GREAT LAKES LAKE STURGEON COORDINATION MEETING

Proceedings of the December 11-12, 2002 Workshop
Sault Ste. Marie, Michigan

Funded by:
Great Lakes Fishery Trust

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2003

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Executive Summary:

The U. S. Fish and Wildlife Service, Great Lakes Fishery Trust, state agencies, tribal governments, universities, and Canadian government representatives participated in a workshop to exchange information relating to the study, management, and restoration of lake sturgeon, *Acipenser fulvescens*, in the Great Lakes Basin. Objectives were to address priority research and assessment needs, to consider issues related to stocking to restore populations and to identify survey techniques for determining status of adult and juvenile life stages. Participants described recent, ongoing and innovative lake sturgeon work across the Great Lakes basin. Presentations covered such topics as juvenile and adult assessments and biology, impacts on sturgeon survival, habitat, and database development. A panel of geneticists fielded questions from the audience and discussed the importance and implications of genetics as they relate to restoration efforts for Great Lakes lake sturgeon.

Basin overview and system specific presentations included information regarding status of remnant lake sturgeon populations in each of the Great Lakes. Lake sturgeon were historically abundant with spawning populations using many of the major tributaries, connecting waters, and shoal areas across the basin. The decline of lake sturgeon populations in the Great Lakes was rapid and commensurate with habitat loss, degraded water quality, and intensive fishing associated with settlement and development of the region. They are considered rare, endangered, threatened, or of special concern by Great Lakes fisheries management agencies, and harvest is generally prohibited or highly regulated in the Great Lakes Basin.

Most discussion groups from the consideration of stocking technical session identified the need for pre-planning and development of a management plan. In addition, the importance of a long-term commitment is vital to achieving success of lake sturgeon recovery. Of particular interest to the genetics panel were suggestions of the need and interest in pursuing development of genetics related guidelines for management plans that may include stocking.

The discussion of survey techniques to determine status was limited in effectiveness due to the large amount of material to synthesize (adult and juvenile sturgeon in all types of systems). However, valuable information was gathered during this breakout session.

Participants were asked to list, comment on, and rank topics they thought would be important to discuss during the technical sessions at future meetings. Habitat classification and restoration practices ranked significantly higher than the other nineteen topics suggested. Fifty three additional research and assessment needs were identified and grouped into five common theme areas of+: individual system and habitat requirements studies, status assessment and development of rapid survey techniques, fish passage technology, propagation techniques and strategy for development.

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Background:

In June, 2000, the Great Lakes Fishery Trust sponsored a workshop to determine the research and assessment needs to restore lake sturgeon in the Great Lakes (Holey et al. 2000). At the conclusion of that workshop, participants expressed a near unanimous opinion that some kind of annual meeting be sponsored to continue the communication of sturgeon work across the Great Lakes basin. In 2001, the Trust included in their request for proposals a call for some entity to organize and convene such meetings. The Great Lakes Basin Ecosystem Team Lake Sturgeon Committee (Lake Sturgeon Committee) of the U.S. Fish and Wildlife Service felt this was a service they could provide and submitted a proposal to the Trust to organize and convene a series of three coordination meetings. The Trust funded this proposal and a meeting was convened December 11-12, 2002 in Sault Ste. Marie, Michigan. This report provides a compendium of the first Great Lakes Lake Sturgeon Coordination Meeting.

Meeting Organization and Purpose:

The meeting was organized by a steering committee composed of representatives from the federal, state, provincial, and tribal agencies throughout the basin. They included:

Rob Elliott (USFWS-Green Bay)	Nancy Auer (Michigan Tech University)
Tracy Hill (USFWS-Alpena)	Ed Baker (Michigan DNR)
Henry Quinlan (USFWS-Ashland)	Ron Bruch (Wisconsin DNR)
Betsy Trometer (USFWS-Amherst)	Doug Carlson (New York DEC)
John Weisser (USFWS-Marquette)	Marty Holtgren (Little River Band)
Emily Zollweg (USFWS-Amherst)	Lloyd Mohr (Ontario MNR)

An open invitation to attend the meeting was distributed to biologists, managers, researchers, students, and the interested public from across the Great Lakes. The invitation was also posted on the Great Lakes Lake Sturgeon Web Page < http://midwest.fws.gov/sturgeon/ >.

PURPOSE: **Provide a forum to foster communication and exchange of information relating to the study, management, and restoration of lake sturgeon in the Great Lakes basin, to address priority research and assessment needs, and to address selected emerging issues.**

The meeting was structured around providing a forum for information exchange, social interaction, and addressing two topics identified by the steering committee as being timely for furthering restoration efforts across the basin. In addition to offering a time for contributed presentations describing recent findings, initiatives or issues of concern, the steering committee solicited a number of key presentations that provided the necessary background for the emerging issue discussions. Presentation formats included 10 minute and 3 minute presentations to allow as many participants as possible to present a variety of topics. Five geneticists were invited to the meeting to provide insight and respond to questions related to lake sturgeon restoration.

Meeting Overview

One hundred fourteen people attended the two day meeting. They represented 42 agencies, states, provinces, tribes, institutions, and organizations. Fifty-six people attended from 12 federal, state and provincial resource agencies, 20 people were from 10 tribal & first nation resource agencies, 25 individuals were from 12 universities and institutions, and 13 were from public or private organizations and companies.

The first day of the meeting served as the primary forum for information exchange during which 40 oral presentations and 19 poster or display presentations were given by 34 different participants. Participants highlighted and describe recent, ongoing and innovative lake sturgeon work across the Great Lakes basin including work being funded by the Great Lakes Fishery Trust (GLFT). These were led by a series of basin overviews that highlighted both the status of remnant populations in each lake as well as ongoing lake sturgeon management, research and assessment work in each lake basin. This information was also summarized on a series of maps and associated tables that were provided to each attendee. The basin overviews were followed by a series of seven presentations that provided examples of stocking activities and stocking considerations and four presentations that detailed genetics evaluations of sturgeon populations in the Great Lakes (see Agenda). These presentations provided background information for the technical sessions scheduled for the second day of the meeting.

The afternoon of the first day featured presentations about juvenile and adult assessments and biology that provided information pertinent to the second technical session scheduled for day two. Presentations covering such topics as impacts on sturgeon survival, habitat, & database development concluded the presentations on day one.

In addition to oral and poster presentations, participants were invited to provide a 1-page abstract describing their work on lake sturgeon or raising an important issue and many gave an informal presentation. A booklet containing 48 of these abstracts (Appendix A) along with an attendance list (Appendix B), maps and tables describing the current status of lake sturgeon populations across the Great Lakes basin, and other information pertaining to the meeting were distributed to each participant when they arrived at the meeting. An evening Chili Social following the first day of presentations provided additional opportunities for informal exchanges and presentation of posters and other display materials.

The second day of the meeting consisted of technical sessions addressing two emerging issues: 1) the consideration of stocking to restore populations and 2) survey techniques for determining status. Many of the solicited presentations given during the first day provided information pertinent to these topics. To facilitate active participation from everyone in these discussions, attendees were divided into nine breakout groups, each with an assigned facilitator and recorder. Each group was provided an objective for their discussion and given a list of guiding questions. After discussing each focus topic for 90-120 minutes, the group participants reconvened and each group reported back the results of their discussions (Appendix C). Following the focused discussion on stocking considerations, a panel of geneticists fielded questions from the audience and discussed the importance and implications of genetics as they relate to restoration efforts for Great Lakes lake sturgeon.

GREAT LAKES LAKE STURGEON COORDINATION MEETING AGENDA

Wednesday, December 11, Day 1 – Participant Presentations

8:00-9:00 Registration

9:00 Welcome, Introductions, Meeting Goal, Objectives and Format (R. Elliott)

9:15-10:15 **Basin overview Presentations of Status and Assessment Activities**

- Lake Superior – Nancy Auer, Michigan Technological University, Henry Quinlan, USFWS - Ashland FRO
- Lake Michigan – Marty Holtgren, Little River Band of Ottawa Indians, Rob Elliott, USFWS - Green Bay FRO
- Lake Huron – Mike Thomas, Michigan DNR - Lake St. Clair
- Lake St. Clair/Erie – Emily Zollweg, USFWS - Lower Great Lakes FRO
- Lake Ontario/St. Lawrence – Alastair Mathers, Ontario MNR - Glenora Field Station, Doug Carlson, New York DEC - Watertown

10:15 Break (refreshments provided)

10:30-11:50 **Examples of stocking activities and stocking considerations**

- Fingerling and fry stocking in the St. Louis R. - Steve Schram, Wisconsin DNR, Bayfield
- Stocking Eggs to Restore Lake Sturgeon in the upper St. Louis River, Henry Quinlan, USFWS – Ashland FRO, Larry Schwarzkopf and Terry Perault, Fond du Lac Band of Lake Superior Chippewa
- Stocking in the Ontonagon River, MI - Ed Baker, Michigan DNR Marquette Research Station
- Restoration in Oneida Lake, NY - James Jackson, Cornell Biological Field Station
- L. Champlain restoration program - Chet MacKenzie, Vermont Dept. of Fish and Wildlife
- Adult transfers in the upper Wolf River - Jeremy Pyatskowit, Menominee Indian Tribe of WI
- Camus Project: student viewing/reintroduction - Larry Robichaud, Club Navigateur La Ronde
- Imprinting of stocked fish - Nancy Auer, Michigan Technological University

11:50 Lunch (on your own)

1:00-1:50 **Genetics evaluations of sturgeon populations**

- Molecular marker development & management - Amy Welsh, University of California-Davis, Tracy Hill, USFWS-Alpena FRO
- Genetic structuring in the Upper Great Lakes - Kim Scribner, Michigan State University
- Genetic determination of parentage - Pat DeHaan, Michigan State University
- Genetics of brood stock development - Adrian Spidle, USGS - Leetown Science Center, WV

1:50-2:40 **Juvenile Assessment and Biology**

- Sturgeon River juvenile assessments - Marty Holtgren, Little River Band of Ottawa Indians
- Trawling to assess YOY and juvenile sturgeon - Henry Quinlan, USFWS - Ashland FRO
- Juvenile habitat of the Groundhog River - Charles Hendry, Ontario MNR-NE Section
- Early life history dynamics in the Peshtigo River, WI - Angela Benson, Purdue University
- St. Lawrence R. distribution, diet and pop. Dynamics - Jennifer Hayes, SUNY-Syracuse
- Radio telemetry on the Kaministiquia R. - Mike Friday, Ontario MNR-Upper Great Lakes

2:40-2:55 Break

2:55-3:55 **Adult Assessment and Biology**

- In-stream Hydroacoustic assessments - Nancy Auer, Michigan Technological University
- Use of archival tags to determine habitat use - Henry Quinlan, USFWS - Ashland FRO
- Trawling assessments and poaching in the St. Clair System - Mike Thomas, Michigan DNR - Lake St. Clair
- St. Mary's River population assessment - Trent Sutton, Purdue University
- Muskegon River assessment and life history study - Douglas Peterson, University of Georgia
- Manistee River population assessment - Joshua Lallaman, Central Michigan University
- Research activities of the LRBOI - Marty Holtgren, Little River Band of Ottawa Indians

Lake Winnebago system sturgeon update - Ron Bruch, Wisconsin DNR, Oshkosh *(cancelled)*

3:55-5:00 **Impacts on Sturgeon Survival, Habitat, & Database Development**

Lampricide impacts on sturgeon in the Garden River - Jerry Weise, Fisheries and Oceans Canada

Waterpower impacts on lake sturgeon in the Ottawa River - Tim Haxton, Ontario MNR

Spawning egg density affects on survival, Ouareau R. - Michel La Haye, Enviro-Science Inc.

Gamete quality evaluation in lake sturgeon - Konrad Dabrowski, Ohio State University

Spawning habitat in Huron-Erie channel - Bruce Manny, USGS Great Lakes Science Center

Fish barrier database in MI/ON waters of Great Lakes - Ed Baker, Michigan DNR, Marquette

MNFI application for sturgeon occurrences - Stephanie Carman, Michigan State Univ. Ext.

Great Lake sturgeon tributary database and GIS - Emily Zollweg, USFWS-Lower Lakes FRO

Documenting wounds, marks and scars - Rob Elliott, USFWS-Green Bay FRO

5:00 p.m. Adjourn (set up for poster session and evening social)

6:00 p.m. Poster and Display Presentations begin

6:15 p.m. Evening Buffet Social and Chili Feed

Day 1 – Poster and Display Presentations 6:00 p.m., Wednesday, December 11

The Role of Public Relations and Education in Lake Sturgeon Rehabilitation and Recovery - Brenda Archambo – Sturgeon For Tomorrow - Black Lake Chapter

Prickett Dam Spillway- Nancy Auer, Michigan Technological University

Influence of External Transmitter Size and Shape on Survival, Growth and Tag Loss of Juvenile Lake Sturgeon - Angela Benson, Purdue University

Lake Sturgeon Spawning in the St. Clair River - James Boase, US Fish and Wildlife Service – Alpena FRO

Michigan Natural Features Inventory Data Management - Stephanie Carman, Michigan Natural Features Inventory, Michigan State University Extension

Cytology of the Lake Sturgeon - Lake Sturgeon Restoration Work at the Northern Appalachian Research Laboratory - Martin DiLauro, USGS-BRD, NARL, Wellsboro PA

Big Game Tags for a Minnesota Fish? - Jeff Eibler, Minnesota DNR Division of Fisheries

St. Louis River Egg Stocking - Larry Schwarzkopf and Terry Perault, Fond du Lac Band, Cloquet, MN

Population Genetics of Lake Sturgeon in Northern Ontario and the Prairie Provinces - Moira Ferguson, University of Guelph

Lake Sturgeon Population Assessment in the Mississaugi River, Ontario, 1998-2002 - Mike Gillies and Ed Desson Anishinabek/Ontario Fisheries Resource Centre, North Bay, ON

Size Selectivity of Several Gear Types Used to Collect Lake Sturgeon - B. Gunderman, R. Elliott (FWS), S. Schram, T. Meronek, T. Lychwick (WDNR), J. Lallaman (CMU), D. Peterson (U of GA)

Characteristics of and Un-impacted Population of Lake Sturgeon in a Small Boreal Headwater System - Charles Hendry, Ontario MNR, North East Science and Information Section

A Historic Lake Michigan Spawning Site Off Chicago - Roger Klocek, Shedd Aquarium, Chicago IL

Lake Superior Lake Sturgeon Surveys as Reported by Commercial Fishers - Scott Koproski, Bay Mills Indian Community; Ed Baker, Michigan DNR; Glenn Miller, USFWS-Ashland FRO

Occurrence of *Argulus* spp. on Lake Sturgeon and Walleye in the St. Mary's River - Alexandre Litvinov and Richard Back, Lake Superior State University

Great Lakes Fishery Trust - Holly Madill, Great Lakes Fishery Trust, Lansing, MI

Juvenile Lake Sturgeon Index Netting Outside the Bad River, WI - Mike Plucinski, Great Lakes Indian Fish and Wildlife Commission, Odanah, WI

John Seyler, Anishinabek/Ontario Fisheries Resource Centre, North Bay, ON

Lake Sturgeon Observations and Collections in Great Lakes Tributaries, 1999 – 2002 - Jerry Weise and Brian Stephens, Fisheries and Oceans, Canada

Thursday, November 12 Day 2 –Technical Sessions, Emerging Issues and Research and Assessment Needs

8:00 a.m.	Orientation for Day 2: Workshop Discussion Format
8:15 a.m.	Emerging Issue #1: Consideration of Stocking to Rehabilitate Populations Disperse to Facilitated Breakout Group discussions
9:45 a.m.	Break to reconvene large group (refreshments provided)
10:00 a.m.	Summary Presentations from Breakout Groups (Baker – moderator)
10:30 a.m.	Genetics Panel Discussion and Question Period (Quinlan - moderator)
12:00 p.m.	Group Lunch ($5 cost per person)
1:00 p.m.	Emerging Issue #2: Consideration of Assessment Techniques to Determine Status Disperse to Facilitated Breakout Group discussions
3:00 p.m.	Break to reconvene large group (refreshments provided)
3:15 p.m.	Summary Presentations from Breakout Group (Auer - moderator)
4:15 p.m.	Identification of Emerging Issues for Future Discussion (Elliott - moderator)
4:30 p.m.	Review of Priority Research and Assessment Needs (Hill - moderator)
4:45 p.m.	Wrap-up, evaluation, and adjourn to Happy Hour

BASIN OVERVIEWS

History

Lake sturgeon, *Acipenser fulvescens*, were historically abundant in the Great Lakes with spawning populations using many of the major tributaries, connecting waters, and shoal areas across the basin. Prior to European settlement of the region, they were a dominant component of the nearshore benthivore fish community, with populations estimated in the millions in each of the Great Lakes (Baldwin et al. 1979, Figure 1). In the mid to late 1800s, they contributed significantly as a commercial species ranking among the five most abundant species in the commercial catch (Baldwin et al. 1979).

The decline of lake sturgeon populations in the Great Lakes was rapid and commensurate with habitat destruction, degraded water quality, and intensive fishing associated with settlement and development of the region. Sturgeon were initially considered a nuisance species of little value by European settlers, but by the mid 1800s, their value as a commercial species began to be recognized and a lucrative fishery developed. But in less than 50 years, their abundance had declined sharply, and since 1900, they have remained a highly depleted species of little consequence. Sturgeon are now extirpated from many tributaries and waters where they once spawned and flourished (Figure 1, Tables 1, 3, 5, 7, 9). They are considered rare, endangered, threatened, or of watch or special concern status by the various Great Lakes fisheries management agencies. Their harvest is currently prohibited or highly regulated in most U. S. and Canadian waters of the Great Lakes.

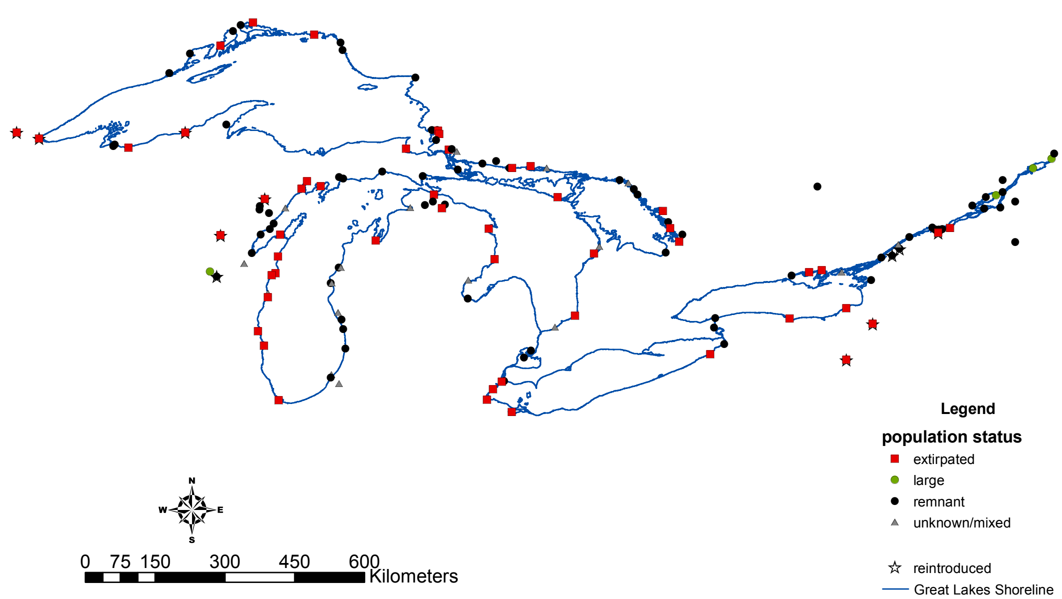

Figure 1. Distribution and status of lake sturgeon populations in the Great Lakes Basin, 2002.

Lake Superior

In Lake Superior, sturgeon are distributed throughout the basin with concentrations found near spawning tributaries in the U. S. and Canada. At least 22 tributaries historically supported spawning populations (Table 1, Figure 2). Current reproduction has been documented in 11 of these tributaries of which 10 are known to be self-sustaining populations. The tributaries in which current natural reproduction has been documented include: Sturgeon River, Michigan; Bad and White Rivers, Wisconsin; and Goulais, Batchawana, Michipicoten, Pic, Gravel, Nipigon, Black Sturgeon, and Kaministiquia Rivers in Ontario. Populations from each of these rivers are reduced from historical levels and the population status is described as "remnant", indicating an annual spawning run of less than 1,000 individuals (Table 1).

There are no estimates of lake sturgeon abundance in Lake Superior prior to information from targeted commercial harvests in the 1880's. Mark and recapture studies have been conducted to estimate the annual spawning population for the Sturgeon and Bad Rivers (Table 1). A few hundred individuals have been estimated to annually ascend each of these rivers. A total population estimate of 140-175 individuals has been made for a resident population in the Kaministiquia River (Table 1). Abundance remains unknown for most rivers.

Currently, there is no commercial harvest of lake sturgeon allowed in Lake Superior. Regulation of recreational and subsistence/home use harvest in Lake Superior varies by agency. A summary of harvest regulations is provided in Table 1.

There are at least 18 agencies and academic institutions involved with lake sturgeon assessment in the Lake Superior basin. They are the Bad River Band of Lake Superior Chippewa, Bay Mills Indian Community, Canadian Department of Fisheries and Oceans, Fond du Lac Band of Lake Superior Chippewa, Grand Portage Band of Lake Superior Chippewa, Great Lakes Indian Fish and Wildlife Commission, Keweenaw Bay Indian Community, Lake Superior State University, Michigan Department of Natural Resources, Michigan Statue University, Michigan Technological University, Minnesota Department of Natural Resources, Ontario Ministry of Natural Resources, Red Cliff Band of Lake Superior Chippewa, University of California – Davis, U.S. Fish and Wildlife Service, U.S. Geological Survey and Wisconsin Department of Natural Resources. Contemporary surveys of varying effort have occurred in 12 of the 22 historic spawning tributaries. In addition, several embayments and nearshore areas that serve as post spawning or feeding areas are surveyed. A summary of ongoing assessment activities and contact persons can be found in Table 2. Agency assessment and research efforts in Lake Superior are guided by several management plans. These plans are listed in Table 2.

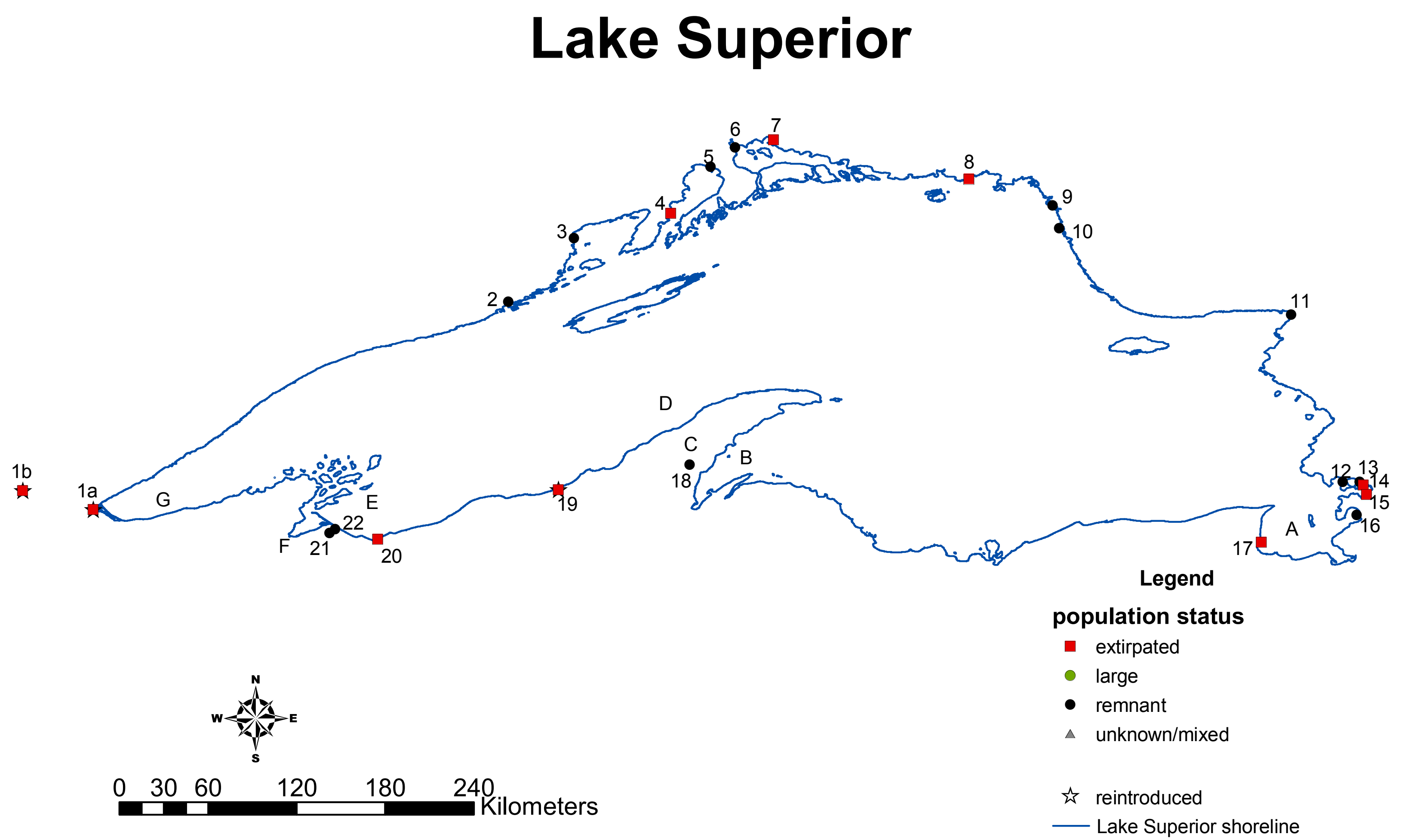

Figure 2. Distribution and status of lake sturgeon populations in the Lake Superior Basin, 2002. Numbers and letters correspond to Tables 1 and 2.

Table 1. Observations or general status of lake sturgeon populations in the Lake Superior Basin. Population status definitions are: **Ext** = extirpated, **Large** = 1,000 or more adults in the annual spawning runs; **Rem** (remnant) = less than 1,000 adults in annual spawning run of natural origin; **Re-I** (reintroduced) = fish stocked into system in reintroduction attempt, or **Unk** = unknown. A "**Yes**" indicates regular observation or presumed annual occurrence. Occasional (**Occ**) observations are as noted. Successful reproduction was defined as recent capture of larval or juvenile sturgeon. Notes on allowed harvest follow the table.

Basin/Site Number	Site Name	Population Status	Size of Annual Spawning Run	Observations:				Reproduction Successful?
				Adults	Spawning	Larva	Juveniles	
Lake Superior								
1a	St. Louis River (lower)	Re-I / Ext	0	Occ	Unk	Unk	Yes (Re-I)	Unknown
1b	St. Louis River (upper)	Re-I / Ext	0	Unk	No	No	Occ (Re-I)	No
2	Pigeon River	Rem	Unknown	Occ	Unk	Unk	Occ	Unknown
3	Kaministiquia River	Rem	140 - 175	Yes	Occ	Occ	Yes	Yes
4	Wolf River	Ext						
5	Black Sturgeon River	Rem	Unknown	Yes	Unk	No	Occ	Unknown
6	Nipigon River	Rem	Unknown	Yes	Unk	No	Occ?	Unknown
7	Gravel River	Ext						
8	Prairie River	Ext						
9	Pic River	Rem	Unknown	Yes	Unk	Unk	Yes	Yes
10	White River, Ont.	Rem	Unknown	Occ	Unk	Unk	Unk	Unknown
11	Michipicoten River	Rem	Unknown	Yes	Unk	Unk	Unk?	Unknown
12	Batchawana River	Rem	Unknown	Yes	Yes	Occ	Yes	Yes
13	Chippewa River	Rem	Unknown	Occ?	Unk	Unk	Occ?	Unknown
14	Harmony River	Ext						
15	Stokely Creek	Ext						
16	Goulais River	Rem	Unknown	Occ?	Occ?	Occ?	Occ?	Yes
17	Tahquamenon River	Ext						
18	Sturgeon River	Rem	≅200	Yes	Yes	Yes	Yes	Yes
19	Ontonagon River	Re-I / Ext	0	No	No	No	Yes (Re-I)	No
20	Montreal River, WI/MI	Ext						
21	Bad River	Rem	≅250	Yes	Yes	Yes	Yes	Yes
22	White River, WI	Rem	>15	Occ	Occ	Occ	Unk	Yes

Allowed Harvest: Wisconsin waters: recreational - 1 per year, minimum length 50 inches (127 cm);
Ontario waters: recreational Pigeon R. to Thunder Bay – 1/day, min. length 114 cm (45 in) between 12/1 - 5/12 and 6/15 - 12/31;
Tribal: Grand Portage – no regulations; Pic River – no regulations; Batchawana – no regulations; Bay Mills Indian Community – recreational – no regulations, commercial - home use of dead fish permitted; Chippewa – Ottawa Resource Authority – recreational – no regulations (harvest discouraged), commercial – home use of dead fish permitted; Keweenaw Bay Indian Community – recreational - 2/year, minimum length 50 inches (127 cm), commercial - home use of dead fish permitted; Bad River Band – recreational – no regulations, commercial – home use permitted; Red Cliff Band – recreational – tributaries 1/year, minimum length 45 inches (114 cm), in lake – follow State regulations, commercial – home use permitted; Fond du Lac Band – recreational – 1/year, commercial – no regulations.

Table 2. Listing of recent and ongoing lake sturgeon status assessment (**SA**), monitoring (**MO**), research (**RE**), management (**MA**), or re-introductions (**Re-I**) occurring in Lake Superior waters with lead contacts for further information. Data or observations from incidental captures by commercial, sport, or other assessment fisheries or from the public are noted (**incidental**). Basin-wide involvement and existing management plans are listed at the end the table.

Basin/Site Number	Site Name	Type of activity	Contact persons/organization
Lake Superior			
1a	St. Louis River (lower)	MO / Re-I	Steve Schram, WIDNR, Bayfield, WI John Lindgren, MNDNR, Duluth, MN
1b	St. Louis River (upper)	MO / Re-I	Larry Schwarzkopf, Fond du Lac Band, Cloquet, MN
2	Pigeon River	SA (planned)	Ben Whiting, Grand Portage Band, Grand Portage, MN
3	Kaministiquia River	SA / RE	Mike Friday, OMNR, Thunder Bay, ON
5	Black Sturgeon River	SA	Mike Friday, OMNR, Thunder Bay, ON
9	Pic River	SA	Bill Gardner, DFO, Sault Ste. Marie, ON Henry Quinlan, USFWS, Ashland, WI
11	Michipicoten River	SA (planned)	Bill Gardner, DFO, Sault Ste. Marie, ON Sue Greenwood, OMNR, Sault Ste. Marie, ON
16	Goulais River	SA	Sue Greenwood, OMNR, Sault Ste. Marie, ON

Basin/Site Number	Site Name	Type of activity	Contact persons/organization
18	Sturgeon River	SA / RE	Nancy Auer, Mich Tech Univ, Houghton, MI Ed Baker, MIDNR, Marquette, MI
19	Ontonagon River	SA / Re-I	Ed Baker, MIDNR, Marquette, MI Nancy Auer, Mich Tech Univ, Houghton, MI
21	Bad River	MO / RE	Henry Quinlan, USFWS, Ashland, WI Bill Mattes, Great Lakes Indian Fish and Wildlife Commission, Odanah, WI
22	White River, WI	SA	Henry Quinlan, USFWS, Ashland, WI Bill Mattes, Great Lakes Indian Fish and Wildlife Commission, Odanah, WI
A	Whitefish Bay	MO	Scott Koproski, Bay Mills Indian Community, Brimley, MI Ed Baker, MIDNR, Marquette, MI
B	Keweenaw Bay	MO	Gene Mensch, Keweenaw Bay Indian Community, Baraga, MI Glenn Miller, USFWS, Ashland, WI
C	Portage Lake (Pike Bay)	SA / RE	Nancy Auer, Mich. Tech. Univ., Houghton, MI Ed Baker, MIDNR, Marquette, MI
D	Western Keweenaw Penn.	MO	Ed Baker, MIDNR, Marquette, MI
E	Mouth of Bad River	MO	Mike Plucinski, Great Lakes Indian Fish and Wildlife Comm., Odanah, WI
F	Chequamegon Bay	MO	Steve Schram, WIDNR, Bayfield, WI
G	Western WI waters	MO	Steve Schram, WIDNR, Bayfield, WI

Management plans: A Lake Sturgeon Rehabilitation Plan for Lake Superior (Auer 2003)
The Wisconsin Lake Sturgeon Management Plan. WDNR. 2000 (Karl Scheidegger, Wisconsin DNR, Madison WI)
State of Michigan Lake Sturgeon Rehabilitation Strategy. MDNR. 1997 (Liz Hay-Chmielewski and Gary Whelan, Michigan DNR, Lansing MI.)

Basin Wide Task Group: None at present

Lake Michigan

Lake sturgeon populations in Lake Michigan continue to sustain themselves at a small fraction of their historical abundance. Based on available data, an optimistic estimate of the lakewide abundance of adult lake sturgeon is below 5,000 fish, well below 1% of the most conservative estimates of historic abundance (Hay-Chmielewski and Whelan 1997). Remnant populations currently are known to spawn in waters of at least 8 tributaries having unimpeded connections to Lake Michigan (Figure 3, Table 3). Estimates of spawner abundance in these rivers range from just a few fish to several hundred annually, with six rivers appearing to support more than 25 spawning adults during the annual spawning run each spring (Table 3). However, spawner abundance is still unknown in several tributaries and successful reproduction has been documented in just four tributaries to date, though it is suspected in several others. Lake sturgeon have been observed during spawning times in three other tributaries and near two shoal areas. It is not known if spawning occurs there and their status in these areas is completely unknown.

There are currently 16 agencies and institutions involved with investigations of lake sturgeon in Lake Michigan (Table 4). They are the Michigan Department of Natural Resources, Wisconsin Department of Natural Resources, U.S. Fish and Wildlife Service, Little River Band of Ottawa Indians, Little Traverse Bay Band of Odawa Indians, Grand Traverse Bay Band of Ottawa and Chippewa Indians, Central Michigan University, Michigan State University, University of Wisconsin-Milwaukee, Michigan Technological University, Purdue University, University of Georgia, University of Massachusetts, Saint Mary's University, and the Shedd Aquarium.

Nine agencies and institutions currently are involved in investigating the status of known and suspected remnant spawning populations. Habitat surveys have been initiated in several tributaries to quantify both existing and potential habitat for various life stages of lake sturgeon. Improved flow regimes through hydroelectric facilities and developing and installing up and downstream fish passage devices have been the focus of other managers and researchers (Table 4). Several agencies have begun to track incidental occurrences of lake sturgeon in assessments for other species and have involved volunteer commercial fishers to gather data from incidental captures (Table 4).

Reintroduction efforts are occurring in upriver reaches of the Menominee and Wolf rivers where sturgeon have been extirpated. Menominee River stockings have involved fry, fingerlings, and yearling and older fish with unknown results to date. Additional stocking initiatives in at least two Lake Michigan tributaries - the Milwaukee and Manitowoc rivers - are planned to begin in 2003 and plans for stocking southern Lake Michigan waters have been proposed (Table 4). In addition, a Lake Michigan Lake Sturgeon Task Force is being formed under the auspices of the Lake Michigan Committee of the Great Lakes Fisheries Commission to develop and coordinate the implementation of a lake-wide lake sturgeon rehabilitation plan.

