Saskatchewan River Sturgeon Management Board

Ten-Year Management Plan
December 2002

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Sturgeon Management Board

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Prepared for the

Saskatchewan River Sturgeon Management Board

by

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EXECUTIVE SUMMARY

BACKGROUND

Similar to other North American populations, lower Saskatchewan River lake sturgeon have been subjected to a history of overexploitation and habitat alteration. Annual commercial harvests of sturgeon from the Saskatchewan River were as high as 56,000 kg (marketed weight) in the early 1900s, but declined rapidly thereafter and were less than 6000 kg by 1938, and less than 1000 kg by the mid 1990s. Commercial and sport harvests of sturgeon were discontinued by 1996 and 1999, respectively, leaving the Aboriginal domestic fishery as the only remaining legal harvest of sturgeon from the lower Saskatchewan River.

Changes to the physical environment of the lower Saskatchewan River over the past half-century have also impacted sturgeon. Construction of Saskatchewan Power Corporation's E.B. Campbell Dam at Iskwao Rapids and Manitoba Hydro's Grand Rapids Dam at Grand Rapids in the early 1960s had direct impacts on aquatic habitat, and has effectively isolated the sturgeon population between the two dams. In addition, there are over 25 major dams/reservoirs located in the Saskatchewan River basin upstream of E.B. Campbell Dam that affect flows in the lower reach of the river. Impacts pertinent to sturgeon resulting from these developments include: loss of potential spawning areas at, and upstream of, E.B. Campbell Dam; habitat fragmentation; dampening of the seasonal flow regime; daily water level fluctuations; and the flooding of Cedar Lake.

Recent monitoring data suggests that the existing sturgeon population in the E.B. Campbell Dam to Grand Rapids Dam reach of the Saskatchewan River is approximately 1300 fish 18 lbs and over. Comparing the current estimate to an estimate of historical abundance suggests that there has been an 80-92% reduction in the abundance of sturgeon 18 lbs and over in this reach of the river during the past 40 years.

PROCESS

Concern over the health of the lower Saskatchewan River lake sturgeon population, particularly in the reach from E.B. Campbell Dam to Grand Rapids Dam, led stakeholders to form the Inter-provincial Sturgeon Steering Committee in the early 1990s and ultimately the Saskatchewan River Sturgeon Management Board (SRSMB) in 1998. The Board mission statement is:

> ***To prevent further decline of the sturgeon population; and to develop and co-ordinate a recovery plan.***

The Board's Terms of Reference state:

> ***The Board will develop a long-range sturgeon recovery (management) plan no later that December 31, 2003.***

To address this responsibility, the Board initiated a series of meetings in January 2002 to discuss current population status and trends, threats to the population, and limits to recovery, and to develop recovery objectives, targets, and priorities. Based on these discussions, a management plan was formulated that would provide a "road map" for sturgeon rehabilitation in the lower Saskatchewan River. The management plan includes: an overview of all pertinent information on the sturgeon population; an outline of the SRSMB's objectives and goals for rehabilitation, and possible strategies and management options; and, an implementation plan for the strategies and management options selected at this point in the process. Prior to developing the management plan, Board members were solicited for their perspectives on participating in the process. Although there was no agreement on what was currently limiting the sturgeon population, it was unanimous that an "even-handed" management approach was needed that addressed all factors including habitat, harvests, and monitoring. A review of management approaches used in other jurisdictions was conducted to gain an understanding of what could be done to affect recovery of the sturgeon population in the Saskatchewan River. Management considerations examined included: monitoring, stocking, habitat enhancement, harvests restrictions, modeling, traditional knowledge, and the criteria for defining a rehabilitated population.

MANAGEMENT PLAN

The Board developed a management plan in recognition that the long-term objective of bringing about a sturgeon recovery may not be achieved for at least 20 years. Implementation of the plan will occur over a ten-year period, but the plan will be reviewed and, if necessary, revised after five years. A complete re-evaluation of the plan will occur at the end of the ten-year period. An adaptive management approach will be used to review information as it becomes available and revise management strategies as appropriate.

Objectives

The short-term objective of the ten-year management plan is to meet the first step of the Board mission statement:

> ***To prevent further decline of the Saskatchewan River lake sturgeon population between the E.B. Campbell Dam and Grand Rapids Dam.***

The long-term objective of the ten-year management plan is:

> ***To have a Saskatchewan River lake sturgeon population between E.B. Campbell Dam and Grand Rapids Dam that is self-sustaining, and, capable of supporting the traditional uses of local Aboriginal people.***

Goals

The SRSMB developed four goals for the ten-year management plan to measure progress toward the short- and long-term objectives.

Goal 1 - Stabilize the existing spawning population in the next five years.

This goal is directed at preventing a further decline of the sturgeon population. The Board recognizes that the existing spawning population is at a dangerously low level and must be protected to maximize and safeguard future generations and to maintain genetic viability. Stabilizing the existing spawning population will require that immature and mature sturgeon mortality be kept as low as possible.

Goal 2 - Achieve a measurable increase in the spawning population in 20 years.

This goal is directed at rehabilitating the sturgeon population such that it is sustainable and meets the needs of local Aboriginal people into the future.

Goal 3 - Achieve community support for voluntary measures that ensure harvest levels are sustainable.

To prevent a further decline and rehabilitate the sturgeon population, harvest levels must be sustainable. The Board will work with local communities to identify traditional needs and encourage harvest levels that are achievable and sustainable.

Goal 4 - Within the next five years, determine the long-term population objective and the most effective way to achieve it.

To effectively direct management efforts, it is essential to have a recovery target. To set a long-term population objective, there must be an understanding of: 1) the number of sturgeon the existing habitat can support; 2) if and how habitat enhancement measures can increase the carrying capacity; 3) the age and sex structure of the population that will ensure the population is sustainable; 4) the desired harvest level; and, 5) the capacity of the Board to implement management measures. Management measures in the short term will be directed at providing an understanding of these factors. In the long term, the measures selected to rehabilitate the Saskatchewan River lake sturgeon population between E.B. Campbell Dam and Grand Rapids Dam should effectively reconcile the five factors listed above.

Strategies

Specific goals of the management program will be achieved by implementing the following management strategies:

Strategy 1- Monitoring

Monitoring is essential to any management plan as it provides the information necessary to make management decisions, and to measure the success or failure of those decisions and progress toward management goals. The current index-fishing program will be conducted annually until the Board decides that more or less effort is required. The Board recognizes a need, and will investigate methods, to broaden the current monitoring program to gain a better understanding of recruitment of young fish into the population. Domestic harvests will also be monitored on a regular basis to determine desirable and sustainable harvest levels.

Strategy 2 - Increase Recruitment

Increasing recruitment will help to meet both the short- and long-term objectives of the plan. The Board will seek to artificially increase recruitment through fish stocking programs if sustainable populations of source fish are found in other locations on the Saskatchewan River. The Board will attempt to increase natural recruitment by decreasing mortality (Strategy 3) and through habitat assessment and enhancement (Strategy 5).

Strategy 3 – Decrease Mortality

Decreasing mortality (the number of fish that die) will also help meet both the short- and long-term objectives of the plan. The Board understands the importance of Aboriginal domestic harvests and recognizes this in the long-term objective of the management plan. However, the Board also recognizes the benefits associated with a harvest reduction and will direct effort at encouraging community members to voluntarily reduce harvests, or to keep only fish of certain sizes. The Board will not recommend infringements on legal Aboriginal rights to harvest sturgeon. Effort also will be directed at encouraging community members to report poachers to the responsible authorities, and increasing regulatory patrols on the river.

Strategy 4 – Communication and Education

To achieve the overall objective of establishing a self-sustaining sturgeon population that meets the needs of local people, it will be necessary to achieve community support for sturgeon conservation. The communication and education programs will focus on: the vulnerability of the sturgeon population; the activities of the Board; receiving feedback on Board initiatives; encouraging informed community involvement; providing the Board with a level of credibility; fostering community support for the need to reduce harvest levels; and, recommending desirable and sustainable harvest levels. The Board will seek to communicate with and educate communities through the following actions: community/band council meetings; newsletter articles; school programs; collection and distribution of traditional knowledge; and posters.

Strategy 5 – Habitat Assessment

To establish criteria for a population objective, the Board requires a better understanding of the suitability of the existing habitat and its current utilization. Habitat assessment will not only provide information to help set a realistic long-term population goal, but will also help to identify limiting factors and opportunities for habitat enhancement; identify critical habitats and prevent further habitat decline; and, foster community participation in management initiatives and interest in sturgeon stewardship. The Board recognizes that there is a need to confirm whether the existing spawning habitat is suitable and if it is being utilized. Habitat assessment priorities include: investigations of spawning site utilization; and habitat modeling and instream flow needs.

Implementation

The SRSMB will operate as outlined in its Terms of Reference for the duration of the ten-year management plan. Management strategies identified within the ten-year management plan will be implemented through the following three processes.

Planning Activities

The SRSMB will meet at least two times per year and additionally as required. An Assessment Meeting will be held in October or November each year to review results of activities from the previous year and assess progress toward meeting management plan goals. The Board will then prioritize proposed management initiatives for the coming year and develop a preliminary plan and budget. Subsequent to the Assessment Meeting, Board members will conduct research and planning activities required to undertake the proposed Board initiatives for the coming year. Board members will be responsible for securing the necessary project funding during this period such that a commitment for implementation of proposed Board initiatives can be made at a Planning Meeting to be held in late-February. The Planning meeting will focus on developing implementation plans for activities to be conducted in the forthcoming year.

Within five years, the Board will work toward identifying appropriate population and sustainable harvest levels based on results from monitoring and habitat assessments, additional research, and community liaison. The population goal will, at a minimum, include a description of population density, population age-structure, and habitat. The sustainable harvest level will be defined by a total number of fish of a certain maturity, age, or size, and may be adjusted as the population is rehabilitated.

The Board will investigate the feasibility of consolidating agency funding for Saskatchewan River lake sturgeon management to provide an annual operating budget that can be partitioned between Board priorities. The Board will also consider provision of travel expenses for members to attend Board meetings.

Field Programs

The Board will facilitate implementation of field programs to achieve management plan goals. Annual field activities will be undertaken as determined during the assessment and planning meetings. Field programs will include, but may not be limited to, the following: population monitoring on an annual basis; harvest surveys at Cumberland House and The Pas at least once every five years and more often if warranted; assessments undertaken by SE to identify possible

sources of sturgeon for brood stock and/or translocation; and habitat assessment activities. From time to time, depending on funding and completion of preliminary requirements, the Board will undertake other field programs such as spawn taking, rearing and stocking operations, translocation of fish, recruitment monitoring, and habitat enhancement.

Community Liaison

The SRSMB will conduct a community liaison program on an annual basis. Annual meetings will be conducted at OCN and Cumberland House to review Board activities, present current information on the status of the Saskatchewan River lake sturgeon population, and present recommendations for safe harvests for the coming year. As warranted, the Board may also undertake other activities within the communities to increase public awareness of, and garner support for, Board activities and recommendations.

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1.0 INTRODUCTION

Lake sturgeon (*Acipenser fulvescens*) is a freshwater fish species dating back over 100 million years to the upper Cretaceous. Its geographical range stretches from the St. Lawrence River in the east, to the headwaters of the Saskatchewan River in the west, and from the Churchill River and Hudson Bay in the north, to the Mississippi River system in Alabama and Mississippi in the south. It is Canada's largest freshwater fish, reaching lengths of over 2 m and weights in excess of 140 kg (Scott and Crossman 1998). In addition to size, lake sturgeon possess a number of unique life history characteristics that distinguish the species from most other fish in North America, including: longevity (sturgeon can reach over 100 years of age), old age at maturity (up to 20 years), and extended spawning periodicity (individual fish may reproduce only once in 3-5 years).

Historically, lake sturgeon were looked upon with scorn by commercial fishermen as a nuisance fish that destroyed gear set for "valuable species" (Scott and Crossman 1998). However, by the late 1800s the value of lake sturgeon began to rise as the desire for caviar (sturgeon eggs), isinglass (gelatin extracted from the swim bladder and used as a clarifying agent and glue) and smoked sturgeon meat increased. Commercial fisheries grew rapidly, and by the mid 1900s most North American sturgeon populations had become depleted. Habitat alterations and pollution resulting from industrial developments have affected the ability of sturgeon populations to recover to historical levels. Houston (1987) has described the decline of sturgeon populations throughout North America as a "synergistic product of life history factors, exploitation, and environmental change".

Once abundant in the Hudson Bay drainage of Saskatchewan and Manitoba, lake sturgeon populations in both provinces have shown a steady decline over the last century. Despite the decrease in numbers, sturgeon have not been given special status by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC – "not at risk"), the Manitoba Endangered Species Act (MBESA – "not listed"), or the Saskatchewan government. Manitoba Conservation has designated the lake sturgeon as a "heritage species" due to its "unique life history characteristics, limited distribution, and economic, social, and historical significance" (Manitoba Department of Natural Resources [MNR] 1991). Management objectives for "heritage species" include: documenting distribution and habitat requirements; assuring stocks are conserved or enhanced; managing and conserving habitat and assuring perpetuation of the stocks; assuring implications to heritage stocks are considered prior to approval of species introductions; and, increasing public information on heritage stocks.

The Saskatchewan River is one of only two river systems in Saskatchewan and a handful in Manitoba (~6) where sturgeon are still found in significant numbers. Historically, lake sturgeon in the Saskatchewan River watershed ranged from Edmonton, Alberta on the North Saskatchewan River, and from the convergence of the Bow and Oldman rivers on the South Saskatchewan River, downstream to Grand Rapids and Lake Winnipeg in Manitoba. Although lake sturgeon are still found throughout most of this historical range, the species was and remains most abundant in the lower reach of the river below the convergence of the North and South Saskatchewan rivers.

Like most other North American populations, lower Saskatchewan River lake sturgeon have been subjected to a history of unsustainable harvests and habitat alteration. Commercial fishing for lake sturgeon in the Saskatchewan River commenced in 1898 at The Pas. Harvests were as high as 56,000 kg (marketed weight) annually in the early 1900s (Dominion of Canada 1907), but declined rapidly thereafter (Harkness 1980). From 1938-1970, harvests from both the Manitoba and Saskatchewan portions of the river combined did not exceed 6000 kg (marketed weight) annually. After a three-year closure in the early 1970s, annual harvests quickly reached approximately 5,700 kg in 1976 and 1977, before decreasing steadily for the following 16 years. Commercial fishing for sturgeon in the Manitoba portion of the Saskatchewan River was closed in 1995 after less than 25 kg were harvested in 1994. A moratorium was placed on commercial sturgeon fishing in Saskatchewan in 1996. Angling catch limits for sturgeon were reduced to zero in Manitoba and Saskatchewan in 1995 and 1999, respectively. The Aboriginal domestic fishery is currently the only legal harvest of sturgeon from the lower Saskatchewan River.

The physical environment of the lower Saskatchewan River has changed dramatically over the past half-century. Construction of Saskatchewan Power Corporation's E.B. Campbell Dam at Iskwao Rapids (formerly called Squaw Rapids) and Manitoba Hydro's Grand Rapids Dam at Grand Rapids in the early 1960s had direct impacts on habitat in the lower Saskatchewan River. In addition, there are over 25 major dams/reservoirs located in the Saskatchewan River basin upstream of E.B. Campbell Dam that affect flows in the lower reach of the river. Impacts pertinent to sturgeon resulting from these developments include: loss of potential spawning areas at Tobin and Iskwao Rapids (dewatered or inundated by E.B. Campbell Dam); habitat fragmentation; dampening of the seasonal flow regime; daily water level fluctuations; and flooding of Cedar Lake in Manitoba.

Concern over the health of the lower Saskatchewan River lake sturgeon population, particularly in the reach from E.B. Campbell Dam to Grand Rapids Dam, led stakeholders to form an Inter-provincial Steering Committee in the early 1990s and ultimately to form the Saskatchewan River

Sturgeon Management Board (SRSMB) in 1998 (see Section 2.0). The mission statement of the Board is as follows:

> ***To prevent further decline of the sturgeon population; and to develop and co-ordinate a recovery plan.***

A responsibility of the Board, as outlined in its Terms of Reference, is as follows:

> ***The Board will develop a long-range sturgeon recovery plan no later that December 31, 2003.***

The SRSMB initiated the process for developing a ten-year management plan in January, 2002. Two 2-day meetings were conducted to discuss current population status and trends, threats to the population, limits to recovery, and recovery objectives, targets, and priorities. Based on discussions at the meetings, an implementation plan was developed subsequent to identification of management plan priorities.

This document provides:

1. An overview of information that must be considered in developing a long-term recovery plan for sturgeon in the Saskatchewan River;

2. An outline of the SRSMB's objectives for recovery, and the strategies and management options that will be implemented to achieve the objectives; and,

3. An implementation plan for the strategies and management options selected.

2.0 SASKATCHEWAN RIVER STURGEON MANAGEMENT BOARD

2.1 HISTORY

During the early 1990s, concern for the sturgeon population downstream of E.B. Campbell Dam led to a four year (1994-1998) sturgeon study funded primarily by SaskPower with personnel and equipment provided by Saskatchewan Environment and Resource Management (SERM, now Saskatchewan Environment [SE]) and Manitoba Natural Resources (MNR, now Manitoba Conservation [MC]). An inter-provincial steering committee was formed to provide guidance to the study with representation from Saskatchewan and Manitoba commercial fishermen, First Nations in Cumberland House and The Pas, SaskPower, MNR Fisheries Branch, SERM, and the Department of Fisheries and Oceans (DFO). At the conclusion of the study, it became apparent that coordinated action would be necessary if the sturgeon population was to be restored to a healthy state. The SRSMB was formed in the fall of 1998.

