Proceedings of the Lake Sturgeon research and recovery workshop, Winnipeg, Manitoba, March 10-12, 2010

D.B. Stewart and F.N. Hnytka (eds.)

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PROCEEDINGS OF THE LAKE STURGEON RESEARCH AND RECOVERY WORKSHOP, WINNIPEG, MANITOBA, MARCH 10-12, 2010,

by

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

Stewart, D.B., and Hnytka, F.N. (eds.). 2011. Proceedings of the Lake Sturgeon research and recovery workshop, Winnipeg, Manitoba, March 10-12, 2010. Can. Manuscr. Rep. Fish. Aquat. Sci. 2953: vi + 176 p.

In 2006, Lake Sturgeon (*Acipenser fulvescens*) populations in western Canada were assessed as “Endangered” by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). These populations are currently being considered for listing under Canada’s *Species at Risk Act* (SARA). Overexploitation along with habitat destruction, degradation and fragmentation are believed to be responsible for the species’ decline. The Lake Sturgeon Research and Recovery Workshop (March 10-12, 2010) gathered together stakeholders, First Nations and Métis representatives, researchers, regulators and recovery planning experts to share information on Lake Sturgeon research and recovery planning efforts. The formal presentations on recent and ongoing research and recovery efforts with accompanying dialogue are summarized in this report.

Key words: distribution; habitat requirements; seasonal movements; reproduction; life cycle; species recovery; population management; Ontario; Manitoba; Saskatchewan; Alberta; Lake Sturgeon.

RÉSUMÉ

Stewart, D.B., and Hnytka, F.N. (eds.). 2011. Proceedings of the Lake Sturgeon research and recovery workshop, Winnipeg, Manitoba, March 10-12, 2010. Can. Manuscr. Rep. Fish. Aquat. Sci. 2953: vi + 176 p.

En 2006, le Comité sur la situation des espèces en péril au Canada (COSEPAC) a évalué les populations d’esturgeons jaunes (*Acipenser fulvescens*) de l’ouest du Canada et les a désignées « en voie de disparition ». On examine présentement la possibilité d’inscrire ces populations à la liste de la *Loi sur les espèces en péril* (LEP) canadienne. On estime que la surexploitation de ces populations ainsi que la destruction, la dégradation et la fragmentation de leur habitat ont entraîné le déclin de l’espèce. L’atelier sur la recherche et le rétablissement concernant l’esturgeon jaune (du 10 au 12 mars 2010) a réuni des intervenants, des représentants des Premières nations et des communautés métisses, des scientifiques, des responsables de la réglementation et des experts de la planification du rétablissement afin qu’ils puissent partager de l’information sur les efforts de planification de la recherche et du rétablissement concernant l’esturgeon jaune. Le présent compte rendu résume les présentations officielles sur les efforts récents ou actuels consentis en matière de recherche et de rétablissement ainsi que les discussions connexes.

Mots clés : esturgeon jaune; répartition; exigences en matière d’habitat; déplacements saisonniers; reproduction; cycle biologique; rétablissement des espèces; gestion de la population; Ontario; Manitoba; Saskatchewan; Alberta; esturgeon jaune.

1.0 INTRODUCTION

In November 2006, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2006) assessed eight populations or designatable units (DUs) of Lake Sturgeon (*Acipenser fulvescens*) from across Canada (Figure 1). Of these, the five western populations; Western Hudson Bay (DU1), Saskatchewan River (DU2), Nelson River (DU3), Red/Assiniboine Rivers/Lake Winnipeg (DU4) and the Winnipeg River/English River (DU5) were designated as "**Endangered**" with the remaining three populations assessed as either "**Threatened**" (Great Lakes/Upper St. Lawrence (DU8) or "**Special Concern**" (Lake of the Woods – Rainy River (DU6) and Southern Hudson Bay/James Bay (DU7)). Overexploitation and habitat destruction, degradation and fragmentation, primarily associated with the construction and operation of dams and other water control structures, have been implicated in the severe decline of this species in Canada and across North America.

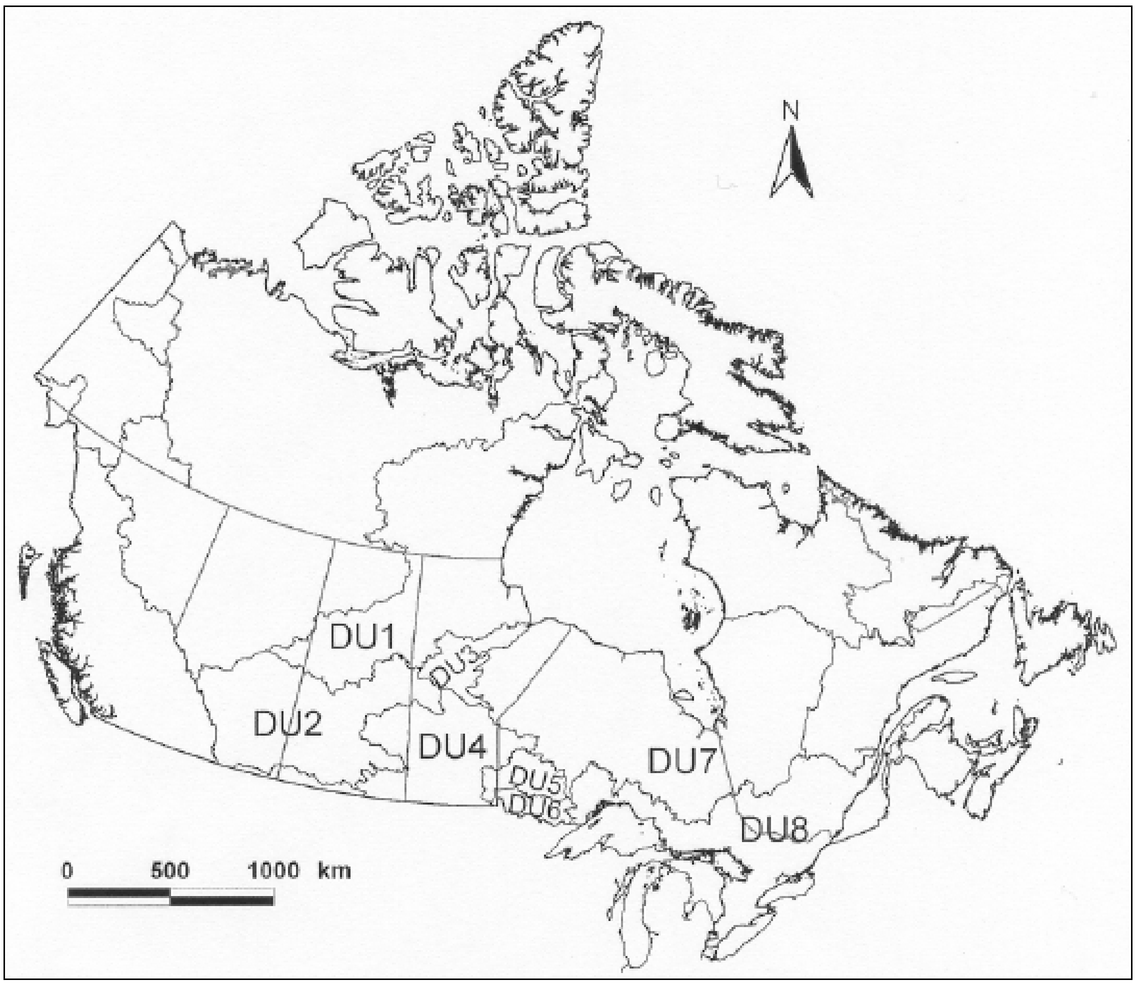

Figure 1. The designatable units used by COSEWIC (2006). DU1 = Western Hudson Bay; DU2 = Saskatchewan River; DU3 = Nelson River; DU4 = Red and Assiniboine rivers and Lake Winnipeg; DU5 = Winnipeg River–English River; DU6 = Lake of the Woods–Rainy River; DU7 = Southern Hudson Bay–James Bay; DU8 = Great Lakes–Upper St. Lawrence.