Lake Michigan

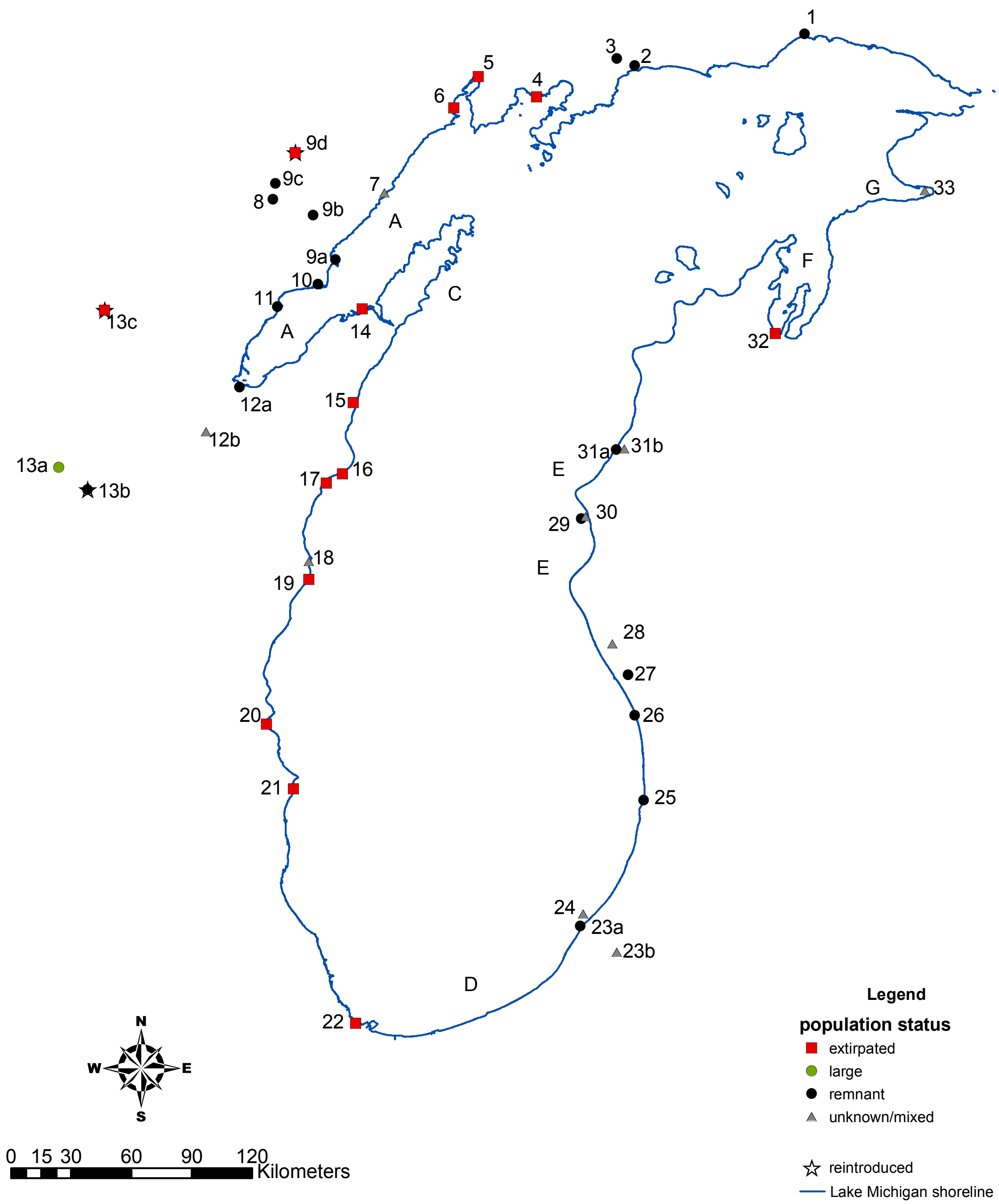

Figure 3. Distribution and status of lake sturgeon populations in the Lake Michigan Basin, 2002. Numbers and letters correspond to Tables 3 and 4.

Table 3. Observations or general status of lake sturgeon populations in the Lake Michigan Basin. Population status definitions are: **Ext** = extirpated, **Large** = 1,000 or more adults in the annual spawning runs; **Rem** (remnant) = less than 1,000 adults in annual spawning run of natural origin; **Re-I** (reintroduced) = fish stocked into system in reintroduction attempt, or **Unk** = unknown. A "**Yes**" indicates regular observation or presumed annual occurrence. Occasional (**Occ**) observations are as noted. Successful reproduction was defined as recent capture of larval or juvenile sturgeon. Notes on allowed harvest follow the table.

Basin/Site Number	Site Name	Population Status	Size of Annual Spawning Run	Observations:				Reproduction Successful?
				Adults	Spawning	Larva	Juveniles	
Lake Michigan								
1	Millecoquins River	Rem	<10	Occ	Occ	Unk	Unk	Unk
2	Manistique River	Rem	10's	Yes	Unk	Unk	Unk	Unk
3	Indian Lake	Rem	Unk	Yes	Unk	Unk	Unk	Unk
4	Sturgeon (Nahma) River	Ext		Occ				
5	Whitefish River	Ext		Occ				
6	Escanaba River	Ext		Occ				
7	Cedar River	Unk	Unk	Occ	Unk	Unk	Occ	Unk
8	Pike River	Rem	Unk	Yes	Unk	Unk	Unk	Unk
9a	Menominee R. (below last dam)	Rem	>200	Yes	Yes	Yes	Yes	Yes
9b	Menominee R. (below GR dam)	Rem	<100	Yes	Yes	Unk	Yes	Yes
9c	Menominee R. (below WR dam)	Rem	≅200	Yes	Yes	Unk	Yes	Yes
9d	Menominee R. (below St. Falls)	Ext, Re-I	None	No	No	No	Unk	No
10	Peshtigo River	Rem	<200	Yes	Yes	Yes	Yes	Yes
11	Oconto River	Rem	<50	Yes	Yes	Yes	Occ	Yes
12a	Fox River (below last dam)	Rem	<100	Yes	Yes	Yes	Unk	Yes
12b	Fox River (between dams)	Unk	Unk	Occ	Unk	Unk	Unk	Unk

Basin/Site Number	Site Name	Population Status	Size of Annual Spawning Run	Observations: Adults	Spawning	Larva	Juveniles	Reproduction Successful?
13a	L. Winnebago – Wolf R. system	Large	22,000	Yes	Yes	Yes	Yes	Yes
13b	L. Winnebago - Upper Fox R.	Rem, Int	≅200-300	Yes	Yes	Yes	Yes	Yes
13c	Wolf River – above Keshena	Ext, Re-I	Unk	Yes	Unk	Unk	Unk	Unk
14	Sturgeon Bay area shoals	Ext						
15	Kewaunee River	Ext						
16	East/West Twin Rivers	Ext						
17	Manitowoc River	Ext, Re-I						
18	Sheboygan River	Unk	Unk	Occ	Unk	Unk	Unk	Unk
19	Barr Creek	Ext						
20	Milwaukee River	Ext, Re-I						
21	Root River	Ext						
22	Chicago Reef complex	Ext						
23a	St. Joseph R. (below last dam)	Rem	Unk	Occ	Unk	Unk	Occ	Unk
23b	St. Joseph R. (between dams)	Unk	Unk	Unk	Unk	Unk	Occ	Unk
24	St. Joseph Shoal	Unk	Unk	Inf	Unk	Unk	Unk	Unk
25	Kalamazoo River	Rem	Unk	Occ	Occ	Unk	Unk	Unk
26	Grand River	Rem	Unk	Occ	Unk	Unk	Unk	Unk
27	Muskegon River	Rem	<25	Yes	Yes	Yes	Unk	Yes
28	White River	Unk	Unk	Unk	Unk	Unk	Unk	Unk
29	Ludington Shoal	Unk	Unk	Occ	Unk	Unk	Unk	Unk
30	Pere Marquette River	Unk	Unk	Occ	Unk	Unk	Unk	Unk
31a	Manistee R. (below last dam)	Rem	<50	Yes	Yes	Yes	Occ	Yes

Basin/Site Number	Site Name	Population Status	Size of Annual Spawning Run	Observations: Adults	Spawning	Larva	Juveniles	Reproduction Successful?
31b	Manistee R. (above last dam)	Unk	Unk	Occ	Unk	Unk	Unk	Unk
32	Boardman River	Ext						
33	Bear Creek	Unk	Unk	Occ	Unk	Unk	Unk	Unk

Allowed Harvest: Menominee River: alternate year recreational hook and line harvest, September-October, 50" minimum length, 1 fish limit. Lake Winnebago: annual recreational spear-harvest, 16 day February season or until harvest cap is reached, 45" minimum length, 1 fish limit.
No harvest allowed throughout the rest of the Lake Michigan basin.

Table 4. Listing of recent and ongoing lake sturgeon status assessment (**SA**), monitoring (**MO**), research (**RE**), management (**MA**), or re-introductions (**Re-I**) occurring in the Lake Michigan waters with lead contacts for further information. Data or observations from incidental captures by commercial, sport or other assessment fisheries or from the public are noted (**incidental**). Basin-wide initiatives and existing management plans are listed at the end of the table.

Basin/Site Number	Site Name	Type of activity	Contact persons/organizations and citations
Lake Michigan			
1	Millecoquins River	MO	Ed Baker, MDNR, Marquette MI
2	Manistique River	MO, SA	Nancy Auer, Mich Tech Univ, Houghton, MI Ed Baker, MDNR, Marquette, MI
3	Indian Lake	MO, SA	Chuck Bassett, US Forest Service, Escanaba MI
4	Sturgeon (Nahma) River	MO, SA	Nancy Auer, Mich Tech Univ, Houghton, MI Ed Baker, MDNR, Marquette, MI
5	Whitefish River	MO, SA	Nancy Auer, Mich Tech Univ, Houghton, MI Ed Baker, MDNR, Marquette, MI
6	Escanaba River	MO, SA	Nancy Auer, Mich Tech Univ, Houghton, MI Ed Baker, MDNR, Marquette, MI
7	Cedar River	MO, SA	Nancy Auer, Mich Tech Univ, Houghton, MI Ed Baker, Michigan DNR, Marquette, MI

Basin/Site Number	Site Name	Type of activity	Contact persons/organizations and citations
9a	Menominee R. (below last dam)	SA, MA	Rob Elliott, USFWS, Green Bay WI Tom Meronek and Greg Kornelly, Wisconsin DNR, Peshtigo WI
9b	Menominee R. (below GR dam)	SA, MA	Tom Meronek and Greg Kornelly, Wisconsin DNR, Peshtigo WI
9c	Menominee R. (below WR dam)	SA, MA, RE RE (fish passage)	Tom Meronek and Greg Kornelly, WDNR, Peshtigo WI Boyd Kanard, USGS, Conte Fisheries Research Center (fish passage)
9d	Menominee R. (below St. Falls)	SA, Re-I	Tom Meronek and Greg Kornelly, WDNR, Peshtigo WI
10	Peshtigo River	RE (juveniles) SA	Trent Sutton, Angela Benson, Purdue Univ., West Lafayette IN Rob Elliott, USFWS, Green Bay WI Tom Meronek, WDNR, Peshtigo WI
11	Oconto River	SA	Rob Elliott, USFWS, Green Bay WI Tom Meronek, WDNR, Peshtigo WI
12a	Fox River (below last dam)	SA, MO	Rob Elliott, USFWS, Green Bay WI Terry Lychwick, WDNR, Green Bay WI Philip Cochran, Saint Mary's University, Winona MN
12b	Fox River (between dams)	MO	Terry Lychwick, WDNR, Green Bay WI
A	Green Bay	SA, MO (+incidental)	Rob Elliott, USFWS, Green Bay WI Tom Meronek, WDNR, Peshtigo WI
13a	L. Winnebago – Wolf R. system	SA, MA, RE	Ron Bruch, Wisconsin DNR, Oshkosh WI Fred Binkowski, Univ. Wis. Milwaukee Water Institute, WI Sturgeon For Tomorrow
13b	L. Winnebago - Upper Fox R.	SA, MA, RE, Re-I	Ron Bruch, Wisconsin DNR, Oshkosh WI Fred Binkowski, Univ. Wis. Milwaukee Water Institute, WI Sturgeon For Tomorrow
13c	Wolf River – above Kashena	MA, Re-I	Doug Cox, Menominee Indian Tribe of Wis. Keshena WI Ann Runstrom, USFWS, LaCrosse WI
B	L. Winnebago and upper lakes	SA, MA	Ron Bruch, Wisconsin DNR, Oshkosh WI Fred Binkowski, Univ. Wis. Milwaukee Water Institute, WI Sturgeon For Tomorrow
17	Manitowoc River	MO, Re-I	Steve Hogler, Wisconsin DNR, Michicott WI
18	Sheboygan River	MO,	Brad Eggold, Wisconsin DNR, Milwaukee WI
20	Milwaukee River	MO, Re-I	Brad Eggold, Wisconsin DNR Fred Binkowski, UW-Milwaukee, WI
C	Wisconsin shoreline	MO (incidental)	Rob Elliott, USFWS, Green Bay WI Brad Eggold, Wisconsin DNR, Milwaukee WI

Basin/Site Number	Site Name	Type of activity	Contact persons/organizations and citations
22	Chicago Reef complex	Re-I (planning)	Roger Klocek, Shedd Aquarium, Chicago IL
D	Indiana shoreline	MO	Brant Fisher, Indiana DNR, Edinburg IN
23a	St. Joseph R. (below last dam)	SA	Trent Sutton, Purdue Univ., West Lafayette IN
23b	St. Joseph R. (between dams)	SA	Trent Sutton, Purdue Univ., West Lafayette IN
24	St. Joseph Shoal	MO	Trent Sutton, Purdue Univ., West Lafayette IN
25	Kalamazoo River	SA	Trent Sutton, Purdue Univ., West Lafayette IN
27	Muskegon River	SA	Doug Peterson, University of Georgia, Athens GA
29	Ludington Shoal	MO (incidental)	Marty Holtgren, Little River Band of Ottawa Indians, Manistee MI Brad Latvaitis, Consumers Energy Env. Dept., Jackson MI
30	Pere Marquette River	MO	Marty Holtgren, Little River Band of Ottawa Indians, Manistee MI
E	Michigan shoreline	MO (incidental)	Marty Holtgren, Little River Band of Ottawa Indians, Manistee MI Rob Elliott, USFWS, Green Bay WI
31a	Manistee R. (below last dam)	SA	Tracy Galarowicz, Central Michigan Univ. Mount Pleasant MI (2001-) Doug Peterson, University of Georgia, Athens GA (1998-2000) Marty Holtgren, Little River Band of Ottawa Indians, Manistee MI
31b	Manistee R. (above last dam)	MO	Marty Holtgren, Little River Band of Ottawa Indians, Manistee MI
F	Grand Traverse Bay	MO (incidental)	Erik Olsen, Grand Traverse Band of Ottawa and Chippewa, Omena MI
33	Bear Creek	MO	Stephen Lenart, Little Traverse Bay Band of Odawa Indians, Petoskey MI
G	Little Traverse Bay	MO (incidental)	Stephen Lenart, Little Traverse Bay Band of Odawa Indians, Petoskey MI
Basin Wide	Basin Wide Genetic Analysis	SA, RE- Genetics	Kim Scribner, Pat DeHaan, Michigan State Univ., East Lansing MI
Basin Wide	Basin Wide Database	SA – Database	Emily Zollweg and Rob Elliott, USFWS, Green Bay WI

Management plans: State of Michigan Lake Sturgeon Rehabilitation Strategy. MDNR. 1997 (Liz Hay-Chmielewski and Gary Whelan, Michigan DNR, Lansing MI.)
Lake Sturgeon Plan for the Green Bay Basin (Draft). MDNR. WDNR, USFWS. 1999 (Tom Thuemler -Wisconsin DNR, Ed Baker -Michigan DNR, Rob Elliott -US Fish and Wildlife Service)
The Wisconsin Lake Sturgeon Management Plan. WDNR. 2000 (Karl Scheidegger, Wisconsin DNR, Madison WI)

Basin Wide Task Group: A Lake Michigan Lake Sturgeon Task Group has recently been formed under Great Lakes Fisheries Commission Lake Michigan Committee structure. They have been tasked with developing and coordinating implementation of a lake-wide rehabilitation plan.

Lake Huron

Lake sturgeon populations in Lake Huron continue to sustain themselves at a fraction of their historical abundance. In Lake Huron, sturgeon are distributed throughout the basin, but concentrations of fish are located in the southern main basin and Georgian Bay. At least 34 tributaries historically supported spawning populations (Table 5). Current reproduction has been documented in just 3 of these tributaries, the Mississaugi and Nottawasaga rivers in Ontario and Michigan's Black River. An additional 14 tributaries are believed to support "remnant" populations, indicating an annual spawning run of less than 1,000 individuals (Table 5). Abundance remains unknown for most rivers. A summary of the status of Lake Huron lake sturgeon populations is shown in Table 5.

Currently, commercial harvest of lake sturgeon is limited to the Ontario waters of Lake Huron. A total of 41 commercial licenses are permitted to harvest lake sturgeon with a total quota of 12,376 kg annually. The quota is set based upon incidental catch rates and the fishing performance of the commercial fishery in the 1978 to 1983 period. The average lakewide harvest is 4,869 pounds, or 325 fish.

Regulation of recreational and subsistence/home use harvest for Lake Huron lake sturgeon varies by agency. For Ontario, harvest by recreational anglers is legal in the tributaries and the waters of Lake Huron. The total recreational harvest from Ontario waters is unknown. In Michigan, recreational harvest is prohibited in Lake Huron and all its tributaries, except for the St. Clair River. In 2002, a total of 6 fish were legally harvested from the Michigan waters of the St. Clair River. Because lake sturgeon are a state listed "threatened" species, tribal harvest is prohibited in Michigan waters of Lake Huron. However, dead sturgeon incidentally caught in tribal nets may be retained for subsistence. Although the number of dead sturgeon encountered in tribal nets in Michigan waters is unknown, it is believed to be quite low.

There are currently 6 agencies and academic institutions involved with sturgeon assessment in the Lake Huron basin. They are the Mississaugi First Nation, Lake Superior State University, Central Michigan University, Anishinabek-Ontario Fisheries Resource Centre, U.S. Fish and Wildlife Service, Michigan Department of Natural Resources, and Ontario Ministry of Natural Resources. Contemporary surveys of varying effort have occurred in 12 of the 22 historic spawning tributaries. In addition, several embayments and nearshore areas that serve as post spawning or feeding areas are surveyed. A summary of ongoing assessment activities and contact persons can be found in Table 6. Agency assessment and research efforts in Michigan waters of the Lake Huron basin are guided by the Michigan Lake Sturgeon Rehabilitation Strategy (Hay-Chmielewski and Whelan 1997).

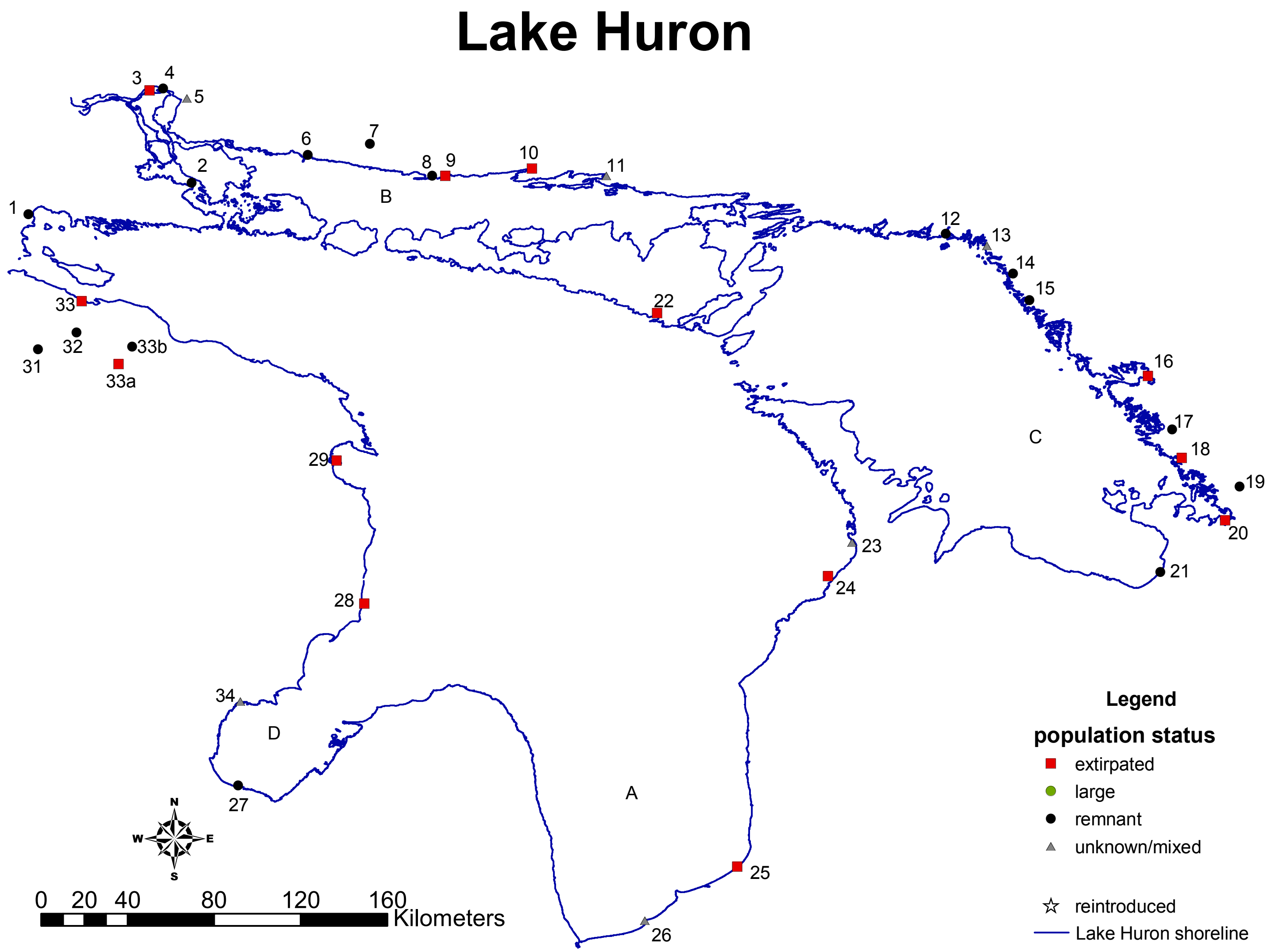

Figure 4. Distribution and status of lake sturgeon populations in the Lake Huron Basin, 2002. Numbers and letters correspond to Tables 5 and 6.

Table 5. Observations or general status of existing lake sturgeon populations in the Lake Huron Basin. Population status definitions are: **Ext** = extirpated, **Large** = 1,000 or more adults in the annual spawning runs; **Rem** (remnant) = less than 1,000 adults in annual spawning run of natural origin; **Re-I** (reintroduced) = fish stocked into system in reintroduction attempt, or **Unk** = unknown. A "**Yes**" indicates regular observation or presumed annual occurrence. Occasional (**Occ**) observations are as noted. Successful reproduction was defined as recent capture of larval or juvenile sturgeon. Notes on allowed harvest follow the table.

Basin/Site Number	Site Name	Population Status	Size of Annual Spawning Run	Observations: Adults	Spawning	Larva	Juveniles	Reproduction Successful?
Lake Huron								
1	Carp River	Rem	Unk	Yes	Occ	Unk	Unk	Unk
2	St. Mary's River	Rem	Unk	Yes	Unk	Unk	Yes	Unk
3	Root River	Ext						
4	Garden River	Rem	Unk	Yes	Occ	Yes	Unk	Unk
5	Echo River	Unk						
6	Thessalon River	Rem	Unk	Yes	Unk	Unk	Unk	Unk
7	Mississagi River	Rem	150	Yes	Yes	Unk	Occ	Yes
8	Mississagi River (landlocked)	Rem	Unk	Yes	Yes	Unk	Unk	Unk
9	Blind River	Ext						
10	Serpent River	Ext						
11	Spanish River	Unk						
12	French River	Rem	Unk	Occ	Unk	Unk	Unk	Unk
13	Key River	Unk						
14	Magnetawan River	Rem	Unk	Occ	Unk	Unk	Unk	Unk
15	Naiscoot River	Rem	Unk	Occ	Unk	Unk	Unk	Unk
16	Seguin River	Ext						
17	Moon River	Rem	Unk	Occ	Unk	Unk	Unk	Unk
18	Go Home River	Ext						
19	Severn River	Rem	Unk	Occ	Unk	Unk	Unk	Unk
20	Sturgeon River	Ext						
21	Nottawasaga River	Rem	Unk	Yes	Yes	Occ	Occ	Yes
22	Manitou River	Ext						

Basin/Site Number	Site Name	Population Status	Size of Annual Spawning Run	Observations: Adults	Spawning	Larva	Juveniles	Reproduction Successful?
23	Sauble River	Unk	Unk	Occ	Unk	Unk	Unk	Unk
24	Saugeen River	Ext						
25	AuSable River, ON	Ext						
26	Blue Point	Unk	Unk	Yes	Unk	Unk	Occ	Unk
27	Saginaw River	Rem	Unk	Occ	Unk	Unk	Unk	Unk
28	AuSable River, MI	Ext	Unk	Occ	Unk	Unk	Unk	Unk
29	Thunder Bay River	Ext						
30	Cheboygan River	Rem	Unk					Unk
31	Burt Lake	Rem	Unk					Unk
32	Mullett Lake	Rem	Unk					Unk
33a	Black Lake	Rem	≅60	Yes	Yes	Yes	Yes	Yes
33b	Black River	Ext						
34	Rifle River	Unk	Unk	Unk	Yes	Unk	Yes	Unk

Allowed Harvest: Commercial (Ontario waters) Quota in North Channel, Georgian Bay, and Main basin, limited to the open waters of Lake Huron. No commercial fisheries allowed in the tributaries. Recreational harvest allowed in all tributaries. Known to exist in Nottawasaga River, Thessalon River, and St. Clair River. Subsistence fisheries also exist on Mississaugi River and Garden Rivers**.**

Table 6. Listing of recent and ongoing lake sturgeon status assessment (**SA**), monitoring (**MO**), research (**RE**), management (**MA**), or re-introductions (**Re-I**) occurring in Lake Huron waters with lead contacts for further information. Data or observations from incidental captures by commercial, sport, or other assessment fisheries or from the public are noted (**incidental**). Basin-wide involvement and existing management plans are listed at the end of the table.

Basin/Site Number	Site Name	Type of activity	Contact persons/organizations
Lake Huron			
1	Carp River	RE	Roger Greil, LSSC
2	St. Mary's River	RE	Roger Greil, LSSC
7	Mississagi River	SA	Mississaugi FN John Seyler, AOFRC Lloyd Mohr, OMNR
21	Nottawasaga River	SA	Lloyd Mohr, OMNR
26	Blue Point	SA	Lloyd Mohr, OMNR
33a	Black Lake	SA, RE	Baker/Borgeson, MDNR Tracy Galarowicz, CMU
A	Lake Huron Main Basin	SA, MA	Lloyd Mohr, OMNR
B	Lake Huron North Channel	SA, MA	Lloyd Mohr, OMNR
C	Lake Huron Georgian Bay	SA, MA	Lloyd Mohr, OMNR
D	Saginaw Bay	SA	USFWS-Alpena

Management plans: State of Michigan Lake Sturgeon Rehabilitation Strategy. MDNR. 1997. (Liz Hay-Chmielewski and Gary Whelan, Michigan DNR, Lansing MI.)

Basin Wide Task Group: Central Great Lakes Bi-National Lake Sturgeon Group (Tracy Hill), MI DNR Sturgeon Committee (Gary Whelan), GLBET Sturgeon Committee (Tracy Hill)

Lake Erie

Lake sturgeon populations in Lake Erie are either extirpated or of remnant status with the notable exception of the Lake St. Clair population (tributary to Lake Erie) (Figure 5, Table 7). Historic spawning areas in Cattaraugus Creek, NY; Maumee River, and Sandusky River, OH; Raisin River and Huron River, MI are all either no longer accessible to sturgeon or have severely degraded habitat. Lake sturgeon are still present in the eastern basin near Dunkirk, NY and in the Upper Niagara River. Lake sturgeon in these areas are often sighted by recreational divers, anglers, and beach users. In the western basin, numerous juvenile lake sturgeon are caught incidentally by commercial fishers, the parental source of these fish has yet to be determined. There are some recently confirmed spawning areas in the Detroit River, and St. Clair River, which may be the sources of these juveniles. Michigan DNR has been studying a large population of sturgeon in Lake St. Clair, which may be the resident source of fish spawning in the St. Clair River and Detroit River.

Habitat assessments and telemetry studies have been conducted or are underway in the Detroit River (USFWS, Central Michigan University, USGS), St. Clair River (USFWS, OMNR, USGS), and Lake St. Clair (MIDNR, OMNR) to determine movements, habitat use, and locate spawning areas (Table 8). A spawning habitat building project is underway in the Detroit River (USGS). There are also volunteer commercial fisher tagging programs ongoing in both the eastern and western basin Canadian waters (USFWS, OMNR, OHDOW). Lake sturgeon sitings are tracked along the Ohio and New York shoreline, and dead sturgeon that are reported and located within 24 hours of mortality are tested for botulism poisoning by NYSDEC.

Research needs include: current spawning use of the Sandusky and Maumee Rivers, OH; and shoreline in the eastern basin; and genetic assessment of the parental stock of western basin juvenile lake sturgeon. Botulism related mortalities continue to be a concern, as well as contamination issues related to spawning and feeding grounds and water and habitat quality. Harvest is limited to commercial and recreational fishing on Lake St. Clair and recreational fishing on the St. Clair River (Table 7).

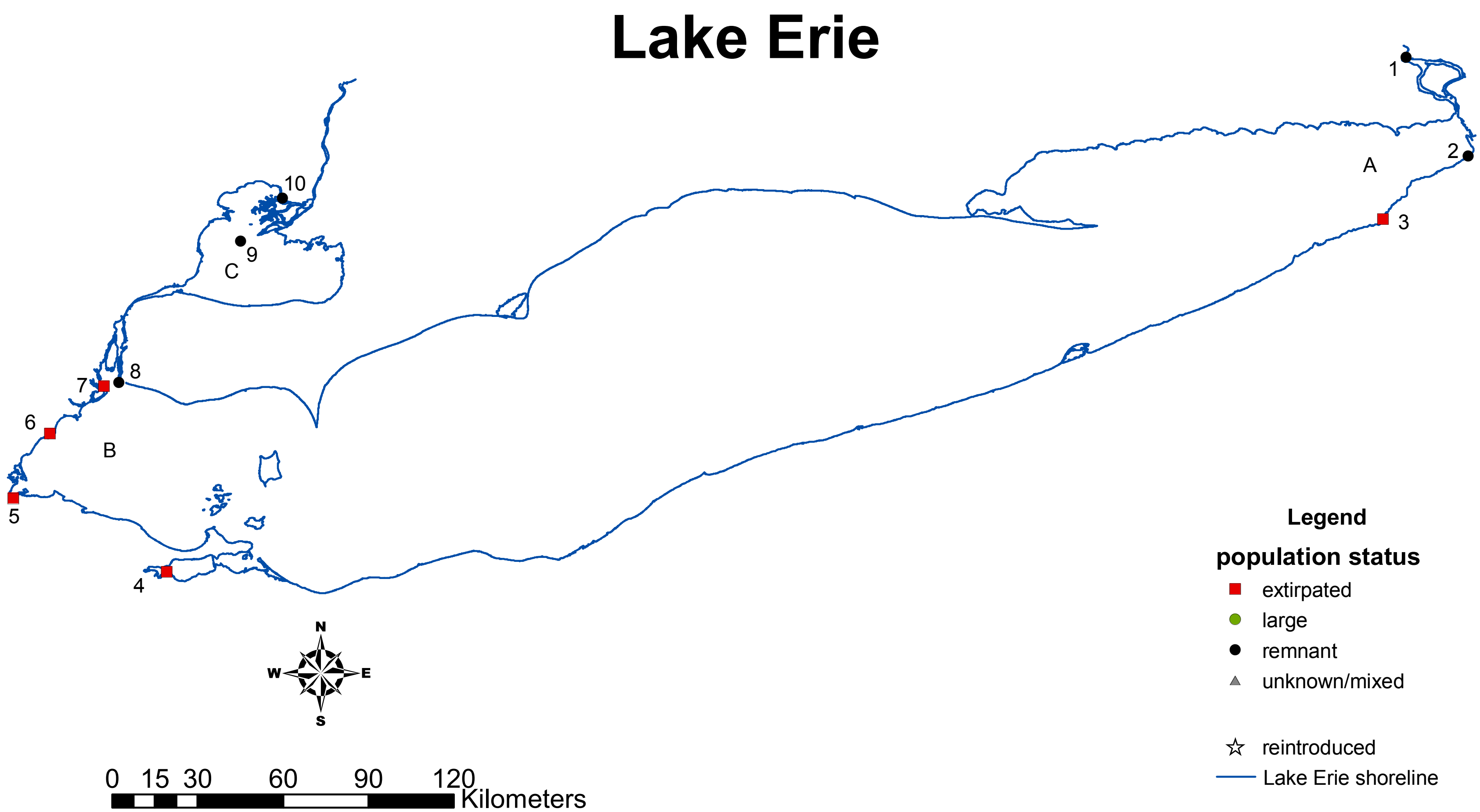

Figure 5. Distribution and status of lake sturgeon populations in the Lake Erie Basin, 2002. Numbers and letters correspond to Tables 7 and 8.

Table 7. Observations or general status of existing lake sturgeon populations in the Lake Erie Basin. Population status definitions are: **Ext** = extirpated, **Large** = 1,000 or more adults in the annual spawning runs; **Rem** (remnant) = less than 1,000 adults in annual spawning run of natural origin; **Re-I** (reintroduced) = fish stocked into system in reintroduction attempt, or **Unk** = unknown. A "**Yes**" indicates regular observation or presumed annual occurrence. Occasional (**Occ**) observations are as noted. Successful reproduction was defined as recent capture of larval or juvenile sturgeon. Notes on allowed harvest follow the table.

Basin/Site Number	Site Name	Population Status	Size of Annual Spawning Run	Observations:				Reproduction Successful?
				Adults	Spawning	Larva	Juveniles	
Lake Erie								
1	Upper Niagara River	Rem	Unk	Yes			Occ	Unk
2	Eastern basin (NYS)	Rem		yes			yes	Unk
3	Cattaraugus Creek	Ext						
4	Sandusky River	Ext						
5	Maumee River	Ext						
6	Raisin River	Ext						
7	Huron River	Ext						
8	Detroit River	Rem	Unk	Yes	Yes			Unk
9	Lake St. Clair	Rem	Unk	Yes	Unk	Unk	Yes	Unk
10	St. Clair River	Rem	Unk	Yes	Yes		Yes	Unk

Allowed Harvest: Commercial harvest in Ontario waters of Lake St. Clair. Recreational harvest in Ontario and Michigan waters of Lake St. Clair and St. Clair River.

Table 8. Listing of recent and ongoing lake sturgeon status assessment (**SA**), monitoring (**MO**), research (**RE**), management (**MA**), or re-introductions (**Re-I**) occurring in Lake Erie waters with lead contacts for further information. Data or observations from incidental captures by commercial, sport, or other assessment fisheries or from the public are noted (**incidental**). Basin-wide involvement and existing management plans are listed at the end of the table.

Basin/Site Number	Site Name	Type of activity	Contact persons/organizations
Lake Erie			
1	Upper Niagara River	SA, RE	Emily C. Zollweg, USFWS, Amherst NY
2	Eastern basin (NYS)	SA	Bill Culligan, NYSDEC, Dunkirk NY
8	Detroit River	RE	USFWS-Alpena Bruce Manny, USGS-Ann Arbor, MI
9	Lake St. Clair	SA, RE	Mike Thomas, MDNR, OMNR
10	St. Clair River	SA, RE	Mike Thomas, MDNR Jim Boase, USFWS-Alpena, MI OMNR Bruce Manny, USGS-Ann Arbor, MI

Management plans: State of Michigan Lake Sturgeon Rehabilitation Strategy. MDNR. 1997. (Liz Hay-Chmielewski and Gary Whelan, Michigan DNR, Lansing MI.)
A recovery plan for the lake sturgeon (*Acipenser fulvescens*) in New York. NYSDEC 2002 (Doug Carlson, NYSDEC, Watertown, NY)

Basin Wide Task Group: Central Great Lakes Bi-National Lake Sturgeon Group (Tracy Hill), MI DNR Sturgeon Committee (Gary Whelan), GLBET Sturgeon Committee (Tracy Hill)

Lake Ontario and St. Lawrence River

Lake sturgeon waters downstream of Niagara Falls were without barriers historically, but these habitats have been fragmented by dams for several decades. Lake Ontario sturgeon are no longer a lake-wide resource and very few catches are taken even though a few sitings occur in the nearshore area (Figure 6, Table 9). The only New York area of Lake Ontario which still has regular sturgeon spawning is the lower Niagara River, near Niagara Falls and at the confluence with Lake Ontario. There are two other areas in New York where spawning is expected in some years, the Black River at Dexter and the St. Lawrence River near Ogdensburg. In the Trent River, Ontario, spawning was documented in 1999, but no additional confirmation more recently. Both the Trent and Black river mouths have vast shallow areas nearby which are well suited to sustain juvenile production. Historically, four other New York tributaries or connected waters supported spawning populations, but they are now extirpated or are immeasurably small: Genesee River, Oswego River, St. Lawrence River at the Oswegatchie River and St. Lawrence River at Red Mills (Carlson 1995). These seven spawning areas probably accounted for most of the production that provided the remarkable catches of lake sturgeon described by Smith and Snell (1891), extending from downstream of Niagara Falls and to the border of New York with Quebec.