2.2 BOARD MEMBERSHIP

The SRSMB is currently comprised of representatives from the following organizations:

Canada Department of Fisheries and Oceans
Cumberland House Cree Nation
Cumberland House Fishermen's Cooperative
Manitoba Conservation, Fisheries Branch
Manitoba Hydro
Opaskwayak Cree Nation
Opaskwayak Commercial Fishermen's Co-op Association
Saskatchewan Environment
Saskatchewan Northern Affairs
SaskPower

2.3 BOARD MANDATE

Role: To act in an advisory capacity on sturgeon management for the Saskatchewan River between Grand Rapids and E.B. Campbell dams to the governments of Canada, Manitoba, Saskatchewan, and First Nations.

Mission: To prevent further decline of the sturgeon population and to develop and coordinate a recovery plan.

Scope: To advise on all matters related to sturgeon management on the Saskatchewan River between the Grand Rapids and E.B. Campbell dams. The board may make recommendations on the following matters: provincial harvest levels (sport, commercial, and domestic), Aboriginal domestic harvest, population monitoring, habitat assessment and enhancement, fish culture activities, community education, water management with respect to sturgeon requirements, and other research. (Compensation for the impacts of hydroelectric facilities is beyond the scope of the Board.)

Decision Making: All decisions are to be made by a consensus of board members.

2.4 BOARD MEMBER PERSPECTIVES

Prior to development of the ten-year management plan, Board members were solicited for their perspectives on the following:

- Why was their organization involved with the Board?
- What would their organization like to see accomplished by the Board?
- Where would they like to see management effort focused?

Summaries of Board member perspectives are provided in Appendix 1.

All organizations represented by Board members had a common goal of supporting efforts to retain a sustainable lake sturgeon population in the E.B. Campbell Dam to Grand Rapids Dam reach of the Saskatchewan River. The provincial government agencies expressed confidence in work that had been conducted on the population in the past and in current population estimates.

All Board members indicated that population monitoring was essential and should continue, not only to determine the success or failure of the management program, but also as an educational and cost-effective means of involving former commercial fishermen in management of the resource.

Domestic harvests were identified as a factor that may be currently limiting sustainability. A need to gain a better understanding of the harvest and to encourage a voluntary reduction was identified. Heightening public awareness of Board activities and educating the public with regard to sturgeon issues were seen as key components to encourage public cooperation to reduce harvests.

There was no consensus on the Board with regard to the relative importance of factors limiting the fishery. Some Board members stated that habitat loss and flow regime are the most important factors currently affecting the population. Others stated that there needs to be an increase in the current population before habitat becomes limiting. Regardless, most Board members indicated that there was a need to have a better understanding of the factors currently limiting the sturgeon population. If habitat is considered to be limiting, then habitat enhancement should be considered as a management option. Stocking was also identified as a method that could be used to revitalize lake sturgeon numbers in the river. It was recognized that additional research was required on rearing methods and on areas to collect spawn before stocking would be feasible.

All Board members supported the concept of working together to effect recovery of sturgeon in the Saskatchewan River. Members stated that it was important not to "finger point" or lay blame. An "evenhanded" approach to recovery was needed that addressed all the issues including harvest levels and habitat. While some members noted that the long-term goal of the management plan should be to bring back the population to a level that could support a commercial fishery, it was generally accepted that the first step should be to ensure survival of the stock and then to reach a population level that could support local Aboriginal needs.

3.0 OVERVIEW OF LAKE STURGEON LIFE HISTORY

The largest lake sturgeon on record form the Saskatchewan River weighed 123 kg (Royer et al. 1968). Sturgeon are capable of attaining such a large size because maturation is delayed. Unlike many other fish species that mature at between 2 and 7 years of age (e.g., walleye, pike, perch), sturgeon devote almost all of their energy for the first 15 years of their lives to body growth rather than to development of gonads (sex organs). Consequently, the age when sturgeon reach sexual maturity is much older than other fish species (Beamesderfer and Farr 1997). Male lake sturgeon mature at 16-20 years of age, while it can take as long as 25 years for females to reach maturity (Scott and Crossman 1998, Auer 1999). Once mature, individual sturgeon do not spawn every year. Spawning periodicity ranges between two and four years for males and three and seven years for females (Scott and Crossman 1998, Auer 1999).

The large size of sturgeon also contributes to longevity by reducing vulnerability to predation, thereby lowering natural mortality. Although individual lake sturgeon may only spawn once every 3 to 5 years, their long life span (i.e., >80 years) allows them to spawn numerous times (possibly more than 12) before dying. Mature female lake sturgeon have been known to lay as many as 6,000 eggs per pound or more than a half million eggs in one year (Scott and Crossman 1998). Laying such large numbers of eggs can improve spawning success in years when suitable conditions are present.

Lake sturgeon typically spawn in fast flowing riffles and rapids, often in the upper reaches of large river systems. Eggs are broadcast over a variety of substrates including rock, gravel and boulder during spring at water temperatures between 11 and 17^{o}C (Kempinger 1988, Le Haye et al. 1992, Rusak and Mosindy 1997, Auer 1999). LeHaye et al. (1992) found that although sturgeon spawn over a variety substrates, depths, and velocities, they do show definite preferences. Egg deposition was substantially higher on bottoms comprised of a variety of materials than on bottoms dominated by just one material such as sand or bedrock. Sturgeon eggs were observed at depths between 10 and 158 cm and at water velocities of 0.02 to 1.39 m/s, but in general, the number of sturgeon eggs deposited tended to decrease as depth and current velocity increased. Barth and MacDonell (1999) found that climatic conditions could have a bearing on where sturgeon spawned within a river in successive years. A change in spawning location was attributed to suitable conditions occurring at different locations under different spring discharges.

Sturgeon eggs are adhesive and remain attached to the bottom substrate until they hatch. Incubation time is dependent on water temperature, with hatching normally occurring

approximately 8-11 days after spawning (Kempinger 1988). Immediately after hatching, lake sturgeon burrow into the gravel and live off their yolk sac. When the yolk sac has been absorbed (in approximately 10 days), the larvae will emerge from the bottom and drift downstream (Kempinger 1988). Little is known of the extent of the drift, or the feeding, resting, and habitat needs of the larvae (Thuemler 1988). The strength of the hatch in any given year is thought to be primarily dependent on weather and flow conditions during incubation, hatching, larval drift and the initiation of exogenous feeding (i.e., external feeding, not living off the yolk-sac) (Nilo et al. 1997). Low flows and low water temperatures were found to negatively impact the reproductive efficiency of Russian sturgeon (Khoroshko 1972). White sturgeon year-classes in the estuary of the Sacramento and San Joaquin rivers were shown to be stronger during years of higher flows (Kohlhorst et al. 1991).

Little is known of the habitat preferences, movements, feeding habitats, and overwintering areas of juvenile sturgeon (Thuemler 1988). Kempinger (1996) captured lake sturgeon less than one year of age from the Wolf River, Wisconsin, on a flat substrate of coarse sand and pea-sized gravel in water less than 0.75 m deep where there was a detectable current. The young lake sturgeon had fed on organisms drifting downstream in the current, such as *Baetidae* (mayfly) nymphs and dipteran (fly) larvae, which composed ~99% of the diet. Kempinger (1996) suggested age 0+ sturgeon might require habitats composed of sandy substrates and fast water that support the preferred food organisms.

Adult lake sturgeon have been described as opportunistic predators, eating a variety of prey and switching dietary items as prey availability changes (Beamesderfer and Farr 1997). Sturgeon primarily feed on benthic macroinvertebrates (organisms without backbones that live on the bottom), including mollusks (clams), and mayfly (fish fly), stonefly, dragonfly, caddis fly, and dipteran (mostly chironomid) larvae (RL & L Environmental Services 1991, McKinley et al. 1993, Chiasson et al 1997, Beamish et al. 1998).

The diet of lake sturgeon can be an important consideration for management of the species. Beamish et al. (1998) found that lake sturgeon diet did not differ from that of sucker, whitefish and burbot, and suggested that intra-specific competition between these species could be high. Chiasson et al. (1997) suggested that macro-invertebrate densities of less than 100 individuals/m^2 might have led to low sturgeon growth rates in the Mattagami and Groundhog rivers in Ontario.

Lake sturgeon are believed to return to their birthplace to spawn, and fidelity to such areas is thought to be high Auer (1996a). However, some sturgeon have been shown to use different

spawning locations during successive spawning periods (Priegel and Wirth 1977, Lyons and Kempinger 1992).

The unique life history traits described above, that have allowed sturgeon to reproduce so successfully over the last 100 million years (i.e., large size, high fecundity [power of producing offspring], longevity, and delayed maturation), have been a hindrance over the last 100 years in the face of overexploitation and drastic habitat changes (Beamesderfer and Farr 1997). In nearly every case where lake sturgeon have supported commercial harvests, the fisheries were characterized by an initial high yield, followed by a rapid and permanent decline (Harkness and Dymond 1961). In many cases, overexploitation has been followed by habitat alteration and/or destruction, which have affected the ability of lake sturgeon populations to recover. Areas that provide suitable conditions for lake sturgeon spawning also often provide the attributes necessary for producing hydroelectricity, which has lead to the destruction or alteration of many lake sturgeon spawning locations. Such habitat changes, in the face of overexploitation, have lead to extirpated and/or threatened sturgeon populations around the world.

4.0 SASKATCHEWAN RIVER LAKE STURGEON

4.1 STUDY AREA

The Saskatchewan River watershed originates in the Rocky Mountains near the British Columbia border (Figure 1). Headwater streams converge into the North and South Saskatchewan rivers in Alberta, which then merge into the Saskatchewan River below Prince Albert, Saskatchewan (approximately 400 km upstream of The Pas). The Saskatchewan River enters Manitoba near The Pas, then flows through Cedar Lake, and enters Lake Winnipeg at Grand Rapids. The Saskatchewan River basin drains an area of approximately 365,000 km^2, making it the largest watershed draining into Lake Winnipeg (Ashmore 1986).

Figure 1. The Saskatchewan River watershed.

The available habitat for the lake sturgeon population that is of concern to the SRSMB lies between the E.B. Campbell Dam in Saskatchewan, and the Grand Rapids Dam in Manitoba (Figure 2). This area includes an estimated total of 900 km of river channels in Saskatchewan, including the Old Saskatchewan River channel (130 km), Tearing River (15 km), and major

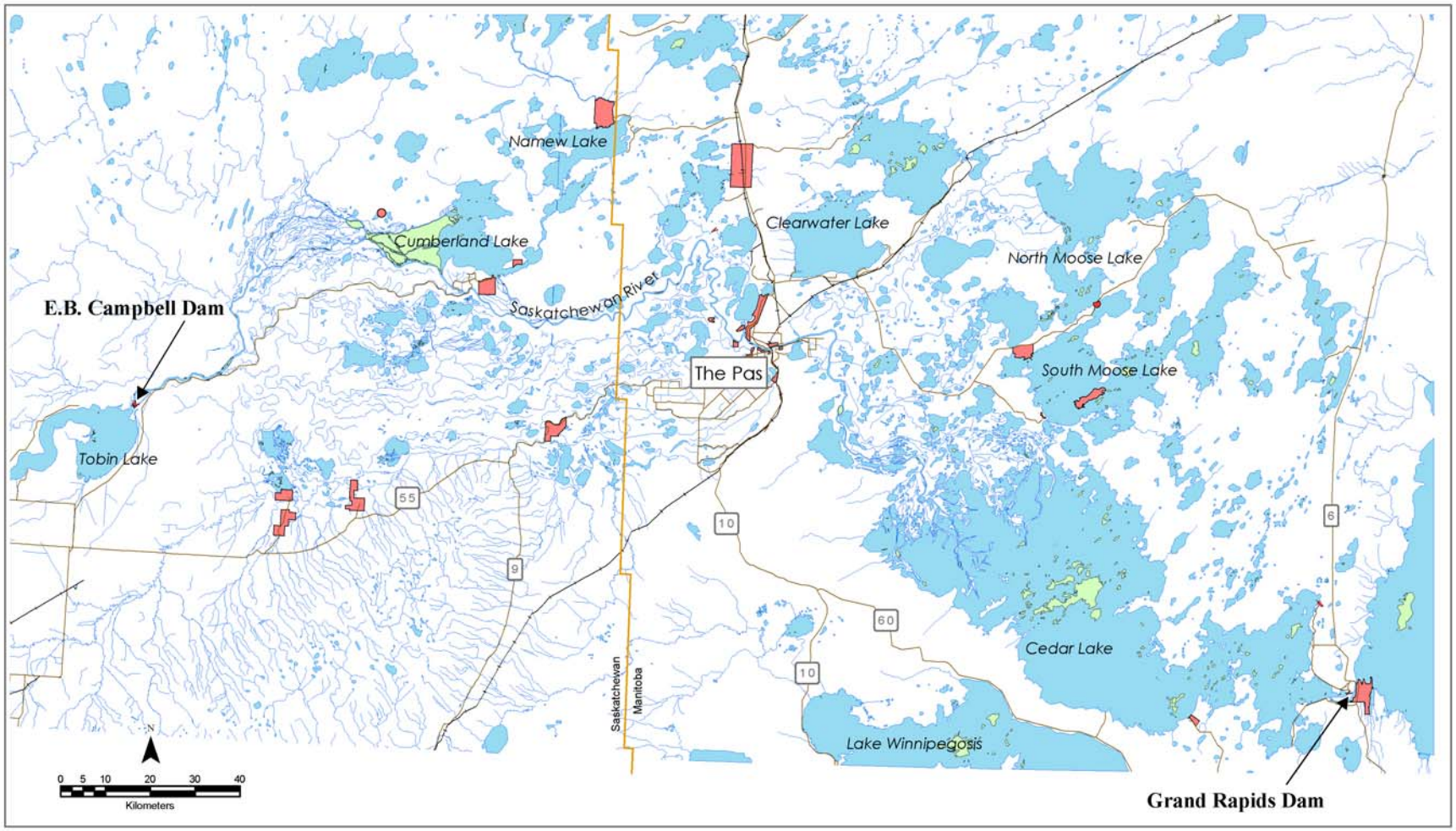

Figure 2. The Saskatchewan River from E.B. Campbell Dam to Grand Rapids Dam.

channels in the Cumberland Lake delta area (490 km) (Royer et al. 1968, Wallace 1991) and 280 km of river channel, including Cedar Lake, in Manitoba (R. Wallace, SE, Saskatoon, pers. comm.). The area also includes Cumberland Lake (including Mud Lake and Cross Bay), which is 95 mi^2 or 60,753 acres (Reed 1959), and Grand Rapids Reservoir/Cedar Lake (including Cross and South Moose Lakes), which is 1,349 mi^2 or 862,694 acres (Manitoba Hydro, unpublished). A detailed map of the Saskatchewan River between E.B. Campbell Dam and Grand Rapids Dam is provided in the back sleeve of this report.

The lower Saskatchewan River downstream of Tobin Lake is underlain by sedimentary bedrock overlain with glacio-lacustrine and till deposits consisting mainly of stratified sands, silts, and clays including alluvial and Aeolian deposits (Smith et al. 1998).

4.2 HISTORICAL OVERVIEW

4.2.1 Commercial Harvest

Commercial fishing for lake sturgeon in the Saskatchewan River commenced in 1898 (Bretecher and MacDonell 2001). Harvests were intermittent for the first four decades, fluctuating in response to a variety of factors including prices, transportation, marketing, quotas, and fish populations. Harvests reported from Manitoba prior to 1930 are suspected to include harvests from both the Manitoba and Saskatchewan portions of the river. Commercial harvests of sturgeon from the both the Manitoba and Saskatchewan portions of the Saskatchewan River from 1906-1995 are illustrated in Figure 3.

4.2.1.1 Manitoba

Commercial harvest records from the Manitoba portion of the Saskatchewan River were found for 21 individual years from 1906 to 1956. Annual harvests reached as high as 56,000 kg (marketed weight) during the early 1900s (Dominion of Canada 1907), but decreased to less than 1000 kg by 1930. As a result of decreasing catches throughout the province, the commercial sturgeon fishery in Manitoba was closed province-wide from 1934-1936. Commercial sturgeon fishing in the Manitoba portion of the Saskatchewan River resumed in 1937 with a harvest of 4500 kg, but after a harvest of 4300 kg in 1939, annual harvests again dropped below 1000 kg.

