THE STATE OF LAKE MICHIGAN IN 2005

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Lake Michigan depicting locations not otherwise identified in this publication. The lake basin is in grey, and treaty-ceded waters are depicted by diagonal lines.

TABLE OF CONTENTS

STATUS AND TRENDS OF LAKE STURGEON

Robert F. Elliott[5]

Maintain self-sustaining stocks of…sturgeon…Sturgeon populations should be enhanced by improving lake and stream habitat, assuring fish passage over barriers in historically used spawning streams, and devising protective regulations.

History

Lake sturgeon, formerly a dominant nearshore species, continues to be the object of increased study and recovery effort, in keeping with the above objective from Eshenroder et al. (1995). The previous state-of-the-lake report (Schneeberger et al. 2005b) identified at least eight known remnant populations, the largest with annual spawning runs of several hundred fish and the smallest with only a handful. Several indications at that time suggested lakewide abundance, although low, was increasing. Despite these positive signs, the sturgeon continues to be considered either rare, endangered, threatened, a species of greatest conservation need, or a resource conservation priority by one or more of the state, tribal, or federal agencies with responsibilities for the lake's fishes.

Progress

Recent mark-recapture estimates and direct counts indicate annual spawning runs of 199-577 adults in the lower Peshtigo River (see frontispiece for location of rivers) (Gunderman and Elliott 2004), 23-52 adults in the lower Manistee River (Gunderman 2001; Peterson et al. 2002; Lallaman 2003), 24-49 adults in the lower Fox River (Gunderman and Elliott 2004), and 15-23 adults in the lower Muskegon River (Peterson and Vecsei 2004). Although

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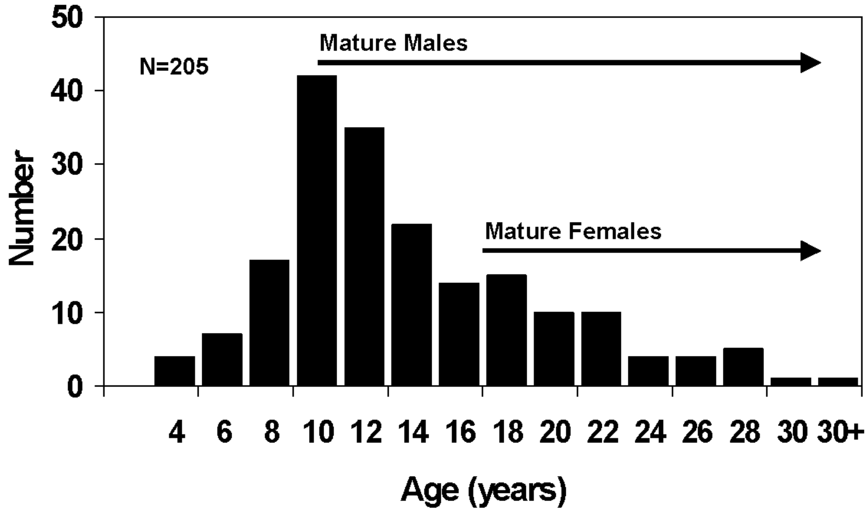
spawning-run size in the lower Menominee River (see frontispiece for river locations) has not been estimated, the resident population during summer was estimated at 457-1,329 fish in 1991 (Thuemler 1997), and spawners are thought to number in the hundreds each spring (G. Kornely, personal communication, 2005). Gillnet assessments and sightings suggest that annual spawner abundance in the lower Oconto (Gunderman and Elliott 2004), lower Manistique (Auer et al. 2004), lower Grand (K. Smith, personal communication, 2005), and lower Kalamazoo (Daugherty and Sutton 2004) Rivers is less than 25 fish per river. Sightings and samplings also suggest that adults may periodically spawn in the lower St. Joseph and Millecoquins Rivers and possibly on some shoals (Hay-Chmielewski and Whelan 1997). Populations also persist in two sections upstream of dams on the Menominee River (Thuemler 1997), in Indian Lake upstream of the lower dam on the Manistique River (Bassett 1981), and possibly upstream of the lower dam on the St. Joseph River (Daugherty and Sutton 2004). A large, self-sustaining population exists in the Lake Winnebago system upstream of the lower Fox River (Bruch 1999). Although fish from these systems can move downstream to Lake Michigan, they cannot return beyond the first dam.