Restoration programs in Lake Ontario have been considered, but will not be pursued by New York State until success has been recognized elsewhere in the tributaries. However, restoration programs have been underway in the Oswegatchie River, Black Lake and St. Regis River, and some juveniles have grown to 40" since 1995. Research has been underway at six project areas in New York, these include the Niagara River by USFWS, Genesee River by USGS and USFWS, Oneida Lake studies by Cornell University, Oswegatchie River and an assessment of the Black Lake stocking program by NYSDEC, a spawning area in the St. Lawrence River at Ogdensburg by NYSDEC, and St. Lawrence River downstream of Massena by NYSDEC and SUNY ESF (Table 10).

Lake sturgeon catches in the upper St. Lawrence River sustained a limited fishery beyond the times of the collapses in the upstream Great Lakes. Harvest continued through the 1960's, until declines were recognized and the fishery closed in 1976. There were two known spawning areas, the large rapids at Red Mills and the rapids at Massena, until they were eliminated by construction of the Massena dam in 1958. Three tributary populations provided occasional catches through the 1950's, the Grasse River, Oswegatchie River and Black Lake. Each river had over 20 mile segments of river available to sustain the resident populations. The Grasse River is the only tributary that still has an intact population with recruitment (Table 9). Tributaries to the St. Lawrence offered spawning at the mouth or the first dam in the Oswegatchie, Grasse, St. Regis and Raquette Rivers. These spawning areas presently have very limited or no use.

Lake sturgeon in the St. Lawrence River in Lake St. Francis, have been sampled by the Quebec Dept. Wildlife and Parks (Table 10). Fisheries here and farther downstream are described by Dumont et al. (1987, 2001), and other population features are described by Fortin et al. (1993). Spawning areas were enhanced with substrate alterations in 1995 (Fortin et al. 2002). Lake sturgeon are harvested in the Montreal vicinity.

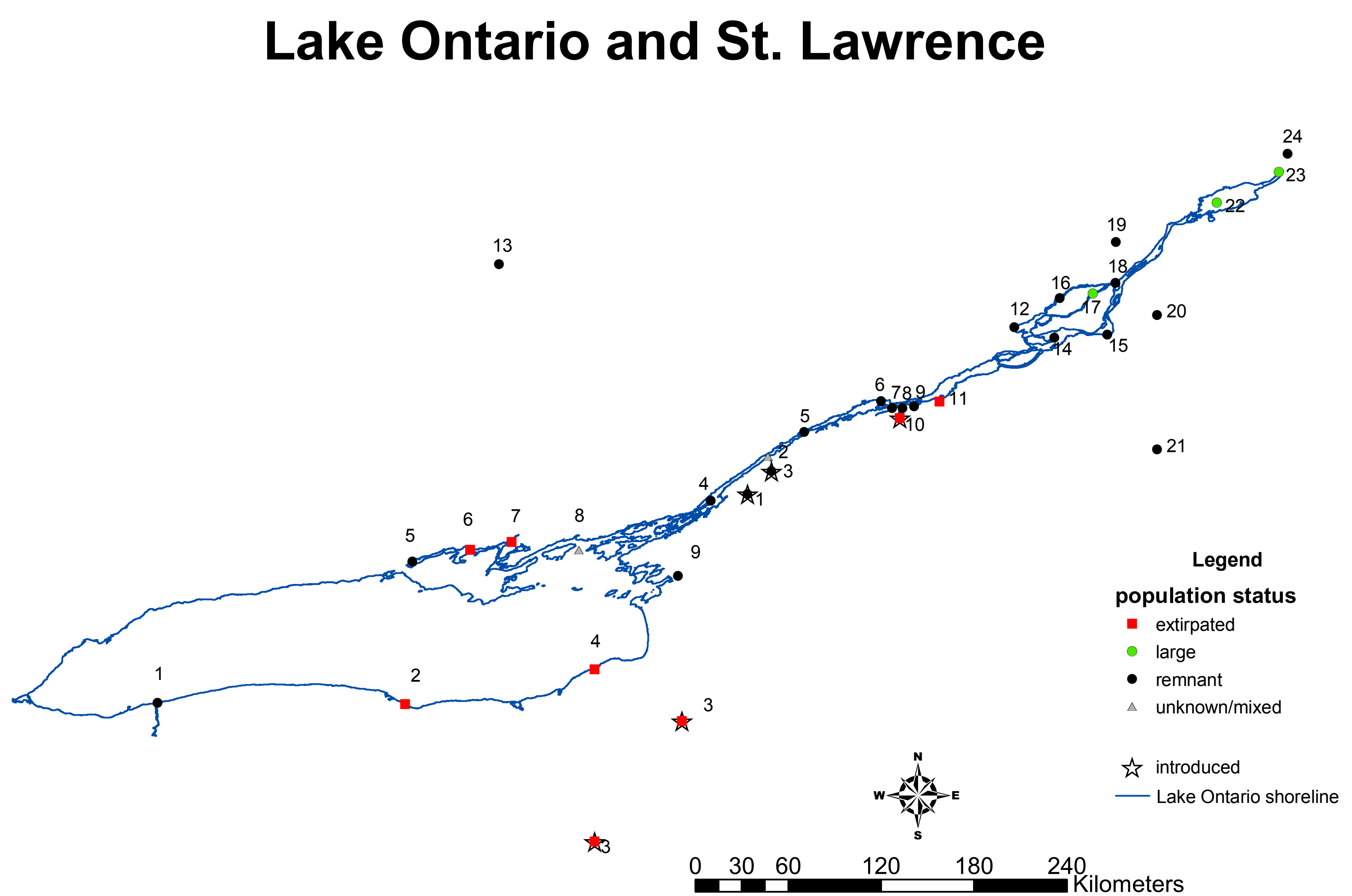

Figure 6. Distribution and status of lake sturgeon populations in the Lake Ontario and St. Lawrence River Basin, 2002. Numbers and letters correspond to Tables 9 and 10.

Table 9. Observations or general status of existing lake sturgeon populations in the Lake Ontario and St. Lawrence River Basin. Population status definitions are: **Ext** = extirpated, **Large** = 1,000 or more adults in the annual spawning runs; **Rem** (remnant) = less than 1,000 adults in annual spawning run of natural origin; **Re-I** (reintroduced) = fish stocked into system in reintroduction attempt, or **Unk** = unknown. A "**Yes**" indicates regular observation or presumed annual occurrence. Occasional (**Occ**) observations are as noted. Successful reproduction was defined as recent capture of larval or juvenile sturgeon. Notes on allowed harvest follow the table.

Basin/Site Number	Site Name	Population Status	Size of Annual Spawning Run	Observations:				Reproduction Successful?
				Adults	Spawning	Larva	Juveniles	
Lake Ontario								
1	Lower Niagara River	Rem	Unk	Yes			Yes	Yes
2	Genesee River	Ext						
3	Oneida/Cayuga lakes	Re-I					Yes	No
4	Oswego River mouth	Ext		Occ				
5	Trent River	Rem	Unk					Yes
6	Salmon River	Ext	Unk					
7	Napanee River	Ext	Unk					
8	Amherst Island Shoal	Unk	Unk					Unk
9	Black River	Rem	Unk	Yes			Yes	Unk

Allowed Harvest: None

Basin/Site Number	Site Name	Population Status	Size of Annual Spawning Run	Observations:				Reproduction Successful?
				Adults	Spawning	Larva	Juveniles	
St. Lawrence								
1	Black Lake	Re-I + Rem		Occ			Yes	
2	Oswegatchie River mouth	Unk						
3	Oswegatchie River	Re-I + Rem		Occ			Yes	
4	St. Lawrence River, Thousand Islands	Rem	100's	Yes	Yes	Yes	Yes	Yes
5	St. Lawrence River, Lake St. Lawrence	Rem	Unk	Yes			Yes	No

Basin/Site Number	Site Name	Population Status	Size of Annual Spawning Run	Observations: Adults	Spawning	Larva	Juveniles	Reproduction Successful?
6	St. Lawrence River, Lake St. Francis	Rem	Unk	Yes	Occ	Occ	Yes	Occ
7	Grasse River	Rem	10’s	Yes	Yes	eggs	Yes	Yes
8	Raquette River	Rem	Unk	Occ				Unk
9	St. Regis River mouth	Rem	Unk (small)	Occ				Unk
10	St. Regis River	Re-I					Yes	
11	Salmon River mouth	Ex						
12	Ottawa River mouth, Lac Des Deux Montagnes							
13	Ottawa River	Rem	Unk					Unk
14	St. Lawrence River, Lac St-Louis							
15	St. Lawrence River, La Prairie Basin	Rem						
16	Des Milles Iles River	Rem	Unk					Yes
17	Des Prairies River	Large	≅7,000					Yes
18	L'Assomption River	Rem	50-150					No
19	Ouareau River	Rem	50-150					Yes
20	St. Francois River	Rem	≅100					Unk
21	Lake Champlain	Rem	Unk	Inf			Inf	Occ
22	St. Lawrence River, Lac St-Pierre	Large						
23	St. Maurice River	Large	≅1,250					Yes
24	Batiscan River	Rem	Unk					Unk

Allowed Harvest: Native American harvest on Mohawk Reservation, Quebec harvest in vicinity of Montreal (see Dumont et al. 1987, Fortin et al. 1993)

Table 10. Listing of recent and ongoing lake sturgeon status assessment (**SA**), monitoring (**MO**), research (**RE**), management (**MA**), or re-introductions (**Re-I**) occurring in Lake Ontario and St. Lawrence River waters with lead contacts for further information. Data or observations from incidental captures by commercial, sport, or other assessment fisheries or from the public are noted (**incidental**). Basin-wide involvement and existing management plans are listed at the end of the table.

Basin/Site Number	Site Name	Type of activity	Involved persons/organizations and citations
Lake Ontario			
1	Lower Niagara River	SA	Emily Zollweg, USFWS, Amherst NY (Hughes 2002)
2	Genesee River	Habitat assessment	Dawn Dittman, USGS, Cortland NY (Dittman and Lowie 2001) Emily Zollweg, USFWS, Amherst, NY
3	Oneida/Cayuga lakes	RE	J. Randy Jackson, CU, Bridgeport, NY (Jackson et al 2002) Tom Chiotti, NYSDEC, Cortland
5	Trent River	SA	Alastair Mathers, OMNR, Picton, ON
St. Lawrence			
1	Black Lake/Indian River	Re-I	Doug Carlson, NYSDEC, Watertown, NY
3	Oswegatchie River	Re-I	Doug Carlson, NYSDEC, Watertown, NY (Schlueter 2000)
4	St. Lawrence River, Thousand Islands	SA	Alastair Mathers, OMNR, Picton, ON Rodger Klindt, NYSDEC, Watertown, NY
5	St. Lawrence River, Lake St. Lawrence	RE, MA	Rodger Klindt, NYSDEC, Watertown, NY Jennifer Hayes, ESF, Syracuse, NY (Hayes 2000a, 2002)
6	St. Lawrence River, Lake St. Francis	SA	Jennifer Hayes, ESF, Syracuse NY Rodger Klindt, NYSDEC, Watertown, NY (LaPan et al. 1997) (Hayes 2000a)
7	Grasse River	SA	Doug Carlson, NYSDEC, Watertown, NY (Hayes 2000a)
10	St. Regis River	Re-I	Doug Carlson, NYSDEC, Watertown, NY
11	Salmon River mouth	MO	John Cooper, SUNY ESF, Syracuse NY
12	Ottawa River mouth, Lac Des Deux Montagnes		Michel La Haye, Enviro-Science, Tres St. Redempteur, Quebec (Fortin et al. 1993)
13	Ottawa River		Michel La Haye, Tim Haxton, OMNR, Kemptville, ON
14	St. Lawrence River, Lac St-Louis		P. Dumont, Dept. of Wildlife and Parks, Montreal, Quebec
15	St. Lawrence River, La Prairie Basin		P. Dumont, Dept. of Wildlife and Parks, Montreal, Quebec
16	Des Milles Iles River		Michel La Haye, Enviro-Science, Tres St. Redempteur, Quebec, (Fortin et al. 1993)
17	Des Prairies River		Michel La Haye, Enviro-Science, Tres St. Redempteur, Quebec, (Fortin et al. 1993)
18	L'Assomption River		Michel La Haye, Enviro-Science, Tres St. Redempteur, Quebec, (Fortin et al. 1993)

Basin/Site Number	Site Name	Type of activity	Involved persons/organizations and citations
19	Ouareau River	SA	Michel La Haye, Enviro-Science, Tres St. Redempteur, Quebec, (Fortin et al. 1993)
20	St. Francois River		Michel La Haye, Enviro-Science, Tres St. Redempteur, Quebec
21	Lake Champlain-Winooski River	SA	Chet MacKenzie, VT F&W, Pittsford, VT
22	St. Lawrence River, Lac St-Pierre		P. Dumont, Dept. of Wildlife and Parks, Montreal, Quebec (Fortin et al. 1993)
23	St. Maurice River		Michel La Haye, Enviro-Science, Tres St. Redempteur, Quebec

Management plans: A recovery plan for the lake sturgeon (*Acipenser fulvescens*) in New York. NYSDEC 2002 (Doug Carlson, NYSDEC, Watertown, NY)

Basin Wide Task Group: GLBET Sturgeon Committee (Tracy Hill)

Technical Session 1:
Consideration of Stocking to Rehabilitate Populations

The purpose of the session was to provide managers and biologists with information to consider when their agencies evaluate whether to initiate or continue stocking, considerations for the design of stocking programs, and to identify human resources for consultation when agencies consider the use of stocking as a tool to rehabilitate populations of lake sturgeon.

The charge of the breakout groups was to generate a list of considerations or recommendations related to stocking. Issues or questions related to genetics were recorded on separate flip chart sheets and were addressed during a genetic expert's panel discussion session that followed the breakout discussion session.

The following topics/questions were provided to breakout groups as guidance and to stimulate discussion.

1) What is the goal of stocking?
2) What should be considered before stocking (i.e. why/why not stock)?
3) Where, what life stage and when to stock?
4) How many and how long to stock?

Results

Responses and number of groups that identified the response are listed in Table 11. A category or heading in the table was derived from all responses and individual group responses were tallied according to the category they fell in. Individual group summaries and responses are also provided (Appendix C). Each question listed above discussed below with responses summarized from the breakout groups.

1) What is the goal of stocking?

Two goal statements were identified by a majority of the breakout groups (Table 11). All nine groups indicated that establishment of a self-sustaining population was an important goal of a stocking project. The other goal mentioned by the majority of groups was the use of stocking to create a fishery, for recreational, commercial, or cultural uses.

2) What should be considered before stocking (i.e. why/why not stock)?

The breakout groups identified seven factors which should be considered before undertaking a stocking program (Table 11). Habitat was a consideration of all nine groups. The concern was whether habitat was available and whether it was sufficient to support a sturgeon population through all life stages, a critical consideration for a self-sustaining population.

Having a suitable donor population was also mentioned by a majority of the groups as one of many variables related to this consideration which need to be taken into account before starting a stocking effort. For example, is there a donor strain available that matches the habitat (e.g. river population vs. lake population)? Will the donor population be affected in its ability to be self-sustaining by loss of reproductive potential? Having access to a long-term brood source may also be a problem.

The majority of groups, as a consideration before stocking, identified development of a management plan. The plan should identify the goal, have specific objectives, and define an endpoint. Having a plan will help managers answer guiding questions three and four.

The majority of groups also listed the concern of impacts to remnant stocks. A remnant stock could be affected directly or indirectly. For example, stocking fish in a system where fish are present will directly affect that population. Fish can be affected indirectly as a result of straying. The concern associated with this is to have an appropriate brood source, identified as one being genetically compatible (i.e. one within the same basin).

Genetics, in a broad sense, was another consideration identified. Specific genetic concerns that were raised included having a suitable strain for a brood source, potential impacts on any remnant stocks, access to enough fish to establish genetic variation within a new population, and a mating scheme to maximize genetic variation. Some of the genetic considerations mentioned were addressed in depth by a genetics panel discussion that followed this session.

Another consideration identified among the majority of the groups was cost. The cost component needs to be viewed in terms of funding and commitment. The life history of the fish, that may span a manager's career, requires effort over a long time period. Agency funding over such a long time period can be sporadic. Many groups indicated the importance of getting public support behind an effort to help direct agency funds and possibly private dollars to an effort. Ideally, support should be in place before starting an effort.

The final consideration mentioned by most groups was the need to determine the cause of the population decline and potential impediments to recovery. In situations where habitat degradation or loss was believed to be the primary or a significant problem for recovery, several groups suggested restoring or creating habitat and then checking for response. If a remnant population exists this may allow the population to rebound or if suitable habitat is created or restored, fish may return to the river or colonize from another system. No suggestions were provided as to the time frame necessary or adequate for this approach.

3) Where, what life stage, and when to stock?

Where?

Logistically, fish are most often stocked where access is easiest but stocking fish in suitable habitat might have a better result. Waters need to be selected based on whether habitat is there to support a lake sturgeon population. Potential impacts to remnant populations and existing fish communities were also listed as concerns.

What life stage?

Imprinting was the only consideration highlighted by the majority of the groups (Table 11). The concern with sturgeon is that very little is known about when or if imprinting occurs or what impact it may have. For example, if it could be determined that imprinting occurs early, egg stocking might be best for getting fish to return in the future. If it occurs later, it might be more advantageous to raise the fish to a larger size in the hatchery. More information on imprinting is required to help make these decisions. Mobile hatcheries were identified as one way to alleviate imprinting concerns. Life stages that were identified for stocking were eggs, fry, fingerlings, yearlings, and adults (Table 11). Each stage has associated advantages and disadvantages. Cost, probability of success (survival), and ability to mark stocked fish were identified within most groups as a way to determine which life stage to stock. Generally, eggs and fry are cheaper but marking these life stages is difficult. Fish stocked at larger sizes tend to survive better and are easier to mark, but they require more money to rear. Adult transfers are constrained by ability to capture and transport and have a high cost.

When to stock?
When to stock can also be addressed several ways. Juvenile imprinting was identified as the main consideration. The life stage being stocked would determine when they actually go into the system (egg stocking vs. fingerlings). Another consideration identified was hatchery capability. Hatcheries may have constraints on length of time they can hold fish and this constraint can be the determining factor for fish stocking.

4) How many and how long to stock?

How many?
The carrying capacity of the system should help to determine numbers to stock (Table 11). The number of fish stocked will also be determined by the life stage stocked. Genetic implications may impact numbers to stock. For example, equalization of family size at stocking may be used to maintain genetic variation. Availability of gametes from a brood source and hatchery capabilities may impact the numbers that are eventually stocked. A management plan could help address how many fish are stocked.

How long?
Defining an endpoint (success or failure) was identified by the majority of groups as the factor which should be used to determine how long to stock (Table 11). A management plan was recognized as a way to address this issue. An endpoint or a time period needs to be defined to determine when to stop stocking. Monitoring and assessment efforts are critical to determine the success of the stocking effort. Without assessment it is difficult to determine whether the goal of the stocking effort has been accomplished. Another consideration for the duration of stocking was cost. As mentioned earlier, it requires a long-term commitment. Ideally, fish should be stocked over one generation, which for sturgeon would be up to 20 years.

Conclusion

Many suggestions were put forth to help consider the role of stocking in the recovery and restoration of lake sturgeon populations. An underlying theme of all the groups was that decisions need to be made based on pre-planning and that a management plan could incorporate most, if not all, of the considerations associated with stocking. In addition, the importance of a long-term commitment is vital to achieving success of lake sturgeon recovery.

Table 11. Guiding questions for breakout groups and related responses:

1) What is the goal of stocking?	**Number of groups**		**Number of groups**
Self sustaining population	9	Maintain genetics	3
Create a fishery	7	Re-establish extirpated populations	2
Rehabilitate populations	4	Public relations	2
Restore community dynamics (biodiversity)	3	Prevent extinction	1
2) What should be considered before stocking?			
Is there sufficient and available habitat	9	Are there alternatives	2
Brood source	7	Carrying capacity of system	2
Develop a management plan	7	Contaminant burden to fish	2
Impact to remnant stocks	7	Impacts to biology of system	2
Genetics	6	Potential for success	2
Resources and commitment to carry out project	6	Straying	2
Identify initial population decline	5	When to supplemental stock	2
Imprinting	4	Cultural importance	1
Improve habitat and see what happens	4	Does coded wire tag affect olfactory	1
Ability to monitor and assess	3	Interactions with lamprey treatments	1
Marking component for stocked fish	3	Models and simulations	1
Protective regulations	3	What to commercial fishers think	1
3) Where, what life stage and when to stock?			
Imprinting	5	Acclimation	1
Mobile hatchery	4	Day vs. Night	1
Earliest life stage	2	Don't stock over existing stock	1
Ease of stocking	2	Site fidelity	1
Marking	2	Stock eggs, fry, fingerlings in same system and year	1
Survival	2	Stock when remnant pop'n <1000 adults	1
Egg Stage		**Fry Stage**	
Low cost	3	Hard to monitor/mark	1
Hard to keep alive	3	Imprinting benefit	1
Hard to monitor/track	2	Low cost	1
High probability for imprinting	1	**Yearling Stage**	
Egg boxes	1	High survival	1
Fingerling Stage		**Adult Stage**	
Acclimation needs	1	Adult females to enhance gene pool	1
Avoid water quality issues	1	Easier to mark and follow	1
Can be marked	1	High cost	1
Hatchery selection	1	Less chance for imprinting	1
Higher cost	1	May spawn	1
Higher survival	1		
4) How many and how long to stock?			
Define an endpoint (success or failure)	5	Depends on survival	1
Use assessment and monitoring	4	Equalize family size	1
Depends on life stage	2	Hatchery production	1
Depends on system (carrying capacity)	2	More than 5 years	1
Funding	2	Over a generation	1
Source of gametes	2	Reproductive potential of system	1
System specific	2	When measurable recruitment	1
		When reduced growth rate	1

GENETICS PANEL DISCUSSION

In conjunction with the break out session on the emerging issue "Consideration of stocking to rehabilitate populations", a panel of 5 geneticists from Canada and the U.S. was convened to address genetic issues related to stocking as a management tool. Participating were Andrew DeWoody, Moira Ferguson, Loren Miller, Kim Scribner and Adrian Spidle. The purpose of this panel discussion was to allow meeting participants an opportunity to learn more detailed information about genetic issues related to stocking and rehabilitation efforts in the Great Lakes.

Biographies of Genetics Discussion Panelists

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Andrew DeWoody is an Assistant Professor of Genetics at Purdue University. He originally hails from Texas and attended Texas A&M University, where he received his BS in Wildlife & Fisheries (1991) and his MS in Genetics (1994). Andrew received his PhD in Zoology from Texas Tech University (1997) and subsequently did postdoctoral research in the Genetics Department at the University of Georgia. His research interests include molecular ecology & evolution, population genetics, parentage, and natural history. Ongoing fisheries research includes genetic studies of Atlantic salmon, brook trout, shovelnose sturgeon, and Japanese medaka. The DeWoody lab also uses molecular markers to study mammals, birds, and amphibians. Andrew currently teaches two courses, Molecular Ecology and Conservation Genetics.

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Moira Ferguson is a Professor in the Zoology Department at the University of Guelph where she has worked since 1986. In addition to her academic responsibilities, she serves as an editor for the Canadian Journal of Fisheries and Aquatic Sciences. She received her BS and MS in Zoology from the University of Guelph and conducted her MS research on genetics of lake charr (*Salvelinus namaycush*) and brook charr (*S. fontinalis*). She received her PhD from the University of Montana where she addressed gene regulation and developmental divergence in Salmonid fishes. Moira's research interests include the application of molecular genetic markers to the management and conservation of fishes and understanding the genetics and evolution of complex traits (evolutionary genomics).

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Loren Miller is the supervisor of the Aquatic Genetics Laboratory at the University of Minnesota under the direction of Dr. Anne Kapuscinski. Loren received his BS, MS and PhD from the University of Minnesota. His MS research addressed genetic alteration of fish size by a size-selective fishery, and his PhD dissertation focused on temporal trends in genetic diversity within a northern pike population and estimates of effective population size, based on microsatellite DNA data. His research interests include fisheries conservation, population genetics, hatchery management and hatchery/wild fish interactions. Currently he is conducting studies using molecular genetic markers (primarily microsatellite DNA) to assess genetic population structure, to identify species and their hybrids, and to determine the source population or parentage of individuals.

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Kim Scribner is an Associate Professor in the Department of Fisheries and Wildlife at Michigan State University. Kim is also a member of the Partnership for Ecosystem Research and Management (PERM). He received his BS in Biology and Wildlife Management from UW–Stevens Point, his MS in Wildlife Science from Texas Tech University, and his PhD in Zoology at the University of Georgia. Kim did his postdoctoral work at the University of Leicester, UK, and was previously the project leader for the Molecular Ecology Lab at the USGS/BRD Alaska Science Center. His research interests include population ecology, population genetics, behavioral ecology, applications of population genetics and evolutionary theory and molecular genetic markers to applied population ecological and conservation research.

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Adrian Spidle is a geneticist at the USGS Leetown Science Center laboratory. He received his BS and MS in Natural Resources from Cornell University and conducted PhD work at the University of Washington School of Fisheries. His interests include the application of techniques of molecular biology to the management of fish and fisheries. He uses molecular techniques in deciphering individual-scale questions to do with mating strategies, population-scale questions relating to discreteness of gene pools within and among populations, and evolutionary questions on the long-term history of populations. Adrian works with Atlantic and Pacific salmon, Atlantic sturgeon, and zebra mussels, among other taxa.

Discussion Summary

Points of discussion were generated in several ways. During the break out session groups identified questions/considerations for the geneticists to address in greater detail. Questions and comments were solicited from the audience during the discussion, and information needs identified in genetics management and rehabilitation plans were put forth. Below is the list of questions posed to the panelists followed by their responses and comments. The questions have been grouped based on the general topics of supplemental and re-establishment stocking, and sample collection and interpretation.

Issues related to supplemental and re-establishment stocking

Is inbreeding a concern for small remnant populations?

Depends on the reason the population is small. If the population has always been small or has gradually decreased over a long time period (interpreted to be many generations), inbreeding may not be a big concern. Populations can naturally purge deleterious genes as they are encountered in a population if the population remains relatively stable. Abrupt reductions in population size pose a greater risk for inbreeding because it increases the potential for deleterious genes to be expressed and inherited before they are naturally eliminated from the population through selection.

Low recruitment in many populations in the Great Lakes is a concern for population viability in general. Inbreeding concerns depend upon the percent relatedness of individuals in the population at the present time and this information is seldom available.

Should biologists/managers be concerned about stocked fish straying and mixing with remnant populations?

Currently we don't have the information to determine the extent of genetic difference that would cause concern if stray fish interbreed with a remnant stock. Since microsatellite markers don't necessarily relate to traits or characteristics it is unclear what the consequences of interbreeding among genetically dissimilar fish would be. If one leans toward the school of thought that differences in markers are indicative of differences in traits, then there would be greater cause for concern of straying.

Since you have alluded to horror stories related to stocking of other species, are geneticists similarly horrified by the discussion and current actions of stocking sturgeon?

Due to low, or a lack of, recruitment among many populations the "do nothing" (wait and see) approach does not seem acceptable to managers. Therefore, the questions becomes, what is the best way to move forward with supplemental or re-establishment stocking.

Stocking programs require a great deal of forethought.

In situations where populations are extirpated or lack access to spawning grounds stocking may be the only option to perpetuate or re-establish a population. In this case the question becomes, what source population should/could be used. Horror stories result from inter basin transfers and from situations where there are major differences in the source stock versus the remnant stock or the habitat being stocked. The Rainy River stock is an example of a severely depleted stock that recovered without stocking as a result of water quality improvements.

Due to the high fecundity of sturgeon the potential exists for them to recover on their own if the environmental conditions are suitable. The high fecundity also allows us to rear and stock large numbers of fish in systems where the habitat may not support the number stocked. It is therefore important to ensure that suitable and sufficient habitat is available to support the number of fish stocked.

What is greatest risk when conducting supplemental stocking?
Biased representation of the brood stock used.

Important to have multiple years of donor stock rather than using the same parents.

Don't want few adults producing lots of offspring.

Want to maximize the number of individuals contributing progeny.

If there is a high degree of relatedness among the progeny being stocked, when they mature and mate they're likely to have poor reproductive capacity or low fitness.

The small number of adults, especially females, available is a real problem for stocking programs. If there are 20-100 reproducing adults in a population and their progeny are being stocked on top of, then swamping of the existing stock is a huge concern.

What are the concerns that need to be researched related to stocking?
Literature exists that explains and examines the concerns of stocking and provides recommendations for developing restoration stocking programs. AFS, USFWS, U of MN, MIDNR, and others have developed guidelines that address this topic.

A general outline of a chapter from Kapucinski/Miller publication was described. For selection of a donor population, the use of a genetically similar source stock is important. This generally (not always) means a geographically close source stock; however, ecological/environment differences are an important consideration. Then an adequate number of fish from multiple years is needed. Numerous considerations are important during the hatchery rearing process. It is important to vary conditions in the hatchery rearing process to avoid environmental selection. It is important to equalize family size to prevent swamping. In situations where permanent brood stock are maintained there are issues related to domestication and hatchery selection. When stocking, there are biological concerns such as overstocking and swamping and ecological concerns such as water source.

How many individuals should be stocked annually or added to small remnant populations?
If a population is small and it is feasible to capture all females each year then the number stocked back into that system isn't changing the ratio or representation present. The

questions that should be asked are, why isn't the population producing more fish on its own and are the existing conditions suitable for natural reproduction.

What degree would/could lake sturgeon hybridize?
It is possible for lake sturgeon to hybridize but the likelihood seems low because of the long evolutionary divergence of the various sturgeon species. Some species of sturgeon have 2 copies of chromosomes and some have 4 copies. Pairings of different sturgeon species with a similar number of chromosome copies would produce fertile offspring; however, those species with different numbers of copies would produce offspring that would be infertile.

Is it better to pool milt from several males or use 1:1 matings?
When pooling milt the potential exists that not all males will contribute equally and in some cases the ratio may be highly skewed toward a single male. Studies have shown that pairing at a 1:1 ratio is best.

<u>Issues related to sample collection and interpretation.</u>

Do samples collected from 1 or 2 spawning seasons adequately represent the genetics of a population?
It depends on the age distribution in the sample. If many age classes are represented in the sample from 1-2 years then it is probably not a problem. It would be best to have samples from all 5-7 years of the spawning cycle, but this is probably not feasible in most cases.

Another way to obtain effective population size information is to get a good number of samples from the mixed (interpreted as non-spawning) adult stock. This method is however most suited to a closed or confined population.

The total number of fish sampled is more critical than whether or not the samples came from only 1-2 years.

What do genetic differences mean?
Makes more sense to use nearby populations.

How should tissue samples be preserved/stored for future genetic analysis?
There are numerous ways in which samples may be stored. They include stored dry in a scale envelope (make sure the sample is dried before sealing the envelope), in non-denatured ethanol, in various buffers available for field use, and freezing. If freezing a sample it is important to keep it frozen and to prevent thawing (e.g. during shipment). Drying and storing a sample in a scale envelope is easy and care free but may not be the best for long term use.

<u>Genetics as an analytical tool</u>

Is it feasible to use genetic markers to identify stocked fish at a later point in time?
Yes. You need to collect samples from the parents and from that you can identify the progeny.

Can genetics be used to differentiate between stocked and naturally reproduced fish?
Yes.

<u>Closing Statements</u>

An example of the importance of selection of a brood source and the potential significance that geographic and environmental factors can play in stocking efforts relates to walleye in southern Minnesota. In some southern Minnesota waters, walleye were introduced for development of put, grow and take fisheries, using millions of walleye primarily from two northern Minnesota sources although many other sources of walleye were also used including fish from several rivers in southern Minnesota. Some natural reproduction has now been documented from these lakes. Despite the millions and millions of fish stocked from the northern sources, the genetic profile of the naturally reproduced fish has been found to be similar to a river in southern Minnesota from which an unknown number of fish were stocked some years ago.

Compared to salmonids, the lake sturgeon spawning cycle reduces the disaster potential of stocking.

The first thing to do is to determine the current status of populations.

Several presentations yesterday described the sex ratios of populations. In most sturgeon species, sex determination is environmentally driven and not genetically determined. Studies specific to lake sturgeon do not exist; however, this is something to consider in management plans.

One option for obtaining fish for stocking is to gather naturally reproduced larvae while drifting. This approach avoids the need to mate and artificially rear fish from the egg stage.

Recommendations

Several geneticists provided suggestions to steering committee members in post meeting comments. Of particular interest were suggestions of the need and interest in pursuing development of genetics related guidelines for management plans that may include stocking as a tool.

Technical Session 2:
Consideration of Assessment Techniques to Determine Status

The purpose of this session was to provide managers/biologists the opportunity to discuss and share detailed information about assessment techniques useful for monitoring and determining the status of (1) spawning adults and (2) juveniles (YOY through age 5). The session was to aid managers and biologists in evaluating how best to monitor and determine the status of lake sturgeon populations, provide a basis for consistency across the basin and provide contacts for further consultation and collaboration.

Charge: Breakout groups attempted to develop a basic design for assessing sturgeon of these life stages and generated a list of important considerations and recommendations for implementing the assessments. Group summaries were shared with all attendees during a large group discussion.

Structure of Session: The breakout groups convened for 2 hours. The groups discussed spawning adult assessments during the first hour and juvenile assessments during the second hour of the session. The breakout discussion was then followed by a 1 hour large group session during which each breakout group report back a summary of its discussion. In addition to the charge, each group was provided a list of topics/questions (see below) used to stimulate and focus discussion. Assessment techniques appropriate for different environments such as small vs. large river systems, river mouths, and open waters were discussed in detail to facilitate information exchange, standardization and provide a complete understanding of how the assessments should be conducted. A facilitator led each group in a manner that allowed everyone to contribute equally and recorded the discussion. A group representative presented a summarization of the group discussion to the reconvened large group audience.

Guiding Questions for Breakout Groups:
1) What techniques/methods will work best and in what types of environments?
2) What details are important for success?
3) When and how long to sample (adequate effort, timing)?
4) What biological data to collect and how (size, age, sex, numbers, tagging etc.)?
5) What standardization is important for comparison among systems/studies?

Results
Several issues contributed to limiting the effectiveness of this session. The scope of the material requested from the session participants was broad. Although the meeting organizers tried to provide some guiding principals to aid in collection of this information, there was too much material to synthesize (adult and juvenile sturgeon in all types of systems) in such a short time period (2 hours). However, valuable information was gathered during this breakout session. Each question listed above will be discussed with responses summarized from the breakout groups.

What techniques/methods will work best and in what types of environments for spawning lake sturgeon?

Thirteen different techniques were identified by the nine breakout groups for sampling spawning lake sturgeon (Table 12). Large mesh (8-14" stretch measure) gill nets, set lines, hand dip netting, visual observations (weirs, scuba divers, ROV and video cameras) and electrofishing were all methods that were recommended by a number of the groups. Each technique recommended would be bested suited for a particular sampling environment. The technique recommended for the different environments are illustrated in Table 13.

Table 12. Consideration of assessment techniques to determine status of spawning lake sturgeon.

Spawning lake sturgeon	Number of Groups		Number of Groups
Large mesh gill nets (8-14" stretch mesh)	9	Hydroacoustic/Side Scan Sonar	5
Set lines	9	Commercial trap nets	5
Visual Observation (weirs, divers, cameras)	8	Telemetry (radio or sonic)	4
Dip Nets (shallow water systems)	8	PIT Tag Readers/Data loggers	3
Electrofishing	6	Trawls	3
Egg Mats	5	Trammel nets	2
		Seines	2

Table 13. Sampling gears which were identified by the breakout groups as viable for sampling spawning lake sturgeon in different environments.