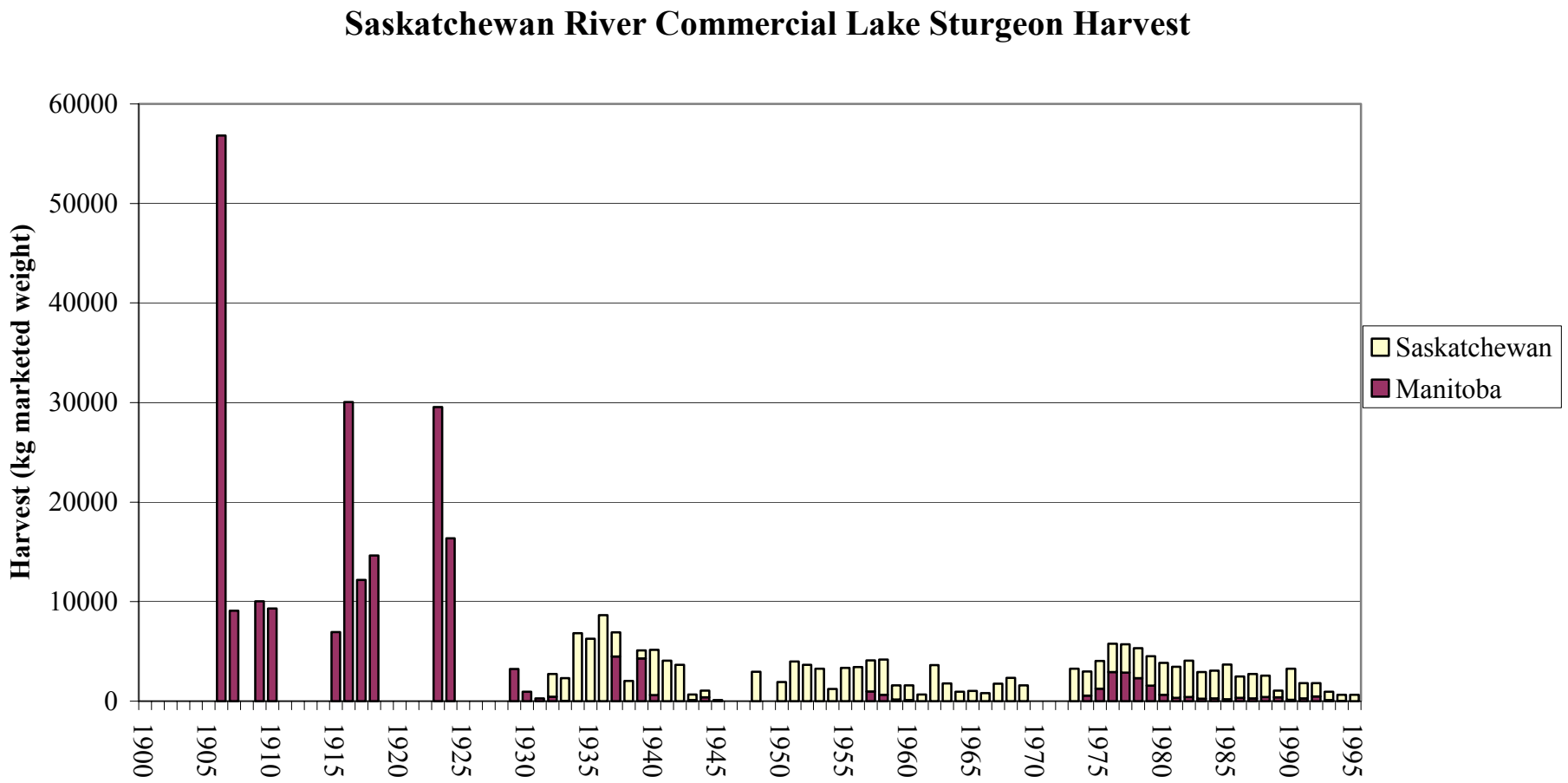

Figure 3. Commercial harvests of lake sturgeon reported from the Saskatchewan River near Cumberland House and The Pas, 1906-1995 (Manitoba data from Dominion of Canada [1907, 1908, 1910, 1911, 1917, 1925], Harkness [1980], and MC Fisheries Branch; Saskatchewan data from S.E. Fisheries Branch and Wallace [1991]). Round weights reported from Manitoba after 1970 have been converted to marketed weight by a conversion factor of 0.6. Raw data are provided in Appendix 2.

The commercial sturgeon fishery was closed province-wide again from 1948-1952. An experimental commercial fishery for sturgeon on the Saskatchewan River was initiated in 1957 with a quota of 11,364 kg (25,000 lbs headless dressed), but closed in 1960, along with all sturgeon fisheries in Manitoba, after an average of just 436 kg was harvested annually over four years. Commercial sturgeon fishing recommenced on the Manitoba portion of the Saskatchewan River in 1974 with an annual quota of 7000 kg (headless dressed). During the next 21 years, harvests averaged 762 kg annually. After a harvest of just 22 kg in 1994, the Saskatchewan River commercial sturgeon fishery in Manitoba was closed in 1995.

4.2.1.2 Saskatchewan

Lake sturgeon harvests from the Saskatchewan portion of the Saskatchewan River exceeded 6000 kg annually from 1934-1936. From 1941-1985, under management quotas of 2,700-3,600 kg (headless dressed), annual lake sturgeon harvests from the Cumberland Lake area of the Saskatchewan River generally ranged between 1000 and 4000 kg (Wallace 1991). The fishery was closed on two occasions during this period – once in the mid 1940s due to low harvests, and between 1968 and 1973 because of mercury concerns (Reed 1959, Walton 1976, Wallace 1991). Annual harvests decreased steadily after 1985 and were less than 1000 kg by 1993. Concern for the health of the sturgeon population prompted an agreement to have a moratorium on commercial sturgeon fishing in Saskatchewan in 1996.

It should be noted that Saskatchewan River sturgeon harvests reported from Manitoba from 1906-1924 (a period of 18 years during which a number of individual harvest years are likely missing) exceeded the total harvest reported from the river from both Manitoba and Saskatchewan during the following 70 years.

4.2.2 Domestic Harvest

The Saskatchewan River historically supported a domestic fishery for lake sturgeon. Both the Opaskwayak Cree Nation (OCN) and Cumberland House Cree Nation have indicated that sturgeon were of historical importance as a food source and for ceremonial purposes. However, historical records on domestic harvests have not been documented.

Findlay et al. (1995) reported that OCN community members did not believe that domestic fishing was to blame for the decline of the sturgeon population in the Saskatchewan River. They reported that the level of domestic fishing for lake sturgeon actually decreased from 1985-1995.

However, anecdotal information received by the Board suggests that there has been a recent resurgence in domestic harvests at The Pas. Concern with regard to the level of domestic harvest led to the implementation of domestic harvest surveys in The Pas and Cumberland House during spring and summer, 2001 and 2002. (discussed in Section 4.3.2).

4.2.3 Habitat Alteration

4.2.3.1 Dams

Climate and upstream water management in Alberta and Saskatchewan are the primary influences on long-term flows in the lower Saskatchewan River. Retention of water behind upstream dams (there are now over 25) for hydroelectric generation, irrigation, and recreation has gradually resulted in a reduction in mean annual flow and a dampening of seasonal flow fluctuations downstream (Figure 4). Average mean annual discharge at The Pas from 1960-1990 (572 m^3/s) was 19% lower than average mean annual discharge from 1913-1959 (704 m^3/s) (derived from data in Environment Canada 1991). While some of this decrease may have been related to climatic factors, much of the flow reduction was likely the result of increased water usage upstream.

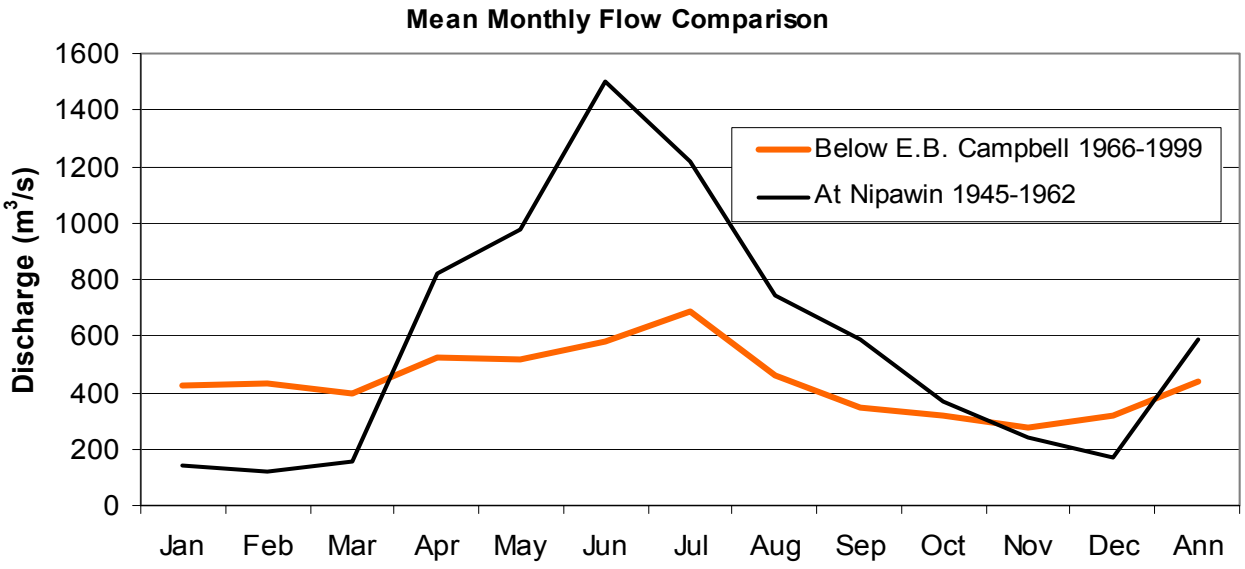

Figure 4. A comparison of mean monthly flows in the Saskatchewan River from 1945-1962 and from 1966-1999.

Construction of SaskPower Corporation's E.B. Campbell Dam at Iskwao Rapids and Manitoba Hydro's Grand Rapids Dam at Grand Rapids during the early 1960s had more direct impacts on

lower Saskatchewan River habitat. Although E.B. Campbell Dam is responsible for only a small portion of the long-term decrease in flows, it has a large affect on daily water levels in the lower Saskatchewan River (Figure 5). The dam is utilized as a hydro-peaking station, generating electricity in response to demand. The license for the station calls for a minimum average daily discharge of 150 m^3/s, but allows for no water to be released for up to 12 hours per day.

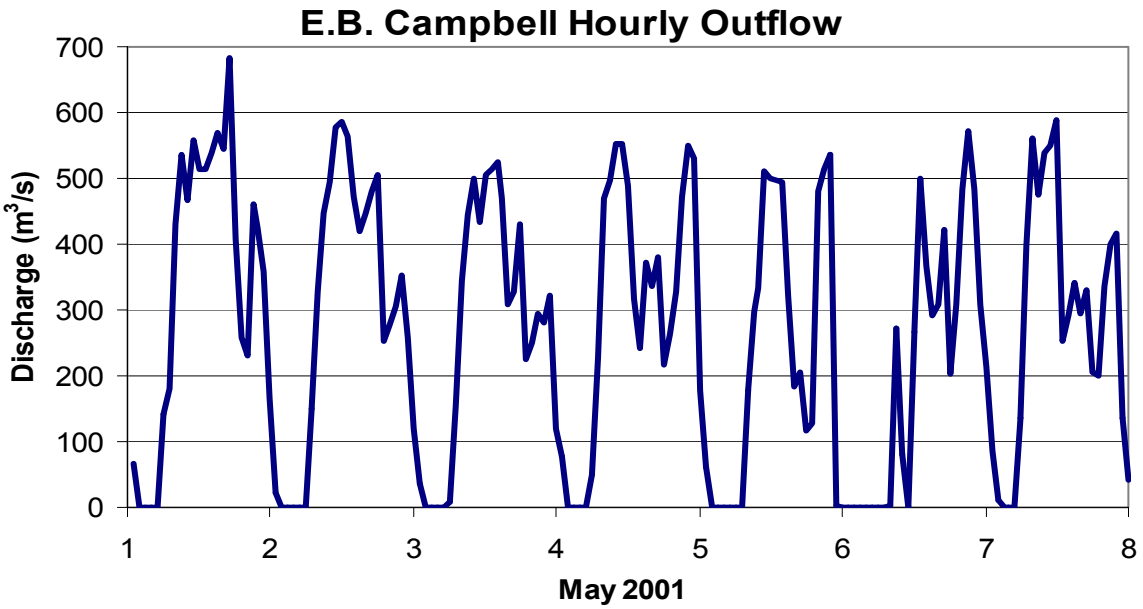

Figure 5. Typical weekly discharge from E.B. Campbell Generating Station (May 1-8, 2001).

Construction of the E.B. Campbell Dam Project resulted in the dewatering and loss of two large sets of rapids (Tobin and Iskwao) that were believed to provide spawning habitat for sturgeon (Wallace 1991). The long-term reduction in flows during spawning and daily fluctuations in the tailrace below E.B. Campbell Dam also affected the remaining spawning habitat (Wallace 1991). Changing flows and water levels during spawning can reduce the capacity for sturgeon to spawn and fertilize eggs and can cause fish stranding and dewatering of eggs (Auer 1996a). Hydro peaking can also make water velocities unsuitable for egg survival, and lead to egg mortality by flushing eggs from substrates at high flow. Such impacts are generally more severe closer to the dams. Findlay et al. (1995) suggested that construction of smaller water control structures on many of the tributaries in the Cumberland House and Saskatchewan River deltas has also affected sturgeon habitat. For example, the control structure at Candle Lake on the Torch River, a known lake sturgeon spawning tributary, disrupts normal spring flows which may negatively impact downstream spawning habitat.

4.2.3.2 Water Quality

Water quality in the Saskatchewan River between the E.B. Campbell and Grand Rapids dams is heavily influenced by upstream land and water use. The North and South Saskatchewan rivers are the receiving environments for run-off and discharges from the majority of agricultural land and most major cities in Alberta and Saskatchewan. Elders from OCN have reported that water quality in the Saskatchewan River has declined due to point source discharges of pollutants from pulp and paper operations and municipal discharges, and run off from fertilizers and pesticides from agricultural lands (Findlay et al. 1995). Although impacts to sturgeon directly attributable to water pollution have not been documented in the scientific literature, the bottom feeding habits and longevity of the species increases its vulnerability to bioaccumulation of pollutants. A modeling excercise conducted by Jager et al. (2001) predicted that poor water quality was a dominant factor influencing recruitment of white sturgeon in the Snake River, ID.

A review of Saskatchewan River water quality data collected at the Manitoba/Saskatchewan border from 1974-1992 revealed a significant long-term increasing trend in alkalinity (Dunn 1995). Although this may be viewed as a decrease in water quality, long-term decreasing trends in nitrate, nitrite, total nitrogen, magnesium, alpha-BHC, potassium, iron, total coliforms, and 2,4-D can be viewed as indications of improving water quality. As discussed previously, a long-term trend showing a decrease in daily flow is attributable to increased water use upstream and possibly to climatic factors.

4.2.4 Population Decline

Wallace (1999a) concluded that the Saskatchewan River sturgeon population was healthy in the 1950s. His conclusion was based on several factors, including: fishing had been sustained since the early 1900s; the population had a good size and age composition (some fish older than 60 years) and acceptable mortality rates (about 4% annually); and, available habitat was suitable for young, mature, and spawning sturgeon. Using two different methods (an analysis of mortality rate and harvests; and, an analysis of carrying capacity of the habitat), Wallace (SE, Saskatoon, pers. comm.) estimated that the abundance of sturgeon 18 lbs and over (round weight) in the Saskatchewan River between Tobin Rapids and Grand Rapids in 1958 was between 6,500 and 16,000 fish.

According to Wallace (1991), the loss of many spawners and habitat changes around 1960 seriously reduced the health of the population. The annual mortality rate rose from 4.8% between 1958 and 1963 to 18.9% between 1975 and 1980. Sturgeon over age 40 completely

disappeared from the population by the late 1970s. By 1990, recruitment was only 8 to 15% of what it was in 1958. There were suggestions of substantially fewer sturgeon under 24 years of age compared to earlier years, because the number of young fish growing to catchable sizes decreased by approximately 90%. However, there were no mark and recapture data to estimate population size in 1990 (Wallace 1991).

The decline of the Saskatchewan River sturgeon population from 1958 to 1990 can be summarized as follows:

> Lake sturgeon of all ages suffered substantial decreases in abundance, while the number of young fish produced by the population on an annual basis decreased by approximately 90%.

4.3 CURRENT KNOWLEDGE

During the early 1990s, concern for the lake sturgeon population downstream of E.B. Campbell Dam led to a four-year (1994-1998) sturgeon study funded primarily by SaskPower with personnel and equipment provided by SERM (now SE) and MNR (now MC). The index-fishing/mark-and-recapture program initiated during these studies was continued from 1999 through 2002. Results from these studies form the basis of our current knowledge of lake sturgeon in the Saskatchewan River.

4.3.1 Population Status

Residents of Cumberland House and The Pas were contracted to conduct an index-fishing program on the Saskatchewan River from 1996 through 2002. Nets and hooks were used to capture sturgeon, which were tagged and released. Program rationale, methods, limitations, and possible improvements are described by Wallace (1999b). Objectives of the index-fishing program are as follows:

1) To provide a catch-per-effort index of fish abundance, for comparison to historical data and as a baseline for future population declines or recoveries;

2) To continue the monitoring of fish-sizes and the movements of sturgeon, using collections from harvesters and surveys; and,

3) To provide sturgeon for tagging and recapture to allow for annual population estimates to be conducted.

Catch data from the index-fishing program are provided in Table 1.

Table 1. Index-fishing program sturgeon catches, 1996-2001.