Terms and acronyms in bold font are defined in the Glossary.

The five western populations assessed as Endangered were the primary focus of the workshop held in Winnipeg, Manitoba, from March 10-12, 2010. The objectives of the workshop were to: 1) draw together individuals to share information and knowledge on recent sturgeon research and recovery efforts and, 2) identify sturgeon management and recovery approaches that might be applied to endangered populations of Lake Sturgeon. The current workshop was preceded by a Sturgeon Recovery Planning Workshop held in Winnipeg in February 2006 (Hnytka and Stewart 2007). Proceedings of the earlier workshop are available at http://www.dfo-mpo.gc.ca/csas/Csas/Publications/Pro-CR/2007/2007_030_e.htm.

As of the date of this publication, the Lake Sturgeon was not listed under the *Species at Risk Act* (SARA). Listing consultations with potentially affected parties are on-going. If the species is listed, recovery strategies must be developed for each of the "Endangered" populations within one year of listing. Given the species' broad geographical distribution; its importance to Aboriginal and First Nations communities, industry, and other stakeholders; and the range of threats and issues to be considered, significant effort will be required early in the recovery planning to meet this timeline. To that end, the "Lake Sturgeon Research and Recovery Workshop" was organized to gather researchers, regulators, resource users, industry, and Aboriginal and First Nations representatives to share information, look for opportunities to work together, and help shape future research and recovery efforts.

This report summarizes presentations and strategic planning discussions at the workshop. This sharing of information was intended to benefit all parties concerned with sturgeon recovery planning, and to enable them to reach a common understanding of the issues and solutions. Workshop participants are identified in ***Appendix 1***, the Agenda is provided in ***Appendix 2***, and comments on the workshop are summarized in ***Appendix 3***.

2.0 PRESENTATIONS

The workshop presentations and discussions that follow have been paraphrased but every effort has been made to accurately convey the information and intent. The editors apologize for any errors that were introduced. Presentations are summarized in the order they were presented, and are indexed in the Table of Contents. Each presenter was allowed twenty minutes to make their presentation, followed by a ten minute question and answer session wherein participants were asked to take turns with questions and respect others. Questions and answers were only included where they clarified or added significantly to the information. Questioner's names were not included as many did not announce their names and could not be readily identified. Copies of the slide presentations are appended with individual slides numbered for reference. Other documents supplied are cited. Where presentations contained a series of slides that built one point at a time on a particular theme, only the final summary slide was included. Acronyms and technical terms used in text are defined in the Glossary (Section 7.0).

2.1 Canada's *Species at Risk Act* (SARA): an overview

Ray Ratynski, Fisheries and Oceans Canada, Winnipeg, MB

Ray's presentation provided context for the workshop with an overview of how the *Species at Risk Act* (*SARA*) works (***Appendix 4***). SARA was brought into force in June 2003 to: 1) prevent wildlife species (i.e., biota other than bacteria and viruses) from becoming extinct in Canada; 2) provide for the recovery of species at risk; and 3) manage species of Special Concern to prevent them from becoming further at risk (***Appendix 4: Slide 2***). Under *SARA*, Fisheries and Oceans Canada is responsible for all aquatic species, Parks Canada Agency for species in National Parks, and Environment Canada for all other species and administration of the Act (***Slide 3***). Basic elements of SARA include science-based species assessments; a formal listing process; protection of individuals of a species, their residences, and **critical habitat**; mandatory recovery planning; and public involvement, all within a defined process (***Slide 4***).

The elements of the *SARA* process are illustrated in ***Slides 5 and 6***. The first element is assessment, which involves the preparation of species status reports by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) (***Slides 7 to 9***). These reports incorporate scientific knowledge, community knowledge and Aboriginal traditional knowledge. They assess the risk of extinction of wildlife species and make listing recommendations to the responsible government Minister. Species may be designated "Not at Risk", or assigned one of several ascending risk categories, ranging from "Special Concern" for species that are sensitive to human activities and natural events, to "Threatened" for species that require action to reduce the risk of extinction, "Endangered" for species in imminent danger of extinction in Canada, or "**Extirpated**" for species that no longer exist in the wild in Canada. Where data are insufficient to assess risk the species may be designated as "Data Deficient".

The second element of the SARA process is the response statement, which is issued by the Environment Minister within 90 days of receiving the assessment. The response statement identifies the responsible minister(s), when to expect a listing decision, and the level of consultations to be undertaken (***Slide 10***). The third element of the SARA process is the legal listing decision, which the responsible Minister(s) makes after considering science advice, undertaking consultations, and analyzing socioeconomic impacts (***Slide 11***). The Minister(s) may decide to accept the COSEWIC assessment and list the species, to not list the species, or to refer the assessment back to COSEWIC for further consideration. The Governor in Council has 9 months to make a listing decision from the time it receives the assessment.

If a species is listed as "Threatened", "Endangered", or "Extirpated", SARA automatically prohibits the killing, harming, harassment or capture of individuals (***Slide 13***). It makes the species illegal to possess, collect, buy, sell, or trade either whole or in part. It also makes it illegal to damage or destroy its residence, although the concept of residence may not apply to Lake Sturgeon. Permits may be issued under SARA (73) or another Act of Parliament (SARA 83) to exempt activities from these prohibitions. Scientific research to assist recovery efforts or incidental harvests with other targeted species might for example be permitted, provided these activities do not jeopardize recovery efforts (***Slide 14***). Critical habitat must be identified in either a recovery strategy or action plan (***Slide 15***). Once the strategy has been accepted this habitat is protected from harm under SARA (58). Projects triggered under the *Canadian Environmental Assessment Act* must consider the effects on listed species (***Slide 16***).

Listing under *SARA* triggers mandatory recovery planning for species designated as "Threatened", "Endangered" or "Extirpated" (***Slide 17***). This involves preparation of a recovery strategy that identifies population objectives, strategies to address threats, critical habitat—to the extent possible, and timelines for the preparation of an action plan(s). Prior to its implementation proposed recovery strategies are posted on the SARA Public Registry for comment. After the recovery plan has been finalized an action plan is developed (***Slide 18***). This plan details what is needed to achieve population objectives, identifies critical habitat and ways to protect it, and evaluates the socioeconomic costs and benefits of implementation. It too involves consultation and posting on the SARA Public Registry.

Species of "Special Concern" require the preparation of a management plan (***Slide 19***). These species are not subject to the automatic prohibitions under SARA, but the management plans do include conservation measures and may incorporate other management plans (i.e., species groups). The also involve consultations and posting on the SARA Public Registry. The involvement of non-governmental organizations (NGOs) in species at risk recovery is supported primarily by the Habitat Stewardship Program (HSP), and the Aboriginal Fund for Species at Risk (AFSR) (***Slide 20***). Projects by Federal departments and agencies are supported by the Interdepartmental Recovery Fund (IRF). Information on the listing process and on ongoing species assessments and recovery or management is provided on the SARA Public Registry (http://www.sararegistry.gc.ca) (***Slide 21***).