Water Type	Sampling Gear
Large connecting Waterways	Set lines
	Large mesh gill nets
	Visual observations
	Hydroacoustics/Side Scan Sonar
	Trawls
	Electrofishing
	Egg traps
Small Rivers	Dip nets
	Electroshocking
	Visual observation
	Hydroacoustics
	Large mesh gill nets
	Trap nets
	Automatic PIT Readers
	Telemetry
	Weirs
	Seines
Lakes	Trap nets
	Trawls

What details are important for success?
The breakout groups had specific suggestion and items for consideration before selecting a gear type for sampling spawning lake sturgeon. Local knowledge of the sampling location was critical for selecting a gear. It was suggested that this knowledge could be gained from local fishers (both recreational and commercial) as wells as local residents who reside on the system. Consulting with Native American Tribes to determine traditional spawning locations was also helpful for some researchers. Occurrence of jumping lake sturgeon was also identified as a likely indicator of spawning fish. Monitoring water temperature (8-20° C) is important for determining when sampling should occur. One group suggested that the lunar cycle and emergence of aspen leaves can be used as indicators of lake sturgeon spawning. High flows and large debris loads would help lead an investigator to selecting set lines instead of gill nets in a large river system. However, gill nets were identified to perform better in a system with less flow and debris load. Several of the groups cautioned the selection of electrofishing as a sampling gear for spawning lake sturgeon. The Wisconsin Department of Natural Resources utilizes this sampling methodology; however, they employ two shocking boats for effective sampling. Telemetry was suggested by several of the groups as being a very good means to determine spawning locations of lake sturgeon. When utilizing set lines investigators should be aware that each system has a specific bait that produces the best catch rates. Therefore, it may be necessary to experiment with different baits to determine which works best. Some researchers have also had higher catch rates by using salted bait. Egg mats were suggested as an alternative to actually handling lake sturgeon prior to their spawning. The presence of eggs indicates that spawning fish were present and provide genetic information that can be very valuable to researchers. By collecting eggs presence of fish could be confirmed without interfering with the lake sturgeon during the process of spawning. An important matter that should be taken into consideration when sampling this rare species.

When and how long to sample (adequate effort, timing)?
The answer to this question was dependent on the objectives of the study. However, several items were identified as critical by each of the breakout groups. Water temperature is the factor that should determine the initiation of an assessment for spawning lake sturgeon. Because lake sturgeon tend to spawn within a very narrow window it is necessary to begin prior to the expected spawning to ensure that it is not missed. Some evidence also suggests multiple spawning runs during a year which could require additional sampling depending on the study objects (genetic variability etc.). Given the experience of the breakout group participants, sampling for at least a month was suggested as a minimum amount of time to dedicate to a spawning run assessment. Because of the unique life history characteristics of sturgeon and their low abundance in the Great Lakes, biologist must be committed to sampling for 5 years or more especially if determining abundance is a goal of the assessment.

What biological data to collect and how (size, age, sex, numbers, tagging etc.)?
The standard suite of variables that are collected on most fisheries assessments are also important during assessments on spawning lake sturgeon. Lengths (total, fork and girth), weight, genetic sample (small tissue clip) and a structure for aging (small section of the fin ray). Captured fish should be examined for tags and wounds or deformities. Capture technique should also be recorded. Most of the groups agreed that PIT tags should be used

for tagging lake sturgeon. If PIT tags are used the fish should be marked with an external tag as well. Many of the groups also suggested care be used when collecting biological data from these fish and to ensure that the data that is being collected is needed. If the data is not going to be used "Don't collect it!"

What standardization is important for comparison among systems/studies?
A number of issues were listed by the breakout groups as important for standardization with regard to sampling spawning lake sturgeon in the Great Lakes. Most breakout groups agreed that the data collected (length, weight, genetics, etc.) should be standardized among agencies collecting information. More than one group recognized a centralized data form and web based reporting of data collected as important for Great Lakes lake sturgeon researchers. The breakout groups were divided on the standardization of assessment gear. Some believed the sampling gear should be standardized and others indicated that the variety of environments being sampled prevented standardization. Those advocating gear standardization saw value in standardized gill net lengths and mesh sizes, equal number of hooks and similar baits on set lines and standardizing the effort among these gears. Tag type and placement was also addressed as an item requiring standardization. Frequency ranges for telemetry tags was another variable that would benefit all researchers if it were standardized across the Great Lakes Basin. Several breakout groups indicated that physical and habitat characteristic measurements should also be standardized.

What techniques/methods will work best and in what types of environments for juvenile lake sturgeon?
Twelve different techniques were identified by the nine breakout groups for sampling juvenile lake sturgeon (Table 14). Small mesh (1-2.5" stretch measure) gill nets, visual observations, trawling, electrofishing and larval drift netting were methods that were recommended by a number of the groups. In general it was assumed that sampling for juvenile lake sturgeon would be occurring in a riverine system.

Table 14. Consideration of assessment techniques to determine status of juvenile lake sturgeon.

Juvenile lake sturgeon	Number of Groups		Number of Groups
Small mesh gill nets (1-2.5" stretch mesh)	8	Set lines	4
Visual observations	8	Commercial fishers (trap nets and gill nets)	3
Trawling	7	Telemetry	2
Electrofishing	5	Angling	1
Drift nets	5	Minnow traps	1
Seines	4	Fyke nets	1

What details are important for success?
Details which were important for success while sampling spawning adults is also important for sampling juvenile lake sturgeon. However, large knowledge gaps exist with regard to capture of juvenile lake sturgeon. Much work is needed to fill these gaps. More is known

with regard to sampling larval lake sturgeon following emergence than with fish from 1-4 years of age. Some evidence suggests that juvenile lake sturgeon inhabit sandy areas. Typically sampling for juveniles requires intensive sampling over a number of years. Stratified sampling in all habitats available then returning to areas where fish are collected was suggested by one group. Some juvenile lake sturgeon have been reported as by catch for both recreational and commercial fishers. Utilizing non traditional methods to gather data on these fish may be necessary especially in areas where abundance is low.

When and how long to sample (adequate effort, timing)?
As with the spawning adults, objectives of the study or project will determine sampling effort. Amount of sampling will vary if the objective is to determine presence/absence rather than abundance. Several of the breakout groups identified night and autumn as times to sample for juvenile lake sturgeon. The juvenile lake sturgeon seem to congregate in the autumn and the age 0 fish will also be larger and possibly easier to catch during the autumn. Sampling near barriers was also suggested by one of the breakout groups.

What biological data to collect and how (size, age, sex, numbers, tagging etc.)?
Same as for the spawning fish.

What standardization is important for comparison among systems/studies?
Same as for the spawning fish.

EMERGING ISSUES FOR FUTURE TECHNICAL SESSIONS

As part of the registration materials, meeting participants were given a response sheet labeled "Emerging Issues for Future Technical Session Discussion" that listed eleven suggested topics. At the beginning of the meeting, participants were asked to review these materials in preparation for a discussion session during the second day of the meeting. At that time, participants were asked to list, comment on, and rank these and additional topics they thought would be important to discuss during the technical sessions at future meetings.

Results

Of the final nineteen suggested topics, 5 ranked significantly higher than the others, and one, habitat classification and restoration practices ranked significantly higher than the rest. Also included in the top 5 were development of standardized survey and assessment techniques, and rehabilitation stocking and genetic considerations, the focus topics discussed during this meeting. All the topics identified in ranked order are listed below.

Highest Rank

Habitat classification and restoration practices

High Rank

Development of standardized survey and assessment techniques
Fish passage needs, technologies and deployment
Rehabilitation stocking and genetic considerations
Development of basin-wide rehabilitation plan

Medium Rank

Great Lakes basin standardized tagging scheme
Public education, involvement and support
Propagation/Reintroduction techniques and deployment
GIS database development
Potential for illegal harvest and mechanisms to prevent it
Meeting the needs of sea lamprey control and sturgeon restoration

Lower Rank

Identifying bottlenecks to recruitment
Techniques/procedures to quantify recruitment
Policy as hindrance to interagency/binational coordination
Top down standardized protocol for techniques and research procedures
Genetic tissue sample standardization
Imprinting cues
Mapping spawning locations
Connecting waterways work

PRIORITY RESEARCH AND ASSESSMENT NEEDS

As part of the registration materials, meeting participants were given a response sheet labeled "Priority Research and Assessment Needs" that listed the four research approaches that addressed the four major problem areas identified at the workshop held in Muskegon, Michigan in June, 2000. Attendees were also given a copy of the final report "Research and Assessment Needs to Restore Lake Sturgeon in the Great Lakes" from that workshop. At the beginning of the meeting, participants were asked to review these materials in preparation for a discussion session during the second day of the meeting. At that time, participants would be asked to list, comment on, and rank research and assessment needs they thought were important and to turn in their response sheet at the end of the meeting.

The four needs that were provided on the survey sheet were:

Status Assessment and Development of a Rapid Survey Process – Specific research activities in this category include consolidation of existing information, design of indicators and survey strategies to provide comprehensive and system-wide inventories, and coordination of periodic census efforts.
Individual System and Habitat Requirement Studies – The lack of detailed understanding of habitat utilization by various life-history stages and the associated lack of detailed habitat classification and inventory are critical information gaps that must be filled.
Fish Passage Technology – Research into the design of safe and effective upstream and down stream passage of dams for lake sturgeon is needed.
Propagation Techniques and Strategy for Deployment – The need for research and development to improve hatchery production and stocking success.

Results

In addition to the four needs provided on the survey form, participants provided 15 additional research and assessment needs during the group discussion, and 23 additional needs (including the 15) on the 52 response sheets that were collected following the discussion.

We also reviewed the notes generated by each of nine breakout groups that discussed the 2 featured emerging issues during the second day of the meeting. The session topics were 1) consideration of stocking to rehabilitate populations, and 2) consideration of assessment techniques to determine status. Although it was not a specific goal of these sessions, we identified 15 research or assessment needs particular to these two topics, most of which were identified by several, if not all of the groups.

The 4 comprehensive needs provided from the Muskegon workshop were given the following order of importance by attendees at this meeting, though all were ranked high.

1. Individual System and Habitat Requirements Studies
2. Status Assessment and Development of Rapid Survey
3. Fish Passage Technology

4. Propagation Techniques and Strategy for Development

We were able to group the additional research and assessment needs provided by the participants into 3 of these 4 comprehensive categories (1, 2 & 4, there were no additional needs listed that directly related to fish passage) or into 2 additional categories of "Contaminants" or "Other" (see below). Many of the additional needs identified were similar or involved common ideas and were able to be combined. It was difficult to assign a specific rank to these additional needs because not all participants listed and ranked the same needs. However, they are presented under each category in order of what we determined to be their relative importance based on how often they were mentioned by individuals or by the nine breakout groups. It should be noted that most of these additional research and assessment needs were included in the listings of research needs identified by the Muskegon workshop discussion groups. Their listing here simply further emphasizes their importance.

Individual System and Habitat Requirements Studies

- Define habitat needs and use for critical life stages (spawning and egg-yearling stages)
- Proportional lack of information for large connecting waterways (potential high importance to restoration)
- Evaluation of existing and potential habitat
- Juvenile assessments are particularly critical to fill knowledge gaps
- Carrying capacity (will current habitat support more fish?, what can a system handle?)
- Identification of areas where pre-spawning, non-spawning, and sub-adult fish congregate

Status Assessment and Development of Rapid Survey

- Long term commitment is required (Timeline for assessments needs to encompass full reproductive cycle or generation time of the species. This is likely to involve a minimum of 3-5 years, 5+ recommended, 7 preferred, even for presence/absence studies, or until sufficient recaptures of both sexes occur.)
- Identify system specific causes of past population decline (do they still exist?, have they been addressed?)
- Lack of information on populations using large connecting waterways
- Comprehensive genetic inventory of existing remnant and stocked populations (needed for stock differentiation, determining effective and critical population size, and for assignment testing)
- Identify and quantify sources of mortality (natural, lamprey related, fishing (incidental/targeted/poaching), early life stage (predation), disease, contaminants, etc.)
- Juvenile assessments are particularly critical to fill knowledge gaps
- Conduct gear comparison and assessment technique studies in systems having lots of fish
- Impacts of sampling/assessments on spawning fish
- Identify parameters and analysis needs necessary for determining population status
- Techniques to determine sex (non-invasive, field technique)

Propagation Techniques and Strategy for Development

- Need for genetic management plans (maintaining diversity)
- Investigations of most suitable life stages for stocking based on imprinting, straying, survival, return rates, etc.

- Need to understand factors that determine sex (thought to be environmentally induced)
- Need for marking of stocked fish (how to tell stocked from wild fish for all life stages stocked)
- Establish protocols related to disease management in propagation settings (i.e. Iridovirus)

Contaminants
- Need for basin wide contaminant analysis and prediction of expected contaminant uptake for stocked fish in various systems
- Identifying contaminant effects on reproductive success
- Development of non-lethal contaminant sampling techniques and measures

Others
- Other species interactions, both exotic/invasive and native species affects (include both negative effects on sturgeon and negative on others species by reintroduced sturgeon)
- Coordinated law enforcement efforts
- Enhance public relations for education, support, and assistance with rehabilitation efforts

MEETING EVALUATION SUMMARY

An evaluation form was distributed to all participants and they were requested to complete the form prior to the end of the meeting. Time also was allotted at the end of the meeting to complete and return the form.

Results

Seventy-three surveys were returned. In general, the responses were positive and indicated that the meeting had been worthwhile (Table 15). There also were a number of suggestions provided that will be useful in preparing for and improving future meetings. Based on the responses, it appears that having these meetings every year may be too frequent, and that the next meeting should be held in 2004. Below are the summaries for each section of the evaluation form.

Question 1. What aspects of this meeting did you find most useful?
Most people (27) felt that the presentations on the first day were the most useful aspect of the meeting. They enjoyed the mix of presentations and some liked the short 3-minute presentation idea, although a couple of respondents felt that the time limits should have been better enforced. Many people (19) felt that meeting people and networking was the most useful aspect of the meeting. Meeting participants (19) also found the second day breakout sessions very useful. Approximately 9 respondents found the Genetics Panel discussion very educational and useful. Nine people felt that the whole meeting was useful.

Question 2. What aspects did you find least useful?
Ten respondents believed the basin overview presentations of status and assessment activities were the least useful. Comments included time spent on the basin overviews could have been shortened, slides were not very legible and all the information was on the handouts, and some misinformation was on the lake map handouts. Six individuals found the presentations least useful. Their comments included not enough time allotted for presentations and too many talks in one day. Eight people felt the breakout group discussions were the least useful. Comments included: breakout sessions should have been based on panel discussions only, stocking was not encouraged by their agency, breakout session was dominated by a few vocal researchers, and more specific methods on assessment techniques would have been more helpful than rehashing all techniques available. Seven meeting participants indicated that the summaries of the breakout sessions were least useful. Comments included needing more time to summarize, too much info in too little time, ended up being a laundry list, and were redundant. Seven people felt the genetics panel was the least useful. One comment was that the session was too long and diffuse. Other comments under least useful included GIS databases, a bit crowded, not enough time to talk with other professionals, cold rooms, not being a biologist or manager, management, limited amount of information on sampling in large lakes, and would have helped to have abstracts out before the meeting. One person said it would have been helpful to have a short discussion following a group of short presentations, maybe combining the expert panel with a group of short technical presentations.

Table 15. Responses to evaluation form statements 1-10.

The Great Lakes 2002 Lake Sturgeon Coordination Meeting:	Strongly Agree 5	Agree 4	Neutral 3	Disagree 2	Strongly Disagree 1
1. Provided me an opportunity to foster professional contacts.	48	24	1		
2. Provided me an opportunity to learn the basics of current research projects.	39	33	1		
3. Provided me an opportunity to get an update on current management activities.	30	33	9		
4. Provided me an opportunity to suggest future research and assessment needs.	23	34	12	3	
5. Format and presentations of the first day were informative and useful.	30	39	3		
6. Breakout groups provided me an opportunity to contribute to the discussions.	39	24	7	1	
7. Stocking breakout discussion was helpful and provided new information that should be useful to sturgeon biologists, managers and researchers.	23	33	13	1	
8. Genetics panel discussion provided new and useful information important for consideration when planning and implementing lake sturgeon restoration efforts.	22	27	22	1	
9. Assessment techniques breakout discussion was helpful and provided new information that should be useful to sturgeon biologists, managers and researchers.	15	34	19	1	
10. The evening poster/display session and chili social was enjoyable and worthwhile.	36	28	7	1	
11. How often should sturgeon coordination meetings such as this be held?	Annually	Every 2 years	Every 3 years	Not be held	
	22	47	5	0	
12. The planning will begin soon for the next Coordination Meeting. Please indicate the month that would be best for you to attend.	June	July	August	September	October
	8	8	8	11	18
	November	December	January	February	
	27	37	4	3	

Very interesting! Should keep presenters to their time limits.

Well organized, good presentations and well facilitated. Somewhat of an info. overload, especially towards the end of the day.

I like the three-minute presentation format! That said, 39 presentations in 1 day is a lot! Genetics forum was great.

I enjoyed the meeting very much. I learned a lot about sampling methods and the need for more genetic research in the Great Lakes. I enjoyed the opportunity to meet and talk to workers in the field of assessing lake sturgeon populations.

Good session. Looking forward to getting the proceedings.

I hope that all this information becomes available at one website. Very important, as it appears many are working on the same things.

I felt that the presentations went far too long. I would suggest to either be more selective with who will present or to break up the presentation schedule over a couple of days. Also many of the shorter presentations may have been effective as poster presentations

Less talks on Day 1 or adding another day would allow greater absorption of information.

I would like to see a longer time slot for individual presentations. The short time provided the opportunity to present a great deal of information, but it seemed rushed.

Perhaps make the meeting longer so that you don't have to cover so much in one day. I personally would like to see presentations grouped by Lake and by agency/tribe/university. This would be useful when talking about standardizing methods for assessment, particularly in bi-national waters.

Basin overview took too long.

A few less speakers (presentations). More 20 minute breaks. Relax and have some fun during the meeting making additional contacts.

The 3-point presentations were a good idea, but no one kept to the time and slide limits.

More breaks and end a little sooner in day. Liked the 3-minute presentations. Group summaries were possibly not needed. Seemed the small group discussion was sufficient.

Two-days with more breaks plus ½ day breakout session. Leave more time between presentations for questions and answers.

Wednesday was quite informative. However, sessions were rather long. Would it be feasible to have concurrent presentations (rooms divided)? This would allow more time for each presentation as well as allow for an individual to attend those presentations most useful to them.

There doesn't really need to be a lot of presentations at these meetings. A series of panel discussions would be more useful. Break up the panels with a few related presentations.

Overall, meeting was excellent. A great deal of information was presented with opportunities to discuss in greater detail. The drawback, of course, with long meetings was that a lot of people were burned out by the mid-afternoon. I would suggest that 1st day was a little too ambitious. Maybe change a 10-minute talk or two to 3-minute or drop a few 3's. Second day spent too much time on synthesis and not enough on future research. I was hoping for more detailed discussion on assessment techniques. I'd love to attend this meeting again in the future.

I think breaking the presentations up into two days as well as one breakout per day would work better (less burnout). I think the panel discussion worked great and should continue.

Very valuable exercise. Provides a great forum for new workers to learn quickly, and insure active workers communicate new findings and new ideas more effectively than primary literature or talks scattered around larger fisheries meetings. Trust should buy us t-shirts.

This was a very worthwhile two days.

Thank you for taking a leadership role in addressing lake sturgeon management issues. "We" are building a legacy.

I greatly enjoyed the conference and appreciate all the hard work of the steering committee.

Good location too!

The arrangement of a power-packed presentation day followed by a brain-storming / experience sharing day was very effective and productive.

Make summary of breakout groups shorter. Have meeting on Thursday and Friday.

Don't spend time on summary presentations after breakout sessions since the results are going to be compiled and published later.

In the second session re: assessment techniques to determine status, the group had a difficult time finalizing thoughts and reaching consensus. Perhaps if the session had been focused around identifying those parameters that need to be reported on (i.e. age distribution, sex ratio, proportion of spawning/non-spawning fish, maturity), then we would at least have targets to work towards. The reason I suggest this is I do not think any one assessment technique will work in all habitat conditions. The variability of habitat used for spawning is too high. Therefore, at best we can identify a suite of tools available . . . focus instead on these parameters / stats that need to be standardized for reporting. Standardized reporting across the G.L. basin will lead us to overall reporting on the status of lake sturgeon in the basin.

Great job! Glad to see this type of workshop! The breakout session #2 was fantastic! Some great talks, discussion, and ideas for the future. Great job folks!

Charge for breakout session #2 seemed too broad – many bullets seemed to be common sense (i.e. trained crews, electrofishing safety, etc.) or a laundry list of fishery assessment gear.

Heed the implicit and explicit warnings of the geneticists.

The genetics panel mentioned various literature sources providing guidelines for stocking many different species of fish (can they provide a list of recommended readings). It would be nice for them to provide a baseline that is specific in detail for the stocking of sturgeon. Case studies for different systems and different population sizes would be helpful. For example, it the panel could show case studies that have worked or not worked.

When will results of analyses on genetic differences among lake sturgeon populations in the different areas of the Great Lakes be shared with those of us who have provided tissue samples for analysis to geneticists since 1998? I was disappointed with the little genetic data that was presented at this coordination workshop.

Efforts should be pushed to have a set of guidelines or a decision matrix developed to assist managers and agencies with whether or not to stock, and if the decision is made to stock, then what criteria should be governing the activities.

Generally an excellent session; only worry was assumption that stocking would occur – what conditions were necessary prior to agreeing to stock?

May want to have every year initially, but curtail to every other year when no new material is presented.

In the future, I would like to see a specific component of the conference focusing on habitat.

At this time or soon, need to formalize a functional group (committee, task force or working group) with formalized sponsorship (consistent/long term funding) to communicate with the wider network, providing ready access to goings-on of Committee/opportunities to participate in decisions or serve in turn on the group. The Committee deals with standardizing protocols, assessment techniques, forms, databases with historical data collection/interpretation, puts out a standard form(s) available on the internet, holds training workshops in standard techniques, establishes the future approach to large group meetings, and sorts out government policy issues. Obviously, interest continues to increase, but there are likely many in the Great Lakes biological/scientific community not yet thinking along these lines. So need for additional outreach to this small but disparate community (may yet be some impressive experiences/knowledge out there!)

I am with the sea lamprey programme. People must be made aware of the real problem this exotic represents. Our efforts can impinge on other species, including sturgeon (with present understanding believe treatments very minimal, while our barrier programme poses a threat – but we are moving to fishways where desirable to assist non-targets). However, vital to realize that in reducing control or improving habitat for sturgeon (similar to sea lamprey), may be helping the lamprey to a greater degree than the non-target, for a net loss! Because of their slow growth, sturgeon remain in what I suspect would be the most vulnerable size range for a long time! Lamprey will readily move to species if convenient or as preferred species disappear!

If this meeting is to coordinate research, it should result in a prioritized list of tasks; the next meeting should focus on addressing progress toward those tasks.

The public relations issue here is crucial. Opinions and values change, especially over long time periods (such as generation times for sturgeon). The current level of interest in sturgeon rehabilitation is just as likely to wane as it is to grow. Without public interest, all our discussions are moot. We must ask ourselves why we do this, and what the public gets out of our efforts. If we can’t answer those questions, then all our efforts will have been in vain.

Some effort should be put to force the different agencies to go in the same direction to get BASIC information on sturgeon habitat (larva, spawning, adult) and involve your knowledge.

The hotel and meal arrangements were adequate and completely satisfactory.

I would like to see more on the effects of contaminants on sturgeon.

Basin wide data base in all aspects is a definite priority.

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APPENDIX A

ABSTRACTS *(Presentations, Poster Displays and others with abstract numbers)*

1. Rapid Assessment of Lake Sturgeon Using Instream Hydroacoustic Technology.
Presentation

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Two priority research needs identified at the June, 2000 Great Lakes Fishery Trust Lake Sturgeon workshop were the development of rapid assessment techniques for lake sturgeon and a basin wide assessment of remnant lake sturgeon populations. Portable hydroacoustic technology has been developed and refined to accurately determine size and direction of movement of migrating salmonids in northwestern rivers but has not previously been used for sturgeon species. In the first year of our two-year project we successfully deployed a split-beam instream hydroacoustic system developed by Hydroacoustic Technology Incorporated, Washington. We have defined a station location on the Sturgeon River suitable for recording passing fish, acquired electricity at the remote site, and successfully ran the system for 1.5 months. We tested standard targets several times to confirm effectiveness and sensitivity of portable hydroacoustic sampling gear. We also conducted a manual count of lake sturgeon at the spawning site in the Sturgeon River to verify hydroacoustic counts. Preliminary results allow us to identify upstream and downstream movement of large fish. We also found more fish were observed passing the hydroacoustic beam than were observed on the spawning site and that was expected due to significant water flow regimes in 2002. To maintain and protect the diversity of sturgeon stocks throughout the Great Lakes requires identification and assessment of each of these unique remnant groups. We feel hydroacoustic sampling will provide an unobtrusive assessment method with minor investment of personnel and time.

2. Research Activities in Lakes Superior and Michigan

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For the last 15 years I have been studying lake sturgeon in the Sturgeon River, Portage Lake, Keweenaw Bay, Lake Superior region. In the last two years I have expanded work to include rivers in the lower-Upper Peninsula of Michigan which drain into Lake Michigan, and also the Ontonagon River system. In 2003 a new MS student and I will be involved in a project on the Manistee River in the lower peninsula of Michigan.

I have experience in collecting drifting newly-hatched larvae, YOY, sub-adult and adult fish. I have experience with drift nets, trawling, gillnet and telemetry tracking of sturgeon. My work

focuses on the ecology of these fishes and the limnology/stream ecology of their environments. I am interested in the roll imprinting may play on the success of rehabilitation of lake sturgeon stocks. I am a member of the Michigan lake sturgeon committee and recently finished editing the Lake Superior lake sturgeon rehabilitation plan, soon to be published by the Great lakes Fishery Commission.

Recently Completed Projects and Students:
Inventory of habitat critical to juvenile lake sturgeon in the Lake Superior basin using aerial photographs, with Becky Cookman (MS student), 2001. G.L. Basin Trust

Movement, habitat utilization, and diel activity of juvenile lake sturgeon *Acipenser fulvescens*, in Portage Lake and the Sturgeon River, Michigan, with Marty Holtgren (MS student), 2001. NOAA/MIDNR.

Current Projects, Students and Co-Investigators
Rapid assessment of lake sturgeon spawning stocks using instream hydroacoustic technology, with Lori Betcher (MS candidate) and Dr. Ed Baker (MIDNR). G.L.F.T.

Status assessment of remnant lake sturgeon stocks in the Lake Michigan basin, with Frank Lepera (MS candidate) and Dr. Ed Baker (MIDNR). USFWS/GLFT.

Habitat of stocked and native juvenile lake sturgeon in the Ontonagon and Sturgeon Rivers, Michigan, with Kyra Ziomkowski-Fillmore (MS candidate) and Dr. Ed Baker (MIDNR). NOAA/MIDNR.

Evaluation of recruitment success, habitat preference, and river retention of young lake sturgeon in the Big Manistee River, Michigan, with Marty Holtgren (LRBOI). G.L.F.T.

3. Lake sturgeon stocking in the Ontonagon River, Michigan. *Presentation*

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The Ontonagon River, a Lake Superior tributary in Michigan's Upper Peninsula, historically supported a large annual spawning run of lake sturgeon. However, overharvest and habitat degradation led to extirpation of the local population. In 1998 the Michigan Department of Natural Resources began an effort to reestablish a self-sustaining lake sturgeon population in the Ontonagon River by annually stocking young-of-the-year lake sturgeon. Gametes have been collected from spawning fish in the Sturgeon River, also a Lake Superior tributary, each year and young-of-the-year lake sturgeon have been raised either at the Wild Rose hatchery in Wisconsin or at the Wolf Lake hatchery in Michigan. Fingerling lake sturgeon have been stocked each September or October since 1998 approximately 33 km upstream from Lake Superior and a total of 26,860 fish have been stocked. All lake sturgeon stocked have been tagged with a coded wire tag in the snout cartilage to allow identification as stocked or wild. Short term post-stocking survival was high in 2001 and assessment sampling with trawl, gillnet, and setline has captured 51 stocked fish since 1999. Captured fish were between 140 and 490 mm total length. The intent is to continue stocking lake sturgeon the Ontonagon River until mature fish return to the river to spawn and begin reproducing naturally.

4. Influence of External Radio Transmitter Shape and Size on Survival, Growth, and Tag Loss of Juvenile Lake Sturgeon. ***Poster Display***

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Radio telemetry is used to determine habitat preferences and movement patterns for fish in the wild. In studies using telemetry, the general rule for determining the appropriate size for a transmitter is that it should not exceed 2% of the body weight of the fish. However, few studies have examined the effects of externally attached radio transmitters on small fishes. We evaluated the influence of two transmitter shapes (cylindrical and compressed) and three transmitter sizes (small [1.25% of body weight], medium [2.00% of body weight], and large [6.00% of body weight]) on the survival, transmitter loss, growth, and condition of juvenile lake sturgeon *Acipenser fulvescens* (total-length range, 297-326 mm; wet-weight range, 93-125 g) over an 8-wk period. For the experiment, fifteen lake sturgeon were assigned to each treatment combination, with an additional fifteen fish serving as the control group (handled, but no transmitter attachment). Fish were randomly distributed among three, 908-L circular tanks so that each tank contained five fish from each treatment and control group (N = 35 fish per tank). Dummy radio transmitters were externally attached and anchored adjacent to the second and third dorsal scutes and the antenna was truncated so that it did not extend past the caudal fin. Fish were measured every two weeks for total length and wet weight, condition was calculated, and mortality and transmitter loss was recorded. Fish with dummy transmitters that were shed during the experiment were not included in statistical analyses.

Juvenile lake sturgeon suffered no mortality during the study period. Regardless of transmitter shape or size, feeding behavior and swimming ability of treatment fish did not differ from control fish. The largest percentages of transmitters were shed during the last four weeks of the experiment (12%). Large and compressed transmitters had a higher shed frequency (9 and 10 transmitters, respectively) than the other treatments. Lake sturgeon with medium and large transmitters, regardless of shape, did not significantly increase in length increments during the experiment, whereas fish with small transmitters and control individuals did significantly increase in length increments. By week two, all lake sturgeon with transmitters exhibited a significant increase in weight increments compared to control fish. However, by the end of the study, weight increments of control fish and individuals with small transmitters were significantly greater than the medium and large transmitter groups. Lake sturgeon with transmitters and control fish had significantly greater condition increments by the second week, but control fish had significantly lower condition increments than individuals with transmitters. By the end of the study, all fish with transmitters had exhibited a significant decrease in condition increments. Our results suggest that external radio transmitters should not exceed 1.25% of body weight for telemetry studies involving juvenile lake sturgeon.

5. Characterization of Early Life History Stages of Lake Sturgeon in the Peshtigo River, Wisconsin. ***Presentation***

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The lake sturgeon *Acipenser fulvescens* is an imperiled species in the Laurentian Great Lakes and efforts to rehabilitate this species are ongoing. However, for this to be successful, information about larval, juvenile, and subadult life stages, seasonal and spatial movement patterns and habitat usage of lake sturgeon populations must be analyzed and quantified from field studies. The study area for this project was the 14-km stretch of the lower Peshtigo River, Wisconsin. Sampling of larval lake sturgeon was conducted from 21 May to 20 June 2002 using D-frame drift nets set at two sites each night. Habitat sampling was initiated on 25 June 2002, using an Ekman and Petersen dredge. Dominant substrate types were identified at 50-m intervals throughout the river, and samples were collected for later analysis of macroinvertebrate taxa. Flow, depth, and site location were also recorded with each sample. Sampling of juvenile lake sturgeon began on 01 July 2002, using set lines, fyke nets, gill nets, bottom trawls, seines, electrofishing, and visual surveys to evaluate effectiveness of capturing juvenile lake sturgeon. Radio transmitters were attached to juvenile lake sturgeon larger than 75 g, and fish with transmitters were tracked at least twice each day. At sites where juveniles were captured, substrate samples were collected and GPS coordinates, water quality, flow, depth, and substrate type were recorded.

A total of 159 lake sturgeon larvae, ranging in size from 15 to 23 mm, were captured, with peak drift occurring from 02 June to 07 June 2002. The total number of collected substrate samples was 667. The dominant substrate type in the lower half of the river study area was sand. In the upper half of the study area, the dominant substrate was a mixture of cobble, gravel, and sand. Macroinvertebrate analyses are ongoing and will be completed in February 2003. A total of 14 juvenile lake sturgeon were captured, ranging in size from 142- to 273-mm total length. One fish was captured in a small-mesh gill net (0.5-mm bar mesh) and 13 individuals were captured during visual surveys with dip nets. All captured fish were found over sand substrates. Only four fish were large enough for an external radio transmitter. These fish remained in the river at approximately the same location from which they were captured until water temperatures dropped to 12°C, before beginning to move downstream to Green Bay.

6. Rupert River derivation project impact assessment study

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Michel Bérubé is a senior biologist working at Hydro-Québec since 1989. He has been working mainly on impact assessment of hydroelectric projects. He is actually conducting an impact study on fish populations of the Rupert River in the James Bay area, for the Rupert River derivation project. The Rupert River shelters a lake sturgeon population for which a special attention is given in the frame of the whole impact study. A major telemetry study is being conducted since spring 2002, to describe the movements and the use of different types of habitats by sturgeon. A habitat model for spawning sites is also being developed for an IFIM/PHABSIM model to determine future instream flow. The interest of Michel Bérubé to participate to the Sault-Ste-Marie meeting is to make contact and share information with sturgeon specialists in North America in order to improve the impact assessment and develop appropriate mitigation measures.

The new generation projects Michel Bérubé is or was involved in at Hydro-Québec are the Rupert River derivation, the Lower Churchill River dam, the Pikauba River Dam, the Peribonka River Dam and the Toulnustouc River Dam. He also participated to numerous impact assessments on existing facilities modifications, and a major bank stabilization project on the Ottawa River.

7. Overview of lake sturgeon studies in New York's Lake Ontario and St. Lawrence R.

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Lake sturgeon waters of the St. Lawrence drainage that were downstream of Niagara Falls were without barriers historically, but those populations have been fragmented by dams for several decades. Lake Ontario sturgeon are no longer a lake-wide resource and very few catches are taken even though a few sitings occur in the shore area of the lake. As known elsewhere for this species, the commercial catches of the 1800s were seasonally very large in near shore areas and near tributaries.. There is an excellent summary by Smith and Snell where they compared catches of lake sturgeon in the US areas in 1885, and there is also an overview article provided by Carlson in JGLR in 1995 (vol. 21:1). The only New York area of Lake Ontario which still has regular sturgeon spawning is the lower Niagara R., near the falls and at the bar just into Lake Ontario. There are two other NY areas with expected spawning in some years, in the Black R. at Dexter and the St. Lawrence R. near Ogdensburg. On the Ontario side of the lake a few years ago, the Trent R. is even more clearly recognized for spawning than these two in NY. Both Lake Ontario areas, Trent and Black river mouths have vast shallow areas nearby which are highly productive and well suited to sustain the juvenile production. Historically, four other New York tributaries or connected waters supported spawning populations, but they are now extirpated or are immeasurably small: Genesee R. mouth, Oswego R. mouth, St. Lawrence R. at mouth of Oswegatchie R. and St. Lawrence R. at Red Mills (Carlson 1995). There was another spawning area near the former site of the Moses Saunders Dam at Massena, but this area is no longer accessible to fish in Lake Ontario. These seven spawning areas probably accounted for most of the production that provided the remarkable catches of sturgeon described by Smith and Snell, (1891) extending from downstream of Niagara Falls and to the border of New York with Quebec.

Restoration programs in Lake Ontario by NYS have been considered, but have not been pursued until success has been recognized elsewhere in the tributaries. Research has been underway at 6 project areas in New York, and reports summarizing the findings are listed in the Species

Account and the Progress Report (attachments). These include: 1) Niagara R. by FWS, with a thesis by T. Hughes providing insight about juvenile nursery habitat and movements. This project was started by C. Lowie, brought up-to-present by Tom Hughes and expected to be continued by Emily Zollweg, 2) Genesee River by USGS, Cortland and FWS, Amherst. Dawn Dittman completed habitat suitability assessments in 2000, and she found conditions that were favorable for spawning and juvenile foraging. This project is likely to go to the next step in Sep 2003 through experimental stocking of fingerlings and tracking studies. 3) Oneida Lake studies by Cornell Univ. staff (J.R. Jackson, T. Brooking and T. Vandevalk) has focused on the use of habitats, food and movements by juveniles stocked from 1995-2000. 4) Oswegatchie R. assessments included netting and extensive field work on habitat used by juveniles. Field studies were carried out by S. Schlueter in a 60 mi. reach of the Oswegatchie R. as part of a masters degree program. Additional follow-up netting has been completed by DEC in the Oswegatchie in 2002, and an assessment of the Black Lake stocking program was completed in 2000. 5) A spawning area in the St. Lawrence R. at Ogdensburg was studied from 1994-96, and placement of artificial substrate attracted adults that spawned successfully (LaPan et al. 1997). The next three years had excessive growths of cladophora, and there was no evidence of continued use. 6) The St. Lawrence R. downstream of Massena has been studied extensively by DEC and by J. Hayes of ESF-SUNY, 1997-2002. The ESF project toward a PhD was funded by NYPA and has provided an estimate of the adult sturgeon in the upper area of Lake St. Francis. This local population was estimated at about 400. Spawning has been documented in the tailwater, and other results include the habitat preferences, movements and foods of juveniles.