Year	Sturgeon Captured	Recaptures
1996	130	5
1997	116	5
1998	128	16
1999	349	51
2000	310	77
2001	357	103
Total to date	1390	257

Data from Rob Wallace (SE, Saskatoon, March 2002)

Based on the data in Table 1, SE and MC calculated population estimates for lake sturgeon 18 lbs and over in both provinces on an annual basis from 1996-2000. The average annual population estimate during this period was 1300 fish (R. Wallace, SE, Saskatoon, pers. comm.). Based on Wallace's estimate of population size in 1958 (6,500-16,000 sturgeon), the current estimates suggest that there has been a 80-92% reduction in the abundance of sturgeon 18 lbs and over in the E.B. Campbell Dam to Grand Rapids Dam reach of the Saskatchewan River during the past 40 years.

4.3.2 Domestic Fishery

The Aboriginal domestic fishery is the only remaining legal harvest of sturgeon from the lower Saskatchewan River. A survey conducted in The Pas from June 17 to August 18, 2001 observed 57 lake sturgeon harvested by domestic fishers, 60% of which were less than 18 lbs. Extrapolation of the observed harvests yielded a total harvest estimate of 302 sturgeon. However, sampling methodology was not well documented and it was recommended that the estimate be viewed with caution.

Additional surveys were conducted at Cumberland House and The Pas in 2002 to provide a more accurate estimate of the harvest. Although these studies provided some additional information on harvest levels, they were also subject to methodological errors and yielded questionable results. A minimum of 17 lake sturgeon, and presumably more, were harvested at Cumberland House from June through September, 2002, but the data did not allow for a total harvest

estimate. A total of 26 sturgeon were reported as harvested at The Pas during the same period, yielding a total harvest estimate of 106 sturgeon.

The harvest surveys suggested that a minimum of 74 sturgeon, and possibly as many as 319 sturgeon, were harvested annually from the lower Saskatchewan River in 2001 and 2002, 50% of which were under 18 lbs. While the observed harvest of fish over 18 lbs (n=37) would be considered sustainable based on the current population estimate of 1300 fish (2.8%), the estimated harvests are clearly unsustainable (over 12%). Of possibly greater concern is that an equal number of fish are being harvested from a segment of the population for which we have little or no information. Adherence to a more rigorous sampling methodology is required if the Board desires a more accurate estimate of harvests in the future.

4.3.3 Spawning Habitat

Several known or suspected spawning locations have been identified for Saskatchewan River lake sturgeon (Wallace 1999a). The capture of sturgeon larvae in the Torch River confirmed that sturgeon spawned there in 1995. Spawning is believed to occur at Bigstone Rapids based on the capture of several ripe male and female and one running female sturgeon there in 1996. Ripe males have also been captured in the E.B. Campbell tailrace area. The Mossy River may also be a spawning location based on reports by local fishers of capturing young-of-the-year sturgeon there (Wallace 1999a).

There is virtually no information on utilization of potential spawning sites and whether successful spawning is occurring. It remains uncertain whether spawning habitat suitability is a factor currently limiting the population. As discussed previously, hydro-peaking is suspected to have a negative impact on the suitability of spawning habitat in the Saskatchewan River downstream of E.B. Campbell Dam. Wallace and Leroux (1999) identified differences in warming rates as a factor that may also affect the suitability of spawning locations. Tributaries (e.g., Torch River) reach spawning temperatures about one week earlier than Bigstone Rapids, and approximately two weeks earlier than the E.B. Campbell Dam area.

Wallace (1999c) investigated the use of a hydraulic model to assess spawning sites under various flow conditions. Spawning habitat suitability was assessed using preference curves for water depth and velocity, lake sturgeon physiology, and other considerations. The model was applied to Bigstone Rapids and the former Tobin and Iskwao rapids. Results suggested that 50% of Bigstone Rapids would have been suitable for spawning during June 1997 flows (903 m^3/sec), which were approximately 75% of median pre-dam flows. The model also suggested that about

74% of Tobin and Iskwao Rapids would be suitable for spawning under near median pre-dam flows of 1,200 m^3/s. Wallace (1999c) concluded that the model may be useful in the decision making process for mitigation or rehabilitation, and compensation of habitat loss.

4.3.4 Foraging and Over-wintering Habitat

Wallace (1999a) investigated general habitat conditions, including depths and food, from the E.B. Campbell Dam to the Manitoba border. Food conditions were reported to be poorest in the E.B. Campbell to Centre Angling River reach where rocks and sand are common. Food conditions were better in clay and weedy areas downstream of Bigstone cut-off.

Bretecher and MacDonell (2001) mapped Saskatchewan River habitat between Cumberland House, Saskatchewan, and The Pas, Manitoba. Study results suggested that this reach of the river had an abundance of optimal rearing areas for sturgeon, but was severely limited in providing suitable spawning habitat.

Wallace and Leroux (1999) reported sturgeon over-wintering in the Saskatchewan River mainstem, including the Centre Angling, the Old Channel outlet, and many deeper portions in Manitoba. They suspected that over-wintering habitat was limited in secondary channels and Cumberland Lake because of lower water and oxygen levels. Recent surveys show winter oxygen conditions in these areas may be better than suspected (R. Wallace, SE, Saskatoon, pers. comm.).

4.3.5 Movements

From 1994 to 1997, Saskatchewan River sturgeon were tagged with individually numbered tags and radio transmitters (Wallace and Leroux 1999). The furthest movements documented were 74 km upstream and 89 km downstream over a two-year period (Wallace and Leroux 1999). After initial movements, many sturgeon remained within a small area over a long period of time. For example, sturgeon tagged near the mouth of the Torch River were recaptured in the same area up to three years later. The ranges of sturgeon tagged at different suspected spawning sites overlapped, and ranges of sturgeon tagged in Manitoba overlapped with ranges of sturgeon tagged in Saskatchewan. Auer (1996b) suggested that sturgeon populations might require at least 250 km of habitat to complete their life cycle. Wallace and Leroux (1999) suggested that the present range in the lower Saskatchewan River appears sufficient, but further barriers would be a concern.

4.3.6 Growth

Based on size-at-age data, growth of Saskatchewan River lake sturgeon appears to be comparable to other populations at similar latitudes. The growth rate is slower than in more southerly areas in Wisconsin and the St. Lawrence River, but faster than in more northerly areas of Manitoba, Ontario, and Quebec (Wallace 1991). Data presented in Wallace (1991) suggested that growth of Saskatchewan River sturgeon did not change dramatically after hydroelectric development in the early 1960s. In contrast, Findlay et al. (1995) compared growth rates and concluded that sturgeon captured at Cumberland House showed a reduced growth rate after 1965/66 and that depressed growth was still evident through 1982. However, this analysis did not use growth data from fish of similar ages and should be viewed with caution. A detailed analysis of pre-and post-development growth rates has not been published.

4.3.7 Genetics

Robinson and Ferguson (2001) examined micro-satellite variation in genomic DNA from lake sturgeon populations in Saskatchewan, Manitoba, and Ontario. Significant genetic differences were found between populations in the Rainy, Saskatchewan, Winnipeg, and Nelson river systems, indicating that unique genetic stocks are located in each river. Robinson and Ferguson recommended that policies and conservation efforts aimed at improving natural lake sturgeon populations should not involve the translocation of mature fish, or gametes between these river systems. Robinson and Ferguson suggested that stocking programs should use parent brood stock from the river system where the stocking will occur.

4.3.8 Recommendations and Conclusions from the 1994-1998 Studies

At the conclusion of the lake sturgeon studies conducted from 1994 to 1998, Wallace and Leroux (1999) put forth the following recommendations and conclusions:

1) Recovery of the Saskatchewan River sturgeon population depends on action on both habitat and harvests;

2) Management should continue as a co-operative effort;

3) Protection of the habitat and protection from local over harvest is required, especially during spawning in former and present sites;

4) Continued harvesting will allow the present decline to continue and delay the recovery of this population;

5) Stakeholders should consider restrictions on commercial and subsistence fishing;

6) Information on subsistence fishing and cultural uses by First Nation and other Aboriginal people is needed;

7) More research is needed on the effects of water levels and flows from hydroelectric generating facilities;

8) Continue radio tagging and index fishing; and,

9) Further trials of egg collection for restocking should be considered.

5.0 MANAGEMENT OPTIONS

It is extremely difficult to design and/or develop management plans and habitat restoration for lake sturgeon because of the following:

- the variety of habitats that are important to sturgeon;
- the geographical extent of sturgeon habitat;
- the long time span required for sturgeon to mature and reproduce;
- sturgeon spawning requirements; and,
- the susceptibility of sturgeon to harvest.

A workshop to identify research and assessment needs to restore sturgeon populations in the Great Lakes (Holey et al. 2000) identified the following impediments to rehabilitation:

- barriers to spawning grounds;
- unfavourable flow regimes;
- lack of public awareness to the value of sturgeon;
- habitat fragmentation;
- contaminants;
- lack of knowledge of early life history requirements and food base;
- overexploitation;
- lack of funding;
- inter-jurisdictional differences;
- spawning habitat degradation;
- water quality;
- lack of knowledge of historic abundance and range;
- low current abundance of sturgeon;
- insufficient hatchery capacity;
- limited availability of brood stock; and,
- illegal harvest.

Management of the Saskatchewan River lake sturgeon population faces many of the same impediments.

Although the above list is daunting, lake sturgeon populations facing similar limiting factors can be sustainable under appropriate conditions and management strategies. For example, sturgeon populations in Wisconsin have been subject to influences from hydroelectric developments and sport harvests for decades, yet are considered sustainable. To ensure sustainability, sturgeon stocks require intensive management, including harvest restrictions, protection during spawning season, supplemental stocking, habitat restorations, and extensive community involvement (Kempinger 1996).

The following summarizes management strategies that have been used on other sturgeon populations and discusses how effective those strategies have been.

5.1 MONITORING

Evaluation is a key component of any fisheries management program. Part of this evaluation process includes monitoring to determine how a fish population is changing in response to management actions or lack of management actions. Monitoring data are also important for determining the possible effects of proposed management actions.

Programs to monitor lake sturgeon populations are conducted in a number of states and provinces. Almost all monitoring programs utilize mark-and-recapture techniques to estimate population size and structure. However, capture techniques differ and are dependent of the nature of the sampling environment. In the Great Lakes, fisheries managers work with commercial fishermen to access incidental catches of sturgeon in trap nets and gill nets. Set lines have been used to capture sturgeon in the St. Clair River in Michigan (U.S. Fish and Wildlife Service 2000) and in the Columbia River in BC (R.L.&L. Environmental Services Ltd. 1994). Electrofishing, seining, trawling, fyke nets, gill nets, and diving have all been used to study and monitor the lake sturgeon population in the Lake Winnebago system in Wisconsin (Kempinger 1996).

The vulnerability of sturgeon to the sampling method used for monitoring determines the proportion of the population that the program will estimate. Electrofishing, trap nets, and set lines are relatively unbiased sampling methods and can allow for population estimates including fish down to three years of age. In contrast, large mesh gill nets generally select for larger fish and only allow for estimates of the mature portion of the population. A summary of gillnet mesh sizes used to capture sturgeon by researchers in Canada and the United States as compiled by Brooking (2000) is provided in Table 2.

Table 2. Summary of gillnet mesh sizes used by researchers in Canada and the United States to capture lake sturgeon (adapted from Brooking 2000).

	Nets for small fish		Nets for adult fish	
Researcher	Size	Type	Size	Type
S. Schram – WI DNR	1.5-7”	mono	8, 10, 12, 14”	mono
C. Mackenzie – VT F&W	--	--	8, 10, 12”	multi, mono
T. Chiotti – NY DEC	5”	--	--	--
J. Hayes – SUNY ESF	1-5.5”	mono	8, 10, 12”	mono
H. Quinlan – USFWS	2-4.5”	multi	8-12”	mono, multi
C. Lowie – USFWS	--	--	10”	mono
D. Noakes – Univ. of Guelph	1-6”	mono, multi	--	--
T. Hill – USFWS	--	--	8, 10”	mono
A. Runstrom – USFWS	--	--	8, 10, 12”	mono, multi
S. Schlueter – SUNY ESF	2.5-6”	mono	7, 8, 10”	mono
R. Colombo – Shedd Aqu.	--	--	8, 10, 12”	mono
M. Bain – Cornell Univ.	2, 4, 6”	mono	14”	multi
R. Fortin – Univ. of Quebec	--	--	8, 9, 10”	mono
L. Mohr – OMNR	4.5-5.5”	mono	9, 10, 12”	multi, mono
D. Peterson – Central MI Univ.	--	--	8, 10, 12”	mono
E. Baker – MI DNR	--	--	8, 10”	mono
L. Meyers – WI DNR	--	--	7.5-8”	multi
G. Kornely – WI DNR	--	--	10”	multi
T. Brooking – Cornell Univ.	1.5-4”	multi	6, 8, 10, 12”	multi
T. Heinrich – MN	--	--	8, 10, 12”	--
G. Whelan – MI DNR	graded mesh	--	8, 10, 12”	--

WI DNR – Wisconsin Department of Natural Resources
VT F&W – Vermont Fish and Wildlife
NY DEC – New York Department of Environmental Conservation
SUNY ESF – State University of New York – Environmental Sciences and Technology
USFWS – United States Fish and Wildlife Service
Shedd Aqu. – Shedd Aquarium
OMNR – Ontario Ministry of Natural Resources
Central MI Univ. – Central Michigan University
MI DNR – Michigan Department of Natural Resources
MN – Minnesota

The number of sturgeon captured on an annual basis for monitoring purposes is highly variable and depends on location, method, and objectives. For example, in the lower Columbia River, USA, approximately 3000 white sturgeon were captured and tagged annually from 1976-1998 out of an estimated population of approximately 200,000 fish (~1.5%) (DeVore et al. 1999). In

Lake St. Clair and the St. Clair River, Michigan, approximately 200 sturgeon per year were tagged and released from 1996-2000 out of an estimated population of between 20,000 and 40,000 fish (1-2%) (U.S. Fish and Wildlife Service 2000).

Pine et al. (2001) stated that given the attributes of sturgeon (late sexual maturation, the fact that few mature females spawn every year, and high early life mortality) managers should be patient and willing to monitor populations for extended periods of time (~20 years) to detect changes in the adult population. Earle (2002) suggested a precautionary management strategy for Alberta where conservative estimates, such as the lower 95% confidence interval of the population estimate, be used to govern all management decisions for lake sturgeon.

5.2 HABITAT

5.2.1 Habitat Restoration

Because sturgeon can undergo extensive movements and use a variety of different habitat types in different seasons and at different life-stages, only system-wide habitat protection can provide significant benefits for threatened or depleted stocks (Rusak and Mosindy 1997). Auer (1996b) suggested a barrier-free 250-300 km of combined river and lake range as a minimum distance to support a self-sustaining population. Options for system wide changes are limited since they involve complex issues of water diversion, land use, and hydropower system development or operation, implementation of which is constrained by social and economic considerations. Consequently, most sturgeon protection measures have focused on harvest restrictions and fish culture rather than habitat enhancement.

Where habitat enhancement has been conducted to benefit sturgeon it has been directed at improving spawning areas. Several studies have demonstrated that construction of artificial sturgeon spawning beds can be effective (Khoroshko and Vlasenko 1970, Priegel and Wirth 1977, Folz and Meyers 1985, La Haye et al. 1992). Because sturgeon use such a wide variety of hard substrates for spawning, including fine to coarse gravel, cobbles, and boulders, fish managers can choose a wide variety of substrates for constructing an artificial spawning bed (LaHaye et al. 1992). Rock rip-rapping of stream banks on the Lake Winnebego system in Wisconsin is believed to have increased available spawning habitat and to have aided in the recovery of the sturgeon stock there (Folz and Meyers 1985). Recommendations for the construction of an artificial lake sturgeon spawning bed are provided in LaHaye and Fortin (1990).

5.2.2 Manipulation of Hydroelectric Operations

Flow during spawning and incubation is the most commonly reported factor influencing year class strength in sturgeon species (Jager et al. 2001). Hydroelectric operations that alter natural water levels and flows on a seasonal and daily basis can be problematic for sturgeon reproduction by causing unsuitable spawning conditions and stranding fish and eggs. Auer (1996a) reported that during years of peaking operations (when water levels and flows changed hourly) at the Pickett Creek hydroelectric dam in Wisconsin, sturgeon were located near the power station, but few fish were ready to spawn during the spawning season. Similarly, Khoroshko (1972) observed that Russian sturgeon lost their capacity for fertilization while the fish remained near the Volgograd Power Station for a long time in the pre-spawning period during peaking operations. Auer (1996a) found that lake sturgeon spawning activity responded positively when the Pickett Creek hydroelectric dam was changed to "run of the river" flows. A greater number of lake sturgeon were captured, including more and larger ripe and running spawning females. The more consistent flows during run-of-the-river operation maintained water depth during spawning season, which was speculated to have resulted in more fish in spawning condition.

5.3 HARVESTS

Overexploitation is a common problem that has plagued many commercial and domestic lake sturgeon fisheries. This is especially problematic for a species that does not mature until 20 years of age and for which individual fish may only spawn once every five years. Sturgeon also become highly concentrated on spawning grounds making them easy targets for fishers. Annual harvest rates greater than 5-10% are almost universally believed to exceed sustainable levels (Beamesderfer and Farr 1997). Brousseau (1987) recommended 0.2 kg/ha/year as a maximum sustainable yield for previously unexploited populations in good habitat. The State of Wisconsin attempts to manage its sturgeon populations at a harvest rate of no more than 5% of mature fish (males greater than 12 years old and females greater than 20 years old) annually (Wisconsin Department of Natural Resources 2002).