Since 2000, production of sturgeon larvae has been documented in the lower Fox, Oconto, Peshtigo, Menominee, Manistee, Grand, and Muskegon Rivers, and fall young-of-the-year (YOY) have been documented in the Menominee, Manistee, Oconto, and Peshtigo Rivers (Benson 2004; Chiotti 2004; Gunderman and Elliott 2004; Peterson and Vecsei 2004). A single larvae has been collected in each of the St. Joseph and Kalamazoo Rivers (K. Smith, personal communication, 2005). The largest catches of drifting larvae and YOY have consistently come from the Peshtigo and Manistee Rivers (Benson 2004; Chiotti 2004). Benson (2004) estimated larval production in the Peshtigo River at 13,000-39,000 (95% CI) and YOY production at 160-390 (95% CI) for the 2002-2003 year-classes.

Populations of sturgeon are genetically structured with differences occurring geographically. Sturgeon populations in the Menominee, Peshtigo, Oconto, lower Fox, and Wolf Rivers (all of Green Bay) were genetically more similar to each other than to populations in the Manistee and Muskegon Rivers, which, in turn, were more similar to each other than to populations in Lake Huron tributaries (DeHaan 2003; Scribner et al. 2004). Small populations do not lack genetic diversity nor do they exhibit higher levels of genetic drift or inbreeding compared to larger populations (Scribner et al. 2004). The significant differences in allele frequency at microsatellite loci and in mitochondrial DNA among populations, including those in relatively close proximity, indicate that populations are reproductively isolated and that spawners exhibit a high degree of fidelity to their river of origin (Scribner et al. 2004). Tag returns also indicate that spawners return to the same river repeatedly to reproduce (RFE, unpublished data).

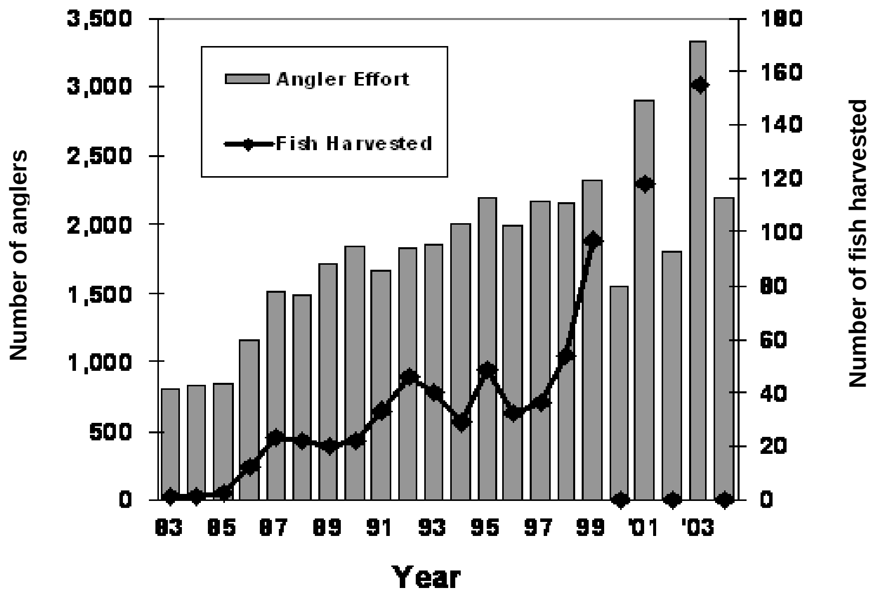
Spawning populations are composed primarily of fish less than 35 years of age and 175-cm total length (TL), although fish exceeding 50 years and 200 cm have been collected (Lallaman 2003; Gunderman and Elliott 2004; Peterson and Vecsei 2004). Sex ratios of spawning fish are highly skewed toward males (as expected), particularly in rivers with younger fish (Lallaman 2003; Gunderman and Elliott 2004; Peterson and Vecsei 2004). Open-water assessments targeting all sizes of sturgeon are dominated by fish less than 1,000-cm TL and younger than 12 years, suggesting recruitment to spawning populations may improve (Fig. 5; Gunderman and Elliott 2004; S. Lenart, personal communication, 2005). Observations of increased numbers of spawning fish in some tributaries (Gunderman and Elliott 2004; T. Thuemler and G. Kornely, personal communications, 2005) and reports of increased encounter rates by commercial and recreational fishers and in agency assessments suggest recruitment has improved in at least some areas of the lake during the 1980s and 1990s. If true, spawner abundance in some rivers may continue to increase in the near future as juveniles reach maturity.