Catches of lake sturgeon in the upper St. Lawrence River were sustaining a limited fishery far beyond the times of the massive collapses in the upstream Great Lakes. Harvest continued though the 1960s, and then declines were recognized and the fishery was closed in 1976. There were two known spawning areas, but one was eliminated once the dam went-in at Massena, in 1958. The large rapids at Red Mills served as a spawning area until inundated by the impoundment, and the rapids at Massena were exchanged for a tailwater spawning habitat to serve the downstream Lake St. Francis population. Three tributary populations provided occasional catches through the 1950s, in the Grasse R., Oswegatchie R. and Black Lake, and each had over 20 mi segments of river available to sustain the resident populations. The Grasse R is the only tributary that still has its intact population with recruitment. Tributaries to the St. Lawrence offered spawning at the mouth or the first dam in the Oswegatchie, Grasse, St. Regis and Raquette Rivers. These spawning areas have very limited or no use in current times.

Restoration programs have been underway in three of these areas, Oswegatchie R., Black Lake and St. Regis R., and some juveniles have grown up to 40" since 1995. Other historic populations are known as remnants in Lake Erie and Lake Champlain. The Allegheny River had sturgeon records from only 30 mi farther downstream in PA, and it is possible that there was occasional spawning at Salamanca and Olean in the Allegheny R.

Credit is extended to the early field studies of J. Greeley in the 1930s and to T. Jolliff and T. Eckert in the late 1960s. More recent advances were made by J. Hayes (SUNY-ESF), S. Schlueter (SUNY-ESF), C. Lowie (FWS), T. Hughes (SUNY Brockport), S. LaPan (NYSDEC), R. Klindt (NYSDEC) and for hatchery production by R. Colesante and M. Babenzien (NYSDEC).

Knowledge of lake sturgeon on the Ontario side of Lake Ontario is described by A. Mathers as mostly in the Bay of Quinte area. Spawning in the Trent R. was documented in 1999, and there has been no additional confirmation more recently.

Lake sturgeon in the St. Lawrence R. farther downstream of New York, in Lake St. Francis, have been sampled in 1963, 1977 and 1996 by the Quebec Dept. Wildlife and Parks, and the population is known as remnant. Fisheries here and farther downstream are described by Dumont et al. (1987, 2001), and other population features are described by Fortin et al. (1993). Spawning areas were enhanced with substrate alterations in 1995 (Fortin et al. 2002). Lake sturgeon are still harvested in the Montreal vicinity, and these river populations are probably better understood than anywhere else in North America.

8. Tracking of Lake Sturgeon Occurrences by Michigan Natural Features Inventory. ***Presentation***

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Michigan Natural Features Inventory (MNFI) maintains a continuously updated information base describing the occurrences of endangered, threatened, or special concern plant and animal species, natural communities, and other natural features in Michigan. The database consists of over 12,000 site-specific records, including many lake sturgeon records. These records are stored in the Biotics, an Oracle database coupled with an Arc View GIS, which was developed by NatureServe, a non-profit international organization dedicated to providing knowledge on rare species and communities. In addition to geographic information, each record contains a great deal of compiled information on the biology, distribution, threats, status, and trends of the species and communities tracked by the program.

This information is used to monitor changes in the populations of rare species, set conservation priorities, guide land use and management activities, and inform regulatory agencies. The data included in the HDMS are recorded and managed using a standardized methodology resulting from over 30 years of development. The records in the MNFI information base are gathered from museum and herbaria records, published and verified unpublished accounts, field surveys conducted by MNFI staff, and private consultants and knowledgeable individuals. In all cases, the MNFI database provides complete acknowledgement of the original source for the information.

The inventory process is not complete for all areas of the state or all species. In particular, aquatic elements need to be added and updated in the database. The absence of abundant information on aquatic elements has been influenced partly by priorities based on relative threats, rarity or fragility of sites or elements, and the historic availability of funding sources. MNFI is committed to filling this data gap, and has expanded its staff to include several aquatic ecologists. These staff are currently gathering information on the rare aquatic species in the state, including the lake sturgeon. The further development of MNFI's sturgeon data will contribute to not only MNFI's database, but also to the effective management and protection of lake sturgeon in the Great Lakes Basin.

9. Assessment of Remnant Lake Sturgeon Stocks and Habitat Availability in Two Southern Lake Michigan Tributaries.

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Little is known about the population structure, spawning success, and habitat use of lake sturgeon (*Acipenser fulvescens*) in Lake Michigan tributaries. The St. Joseph and Kalamazoo Rivers, located in southwestern and west-central Michigan, respectively, historically supported large populations of lake sturgeon. However, little data has been collected on this species despite reported sightings of spawning adults in each system. In this study, we examined the present status of lake sturgeon as well as their habitat use and availability in these tributaries.

From 02 April to 23 May 2002, 2,885 hours of gill-net effort, combined with 821.5 hours of set-line effort, were employed to assess the spring spawning migration of lake sturgeon in the free-flowing section of the St. Joseph River. Efforts were concentrated 1-km upstream of the river mouth, where water velocities allowed gill nets to be set perpendicular to the river current. We captured no adult sturgeon during the 2002 sampling season. However, our efforts were made difficult by large fluctuations in water temperature (range, 9 to 19°C) and high water velocities (greater than 1.5 m/s). In addition to spring sampling, we deployed set lines in the impoundments between Berrien Springs, Michigan, and Elkhart, Indiana, during July and August 2002 to capture lake sturgeon that may reside in the impounded reaches of the system. We compiled 384 hours of set-line effort in each impoundment, also resulting in the capture of no lake sturgeon.

In the Kalamazoo River, we deployed one, 80-m gill net perpendicular to the current at the river mouth from 27 April to 23 May 2002. One female lake sturgeon (188-cm total length, 177-cm fork length, 82-cm girth, and 55.3-kg weight) was captured during 1,423 hours of effort. Internal examination of the gonadal tissue revealed that this fish was not in the river to spawn, as the eggs were not fully developed.

Habitat sampling in the St. Joseph River occurred from 24 May to 15 August 2002. We collected 1,043 habitat samples from the river mouth to the Twin Branch Dam in Elkhart, Indiana. One sample was collected using a Ponar grab from the right, center, and left segments (approximately one-third of the river width in cross section) along transects spaced at 0.2 and 0.5-km intervals in the free-flowing and impounded sections, respectively. A majority (58%) of substrate samples collected in the free-flowing section were dominated by gravel. Spawning cobble comprised less than 2% of the substrate samples, while nursery (sand) substrates were found in 29% of the samples. In the impounded sections, substrate samples were dominated by gravel (39%) and silt (32%). Preliminary analysis of invertebrate samples revealed communities dominated by caddisflies (Hydropsychidae) and Asian clams (Corbiculidae) in gravel substrates at mean densities of 355 and 575 individuals/m^2, respectively, while sand substrates were dominated by Diptera (Chironomidae) larvae at a mean density of 80 individuals/m^2.

10. Lake Sturgeon Reproductive Ecology and Conservation Status Based Upon Genetic Determination of Parentage. ***Presentation***

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Over the past 100 years lake sturgeon have experienced severe declines in population abundance and distribution. Rehabilitation strategies for lake sturgeon should be based on fundamental aspects of their reproductive ecology. Historically sturgeon congregated in large numbers on spawning grounds and assessment of many aspects of their reproductive ecology has been difficult, however. The objective of this study was to use genetic markers in order to gather information about the reproductive ecology and conservation status of lake sturgeon. During April and May of 2001 tissue samples were taken from adult lake sturgeon as they migrated to spawning grounds on the Black River in North East Michigan. Following adult spawning, larval lake sturgeon were captured during downstream migration and transported to a hatchery where they were reared for approximately 4 months. Prior to release, tissue samples were taken from all juvenile sturgeon. Adult (n males = 70 and n females = 44) and juvenile (n = 288) sturgeon were genotyped using 8 polymorphic microsatellite loci. Assignments of parentage were made using likelihood-based estimates. Polygamy and polyandry were widespread with the number of mates ranging from 0 to 5 for both males and females. Reproductive success varied considerably among males and females. Little correlation was found between reproductive success and body size, however, a high degree of correlation was found between male and female reproductive success and the number of mates.

Effective number of breeders for the spawning year was calculated to be approximately 40% less than the number of fish that were sampled. Management implications of this data will be discussed in light of low and declining species abundance and distribution in the Great Lakes Basin and in the context of artificial supplementation strategies.

11. Update on the status of lake sturgeon (*Acipenser fulvescens*) in Canada.

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Lake sturgeon populations were extirpated from some of their range over a century ago due to intensive fishing. There has been sustained pressure on sturgeon populations through continued commercial, sport and subsistence fishing but this varies across Canada and by watershed. Loss of habitat through hydroelectric developments and modified flow regimes, and agricultural practices continues to be a concern. While there is an accumulating body of knowledge on current populations there is little information on populations prior to their decline. Sturgeon populations are variable across Canada with the least problems appearing in Quebec and Ontario. However, it is difficult to make a comprehensive evaluation where there is a commercial or sport fishery as complete data sets over time are needed on populations numbers, age to sexual maturity, numbers of spawning individuals, recruitment rates and the combined annual harvest from subsistence, commercial and sport fishing. Nevertheless, based on data from the literature and discussions with numerous biologists and managers in Quebec and Ontario the populations are considered stable or increasing, albeit much below historical highs. There are some local problems in Ontario related to hydroelectric developments but overall it appears that Ontario and Quebec may be able to use conservation measures and fishing regulations to manage these sturgeon populations to increase their numbers.

The situation in the Hudson Bay drainage is quite different as there is no evidence of reproducing lake sturgeon populations in Lake Winnipeg, and the Red, Assiniboine and Roseau Rivers. The populations in the Nelson and Winnipeg Rivers are protected for conservation reasons and there are no reports of sturgeon from the lower Churchill River for many years. The decline of populations in Manitoba and Saskatchewan led to closures of all commercial and sport fishing and some subsistence fishing. The decline and cessation of commercial fishing activities on the large inland delta on the Saskatchewan River at Cumberland House indicates this population is in trouble.

Sturgeon populations in the Hudson Bay drainage should be listed as threatened and a recovery plan developed. This is especially important for the Roseau, Red, Assiniboine and Winnipeg Rivers, Lake Winnipeg and the interface between the Red, Winnipeg, Bloodvein, Pigeon, Berens and Polar Rivers and Lake Winnipeg. The Nelson and Saskatchewan Rivers to the Campbell dam in Saskatchewan have limited numbers of sturgeon and populations are still declining. Sturgeon occur from the Campbell dam to the Alberta border but reproductive status and numbers are unknown and none were recovered below Prince Albert during electrofishing in 2002. In the upper reaches of the North and South Saskatchewan breeding populations may be limited. These populations are a small component of the original lake sturgeon populations in the Hudson Bay drainage and are separated by natural and man-made barriers. However, as these populations are at the limits of the lake sturgeon range they need to be watched closely, especially since there is still an active sport fishery and water conservation measures such as new dam construction would likely have a negative impact on the remaining populations.

12. The culture and comparison of movements of cultured and wild lake sturgeon in the Winnipeg River, Canada.

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A series of experiments were undertaken to test a variety of feeds such as live brine shrimp, frozen brine shrimp, ocean plankton, specifically designed experimental and commercial feeds. Experiments were replicated and conclusions are based on over 8 years of culturing lake sturgeon from a number of genetic sources. Feeding was done to apparent satiation 3 to 4 times daily. The food ration was 2-3% of body weight but was dependent on temperature and size of fish. When live feed was used survival of juvenile sturgeon was greater than 95% and survival of sturgeon fed commercial feeds ranged from 77 to 90% with specific growth rates (SGR) in some trials >8% for fish under 3 months of age. Optimum growth was considered to be between 15 and 18C because at these temperatures less abnormal behavior was observed even though SGR was slightly higher at 20C.

Sturgeon are well known to have a high lipid content in the flesh and this lipid is important as an energy reserve and for reproduction. A study was undertaken to determine the lipid content of cultured sturgeon and compare these values with wild sturgeon. Juvenile sturgeon raised at 12C had a fatty acid composition similar to wild sturgeon while those grown at 20C had fatty acid composition more like marine fish. Cultured lake sturgeon are much more robust than wild sturgeon at the same age.

To determine how cultured sturgeon behave when released into the wild observations on the movements of cultured and wild sturgeon were conducted simultaneously. Wild sturgeon were collected with gill nets and were similar in size to cultured fish. Both position and depth tags were attached externally and two radio-linked acoustic arrays were deployed. Each array consisted of a computer controlled base station which communicated via VHF radio modems with each 3 buoys system. The acoustic positioning system produced fish position data tables using an arbitrary coordinate system. Cultured lake sturgeon initially moved erratically but quickly settled down and moved similar to wild sturgeon, even following similar depth contours. Cultured fish fed on the same natural foods as wild sturgeon. Swimming behavior (speed and depth) was similar for cultured and wild fish. Cultured sturgeon lost 10% of body weight in the first 2 months after stocking but no further weight loss was noted. Additional sampling with gillnets of doubly tagged sturgeon (PIT and external tags) indicates that sturgeon remain in the area for at least 2 years.

We conclude that lake sturgeon can be cultured for a short period on live food followed by a short period of feed training at a lower temperature and then culturing at 20C. Juvenile lake sturgeon fed on defined feeds under laboratory conditions appear after stocking to behave like wild sturgeon from the same habitat, following a short period of adjustment. The strategy for large scale lake sturgeon recovery programs could be stocking fewer numbers of larger fish with higher energy reserves rather than stocking larger numbers of YOY with limited energy reserves.

13. Cytology of the Lake Sturgeon. ***Poster Display***

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The lake sturgeon (*Acipenser fulvescens*) is now depleted or extinct throughout much of its native range. It's native habitat of freshwater lakes and rivers was bounded by the Rocky Mountains of western Canada to the Great Lakes drainage in the eastern U.S. and Canada to the western Appalachians southward to northern Alabama, and the Mississippi, Ohio, and Missouri river drainages in the Midwestern U.S. Overfishing, obstruction of traditional migratory spawning routes by dams, and pollution are primary causes for its decline. It is currently the subject of several state and federal restoration efforts in the U.S. and Canada, and is listed by several states as an endangered species.

As with other sturgeons, the U.S. Fish and Wildlife Service (FWS) has promoted the development of cryopreservation (CP) method development. The FWS rationale is to have frozen sturgeon sperm ready in the event a gravid, spawning female is captured, which would enable artificial propagation of the species with the thawed sperm and fresh eggs.

This first description of the lake sturgeon sperm cell cytology was performed as supportive baseline work for the CP method research. This work provides a description of a normal cell, allowing for comparison with cells subjected to the rigorous CP environment of freezing in liquid nitrogen at -196^{o} F.

TEM and SEM, transmission and scanning electron microscopy, respectively, were used to reveal the cytology of the lake sturgeon sperm cell. The microscopes used in this study were a JEOL 1200 EXII SEM and a JSM 5400 SEM at Penn State University.

A comparison of the lake sturgeon sperm cell with others described to date appears in Figure 1, all drawn to scale. It is smaller than the shortnose sturgeon sperm cells and larger than that of the Atlantic sturgeon sperm cells. Figure 2 is an SEM micrograph of two lake sturgeon sperm cells. Figures 3 through 7 provide TEM micrographs using ultra thin sections through the cells, revealing the ultrastructure of the cell, complete with labels and key for abbreviations.

The lake sturgeon sperm cell is similar in structure to those of all North American sturgeons described to and including 2000, excepting that of the Atlantic sturgeon. The Atlantic sturgeon cell tapers decreasingly in girth from anterior to posterior and has only 2 endonuclear canals, while the lake sturgeon sperm cell tapers vice-versa, and has 3 endonuclear canals, both characteristics of all North American sturgeon sperm cells described to date.

This basic scientific information could help in restoration CP efforts described above, and could help lead to a refinement of taxonomic, evolutionary, cytological, forensic, aquacultural, management, and physiological knowledge and methods concerning this now rare fish.

14. Lake Sturgeon Restoration Work at the Northern Appalachian Research Laboratory, Wellsboro, Pennsylvania. ***Poster Display***

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In 1993 and 1994, Dr.'s Martin DiLauro and William Krise, both with the U.S. Fish and Wildlife Service Northern Appalachian Research Laboratory (NARL) Wellsboro, Pennsylvania, commenced lake sturgeon restoration research efforts in support of the New York State Department of Environmental Conservation (NYSDEC).

In close coordination with NYSDEC's Region 6 (Watertown, NY), DiLauro and Krise traveled to Laval, Quebec (Canada) with NYSDEC and University of Quebec (Montreal) biologists to collect gametes from spawning adults for artificial propagation. Borrowing techniques developed by Anderson et al. in Wisconsin, and modifying or developing new methods, DiLauro and Krise were successful in artificially propagating and supplying nearly 10,000 fry to the NYSDEC hatchery in Constantia, NY for stocking into St. Lawrence River tributaries stateside in each of those years.

DiLauro and Krise conducted most of the lake sturgeon propagation and research related to culture methodology and reproductive physiology for the NYSDEC during that period at the NARL. Dr. Bob Ross has also conducted a behavioral study on lake sturgeon at the NARL.

After 1994, the NYSDEC biologists continued the program, using the methods DiLauro and

Krise used or developed at NARL-Wellsboro. As of 2000, NYSDEC had stocked a total of seven lake sturgeon year classes into several Lake Ontario drainage waters, and indications are that survival of the stocked fish has been excellent.

Dr. DiLauro, having since been transferred to the U.S. Geological Survey's Biological Resources Division, continues with his cell morphology and histological descriptions of this species, as well as those of other sturgeon species at risk at NARL in Wellsboro, PA. This work is in support of the U.S. Fish and Wildlife Service's efforts, as well as those of the NYSDEC, in keeping with the U.S. Geological Survey's firm commitment to providing research assistance to U.S. Dept. of the Interior agencies and the states.

15. The evolution and management of the St. Lawrence River Lake Sturgeon (*Acipenser fulvescens*) stock, Québec, Canada.

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With annual catches in the past 15 years exceeding 150 metric tons and annual yields exceeding 1.5 kg/ha, the commercial fishery of the St. Lawrence River lake sturgeon is one of the most important sturgeon fishery in North America. In the early 1980s, an increase in demand for commercial fishing licenses led us to study various aspects of the biology and dynamics of this population. Over a 350 km stretch, from Lake St-Louis (Montréal) to the brackish waters, downstream of Québec City, lake sturgeon likely form a unique phenotypic and genotypic stock (Guénette et al. 1993). Mark-recapture experiments indicated that, with the exception of spawning migrations which seem rather extensive, movements are restricted (Dumont et al. 1987; Fortin et al. 1993). In this system, lake sturgeon occur in large numbers in small localized sites. Growth rate was found to be moderately high (Dumont et al. 1987) and sexual maturity delayed, the females median age at first maturity being 26 years (Guénette et al. 1992). In 1987, the stock was considered overexploited due to high annual natural and fishing mortality rates of the exploited segment (ages 15 to 30), unbalanced age structure, deficit of reproductive potential and excessive annual yield (Dumont et al. 1987). Negative effects of contaminants and man-made habitat changes, including dredging, were also suspected (Dumont et al. 1987; Guénette et al. 1993; Rousseaux et al. 1995; Doyon et al. 1998). The number of spawning grounds was found to be limited, most of them being located in the upstream part of the system. Many previously used sites were no longer accessible or utilized because of various types of human interventions (Dumont et al. 1987; La Haye et al. 1992). Three major factors were identified to probably account for the high resilience of this stock: 1. the relatively high productivity of the system; 2. the fact that the intensive commercial fishing was restricted to specific zones, leaving some sectors to act as reservoirs; 3. the high selectivity of the historically used commercial gill nets.

Between 1987 and 1991 a new management plan was gradually implemented to reduce the catch, provide more protection to the spawners and increase poaching controls. The fishing season and the number of fishing licenses were reduced, longlines and seines were banned and gillnets stretched mesh restricted to 200 mm. Sport fishing regulations were also tightened. In the 1990s, research was undertaken to : 1. increase the knowledge on the characteristics of spawning grounds and juvenile habitats; 2. develop an index of year-class strength in order to anticipate the evolution of the fishery, which harvests mainly fish over 15 years old, and prevent collapse (La Haye et al.1992; Nilo et al. 1997; Fortin et al. 2002). In 1994, the commercial harvest was sampled again in four fishing sectors. Additional data were collected in 1998. This information led to a new diagnosis of the status of this stock and to revise the management plan of the fishery.

Larval drift downstream of the main spawning ground (des Prairies River, Montréal), size and age distribution of juveniles in the experimental samples (mostly age 1 to 8) and of subadults in the commercial harvest samples suggest that sturgeon larvae are mainly produced in the upper part of the system. They drift downstream towards the lower part and they gradually colonize the river along a downstream-upstream gradient. Most of the juvenile concentrations are founded in the lower part, between the Lake St-Pierre archipelago freshwaters and the estuary brackish waters. In Lake St-Louis, males and females are longer, heavier and older and almost half of the females (45%) are maturing. In the most downstream commercial fishing sector, sturgeon are smaller, lighter and younger and only 2.4% of the females are maturing. Intermediate values are observed in the two median fishing sectors.

From the beginning of the 1980s to the mid 1990s, growth rate remained about the same. However, for identical lengths, in the four fishing sectors sampled in 1994, sturgeon weights were 7 to 14.8% lower than they were a decade earlier. For most 100 mm length classes well represented in the four samples (800 to 1300 mm), the Fulton condition factor (K) was lower in 1994 (Kruskal-Wallis tests; $P < 0.05$ to $P < 0.01$); the decrease varied between 5% and 21% and was generally over 10%. Catch curves of the commercial harvest show that annual mortality rates remained high and, moreover, that the peaks of the catch curves, or the apparent age of full recruitment, shifted substantially to older fish in Lakes St-Louis (from age 16 to 23) and St-Pierre (from age 14 to 20). Temporal comparisons of the 20 cm gillnet CPUE show a reduction of 7% in Lake St-Louis from 1994 to 1998 and of 25% from 1984 to 1998 in Lake St-Pierre. The annual rate of decrease is similar (1.75%) but only the second decrease is statistically significant (Kruskal-Wallis tests; $P < 0.05$). Juvenile surveys reveal that there has been no rupture in the sequence of cohorts between 1980 and 1996. However, a gradual reduction of 58 % of the year-class strength index was observed from 1984 to 1992 ($r_s = -0.7$; $P=0.02$). Two comparatively strong year classes were produced in 1993 and 1994; they were followed by one average and one weak year classes. From 1995 to 1999, mark-recapture estimates of the number of mature females on the des Prairies River spawning ground declined by 61%, from 1 231 to 500 fish (Fortin et al. 2002).

Observed trends in age structure of the harvest (15 to 30 years old fish), year-class strength (based on the 1 to 8 year old fish) and abundance of mature females (over age 25) form a coherent set of observations indicating an overexploitation status that likely began in the mid 1970s. Combined to the fact that, since 1986, the declared commercial catch remained very high (152-259 tons; average, 202 tons) and greatly surpassed the historical landings reported before 1983 (maximum ca 65 metric tons), it is clear that the 1987 management plan failed to inverse the decline. The observed decrease of the condition factor is an unlikely response to the reduction in abundance of lake sturgeon and is possibly related to changes in the trophic conditions of the St. Lawrence River, thus probably decreasing the potential production of the sturgeon population. A 200 ton commercial catch quota has been enforced in 1999, coupled with the obligation to tag each sturgeon carcass. It has then been decreased by 20% in 2000 2001 and 2002. (40 tons per year). Concurrently, the quality and surface area of four spawning grounds were increased; another one was artificially created. Dredging projects along the navigation channels and in harbor works were analyzed and modified in order to protect juvenile habitats.

16. Rupert River derivation project impact assessment study.

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Gabriel Durocher is a senior biologist working for Hydro-Québec since 1990. He has been working mainly on impact assessment of hydroelectric projects. He is actually conducting an impact study on lake sturgeon populations of the Rupert River in the James Bay area, for the Rupert River derivation project. The Rupert River shelters a lake sturgeon population for which a special attention is given in the frame of the whole impact study. A major telemetry study is conducted since spring 2002, to describe the movements and the use of different types of habitats by sturgeon. A habitat model for spawning sites is also developed for an IFIM/PHABSIM model to determine future instream flow. The interest of Gabriel Durocher to participate to the Sault-Ste-Marie meeting is to make contact and share information with sturgeon specialists in North America in order to improve the impact assessment and develop appropriate mitigation measures.

The hydroelectric generation projects Gabriel Durocher is or was involved in at Hydro-Québec are the Rupert River derivation, the Romaine River dam, the Sainte-Marguerite River Dam and the Outarde-2 River Dam

17. Big Game Tags for a Minnesota Fish? ***Poster Display***

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The Minnesota Department of Natural Resources, Division of Fisheries is proposing a change in angling regulations for lake sturgeon of the Minnesota-Ontario border waters. Remnant sturgeon populations still exist in most parts of their original range in the border area. These populations are recovering from overexploitation by sport and commercial fisheries and poor water quality that negatively impacted spawning and nursery habitat. To allow for continued recovery of these populations, safe harvest quotas were set at 60% (0.031 kg/ha) of the theoretical potential yield established by the Minnesota-Ontario Fisheries Committee. The quota for the Minnesota waters of Lake of the Woods and Rainy River is 3,447 kilograms. In spite of the current regulation, a harvest slot length limit from 114-140 cm with a possession limit of one fish annually, angler creel surveys have indicated that the mean annual harvest in 2001 and 2002 was 4,347 kilograms. Minnesota has proposed three alternatives to control harvest; 1) close the fishery to harvest until the population has recovered, 2) close the fishery each season when the harvest quota is reached or 3) request legislative authority to issue 300 harvest tags to resident anglers. Licensed anglers without a tag would still be allowed to fish for lake sturgeon during the open season, but only anglers in possession of a tag could harvest one. Tags would be allocated randomly among all applicants. Unsuccessful applicants would earn preference in subsequent years much the same way that limited entry big game hunting licenses are issued in Minnesota. Public comment on the proposals will be sought during the winter of 2002-03. Earliest implementation would be 2004.

18. Status Assessment of Remnant Lake Sturgeon Stocks in Green Bay Tributaries.
Presentation

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Efforts are currently underway to determine the population dynamics of the lake sturgeon populations in four Green Bay tributaries: the Fox, Oconto, Peshtigo, and Menominee Rivers. The project has four objectives: (1) estimate the abundance of adult lake sturgeon in each of the four rivers, (2) describe and quantify the reproductive success of spawning lake sturgeon in these rivers, (3) describe spawner habitat availability and use in these systems, and (4) determine the contribution of the four spawning stocks to the mixed population in Green Bay.

A variety of methods have been employed during spawning run assessments. Large-mesh gill nets (20.3-cm to 35.6-cm stretch mesh) are deployed at river mouths and in deep pools below dams. When conditions are suitable, electrofishing surveys are conducted below the lowermost dams on each river. Dip net sampling coupled with visual observations of lake sturgeon has been used successfully on the spawning grounds on the Fox and Peshtigo rivers. These same methods, and to a lesser extent set line sampling, also have proven effective for collecting lake sturgeon in the fall.

With assistance from a commercial fishing business, trap net sampling for lake sturgeon in the open waters of Green Bay was conducted during May-July 2002. A total of 51 lake sturgeon were captured, and one sturgeon was recaptured during the sampling period. Both juvenile and adult lake sturgeon were represented in the sample. Assistance by local commercial fishers has resulted in the collection of data and tissue samples from an additional 24 sturgeon.

Vital statistics (total and fork length, maximum girth, and sex) are recorded as well as the presence of distinguishing marks, scars, and wounds. Sturgeon are tagged with passive integrated transponder (PIT) and Floy tags, and tissue samples are collected for subsequent genetic analyses. Genetic analyses are being conducted by Dr. Kim Scribner and Pat DeHaan from Michigan State University (see their abstract).

Available information suggests that small spawning runs (<100 individuals) occur in the Fox and Oconto rivers, with larger spawning runs (100-500) occurring in the Peshtigo and Menominee rivers. During 2000-2001, 50 lake sturgeon were collected on the lower Fox River, with recaptures from Lake Winnebago (upriver) and from previous tagging events on the lower Fox river being common. Run size appears to vary between 25-75 individuals. Fourteen sturgeon were sampled from the Oconto River in 2002 with no recaptures encountered. Though unknown, the annual run size in the Oconto River appears to be less than 50 fish. Although 112 lake sturgeon have been collected from the Peshtigo River during 2001-2002, very few fish have been recaptured.. A population estimate for this system is currently unavailable, but annual run size appears to be between 100-200 individuals. The Menominee River is considered to have a much larger run, but the exact number is still unknown. Thuemler[1] (1997) estimated that 893 sturgeon were present in the lower Menominee River during the summer (non-spawning period) in 1991, but over half of these fish were likely juveniles. Continued sampling is needed to obtain an accurate population estimate for each river.

Drift net sampling for larval lake sturgeon is used to evaluate reproductive success in each of the four tributaries. Larval sturgeon have been collected in the Peshtigo River on a regular basis, and young-of-year (YOY) lake sturgeon are commonly observed and captured. No larval lake sturgeon have been collected in the Oconto River, but two YOY sturgeon were collected from this system in 1998 (John Weisser, USFWS, Marquette, MI). In both the Fox and Menominee rivers, a single larval sturgeon has been collected, and juveniles commonly are captured on the Menominee River where successful reproduction is presumed but unquantified. Recruitment from the lower Fox River is uncertain. Both systems have upriver populations that are probable sources of recruitment. More intensive sampling efforts are planned to better evaluate reproductive success in all four tributaries.

Potential lake sturgeon spawning sites (i.e. areas with rocky substrates and high current velocities) in the Fox, Oconto, and Peshtigo rivers have been identified and measured so that the total area of suitable spawner habitat available in each river can be calculated.

[1] Thuemler, T. F. 1997. Lake sturgeon management in the Menominee River, a Wisconsin-Michigan boundary water. Environmental Biology of Fishes 48:311-317.

19. Kaministiquia River Lake Sturgeon Radio Telemetry Study. *Presentation*

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Radio telemetry was used to study the movement patterns of adult and juvenile lake sturgeon tagged in the Kaministiquia River, Thunder Bay, ON. Twenty-seven sturgeon were surgically implanted with radio transmitters in October 2000 and June 2001. The objective was to determine seasonal distribution and to identify critical habitat including spawning and feeding areas. Tracking took place daily in May and June, weekly during the open water season and monthly during ice on conditions. Critical spawning habitat was identified below Kakabeka Falls (approximately 47 km upstream of Lake Superior). An over-wintering area and spring and summer feeding areas were also documented. Adult lake sturgeon are river residents and occupy specific areas at certain times of the year. Juvenile lake sturgeon leave the river as one fish was captured in a commercial net near Hovland, MN, approximately 100 km from the tagging location. Another juvenile was located in the river after a 22 month absence. In 2001, spawning adults were most often located just downstream of the Falls and above the Ontario Power Generation hydro plant (850m downstream). Tagged fish spent 2 to 4 weeks in this area. In 2002, low water levels and minimal flows over Kakabeka Falls forced the fish to congregate below the hydro plant. During years of low springtime flows the present hydro operating policy impacts lake sturgeon spawning success by preventing access to traditional spawning areas.

20. Gamete quality evaluation in lake sturgeon (*Acipenser fulvescens*). ***Presentation***

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Lake sturgeon (*Acipenser fulvescens*) populations have been seriously decimated throughout their native range because of over-fishing, dam construction, and loss of spawning habitat. This situation has created enough concern to have the lake sturgeon listed as a species of special concern, threatened, or endangered in all eight of the Great Lakes states. Captive breeding may be the only mechanism for the conservation and reestablishment of lake sturgeon populations. A breeding program of endangered sturgeon should be combined with the formation of a cryopreserved sperm bank. The goal of preventing disappearance of isolated populations of lake sturgeon, as in the case of Lake Erie, can be achieved by establishing a sturgeon cryopreserved sperm depository.

The focus of our project is to 1) collect sturgeon gametes from the Detroit River (Michigan), the St. Clair River (Michigan), the Wolf River (Wisconsin), and a domesticated stock at the Ohio State University in order to establish a sturgeon sperm bank, 2) evaluate the quality of the gametes collected in the wild, and 3) develop a procedure for androgenetic diploid production.

Some gametes were successfully collected in the spring of 2002, and another attempt will be made in the spring and early summer of 2003. Tissue (liver, kidney, gonad) samples were collected from fish at the Detroit River and St. Clair River sites along with blood, egg and milt samples. We have begun to analyze these samples for vitamin C (ascorbic acid) concentrations, as it has been shown that vitamins C and E play an important role in reproduction of fish. Specifically, we want to determine the dynamics of ascorbic acid during spawning season and look for the relationships between ascorbic acid in reproductive tissues and gamete quality (fertilizing ability) in each population.

21. Improving Electrofishing Methods Used to Assess and Sample Juvenile Lake Sturgeon *Acipenser fulvescens* Populations.

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Electrofishing is currently used to collect large lake sturgeon *Acipenser fulvescens* (>250 mm total length; TL) for population assessments by federal, state, and tribal agencies. Electrofishing could also be used to collect small (<250 mm TL) lake sturgeon for contaminant analyses, population studies, etc. In a recent literature searches, no information could be found that documents optimum electrical stimuli that minimizes damage to lake sturgeon and maximizes capture. In addition, electrofishing parameters are undefined for the successful capture of small lake sturgeon. The lack of data defining optimal electrofishing parameters for small lake sturgeon currently limit the potential use of electrofishing as a tool to sample lake sturgeon populations. This study will provide a scientifically derived set of recommendations for voltage type (Direct Current {DC} or Pulsed DC {PDC}), power density, pulse frequency, and duty cycle that maximize electrofishing success and minimize damage in small (<250 mm TL) lake sturgeon. Electrical parameters will be assessed in laboratory studies and in simulated field studies.

22. Environnement Illimité, Inc. lake sturgeon studies.

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Marc Gendron, senior biologist and partner in the firm Environnement Illimité inc., has been specializing in the study of fish and fish habitat since 1982, and more specifically on the impact of various projects with respect to the Federal and Provincial legislation regarding fish habitat protection. Mr. Gendron has led a number of studies on the effects of hydroelectric infrastructures and generating facility construction on lake sturgeon populations from St-Lawrence River and other rivers of James Bay territory. Among these studies, the ones most significant ones pertaining to lake sturgeon are the following:

- Project manager for a monitoring study of fish spawning and rearing (especially on sturgeon) on a man-made spawning area in the reach downstream from the Rivière-des-Prairies power plant (synthesis report 1982-1988 for Hydro-Québec).
- Project manager for an impact assessment study of the hydroelectric development of the Nottaway, Broadback and Rupert rivers area on fish life and its exploitation. NBR Project. (for Hydro-Québec, 1993).
- Project manager for a study on lake sturgeon reproduction in the reaches downstream from the Beauharnois power plant and Pointe-des-Cascades dam (for Hydro-Québec, 1993).
- Project manager for the impact assessment study of the Mégiscane River diversion project. (for Hydro-Québec, 1998).
- Project manager for the impact assessment study of the Rupert River diversion project on the sturgeon communities of more than 300 km of river systems (for Hydro-Québec, 2002).
- Project manager for the design of aquatic habitats, especially for sturgeons, in order to attenuate and compensate the effects of the creation of the Eastmain reservoir and generating facility (for the SEBJ, 2002).

23. Lake Sturgeon *Acipenser fulvescens* Population Assessment in the Mississaugi River, Ontario, 1998-2002. ***Poster Display***

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Members of Mississauga First Nation (MFN) have harvested lake sturgeon *Acipenser fulvescens* from the Mississaugi River for personal and ceremonial purposes for many generations. Over the last half-century, development and exploitation have been blamed for drastic reductions in lake sturgeon catches. Development on the Mississaugi River has included the establishment of the CAMECO uranium refinery in 1983, the Huron Pines Golf Course in 1984 and four hydro-electric dams built by the former Ontario Hydro (now Ontario Power Generation). After fishermen and elders complained that sturgeon were not being caught in the same locations and in the same numbers as they historically were, the Anishinabek/Ontario Fisheries Resource Centre (A/OFRC) was requested to investigate the status of this once abundant population.

