sutton, R. F. Elliott, and T. G. Meronek. 2005. Seasonal movement patterns and habitat preference of age-0 lake sturgeon in the lower Peshtigo River, Wisconsin. Transactions of the American Fisheries Society 134:1400–1409.

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., 2008. Modeling the population dynamics and sustainability of lake sturgeon in the Winnebago system, Wisconsin. PhD Dissertation. The University of Wisconsin-Milwaukee.

Crossman, J. A., K. T. Scribner, C. A. Davis, P. S. Forsythe, and E. A. Baker. 2014. Survival and growth of Lake Sturgeon during the early life stages as a function of rearing environment, Transactions of the American Fisheries Society, 143:1, 104-116.

Cushman, R. M. 1985. Review of ecological effects of rapidly varying flows downstream from hydroelectric facilities. North American Journal of Fisheries Management 5:330-339.

Cwalinski, T. A., and P. A. Hanchin. 2011. The fish community and fishery of Black Lake, Cheboygan and Presque Isle counties, Michigan, with emphasis on walleye, northern pike, and smallmouth bass. Michigan Department of Natural Resources, Fisheries Special Report 56, Lansing.

Doppelt, B. 1993. Entering the watershed: a new approach to save America's river ecosystems. Island Press, Washington D. C.

Godby, N. A., Jr., T. C. Wills, T. A. Cwalinski, and B. J. Bury. 2015. Cheboygan River assessment. Michigan Department of Natural Resources, Fisheries Report 10, Lansing.

Hammad, H. Y. 1972 River bed degradation after closure of dams. American Society of Civil Engineers, Journal of the Hydraulics Division 98:591-607.

Hay-Chmielewski, E. M.1987. Habitat preferences and movement patterns of the lake sturgeon (*Acipenser fulvescens)* in Black Lake, Michigan. Michigan Department of Natural Resources, Fisheries Research Report 1949, Ann Arbor.

Hayes, D. B., and D. C. Caroffino, editors. 2012. Michigan's lake sturgeon rehabilitation strategy. Michigan Department of Natural Resources, Fisheries Special Report 62, Lansing.

Holtgren, J. M., and N. A. Auer. 2004. Movement and habitat of juvenile lake sturgeon (*Acipenser fulvescens*) in the Sturgeon River/Portage Lake system, Michigan. Journal of Freshwater Ecology 19:419–432.

Ligon, F. K., W. E. Dietrich, and W. J. Trush. 1995. Downstream effects of dams. BioScience 45(3):183-192.

Mann, K. A. , Holtgren, J. M. , Auer, N.A. and Ogren, S.A. 2011. Comparing size, movement, and habitat selection of wild and streamside-reared lake sturgeon. North American Journal of Fisheries Management 31:305-314.

Petts, G. E. 1980. Long-term consequences of upstream impoundment. Environmental Conservation 7(4):325-332.

Pledger, S., E. Baker, and K. T. Scribner. 2013. Breeding return times and abundance in capture-recapture models. Biometrics. 69:991-1001.

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

Shuman, J. R. 1995 Environmental considerations for assessing dam removal alternatives for river restoration. Regulated Rivers: Research & Management 11:249-261.

Sutherland, W. J. 2006. Ecological census techniques. Cambridge: Press syndicate of the University of Cambridge.

Tip of the Mitt Watershed Council. 2014. Volunteer lake monitoring program. Petoskey, Michigan. http://www.watershedcouncil.org/

United States v. Michigan, 2007. Consent Decree. United States District Court for the Western District of Michigan File No. 2:73 CV 26.

Vondette, H. J. 1957. A questionnaire census of sturgeon spearing, January-February, 1956, on Black, Burt, and Mullett lakes, Cheboygan County. Michigan Department of Natural Resources, Institute for Fisheries Research Report 1529.

Vondette, H. J., and J. E. Williams. 1961. The sturgeon fishery of Black, Burt, and Mullett lakes, Cheboygan County, 1957-1958. Michigan Department of Natural Resources, Institute for Fisheries Research Report 1616.

Ward, J. V., and J. A. Stanford. 1989. Riverine ecosystems: the influence of man on catchment dynamics and fish ecology. Pages 56-64 *in* D. P. Dodge, editor. Proceedings of the International Large River Symposium. Canadian Special Publication of Fisheries and Aquatic Sciences 106.

Appendix A. Lake Sturgeon harvested from Black Lake from 1999 through 2015.