Fig. 5. Age-frequency distribution of Lake Michigan lake sturgeon, projected from a subsample of 102 lake sturgeon captured during open-water assessments in Green Bay, 2002-2003. Maturity assignments reflect earliest maturity and are based on spawning assessments of Green Bay populations (from Gunderman and Elliott 2004).



Recaptures of marked sturgeon from the open waters of central and southern Green Bay indicate a population (fish ≥122 cm TL) of 920-4,455 (95% CI) (Gunderman and Elliott 2004). In a population of this size, a loss of more than 100 adult fish•yr^{-1} could be excessive (Bruch 1999). The recreational harvest in the lower Menominee River has increased steadily over the past 20 years, reaching a high of 150 fish (125-cm minimum length limit) registered during the 2003 season. While increasing harvest could be indicative of increasing abundance, effort also is increasing (Fig. 6). Other sources of mortality are from injury of fish released alive by recreational and commercial fishers, from fish struck by boat propellers or killed when passing through or around hydropower facilities, and from disease (RFE, unpublished data). Each summer since 2001, dead sturgeon have been reported washed up on numerous beaches around the lake. As many as 21 fish were reported in 2003, and most were from central Green Bay (Gunderman and Elliott 2004). Other dead fish have been recovered from near Michigan City (see frontispiece for location of ports), IN, and Manistee and Petoskey, MI. What proportion of this die-off was observed or reported is unknown. At the time of recovery, no obvious cause of death has been apparent, but laboratory examination of fresh specimens recovered from Green Bay found enough *Clostridium botulinum* in ingested prey items to suspect type-E botulism (R. Getchell, personal communication, 2005). Similar die-offs in Lake Erie and Lake Ontario since 2000 have been associated with type-E botulism (D. Carlson, personal communication, 2005).

Fig. 6. Harvest and effort for the recreational hook-and-line lake sturgeon fishery in the lower Menominee River (G. Kornely, personal communication, 2005). Zero catches in 2000, 2002, and 2004 reflect closures in alternate years.



Although sea lamprey related mortality has not been quantified for sturgeon, 82 of 212 fish collected in 2003 from the open waters of Green Bay bore a total of 128 marks. Type A-IV (feeding, healed) and Type B-IV (non-feeding, healed) marks (King 1980) were most common and amounted to 37 per 100 fish, indicating that sea lampreys commonly attached to sturgeon. Marking rates were 6 per 100 fish for A-I-III marks, which indicate more-recent attachments. The relationship between sea lamprey marking and mortality is currently being researched. The sensitivity of young sturgeon to the chemical 3-trifluoromethyl-4-nitrophenol (TFM) used to treat rivers for larval lamprey (Johnson et al. 1999) has led to the implementation in 1998 of a "sturgeon protocol" that reduces the concentration of TFM and defers treatments until after July 1 in rivers where YOY sturgeon are known or suspected to occur (U.S. Fish and Wildlife Service/Fisheries and Oceans Canada 2005).