An initial presence/absence netting study was conducted in May and June of 1998 utilizing large mesh monofilament gillnets in historic spawning locations. Nine lake sturgeon were captured during the project indicating that there was at least a remnant population utilizing the river. From 1999 up to and including 2002, the A/OFRC and MFN have conducted spring lake sturgeon assessments near "the Chutes" where lake sturgeon were once abundant. The purpose of this work was to establish a baseline of biological data, combined with a mark-recapture component to estimate abundance of the spawning population and to monitor movements.

We have yet to estimate abundance and have received very few reports of the capture of tagged fish, however, over the four years of the project 363 lake sturgeon have been captured in the Mississaugi River. Of the 363 fish captured, 269 were tagged and age information was obtained from 283. Captured fish ranged in age from 6 to 60 years while the estimated mean age from each of the years ranged from 19.5 years to 21.5 years.

Based on the large number of lake sturgeon caught over the course of this study, it is clear that the Mississaugi River provides excellent lake sturgeon spawning habitat and is a major contributor to lake sturgeon populations in Lake Huron. We also present bathymetric mapping of "the Chutes" and potential staging and post-spawning refuge areas.

24. Lake Sturgeon Restoration Efforts Being Carried out at Genoa National Fish Hatchery.

For more information about the program at Genoa NFH please contact Doug Aloisi or Roger Gordon at 608-689-2605 or e-mail at roger_gordon@fws.gov

Genoa National Fish Hatchery, located in southwestern Wisconsin, has been involved in the restoration of Lake Sturgeon in the Great Lakes region since the mid 1990's. Currently, Genoa NFH produces two strains of Lake Sturgeon for restoration efforts by Federal, Tribal, and State cooperators, as well as provides fish and eggs for research purposes. Annual production for 2002 included over 31,000 fish and 50,000 eggs distributed to six states in the eastern United States. Capital improvements to the facility in the near future will increase the projects production capability to over 50,000 fall fingerlings, of multiple strains.

25. Assessment of the impacts of waterpower management on fish in the Ottawa River, Canada. ***Presentation***

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Lake sturgeon (*Acipenser fulvescens*) were once considered abundant in the Ottawa River. Anthropogenic stressors including commercial harvest, dam construction and pollution caused lake sturgeon numbers to drastically decline from their levels in 1800's. This precipitous decline was not restricted to the Ottawa River, but occurred across their natural range to levels where they are now considered threatened or endangered in many jurisdictions. A preliminary assessment of lake sturgeon populations of the Ottawa River revealed a wide variation in the relative abundance and size distribution amongst nine reaches (Carillon to the outflow of Lake Temiscaming). While the aforementioned stressors have had an impact on lake sturgeon populations, it is believed that the current water management operating regimes have the greatest controlling effect on their current populations in the different reaches.

In the section of the Ottawa River between Carillon and the outflow of Lake Temiscaming, a distance of 480 km, there are nine river reaches delineated by either hydroelectric dams or natural rapids. These reaches are managed under different water management regimes: peaking, run-of-the-river, winter reservoir and "quasi" natural. The Ontario Ministry of Natural Resources is conducting a study in this section of the Ottawa River to assess the impact of different water management regimes on the fisheries of the river. This study is being conducted in partnership with the Société de la faune et des parcs du Québec, Ontario Power Generation and the University of Ottawa. Five species, including lake sturgeon, are being studied: walleye (*Stizostedion vitreum vitreum*); northern pike (*Esox lucius*); smallmouth bass (*Micropterus dolomieui*); and channel catfish (*Ictalurus punctatus*). Lake sturgeon are the primary focus of this study. A set of hypotheses has been developed on the expected effects of waterpower management on each species including other anthropogenic stressors for lake sturgeon. Predictions on end points such as relative abundance, year class strength, growth etc. will be tested.

The study will be conducted through several stages. Standardized index netting will be conducted in all reaches of the river to assess the relative abundance and population characteristics within each reach. Lake sturgeon are sampled for length, weight and a section of pectoral ray is being extracted for aging purposes. In addition, a subsample of 20 lake sturgeon from various size ranges in each reach are assessed for sex, stage of maturity, contaminant analysis (complete organic contaminants and mercury) and tissue sample is collected for genetic analysis.

Lake sturgeon spawning assessment will be conducted early summer to ascertain the location of spawning sites; asses the condition of spawning site; monitor water level and flows over spawning sites; and assess spawning population characteristics.

Water quality was considered to be a limiting factor for fish in the Ottawa River from early 1900s through until the early 1970's. Industrial pollution, debris from log drives, waste from saw mills, raw sewage from municipalities all had an effect on water quality. All sources of pollutants are now subjected to treatment and subsequently water quality has improved in the river and will be assessed.

There used to be a lucrative commercial harvest of lake sturgeon from the Ottawa River starting in the late 1800's and currently there is a limited commercial harvest from the Quebec portion of the river. A review will be conducted on the past and current harvests of lake sturgeon to assess whether could have limited or be limiting populations.

Dams construction has altered and fragmented habitat for lake sturgeon. These dams were generally constructed in narrow sections of the river which potentially were lake sturgeon spawning sites, and/or they flooded spawning locations to deem them not suitable. A review of historical and current conditions of the river will be conducted to assess potential impacts of dam construction. A spatial habitat suitability model will be developed to assess habitat in the various reaches to assess whether fragmentation has resulted in less than optimal conditions for the various life stages of lake sturgeon.

26. A review of current and complete lake sturgeon (*Acipenser fulvescens*) studies in the St Lawrence River near the St. Lawrence-FDR Power Project. *Presentation*

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The population dynamics, movements and habitat use of juvenile and adult lake sturgeon below the St. Lawrence-FDR Power project were studied form 1995-2002. A total of 1302 sturgeon (n=997 adults and n=305 juveniles) ranging in size from 274 mm to 1895 mm were handled during mark-recapture and telemetry efforts. A total of 53 adult sturgeon were released with ultrasonic tags to determine spawning areas and post-spawning migrations and habitat use. Spawning within a small area of the Canadian tailwater region of the FDR Power Project was confirmed with the collection of fertilized eggs. Telemetry results indicated a resident by-pass channel stock and a downstream, Lake St. Francis stock that utilizes the seaway main shipping channels as the primary migration corridor. Length-weight relationships, length-at-age, condition factors and by-pass channel population estimates were calculated for this stock.

The spatial distributions, movements and preferred habitats of juvenile lake sturgeon were examined during a juvenile assessment and telemetry study. Catch per unit effort results indicate the largest concentrations of juveniles occur within specific areas of the lower reaches of a non-flowing by-pass channel referred to as the south channel. Ultrasonic telemetry results indicated that the juveniles in our study exhibited clustering behavior and high levels of site fidelity to preferred microhabitats characterized by low current velocities and large homogenous expanses of silt. Chironomidae and brachycentridae were the two most abundant prey types identified in samples of macrobenthos samples collected from areas identified as juvenile habitat.

A study to examine the feeding dynamics within 3 different size classes of sturgeon is currently in progress through the 2002 field season. Amphipods and chironomids appear to be the dominant prey type in the smallest size class (300 – 650 mm). Molluscs (zebra mussel and gastropod) appeared in the 651 mm-1001 size class and are the dominant prey type in the largest size class (1002 mm-1352 mm). The size threshold for zebra mussel consumption in this study appears to be 660 mm. We suggest that the distinct habitat partitioning between juvenile and adults that we observe in this system (juvenile clustering) is related to prey densities. Benthic evaluations to determine prey densities and substrate type were conducted within preferred juvenile and adult habitats.

27. Lake Sturgeon Research, Management, and Education Activities of the Little River Band of Ottawa Indians. *Presentation*

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The lake sturgeon (Nmi) is a species of Cultural Significance to the Little River Band of Ottawa Indians (LRBOI) and considered a "Grandfather Species" among many Ottawa bands. The LRBOI has committed to helping return lake sturgeon populations to healthy and sustainable numbers. The Big Manistee River, located on the eastern shoreline of Lake Michigan, flows through the heart of the Tribes Reservation. The Manistee River historically supported a large spawner population, however, only a small group of spawners return annually to the river. From 1999 to the present the Tribe has been committed to activities promoting lake sturgeon rehabilitation. The Tribe has fostered public awareness by coordinating a Sturgeon Youth Day and by giving presentations for local civic and private groups. Assessments are conducted within the Manistee River, Manistee Lake and Lake Michigan. These include juvenile and spawner assessments in Manistee Lake, and early-life history studies in the Big Manistee River. Also, Tribal commercial fishermen and the LRBOI Great Lakes Assessment crew report and collect data on lake sturgeon by-catch in Lake Michigan.

The LRBOI has focused on recruitment of sturgeon in the Big Manistee River. During spring 2002 baseline data of larval drift were collected. Thirteen larval drift surveys were conducted from 5/24-6/19, from 10 pm-1 am by placing 4 d-frame drift nets in varying positions across the river. Nets were lifted hourly, samples sorted, with larval lake sturgeon measured and released. Fish and insect by-catch was also identified and enumerated. A total of 36 larval lake sturgeon were recovered, total length ranging from 12.5-24mm. Peak drift was observed on 6/13 as 16 lake sturgeon larvae were observed.

Great Lakes Fishery Trust funding was awarded to the Tribe to continue and expand early-life history studies in the Big Manistee River. The Project, "Evaluation of recruitment success, habitat preference, and river retention of young lake sturgeon in the Manistee River" will begin in the spring of 2003 and continue until the fall of 2004. The LRBOI and Michigan Technological University will work collaboratively on the project. The project will continue to monitor larval drift, identify spawning areas, evaluate juvenile/young-of-the-year habitat use, and determine extent, duration, and location of young lake sturgeon in the Big Manistee River.

28. Population characteristics, habitats, and movements of lake sturgeon (*Acipenser fulvescens*) in the lower Niagara River. Master's thesis. State University of New York College at Brockport. Brockport, NY. 175 p.

Thomas C. Hughes, Senior Fisheries Technician, Freshwater Fisheries Unit, Region 1 - Bureau of Fisheries, New York State Department of Environmental Conservation, (631) 444-0280, tchughes@gw.dec.state.ny.us

Before my study, anecdotal information, such as incidental catches and reported sightings, provided the only means of assessing lake sturgeon, a species listed as threatened in New York State, in the lower Niagara River. The objectives of my study were to (1) assess the population of lake sturgeon by collecting and analyzing age, growth, and CPUE data, (2) compare the habitats and movements of adults and juveniles, and (3) identify potential spawning, feeding, and nursery habitats and compare use of these habitats between adults and juveniles. From late July 1998 through August 2000, 67 lake sturgeon were captured using gill nets, baited setlines, and SCUBA divers. Overall, divers (2.5 fish/night) performed better than gill nets (0.25 fish/night) and setlines (0.23 fish/night). Age of lake sturgeon captured ranged from 1 to 23 years, with most fish (n = 47) less than 10 years old. Six percent (4 out of 63) of the lake sturgeon captured had deformities, such as spinal curvature. Ultrasonic transmitters were attached to 24 fish (12 adults and 12 juveniles) to determine their habitat use and movements. Depth, current velocity, and substrate uses were similar between juvenile and adult fish. Monitoring the movements of adult fish during likely spawning temperatures (11 to 18 ^{o}C) revealed that fish congregated both 8 to 10 km up river and within 5 km of the river's confluence with Lake Ontario. Based on the results of my study, I recommend that the lake sturgeon in the lower Niagara River remain listed as "threatened" by the NYSDEC and that the commercial and recreational fisheries remain closed. In addition, I recommend further studies investigating year class abundance, the cause of growth deformities, and the abundance and availability of food resources.

29. Population Dynamics of Lake Sturgeon Stocked Into Oneida Lake, New York.
Presentation

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The lake sturgeon was classified as threatened in New York State in 1983, and in 1995 efforts were initiated to restore populations in several areas that were part of their historic range. Between 1995 and 2000, 6,600 age-0 and age-1 lake sturgeon were stocked into Oneida Lake as part of the larger restoration program. Assessments of growth and condition of juvenile lake sturgeon indicate that conditions in Oneida Lake are excellent for juvenile sturgeon. Some lake sturgeon from the initial 1995 stocking have already surpassed 120cm total length and achieved weights approaching 13.6kg. Age 1-7 fish grew at a rate of 125mm/year, faster than rates for other lake populations for which data are available. Additionally, length-weight relationships suggest that juvenile lake sturgeon in Oneida Lake tend to be heavier than same-sized fish from other populations.

Characterization of diets of lake sturgeon in Oneida Lake reveal amphipods and snails to be the most common foods, with zebra mussel becoming an important component in the diets of fish over 700mm total length. In 2002, we initiated a study designed to assess the relative importance of available habitats to lake sturgeon based on catch rates from gill net sampling and comparisons of sturgeon diet composition with substrate-specific benthic fauna. Available foods from sand and shoal habitats most closely matched diets of lake sturgeon, and gill net catches tended to be higher at sample sites in these substrates. Conditions in Oneida Lake appear to be excellent for juvenile lake sturgeon, and may provide insights into selection of areas elsewhere in the Great Lakes watershed where successful restoration programs might be established.

30. Lake Superior Lake Sturgeon Survey as Reported by Commercial Fishers. *Poster Display*

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Lake Superior is largest of the Great Lakes by surface area at approximately 82,100 sq. km. It is the largest fresh water lake in the world and it is the northern most and coldest of all the Great Lakes. The outlet for Lake Superior is the St. Mary's River which is the connecting waterway between Lake Superior and the lower Great Lakes. Lake Sturgeon, *Acipenser fulvescens,* abundance was historically very high in Lake Superior. However, over-exploitation coupled with the damning of rivers utilized as spawning habitat has reduced the population to about 1% of its former size. Very little is known about the lake sturgeon's current population size, habitat usage, and movement in Lake Superior.

Beginning in 1998 agencies began utilizing commercial fishermen to obtain some basic information from this pre-historic fish species. In 1998 the Michigan Department of Natural Resources (MDNR) recruited 2 trap net fishermen to tag and collect biological data from sturgeon caught in their nets. In 2001 both Bay Mills Indian Community (BMIC) and the U.S. Fish and Wildlife Service-Ashland Fishery Resources Office (Ashland FRO) began recruiting both trap net and gill net fishermen and have a total of 8 fishers between the two agencies. There are a total of 7 trap net fishermen and 3 gill net fishermen who are actively collecting information from lake sturgeon in the U.S. waters of Lake Superior. Each fishermen participating in the project was supplied with a "Sturgeon Box." The Sturgeon Box has a soft tape measure to record total length, fork length, and girth, a Floy Tag Applicator and sequentially numbered Floy Tags, and a mini-hacksaw. The hacksaw is used to remove the leading edge of the left pectoral fin ray which will allow agency biologists to obtain age estimates and identify the genetic make up of individual fish. Abiotic data such as location, water depth, substrate, and date are also recorded from each individual fish. The fishermen who are currently participating in the project fish from the Keweenaw Bay area of Lake Superior to the eastern most portion, Whitefish Bay.

Since beginning this project a total of 51 lake sturgeon have been captured by all the fishermen cooperating in the project. MDNR, Ashland FRO and BMIC have data from 21, 16, and 14 fish respectively. Of the 51 fish sampled only one fish was recaptured. This fish was first encountered on July 8, 2001 just west of Whitefish Point and was then re-captured on May 5, 2002 in Whitefish Bay. The length range for all the sturgeon capture is 52-167.5 cm. Most of these fish would be classified as sub-adult fish. Sturgeon are typically encountered in the spring and fall. The months where sturgeon have been captured include: May, June, July, September, October and December. The two months with the most frequent occurrence of sturgeon are May and October. This is primarily due to the fact that whitefish tend to be shallow at these times of the year and the fishermen themselves begin moving shallow to maximize whitefish catches. Water depth where sturgeon were captured ranged from 15-150 ft. of water with most fish being captured in 50 ft. of water or less.

Without the help of commercial fishermen this information would be quite difficult to obtain. They spend their lives on the lake and have proved quite useful in this application as well as others. The data being collected will provide biologists with baseline information. Basic movement patterns, length at age estimates, and more importantly genetic make-up will be identified. This will allow biologists to determine if we have genetically unique stocks of fish across the lake or we have a population of fish that intermix on a more regular basis.

31. Stock Assessment of Lake Sturgeon in the Manistee River. *Presentation*

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Lake sturgeon, *Acipenser fulvescens,* in Lake Michigan suffer from the same problems of overfishing, dam construction, and pollution that are facing lake sturgeon populations throughout the Great Lakes. The Manistee River is located in the northwest region of Michigan's Lower Peninsula and is believed to support one of the largest remaining spawning populations of lake sturgeon in Lake Michigan. The objectives of this study were to 1) obtain basic population data for lake sturgeon in the Manistee River and 2) estimate the number of spawning individuals in the Manistee River in 2001 and 2002. Adult lake sturgeon were sampled using 20.3, 25.4, 30.5, and 35.6-cm stretch mesh monofilament gillnets set near the river mouth from mid-March through the end of June in 2001 and 2002. Each fish was marked with a passive integrated transponder (PIT) tag and total length and weight were recorded. Age was estimated from cross sections of the leading pectoral fin ray. Spawning condition was determined by visually inspecting the gonads through a 4 to 6 cm surgical incision made in the ventral midline just anterior to the pelvic girdle. Spawning estimates were calculated using the Schnabel mark recapture method. Age of captured lake sturgeon ranged from 6 to 54 yrs old, although nearly half of the captured individuals were younger than 20 yrs old. Estimates of 23 (95% CI: 16-35) and 36 (95% CI: 21-68) spawning individuals were calculated for 2001 and 2002, respectively. The male:female ratio for spawning individuals in 2001 was 4.25:1, while a much higher ratio of 22:1 was observed in 2002. These low spawning estimates, in addition to the highly skewed sex ratios, indicate a limited reproductive potential. Despite this, many of the population parameters, such as growth and condition, are comparable to other systems, and the large presence of older juveniles and younger adults suggests some recruitment is still occurring in the Manistee River population.

32. Status assessment of remnant lake sturgeon stocks in the Lake Michigan basin.

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The project focus is to locate, tag, and collect biological data from lake sturgeon found in the Manistique, Sturgeon (Nahma), Escanaba, and Whitefish Rivers and identify spawning areas, spawning success, and range into Green Bay and Lake Michigan.

33. Occurrence of Argulus spp. on Lake Sturgeon (*Acipenser fulvescens*) and Walleye (*Stizostedion vitreum*) in St. Mary's River (MI/ON). ***Poster Display***

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The parasite fauna of fish in the St. Mary's River is poorly known. Virtually no extensive survey of parasites have been conducted, and only few limited studies of parasites of St. Mary's River have been published to date.

In the summer of 2002 several observant, local anglers turned samples of a fish parasite, collected from walleye, into the LSSU Aquatic Research Laboratory for identification. The parasite was identified as an Argulus spp. (coregoni or canadensis).

During our subsequent summer survey on St. Mary's River, additional specimens have been collected from Lake Sturgeon. Ten of the 45 lake sturgeon captured (25 %) were infected with Argulus spp.

Argulus are found nearly worldwide with about 150+ species known presently. Twenty-three species are recognized in marine and freshwaters of the United States.

This relatively small (from 6 to 22 mm TL), non-descript, crustacean parasite is actually fairly-well known and easily identifiable. The flat, shield-like part of the body is the carapace and it is fused with the head and partially covers the thorax. Two movable compound eyes are present on the head region and are usually conspicuous. They have four pair swimming legs, and the abdomen is extended beyond the carapace posteriorily. These parasites have a long, slender preoral sting that is used to pierce the host's skin and inject an anticoagulant. The mouth is then used to consume the blood, mucous, tissue at the puncture site. They can be damaging to fishes mainly due to secondary fungal infections that attack at the puncture sites. Argulus can also transmit fish viral diseases and other fish parasites.

The new occurrence in the St. Marys River may be attributed to several factors. It could be that Argulus has been present in low numbers, and was not previously noticed. Heightened angler awareness of parasites and exotic species may have more people looking more closely at their catch. The temperature dependence for reproduction could also explain this year's observations - it has been warmer, and warmer earlier than previous years. Finally, this could be yet another unfortunate introduction of an exotic species to the St. Marys River ecosystem.

34. Applicability of Lake Huron GIS project to great lakes lake sturgeon conservation.

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The Lake Huron GIS project (funded by the Great Lakes Fish and Wildlife Restoration Act) has improved the spatial locations for all fish barriers in the state of Michigan. A database with fish passage information; dam removal status; impacted fish species (i.e. threatened, endangered, special concern, and game fish) for each dam is currently being populated. A database for Ontario fish barriers in Huron and Erie Basins is also under development. The status of these and other databases included in the Lake Huron GIS (e.g. physical stream habitat data) can be used to identify potential sturgeon habitat and rank remedial actions. The applicability of the Lake Huron GIS to lake sturgeon conservation, rehabilitation, and management will be discussed.

35. Lake Champlain Lake Sturgeon Restoration Program. ***Presentation***

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Lake Champlain once supported a small commercial fishery for lake sturgeon that harvested from 50 to 200 fish annually in the late 1800's and early 1900's. Annual harvest declined rapidly in the late 1940's, and the fishery was closed in 1967. Damming of spawning tributaries, fishing and pollution may have played a role in this decline. Lake sturgeon are currently listed as endangered by the state of Vermont.

In 1994, a study of the feasibility of restoring lake sturgeon to Lake Champlain concluded that suitable sturgeon habitat still exists in Lake Champlain but that the likelihood of achieving restoration through the natural reproduction of existing sturgeon populations was small. After reviewing the study, biologists from the Vermont Department of Fish & Wildlife, U.S. Fish & Wildlife Service (USFWS), and the Cooperative Fish & Wildlife Research Unit at the University of Vermont recommended that a survey of the existing adult population be conducted before deciding whether or not sturgeon needed to be stocked from other lakes into Lake Champlain. Sampling would focus on tributaries near historic spawning locations to determine if adult sturgeon were still present and their relative abundance. The Missisquoi, Lamoille, and Winooski Rivers, and Otter Creek are the 4 tributaries where sturgeon spawning activity had been noted in the past.

Sampling with multifilament gillnets (8", 10", and 12" stretched mesh) began in the spring of 1998 in the Lamoille and Winooski rivers. Three to 11 individual sturgeon have been captured each year. Several individual sturgeon have been captured in more than one year and more then once in a year. The total number of individual sturgeon captured during the past five years of gillnetting is 15 in the Winooski and 9 in the Lamoille.

Lake sturgeon were weighed, tagged with PIT tags just behind the skull, and measured for fork and total length. A small section of the first pectoral spine was removed from the left pectoral fin for aging and tissue samples were collected and archived for future genetic analysis.

Fish ranged in size from 958 to 1690 mm TL, weighing from 5 to 33 kgs. All sturgeon that have been captured have been males with the exception of 2 small sturgeon that could not be sexed. One young sturgeon (170 mm TL) was caught in the Winooski River during August, 2001.

In addition to the sturgeon captured in the Lamoille and Winooski rivers, a large dead sturgeon was found in Otter Creek in June, 2000. Sampling by the USFWS near spawning sites on the Missisquoi River in 2001 was unsuccessful.

Radio transmitters were surgically implanted in 3 sturgeon captured this spring. An additional 7 transmitters may be implanted in the coming year. Tracking adults may allow sampling to be targeted to areas in the rivers where sturgeon stage before moving onto the spawning grounds or in areas of the lake where sturgeon congregate in other seasons. Trotlines were also set in the Lamoille and Winooski Rivers in 2002 but no sturgeon were captured with this technique.

It is still too early to judge whether the Lake Champlain lake sturgeon population can recover on its own without hatchery supplementation, but the initial sampling has found multiple sizes (ages?) of sturgeon including very young fish. Further assessment is planned, including expanded efforts on the Missisquoi River, and focused sampling based on the radio telemetry data. Future assessment efforts may also include sampling for drifting larvae or juveniles and sampling at historic commercial fishing sites in the lake.

36. Sturgeon Spawning Habitat in the Lake Huron-Lake Erie Waterway. ***Presentation***

A partial summary of lake sturgeon research during the past 2-3 years by *Bruce Manny and Greg Kennedy at the USGS's Great Lakes Science Center in Ann Arbor. Contact: Bruce Manny or Greg Kennedy at the USGS Great Lakes Science Center, 1451 Green Road, Ann Arbor, MI 48105, Tel: 734-214-7255 or bruce_manny@usgs.gov.

1. Condition of historic, reputed lake sturgeon spawning sites.

Eighteen sites mentioned in Goodyear et al. (1982) or reported by local residents (two active and six reputed in the St. Clair River and one active and nine reputed in the Detroit River) were documented with side scan sonar and underwater TV, using a Global Positioning System. Suitability of bottom substrates at each site for protection of developing sturgeon eggs and sac-fry was gauged by subjective estimation of interstitial void space present among layers of rock on rock. Estimated area of suitable spawning substrates in the St. Clair River (1279 ha or 2814 acres) exceeded that in the Detroit River (645 ha or 1419 acres). Only 2 of 9 historic, reputed spawning sites in the Detroit River possess enough interstitial void space for egg incubation (> 30 cm), due to siltation, but a majority of such sites in the St. Clair River possess that much void space. Hence, potential for sturgeon reproduction in the waterway is much greater in the St. Clair River than in the Detroit River.

2. Substrates at three active known spawning sites.

Substrates at the three active, known spawning sites in this waterway consisted of beds of either metamorphic, rounded, cobble (10-40 cm in diameter) and coarse gravel (2-8 cm in dia.) of glacial origin or coal cinders (0.5-12 cm in dia.) of human origin, >0.25 ha in area and >0.3 m in thickness. Water velocity at the bottom at these sites (0.36-0.98 m/s) was in the range in which lake sturgeon were reported to deposit eggs in two small Canadian rivers. Results of this research were published in J. Appl. Icthyol. 18 (2002):1-5.

3. Construction of clean, new spawning habitat in the upper Detroit River.

Because suitable spawning habitat is limited in this river, funding has been sought from the Great Lakes Fishery Trust and MDEQ's Coastal Restoration Grant program to enhance a healthy, self-sustaining population of lake sturgeon in the river. We propose to construct clean spawning habitat near the head of the river in an area of high current velocity, using beds of three preferred spawning substrates of lake sturgeon: screened, limestone "shot rock", 6-24 in dia.; a mixture of 4-6 in, igneous cobble and 1-3 in gravel; and 1-3 inch coal cinders. The project is a collaboration among Michigan Sea Grant, Smith Group-JJR, the Army Corps of Engineers, and USGS and includes three elements: bed construction, fisheries monitoring, and public education.

37. Managing the Recovery of Lake Sturgeon in the Ontario-Minnesota Border Waters.

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Recovery of lake sturgeon populations in the Rainy River and south end of Lake of the Woods, largely in response to improvements in water quality, has focussed public attention on this species in the border waters between Ontario and Minnesota. A committee comprised of Ontario MNR, Minnesota DNR, Voyageurs National Park and Rainy River First Nations representatives identified current issues related to management of sturgeon within this area and developed a strategy to deal with them. Management recommendations to foster recovery of other border waters populations included:

- expanding existing closed season dates
- identifying minimum flow requirements for successful spawning and incubation downstream of power generation dams
- rehabilitating and/or creating spawning habitat
- initiating studies to investigate population discreteness and the value of stocking
- standardizing population assessment protocols
- establishing angling regulations to limit harvest and protect mature females

Since approval of this strategy by the Ontario-Minnesota Border Waters Fisheries Technical Committee in 1998, progress has been made to address each of its recommendations.

38. Menominee Indian Tribe Lake Sturgeon Management Plan. ***Presentation***

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Since the 17th century, the lake sturgeon (*Acipenser fulvescens*) has been a significant cultural and spiritual resource for the Menominee Indian Tribe of Wisconsin. Tribal members living in northeastern Wisconsin historically participated in an annual subsistence harvest each spring when large numbers of lake sturgeon moved upstream in the Wolf River to spawn. Until construction of two hydroelectric dams, lake sturgeon in the Lake Winnebago-Wolf River system were able to swim upstream to Keshena Falls, a traditional spawning site located on the reservation. These artificial barriers resulted in increased pressure on the remaining upstream populations resulting in extirpation of the species from those areas. The lake sturgeon remained a missing component of the native fish community until a unique multi-agency management plan for this species was initiated in 1995. Goals include the restoration and maintenance of multiple populations on the reservation. Starting in 1995, twenty adult lake sturgeon were transferred from the Wolf River in Shawano County to Keshena Falls on the Wolf River. This effort has been continued with approximately 20 fish transferred each year since the initial transfer. The fish have been released at three different points along the river on the reservation. The first few years saw the fish released at Keshena Falls, which is approximately five miles upstream of the Balsam Row dam. The fish released here suffered the largest losses as a result of emigration. The second release point was Big Eddy Falls, which is approximately ten miles upstream of the hydroelectric facility. Retention of the fish was better, although over time they still continue to drift downstream until a portion of them left the reservation. The third release point is Sullivan Falls, which is approximately fifteen miles upstream from the dam. This area has produced the best results to date of keeping fish on the reservation. To date, this area has the best retention of fish in reservation waters. As of 2001 73.5% of the transferred fish remained in the system. Each fish transferred is fitted with an external radio transmitter and are being tracked by the Menominee Conservation Dept. Transferred fish are fitted with an external radio transmitter and tracked by the Menominee Conservation Department. Data loggers are in place at the two downstream hydroelectric dams to confirm fish leaving the reservation or confirm fish returning to the dams in the spring to spawn.

Since, the Wolf River population has been designated a non-harvestable population, the Lake Sturgeon Restoration Management Plan has included provisions for developing a harvestable population in several lakes on the reservation. Legend Lake is a highly developed 1200-acre impoundment in the southeast corner of the reservation. It consists of 8 connected original lake basins that were connected in the 1960s as part of a large development project. The shoreline is highly developed with many vacation homes on the lake. Maximum depth of the lake is 70 feet but it averages5-15ft, with large littoral areas. Stocking of fry and fingerlings has been ongoing yearly since 1995 and the population is growing well. The total number of fish stocked as of 2001 is approximately 46,000. The other lake actively receiving lake sturgeon is Upper Bass Lake in the northwest part of the reservation is also being stocked regularly. Upper Bass Lake is approximately 112 acres with a maximum depth of 48 feet and an average depth of 20 feet. Approximately 2700 sturgeon have been stocked in this lake. Annual assessments are used to determine stocking success and growth rates. Stocking efforts in both lakes will be continued until goals of the plan are met.

39. Stocking Eggs to Restore Lake Sturgeon in the upper St. Louis River *Presentation*

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A river resident lake sturgeon population was historically present in the St. Louis River, Minnesota, upstream of the barrier falls to Lake Superior at Fon du Lac, Minnesota. The Fon du Lac Band is leading the effort to restore a river resident sturgeon population in the upper St. Louis River. The reach selected is upstream of 5 dams and a natural barrier to Lake Superior. No sturgeon were captured in surveys conducted to determine the status of the river resident population. Efforts to collect eggs from a local river resident population were unsuccessful. With assistance from Wisconsin DNR and the USFWS, eggs were obtained from a resident population in the Menominee River, Wisconsin/Michigan (Lake Michigan watershed). Eggs were reared at the Wisconsin DNR Wild Rose Hatchery for 1 week and transported to the stocking site. Mortality during transport has ranged from 10-30%. Eggs were manually placed in "nest boxes" between layers of Astroturf. The "nest box" design is based on boxes used by Wisconsin DNR for lake trout in Lake Superior. Each layer holds about 300 eggs and each "nest box" contains 3 layers for a total of about 1,000 eggs per box. Egg stocking has biologic/ecologic and economic advantages over stocking of other life stages. These include a reduced potential for hatchery selection influence, the survival of fish adapted to local river conditions, the opportunity to imprint to spawning habitat at an early life stage, and reduced rearing expense. The nest box design provides protection from predatory fish and crayfish and is believed to reduce egg and sac fry mortality. A total of 70,000 eggs were stocked over a 3-year period from 1998-2000. To date, assessment efforts have been unsuccessful at capturing sturgeon, however, anglers are reporting catches of juvenile sturgeon.

40. Use of Archival Tags to Determine Habitat Use

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Rehabilitation of lake sturgeon in the Great Lakes is one priority of the fishery agencies participating on the Great Lakes Fishery Commission. An understanding of basic habitat use by Great Lakes sturgeon is needed to assist rehabilitation efforts. The objective of this pilot project is to establish the feasibility of archival tags to determine seasonal and diel bathythermal habitat use profiles for lake sturgeon. Information on the depths and temperatures occupied by most fishes in the Great Lakes is deduced from captures in assessment and harvest fisheries that provide only point estimates of these two variables. Surgically implantable, archival (i.e., data recording) tags are an emerging technology capable of collecting depth and temperature data from fish at large in the Great Lakes. These tags will record data at intervals of an hour or less and provide an unprecedented picture of the seasonal and diel bathythermal distribution of lake sturgeon in the Great Lakes. In June 2002, archival tags were surgically implanted in 20 lake sturgeon. Sturgeon were captured in trap nets by Purdy Fisheries in southern Lake Huron and transported to holding troughs in Sarnia, Ontario, where the surgery was performed. Fish were allowed to recover and observed for up to 2 weeks prior to release. Two fish were recaptured after several months of free ranging. Depending upon the time at large, recovery of an archival tag can provide tens of thousands of data points. For example, over 22,000 data points, with a data point every 6.5 minutes, are available from a sturgeon at large for about 3 months. That is likely more data points than from all previous captures in Lake Huron or all of the Great Lakes combined. The entire data series and a select 24-hour period will be graphically presented from each recapture to provide an indication of the amount and type of information provided by archival tags.

41. Trawling to Assess Young-of-the-Year and Juvenile Lake Sturgeon

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The USFWS Ashland Fishery Resources Office utilized bottom trawls to survey juvenile lake sturgeon. Two Lake Superior rivers were surveyed, the Bad River, Wisconsin and the Sturgeon River, Michigan. Both rivers support naturally reproducing remnant lake sturgeon populations.

Trawling was conducted with 3.0 m (10 foot) and 4.9 m (16 foot) foot ropes 1997, 1998, and 2001. Cod end mesh size was 6.4 mm (0.25 inch) bar. Trawls were towed at speeds of 3-3.5 miles per hour in a downstream direction and are deployed at 2.5-3 times the water depth. In the Sturgeon River during July and August 1997, catch per effort was 4.7 per hour in the 3 m trawl and 4.7 per hour in the 4.9 m trawl. Lake sturgeon length ranged from 77-165 mm. In the Bad River, juvenile lake sturgeon catch per hour ranged from 0.3 to 2.2 and length ranged from 97-849 mm.

42. A Non-Lethal Sampling Technique for the Determination of Organic Contaminants in Lake Sturgeon (*Acipenser fulvescens*).

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A unique method has been developed to allow the inclusion of lake sturgeon (*Acipenser fulvescens*) in routine organochlorine contaminant monitoring programs without the need to sacrifice fish. After examining several methods and tissues, a procedure was selected that employs a sharpened steel tube to take a small plug of tissue next to the dorsal fin. The new, non-lethal method is simple, uses a standardized anatomic location and produces a mass of tissue sufficient for today's instrumentation to accurately analyze. In field tests, fish collected from southern Lake Huron recovered quickly and showed no lasting effect from the procedure. All of the test fish were tagged during the procedure and successfully released after a 16-day holding period.

43. Application of microsatellite analysis to the management and conservation of Canadian lake sturgeon in Northern Ontario, Manitoba, and Saskatchewan. ***Poster Display***

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The lake sturgeon (*Acipenser fulvescens*) is the largest freshwater fish in North America and is native to the Great Lakes, Hudson/James Bay, and Mississippi River drainages. Lake sturgeon stocks throughout their range have been severely reduced from historical levels of abundance, primarily through habitat degradation and overfishing. This project addressed large and small scale management concerns through the application of nuclear DNA markers to wild and hatchery populations of Canadian lake sturgeon within the Hudson/James Bay drainage. We used a suite of 8 polymorphic microsatellite markers to determine the genetic population structure of lake sturgeon populations in Manitoba, Saskatchewan, and Ontario within the Nelson, Rainy, Winnipeg and Saskatchewan Rivers. All populations sampled were significantly different from one another suggesting that these rivers should be managed as discrete stocks and that translocation of fish between these rivers should be avoided. We also conducted a microsatellite-based evaluation of the current hatchery practices in a small First Nations lake sturgeon hatchery in Fort Francis on the Rainy River in northern Ontario. This hatchery collects and spawns wild fish from the Rainy River each spring and raises the offspring to a fingerling stage after which they are released back into the wild in an effort to enhance the natural recruitment within the population. A pedigree analysis of genotypes between the broodstock and progeny and a comparison of the progeny to a sample of the wild population suggests that effective population size within the broodstock should be maximized in an effort to maintain the levels of diversity present in the wild population.