In 2006, COSEWIC identified eight **designatable units** (8 DUs) for Lake Sturgeon in Canada and recommended various status levels (***Slides 22 and 23***). Populations in western Canada (DU1 to DU5) were designated as "Endangered"; those Lake of the Woods/Rainy River (DU6) and Southern Hudson Bay/James Bay (DU7) as "Special Concern"; and those in the Great Lakes/St. Lawrence River (DU8) as "Threatened". No decision has yet been made by the Government of Canada on listing of the species under SARA. Work on draft recovery strategies is being undertaken in advance of a listing recommendation to identify possible exceptions and exemptions, as these will affect the socioeconomic analysis that is taken into account in the listing decision. Science advice to inform the listing decision has been prepared for Lake Sturgeon in DU8 and is in preparation for DUs1-5 (***Slides 24 and 25***). Some consultation has been conducted and more is planned. Socioeconomic analyses are being undertaken, and draft recovery strategies will be developed.

Questions (Q), Answers (A), Comments (C), and Responses (R):

Q: How will Section 35 consultations work?

A: Some consultations have already been conducted and more are planned. DFO hopes to consult on the listing and the draft recovery strategies at the same time. The draft recovery strategies will also be developed in a collaborative way by recovery teams that include representatives of organizations with information to contribute.

C: Concern was expressed about the need for protection of the Berens and Pigeon rivers, which provide important sturgeon spawning habitat; the lack of a hatchery on Lake Winnipeg; and the lack of DFO research on the lake.

Q: How will efforts to recover Lake Sturgeon populations affect Aboriginal Treaty Rights to fish, and why was there no mention of decommissioning and reclamation?

A: During consultation on the recovery of the American Eel, a species that has almost disappeared from southern Ontario, Aboriginal elders explained how important the species was to their people. We need to work together on recovery planning to avoid a similar situation with the Lake Sturgeon.

Q: Does SARA outline any government-to-government relationships or protocols for the protection of species at risk that move across international borders?

A: I am not sure whether such cooperation is specified under SARA. But, Canada and the United States have worked together on recovery planning for shared species at risk, such as Shortjaw Cisco in the Great Lakes.

2.2 Population genetic structure of Lake Sturgeon in the Great Lakes and its implications for stocking

Amy Welsh, State University of New York, Oswego, NY

Amy's presentation illustrated the value of understanding population genetics when developing effective management and recovery strategies for Lake Sturgeon populations (***Appendix 5***). Genetic diversity and genetic diversification are important factors to consider (***Appendix 5: Slide 2***). To maintain genetic diversity inbreeding must be avoided. Inbreeding can occur as a result of stocking actions when hatcheries rely on the **gametes** from just a few individuals and the resulting offspring that are released are closely related. Inbreeding can also occur in small, isolated natural populations. The degree of **heterozygosity** in a population is a measure of its genetic diversity. A decrease in heterozygosity can indicate inbreeding. Populations with high genetic diversity also have a high evolutionary potential. They have more **alleles** to chose from and are better able to evolve in response to natural selection pressures than populations with low genetic diversity. **Genetic drift** is a random change in gene frequency in response to chance rather than selection. Genetic drift can also result from stocking. Genetic drift can result in a loss of alleles and thereby lower genetic diversity. Its effects are more pronounced and of greater concern in small, isolated populations. Another genetic consideration is the level of genetic differentiation between populations. Cross-breeding fish from populations that are genetically different can reduce the fitness of the offspring, causing outbreeding depression. This can be a management concern when stocking with fish from a different population.

The genetic structure of 29 spawning populations of Lake Sturgeon in the Great Lakes watershed was documented by analyzing genetic sequences at 8 different microsatellite loci (***Slides 3 and 4***). Samples were also analyzed from the Mattagami River and Rainy River/Lake of the Woods in the Hudson Bay watershed. No correlation was found between population size and heterozygosity (i.e., genetic diversity) or between population size and allelic richness, which is the number of alleles in the population corrected for sample size (***Slides 5 and 6***). So, even though some of these populations are small they appear to be maintaining relatively high levels of genetic diversity.

Sturgeon from the Hudson Bay watershed had the lowest allelic richness and lowest heterozygosity. Both measures were significantly lower for the populations in the Rainy River (ON) and Grasse River (NY), a tributary of the St. Lawrence, than they were on average for sturgeon from the Great Lakes watershed. Low genetic diversity in the Grasse River population is likely due to long term isolation (***Slides 7 and 8***). A dam that was in place for over 100 years has now been removed. Fish from St. Lawrence River that are now moving into the Grasse River could rescue the genetic diversity of Grasse River stock.

Pairwise statistical comparisons of the proportion of heterozygosity (F_{st}) shows that most populations in the Great Lakes are significantly different, indicating that there is some spawning fidelity among populations (***Slides 9 to 11***). An F_{st} value of 0 indicates that populations are closely related and a value of 1 that they are not. Surprisingly, the Detroit and St. Clair populations were closely related to the Lower Niagara population despite being separated by Niagara Falls. Fish from the Detroit and St. Clair River populations may have recolonized the Niagara River naturally after that population was extirpated in the 1940s. There is a big difference in the proportion of heterozygosity (F_{st}) between the Great Lakes and Hudson Bay populations (***Slide 12***). Within the Great Lakes the highest F_{st} was observed in Lake Superior. Genetic differentiation of the Grasse River population from the other populations is due to loss of genetic diversity and genetic drift due to isolation. Bayesian analysis suggests that clear genetic differences exist between stocks in Hudson Bay and Lake Superior, but the differences are not as clear in the lower Great Lakes.

Based on the genetic analyses of the spawning populations, six genetic stocking units (GSUs) were identified in the Great Lakes (***Slide 13***). These are essentially management units but their primary purpose is for making stocking decisions. Five spawning populations (black dots on Slide 13) did not fit consistently into one of the GSUs or were so genetically different that they were treated as their own GSU.

To assist stocking decisions, genetic stocking guidelines have been developed (***Slide 14***). These guidelines consist of four steps. The first step is to identify which stocking unit the spawning population of interest belongs to, so an appropriate donor population can be identified. The second step is the identification of priority conservation populations. Populations with particularly valuable traits such as high genetic divergence or unique life history characteristics, and those that are natural and self-sustaining are of particular conservation interest. Managers are encouraged to identify at least one priority conservation population within each genetic stocking unit. The third step is a decision tree that managers can use to assess the status of their stocking site prior to stocking. Is there, for example, an existing population? If so, a very conservative approach should be taken to stocking. If the goal is to have a self-sustaining population, have the problems that affected the population been resolved? Is straying likely to occur that could affect priority conservation populations? The decision tree also helps guide the selection of a genetically suitable strain for stocking, and ensure that the donor stock is large enough to sustain stocking over the long term and thereby avoid unnecessary mixing. The final step recommends how best to design and implement the stocking program. Ideally the stocking program should use gametes from at least 250 female donors and 250-1250 male donors over a period of 25 years (~1 generation). This results in an effective population of about 500 fish and helps to maintain the long-term evolutionary potential of the population. As a minimum the stocking program should involve at least 100 fish of each sex over a 25-year period, which should still result in the representation of rare alleles in the resulting population. Stocking numbers should be based on local survival rates. Monitoring should be conducted to ensure that the stocking program is right and to determine whether adaptive management is necessary.

Questions (Q), Answers (A):

Q: After stocking begins how long does it take until changes in genetic diversity are observed in a population?

A: It can take many generations before the genetic signature of a loss of diversity is observed. Because Lake Sturgeon have a long generation time, about 25 years, this can take many years.

Q: Have you sampled the genetics of Lake Sturgeon in Lake Nipigon, ON?

A: No.

Q: Is there evidence of sturgeon spawning below Niagara Falls?

A: Yes. The samples for genetic analyses were taken from spawning adults.

Q: Do you use local Aboriginal knowledge in your studies?

A: Local ecological knowledge was used in the development of the stocking guidelines.