Management

Substantial portions of the sturgeon's historical spawning and rearing habitats are impounded or blocked by dams, and no effective passage exists around these barriers. Passage, however, is being designed into a replacement for a dam on the Manistique River and for several dams on the Menominee River. Passage for native fishes, including sturgeon, also will be provided as a condition for operation of a barrier planned for the Cedar River. Careful regulation of flow over dams and through hydropower facilities is also necessary to ensure that river segments below dams remain usable by sturgeon.

In 2000, recreational harvest of sturgeon from Lake Michigan was banned, except in the Menominee River where harvest from a fall recreational fishery was reduced by increasing the minimum size limit from 50 inches to 70 inches (TL) in even-numbered years, creating essentially a catch-and-release fishery (M. Donofrio, unpublished data).

In 2004, the Little River Band of Ottawa Indians began a long-term rearing program on the Manistee River where wild-caught larvae are transferred into a streamside rearing facility for several months, to enhance early survival, before they are released in the river, typically in late summer (M. Holtgren, personal communication, 2005). The goal is to increase early survival before they are released.

In 2003, the Wisconsin Department of Natural Resources initiated a reintroduction of sturgeon into sections of the Milwaukee and Manitowoc Rivers having an unimpeded connection to Lake Michigan. Hatchery-reared larvae from egg-takes in the Wolf River were stocked into the Manitowoc (N = 119,793) and Milwaukee (N = 64,000) Rivers in the spring of 2003. In 2004, fingerlings (N = 2,000) and juveniles (N = 200) were stocked into the Milwaukee River and will be stocked in both rivers in 2005. In addition, 6-8 adults were transferred from the Wolf River into the Milwaukee River in each of these years (B. Eggold, personal communication, 2005). Details of these stocking programs spurred considerable debate among the agencies and institutions involved with sturgeon management and research. Concerns focused on the need to maintain and ensure genetic diversity among populations and on the potential risks posed to remnant populations if stocked fish were to stray and spawn in non-target rivers. In 2003, the Lake Michigan Committee formed the Lake Michigan Lake Sturgeon Task Group (LSTG) and charged it with reviewing stocking proposals and developing a restoration plan for sturgeon. Initial work on this plan resulted in draft *Guidelines for Genetic Conservation, Propagation and Stocking of Lake Sturgeon in Lake Michigan*. The agencies agreed to follow these guidelines when stocking fish in the future and began work to develop streamside facilities as means of rearing sturgeon in a manner that all agencies could support, beginning with the Milwaukee, Manitowoc, Cedar, and Whitefish Rivers in 2006.

Progress and Recommendations

Lakewide abundance and distribution of sturgeon in Lake Michigan remain low and restricted compared to historical levels. Although some populations appear to be self-sustaining and possibly increasing in abundance, the long-term status of other populations remains questionable. Research and assessment during the last five years represent progress in meeting the fish-community objective of maintaining self-sustaining stocks, but the objective of enhancing the lakewide population will require a larger effort. Existing agency restoration plans (Hay-Chmielewski and Whelan 1997; Wisconsin Department of Natural Resources 2000) and the current draft of the LSTG restoration plan provide additional objectives and strategies for maintaining and enhancing self-sustaining stocks of sturgeon. Specific strategies include inventorying populations and habitats so that areas for protection and restoration can be prioritized; augmenting remnant populations and reestablishing others; determining effects of exotic species, contaminants, and diseases on sturgeon; and implementing public education. A long-term commitment of additional resources will be required to implement and evaluate these strategies. With the eventual approval of a lake sturgeon restoration plan, more-specific objectives and strategies for sturgeon should be incorporated into a revision of the lake's fish-community objectives.

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