Agency	Date	Total Length (in)	Weight (lbs)	Sex	Gear	Quota	Harvest
State of Michigan	02/04/1999	61.0	-	U	Spear	5	4
State of Michigan	02/01/1999	51.0	-	U	Spear		
State of Michigan	02/02/1999	67.0	-	M	Spear		
State of Michigan	02/04/1999	65.0	76.0	F	Spear		
State of Michigan	02/15/2000	66.0	63.0	F	Spear	5	5
State of Michigan	02/15/2000	61.5	49.1	F	Spear		
State of Michigan	02/15/2000	61.7	58.8	M	Spear		
State of Michigan	02/15/2000	57.5	49.6	F	Spear		
State of Michigan	02/16/2000	46.0	18.5	M	Spear		
State of Michigan	02/15/2001	67.0	63.0	M	Spear	5	6
State of Michigan	02/15/2001	65.5	58.6	F	Spear		
State of Michigan	02/15/2001	67.8	65.0	M	Spear		
State of Michigan	02/15/2001	66.5	78.0	F	Spear		
State of Michigan	02/15/2001	44.5	18.0	U	Spear		
State of Michigan	02/15/2001	58.0	51.0	F	Spear		
State of Michigan	02/15/2002	49.6	29.2	M	Spear	5	5
State of Michigan	02/16/2002	63.5	65.1	M	Spear		
State of Michigan	02/17/2002	70.25	108.6	F	Spear		
State of Michigan	02/18/2002	49.0	24.25	U	Spear		
State of Michigan	02/26/2002	60.0	48.3	M	Spear		
State of Michigan	02/15/2003	43.0	15.0	M	Spear	5	5
State of Michigan	02/15/2003	60.0	57.6	F	Spear		
State of Michigan	02/15/2003	55.8	59.3	F	Spear		
State of Michigan	02/15/2003	60.0	50.8	M	Spear		
State of Michigan	02/16/2003	45.7	23.0	M	Spear		
State of Michigan	02/15/2004	48.8	22.0	M	Spear	5	5
State of Michigan	02/16/2004	60.8	50.0	M	Spear		
State of Michigan	02/18/2004	71.8	92.0	F	Spear		
State of Michigan	02/23/2004	67.3	75.0	F	Spear		
State of Michigan	02/24/2004	58.5	39.0	M	Spear		
State of Michigan	02/05/2005	52.5	35.0	F	Spear	5	5
State of Michigan	02/07/2005	76.0	115.0	F	Spear		
State of Michigan	02/08/2005	58.0	45.0	M	Spear		
State of Michigan	02/09/2005	70.0	105.0	F	Spear		
State of Michigan	02/10/2005	73.0	76.0	F	Spear		

Appendix A. Continued.

Agency	Date	Total Length (in)	Weight (lbs)	Sex	Gear	Quota	Harvest
State of Michigan	02/04/2006	54.0	32.0	M	Spear	5	4
State of Michigan	02/06/2006	45.0	23.0	U	Spear		
State of Michigan	02/07/2006	60.5	48.0	M	Spear		
State of Michigan	02/08/2006	65.0	64.0	F	Spear		
State of Michigan	02/03/2007	69.5	70.5	F	Spear	5	4
State of Michigan	02/03/2007	63.0	69.0	F	Spear		
State of Michigan	02/07/2007	51.0	38.0	M	Spear		
State of Michigan	02/08/2007	63.0	59.0	U	Spear		
State of Michigan	2008					5	0
State of Michigan	02/07/2009	67.5	83.0	F	Spear	5	5
State of Michigan	02/08/2009	64.5	66.0	F	Spear		
State of Michigan	02/08/2009	70.5	89.5	F	Spear		
State of Michigan	02/09/2009	63.0	60.0	U	Spear		
State of Michigan	02/10/2009	53.5	35.0	M	Spear		
State of Michigan	02/06/2010	75.0	104.0	F	Spear	5	5
State of Michigan	02/06/2010	50.5	28.0	F	Spear		
State of Michigan	02/06/2010	73.5	100.5	F	Spear		
State of Michigan	02/06/2010	57.0	48.0	F	Spear		
State of Michigan	02/07/2010	70.0	102.5	F	Spear		
Tribal	02/13/2010	62.5	75.5	M	Spear	5	2
Tribal	04/15/2010	60.5	61.0	F	H&L		
State of Michigan	02/05/2011	66.0	73.0	F	Spear	7	11
State of Michigan	02/05/2011	54.7	38.0	M	Spear		
State of Michigan	02/05/2011	68.1	69.0	F	Spear		
State of Michigan	02/05/2011	55.0	39.0	M	Spear		
State of Michigan	02/05/2011	66.0	72.0	F	Spear		
State of Michigan	02/05/2011	66.5	66.0	F	Spear		
State of Michigan	02/05/2011	61.2	49.0	M	Spear		
State of Michigan	02/05/2011	52.0	30.0	M	Spear		
State of Michigan	02/05/2011	37.0	8.0	F	Spear		
State of Michigan	02/05/2011	29.0	5.0	M	Spear		
State of Michigan	02/05/2011	59.0	40.0	M	Spear		
Tribal	05/05/2011	61.8	58.0	M	H&L	7	5
Tribal	05/05/2011	61.8	59.0	M	H&L		
Tribal	02/09/2011	33.5	7.7	M	Spear		
Tribal	05/14/2011	76.4	108.0	F	H&L		
Tribal	05/20/2011	58.0	50.0	U	Spear		

Appendix A. Continued.