Q: Have you studied genetic differences between populations in lakes and rivers that look different?

A: Not yet. So far we have studied neutral genetic markers. In future we hope to look at adaptive genetic traits to identify different Lake Sturgeon morphs in lakes and rivers.

2.3 Great Lakes tribal involvement in Lake Sturgeon movement – Little River Band of Ottawa Indians case study

Henry Quinlan, U.S. Fish and Wildlife Service, Ashland, Wisconsin

Lake Sturgeon have no federal status designation in the United States (***Appendix 6***). Many Indian tribes are involved in Great Lakes sturgeon management. The Little River Band of Ottawa Indians, on the east side of Lake Michigan, has embarked on a process to integrate traditional and biological criteria in the development of a stewardship plan for Lake Sturgeon (***Appendix 6; Slides 3 and 4*****;** see also Little River Band of Ottawa Indians 2008). The interests of the State of Michigan, which manages fisheries in the state, are not always the same as those of the tribal communities. The tribe believes that cultural indicators should be integrated into sturgeon management (***Slides 5 and 6***). As sturgeon populations have declined so have the sturgeon clan families (***Slide 7***). The technological advances and population growth that led to declines in the Great Lakes Lake Sturgeon populations in the late 1800s were not foreseen when the 1836 Treaty was signed. These declines led to a shift in the fisheries management focus toward sport fish and non-native species, and to the extinction and reduction of many cultural indicators (***Slide 8***). This caused a decline in the health and well-being of the tribes, including the Little River Band.

Since 1994 there has been a resurgence of tribal presence in the area and a reaffirmation of tribal hunting, fishing, and gathering rights (***Slide 9***). Tribal natural resources management was established because tribal needs--such as opportunities for subsistence harvest, were not being met (***Slide 10***). They also wanted to address the need for cultural integration in fishery management. The Little River Band is working to integrate cultural and biological knowledge (***Slide 11***). Biologically, there is a small remnant population of Lake Sturgeon in the Big Manistee River, with low recruitment, marginal habitat, migration barriers, and little management focus on the species as it is not fished for sport. The tribe felt that the connection between the community and Lake Sturgeon had diminished. The Nmé Cultural Task Group, tribal elders, tribal leaders and natural resource staff was established to address these concerns by developing a sturgeon stewardship plan (***Slides 12 to 15***). The ultimate goal of this plan was to have both the sturgeon population in the Big Manistee River and the people who use it increase in prosperity. The plan emphasized strategies for restoring connections between the people and the river, improving habitat, and protecting tribal sovereignty and treaty rights. Its 25-year recovery target was to establish a self-sustaining, naturally reproducing Lake Sturgeon population with at least 750 individuals capable of spawning (***Slide 16***). Its long-term target (7 generation) was to return the population to pre-1836 levels and/or to the contemporary carrying capacity.

In response to interest by the Task Group, a streamside rearing facility for Lake Sturgeon was developed, consisting of a portable trailer with raceways (***Slides 17 and 18***) (see also Holtgren *et al*. 2007). Its purpose was to increase recruitment by eliminating the bottleneck during the first few months when the fish are more vulnerable to predation. This strategy has the biological advantages of not causing genetic or imprinting problems as the fish are simply removed temporarily from the system (***Slides 19 to 22***). Different life stages were studied to identify when best to collect stock for rearing. Based on the cultural and biological considerations larvae were preferred. They were removed in the spring and returned to the river in the fall. The portable facility is more cost effective than establishing a permanent facility. Water from the river is pumped through the hatchery to maintain imprinting. Fish reared in streamside hatcheries grew faster than those in established hatcheries; growth was similar to that of fry in rivers and continued once released (***Slides 23 to 25***). This type of facility works well for involving the community. Four other streamside rearing facilities have since been established related to Lake Michigan.

Questions (Q), Answers (A):

Q: Did you conclude that there was no advantage to rearing sturgeon to a larger size before releasing them in order to meet your goals?

A: That is correct. The larvae were collected shortly after hatch, and released in the fall when they were 125 to 200 mm long (5 to 8″).

2.4 Lake Sturgeon in the Winnipeg River: management implications of new information on biology, behaviour and ecology

Steve Peake, Canadian Rivers Institute, University of New Brunswick, Fredericton, NB

Steve presented information gathered by his research team on Lake Sturgeon abundance and distribution, spawning behaviour and success, habitat use, and movements in the Winnipeg

River, between Lac du Bonnet and Pointe du Bois (***Appendix 7; Slides 2***). He began by introducing the graduate students involved in the different aspects of this work (***Slides 3 to 13***)

The abundance of juveniles and adults is relatively low downstream of the Seven Sisters Dam (***Slides 14 and 15***). In summer most adults are found in the Lac du Bonnet area, while juveniles are found farther upstream. Between the Seven Sisters and Slave Falls dams the abundance of adults is moderate while that of juveniles is high (***Slides 16 and 17***). Adults summer below Slave Falls and in the Sylvia Lake area, while the juveniles tend to be farther upstream. Between the Slave Falls and Pointe du Bois dams the abundance of adults is high and that of juveniles moderate to high (***Slides 18 and 19***). In summer both adults and juveniles tend to be distributed in the upper two-thirds of that section.

Abundance appears to be related to the quality and quantity of the spawning sites relative to the size of the impoundment (***Slides 20 to 22***). Sturgeon abundance is low below Seven Sisters, where there is a relatively large area of river but limited spawning habitat. The primary spawning site is located just below the dam and there are few suitable sites downstream in this reach. Fish are more abundant in the reach between Seven Sisters and Pointe du Bois, which also has a fairly large area of river but with a primary spawning area at Slave Falls, secondary spawning areas potentially at Scott's Rapids and Sturgeon Falls, and possibly some small spawning areas downstream. The next reach upstream is small but sturgeon are relatively abundant as the reach has a good primary spawning area below the Pointe du Bois Dam. Provided suitable habitat is available, fish tend to inhabit areas within a few kilometres downstream of spawning sites (***Slides 23 to 24***). This can lead to a patchy distribution that must be considered in the design of sampling programs to avoid bias. Spawning habitat is particularly important in large river systems with few spawning sites. The fish may not be uniformly distributed, biasing sampling.

Flow rates dramatically impact spawning location and spawning success in the Winnipeg River. Sturgeon spawn below the powerhouse of the Seven Sisters Dam during low water years and below both the powerhouse and spillway during high water years (***Slides 25 to 27***). Between Seven Sisters and Slave Falls, spawning can occur at Scotts Rapids, Sturgeon Falls, Barrier Bay, and Otter Falls (***Slides 28 to 32***). In low water years most fish spawn below the powerhouse at Slave Falls, although some spawn at Sturgeon Falls. In high water years most fish spawn below the spillway at Slave Falls, although many spawn at Sturgeon Falls, and some at other sites. The overall hatch success is poor during low water years, when most spawning occurs below the powerhouses. It is good in high water years when fish are able to spawn below the spillways—for reasons unknown.

Reproductive failures often occur during low flow years when spawning efforts are concentrated at the most upstream sites in areas that are not conducive to hatch success (***Slides 33 to 36***). Consequently, efforts to protect or remediate sturgeon habitat should focus on upstream spawning habitat rather than creating or enhancing downstream sites, unless downstream sites are difficult or impossible for the fish to pass. Low water years create a good opportunity for the collection of gametes for hatchery culture. Occasional year class failures are not catastrophic to populations because the fish are long-lived. The most challenging situation for depressed populations is likely where they have to spawn below a powerhouse.