Harvest restrictions have been used as a measure to offset decreasing sturgeon populations. Even though fishing may not be the reason for a decline in abundance, reducing fishing mortality is an effective means of offsetting the effects on reproductive potential caused by other, perhaps uncontrollable, mortality sources. Reduction of fishing pressure is currently being employed to rebuild the population of white sturgeon in the lower Columbia River (Boreman 1997). Closing fishing seasons or introducing or reducing quotas are the most direct methods to reduce harvests.

Thuemler (1997) recommended restricting harvests on a two-year rotational basis as a method to reduce harvests by 50% in the Menominee River, WI.

There are a number of management alternatives that preserve harvesting activity while decreasing mortality rates. Maximum size-limits, where all fish above a specified length must be returned to the water, are rarely imposed on fisheries, largely for social, rather than biological, reasons (Brousseau and Armstrong 1987). A maximum size-limit can help to protect brood stock in highly exploited populations with low densities of mature fish and low recruitment. Maximum size limits can protect the large female sturgeon that are critical to the short-term reproductive potential of a population. However, maximum size-limits focus the harvest on immature fish and fish that are just being recruited into the spawning population. Although these younger fish have a lower reproductive potential in the short-term, they can have a greater reproductive potential than older fish over the long-term (depending on survival).

Imposing a minimum size-limit, where all fish below a specified length must be returned to the water, protects smaller fish and can be used to maximize the number of fish that spawn at least once prior to being harvested. Minimum size-limits can also be effective in reducing overall harvests by focusing the fishery on less common larger fish. In fisheries where large fish and catch-and-release are not common, a minimum size-limit that protects first time spawners may be an effective initial approach in protecting stock abundance. However, based on experience from Wisconsin, where minimum size restrictions have been utilized as a lake sturgeon management tool for decades, such restrictions must be applied with a caution. Up until recently, the minimum size-limit for sturgeon in the Winnebego System in Wisconsin was 114 cm (45 inches), which allowed a large proportion of males to reach maturity prior to becoming susceptible to capture, but provided no assurance that females would reach maturity (Bruch 2001). With a concurrent decrease in the season length, the minimum size-limit helped to substantially reduce overall harvests. However, Wisconsin fisheries managers realized that although the sturgeon population had increased, the population was also experiencing an overexploitation of adult females, which grow to larger sizes and live longer than males (Bruch 2001). Adult females accounted for nearly half the harvest despite only comprising a relatively small portion of the harvestable population. The minimum size-limit was subsequently reduced to 91 cm (36 inches), which resulted in a decrease in the proportion of total harvest comprised of females (from 46% to 34%), and a decrease in the female exploitation rate (from 17% to the recommended 5%). Essentially, the larger minimum size-limit in Wisconsin acted to increase overall abundance of sturgeon, while at the same time decreasing the reproductive potential of the population.

Slot limits, which protect fish within a specified size range, are a relatively new concept in fisheries management, but can be effective in protecting stocks that have good natural reproduction (Brousseau and Armstrong 1997). Slot limits can be designed to protect the majority of the spawning population, or to protect small immature fish and/or larger more fecund fish. On the lower Columbia River downstream of the Bonneville Dam in Washington and Oregon, USA, sport fishermen are only allowed to harvest white sturgeon between 107 and 152 cm (42 and 60 inches) in length, and commercial fishermen can only harvest sturgeon between 48 (122 cm) and 60 inches (152 cm) in length (DeVore et al. 1999). In an area of the St. Lawrence River (Quebec), a minimum size-limit and a maximum mesh size are used to limit commercial harvests of sturgeon to fish between 80 cm (31 inches) and approximately 135 cm (53 inches) in length (Fortin et al. 1993).

Shortening of fishing seasons and protecting spawning areas are considered effective alternatives/additions to harvest restrictions (Thuemler 1997). Education has also been used as a tool to encourage harvest reductions.

5.4 STOCKING

Culture of lake sturgeon currently relies on the collection of gametes (eggs and sperm) from wild brood stock. Mature sturgeon must be captured from natural spawning sites where fish congregate during the spawning season. Ovulating females are difficult to find and give up their eggs very sparingly. Removal of eggs often requires administering hormones to induce ovulation (Golder Associates Ltd. 1999).

The technology to rear lake sturgeon in a hatchery system is complex and costly (Binkowski 1997). Incubation and successful hatching of sturgeon eggs requires specific temperature control and treatment for disease (Binkowski 1997, Czeskleba et al. 1985). There are few chemicals approved for use as a treatment for fungal infections in sturgeon eggs (Wisconsin Departments of Agriculture, Trade and Consumer Protection, and Natural Resources 2000). Sturgeon do not take well to commercial fish food diets during early life stages and must be fed expensive live or natural foods (Czeskleba et al. 1985). Providing the necessary food for larvae that have just exhausted their yolk sacs is very labour intensive and costly (Wisconsin Departments of Agriculture, Trade and Consumer Protection, and Natural Resources 2000). Once juvenile sturgeon begin to feed, they require optimal environmental conditions for successful growth and survival.

There are few sites currently known on the Saskatchewan River where mature sturgeon can be captured to obtain eggs for culture purposes. In 1999, 5.2 L of eggs were collected from two female sturgeon captured from the Saskatchewan River at Bigstone Rapids (Golder Associates Ltd. 1999). The eggs were fertilized with milt from males caught nearby and incubated in the Grand Rapids Hatchery. The eggs produced approximately 33,000 fry that were stocked near Cumberland House during the summer, and about 7,000 fingerlings that were stocked near The Pas, Manitoba in September, 1999. Spawn-taking operations at Bigstone Rapids in 2000 were less effective, producing just one mature female (J. Durbin, SE, Prince Albert, pers. comm.). The eggs were fertilized with milt from a male captured by index fishers at the Centre Angling Channel, and incubated in the Grand Rapids Hatchery. A total of 22,200 fry and 300 fingerlings were stocked near Cumberland House on June 2 and September 7, 2000, respectively.

Lake sturgeon spawn taking investigations by Manitoba Conservation and the Nelson River Sturgeon Co-management Board in Manitoba have occurred on the Winnipeg River, Landing River, Weir River, and Saskatchewan River. The cost of raising sturgeon in a hatchery to the fingerling stage (to October) is currently approximately $1 per fish (T. Smith, MC, Whiteshell Hatchery, pers. comm.). A cost-analysis for lake sturgeon culture in Wisconsin, which included a detailed analysis of labour, equipment, supplies, and utilities, yielded a cost of $5.56 (in 1997 US$) per 6-month-old fish (Binkowski 1997). There may be some potential to reduce costs if alternative food sources can be used. Experimental portable raceways that utilize natural production of black fly larvae as food have the potential to reduce costs significantly (S. Peake, University of New Brunswick, pers. comm.). The black fly larvae can be collected during peak abundance and frozen for use throughout the summer. White sturgeon have been cultured from egg to stocking on artificial diets in BC (R. Courtney, DFO, Prince Albert, SK, pers. comm.).

For rehabilitation purposes, the Wisconsin Department of Natural Resources recommends stocking at a rate of 80 fingerlings or 40 yearlings per mile of river and two fingerlings or one yearling for every four acres of lake for a period 25 years (Wisconsin Department of Natural Resources 2000).

The success of stocking programs is unknown at present. Sturgeon fingerlings raised at the Grand Rapids Hatchery and stocked into the Saskatchewan River in 1999 were marked with small wire tags that require detection with a specialized scanner. Detection of these tags in the future will provide information on the contribution of stocked fish to the overall population. Stocking has met with some success in the Assiniboine River in Manitoba and the Red River in Minnesota, where sturgeon were known to be extirpated for decades. Small populations have been re-established in both of these rivers resulting in development of a limited catch-and-release

fishery. However, it remains unknown whether these populations will be able to successfully reproduce.

A Great Lakes Fisheries Trust Workshop concluded that there are a number of impediments in hatching and rearing sturgeon that need to be solved before hatchery rearing can be implemented as a rehabilitation tool on a basin-wide scale (Holey et al. 2000). The two most significant limitations included: identifying a reliable source of wild brood stock; and, maintaining genetic diversity.

5.5 MODELING

Modeling attempts to relate observations and data to unknown quantities. For example, models can use hydraulic and habitat suitability data to predict the suitability of habitats under different flow scenarios (as was conducted by Wallace 1999, see Section 4.3.3). Models can also be used to determine hatching and recruitment success under differing population structures, environment variables, and/or flow regimes. Modeling can be an effective method of determining the effects of limiting factors and how manipulation of those factors may affect a sturgeon population. For example, Pine et al. (2001) used an age-structured model to reveal that a population of Gulf of Mexico sturgeon was highly sensitive to changes in egg-to-age-1 mortality, the percentage of females that spawn annually, and adult mortality. The model predicted that even slight increases in mortality (e.g., from 16 to 20%) would result in a decline in the population. Because models can predict how a population will react to a change in some controlling variable, they are a valuable tool to assess the possible effects of proposed management strategies, such as stocking, habitat manipulation, and harvest restrictions, prior to implementation. Models can also be used for population viability analysis (PVA), which is a collection of methods used to evaluate the threat of decline, extinction and recovery of a population, and to predict the benefits of alternative management actions (Akcakaya and Sjogren-Gulve 2000).

It is important to note that models are only as effective as the quality of data used in the model. For example, models that utilize data with a high degree of uncertainty will produce results with a high degree of uncertainty. Applying data collected in one location to a model of another location can add to the uncertainty. Extensive collection of relevant field data is essential if modeling is to be used as an effective management tool.

5.6 TRADITIONAL KNOWLEDGE AND CO-MANAGEMENT

The collection of traditional knowledge has been identified as a valuable tool for lake sturgeon management because of the long life span of the fish and length of time that it takes for impacts on populations to occur. In many areas, traditional knowledge provides the only long-term information on the species. Wallace (1999c) stated that traditional knowledge has highlighted problems, identified spawning sites and other local habitats, and provided long-term perspectives. Western science fisheries methods can be used in conjunction with traditional knowledge to confirm the information and supplement long-term observations. Traditional knowledge has been seen as a tool to foster interest in lake sturgeon populations within stakeholder communities and encourage active participation in sustainable management of the species (MacDonell 1997).

The SRSMB and Nelson River Sturgeon Co-management Board are examples of groups that have been created to aid the recovery of sturgeon stocks in Saskatchewan and Manitoba. These boards are comprised of resource users, Aboriginal people, and government agencies in Saskatchewan and Manitoba. While co-management has met with varying degrees of success, it has been recognized in the Manitoba Lake Sturgeon Management Strategy (MNR 1994) as an essential component of lake sturgeon management on the Saskatchewan River.

5.7 CRITERIA FOR A RESTORED/RE-HABILITATED STURGEON POPULATION

To measure the success of a lake sturgeon rehabilitation program, it is essential to define the attributes of a healthy or restored population. The health of a sturgeon population is dependent on the number of fish present, the population structure (e.g., age structure, sex ratio, genetic diversity, successful recruitment), habitat, and harvest. At a workshop sponsored by the Great Lakes Fishery Trust, lake sturgeon specialists from the Great Lakes region provided a wide range of possible criteria for a restored population (Holey et al. 2000). It was subsequently recommended from the workshop proceedings that a working definition of a rehabilitated population contain at least three elements: density/abundance; age structure; and habitat use. It was also recommended that separate attributes be defined for both stream and lake populations.

Fisheries managers today have little understanding of the number of sturgeon that each acre of river or lake habitat can support because there is very little information on historic densities of sturgeon populations in unexploited rivers (Holey et al. 2000). According to Holey et al. (2000), the number should be based on the productivity and size of the river or lake and include at least enough adults to provide a self-sustaining population under an exploitation rate of 5%. The

Wisconsin Department of Natural Resources currently manages for sturgeon to achieve densities of 250 age-2+ fish/mile of river and 1.5 age-2+ fish per acre in lake systems (Wisconsin Department of Natural Resources 2000).

A rehabilitated lake sturgeon population in a river should have an age structure that includes females at least 70 years old and males at least 40 years old (Holey et al. 2000, Wisconsin Department of Natural Resources 2000). Lake populations should be represented by at least 40 year classes and 10-15% mature fish, and at least 3% of the population should be 40 years of age or older (Holey et al. 2000). It has also been suggested that although annual recruitment is not fundamental, there should always be recruitment in the 0-5 year age groups (Holey et al. 2000).

Holey et al. (2000) suggested that a restored river population of lake sturgeon should have access to the same amount of habitat as was historically available in the river. This would include spawning, nursery, and adult habitat. Holey et al. (2000) also suggested that for a lake population, 50% of the tributaries and 50% of shoal habitat that was used historically should be available and utilized for the population to be considered rehabilitated.

6.0 RECOVERY OBJECTIVES, GOALS, AND STRATEGIES

6.1 OBJECTIVES

This section describes the objectives of the SRSMB long-range recovery plan and the measures that will be undertaken to achieve those objectives. The plan was developed with the expectation that the long-term objective may not be achieved for at least 20 years. Implementation of the plan will occur over a ten-year period, but the plan will be reviewed and, if necessary, revised after five years. A complete re-evaluation of the plan will occur at the end of the ten-year period. An adaptive management approach will be used to review information as it becomes available and revise management strategies as appropriate.

Short Term Objective

The short-term objective of the ten-year management plan is to meet the first step of the Board mission statement:

> ***To prevent further decline of the Saskatchewan River lake sturgeon population between the E.B. Campbell Dam and Grand Rapids Dam.***

Long Term Objective

The long-term objective of the ten-year management plan is:

> ***To have a Saskatchewan River lake sturgeon population between E.B. Campbell Dam and Grand Rapids Dam that is:***
>
> - ***self-sustaining; and,***
> - ***capable of supporting the traditional uses of local Aboriginal people.***

6.2 SPECIFIC GOALS

The SRSMB has developed four goals for the ten-year management plan to measure progress toward the short- and long-term objectives.

GOAL 1 Stabilize the existing spawning population in the next five years.

This goal is directed at the short-term objective of the ten-year management plan.

The index-fishing results suggest that the average population of lake sturgeon 18 lbs and over in the Saskatchewan River between E.B. Campbell Dam and Grand Rapids Dam from 1995-2000 was 1300 fish. To achieve a stable spawning population, the number of fish recruited to the spawning population must be equal to the number of fish dying naturally and through fishing mortality. The Board believes that closure of the commercial fishery in 1996 was an important step toward achieving this goal. However, the current spawning population is a product of spawning and juvenile survival that occurred over 20 years ago. Harvests, lack of habitat, and poor water quality are factors that can cause pre-mature mortality of sturgeon and deplete the supply of spawners (Jager et al. 2001). Because the Board does not have an accurate estimate of population levels of fish less than 18 lbs, the Board does not know how many fish will reach spawning size over the next 10 years. Thus, the stability of the current spawning population is unknown.

The availability of spawning adults can be an important limitation in small populations (Jager et al. 2001). The Board recognizes that the current spawning population in the Saskatchewan River is at a dangerously low level where as few as 130 females may spawn in any given year (assuming a sex ratio of 1:1 and a spawning periodicity of five years). When a population decreases to below 500 breeding individuals, its ability to maintain adaptive variation (i.e., its genetic viability) is threatened (Rieman and Allandorf 2001). The existing spawning population must be protected to maximize the level of natural reproduction and recruitment that occurs in the near future and to maintain genetic diversity. Stabilizing the existing spawning population will require that immature and mature sturgeon mortality be kept low to maintain or increase the current reproductive capacity. It is possible that the spawning population might continue to decrease in the near future regardless of current harvest levels because of negative effects on recruitment that may have occurred over the past 20 years (e.g., the commercial fishery was closed just six years ago and the domestic harvest is primarily comprised of immature fish). Consequently, although this is a five-year goal, it may require a significantly longer period of time (up to 20 years) to determine the population trend, and/or to achieve the desired results. Success in achieving this goal can be determined by monitoring the lake sturgeon spawning population on a regular basis (i.e., continuing the index-fishing program).

GOAL 2 Achieve a measurable increase in the spawning population in 20 years.

This goal is directed at the long-term objective of the ten-year management plan.

Because of its small size, the current lake sturgeon population in the E.B. Campbell Dam to Grand Rapids Dam reach of the Saskatchewan River is extremely vulnerable to over-harvest and poor environmental conditions. Poor spawning or excessive removal of fish in just one year could substantially increase the chances of the sturgeon population to become locally extinct. The intention of this goal is to increase the sturgeon population to a level that is sustainable and meets the needs of local Aboriginal people into the future.

By the end of this ten-year management plan, it will likely not be possible to show an increase that is not expected to occur for 20 years. However, monitoring, including an assessment of abundance and age and sex structure of the population, will show us if we are heading in the right direction.

GOAL 3 Achieve community support for voluntary measures that ensure harvest levels are sustainable.

This goal is directed at the short-term and long-term goals of the management plan.

A self-sustaining sturgeon population must be able to reproduce at least as fast as the death rate. If harvests and other mortality exceed the reproduction rate, then the population will decrease. The harvest rate is the main mortality factor over which we have some level of control. If we can reduce the harvest rate, it will result in better sturgeon survival and reproduction.