44. Chequamegon Bay Lake Sturgeon Movements.

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Lake sturgeon were captured in Lake Superior at Chequamegon Bay, WI, between 1988 and 2002 by the Wisconsin Department of Natural Resources (WDNR). Large mesh gill nets of 8, 10, 12, and 14 inch stretch mesh were used to capture 703 lake sturgeon. All fish were marked with metal monel and Floy tags between 1988-1994 (N=309), Floy tags only from 1995-1999 (N=217), and Floy and PIT tags from 2000-2002 (N=177). Movement was determined from the recapture of 89 fish during WDNR, Bad River Tribal, USFWS and Michigan Technological University assessments as well as commercial fishing operations.

Lake sturgeon recaptured in DNR assessment nets in Chequamegon Bay represented over 60 % (N = 54) of the recaptures and were generally caught near the tagging location. All fish were marked and recaptured in less than 9 m of water with the majority in less than 4 m. Nearly 34 % (N = 30) of the recaptures were caught while spawning in the Bad River, WI, a known lake sturgeon spawning tributary. Two fish migrated to the Sturgeon River, MI, and were captured while spawning, one fish was captured in a commercial trap net in Misery Bay, MI, and two were caught in commercial nets in the Apostle Islands. In addition to the two sturgeon recaptures from the Sturgeon River, another sturgeon was marked in 1977 within the Apostle Islands and recaptured 10 years later spawning in the Sturgeon River. Several sturgeon tagged while spawning in the Sturgeon River have been recaptured in Chequamegon Bay.

Recapture data suggests most lake sturgeon from the Bad River spawning population utilize Chequamegon Bay as a home area for immature and non-spawning adults. Chequamegon Bay is only 16 km from the mouth of the Bad River, has a mean depth of slightly over 8 m and provides over 15,000 ha of suitable foraging habitat for lake sturgeon. A small percentage of mixing occurs between the Sturgeon and Bad River populations, a distance of approximately 210 km.

45. Stocked Lake Sturgeon Dispersal in Lake Superior. ***Presentation***

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A project to reestablish a spawning lake sturgeon population in the St. Louis River was undertaken by the Wisconsin Department of Natural Resources (WDNR) and Minnesota Department of Natural Resources (MDNR). Between 1983 and 2000, 761,000 lake sturgeon fry and 143,000 fingerlings were released in the St. Louis River. Lake Winnebago, WI, strain fish were released from 1983 through 1994 and Sturgeon River, MI, strain fish were released from 1998 through 2000. As fish migrated into Lake Superior, they were captured during routine assessment work by the WDNR, measured, and marked with numbered Floy anchor tags along the side of the dorsal fin. Between 1985 and 2002, 968 lake sturgeon were captured, marked and released in Wisconsin waters between the St. Louis River mouth and Bark Point. Movement was determined from the recapture of 43 individuals during WDNR assessments and commercial fishing operations.

During the 1980s, recaptured sturgeon remained in an area between the St. Louis River mouth and Bark Point. This pattern continued into the 1990s with the exception of four fish that migrated to the Apostle Islands (average 93 km) and one fish captured in Black Bay, Ontario (approximately 300 km). Another fish was recaptured in Black Bay, Ontario in 2000 and one in Thunder Bay, Ontario (approximately 264 km) in 2002. Stocked lake sturgeon generally avoided the deeper, rocky Minnesota shoreline although they probably moved along this shoreline to reach Ontario.

Daily movement was estimated from three fish recaptured within the same year. The three fish had been at liberty for 4, 10 and 70 days and had moved 27, 42 and 6 km respectively. This represents an average minimum speed of 3.7 km/day.

Recapture information suggests the Wisconsin waters of Lake Superior between the St. Louis River mouth and Bark Point appears to be an important area for the St. Louis River lake sturgeon population. Lake sturgeon were moving both easterly and westerly along this predominantly clay and sand bottom that slopes gradually to 150 m. Previous work found the majority of lake sturgeon in waters 30 m or less. The 30 m contour comes within 1 km of Bark Point which likely constricts eastward movement to a narrow corridor along the shore. Nearly two decades after the rehabilitation program began, stocked lake sturgeon generally remained along the 65 km shoreline from the mouth of the St. Louis River to Bark Point.

46. Lake Sturgeon population genetic structure in the upper Great Lakes: implications for population assignments and delineation of populations for purposes of supplementation. ***Presentation***

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Lake sturgeon (*Acipenser fulvescens*) were historically widely distributed and numerically abundant throughout the Great Lakes Basin. Range-wide declines in numbers and distribution have resulted in assignment of Vulnerable and Threatened status. Sound stewardship of remaining lake sturgeon populations would profit from a fundamental understanding of how populations are structured genetically and of the effects of anthropogenic factors. Quantifying levels of genetic diversity present and how this diversity is partitioned (i.e., among lake basins and spawning populations within each basin) can provide managers and biologists with critical information to address important management questions. For example, the extent to which populations are genetically differentiated (and inferentially reproductively isolated) can be of importance in defining evolutionary significant units or management units. Based on microsatellite loci and control region sequences we quantify levels of genetic differentiation among populations across the upper Great Lakes. We show that populations are genetically structured at the level of lake basin and even at a fine spatial scale (e.g., among drainages to Green Bay in Lake Michigan). We show that multi-locus genotypes can be used to assign individual sturgeon to population of origin with high accuracy. Data highlight important areas of genetic discordance among populations that can be used to guide restoration efforts. Stocking has not historically been conducted in a manner consistent with preservation of genetic diversity among locations or to maintain levels of genetic variation within the locations where offspring have been stocked.

47. Population Status, Biological Characteristics, and Stock Structure of Lake Sturgeon in the St. Mary's River. ***Presentation***

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The St. Mary's River, a 112-km connecting waterway between Lakes Superior and Huron, has been identified as historically supporting an abundant, self-sustaining population of lake sturgeon *Acipenser fulvescens*. However, the current population status, biological attributes, and stock structure of lake sturgeon in this system remain unknown. Using baited set lines (4 to 10 set lines per night, with each line 100 m in length and containing 25 snews), sampling was conducted in the lower river from just below the St. Mary's rapids to Lake George from 15 August to 25 September 2000 (158 set-line nights) and 23 May to 30 August 2001 (638 set-line nights). From 03 June to 30 August 2002, baited set lines (5 to 15 lines per night; 1,154 set-line nights) were also used in these areas of the river, as well as the upper St. Mary's River from the compensating gates to the eastern end of Whitefish Bay at Point Iriquois. Set-line baits used during this study period included nightcrawlers, frozen and pickled squid, and strips of lake trout *Salvelinus namaycush*, lake whitefish *Coregonus clupeaformis*, lake herring *C. artedi* and round whitefish *Prosopium cylindraceum*, with fish baits catching the majority of lake sturgeon. All captured lake sturgeon were measured for total and fork length, girth, and wet weight, and each fish was checked for internal and external tags. If tags were absent, each fish was implanted with a PIT tag below the second or third dorsal scute and given an external Floy T-bar anchor tag along the upper left side of the body below the dorsal fin. In addition, a 1-cm section of the left marginal pectoral fin ray was removed for aging in purposes, a 0.5-cm section of the dorsal fin was removed for genetic analysis, and the presence or absence of sea lamprey *Petromyzon marinus* wounds or scars was noted for all captured lake sturgeon.

Over the three sampling seasons, a total of 92 lake sturgeon were collected from the lower (N = 90) and upper (N = 2) St. Mary's River (2000: N = 2; 2001: N = 45; 2002: N = 45). These catches included 10 individuals that were recaptured (R; 2000: R = 0; 2001: R = 2; 2002: R = 8), with all recaptures occurring in the lower river. Using the Schnabel method, we estimated the population abundance of lake sturgeon at approximately 200 fish (95% confidence limits = 110 to 374 individuals). The lake sturgeon size distribution was similar among sampling seasons, ranging from 80 to 175 cm in fork length and 6 to 37 kg in wet weight. Based on analyses of pectoral fin ray cross-sections, the mean age of lake sturgeon was estimated to be 22 years and ranged from 9 to 59 years. From these estimates, approximately 40% of the lake sturgeon captured were determined to be subadult fish. A total of 20 fish (22% of the total sample across all sampling years) contained sea lamprey scars, with less than 5% of these fish containing 2 or more scars. In no cases were sea lampreys still attached to lake sturgeon at the time of capture.

48. Lake St. Clair and St. Clair River Lake Sturgeon Assessment. ***Presentation***

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Historically, the St. Clair River and Lake St. Clair supported an abundant lake sturgeon population. Since the early 1900's, the status of lake sturgeon populations within these waters has been largely unknown. We initiated a study in 1996 to determine the abundance, age structure, and spatial distribution of lake sturgeon in the St. Clair River and Lake St. Clair. Through 2001, more than 1,100 lake sturgeon were captured with setlines and trawls, tagged and released. Bait comparison studies documented round gobies produced the highest setline sturgeon catch rates. Monel cattle ear tags were originally used for marking the fish. In 2000 and 2001, all lake sturgeon have also been tagged with PIT tags. Thirty-nine tag recoveries have been recorded. Fourteen were recovered during the setline surveys in the North Channel, while six were recovered while survey trawling in Lake St. Clair. Eight recoveries were reported by sport anglers in the St. Clair River. Nine recoveries have been reported from the Ontario commercial trap-net fishery in southern Lake Huron, approximately 70 kilometers from the tag site. One recovery was reported by a sport angler from Lake Erie near Huron, Ohio. All other recaptures have occurred within 10 km of the tag sites. These recovery data confirm that St. Clair system lake sturgeon move into Lake Huron and Lake Erie. Furthermore, it suggests sturgeon that spawn in the Michigan waters of the St. Clair River experience considerable fishing exploitation in the Ontario waters of southern Lake Huron. Preliminary mark-recapture analysis produced a population estimate of 25,500 lake sturgeon for the St. Clair system. Ages have been estimated for 973 fish based on interpretation of pectoral fin ray sections. Age structure indicates consistent recruitment during the 1970's and 1980's. Relatively low catches of fish older than 30 years could indicate poor recruitment or higher exploitation in earlier years. Low catches of fish from the 1995 to 2000 cohorts may be a reflection of poor recruitment, gear bias, or spatial distribution. Round gobies with stomachs containing sturgeon eggs were collected from a known spawning location in the St. Clair River North Channel. Video observations also documented silver redhorse and lake sturgeon feeding on the spawning site. Lake sturgeon stomach contents have been collected from 20 fish collected with trawls in Lake St. Clair. Common diet items included zebra mussels, burrowing mayflies, snails, and amphipods. No fish have been observed in the diet. Trawling and sidescan sonar analysis documented an area of consistently high lake sturgeon density in US waters of the lake near the St. Clair River delta. Estimates of abundance based on sidescan sonar supported the mark-recapture abundance estimates. Results of this study indicate the St. Clair system supports a large sturgeon population that is often densely aggregated in a small geographic area. Gaining an understanding of the habitat characteristics that make that area a preferred location may enhance environmental protection efforts and assist in habitat restoration efforts in other Great Lakes connecting waters. Areas of emphasis for this study in 2003 include refined mark-recapture abundance estimates, additional diet investigations, continued search for age 0 and 1 lake sturgeon, and habitat characterization.

49. Population Dynamics of Lake Sturgeon in the Muskegon River, Michigan. ***Presentation***

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Although lake sturgeon (Acipenser fulvescens) were once abundant in all of the Great Lakes, overfishing and the construction of dams that blocked spawning migrations have devastated most populations. Historic records from commercial fisheries of the late 19th century indicate that Lake Michigan once supported the largest known population, comprised of several million adult fish. While biologists now recognize that each of the Great Lakes are inhabited by many discrete stocks, little is known about the current status or distributions of these remnant lake sturgeon populations. The main objective of this study was to obtain an estimate of the annual spawning run of lake sturgeon in the Muskegon River, one of the last remaining populations in eastern Lake Michigan. From March through June 2002, we conducted a mark-recapture estimate of adult lake sturgeon in the mouth of the Muskegon River using bottom-set gill nets to capture migrating adults. Using a modified Schnabel method, we estimated that that 2002 spawning run consisted of 17 mature individuals. Gonadal biopsies of all captured fish showed that only 1 of the 13 individuals captured, was female. Using radio-telemetry, we monitored spawning migrations and habitat use of 4 adults (3 male, 1 female) from April to June. Although spawning could not be verified in 2002, all 4 fish converged on a single reputed spawning pool in mid-May as water temperatures reached 15°C. In 2003, larval nets will be deployed just downstream of this site in an effort to confirm this location as an active spawning site.

50. Lake Sturgeon Observations and Collections in Great Lakes Tributaries by the Canadian Sea Lamprey Control Centre, 1999-2002. ***Poster Display***

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Increased interest in lake sturgeon around the Great Lakes basin stimulated a review of lampricide impacts on lake sturgeon. Studies found that lake sturgeon less than 100 mm were susceptible to lampricides applied in streams at concentrations previously considered acceptable for a given river. For this reason the Canadian sea lamprey control centre in Sault Ste. Marie, Ontario, has intensified sampling efforts in large rivers that have a history of lake sturgeon reproduction.

Since 1999 we have initiated an effort to document lake sturgeon reproduction in streams by using fyke nets designed to collect larval lake sturgeon. Where we have documented reproduction, we have searched randomly selected sites following the application of lampricides to determine if there was any lake sturgeon mortality. All streams where lake sturgeon historically reproduced are searched carefully during lampricide applications for non-mortality, especially lake sturgeon.

Since 1999, lake sturgeon were observed or collected from four streams in Lake Superior and three streams in Lake Huron. Adult lake sturgeon were observed in the Black Sturgeon River, and the Goulais River in Lake Superior and in the Koshkawong River and Nottawasaga River in Lake Huron. Larval lake sturgeon were collected from the Batchawana River and Goulais River in Lake Superior, and from the Garden River and Thessalon River above Rock Lake in Lake Huron. Young-of-the-year lake sturgeon were found in the Kaministiquia River and Goulais River of Lake Superior and in the Garden River of Lake Huron.

Sizes, methods of capture, dates of capture, and observational information are provided on a poster for this meeting. Seventeen streams that have a history of lake sturgeon production have been

treated with lampricides (two twice) since 1999. Only one lake sturgeon has been found that was killed by lampricides. On August 12, 2002, a small young-of-the-year lake sturgeon (78 mm TL) was found dead in the Kaministiquia River, just above the confluence with the Whitefish River. Normally lake sturgeon are expected to be longer than 100 mm by the first of August but this fish probably came from a late repeat spawning of sturgeon in the river.

51. Impact of Lampricides on Lake Sturgeon in the Garden River, 2001. *Presentation*

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The Garden River has a history of lake sturgeon reproduction and locals reported that lake sturgeon spawned in several rapids. The largest numbers were reported to be spawning in Murphy's Rapids at the foot of Nine Mile Rapids. We surveyed this river in May and June prior to the lampricide application in July to determine if successful reproduction was occurring. We surveyed the stream again immediately prior to the lampricide application to determine if the sturgeon were still present in the river. Following the lampricide application, we surveyed random stream sites to determine if any lake sturgeon were killed by the lampricide application.

During spring sampling with fyke nets designed for larval lake sturgeon, we captured larval lake sturgeon at two locations in the river. We sampled about 7% of the stream flow immediately below Murphy's Rapids and 12% of the stream flow below Driving Creek (at the power lines) between May 14 and June 28. The nets were fished between 1800 hrs and 2400 hours, five days a week, flows permitting. Fourteen larval lake sturgeon were captured below Murphy's Rapids between May 31 and June 15. Another four larval lake sturgeon were captured at the power lines between June 1 and June 7. The mean size of the larval lake sturgeon was 20 mm (TL) and 0.028 g.

The lampricide application to the main river occurred between July 9 and July 14, 2001. Before the lampricide reached the study area a lake sturgeon was captured in the fyke nets at the power lines on July 10. It was 80 mm (TL) and weighed 2.022 g.

The Great Lakes Fishery Commission "Sturgeon Protocol" for treating streams with lake sturgeon present less than 100 mm long recommends that lampricide concentrations should not exceed 1.0x minimum lethal for sea lamprey. The minimum lethal for this stream was 0.9 ppm TFM for nine hours. The remoteness of the river, the complex system of tributaries and extensive escapement areas make this river impossible to successfully treat under this restriction. The lampricide was applied about 2x minimum lethal at the primary application site and concentrations were boosted three times to maintain lethal concentrations through the area known to have lake sturgeon present. The maximum concentration recorded in the area where lake sturgeon were known to be present was 1.5 ppm.

Random sampling of about 19% (~ 11 ha) of the stream area between Murphy's Rapids and the mouth found no lake sturgeon mortality. Stream conditions were perfect for sampling. The stream was clear, the skies remained sunny, and the maximum depth of the stream was less than 1 m except for a few small pools. All random sites were carefully searched by two or three people.

52. Integrated Sea Lamprey Management Program and Lake Sturgeons in the Great Lakes Basin in the United States during 2000 to 2002.

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I work with others to assess the risk of lampricide treatments (treatments) on nontarget organisms for the continued benefit of the American people. I often work with personnel from federal and state agencies and tribal nations to address sea lamprey related issues by risk communication (an interactive exchange of opinions and information) and risk management (a formal and systematic procedure to forge consensus from divergent opinions to assess the risks of management activities). Frequent consultations occur with federal and state agencies to protect and avoid disturbance to listed endangered, threatened, candidate, proposed, and special concern species and proposed or critical habitats in or near Great Lakes streams proposed for treatments by the Sea Lamprey Management Program (Program).

During 1988 to 1998, Program personnel participated in cooperative field and laboratory projects with partner agencies to assess spawning adults, fry, and juvenile lake sturgeons in streams where treatments occur and conducted toxicity tests to determine the concentration of lampricides that kill sea lampreys and do not harm lake sturgeons. Treatments are managed to minimize the risk in state-designated lake sturgeon streams with the support and concurrence from jurisdictional agencies.

Since the Research and Assessment Needs to Restore Lake Sturgeon in the Great Lakes workshop was held at Muskegon, Michigan during 2000, 18 treatments have been conducted in state-designated lake sturgeon streams and no lake sturgeon mortality has been observed.

I continue to assist others in the coordination of lake sturgeon assessments in streams where lampricides are applied and serve as a member of the following work groups: the Lake Sturgeon Committee of the U.S. Fish and Wildlife Service Great Lakes Basin Ecosystem Team, Lake Sturgeon Subcommittee of the Lake Superior Technical Committee of the Lake Superior Committee of the Great Lakes Fishery Commission, Green Bay Lake Sturgeon Work Group, Central Great Lakes Binational Lake Sturgeon Group, and New York Lake Sturgeon Research Group.

The Great Lakes Fishery Commission contracts field operations of the Program to the U.S. Fish and Wildlife Service and Department of Fisheries and Oceans of Canada according to the Convention on Great Lakes Fisheries between the United States of America and Canada, 1954. Details of the Convention and Program activities are posted on the following websites:

http:www.glfc.org/pubs/conv.htm
www.glfc.org/pubs/SpecialPubs/StrategicVision2001.pdf
http://midwest.fws.gov/Marquette/
http://midwest.fws.gov/Marquette/etc/sturgeon.html

53. Microsatellite Marker Development and Standardization for Lake Sturgeon Management. ***Presentation***

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The development of a basin-wide management plan for the lake sturgeon in the Great Lakes is a multifaceted project. The first phase involved the development of both nuclear and mitochondrial molecular markers that would be used by all investigators studying lake sturgeon. These markers are now being standardized among laboratories conducting lake sturgeon genetics research and will then be used to characterize the population genetic structure within the Great Lakes Basin. The resultant information will help us formulate a unified strategy for the management of lake sturgeon. This presentation will focus on marker development and standardization, and will be combined with Tracy Hill's presentation on the sampling strategy.

Following a workshop in 1999 involving lake sturgeon geneticists, biologists, and managers, molecular marker development was identified as an important component to an effective management plan for lake sturgeon. Markers for microsatellite loci and mitochondrial DNA were deemed to be most informative. Our laboratory was designated to conduct the microsatellite development and geneticists agreed that the effort should focus on marker development for disomic loci. Much of the lake sturgeon genome is duplicated, where many of the loci have four chromosomal copies (tetrasomic) as opposed to the standard two chromosomal copies (disomic). Over 200 primer pairs were developed, resulting in nine primer pairs that amplified disomic polymorphic loci. Inheritance testing was performed using these nine primer pairs to confirm their disomic status.

In addition to disomic microsatellite markers developed previously, a suite of twelve microsatellite markers are currently being standardized among participating laboratories. Standardization eliminates differences that may arise between laboratories in regards to markers used and allelic designations. If laboratories are analyzing different loci, data synthesis between laboratories becomes impossible. Laboratories using different genotyping systems could also result in incompatible allelic designations. The standardization effort entails optimization of the selected microsatellite markers on each laboratory's genotyping system, followed by genotyping of both known and unknown samples of DNA. Communication between the laboratories will ensure consistent allelic designations. Protocols will be developed to facilitate the incorporation of new laboratories to the standardization process.

As samples continue to be collected, these twelve microsatellite markers will be used to assess the population genetic structure of lake sturgeon in selected candidate waters. These data will then be synthesized with data collected from other laboratories to develop a genetics-based management plan for waters throughout the Great Lakes Basin.

54. Great Lakes Basin Lake Sturgeon GIS Database Web Page. ***Presentation***

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This project will create a unified, interactive web-based GIS map and meta-database of Great Lakes lake sturgeon information important to researchers and managers. The database will enhance the existing map and database developed for the 2000 GLFT Lake Sturgeon Workshop. Our long-term objective is to compile the available lake sturgeon data sources to help focus restoration and research activities on priority lake sturgeon waters. Lake sturgeon researchers are the intended audience; however, it will also be useful to natural resource managers and biologists. The project is an initiative of the Lake Sturgeon Committee of the U.S. Fish & Wildlife Great Lakes Basin Ecosystem Team led by committee members Emily Zollweg, Rob Elliott, Henry Quinlan and Tracy Hill along with participation by Dr. Ed Baker (MDNR) who developed the materials for the 2000 GLFT Workshop, and assistance from Chris Castiglione, USFWS GIS Specialist.

The GLFT Workshop base map and database identifies and categorizes all known lake sturgeon waters within the Great Lakes Basin into extirpated, historic, reintroduced, and/or current lake sturgeon populations. Also, the size of the spawning run is given, or whether there is known evidence of successful reproduction. This project has created a metadata structure that will broaden the information that can be stored and made available to researchers. Greater resolution of the degree of use or presence in a river system has been added for all populations. Where available, information is referenced for presence of adults, juveniles, and subadults, and whether spawning has been observed, egg deposition documented, and larva captured. Data fields reporting sampling methods used, whether contaminant, genetic, or aging samples were collected, date(s) or year(s) for which the information was collected, investigator(s) involved, citations for available reports and publications, and point of contact for additional information are included. GIS layers and data on dams/lake sturgeon barriers and a contaminants layer based on EPA designated Areas of Concern river segments will be added in the future.

The final GIS map and database will than be incorporated into an interactive web page. This web page will function much like a GIS database, allowing selection of various data layers and enabling the user to query available data to find specific information of interest. Users will also be able to use an attached form to e-mail additional information and/or data updates for inclusion to the database.

Our partner for the web based versions of this database, the Upper Midwest Environmental Science Center of the U.S.G.S. Biological Resources Division, is nationally known for their technological capabilities. They will be assisting us in upgrading the existing GIS, as well as designing and implementing the web page. USGS will host the web page for an initial six month period. We are currently exploring a long term host and maintenance agreement with USGS and others.

At this time, we are working with data from Fish & Wildlife employees and the State of Michigan to create a prototype GIS version for webpage development. We have initiated contacts with our state, tribal, academic, NGO and Canadian partners to complete the database, once the prototype has undergone beta testing. We anticipate that the Lake Sturgeon Coordination meetings will be a venue to share this database initiative, demonstrate its use, receive updates, and discuss enhancements on a yearly basis.

APPENDIX B
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APPENDIX C

Discussion Group Summaries December 12, 2002 - A.M.

Technical Session 1:
Consideration of Stocking to Rehabilitate Population

Group 1 Facilitator: Ed Baker
Participants: Nate Caswell, Andrew DeWoody, Brenda Archambo, Angela Benson, Stephanie Carman, Barbara Evans

Brenda A. -Black Lake Genetics

- Poor sex ratio/genetic diversity in previous stockings
- Lake sturgeon there over lap b/t cohorts?
- What # of fish should we use now
- Will they represent a significant portion of the spawning population
- Hope that over time with enough individuals that you would get enough genetic diversity
- Are we overstocking in places?
- Using normal sex ratios
- Sturgeon have environmental sex determination, are sex ratios skewed in places with high pollution, little is known about the factors that determine this, see Devlin 2002 in Aquaculture
- **This is a definite research need**

Questions

1. Goal of stocking
    - Recovery of self-sustaining population
    - Recreation
    - Depends on what you want

2. Consider before stocking
- How specific is a particular strain to a particular habitat
- How small does a population have to be to decide it can't make it on its own
- How many fish can the system handle
- Why not improve habitat first and see what the outcome is
- Number one issue identify what was the cause for the population decline initially
- Do CWT affect olfactory senses
- Will imprinting cues change over 20 years
- Will the fish find their way home

3. When do they imprint
- In-stream rearing best to allow lake sturgeon to imprint to the stream

4. How Many
- How good is survival
- Probably better to get fewer fish from egg stocking on an annual basis than stocking older fish every year

Group 2 Facilitator: Doug Cox
Participants: Jim Boase, Amy Welsh, Henry Quinlan, Larry Kallemeyn, Josh Lallaman, Jeff Eibler, Charles Hendry, David Tremblay, Michel Bérubé, Lori Betcher

What is goal of restoration?

1. Restoration needs to be defined; to what point?
2. Rehabilitation – self-sustaining stocks
3. Need to find / develop reference populations (id source populations to get better target numbers)
4. Jurisdictional issues / policies
5. Consider harvest goals
6. Cultural considerations

Q. 1 What should be considered before stocking?

1. Is there potential for restoration?
2. Address problems that led to demise
    a. Pollution
    b. Harvest
        i. Past
        ii. Present
3. Habitat: Is sufficient habitat available and suitable?
4. What is impact to remnant stocks/fish?
    a. Within system considered for stocking
    b. In systems connected or accessible
5. What are alternatives to stocking?
6. Develop a management plan
    a. Uniformly across jurisdiction
    b. Long term monitoring
7. Need to identify resources available to carry out project
    a. Public input and education
8. Concerns related to stocking
    a. Fragmentation
    b. Genetics
    c. Suitable source populations
    d. Over stocking
    e. Costs
    f. Ability to monitor and assess stocking
    g. Impacts to the biology of the system – what impact will more sturgeon have on system

Q. 2 Where, what life stage and when to stock?

1. With remnant populations (remnant defined as <1000 adults)
2. Early in life stage
    a. Problems with monitoring at early life stages (eggs and fry)
3. Ease of stocking
4. What part of system
5. Consider survival
6. Innovations
    a. Mobile hatchery
    b. Artificial egg boxes in-stream stocking

Q. 3 How many and how long to stock?

1. #'s of fish = eggs, fry or fingerlings – will vary with system
2. Important to equalize family size over many years of stocking
3. Consider reproductive potential of system
4. Define failure in stocking
    a. Strategy - % of success (50% ?)
    b. Objectives

c. Goals

Genetic Issues

1. Focus on areas close (geographically and genetically) to where healthy populations exist
2. Consider combining fish from more than one nearby system to restore extirpated populations
3. Use larvae from system - pull fry from system to raise in hatchery then re-release in system – (doesn't address problem of poor or no fry survival and initiates hatchery selection processes)

SUMMARY

1. Rehabilitation to reach self sustaining populations take into account harvest goals, policy, some reference numbers for targets, management and cultural issues.
2. See Questions 2-4

Group 3 Facilitator: Doug Aloisi

Participants: Glenn Miller, Pat DeHaan, Brant Fisher, Neal Godby, Tom Meronek, James Jackson, Roger Greil, Mike Plucinski, Kyra Fillmore, Greg Kennedy, Mark Gendron, Nate Bigboy

Considerations of Stocking to Rehabilitate Populations

1) What is the goal of stocking?
- Re-establish self sustaining populations
- Re-establish extirpated populations
- Re-establish historic range
- Have adults returning to river to reproduce populations
- Establish a fishery, both recreational and commercial
- Money is available for stocking
- Enhancement of existing populations
- Range expansion, both in known native range and, if suitable, outside of native range

Questions that arose from this discussion:
- What is definition of self-sustaining populations?
- Is population a river-by-river basis or is it a larger group, i.e. lake or basin wide habitat considerations?
- Politics involved in stocking, will public support stocking program and is long term funding available?

2) What should be considered before stocking (i.e. why/why not stock)?

Considerations before stocking:
- Why did fish disappear initially, habitat damage, over fishing?
- Will current habitat support re-established population?
- Is target location part of native range, and is habitat suitable for stocking?
- Population status of stream is there a remnant population in water body or are they completely extirpated?
- Bloodstock concerns, mainly genetics, also availability of long-term brood source, along with resemblance of brood source to water body to be stocked.
- Will it affect the current population of fish that is to be used as fish source by removal of gametes/fish from this system?

  Considerations of imprinting:
- Will fish imprint?
- When is the best time to stock for imprinting?
- How far will fish stray from natal streams?
- Will fish come back to stocked water body when they have strayed long distances, i.e. cross great lakes?
- Will hatchery fish stray more than stocked fish, any information exist?
- What happens when fish from one broodstock is stocked into another water body (example; Wolf River into Menominee River) and they leave in juvenile life stage? Will they return to stocked water body or possibly head back to natal river, especially if the water bodies are close by?

  Resource Management:

- Development of stocking plan and management plan. Genetic plan needs to be developed as part of both plans.
- How do you determine genetic makeup of a population that is extirpated?
- Extirpated systems; do you use the closest geographic location stock that exist? Or do you develop new bloodstock that is made up of individuals from several different water bodies and hope that one will match with available habitat and behavior for system?
- Remnant systems; use of remnant stock and incorporate genetic material from closest geographical strain.

  Considerations of gamete gathering:
- What happens when low numbers of females are gathered for collections, or if only one female is caught? Concerns with obtaining numbers of males and females.
- Use of maximum available genetic material
- Consistent multiple year class stocking to increase diversity of spawning populations.
- Use of models/simulations to evaluate what will be optimal stocking numbers to achieve population goals and to determine probability of post-stocking success.

3) Where, what lifestage and when to stock?

   Egg stage;
- Hardest to keep alive
- Cost benefit, low cost
- Highest probability for imprinting
- If new spawning area is being built, might be best way to stock system.
- Survival questions, is it lower than other stages, uncertainty of putting money into this type of stocking.

  Fry stage;
- Low cost benefit
- Possible imprinting benefit

  Fall fingerlings;
- 5 – 6" range, much higher survival pre and post stocking.
- Cost is getting higher to raise fish to this stage
- Possible need for acclimation to system for higher survival rates, and how long for acclimation, day, week?
- Diet considerations, are the hatchery selection for stocking leaning towards fish that will eat only dry food, and loosing the "good" eaters that like natural diets?

  Yearlings;
- 8 – 12" range, higher survival rates
- same considerations as fall fingerlings

  Adult;
- cost associated with relocation/transfer may be lower or higher than previous lifestages, depends on locality, availability of adults to be transferred/relocated, manpower available
- Possible less time to assess spawning success if adults use habitat available and fish are stocked in condition ready for spawning.
- Overall cost increase and imprinting benefits decrease as you go down list
- Larger fish are easier to mark and tag to follow how they act in the system, possibility for movement studies
- Is it possible to have captive stock for stocking. Most likely cost prohibitive due to time investment for obtaining gametes. Also, worries of density issues in hatcheries, possibility of deformities.

4) How many and how long to stock?
- What type of habitat to assess for stocking, and number of each lifestage wanted in each habitat.
- Number of individuals needed for stocking into system. Example used was Wisconsin, recommended minimum stocking of fall fingerling at stocking rate of 80/river mile and 1 per 2 mile lake circumference, yearling at 40/river mile and 1 per 4 mile lake circumference.
- Base numbers per area recommendations on "healthy" populations, either in literature or in geographic area.
- Computer modeling to estimate survival data to determine size of spawning population
- Overall, stocking rates specific to each system to be stocked.

- Determination of stocking length dependent on source of gametes, funding available. Need to realize this is long term stocking, minimum of 20 years to see fish return for spawning.
- What is "established" population? One pair, twenty pair, how many different year classes of different lifestages needed?
- Regulation concerns, who regulates and at what level? Same for stocking, who does it? State, Federal and/or tribal agencies, partnerships with private aquaculture?
- Assessment after reproduction is established. Is there a need to assess if individuals you see spawning are actually the individuals you stocked.

Group 4 Facilitator: Rob Elliott
Participants: Adam Kowalski, Moira Ferguson, Chet MacKenzie, Steve Schram, Alexandre Litvinov, Gene Mensch, Jerry Weise, Tim Haxton, Frank Lepera, Michel La Haye

1) *What is the goal of stocking?*
   A. Produce a self-sustaining population (top priority)
   B. Provide a fishery
   C. Prevent extinction
   D. Restore community dynamics
   E. Increase our understanding of lake sturgeon biology (research)
   the above entail very different considerations

2) *What should be considered before stocking (i.e. why/why not stock)?*
   A. Know historical and present status of population
      - were they present historically?
      - are they extirpated?
      - if remnant, what is population status including genetic characteristics?
   B. Quantify availability of suitable habitat for all life stages
      -amount relative to historic conditions
      -includes physical, biological, and ecological habitat: know requirements
      -need to know requirements prior to increase likelihood for success
   C. Proximity of other populations
      (1) Likelihood of repopulating on own
      (2) Detrimental to nearby population
   D. Availability of donor stock
      (1) Size (should not impact donor population)
      (2) Genetics
      (3) Proximity
      (4) Similar system
      (5) Effective genetic population size
   E. Protective regulations in place
   F. Recovery plan in place that includes Evaluation Schedule
      -have goals identifies
      -identify when to stop/change
      -important because process may continue longer than biologists career
   G. What lifestage is needed/best?
   H. What is the carrying capacity of the system?
   I. Long-term commitment of funding and personnel is needed

3) *Where, what lifestage, and when to stock?*
   Determined through completing process identified in #1 and #2 above

4) *How many and how long to stock?*
   Determined through completing process identified in #1 and #2 above.

Group 5 Facilitator: Trent Sutton
Participants: Betsy Trometer, Bill Gardner, Scott Koproski, Julia Froschauer, Roger Gordon, Rod McDonald, Jay Woiderski, Brad Eggold

The group addressed the four guiding questions listed on the bottom of the handout describing the session.

1) What is the goal of stocking?