The life history stages of Lake Sturgeon often segregate themselves based on habitat (***Slides 37 to 40***). Juveniles (age 1-9) prefer deep water with a sandy bottom and detectable current, sub-adults congregate in off-current areas of moderate depth, and adults tend to use shallower areas near shore where juvenile and sub-adult numbers are low. This segregation enables biologists to target fish of a particular life stage, but it also leads to sampling biases. Heterogeneous habitat is likely ideal for healthy populations as it enables each of the life stages to find appropriate habitat.

In the spring adult sturgeon move upstream into spawning areas (***Slide 41***). Engineered fishways have had low success in facilitating upstream movements of sturgeon (***Slide 42***). The most successful fishways have slopes of less than 3% and low turbulence. This makes it tough to pass sturgeon except in a long nature-like fishway. Trap and transport programs are highly successful. Spawning fish that were moved upstream of Seven Sisters, continued moving upstream to the spawning site at Sturgeon Falls, although spawning there could not be confirmed (***Slide 43***). These fish then moved downstream to Natalie Lake, but did not pass over the Seven Sisters spillway (***Slide 44***). Instead, they returned upstream to Dorothy Lake (***Slide 45***). Trap and transport may be a viable way of re-establishing populations.

After the hatch, there was downstream drift of age-0 fish (***Slides 47 to 53***). They did not drift far, settling out once the water velocity slowed. Juveniles become more mobile but remained in discrete nursery areas, which in some areas leads to crowding and slow growth. Moving them to less crowded areas could be used as a management tool. Adults returned to their normal range after spawning. The probability of sturgeon passing through the turbines or over spillways at Seven Sisters, which has a large forebay, was considered low. The probability of entrainment is likely higher in reaches where there is less suitable habitat upstream of the dam. In 2009, one fish passed over 5 dams enroute from Ontario to Lac du Bonnet, with only a gash on its head.

Questions (Q), Answers (A):

Q: Were water temperatures or bottom substrates different below the spillways and powerhouses?

A: The water was well mixed in both areas so the temperatures were similar. Bedrock is the dominant substrate below the spillways, where there are few fine particulates; there were more particulates below the powerhouse, but otherwise little difference in substrates.

Q: Were natural spawning habitats studied?

A: Sturgeon Falls is the only natural spawning habitat in these reaches of the Winnipeg River that gets significant attention from the sturgeon. The movements of fish there were tracked to establish when fish were spawning at the waterfalls. Spawning success was not studied but juveniles in Natalie Lake appeared to be the progeny of sturgeon that spawned at Sturgeon Falls.

Q: Has the genetic diversity of these populations been studied?

A: Not yet, but samples for such studies are being collected for Dr. Amy Welch.

Q: Are the management implications of dams to sturgeon similar between the Winnipeg and Nelson rivers?

A: There are some differences in sturgeon behaviour between the two rivers. Some of this information will be transferable but such transfers should be made with caution given the differences in location and river size.

Q: Why is this research being conducted in the Winnipeg River and not in Lake Winnipeg and the Pigeon River?

A: The study area was chosen in part due to practical considerations related to the access, equipment, and infrastructure needed for work on sturgeon. The program does not have the resources to expand the existing study.

2.5 Spatial distribution of juvenile Lake Sturgeon in a large fragmented river

Tim Haxton, Ontario Ministry of Natural Resources, Bracebridge, ON

Tim described his research on how habitat fragmentation affects the spatial distribution of juvenile Lake Sturgeon in impounded and un-impounded reaches of the Ottawa River (***Appendix 8***). He also put in a plug for the upcoming annual conference of the World Sturgeon Conservation Society (www.wscs.info) (***Appendix 8: Slides 2 and 3***).

Little is know of habitat use by juvenile sturgeon, particularly in large rivers (***Slide 4***). These fish are perhaps the most important life history stage for population recovery, as their mortality rate is higher than sub-adult and adult fish. The sampling program looked for evidence of depth selection by sturgeon as a function of size and reach type (impounded cf. natural), and of spatial segregation based on size in the impounded and unimpounded reaches (***Slide 5***). The study area included ten reaches of the Ottawa River from Lake Temiscaming downstream to the Carlton Generating Station (***Slide 6***). Three contiguous, uninhabited reaches in the middle of the study area with undeveloped rapids were used as the control. The sampling program followed Ontario's broad-scale monitoring protocol, whereby small (13-38) and large (38-127 mm stretched measure) mesh monofilament gillnets are set randomly at different depth strata for a maximum of 22 h; the number of surface sites sampled is determined by the surface area and depth; and sampling is conducted at water temperatures of 18°C or greater (~mid-June to mid-September) (***Slides 7 and 8***). Data analyses followed a Bayesian approach to assess the probability of capturing a sturgeon (binomial distribution, logistic regression, Poisson regression, general linear model ANOVA, uninformative priors, WinBug). Netting was conducted in 9 of the 10 reaches—the Lac la Cave reach was not sampled due to temperature.

A total of 441 nets were set; 163 sturgeon were sampled from the 263 large mesh and 22 from the 178 small mesh nets (***Slides 9 and 10***). The mean size was 628 mm TL (±152 mm SD), which equates to about age 11. The largest fish caught was 1050 mm TL. Fish in the Ottawa mature at about 1150 mm TL. The gillnets used showed selectivity for juvenile sturgeon (***Slide12***).

The broad-scale monitoring program provided a good indicator of sturgeon recruitment. Significantly more juvenile sturgeon were caught in unimpounded than impounded reaches, although recovery or drift may be occurring in some of the latter (***Slides 13 and 14***). The probability of catching juvenile sturgeon was greatest at depths of 12 to 20 m in both impounded and unimpounded reaches, and least at depth of 35 to 50 m (***Slides 15 to 17***). The smallest juveniles were found in the shallowest depth strata and the largest in the deepest. Size segregation also occurred along the reaches but was opposite in unimpounded vs. impounded reaches. In the unimpounded reaches, the small fish were found in the lower reaches whereas in the impounded reaches they were found in the upper reaches (***Slides 18 and 19*** **—** Note: on these slides the largest fish icons indicate the smallest fish). This difference may be related to flows.

Questions (Q) :

None.

2.6 Differences in distribution, size, condition and growth of Lake Sturgeon within an impounded reach of a large Canadian river

Cam Barth, University of Manitoba, Winnipeg, MB

Cam described his research on the habitat use, diet, growth, and abundance of juvenile Lake Sturgeon in the Winnipeg River, MB (***Appendix 9***). The work was conducted in the impounded reach that extends from the Slave Falls Generating Station (**GS**) downstream to the Seven Sister's GS (***Appendix 9: Slides 3 to 5***). Juvenile sturgeon were very abundant in areas characterized by deep water (>13.7 m), detectable current (>0.1 m/s up to 0.7 m/s), and various substrates including bedrock, cobble/gravel and sand (***Slide 7***) (see also Barth *et al*. 2009). Juveniles were rare at depths of < 6 m (20 ft). Larval trichopterans, dipterans and ephemeropterans comprised 97.4% of the diet of juvenile sturgeon (200-700 mm TL; May-Oct.) (***Slide 8***). The mix of these insect larvae in the diet varied with season and substrate type. Tagging studies found few juveniles moving up or down-stream past rapids and waterfalls. In three years of tagging studies, only 2 fish were found to have moved over Scotts Rapids, and 2 over Sturgeon Falls (***Slide 9***; T = # tagged, R = # recaptured).