At present, we do not know if the existing population can sustain current harvest levels. We do not even know what the current level of harvest is. Domestic harvest is an individual treaty right that cannot be removed unless the population is in danger of local extinction. In the long-term objective of this management plan, the Board has made a commitment to manage the Saskatchewan River sturgeon population to provide for the long-term traditional needs of local Aboriginal people. The SRSMB does not want the sturgeon population or the harvest to reach a level where it becomes necessary to close the domestic fishery. The Board will work with local communities to identify traditional needs and encourage harvest levels that are achievable and sustainable. Monitoring of harvest levels will provide an indication of whether this goal is being achieved.

GOAL 4 Within the next five years, determine the long-term population objective and the most effective way to achieve it.

This goal is directed toward the long-term goal of the ten-year management plan.

To determine the long-term population objective, we must have an understanding of the following:

- the number of sturgeon the existing habitat can support;
- how habitat enhancement measures may increase the carrying capacity of the habitat;
- the age and sex structure of the population that will ensure the population is sustainable;
- the desired harvest level; and,
- the capacity of the Board to implement management measures.

The measures selected to rehabilitate the Saskatchewan River lake sturgeon population between E.B. Campbell Dam and Grand Rapids Dam should effectively reconcile the five factors listed above. This goal will be achieved by the development of a long-term population objective within five years time, and specific management measures to achieve it.

6.3 MANAGEMENT STRATEGIES

The specific goals of the management program will be achieved by implementing the following management strategies:

6.3.1 Strategy 1 – Monitoring

Monitoring is essential to any management plan as it provides the information necessary to make management decisions, and to measure the success or failure of those decisions.

6.3.1.1 Monitoring the Sturgeon Population

Index Fishing

The current index-fishing program will be conducted annually until the Board decides that more or less effort is required. The program will focus on providing data that will allow the Board to estimate the number of sturgeon in the river between E.B. Campbell Dam and Grand Rapids Dam on an annual basis. The Board will work toward standardizing current methodologies and

developing new methodologies to ensure data collection is consistent, and provides the information necessary to estimate the desired portion of the population (e.g., sturgeon 18 lbs and over; sturgeon that are vulnerable to domestic harvest [mostly >4 kg]; spawning population). Current monitoring data only allow for population estimates of fish 18 lbs and over. Because 60% of the current domestic harvest is comprised of fish under 18 lbs, the monitoring program needs to be expanded to provide information on the sizes of fish that are being most heavily exploited. Increasing the amount of information on smaller fish in the population will allow the Board to make more timely decisions with regard to achieving Goals 1 and 2.

Recruitment Monitoring

Restoring self-sustaining populations of fish requires an understanding of recruitment because populations can only sustain themselves if successful reproduction, followed by survival to maturation, occurs (Jager et al. 2001). The Board recognizes a need to broaden the current monitoring program to gain a better understanding of recruitment of young fish into the population. The current index-fishing program cannot detect a change in the number of small sturgeon entering the population until as much as 20 years after the change has occurred (i.e., until fish have reached 18 lbs). By understanding changes in the number of young fish in the population, the Board will be able to make better and more timely management decisions with respect to Goals 1 and 2 and to evaluate progress toward Goal 2 at the end of the ten-year plan.

A method has not been identified to date that can adequately measure the population of young sturgeon in the Saskatchewan River. Recent catches of large numbers (~100) of juvenile sturgeon in 4.25 inch nets set by commercial fishermen near The Pas (A. Constant, The Pas, MB., pers. comm.) provides an indication that gillnetting may be an effective method of catching young fish in certain locations. Bretecher and MacDonell (2001) recommended that seines fixed with tickler chains may be an effective method to sample juvenile sturgeon on the margins of the Saskatchewan River downstream of Bigstone Rapids. The Board will investigate these and other methods to monitor young sturgeon and implement a suitable program as soon as possible.

6.3.1.2 Monitoring the Domestic Harvest

To have an understanding of the factors limiting the sturgeon population and to direct management efforts, it is important to have an understanding of the number of fish that are being removed from the population. At present, the Board has little understanding of the harvest of sturgeon from the river.

Determining the size of the domestic harvest at Cumberland House and The Pas is important for understanding how harvests may be affecting the population. The types of information that are required include: the number of fish caught; the number of tagged fish caught; the size of the fish caught; and whether the fish are kept or released. The Board recognizes that this information should be requested on a confidential and voluntary basis and must not be related to enforcement activities. The Board will consider a number of harvest study methodologies including river surveys, household surveys, and harvest calendars (where individuals track harvests on calendars) and implement the most appropriate approach on a regular basis.

6.3.2 Strategy 2 – Increase Recruitment

Increasing recruitment (the number of fish coming into the population) is one of two management strategies (see Strategy 3) that can be employed to increase the spawning population in 20 years and achieve Goal 2 of the ten-year management plan. Increasing recruitment will:

- enhance the chances of population survival;
- help to maintain or increase the current population size into the future; and,
- help support the domestic harvest.

The number of sturgeon that hatch each year may currently be limited by the size of the spawning population or by habitat limitations. Increasing natural recruitment requires an understanding of the habitat factors currently limiting the population. This understanding will be provided through habitat assessment studies, which are discussed under Strategy 5. Introducing sturgeon into the system is an immediate method of increasing recruitment and will be considered by the Board over the short term.

There are two methods of introducing sturgeon into a system: translocation and stocking. Translocation would involve transferring juvenile or adult sturgeon into the reach between E.B. Campbell and Grand Rapids dams from another location (e.g., from above E.B. Campbell Dam) and could have an immediate positive effect on the spawning population. However, to have a measurable effect on the population, relatively large numbers of sturgeon would need to located and moved. For example, to increase the adult sturgeon population between E.B. Campbell and Grand Rapids dams by 5%, 65 adult sturgeon would need to be moved into the reach. The 22 km river section of Tobin Lake below Francois-Finlay Dam yielded a relatively large number of sturgeon during experimental gillnetting by SE during spring, 2002, and may be a potential source of sturgeon for translocation. The Board will continue to investigate other sites to source

sturgeon and evaluate the feasibility and benefits of implementing a sturgeon translocation program. The Board will not undertake a translocation program without conducting a thorough assessment of the risks involved (i.e., determining risks to both the population from which the fish are taken and the population into which the fish are to be introduced) and will not proceed unless the risks to both populations are minimal.

Stocking has the potential to have a more measurable effect on the population, but over a much longer term than translocation (it would require approximately 20 years to have a measurable effect on the spawning population). Sturgeon stocking requires the collection and artificial fertilization of eggs from wild brood stock. The sturgeon can then be stocked as eggs, larvae, or fingerlings.

If the brood stock were to originate from downstream of E.B. Campbell Dam, the intent of stocking would be to increase fertilization, hatch, and larval survival rates compared to the natural setting. While this is often assumed to be beneficial, there are few studies showing that collection and fertilization of eggs is better than natural reproduction. However, if natural spawning conditions are limiting, collection and incubation of eggs in a hatchery may significantly improve recruitment. Stocking of sturgeon originating from brood stock collected outside of the E.B. Campbell Dam to Grand Rapids Dam reach of the river would supplement recruitment from natural reproduction.

Maintaining the genetic integrity of the Saskatchewan River sturgeon is a primary concern. Saskatchewan River sturgeon are genetically distinct from other populations in Manitoba where spawn-taking operations have been conducted. The Board believes that it is currently undesirable to mix stocks without a more detailed consideration of the consequences. Thus, the source of brood stock for stocking would be restricted to the Saskatchewan River and its tributaries from the forks of the North and South Saskatchewan rivers downstream to Grand Rapids Dam.

For rehabilitation purposes, the Wisconsin Department of Natural Resources recommends stocking at a rate of 80 fingerlings per mile of river and one fingerling per two acres of lake on an annual basis for 25 years. Assuming that the river reach of interest (E.B. Campbell Dam to the Summerberry River) is 300 km long, approximately 15,000 fingerlings would be required each year to achieve the recommended stocking rate. If the other 880 km of river channel in the Delta and Cedar Lake (as discussed in Section 4.1) were stocked at the same rate, an additional 44,000 fingerlings would be required annually. Based on previous sturgeon culture experience on the Saskatchewan River (see Section 5.4), the required number of fingerlings for the river

could be produced from the eggs of nine female sturgeon. If Grand Rapids reservoir (including Cedar, Cross, and South Moose lakes), which is 862,502 acres (Manitoba Hydro, unpublished), and Cumberland Lake, which is 60,753 acres (Reed 1959), are stocked at the recommended rate, it would require approximately 431,000 and 30,000 fingerlings, respectively. Based on previous culture experience, this would require collecting eggs from over 100 female sturgeon, and is clearly not feasible.

Rearing young sturgeon to the fingerling stage in a hatchery currently costs approximately $1 per fish (T. Smith, MC, Whiteshell Hatchery, pers. comm.). Additional costs would be incurred to capture the brood stock and collect and transfer the eggs to the hatchery.

The SRSMB is committed to investigating the potential for stocking. Priority tasks will be:

- to identify a source of wild brood stock;
- to investigate alternative rearing techniques, in consultation with fish culture experts, to determine if there is a more cost-effective way to raise sturgeon to the fingerling stage; and,
- to determine how stocking contributes to the population by checking captured fish for previously applied marks and by marking any additional stocked fish.

Prior to committing to a large-scale stocking program, it is essential that the Board has some level of comfort with its understanding of natural recruitment and whether it is currently a limiting factor. The decision to stock must be based on the recognition that it will be a long-term effort and may require the development of infrastructure.

6.3.3 Strategy 3 – Decrease Mortality

Decreasing mortality (the number of fish that die) is the second strategy that can be employed to increase the spawning population in 20 years and achieve Goal 2 of the ten-year management plan. This strategy will also help to stabilize the existing spawning population (Goal 1), particularly if the number of fish entering the spawning population decreases in the near future.

Decreasing mortality will:

- help to maintain or increase the current population;
- help to maximize the number of fish spawning now;
- increase the chances of survival of the stock; and

- increase the speed of recovery.

Sturgeon mortality results from both "natural" (e.g., climatic, predation) and "human" (e.g., fishing, habitat manipulation) causes. The "natural" reasons for mortality are hard to control and often difficult or impossible to offset. The "human" reasons for mortality are more easily off set through harvest reductions or habitat improvement. Habitat improvement requires an understanding of the habitat factors that are currently limiting the population. This understanding will be provided through habitat assessment studies, which are discussed under Strategy 5.

To decrease mortality over the next five years, the Board will focus effort on decreasing both legal and illegal harvests.

6.3.3.1 Legal Harvests (i.e., Aboriginal harvests)

First Nations have the right to harvest fish for their own consumption at any time of the year without the need for fishing licenses. The legality of other Aboriginal harvests (e.g., Métis) is gradually being defined by the courts, and is currently viewed differently in each province. Regardless of interpretation, the Board understands the importance of Aboriginal harvests and recognizes this in the long-term objective of this management plan. The Board will not recommend measures that will infringe on legal Aboriginal rights to harvest sturgeon.

The Board also recognizes the benefits associated with a harvest reduction and will direct effort at encouraging community members to voluntarily reduce harvests, or to keep only certain numbers or sizes of fish. For example, female sturgeon, which are critical to the reproductive capacity of the population, comprise a significantly higher proportion of the larger fish in the population than male sturgeon. The Board could choose to recommend that fish of a certain size be released to protect a key segment of the population.

6.3.3.2 Illegal Harvests (i.e., poaching)

Although Aboriginals have the right to harvest fish for their own consumption at any time of the year, they cannot sell fish without being in possession of a commercial fishing license. Non-Aboriginals cannot retain any sturgeon captured in Saskatchewan or Manitoba. The Board will focus effort on eliminating Aboriginal harvests that are sold, and non-Aboriginal harvests.

Based on the Board's current understanding, sturgeon poaching is not a significant problem on the Saskatchewan River. However, it should be noted that an illegal harvest of just 13 sturgeon 18 lbs and over amounts to 20% of the annual sustainable yield from the current population estimate (assuming the sustainable yield is 5% of 1300 fish or 65 sturgeon). Consequently, the Board sees the elimination of even a small amount of poaching as desirable. Effort will be directed at encouraging community members to report poachers to the responsible authorities and increasing regulatory patrols on the river. Harvest reductions and reporting poachers will be encouraged, and educating poachers will be accomplished, through Strategy 4 - Communication and Education, as discussed in the following section.

6.3.4 Strategy 4 – Communication and Education

To achieve the overall objective of establishing a self-sustaining sturgeon population that meets the needs of local people, it will be necessary to achieve community support for sturgeon conservation. To gain this support, the communities must feel involved in, and part of, the decision making process. It is important for the Board to communicate to community members the rationale for, and results of, Board activities, and to educate community members with regard to the vulnerability of Saskatchewan River lake sturgeon. Each representative on the Board must ensure that the Board's message reaches their community or organization and, in turn, ensure that the opinions of the community or organization are expressed to the Board. Community representatives must be given the full support of the Board.

The communication and education programs will focus on:

- fostering interest in lake sturgeon;
- educating the communities about the low population levels of sturgeon;
- educating the communities about the activities of the Board;
- providing valuable feedback on Board initiatives;
- encouraging informed community involvement;
- providing the Board with a level of credibility;
- fostering community support for the need to reduce harvest levels;
- conveying recommended sustainable harvest levels to harvesters; and,
- encouraging voluntary harvest reductions.

The Board will seek to communicate with and educate communities through the following actions:

Community Meetings/Band Council Meetings

Meetings will be conducted in Cumberland House and The Pas to discuss Board activities, and to present findings of Board investigations and recommendations, and to seek feedback on management options (e.g. on desired harvest levels). The information will be conveyed in a manner that it is understandable to a non-technical audience.

Newsletter Articles

The Board will contribute articles to community newsletters that discuss sturgeon issues and Board activities.

Sturgeon in Schools Program

The Board will continue to participate in school programs to educate students about sturgeon.

Traditional Knowledge

The Board will examine the feasibility of collecting traditional knowledge of sturgeon and the sturgeon fishery from the communities of The Pas and Cumberland House. Traditional knowledge is a tool that can foster interest in lake sturgeon populations within the communities and encourage active participation in sustainable management of the species. Traditional knowledge can provide information on lake sturgeon life history characteristics and habitat, including historical information that is not available from other sources.

Posters

The Board will produce posters to be displayed in communities describing the Board, its activities and recommendations, and the vulnerability of the Saskatchewan River sturgeon population.

6.3.5 Strategy 5 – Habitat Assessment

Identification of a long-term population objective (Goal 4) requires an understanding of the harvest level desired by the Aboriginal harvesters, the carrying capacity of the habitat, and the age, sex and genetic structure of the population that is required for the population to be sustainable.

Domestic harvest monitoring as outlined in Management Strategy 1 will facilitate the determination of the desired harvest level by providing an understanding of the current harvest level. The Band council/community meetings outlined in Management Strategy 4 will provide a forum in which the Board can inform communities of current harvest levels and receive feedback

on desired harvest levels. For the desired harvest level to be sustainable, it should not exceed 5% of the carrying capacity of the habitat.

Wallace (SE, Saskatoon, pers. comm.) used two methods (an analysis of mortality rate and harvest; and, an analysis of carrying capacity of the habitat) to estimate that the abundance of sturgeon 18 lbs and over in 1958 was 6,500-16,000 fish. If it were assumed that the current carrying capacity is similar to 1958, this provides a very rough estimate of the number of fish that the reach of the Saskatchewan River between E.B. Campbell Dam and Grand Rapids Dam may be able to support. The Wisconsin Department of Natural Resources (2000) Management Plan for Lake Sturgeon recommends managing a 300 km stretch of river (approximately the distance from E.B. Campbell Dam to the Summerberry River) for a density of 45,000 age 2+ sturgeon.

The Board recognizes that habitat within the Saskatchewan River is unique and has been irreversibly changed. At least two sets of rapids (Iskwao and Tobin) have been permanently de-watered or inundated, and the suitability of the remaining habitat for spawning remains in question. Although the carrying capacity of the habitat is probably less than it was historically (i.e., in 1958), the extent of the decrease is unknown. There is very little known with regard to the factors currently limiting the population and a better estimate of the carrying capacity would be desirable. To provide this estimate, it is necessary to gain a better understanding of the suitability of the existing habitat and its current utilization.

Habitat assessment is a critical component of the management plan because it will:

- provide information on limiting factors and critical habitat;
- help to prevent a further decline of existing habitat;
- help identify opportunities for habitat improvement;
- help set a realistic long-term population goal; and,
- increase interest in sturgeon, fostering community participation in management initiatives.

Spawning habitat (along with overexploitation) is often suspected to be one of the key limiting factors of impacted sturgeon populations. As discussed previously, at least two sets of rapids where sturgeon may have formerly spawned (i.e., Tobin and Iskwao) no longer exist. The Board has identified a number of other sites where sturgeon are, or were, suspected to spawn in the Saskatchewan River, including:

- E.B. Campbell tailrace;
- Bigstone Rapids;
- Torch River;
- Mossy River;
- Cumberland Lake islands;
- Tearing River;
- Centre Angling River; and,
- Big Bend.

It should be noted that conditions at all of these sites have changed dramatically since the 1950s because of upstream water and hydroelectric development and their present suitability for spawning remains in question. The Board recognizes that there is a need to confirm whether the existing spawning habitat is suitable and if it is being utilized. This information will also facilitate the decision making process for implementation of a stocking program.