Several potential goals were listed. These differed by lake/basin vs. inland.
They are in no particular order.

a. Maintaining ecosystem diversity
b. Provide a base for a sport fishery
c. Rehabilitate a extirpated or remnant population to a self-sustaining population
d. Maintaining current genetic strains
e. Allow a harvest component for a recreational fishery
f. Native species preservation (natural biodiversity)
g. For public relations, education and outreach

2) What should be considered before stocking (i.e. why/why not stock)?

a. Last resort
b. Does a self-sustaining remnant stock exist
c. Why a remnant population (habitat, poaching, harvest)
d. The source of the stocked fish
e. What is the effective population size of remnant stocks
f. What is the best age to stock
g. Public relations
h. Develop criteria to follow to make a decision whether to stock (i.e. a dichotomous key)
i. Economics, can we afford to stock
j. What is the available habitat
k. Interspecific interactions, especially with threatened and endangered species
l. Interactions with sea lamprey treatments
m. Should include a marking component to the project
n. Source of funding
o. Develop a rehabilitation plan

3) Where, what lifestage and when to stock?

a. Depends on goals of stocking program (rehabilitation, create a fishery)
b. Difficult to determine due to lack of information
c. When does imprinting occur
d. Select the earliest life stage that you can get a return from \
e. Marking evaluation (live state)
f. Raise egg hatch on water system for imprinting for a short time, raise to larger size at hatchery, then restock in water system
g. When have best survival during transport
h. Acclimatize in cages before releasing
i. Day vs. night stocking (may have better survival of stocked fish at night)

4) How many and how long to stock?

a. count on a long-term commitment (15-20 years)
b. depends on life stage stocked and available habitat, depends on economics/logistics, genetics, biological constraints (eggs availability), how long politics, goals

Group 6 Facilitator: Marty Holtgren
Participants: John Weisser, Liz Hay-Chmielewski, Kim Scribner, Terry Lychwick, Steve Fajfer, John Pagel, Chris Vandergoot, John Fitzsimmons

1) Self sustaining populations
   To re-create a population
2) Genetics
   Equivalency
   Habitat for all life stages
   What do commercial fishers think? Supportive?
   Impacts of imprinting
   Follow-up assessments
3) If imprinting- at what stage
   - stock before then

   Take larval fish from a system- take to a hatchery and raise to a larger size- release back to stream of origin
   Stock fingerlings to avoid water quality or other issues
   Raise eggs-fry at a mobile on-site hatchery unit
4) Hatchery production
   Number of fish available to use
   Minimum one generation, may in reality need to be longer
   Stock eggs, fry, and fingerlings in same system, same year

Group 7 Facilitator: Emily Zollweg
Participants: Brian Gunderman, Steve Hogler, Mike Thomas, Doug Peterson, Konrad Dabrowski, Andy Edwards, Jeremy Pyatskowit, Tom Pratt, Mike Gilles, Sue Greenwood, Dan Daugherty, Bruce Manny

Final Summary

1) What is the goal of stocking? (priority order)
1. Enhance survival of existing wild populations
3. Re-establish self-sustaining populations where extirpated
4. Establish a fishery (put-grow-and-take)

2) What should be considered before stocking (i.e. why/why not stock)? (priority order)
1. Consensus planning process/decision tree that is science-based
2. Maintain genetic diversity of existing remnant stocks
3. No measurable or very little recruitment
4. Availability of suitable habitat for all life stages
5. Importance of sport fishery/cultural use
6. Contaminant burdens

General discussion

Considerations:
Match hatch- use gametes from same system when possible
Reintro vs. supplemental
How many fish is a remnant population?
Unique spawners to a location
Complicated by dispersal
Resilient/adaptable species!
Physical habitat availability
Degree of isolation

Site fidelity
Not stocking- preserve habitat, help remaining fish
For stocking- immovable limitation, stocking could help
Life stage
Effective breeding pop'n
Overstocking
No "blanket" stocking
Fix habitat first if few fish there
Fix habitat later if no fish attempting spawning
Need to mark stocked fish

Criteria to stock
To increase numbers- to fill niche where sturgeon had important ecological function
Where no successful recruitment- multi years (≈5)
Good habitat avail. for all life stages
Presence of contaminants- body burden of stocked fish
Where exploitation is controlled
Cultural importance
Long term stakeholder support, patience
Wisconsin Success- 50 years of management 3rd Symposium

When to stop stocking
#'s of adults
#'s of subadults
measurable recruitment
annual stocking or every 2, 3, 4, 5 years?
Gaps in stocking can be useful to assess natural reproduction
When see reduced growth rate

Life Stage
Fry/eggs- hard to mark
YOY/age 1- can be marked
Imprinting- use younger stage where shorter distance to barrier
- use mobile hatchery

Group 8 Facilitator: Nancy Auer
Participants: Jonathan Pyatskowit, Adrian Spidle, Jim Waybrant, Jennifer Hayes, Alastair Mathers, Marilee Chase, Larry Robichaud, Gil Archambo, Mark Gaikowski, Jim Snyder

Priority Questions:

1) Is there a population size genetically speaking that is too low and would stocking fish alleviate this situation?
2) What is the goal of stocking (i.e. create a fishery or a self-sustaining population)?
3) Is genetic fingerprinting a method of assessing spawning success (i.e. is the remnant population spawning or are stocked fish reproducing) and is it an alternative to other marking methods?

Group Discussion Points:

1) Why stock
    a. Is population too low (use stocking to increase genetic variation)
    b. Don't stock because sturgeon life history promotes genetic diversity and population rebounds
    c. Ontario – stocking used for rehabilitation
    d. New York State – has had indiscriminate stocking
    e. Because it is cheap, easy, and a public relations plus
2) Goal of Stocking
    a. Genetic refugia
    b. Population rehabilitation
    c. Create a fishery – public/politically driven
    d. Self-sustaining population – biologically driven
3) Alternatives to Stocking
    a. Transfer of adult fish if "upper" system still contains habitat – impounded systems
    b. Sit and wait – see if remnant populations rebound on their own or if fish stray into favorable habitat
    c. Enforcement to stop poaching (Black Lake, Michigan) – stop all harvest (regulations)
    d. Egg stocking upon new habitats to promote the use of new habitat through imprinting
4) Concerns of stocking
    a. Assessment before stocking
        i. System has to support sturgeon at all life stages (i.e. adults that return to spawn in 15-20 years)
        ii. Are there any fish there now and are they successfully reproducing
    b. Assessment after stocking
        i. What constitutes success
    c. Need to be able to identify stocked fish (marking, genetic fingerprinting)
    d. What life stage to stock
    e. Imprinting
        i. do we know enough about this in sturgeon
        ii. imprinting study may be unrealistic in light of time frame and funding (may need to be studied by academia)
    f. Are stocked fish going to return (get a return for effort)
    g. What is a genetically effective population size – how many to stock
    h. Is there spawning site fidelity
        i. Straying
        ii. Positive returns for effort
    i. What fish to stock (strain)
    j. Egg stocking potential - inexpensive but how to evaluate its effectiveness (can't mark eggs)
    k. Don't stock over an existing stock
    l. Where to stock
        i. Most often easiest access
        ii. Depends on goal of stocking (fishery vs. self sustaining)
    m. How long to stock

Time to stop stocking is when the goal is reached therefore need an effective evaluation within a given time period

Group 9 Facilitator: Tracy Hill
Participants: Doug Carlson, Mark Coscarelli, Stephanie Ogren, Loren Miller, Scott Zajac, Eric Volkman, Tom Mosindy

1. Reasons for Stocking (goal)
    - Development of a fishery
    - Restoration of historic populations (self sustaining)
    - Aesthetic benefit to the public of still having the fish around, even when the population must be maintained by hatchery replacement (tribes)
    - To add biodiversity to a depleted broodstock that has been restricted to a narrowed gene pool

2. Considerations prior to stocking
    - Do you know whether there is recruitment
    - Do you know whether spawning habitat is still present
    - Do you know whether there is adequate long term planning and funds to carry out the program
    - What will be the ramifications to other populations (disease)
    - What is public opinion/ramifications
    - Have all the governments or publics been informed
    - Does the stocking plan fit with a long term management plan

3. What size or life stage to stock
    - Discussion of portable hatchery (solve imprinting and transportation issues) and challenges to developing one
    - Imprinting does not seem critical
    - Adult female transfers might be beneficial in some instances to enhance gene pool
    - Late fingerlings have been commonly used

4. How long to stock
    - Certainly more than 5 years perhaps not more than 10 need to recognize the 20+ years between generations

5. Other benefits of hatchery stocking
    - Provide genetic refugia
    - Preservation of gametes

Technical Session 2:
Consideration of Assessment Techniques to Determine Status

Group 1 Facilitator: Mike Thomas
Participants: Glenn Miller, Amy Welsh, Doug Carlson, Tom Meronek, Trent Sutton, Stephanie Ogren, Jerry Weise, Maureen Peltier, Marilee Chase, Eric Volkman, Josh Lallaman

1) What techniques/methods will work best and in what types of environments?

Juveniles (larvae → age 5)

A. Drift nets – larval sturgeon
B. Seines
C. Dip nets
D. Visual surveys (wading or drifting)
E. Small mesh gill nets (0.5-1.25" bar; 1-2.5" stretch)
   (1) Bycatch varies; less in 1" stretch
   (2) Set parallel to the current
   (3) Set off sandbars
   (4) Set by deep holes
F. Not real mobile; hang out in the same area
G. Electrofishing – not successful
H. Setlines – not successful
I. Visual wading surveys best (night)
J. Trawls
K. Monitoring commercial fishers

Adults

A. Large mesh (8-14" stretch) gill nets
   (1) Mono- or multifilament
   (2) Work well in areas with little current
   (3) Work in areas with high flow, but have to clean them out
   (4) 12" mesh good – not missing many spawning adults
B. Setlines
   (1) Not successful
   (2) Sturgeon not feeding at spawning time(?) so they probably are not going to take setlines
C. Electrofishing
   (1) Catch fish too large for gill nets
   (2) Some evidence of delayed adult mortality
   (3) Used by Wisconsin DNR
      a. Multiple boats involved
      b. Targeting non-spawning fish (not during spring)
D. Telemetry - used to locate spawning areas
E. Video telemetry (weir)
F. Visual searches – dip nets
   (1) Need low flows
   (2) Experience important
G. Egg mats – will tell if spawning has occurred; presence/absence
H. Trap nets – open lake sampling

2) What details are important to success?

Juveniles

A. Don't know where to begin (location-wise)
B. Where are they going?
C. Timing and location
D. Record failures as well as successes

Adults

A. Areas of river selected; incorporating local knowledge
B. Visual searches difficult in high flows
   (1) Watch for tails, fins, and movement
   (2) Experience is important
C. Multiple boats for electrofishing
D. Consistency

3) When and how long to sample (adequate effort, timing)?

Juveniles

A. Can take a long time to stumble upon these (small localized areas)
B. Short window of opportunity for drifting larvae
C. Set at night for five to six hours → larvae
D. Age 0: out-migrate when water temperature fell to 12^{o}C (Peshtigo River); maybe older fish moving in at that time
E. Fall congregations

Adults

A. Effort levels vary; four to five days per week (March-June)
B. Will leave nets in 14-15 days at a time; check once per day
C. Consistency is important
D. Sample during upstream and downstream movements
E. Night sets usually more productive
F. Issue of debris of mixed importance
G. Paired sets – parallel
H. Sturgeon pretty hardy in nets - low mortality
I. Monitor temperature to determine when to sample (8^{o}C to 20^{o}C)
J. Tribes – sample by aspen trees
K. Some evidence of overwintering (may be able to collect data in the fall)

4) What biological data to collect and how (size, age, sex, numbers, tagging, etc.)?

Juveniles

A. Habitat important → know little about this
B. Substrate samples for food habits
C. No gonad exam
D. Larvae
   (1) Size
   (2) Whole fish for genetics analyses
   (3) Yolk sac length

Adults

A. Size, age, sex, numbers, tagging
B. Visual examination of gonads
   (1) Spawning vs. non-spawning fish
   (2) Every fish larger than 110 cm
C. Gonad samples from harvested fish
D. Genetic samples

E. Wounds and abnormalities
F. Weight and girth
G. Pectoral fin ray samples for age determination
H. PIT tagging
    (1) Who has equipment to detect tags?
    (2) Insertion in consistent places
I. Physical characteristics of rivers - habitat

5) What standardization is important for comparison among systems/studies?

<u>Juveniles</u>

A. Same as adults (see below)
B. Drift nets
    (1) Velocity
    (2) Length
    (3) Height
    (4) Area
    (5) Numbers
    (6) Substrate
    (7) Depth
    (8) Time fished
C. Standardization hard because there is lots of variability
D. Standardization of visual searches
    (1) Length
    (2) Time searched
E. Standardization more important for within study consistency than for comparison between studies

<u>Adults</u>

A. Standardization of net lengths, sizes, time, height (gear size, length)
B. Setlines
    (1) Bait
    (2) Number of hooks
C. Consider target of assessment in conclusions
D. Similar to CPUE
E. Importance
    (1) Literature comparisons
    (2) Basin-wide assessments of population status (including bi-national comparisons)
F. PIT tag placement (hard to standardize because of different uses of fish)
G. Measurements (total length vs. fork length)
H. Tag types (encrypted PIT tags)
I. Physical characteristics and habitat data

Additional Questions

A. Is it worth sacrificing larvae for genetic samples when abundance of larvae is low?
B. Is it worth sacrificing juveniles for diet samples when abundance is low?

Group 2 Facilitator: Henry Quinlan
Participants: Andrew DeWoody, Roger Greil, Harold Michon, Jim Waybrant, James Jackson, Bruce Manny, Daniel Parker, Dan Daugherty, Nate Bigboy, Stephanie Carman

Spawning Adults

Assessment Techniques

- Begin with pre-assessment information collection
    - Is there spawning habitat present
- Determine timing of spawning run
    - Monitor water temperature (spawning generally reported between 12-17 ^{o}C)
    - Observe lunar cycle – full moon signals start of spawning and peak occurs shortly afterward
    - Aspen leaves emerge about time of peak spawning
- Identify staging areas – typically deep holes in rivers
- Gather information from anglers and locals in area
- Telemetry studies can be very useful for determining where and when fish aggregate
- Egg traps/mats can be used to confirm spawning sites and determine density (#/m2)
    - Traps set for specific time period and checked at regular intervals
- Visual observation

Large Interconnecting Channel

Set lines - (group members had varied experiences) – some had success during spawning run with salted baits, others had not been successful during the spawning run
Set lines captured sturgeon by snagging when set in areas of spawning
Large mesh gill nets (8-12" stretch)
Divers / visual observation
Can lead sturgeon with trap net style lead to shallower waters for visual observation
Underwater stationary video camera

Medium to Small Rivers

Wading with dipnet and by hand
Electroshocking – some disagreement on suitability for spawning fish
Video – mounted over small rivers to record adult movement
In stream camera/video
Visually
Hydroacoustics seems to have potential
Large mesh gill nets (8-12" mesh)
Trap and Pond nets (latter found to be more successful)
PIT tags with remote / automatic reader
Telemetry both ultrasonic and radio

Details for Success

- Techniques tend to be rather site specific (for example, gill nets in systems with a lot of flotsam don't remain upright or clean)
- Strive to develop standardized technique at all sites
- Use gill nets at mouth of rivers or in lower reaches – may sample fish not spawning
- J-set or brassiere style set have been effective for out migrating sturgeon – out migration likely to occur over shorter time period than upstream movement which can be prolonged.
- Spawning run may last for many weeks/months so should sample for multiple years

Depends upon the goal? Group decided to focus on determination of annual run size.

- Sample every year for full reproductive cycle (4 to 6-7 years) or until start getting recaptures

- Suggest focusing on the number of spawning females – since some males in run spawn and others don't (analogs to jacks) the number can be misleading
- Egg collection has great potential and several benefits, 1) Can measure egg density on egg standard sized traps/mats, 2) genetic analysis of fertilized eggs collected can provide precise info on the number of females and males spawning, 3) adults aren't captured and handled during stressful and critical spawning period, 4) can be relatively simple to deploy and retrieve
- Multiple runs are problematic for sampling – there is potential for early and late run "strains"
- Important to identify all spawning sites in the river system

<u>YOY – Age 5</u>

Assessment Techniques

- 8-25 mm: Larval drift nets effective for sturgeon - fished at night during May and June about 7 days after spawning
- 50 mm to roughly 150 mm:
    - seine from late June through September – suggest trying tickler chain to improve success
    - visual observation: wading during daylight (early morning generally has calmest conditions), use of spotlight at night and focus on eyeshine
    - trawling has been effective for sturgeon 65+ mm to adult during daytime
    - bagged set gill nets (1" mesh) effective at variety of depths – target slope at head and tail of islands
- 1-5 years
    - trawl – lower reaches of rivers (index with standard locations and time of year)
    - small mesh (4.5" mono) gill net fished off river mouth during July – August catches sturgeon as young as ages 3 or 4+
    - set line with #1 or 2 hooks baited w/ nightcrawlers
    - Index sampling for natural recruitment or for stocking evaluation important to do annually - a sample design of 1 week per month would provide excellent data set
    - Telemetry can be use to determine index sites – short battery life is problematic

Question: When is year class strength determined?

- Some in group suggest that after sturgeon reach 4-6" survival is high
- Fall of first (YOY) season or early in yearling stage
- Lack information on predation on sturgeon young, parasites and other sources of mortality

Group 3 Facilitator: Sue Greenwood
Participants: Nate Caswell, Doug Peterson, Andy Edwards, Steve Schram, Scott Zajac, Jeff Eibler, Charles Hendry, John Pagel, Jay Woiderski, Bruce McGregor

Adult Assessment

Large River/Small River –Difficult to define- methods will be based on the situation at hand

1) Weirs - count individual fish
    - handle
    - temporary
    - small rivers
2) Trap nets/Gill nets/Set lines - mark/recap
    - index abundance
3) Seines/ Gill nets/Dip nets/Hands- M/R
4) NOT Electrofishing
5) Hydroacoustics - count fish
    - movements
    - no handling
    - size
6) Visual – count (can use lights)
7) Other sources of fish – anglers

Note: Connecting waterways

Resident/Non resident
- difficult to get population estimate
- Assess spawning sites
    - Side Scan Sonar
    - Broad river-wide assessment

River Mouth
- highly variable
- similar to move upriver

Open Water (shoals) (connecting waterways)
- visual assessment
- camera

Details for Success

1) Preplanning- basic study/experimental design
2) Know environment
    - velocity, turbidity, depth, potential for bycatch, temps
    - angling, other agency, commercial activity
3) choosing appropriate gear
    - may be a learning process
4) appropriate manpower/ safety precautions
    - physically capable

Sampling

1) Spawning run assessment
    - be on site in advance
        - don’t depend only on temp
        - other factors help trigger
    - Follow pop’n spawning cycle
        - Min. 3-5 years
        - Recommend 5 years
        - Prefer >7

Biological Data

Handling fish- discourage anesthesia

- Maximize opportunity
  - Sex/reproductive condition
  - L/W, etc.
  - Genetic sample
  - No diet on spawning fish
  - Pectoral fin section

Tagging

- 2 tags
  - PIT- researcher
  - External – for other people

Standardization

- Standardize information
  - Reporting statistics
    - Sex ratios, age- structure- fin ray, genetic data, physical data
    - Report number of spawners/runners
- tag placement/type

Juveniles

River + Open water

- Adult capture methods
- Larval nets
- Trawls
- Electrofishing
- Short-term M/R of stocked fish
- Assess natural reproduction

Details

- needs to be juveniles present
- know where they are
- similar planning as for adults
- age class targeting

When

Fry- during/post spawn

- multiple year min 3-5, 5-7 better

Bio Data

Fry – estimate production

- effort expended – across agency comparison
- physical data collection

YOY (age 0 juveniles)- all but sex + age

- may be able to tag – smaller PIT, scute removal

1+ to 5 years

- no sex
- age – length freq. histogram

** Research Question- when does a juvenile recruit??

Data requires standardization

- start with GLFC- link to permitting rules/process

Group 4 Facilitator: Alastair Mathers
Participants: Rob Elliott, Loren Miller, Brant Fisher, Neal Godby, Julia Froschauer, Cynthia Roy, Ed Desson, Rich Quintal, Gil Archambo, Kyra Fillmore, Mark Gaikowski

1) What techniques/methods will work best and in what types of environments?

Adults – Small Rivers

I. Video camera and weir in shallow water to constrict and visually record movement
    (1) Eight hour or 24 h tapes (1 h to review)
    (2) Weir = welded wire fence (cleaning easy)
    (3) Area covered by camera = 10-15 ft
    (4) No disturbance
    (5) Need a power source
    (6) High flows can wash out weir
    (7) Fish must migrate close to spawning – early migrants might be missed
    (8) Requires clear water to see white counting board
    (9) Length estimates possible
    (10) Fish taped moving up and down
    (11) Risk of vandalism
    (12) Works well on the Black River (width =~150')

J. Dip nets
    (1) Best at night – eyes shine
    (2) Start downstream and move upstream
    (3) Catch males first, then females
    (4) Use 0.25" soft mesh and 7' long sock

K. Hydroacoustics
    (1) Good for stained water
    (2) Refine technique to automate

L. Remote PIT tag reading of migrants

M. Seines
    (1) Need shallow water
    (2) Can use in combination with dip nets

N. Electric seines??

O. Gill nets
    (1) Slow-moving waters
    (2) Off river mouths

P. Electrofishing – danger to fish?

Adults – Large Rivers

A. Gill nets
    (1) Use multiple mesh sizes (8-14")
    (2) Set late at night and lift early in the morning
    (3) Can catch lots of carp in 8" mesh
    (4) Problems with drifting debris
    (5) Safety and expertise a big issue
    (6) Very size selective

B. Trammel nets (same as gill nets)

C. Setlines
    (1) Low mortality if maintained regularly
    (2) Can use salted sucker heads as bait

D. Trawls (substrate important)

E. Large pound nets near river mouths to collect fish coming and going
    (1) Need expertise and equipment

F. Remotely-operated vehicle and divers
    (1) Labor intensive and expensive

(2) No biological sampling
(3) Need to be out every day
(4) Only cover a small area
(5) Could be remote and with laser for size measures

G. Hydroacoustics
H. Electrofishing – BUT needs to be standardized (chemical/conductivity conditions) and proven to be a safe practice to be useful without damaging the fish
I. Open water spawning
   (1) SCUBA divers after visual observation
   (2) Similar techniques to large rivers
J. Getting abundance estimates requires the ability to count a large proportion of the fish or lots of sampling and tagging for mark-recapture work

<u>Juveniles</u> (larvae → age 5)

L. Drift nets – larval sturgeon
   (1) Stationary frame net or anchored drift net
   (2) Sample between dusk and 2:00 am
   (3) Set nets within 0.5 miles of the spawning grounds
   (4) Less effective in large rivers (a volume issue)
      a. Small percentage of river sampled
      b. Likelihood of capture decreases as river size increases
M. Visual dip netting (most effective at night with spot lights – reflect off sturgeons eyes)
N. Trawl
   (1) 18' boat
   (2) Variable catches – reasons unknown
   (3) Large rivers only
O. Graded-mesh gill nets
P. Electrofishing
   (1) Backpack or boat
   (2) Low success rate
   (3) Need to determine safe techniques (if they exist) and standardize
Q. Setlines
   (1) Use #6 hooks for YOYs
   (2) Bait = nightcrawlers or salted sucker heads
R. Hook and line sampling
   (1) Use small hooks
   (2) Bait = worms

2) *What details are important to success?*

See above

3) *When and how long to sample (adequate effort, timing)?*

Life history and small abundance often requires long period of assessment – 5+ years

4) *What biological data to collect and how (size, age, sex, numbers, tagging, etc.)?*

A. How?
   (1) Keep fish in water
   (2) Handle carefully
   (3) Use cradles
   (4) Weigh in sling
B. Pectoral fin ray
   (1) Remove 1 cm piece ~1 cm from the knuckle
   (2) Don't take during the spawning run
C. Make sure you need the age/sex data before you take it
D. Routine tagging and tissue samples
E. For very small populations:

(1) No need to sample anything (leave them alone)
(2) Won't be able to describe anything anyway

F. Measurements
(1) Total length
(2) Fork length
(3) Girth
(4) Commercial length?
(5) Weight (supported in sling)

G. Parasites

H. Marks/wounds
(1) DELT (deformities, erosions, lesions, and tumors)
(2) Data registry of tumors in lower animals

I. Sex – take a peak

5) What standardization is important for comparison among systems/studies?

A. All collect the same data
B. Impractical to standardize gear/techniques due to such wide differences in river systems and techniques that will work

Group 5 Facilitator: Terry Lychwick
Participants: Tracy Hill, Pat DeHaan, Doug Aloisi, Chet MacKenzie, Konrad Dabrowski, John Seyler, Frank Hardy, Larry Robichaud, Scott Koproski, Frank Lepara

Small Tributaries

- Large mesh gillnets (multifilament 8,10,12" stretch) 150' long 6' deep
- Trot lines don't seem to work, why
- adults can be captured in rivers during spawning by hand with large dip nets

Large Tributaries (connecting waterways)

- Set lines two night sets in systems with low abundance of sturgeon
- Each system seems to have a specific bait
- Fish will hit baits prior to spawn when incidence of snagging occurs set lining is halted
- 300' lines with hooks spaced 10' apart 10/0 hook size
- honey holes or spot on the spot for both gillnets and set lines produce 90% of the fish, moving sites around can help you catch more fish
- electrofishing is a potential hazard for adult fish
- gillnet selectivity is an issue more data is needed
- most gillnetting is done with short sets
- egg traps can be used to indicate adult presence

Lake

- adults commercial trap nets 4.5" 25-40' tall, peak catch in Oct. and April
- bottom trawls peak catch in July-August

Important Details

Gillnets

- closer to the spawning site the higher the catch
- direction of set with relation to the current flow doesn't seem to matter
- key: spot on the spot locate the microhabitat
- mesh size should be > 8" to avoid by catch
- Start setting at 10 C, when temps hit 15 C or greater usually pull out

Set Lines

- Each system (large river) has a specific bait that will capture fish
- Salted bait has worked in some areas
- Two night sets are used in systems with low abundance of sturgeon, no mortalities have been recorded
- Re-bait with fresh bait everyday

Electrofishing
- 2 boats are most successful
- turbidity is key

How long
- commit to 5 years or more for determining presence absence
- one complete spawning cycle for spawning populations (5-7 years)
- big concern is the large variation in the number of fish from year to year, this is especially important for estimating abundance

Biological data
- collect as much as possible
- data collected should be standardized
- tags used should be standardized (PIT)

Standardization
- tagging
- wound ID
- data format
- genetics

Juveniles

Small tributaries
- small mesh gillnets 1-16 year old fish
- 1.5 to 4" stretch mesh, 7-8 meters of water
- visual observation
- drift net (larvae)

Lakes
- commercial gillnet targeting yellow perch
- 2.5" stretch mesh
- some limited catch in the trap nets

Huge knowledge gaps exist with the juveniles of this species. This is a big concern and much work is needed to fill these gaps.

Most of the points made for items 2-5 on the adult assessment holds for the juveniles

Group 6 Facilitator: Tim Haxton
Participants: Emily Zollweg, Ed Baker, Gene Mensch, Jeff McLeod, Adam Kowalski, Michel La Haye, Steve Fajfer

Spawning Adults

Techniques/Methods- Types of environments

Gill netting- too intensive- Try 8", 10", 12" mesh- use spreaders in fast current
- peak catch at dusk to midnight, set parallel to current

Observation of jumping- good indicator
To confirm spawning grounds- need to catch eggs
Set lines
Electrofishing- not effective, can kill them
Shallow – dipnet
- noose on pole- catch by tail

Deeper – scuba divers

Details

Do observations and habitat survey first, then sampling
Ask at bait stores, ask anglers
Open mind

When and how long to sample

Go when apple tree blooms
Earlier rather than later
Use water temperature cue 7-8C go look, 10-12 but up to 16-20C if hydrograph is wrong
Descending hydrograph
Until they are done- catching only runners
Check gender w/incision and tool
Adequate effort- at first cover lots of ground w/lots of gear
- more refined after spawning grounds identified

Bio data and how

Every fish is tagged- Floy + PIT
FL, TL, weight, girth, scars and marks, gender (biopsy), genetics sample- fin clip (1cm), barbel clip (1cm)
Keep fish in water as much as possible
- don't hang by tail
- don't turn on back

Pectoral rays- new pop'n yes, but if stable pop'n don't

Standardization

Gear
Data analysis
Habitat characteristics
Effort- consistent methodology
Data collection
Tagging
Observations, field notes v. impt.

Juveniles

Techniques/Methods

Setlines- 16 hrs or every other day- perch size hooks 2/0
Gill nets- experimental ½"to 4", 1" to 4"- overnight

Electrofishing
"Finland Net" for YOY (regular size experimental but ½ as high- 0.75m tall)
Trawl
Visual observations
Dip nets, smelt nets
Shore seining- shallow water at night maybe
Pools and slopes, front of islands
Trap nets not v. effective

Details impt for success
Sample intensively/extensively for a few years
Cover all habitats- stratify sampling
Then concentrate on successful areas
Take habitat data also
Advance planning

When and How long
Aug/Sept/Oct congregate- YOY bigger to catch then
Small rivers- during low flows
Near barrier
How long depends on habitat and funding
Stop when Oct winds start

Biological Data
TL, FL, weight, tag (PIT), scars/wounds, tissue sample
Diet

Standardization
Habitat characterization
Same as adults

Group 7 Facilitator: Moira Ferguson
Participants: John Weisser, Mike Plucinski, Jeff Allen, Mark Coscarelli, Dave Tremblay, Mike Gilles, Marc Gendron, Marty Holtgren, Chris Vandergoot, Roger Gordon

Adults:

1. Review of historical information – elders, fisherman, locals
2. Understand environment: (8-12 C, velocity, substrate)
   - -habitat
   - -water flow changes
   - -hydro dams and safety
   - -hydro outcome recommendations (possibly FERC Agreements)
   - -Site visit – maps – roads for access
3. Select gear at the time based on conditions
   - Visual observation
   - Gill nets: 8-10-12-14 mesh size
4. Sampling
   - Minimum of 1 month
   - 1-3 months on more complex systems
   - time over years (5+)
5. Replicate approach

Larva/Juveniles YOY-5 years:

1. Same as above for adults
2. Same as above for adults
3. Gear:
   - -Smaller mesh experimental gill nets
     - perpendicular to current
     - modified 1.5’ high by 100’–150’ long
     - hanging ration = 25%
     - overnight sets
   - -Visual observation
   - -Telemetry for especially rare fish
4. Length of time
   a) sample on feeding habitat based on budget
   b) entire season
5. Common measurements – conductivity, temp, substrate, flow

Recommendations:

1. data base
2. test hear in systems with fish
3. deal with hydro companies regarding water flow

Group 8 Facilitator: Jonathan Pyatskowit
Participants: Nancy Auer, Kim Scribner, Steve Hogler, Doug Cox, Bill Gardner, Larry Kallemeyn, Tom Mosindy, Michele Bérubé, Angela Benson, John Fitzsimons

Spawning Adult Assessment

Group Discussion Points:

1) Techniques/methods – Depends on goals of project and system size and location
    a. Dip nets – small rivers
    b. Electro-fishing – possible damage to fish need evaluation
    c. Telemetry – is there movement/separation of populations
        i. Data loggers
    d. Gill netting – prior to spawning – tag fish can be identified on spawning ground
    e. Camera counting or automated PIT tag counting – confined passage
    f. Weirs – to guide and direct fish
    g. Hydroacoustics
    h. Scuba – whole club to cover river
    i. Trawling
    j. Trotlines and setlines – may not work for spawning/non feeding fish)
2) Details Important for success
    a. Meta populations vs. smaller ones
    b. Site fidelity – use traditional knowledge to help locate (First Nations Peoples)
        i. Spawning areas may change with changes in flow
    c. Use telemetry to find areas used for spawning
    d. Need a way to differentiate fish that use different sites
    e. Gill netting for short periods (1 hour)
        i. Some overnight sets seemed okay – Pic River
        ii. Concern for interruption of spawning with longer sets
    f. Use a brand to visually id fish on site each year
    g. What are the impacts of any sampling on the spawning fish (disruption of spawning a concern)
3) When and how long to sample – adequate effort and timing
    a. Sample through generations (full female cycle)
    b. Timing by "run" – temperature and flows important
        i. River mouth sampling – need to start early enough and continue long enough to sample the "run"
4) Biological Data
    a. Determine reproductive condition (incision, gamete expression)
    b. Fork and total length
    c. Tags or brands to id fish
    d. Tissue samples for genetics
    e. Possibility to sex fish using a blood sample
5) Standardization
    a. Base on system size
        i. Large rivers
        ii. Small rivers
        iii. Lakes
    b. Databases
        i. Forms and reporting
    c. All researchers use coded wire tag reader
    d. Color code tags by river
    e. Assign frequency ranges for telemetry
    f. PIT tag location
6) General questions
    a. Need more quantitative ways to assess abundance to get better standard deviation

   b. Does electrofishing affect either eggs or the spawning act
   c. How do we assess the actual impacts of assessment and biological data collection (aging data – especially fin ray removal) on spawning fish

Juvenile Assessment

Group Discussion Points:

1) Techniques/methods
   a. Gillnet (1" – 3.5") – within lakes
      i. More mortality with monofilament and deeper sets
   b. Spotlights
      i. Need shallow clear water (<3')
   c. Trawling – effort intensive and need clear waterways
   d. Electrofishing
   e. Set-lines – need to know season and place
2) Details important to success
   a. Location
      i. Sand beaches
      ii. Sand on Wolf and Peshtigo rivers
      iii. Silt in the St. Lawrence River
   b. Bait preference for set-lines
      i. Nightcrawlers worked best in Sturgeon R. system (Portage Lake)
   c. Hook size
   d. Gillnet mesh size
   e. Diurnal patterns – often more effective at night
3) How long and when to sample – adequate effort and timing
   a. Varies with system and abundance of fish
   b. Depends on goal – presence and absence vs. estimates
4) Biological Data
   a. Tissues for genetics
   b. Determine sex from blood samples
   c. Tagging
      i. PIT over 150mm – Peshtigo River
      ii. Floy tags
   d. Length
   e. Aging vs. disruption trade off
5) Standardization
   a. Mostly qualitative right now so cannot really compare – need more quantitative
   b. Use of decision tree
      i. River – use visual surveys
      ii. Lake – use gillnets and setlines
   c. Depends on size of system and system characteristics
   d. Database – records and forms
   e. DNR and FWS – use same tags and color code by river or water body
   f. Telemetry – cross agency effort – assign frequencies and share effort
   g. PIT tag in same place and get all researchers tag readers

Group 9 Facilitator: Jim Boase
Participants: Betsy Trometer, Adrian Spidle, Brenda Archambo, Rod McDonald, Jennifer Hayes, Alexander Litvinov, Liz Hay-Chmielewski, Tom Pratt, Jim Snyder, Gabriel Durocher

The group addressed the five guiding questions listed on the bottom of the handout describing the session in regards to spawning adults and juveniles (0-5).

Guiding Questions for Breakout Groups**:**

1) What techniques/methods will work best and in what types of environments?

Spawning Adults	**Juveniles**
- Gill nets and set lines in large river systems (problems: high current and debris, and snagging with set lines)	- Small mesh gill nets in both types of systems
- Dip nets in shallow low flow systems	- Drift nets for larval fish
- Weir with camera or trap net in shallow system	- Visually in shallow clear streams
- Hydroacoustics with ground-truthing in both types of systems	- Minnow traps
- Electrofishing in shallow system	- Electrofishing in shallow systems
- Trawling in large river systems or nearshore areas	- Seining in shoreline areas and shallow systems
- Underwater video	- Trawling in larger systems
- Sonic/radio tracking to help identify spawning areas	- Sonic tags if fish is large enough
- Egg traps/mats to identify spawning areas	- Fyke nets
- Drifting gill nets in fast water	- Drifting gill nets
- ROVs in both systems	
- Divers in large systems	
- Trammel nets	

2) What details are important for success?
   a. Local knowledge, know your type of habitat before selecting gear. Environment for first year of life: low flow with sand/silt bottom, sometimes found clustered along the rise of sand bars, typically non-vegetated areas.
   b. Consistent sampling
   c. Lunar cycle
   d. Are there multiple spawning runs?
   e. Best time of day to use gear
   f. Temperature monitoring to ensure that you are sampling during the spawning run.
   g. Should consider whether you are harming existing spawn while sampling.
   h. Water quality, water velocity, flow regimes, potential disruptions to sampling
   i. Idea of number of spawning adults and larval production
   j. Exchange information/use existing information and collaboration
   k. Effort should be high – need to know available staff and resources
   l. Program needs to be a management priority of agency (policy/practice)

3) When and how long to sample (adequate effort, timing)?

   a. Temperature dependent. May be some early and some late spawners.
   b. Must sample 24/7
   c. Start 1-2 weeks prior to expected spawning period and end 1-2 weeks after.
   d. Long term sampling (for at least 5 years in order to sample whole adult population)
   e. Depends on objectives of the project
   f. Night sampling preferred for juveniles
   g. Fall sampling for juveniles

4) What biological data to collect and how (size, age, sex, numbers, tagging etc.)?

Collection should be basically the same for both spawning adults and juveniles.

a. Wounds and deformities, both biological and human caused.
b. Length (length- top fork, bottom fork, caudal)
c. weight
d. Photos – each side
e. Spawning stage/ readiness
f. Sex
g. Tissue for genetic analysis (fin clip)
h. Age using fin ray section (not the whole ray)
i. Tag/marking information (may be latex, scute or freeze brand for juveniles)
j. Gear type used to collect fish
k. Water parameters (temp., depth, D.O., turbidity, velocity)
l. Location – GPS
m. Substrate in standard terminology
n. Diet (for juveniles only)

5) What standardization is important for comparison among systems/studies?

a. Standard data collection protocols and form (downloadable from the WEB)
b. Central data base
c. Make sure everyone is collecting the information listed under # 4 using same protocol and reporting in a standard way
d. Standardize substrate measurements