Work was conducted in the fall of 2008 to determine the abundance, size, condition and growth of juvenile sturgeon in eight sections of the study area (***Slides 10 to 13***). The study used four sizes of gillnet (25, 76, 127, and 203 mm stretched mesh), set at depths >13.7 m in currents of 0.1-0.5 m/s to sample the fish community. The particle size of the bottom substrate was coarser in the upper sections (RS 1-3) where it was predominately sand (>0.063 mm) or larger, relative to the lower sections (RS 4-8) where it was finer (<0.063 mm). Fish ages were determined using pectoral fin rays. Based on several recaptures, the 1 cm sections of fin removed for aging grew back leaving the fish with a useable fin.

The composition of the fish community changes with distance downstream. The proportion of juvenile sturgeon in the catch decreased moving downstream, as did the catch of sturgeon per unit of sampling effort (***Slides 14 to 16***). Sturgeon in the upper sections were shorter on average than those in Nutimik Lake and downstream (***Slides 17 to 19***). They were also in poorer condition (skinnier) across all size classes. The growth rate (size at age) of juvenile sturgeon increased with distance downstream from the Slave Falls GS (***Slides 20 and 21***). In the upper sections the growth rate was similar to that of other slow-growing sturgeon populations (e.g., Kenogami R., ON); in the lower sections it was faster than in the Ottawa River (ON) but slower than the fast-growing population in Lake Winnebago, WI (***Slide 22***). The growth rate differences are likely due to competition for resources with other species, while abundance differences may be related to juvenile survival and/or larval dispersal. But further research is needed to confirm this (***Slides 23 to 28***).

Questions (Q):

None.

2.7 Utilizing artificially propagated Lake Sturgeon for stocking programs: a review from the hatchery to the river

Cheryl Klassen, University of Manitoba, Winnipeg, MB

Cheryl presented the results of her ongoing research to assess the survival and growth of hatchery-reared Lake Sturgeon released into the Winnipeg River, MB (***Appendix 10***). Fish used in the study were reared in the Grand Rapids hatchery from gametes collected at Slave Falls, fertilized on 28 May and hatched 8 June (***Appendix 10: Slide 5)***. Two age/size groups of fish were studied. The first group consisted of 7500 fish aged 3 months (***Slides 6 to 8***). These fish were released in mid-September 2008–2500 each at Dorothy, Nutimik, and Numao lakes, which are located in the impounded reach of river between the Slave Falls and Seven Sisters generating stations. Sampling later that September recaptured 21 of these fish (***Slides 9 to 11***). Most had lost weight and 5 had drifted downstream from their stocking site. Sampling the following summer (June-September) recaptured 4 fish, 1 of which had moved downstream from its stocking site and all of which were eating and growing (***Slides 12 to 17***; Note: each yellow dot on the maps denotes the site of a 91.4 m of 25.4 mm stretched mesh gillnet set 18 - 22 h). The second group consisted of 400 fish aged 1 year, each with a 12 mm **PIT** tag in its abdominal cavity (***Slides 19 to 25***). In mid-June 2009, half of these fish were released into Dorothy Lake and the other half into Numao Lake. Sampling during the summer (June-September) recaptured 7 of the fish in Dorothy Lake and 2 in Numao Lake. All of them were recaptured in the same lake where they were released. The fish stocked into Numao Lake grew slower than those stocked into Dorothy Lake, downstream—a pattern similar to that observed for the natural populations by Barth (see previous presentation). The low recapture rates of young-of-the-year fish may reflect fin grow-back, and consequent low recognition of tagged fish. Acclimation and release techniques may need to be adjusted to improve young-of-the-year survival rates.

Questions (Q), Answers (A), Comments (C), and Responses (R):

Q: How were the stocking locations selected?

A: This was an experiment to study the survival and growth of stocked fish, so the fish were stocked into areas where juvenile survival was known to be good to remove that as a complicating factor in the experiment.

C: Stocking should be considered in areas of the Winnipeg River downstream where sturgeon populations are low.

R: It might be better to wait until further research has been conducted and stocking techniques have been refined to reduce mortality.

Q: The drop in condition post-stocking is a concern. What mortality rate would occur in a hatchery situation where fish experienced similar weight losses?

R: That is a good question to follow up on.

2.8 Lake Sturgeon studies at Pointe du Bois

Don MacDonell, North/South Consultants Inc., Winnipeg, MB

Don described studies conducted in 2006 through 2009 to assess habitat use by sturgeon in relation to the proposed modernization of the Pointe du Bois GS (***Appendix 11***). Prior to hydroelectric development the Winnipeg River from the Ontario Border to Lake Winnipeg consisted of a series of low gradient areas interspersed with short stretches of high gradient (***Appendix 11; Slides 2 to 7***). The high gradient sites had rapids and waterfalls that may have affected fish movements and distributions, and were attractive for hydroelectric development. The Pointe du Bois GS, which was constructed between 1909 and 1926 at one of these rapids, now requires modernization. To assess potential environmental impacts of the proposed changes, aquatic studies were conducted from Lamprey Rapids, at the upper end of the Pointe du Bois forebay, to downstream of Slave Falls (***Slides 7 to 9***). Research was conducted on the habitat use, spawning, movements, and abundance of Lake Sturgeon, which are common in this study area (***Slides 10 to 14***).

The bathymetry, water velocities, and substrates of habitats in the five reaches of the study area were mapped to better understand the physical attributes of sturgeon habitat (***Slide 15***). Measurements collected by Manitoba Hydro were used to prepare the bathymetric maps and two and three-dimensional models of water velocities. Below Eight Foot Falls the water depth increases to 60 m (200 ft) and remains deep along the length of the Slave Falls Reservoir and below Slave Falls (***Slide 16***). High water velocities (2 m/s) occur at Eight Foot Falls and at pinch points along the river channel (***Slide 17***). Sonar acoustic transects (Quester Tangent System) were used to identify different classes of bottom substrates, which were then identified by ground-truthing with Ponar dredges and geo-referenced underwater videography (***Slides 18 to 20***). Bedrock is the primary substrate from Pointe du Bois downstream to Eight Foot Falls (***Slide 21***). From the falls downstream to below Slave Falls the deep, central areas of the forebay have primarily sand bottom with some areas of larger substrates, and the shallower bays have silt and mud bottoms.

Spawning studies used spring gillnetting to detect the presence of sexually mature/spawning sturgeon. Spring gillnetting did not find evidence of sturgeon spawning at Lamprey Rapids or Eight Foot Falls but found sexually mature fish congregating below both the Pointe du Bois GS and Slave Falls GS (***Slides 22 to 25***). In 2007, when there was little water passing over the Pointe du Bois Spillway, more fish were found in proximity to the generating station than below the spillway. During higher flow years when the spillway was in operation (2006, 2008, 2009) fish densities increased in proximity to the spillway.

Egg mats, comprised of a cinder block wrapped in a furnace filter, were deployed below both generating stations to identify spawning locations (***Slides 26 to 27***). Floating and bottom set drift traps were also set to confirm where emergence was occurring and its relative annual strength (***Slide 28***). In 2007, the low spill year, nearly all of the egg deposition found was below the powerhouses of Pointe du Bois and Slave Falls generating stations (***Slides 30 to 32***). Some eggs were found below the Pointe du Bois Spillway in two areas where water was leaking over the spillway. In 2008, a spill year, much of the egg deposition shifted to below the spillways (***Slides***

33 to 36). Some sturgeon continued to spawn in habitats immediately below the powerhouses—particularly at the flow edges adjacent to shutoff turbines. When the Pointe du Bois powerhouse was shut down to permit an egg search by divers, the highest *in situ* egg densities were found in cobble areas immediately downstream, and there seemed to be a lot of egg drift. Larval drift was observed from the spillway side of the Pointe du Bois GS, but not from the powerhouse side. In 2009, a high spill year (95th percentile) spawning continued below the powerhouses and spillways but, in the latter, shifted away from the highest velocity areas (***Slides 37 to 39***). Larval drift occurred along the full length of the Slave Falls Reservoir.