Habitat assessment priorities include:

Investigations of spawning site utilization

Investigation of spawning sites will identify critical habitats for protection and provide an understanding of current reproductive activity and recruitment. Sites should be prioritized according to known spawning activity (e.g., Torch River) and suitable conditions for spawning (i.e., appropriate substrates, water velocities and depths).

Habitat modeling and instream flow needs

Habitat modeling will provide information on the suitability of existing habitats and how those habitats may be enhanced. Instream flow needs studies will provide information on how to optimize flow management for power generation and lake sturgeon production. For example, the area immediately below the power station outfall at E.B. Campbell Dam contains the last available section of the extensive pre-dam rapids that has coarse substrate suitable sturgeon spawning. However, existing hydro-peaking operations are suspected to make much, or all, of the area unsuitable for spawning. Determining if conditions for sturgeon spawning in this area can be improved requires the collection of habitat data in the field and modeling of the habitat conditions under various flows.

Over the course of this management plan, the Board will examine the need for and feasibility of conducting such investigations and develop further plans as required.

7.0 IMPLEMENTATION PLAN

The SRSMB will operate as outlined in its Terms of Reference for the duration of the ten-year management plan (Appendix 3). Management strategies identified within the ten-year management plan will be implemented through the following three processes.

7.1 PLANNING ACTIVITIES

The SRSMB will meet at least two times per year and additionally as required. The responsibilities of the Board organizations, members, and chairperson are outlined in the SRSMB Terms of Reference (Appendix 3). During the ten-year management plan, the Board will undertake the following:

7.1.1 Assessment Meeting

An Assessment Meeting will be held in October or November each year to review results of activities from the previous year and assess progress toward meeting management plan goals. The meeting agenda will include*:*

Presentation of Results from Previous Year

- Each organization that conducted work for the Board in the previous year will provide a presentation their results.

Review of the Monitoring Program

- A review of the monitoring program from the previous year will be conducted. The Board will recommend changes to the program for the upcoming year that will satisfy the monitoring needs of the Board.

Sustainability Assessment

- The Board will review the most recent monitoring data, including the population estimate, age and sex structure of the population, domestic harvest estimate, and current understanding of poaching, and evaluate the progress toward achieving both Goals 1 and 2 of the monitoring plan and the sustainability of the existing population. A decision making flow-chart for annual implementation of management strategies to achieve a sustainable lake sturgeon population is provided in Figure 8. Management strategies that can be applied to achieve specific management goals are summarized in Table 3.

Table 3. Summary of relevant management strategies for each management plan goal.

	Goal	Relevant Management Strategies
Goal 1	Stabilize the existing spawning population in the next five years.	**Strategy 1 – Monitoring –** measure success **Strategy 2** – **Increase recruitment -** through translocation. **Strategy 3** – **Decrease mortality** - through harvest reduction. **Strategy 4** – **Education and communication** - Fosters support for a harvest reduction.
Goal 2	Achieve a measurable increase in the spawning population in 20 years.	**Strategy 1 – Monitoring –** measure success **Strategy 2** – **Increase recruitment** – through translocation and stocking. **Strategy 3** – **Decrease mortality** - through harvest reduction. **Strategy 4** – **Education and communication** - Fosters support for a harvest reduction. **Strategy 5** – **Habitat assessment and enhancement** - Increase natural recruitment and carrying capacity.
Goal 3	Achieve community support for voluntary measures that ensure harvest levels are sustainable.	**Strategy 4** – **Education and communication** – Informed community involvement will build credibility and support for Board initiatives.
Goal 4	Within the next five years, determine the long-term population objective and the most effective way to achieve it.	**Strategy 4** – **Education and communication** – Provides information on desired harvest levels. **Strategy 5** – **Habitat assessment and enhancement** - Provides information on carrying capacity.

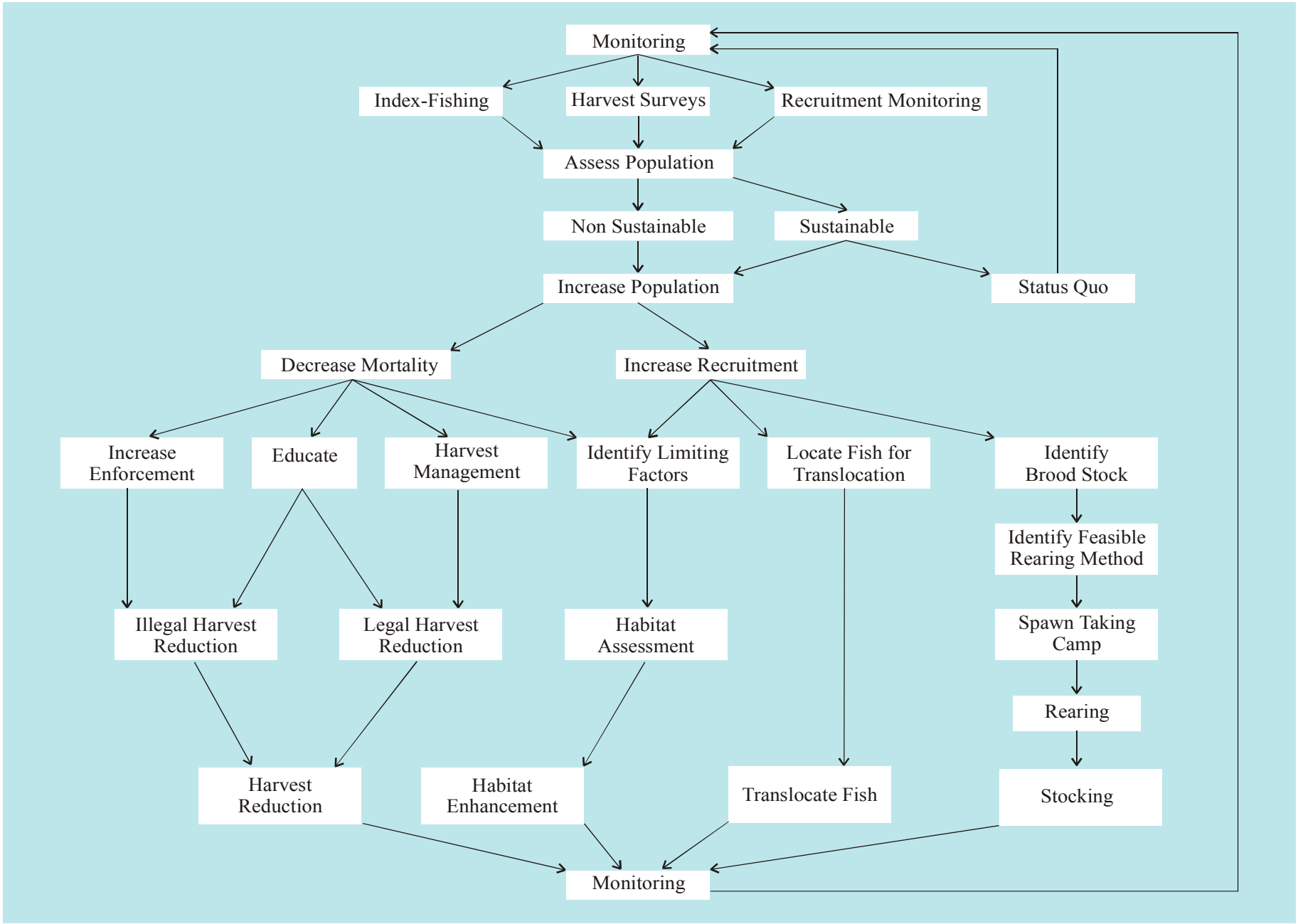

Figure 6. Decision making flow chart for annual implementation of management strategies to achieve a sustainable lake sturgeon population.

Review Management Strategies and Progress Toward Goals

Pending the evaluation of sustainability, the Board will:

- Investigate, discuss, and recommend appropriate management measures (e.g., habitat protection, harvest recommendations) to ensure sustainable harvests.
- Review the communication and education initiatives undertaken in the previous year and recommend appropriate actions in the coming year particularly with regard to achieving Goal 3 – Achieving Support for Sustainable Harvest Levels.
- Review progress toward Goal 2 – Achieving a measurable increase in the spawning population in 20 years. The review will include an evaluation of the sustainability of the harvest (as above) and an evaluation of stocking and translocation activities from the previous year. The Board will discuss and recommend appropriate actions for the coming year. The primary focus initially will be on locating suitable brood stock and developing a more cost-effective method of rearing fingerlings.
- Review habitat assessment activities from the previous year particularly in relation to: identifying limiting factors and developing an estimate of the current carrying capacity of the Saskatchewan River; increasing recruitment; and decreasing mortality. The board will discuss and recommend appropriate actions for the coming year.
- Pending the outcome of habitat assessment activities, the Board will develop plans for habitat enhancement initiatives that will increase recruitment and/or decrease mortality and ultimately increase carrying capacity.

Prioritize and Develop Preliminary Budget

- The Board will prioritize the proposed management initiatives based on cost, available funding and importance of the initiatives for reaching management plan goals, and develop a preliminary plan and budget for Management Board activities for the coming year.

Subsequent to the Assessment Meeting, Board members will conduct research and planning activities required to undertake the proposed Board initiatives for the coming year. Board members will be responsible for securing the necessary project funding during this period such that a commitment for implementation of proposed Board initiatives can be made at the Planning Meeting in February.

7.1.2 Planning Meeting

A Planning Meeting will be held near the end of February each year to commit to activities and conduct detailed planning for the coming year. The Planning Meeting agenda will include implementation plans for the following:

- monitoring, including index fishing, recruitment monitoring, and monitoring of the domestic harvest;
- communication and education initiatives;
- spawn-taking, rearing, stocking, and translocation; and,
- habitat assessment/enhancement.

Responsibilities for reporting, population estimates, and further research will also be assigned at the meeting. Budgets to conduct the planned activities will be finalized.

7.1.3 Identify Population Goal and Harvest Level

Within five years, the Board will work toward identifying appropriate population and sustainable harvest levels based on results from monitoring and habitat assessments, additional research, and community liaison. The population goal will, at a minimum, include a description of population density, population age-structure, and habitat. The sustainable harvest level will be defined by a total number of fish of a certain maturity, age, or size, and may be adjusted as the population is rehabilitated.

7.1.4 Funding

The Board will investigate the feasibility of consolidating agency funding for Saskatchewan River lake sturgeon management to provide an annual operating budget that can be partitioned between Board priorities. The Board will also consider provision of travel expenses for members to attend Board meetings.

7.2 FIELD PROGRAMS

The Board will facilitate implementation of field programs to achieve management plan goals. Annual field activities will be undertaken as determined during the assessment and planning meetings. Field programs will include, but may not be limited to, the following activities.

7.2.1 Population Monitoring

The Board will conduct a population-monitoring program in both Saskatchewan and Manitoba on an annual basis.

The primary objective of the population-monitoring program will be to provide information (i.e., scientific data) on the size and condition of the Saskatchewan River sturgeon population to act as a base against which progress of the management plan can be measured. Monitoring program results will also provide information upon which to base implementation of management strategies and measure the success or failures of those strategies. Therefore, the population-monitoring program should be designed to provide, where possible, the type of information upon which management plan strategies are based. This includes providing information on abundance and condition of the following:

- the spawning population;
- fish to be recruited into the spawning population in the near future; and
- the population targeted by harvesting activity (sturgeon 4 kg and up).

A secondary objective of the monitoring program is to utilize the experience and knowledge of former commercial fishermen, and to allow the fishermen to participate in the management program while supplementing their incomes.

Saskatchewan Environment and Manitoba Conservation will coordinate the population monitoring programs in Saskatchewan and Manitoba, respectively. Population monitoring will continue to be conducted by index-fishing and mark-and-recapture. The Board will work towards standardizing index-fishing methods to ensure that the program provides the necessary information against which progress towards program goals can be measured. Presently, the index-fishing program only provides information to estimate the sturgeon population 18 lbs and over. If feasible, the Board will implement additional methods of monitoring that will provide a better understanding of the progress being made towards achieving the management plan goals.

7.2.2 Harvest Surveys

The Board will undertake a harvest survey at Cumberland House and The Pas at least once every five years and more often if warranted. Harvest surveys will be developed in consultation with community members on the Board and will focus on hiring local people. Harvest studies will be designed to provide an estimate of the overall domestic harvest from the Saskatchewan River.

The Board will consider a number of harvest study methodologies including river surveys, household surveys, and harvest calendars (where individuals track harvests on a calendar). The harvest estimate in concert with the population estimate of harvestable sturgeon will provide a measure of the sustainability of the domestic harvest.

7.2.3 Brood Stock/Translocation Assessments

Saskatchewan Environment will undertake investigations to identify possible sources of sturgeon for brood stock and/or translocation. Target locations will be netted to determine the presence/absence of mature sturgeon, their abundance, and the potential risks associated with removing spawn or adults from the population. Saskatchewan Environment will provide a report to the Board on the results of investigations on an annual basis. Once a site has been identified with surplus spawners, the Board will need to make a decision on which course of action to pursue, and to find and allocate funds for transfer or infrastructure.

7.2.4 Habitat Assessment

Habitat assessment is seen as one of the key priorities of the management plan. SaskPower is currently developing a study in consultation with DFO to assess the impacts of hydro peaking below E.B. Campbell Dam. The SRSMB will support this study and, pending prioritization of habitats and methods, and obtaining the necessary funding, will develop other habitat assessment studies as warranted.

7.2.5 Other Field Programs

Based on annual assessments of monitoring results, planning activities, and results of other field activities, the Board may undertake other field programs to achieve management plan goals. These field programs would be dependent on available funding and completion of certain preliminary requirements or investigations (Table 4).

Table 4. Potential SRSMB field programs and preliminary requirements for implementation.

Field Program	Preliminary Requirement for Implementation
Spawn Taking Operation	Identify brood stock.
Rearing and Stocking Operation	Identify feasible and cost-effective rearing technology.
Translocation	Identify adequate source of sturgeon.
Monitoring Abundance of 4-8 kg sturgeon	Identify feasible method.
Monitoring Recruitment (young-of-the-year)	Identify feasible method.
Habitat Enhancement	Identify limiting habitat and feasible cost-effective improvements.

7.3 COMMUNITY LIAISON

The SRSMB will conduct a community liaison program on an annual basis. The program will consist of the following components.

7.3.1 Community/Band Council Meetings

OCN – The Board will hold a meeting with the OCN Band Council on an annual basis. The meeting may be scheduled to coincide with regularly scheduled assessment or planning meetings. The purpose of the meeting will be to review Board activities, present current information on the status of the Saskatchewan River lake sturgeon population, and review proposed Board activities for the coming year and recommendations for safe harvests.

The Board member representing OCN will organize and chair the meeting. Other Board members will attend, as required, to help present information. Information will be presented at a level understandable to those with no background in fisheries sciences.

Cumberland House – A community meeting will be held in Cumberland House on an annual basis. The purpose of the meeting will be to review Board activities, present current information on the status of the Saskatchewan River lake sturgeon population, and review proposed Board activities for the coming year and recommendations for safe harvests. The meeting will be organized and chaired by the Board members representing Cumberland House. Other Board members will attend, as required, to help present information. Information will be presented at a level understandable to those with no background in fisheries sciences.

7.3.2 Community Newsletters

With assistance from the Board members from OCN, the Board will prepare and submit articles on Saskatchewan River lake sturgeon to OCN for distribution within OCN community newsletters. The objective of the articles will be to garner support for the Board and sustainable harvest levels. The articles will focus on the vulnerability of lake sturgeon populations, the current status of sturgeon in the Saskatchewan River, and current Board activities and recommendations for safe harvests.

The Board will examine the feasibility of producing a newsletter for distribution in Cumberland House. The purpose of the Cumberland House newsletter would be similar to the OCN newsletter articles.

7.3.3 Schools Program

The Board will continue to pursue the Sturgeon in Schools Program at both OCN and Cumberland House. This program educates school children about lake sturgeon, in part by providing sturgeon fingerlings for school aquaria.

7.3.4 Posters

The Board will develop posters for distribution and display in public areas of OCN, The Pas, Cumberland House and elsewhere in the region. The posters will focus on increasing awareness of the vulnerability of lake sturgeon, the current status of the Saskatchewan River sturgeon population, and current Board activities and harvest recommendations.

7.3.5 Traditional Knowledge

The Board will examine the feasibility of collecting traditional knowledge on lake sturgeon from community members at Cumberland House and OCN. Collection of traditional knowledge will focus on increasing knowledge of lake sturgeon life history characteristics and habitat utilization in the Saskatchewan River and on increasing awareness and support for Board activities.

7.3.6 Sustainable Harvest Goal

The Board will use community consultation and traditional knowledge to define traditional use of sturgeon within the communities, and establish a safe harvest goal based on those traditional uses and knowledge of the existing population.

7.3.7 Other Activities

Based on annual planning activities and results of field and community liaison programs, the Board may undertake other activities to increase public awareness of and garner support for Board activities and recommendations.

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APPENDIX 1.
Saskatchewan River Sturgeon Management Board
member perspectives – January 2002.