Agency	Date	Total Length (in)	Weight (lbs)	Sex	Gear	Quota	Harvest
State of Michigan	02/04/2012	59.0	45.5	M	Spear	3	2
State of Michigan	02/04/2012	53.5	32.2	M	Spear		
Tribal	05/01/2012	54.5	45.0	F	H&L	7	2
Tribal	05/01/2012	59.5	42.5	M	H&L		
State of Michigan	02/02/2013	39.0	11.0	M	Spear	7	6
State of Michigan	02/02/2013	66.0	67.0	F	Spear		
State of Michigan	02/02/2013	63.5	54.0	M	Spear		
State of Michigan	02/03/2013	42.0	13.0	M	Spear		
State of Michigan	02/04/2013	59.5	42.0	F	Spear		
State of Michigan	02/04/2013	45.0	18.0	F	Spear		
Tribal	05/01/2013	70.5	94.0	F	Spear	7	3
Tribal	05/04/2013	75.0	124.0	F	Spear		
Tribal	05/09/2013	65.5	-	M	Spear		
State of Michigan	02/01/2014	66.5	90.0	F	Spear	6	6
State of Michigan	02/01/2014	61.0	59.0	F	Spear		
State of Michigan	02/01/2014	66.0	70.0	M	Spear		
State of Michigan	02/01/2014	41.0	12.0	M	Spear		
State of Michigan	02/01/2014	51.5	28.0	M	Spear		
State of Michigan	02/01/2014	56.0	34.0	M	Spear		
Tribal	05/04/2014	63.0	56.0	M	H&L	6	4
Tribal	05/04/2014	73.0	108.0	F	Spear		
Tribal	05/11/2014	62.2	66.0	F	Spear		
Tribal	05/25/2014	67.0	-	F	Spear		
State of Michigan	02/07/2015	67.0	75.0	F	Spear	6	5
State of Michigan	02/07/2015	69.0	80.0	F	Spear		
State of Michigan	02/07/2015	58.5	45.0	M	Spear		
State of Michigan	02/07/2015	71.0	87.0	F	Spear		
State of Michigan	02/07/2015	50.0	31.0	F	Spear		
Tribal	05/02/2015	61.5	51.5	M	Spear	6	4
Tribal	05/02/2015	61.5	52.0	M	Spear		
Tribal	05/25/2015	68.5	-	F	Spear		
Tribal	05/02/2015	74.0	108.0	F	H&L		
State totals						89	83
Tribal totals						48	20

Appendix B. Population estimates for Black Lake Lake Sturgeon.

Year	Marking Method	Recapture Method	Method	Estimate of 30" and larger fish	Estimate of 50" and larger fish	Estimate of fish less than 50"	Spawning Stock
1975	Consecutive year summer tagging and harvest data	Summer Netting and Harvest Data	Peterson Estimator Modified	--	1,599 (714-3,998)	--	--
1997	May-July Gill Netting	Cumulative May-July Gill Netting	Schnabel Estimator	1,241 (792-2,418)	549 (366-1,101)	--	--
2002	July Gill Net Survey	July Gill Net Survey	Schnabel Estimator	725 (390-1103)	291 (152-706)	--	--
2007	Spring Spawning Run	July Gill Net Survey	Peterson Estimator	--	873 (548-1,772)	--	--
2007	July Gill Net Survey	July Gill Net Survey	Schnabel Estimator	1,305 (808-2,737)	309 (165-985)	--	--
2013	August Gill Netting	Cumulative August Gill Netting	Schnabel Estimator	--	--	6,114 (3,135-22,926)	--
2014	Cumulative Spawning Run Captures 2001-2014	Cumulative Spawning Run Captures 2001-2014	Breeding Return Time Model	--	--	--	Females=451 Males=577
2015	Cumulative Spawning Run Captures 2001-2015	Cumulative Spawning Run Captures 2001-2015	Breeding Return Time Model				Females=473 Males=603
2016	Cumulative Spawning Run Captures 2001-2016	Cumulative Spawning Run Captures 2001-2016	Breeding Return Time Model				Females=486 Males=627