Spawning occurred as early as 10 May in 2006 and as late as 2 June in 2009 (***Slide 40***). The differences were related to water temperature. Sturgeon moved between spawning areas in response to flow changes. They continued to use small areas of suitable habitat despite the attraction of large flows nearby. A spawning habitat suitability model is being developed based on depth, substrate, water velocity, and flow direction so these data can be applied more widely to assess and mitigate potential impacts (***Slides 41 and 42***).

Standard index gangs of large mesh gillnets were used to assess habitat use by juvenile (<800 mm TL) and adult sturgeon (***Slides 43 to 48***). The density of juvenile and adult sturgeon above the Pointe du Bois GS (Reach 1) appeared to be lower than in the Slave Falls Reservoir (i.e., Reaches 3 and 4). In the Slave Falls Reservoir, juvenile sturgeon were concentrated in deep water, low velocity areas over sand substrate from Eight Foot Falls to just upstream of Moose Creek. Young-of-the-year were only captured in these areas. Adult sturgeon were found throughout the reservoir in a variety of depths and over a variety of substrates. Small juveniles (<400 mm) inhabited water depths >15 m. Larger fish inhabited depths from 4 to 27 m but most large juveniles were found at depths of 15 to 27 m and most adults between 4 and 19 m. Despite considerable effort no sturgeon were captured in nearshore areas in water <3.5 m deep.

Floy tagging and radio telemetry studies were conducted to follow sturgeon movements (***Slides 49 to 52***). Few of the ~1780 Floy tagged and 32 acoustic tagged sturgeon moved downstream past one of the generating stations. One of the 18 fish tagged in the Pointe du Bois Reservoir was recaptured downstream of the Pointe du Bois GS; two of the ~1762 fish tagged in the Slave Falls Reservoir moved downstream past the Slave Falls GS. In all, ~215 tagged fish were recaptured to the end of 2009. The population of sturgeon >800 mm in length was estimated in 2007 at 2,205 (95%CI 921-4095)—recent data suggest a larger population.

A spawning enhancement study was conducted downstream of the Pointe du Bois powerhouse in the spring of 2009, in an area sturgeon abandoned during a spill event (***Slides 53 to 59***). A rock bed was added with large boulders upstream to reduce flow velocities to about 1 m/s. The site was not used during a subsequent spill event, suggesting that there is more to be learned.

Questions (Q), Answers (A), Comments (C), and Responses (R):

Q: Can knowledge of sturgeon spawning habitat in relation to Winnipeg River powerhouses and spillways be transferred to hydroelectric developments on the Nelson River system at Keeyask and Conawapa?

A: Some of this information can be used but we do not yet understand all of the factors that sturgeon select for when choosing spawning sites. Adding to existing spawning habitats may offer a better opportunity for enhancement than trying to build new microhabitat.

Q: Most studies seem to be on impacted populations. Have populations living under natural conditions been studied?

A: Work has been done on populations in the Pigeon River (T. Dick, Univ. of Manitoba) and the Fox River (North/South Consultants Inc., Winnipeg, MB). These rivers offer pristine habitat but the populations have been subject to some exploitation.

C: Aboriginal fishermen have described spawning by Lake Sturgeon in large bays.

R: There are written accounts of sturgeon spawning in lakes but these populations may have been so exploited that they are no longer available for study.

Q: Why not study sturgeon on Pigeon River?

A: T. Dick has studied Lake Sturgeon in the Pigeon River.

Q: How powerful are the powerhouses on the Winnipeg River relative to those on the Nelson River? Given the difference in size between the two rivers, can information on sturgeon in the Winnipeg be transferred to the Nelson?

A: The Winnipeg River only has 20% of the flow of the Nelson River. But, information about the fishes' choice of velocities in the Winnipeg River may be useful for designing generating stations in the Nelson River system to accommodate sturgeon.

2.9 Lake Sturgeon in the Nelson River from the Kelsey to the Kettle generating stations

Friedrike Schneider- Vieira, North/South Consultants Inc., Winnipeg, MB

Friedrike described research on Lake Sturgeon that has been ongoing since 2001 in the Nelson River, from the Kelsey GS downstream to the Kettle GS (***Appendix 12; Slide 3***). Sturgeon populations in this section of river have been affected by commercial and domestic fisheries and hydroelectric developments (***Slides 2 to 8***). The commercial fishery began ca. 1917 and has been closed since 1992. It was not particularly large, relative to harvests in the Nelson River up and down stream. Little is known about the size of the Aboriginal domestic harvest, which continues. Sturgeon were abundant at the base of Kelsey Rapids (now site of Kelsey Generating Station), at the base of Witchai Lake Falls (Grass River), and at First Rapids on the Burntwood River in the 1940s, prior to construction of the Kelsey GS and Kettle GS. Unfortunately baseline scientific data on sturgeon life history and habitat use was not collected prior to construction of these hydroelectric developments. Construction of the proposed Keeyask GS could affect sturgeon in the future.

Sturgeon research in the study area has been ongoing since 2001 as part of the environmental impact assessment for Keeyask, which has been proposed by Manitoba Hydro and four First Nations (Fox Lake Cree Nation, War Lake First Nation, York Factory First Nation, and Tataskweyak Cree Nation (***Slide 9***). Sturgeon habitat use was separated into three general areas: 1) Split Lake including the Nelson River below Kelsey and Grass River, Burntwood up to the First Rapids, and Clark Lake; 2) the outlet of Clark Lake to Gull Rapids (Keeyask reach); and 3) Stephens Lake, including Gull Rapids (***Slide 10***). While there is little specific information on the long-term trends in sturgeon abundance in the Keeyask reach, commercial fishing data and Aboriginal traditional knowledge indicate that populations in the other two areas have been much reduced from their historical levels.

A longer data record is needed to establish recent trends in sturgeon abundance, which is likely below carrying capacity (***Slide 11***). Mark-recapture data were used in Program MARK to estimate populations of mature sturgeon (***Slide 12***). In 2008 there was an average of ~350 mature fish (range 210-660) between Birthday and Gull rapids; in 2007 there was an average of ~500 mature fish (range 340-700) in the Nelson River below Kelsey and the Burntwood River area. Too few fish were caught in Stephens Lake to generate an estimate. The presence of young fish indicates that recruitment is occurring. Floy (3.6%; Kelsey to Kettle) and acoustic (21%; Gull/Stephens Lake) tag returns provide an indirect estimate of sturgeon mortality rates in the domestic harvest that, when used in the population model, suggest a gradual decline in the population (***Slide 13***).

Habitat studies have focused on the hydraulic zone of influence of the Keeyask Project (***Slide 13***). Habitat suitability indices (**HSI**) have been developed for the adult, juvenile/subadult (~200-834 mm), young-of-the-year (fall captures), and spawning/hatch life history stages based on research in the study area and/or in similar areas. The spawning model was based on work conducted at Pointe du Bois because similar habitats in the larger Nelson River are too dangerous to study. Data were collected on water depth, flow velocity, and bottom type (***Slides 15 to 17***). The Keeyask reach of the Nelson River is seldom deeper than 15 m, which is shallower than the Winnipeg River below Pointe du Bois. Current velocities in the upper and lower reaches can exceed1.5 m/s but are moderate to low at Gull Lake (1.5 to 0.2 m/s) and quiet in large bays (<0.2 m/s). Along the main river channel, cobble and boulder substrates dominate upstream of Gull Lake and gravel in the lake itself. The large, quiet bays have silt or mud bottom, except for an area with sand bottom north of “Caribou Island” (Note: accepted geographical name Howe Island).