JOHN DURBIN – Saskatchewan Environment

- SE is responsible for management of fish resources in Saskatchewan.
- There is no specific sturgeon strategy in Saskatchewan.
- Short-term objective – Stock recovery to allow sustainable food fishery to meet traditional needs of Aboriginal residents.
- Long term objective – Re-establish commercial fishery, if possible.
- There is an indication presently that the current food fishery is not sustainable.
- However, there is a lack of information on the extent of the domestic catch. SE's impression is that the domestic harvest is greater in Manitoba than in Saskatchewan.
- It is important to gain an understanding of the extent of the harvest. However, this has not been accomplished to date and will not be easy. SE is hoping there will be some good information coming from the Manitoba side.
- SE has confidence in the present population estimates. The lack of information on domestic harvest raises concerns with regard to present sustainability. The harvest may be causing a continual decrease in the population. Communities must be convinced that the domestic harvest has to be reduced to ensure the population does not decline further.
- Cannot rely on just harvest level controls. Need an even-handed approach to recovery. This should include:
  - *continued monitoring* – for population estimate purposes and to ensure the population, which is at a very low (unsafe) level, does not decline further;
  - *fish stocking* – which may depend on whether portable raceways for rearing sturgeon are feasible – also need supply of spawn – should not be viewed as a "cure all", but as an enhancement tool;
  - *habitat enhancement* – practical options should be considered and tried to counter known impacts of dams; and,
  - *investigations* – to identify additional spawning areas, especially outside the delta area, for spawn taking purposes.

ROB WALLACE – Saskatchewan Environment

"Habitat and harvest issues must both be addressed."

HABITAT

- There has definitely been a loss of spawning habitat since hydroelectric development took place.
- However, it is reasonable to ask – Do we currently have enough females to use the habitat that is available now?
- Must determine if spawning habitat is limiting.
- Would like to have someone look at tailrace at E.B. Campbell for suitability of spawning habitat. Possibly using River 2D model. Will produce depths velocities, angles of flows, etc.
- Temperature may also be an issue for spawning in tailrace.

HARVEST

- Index fishing is a good biological tool for monitoring abundance and sizes, is an educational tool for fishermen, provides fishermen with income, and gives the Board a presence on the river.
- Thinks there is an understanding in the communities that over harvesting is a problem.

FRANKLIN CARRIERE – Saskatchewan Northern Affairs

- Northern Affairs mandate is to support Cumberland Lake fishermen.
- Their goal is bring the Saskatchewan River sturgeon population back to a level that could support a commercial fishery – albeit at a lower production limit than historically.
- Northern Affairs views their position as an advisory role – Franklin was a commercial fisherman at one time.
- Main concern at the present time is water levels. Need water for suitable habitat.
- Index fishing should be continued (especially considering the reduced water levels). The Board can not stop monitoring now and say that the fishery has recovered.
- The Board is doing a reasonable job monitoring and educating electric utilities and local people.
- Domestic fishery should be monitored. Need to determine how many small sturgeon people are catching.
- The Bands may need to conduct workshops to encourage reporting of domestic harvests.
- Encourage Bands to exert community pressure to reduce harvest. Need to encourage Bands to police themselves.

LIEWELLYN MATTHEW – SaskPower

- SaskPower operates utilities on the Saskatchewan River.
- Recognize that the sturgeon population is an issue both from an ecological and social perspective.
- Basic outlook
  - SaskPower recognizes that their facilities are a contributing factor to declining sturgeon populations in the river.
  - However, SaskPower believes that overharvesting both pre- and post-project is a significant, if not the most significant, factor in the decline.
  - SaskPower strongly disagrees with those who lay the blame solely on SaskPower.
- SaskPower believes a solution will only come if all stakeholders work together. There is no single cause and no single solution.
- SaskPower fully supports recovery of sturgeon in the reach below E.B. Campbell Dam.
- SaskPower wants to ensure that the plans of the Board are appropriate for all stakeholders and believe that active participation in the Board is the best way to go about this.
- SaskPower sees current harvest as the biggest issue. It is unsustainable and if left uncurbed will lead to the demise of the population.
- SaskPower does not share the opinion that some have that spawning habitat is a current limiting factor. It is suspected that there is sufficient habitat there now for the current sturgeon population.
- There must be an increase in the current population to warrant habitat enhancement.
- Priorities:
  - *harvest management* – to maintain current spawning population
  - *hatchery operation* – to provide fish in river now
  - *monitoring* – to be aware of population status and determine when stocked fish are entering fishery
- However, not sure if the current level of monitoring is required.

JOHN CARRIERE – Cumberland House Fishermen's Co-op

- Represents the commercial fishermen at Cumberland House. The stakeholders with the most direct link to the sturgeon population.
- Wants to see sturgeon in the river.
- Have seen a decrease in the number of sturgeon over the years.
- Attribute decrease in sturgeon to loss of habitat.
- There is no domestic fishery for sturgeon - only incidental catches in nets targeting other species.
- Main interest:
  - Monitoring (index fishing) – should continue.
  - Habitat Enhancement – primarily with regard to discharges and water levels;
    – need water management from upstream; and,
    – Improvements in weir system needed to retain water.
- Current fishermen involved in index fishing are barely covering their expenses.
- Strongly against recommendations to do away with commercial fishery in favour of domestic fishery. Believes that this policy on the Nelson River encouraged people to develop a domestic fishery that did not exist prior to the policy.

DENNIS WINDSOR – Manitoba Hydro

- Manitoba Hydro has a corporate commitment to sturgeon in Manitoba.
- Manitoba Hydro has an interest in supporting Manitoba Conservation's departmental commitment to sturgeon.
- Manitoba Hydro is interested in establishing the facts with regard to the Saskatchewan River sturgeon population and sees the Board as a means of collecting the facts.
- Manitoba Hydro wants to reduce finger pointing and deal with facts.
- Manitoba Hydro wants the Board to have a clear idea of where it is going. The Board should establish a plan and work with it.
- Activities need to be prioritized.
- Suggested that more information is needed on the status of the stock.
- Talking about finances is fundamental to the management plan.

JEFF MOYER – Manitoba Conservation

- Manitoba Conservation is responsible for sturgeon management in Manitoba.
- They have confidence in the current population estimates.
- Would like to see monitoring (index fishing) continued with standardized methodology for the whole river and including all sizes of sturgeon. However, level could likely be reduced and funds reallocated to other priorities.
- Domestic harvest needs further examination. There are still hopes in the communities that the commercial fishery will re-open but he does not see that happening. The goal should be to bring back stocks so they can be used to meet traditional needs of First Nations.
- Domestic harvest can be managed through community awareness and communication. Possibly some of the funds from monitoring can be shifted to this.
- Habitat enhancement and stocking should also be looked at.
- Recognize that co-management is necessary to protect the stock.
- Saskatchewan River is considered to be a high priority area.

MANITOBA STURGEON MANAGEMENT STRATEGY	
Long-term objective:	"To re-establish or maintain (at least at 1990 levels) sturgeon populations in Manitoba in balance with carrying capacity of its habitat."
Guiding Principles:	• Maintain Genetic Integrity. • Protect Existing Stocks - relates to harvest use. • Maintain and Enhance Existing Sturgeon Habitat. • Stocking – to accelerate recovery.
Goals:	• Heighten public awareness - inform and share information with resource users and others. • In conjunction with First Nations, develop and implement domestic harvest census and monitoring program, and negotiate an appropriate level of harvest. • Monitor and enforce domestic harvest. • Examine habitat and water flows and enhance if necessary. • Assess and monitor sturgeon stock. • Develop stocking plan.

DON LAITHLIN – Opaskwayak Cree Nation
(member of the OCN Resource Council)

- There is no doubt that the Saskatchewan River sturgeon population has suffered a decline from historical levels.
- OCN does not agree with those that lay the blame solely on overfishing.
- OCN believes that the E.B. Campbell and Grand Rapids dams have had a significant effect on the sturgeon population.
- However, it is important for the Board not to lay blame.
- Overall objective of OCN is to have a sustainable sturgeon population that can be a food source for the people of OCN.
- There is recognition by OCN members that a commercial fishery is no longer sustainable.
- However, it is important to maintain the domestic fishery.
- The general belief is that we now have a good understanding of the problem and that the focus should be on educating Band members with regard to sturgeon.
- Funding will be needed for educational purposes. Manitoba Hydro should be making a bigger financial commitment to the Board. SaskPower is making great strides on the sturgeon issue on the Saskatchewan side.
- Education should focus on the current status of sturgeon in the river and should not be geared toward reducing harvests. Reduced harvests must be voluntary. The treaty right to fish is fundamental. However, the harvest study conducted by the OCN student was an "eye-opener".
- Education could be fostered through OCN participation in stocking and hatcheries and through the collection of lake sturgeon TEK from the community.
- Manitoba Hydro has dealt with the people (e.g., by paying compensation) but not the fish. Some effort should be put into increasing the suitability of the habitat. Manitoba Hydro has provided very little input with regard to the depletion of the stock in Manitoba.
- TEK should be used in concert with scientific data in Board decisions.
- Reports produced by the Board should be written in a way that is understandable to average community members.

ROBERT McGILLIVARY – Opaskwayak Cree Nation

- OCN is concerned with what is happening on our lands.
- We are trying to help correct the wrongs brought about by SaskPower and Manitoba Hydro.
- Reservoirs holding water back are a problem.
- Spawning areas have been destroyed.
- Sturgeon are hungry and easily caught by anglers.
- We need to educate our own people.
- To educate, the Board must spend money on the media and go to the general public to let them know what we are doing.
- Some people do not know that there is a Sturgeon Management Board operating.

RICK COURTNEY – Department of Fisheries and Oceans

- DFO mandate is to protect subsistence fishery through protection of habitat.
- DFO does not want to see the species become extirpated or extinct.
- Federal role may change in the future with endangered species legislation if the sturgeon become listed.
- The Board must have an understanding of factors that are limiting the population.
- None of the factors should be off limits. This includes flows.
- DFO understands that there is currently a significant harvest, low population, and low recruitment.
- It is important that a report be produced outlining current data on status of population (i.e., latest numbers from Rob Wallace).
- Do the numbers suggest that the population is in imminent danger of extirpation?
- We need to understand what will happen if we do nothing. This is the first place to start.
- Long-term goals 1st – survival
  2nd - recovery
- Latest numbers suggest domestic harvest is too high. It must be controlled.
- There is concern population is so low there may be insufficient spawners each year to reproduce successfully. Is spawning habitat limiting?
- Spawning habitat has been depleted. E.B. Campbell has destroyed biggest potential spawning site.
- All factors should be considered for survival of population – Harvest
  – Spawning habitat
  – Instream flow needs
- If spawning habitat is limiting, spawn taking camps and hatchery make sense.

CHIEF PIERRE SETTEE – Cumberland House First Nation

- We must educate our people and convince them that we need support.
- We must relay the message of what we are doing and what we trying to achieve.
- We need co-operation.
- We do not want to give up domestic use of sturgeon, but we do want to co-operate with the Board.
- Lots of people have cut back on fishing already.
- We must work together.
- There will be lots of work to do.
- Cumberland House First Nation requires funding to attend SRSMB meetings.
- There is currently very little water in the area near Cumberland House.
- It is difficult to get sturgeon in the summer because of the low water.
- Sturgeon are no longer in the area because of low water.
- Green stuff in the water during the summer makes it difficult to set nets.

APPENDIX 2.

Commercial harvests of lake sturgeon reported from the Saskatchewan River near Cumberland House and The Pas, 1906-1995.

Commercial lake sturgeon harvests (in kg marketed weight [headless dressed]) from the lower Saskatchewan River, 1906-1995.

Year	Saskatchewan*	Manitoba**	Year	Saskatchewan*	Manitoba**
1906		56818	1951	3990	
1907		9091	1952	3655	
1908			1953	3250	
1909		10045	1954	1230	
1910		9318	1955	3335	
1911			1956	3440	
1912			1957	3129	967
1913			1958	3550	636
1914			1959	1428	157
1915		6955	1960	1455	123
1916		30045	1961	682	
1917		12182	1962	3626	
1918		14636	1963	1782	
1919			1964	935	
1920			1965	1043	
1921			1966	804	
1922			1967	1760	
1923		29545	1968	2344	
1924		16364	1969	1591	
1925			1970		
1926			1971		
1927			1972		
1928			1973	3249	
1929		3227	1974	2410	563
1930		956	1975	2799	1252
1931		273	1976	2845	2915
1932	2273	455	1977	2841	2870
1933	2273	41	1978	3026	2312
1934	6818		1979	2973	1550
1935	6273		1980	3212	628
1936	8636		1981	3144	323
1937	2409	4500	1982	3672	412
1938	2045		1983	2687	240
1939	795	4300	1984	2774	289
1940	4545	600	1985	3488	201
1941	4082		1986	2131	346
1942	3647		1987	2469	272
1943	564	100	1988	2153	410
1944	670	400	1989	667	391
1945		100	1990	3131	134
1946			1991	1537	267
1947			1992	1330	485
1948	2954		1993	831	118
1949			1994	628	22
1950	1922		1995	641	

* data from Saskatchewan Environment, Fisheries Branch, Saskatoon and Wallace (1991).

** data from Dominion of Canada (1907, 1908, 1910, 1911, 1917, 1925), Harkness (1980), and MC, Fisheries Branch, Wpg. Round weights reported from 1974-1994 have been converted to marketed weights by a conversion factor of 0.6.

APPENDIX 3.
Saskatchewan River Sturgeon Management Board Terms of Reference.

The Saskatchewan River Sturgeon Management Board

Terms of Reference

Role

The Board will act in an advisory role on sturgeon management on the Saskatchewan River between the Grand Rapids and E.B. Campbell dams to the governments of *Canada,* Manitoba, Saskatchewan and First Nations.

Mission Statement

To prevent further decline of the sturgeon population; and to develop and coordinate a recovery plan.

Scope

The Board will advise on all matters related to sturgeon management on the Saskatchewan River between the Grand Rapids and E.B. Campbell dams. The Board may, but is not restricted to, making recommendations on the following matters:

- Provincial harvest (sport, commercial, and domestic);
- Aboriginal domestic harvest;
- Population monitoring;
- Habitat assessment and enhancement;
- Fish culture activities;
- Community education;
- Water management with respect to sturgeon requirements; and
- Other research.

Compensation for the impacts of hydro-electric facilities is beyond the scope of the Board.

Membership

The Board shall consist of one representative appointed by each of the following organizations:

- Saskatchewan Environment and Resource Management;
- Manitoba Natural Resources;
- Opaskwayak Cree Nation;
- Cumberland House Cree Nation;
- Cumberland House Fishermen's Cooperative;
- Saskatchewan River Fishermen's Association;
- SaskPower;
- Manitoba Hydro;
- Saskatchewan Northern Affairs; and
- *The Department of Fisheries and Oceans is also invited to participate.*

The Chairperson of the board shall be elected by the board members to serve for a one-year period.

Decision Making

The Board shall make all decisions by a consensus of members. While observers and guests may be invited to meetings, they shall not be included in the determination of a consensus. Following each meeting, the Chairperson shall compile and circulate a draft Record of Decisions for review by each member which, once signed at the next meeting, shall constitute a formal record of the decisions made by the Board. All Board members need not be present at a meeting for a decision to be made by consensus, however all members must sign the Record of Decision to indicate their agreement.

Responsibilities of the Board

1. To develop and implement an annual management/activity plan, including a proposed budget, for recommendation to the member organizations. This shall be completed no later than December 31 for the following year.

2. The Board will develop a long-range sturgeon recovery plan no later than December 31, 2003. After that date, the recovery plan will be annually reviewed and updated.

3. To coordinate the sturgeon management activities of the member organizations within the scope of its mandate.

4. To review all research conducted by member organizations on sturgeon in the Board's area of operations.

5. To produce an annual report on its activities for distribution to the member organizations and the affected communities.

6. To identify and source financing for all board activities.

7. To hold at least one community informational meeting per year to inform the community of Board activities.

Responsibilities of Member Organizations

1. To designate their representative in writing to the Chairperson. A member organization may change their representative at any time by notifying the Chairperson in writing.

2. To review all recommendations submitted by the Board. If a recommendation pertaining to that organization is not accepted, then a written response detailing the reasons for rejection shall be sent to the Board within 45 days.

3. To submit all relevant research to be conducted by the organization to the Board for review.

4. To submit an annual report to the Board on all activities conducted by their organization in accordance with the Board's management plan for that year.

Responsibilities of the Chairperson

1. To arrange for all meetings of the Board and prepare the agenda.

2. To chair and ensure the orderly conduct of all Board meetings.

3. To determine if a consensus has been reached on all decision items.

4. To compile and circulate a draft Record of Decision following each meeting, for signature by all members at the next meeting.

5. To ensure follow-up action takes place on any action item resulting from a Board meeting.

6. To maintain the official file on all Board matters.

7. To convey all recommendations of the Board to the respective governments.

8. To notify other members of any change in representatives to the Board.

9. To ensure the Board carries out all its responsibilities and that the Terms of Reference are adhered to.

10. To act as a spokesperson and the point of contact for the Board.

Meetings

The Board shall meet as required, but as a minimum no less than two times per year. A tentative date for the next meeting shall be set at the end of each meeting. The meeting date shall be confirmed, and agenda circulated by the Chairperson, no later than 14 days prior to the meeting date. Any member is entitled to ask for a meeting to be rescheduled. If a representative is unable to attend a particular meeting, they are expected to send a designate.

Board members may only invite guests or observers to meetings with the approval of the Chairperson who shall notify the other Board members in advance of the meeting.

Finances

Each member organization is responsible for all costs related to the participation of its representative on the Board.