Acoustic tags were used to study habitat use and develop the HSI. Adults are quite general in their habitat preferences (***Slides 18 to 21***). During summer most were found in the low or moderate velocity habitat of Gull Lake; some in more riverine/rapids habitat. Sub-adults (yearling to 843 mm) prefer fairly deep, low to moderate velocity habitat with gravel to boulder substrate (***Slides 22 to 24***). They were concentrated in hotspots such as the sandy area and a deep gravel trench in Gull Lake, and made more use of habitats downstream of Birthday Rapids than is apparent from the HSI. Young-of-the-year are the most specialized sturgeon in terms of their habitat use, which becomes more general with age. In the fall, most young-of-the-year sturgeon (130-170 mm) were caught at depths of 8 to 11 m over sand substrate north of “Caribou Island” (i.e., Howe Island) (***Slides 25 to 26***). They may have drifted 20 to 30 km downstream from the spawning site at Birthday Rapids. Sturgeon spawn at First Rapids (Burntwood River), between Clark Lake and Birthday Rapids, and at Birthday and Gull rapids. Spawning is also suspected at the base of Witchai Lake Falls (Grass River) and below the Kelsey GS (***Slides 27 to 28***). Key spawning habitat considerations included velocity, depth, and substrate. Turbulent flow over boulders that create whitewater, and current breaks that offer shelter may attract fish to spawn. These areas may change in response to flow, which can vary widely among years—as shown at Birthday Rapids in ***Slide 28***.

Movements were studied with Floy tags and acoustic and radio telemetry (***Slides 29 to 33***). Most Floy-tagged sturgeon were recaptured in the same reach of river where they were tagged. But, the telemetry studies found individuals moving back and forth through Gull Rapids.

Questions (Q) :

None.

2.10 Lake Sturgeon: Nelson River (Kettle GS to the Estuary) and Hayes River

Don MacDonell, North/South Consultants Inc., Winnipeg, MB

Don described research since 1988 on sturgeon in the Lower Nelson and Hayes rivers to monitor the environmental impacts of the Limestone GS, and to assess potential impacts of the proposed Conawapa GS (***Appendix 13; Slides 3 to 6***). There is a large freshwater plume from the Nelson River into Hudson Bay, and the tidal effects from Hudson Bay are felt in the Nelson estuary upstream to Gillam Island. Comeau (1915) reported that sturgeon were more abundant in the Nelson River upstream of lower Limestone Rapids, than downstream. Scientific studies of sturgeon in the lower Nelson River were begun in 1985 by the Province of Manitoba, which continued them until 1989. North/South Consultants Inc. began its studies for Manitoba Hydro in 1988 and they are still ongoing. The early work focused on fish presence, growth, and movements; more recent work has focused on identifying and characterizing habitats important to specific life stages of sturgeon. The studies were conducted using a wide variety of techniques. Sampling has been conducted from Kettle GS downstream to the Nelson estuary, and in the Hayes River upstream into the Pennycutaway River. This area includes the Long Spruce GS (completed 1979) and Limestone GS (1990), both of which have large reservoirs. Conditions in these reservoirs are quite different than those in the Winnipeg River reservoirs, with higher flow velocities, different substrates, and much larger generating stations.

Lake Sturgeon inhabit the lower Nelson River from Kettle GS to the estuary. But, within the Long Spruce and Limestone reservoirs abundance is low and generally confined to the upper ends (***Slides 7 and 8***). There is no evidence of sturgeon spawning in the reservoirs but some fish younger than the reservoirs are present. Tagging studies at both reservoirs have found significant downstream emigration of sturgeon following construction or later introduction. Some of these fish pass through the turbines enroute downstream.

The Lake Sturgeon population from the Limestone GS downstream to the estuary currently numbers about 5460 adult fish (i.e., >834 mm; 95% CI = 3768-8018) (***Slide 9***). Spawning occurs at the Lower Limestone Rapids, the mouth of Angling River, and in the lower Weir River (***Slides 10 to 12***). Egg mats have been used to delineate and quantify spawning habitats at each location so their characteristics can be better understood. Sturgeon spawn in the Weir River from 31 May to 25 June and have done so successfully every year it has been studied. Spawning locations in the Weir and Angling rivers change each year with the flow. Sturgeon spawn on both the north and south sides of the Lower Limestone Rapids in very shallow, high velocity water. [Note: In ***Slide 13*** the colour key is reversed—white indicates high velocity and red low.] These habitats are heavily influenced on a daily and hourly basis by changes in discharge by the Limestone

GS. Young-of-the-year are difficult to capture and have not been captured in high concentrations (***Slide 14***). A few have been captured at depths of 3 to 9 m over soft substrates, none in the shallow, peripheral areas. They likely occupy the **thalweg** where the water is deep and strong currents make sampling difficult.

Juvenile and adult sturgeon are widely distributed in the mainstem of the lower Nelson River and sometimes enter tributaries (***Slides 15 to 18***). Telemetry studies have found they are generally quite sedentary but periodically will undertake extensive movements. Some fish migrate from the Nelson River into the Angling River and then 30 km upstream into Angling Lake, where they can remain for up to 5 years before returning downstream and moving widely. The lake may serve as a refuge for maturing sturgeon. Sturgeon from the Nelson River also enter the coastal waters of Hudson Bay to move to and from the Hayes River. In the Hayes River system they can move upstream to Pisew Rapids on the Gods River and are reported to enter Sturgeon Lake (55°23'48"N, 90°54'20"W) in Ontario. Sturgeon overwinter throughout the lower Nelson River system in deep areas such as Limestone Quarry, near Jackfish Island, Angling Lake, and the estuary (***Slide 19***).

Tag returns in the late 1990s indicate a minimum fishing mortality of 2.6 to 3.5% (***Slide 19***). This mortality could be significantly higher depending upon the number of recaptures that are not reported. The genetic diversity and population structure of sturgeon populations along the Nelson, Hayes, and Churchill rivers are currently being studied in collaboration with Laval University (***Slide 20***).

Some sampling for Lake Sturgeon has been conducted in the Hayes River (***Slide 21***). In the fall of 2005, 24 sturgeon were captured in gillnets at the river mouth. Half of these fish were small juveniles including young-of-the-year, which were captured off the shores of sandy islands. Spawning investigations of the lower Hayes and Pennycutaway rivers did not locate spawning sites but did capture sexually mature male sturgeon. Spawning sites may be located much further upstream in the Fox River or near Shamattawa.

Questions (Q):
None.

2.11 The status of Lake Sturgeon under Ontario's *Endangered Species Act*

Stephen Casselman, Ontario Ministry of Natural Resources, Peterborough, ON

Stephen provided an overview of Ontario's *Endangered Species Act* (**ESA**), and of the status of Lake Sturgeon under the Act. Readers are referred to ***Appendix 14*** (***Slides 3 to 17***) for detailed notes on the ESA.

Species at Risk in Ontario (**SARO**) are identified by an independent Committee on the Status of Species at Risk in Ontario (**COSSARO**), which makes listing recommendations to the Minister of Natural Resources (***Slide 7***). The Minister does not have discretion and must list recommended species. Protection is automatic and immediate for species classified as Extirpated, Endangered or Threatened and for their habitat (***Slide 8 to 10***). Habitat can be defined as general or regulated; the level of protection is the same but the area is described in a different way. Timelines for preparation of the recovery strategy are tight, 1 year for Endangered and 2 years for Threatened species. These strategies must identify habitat needs, describe threats, and recommend protection and recovery objectives and approaches to achieve them (***Slides 11 to 15***). Management plans are prepared for Special Concern species within 5 years of listing. They can be prepared for a single species or using a multi-species approach. The Government response statement allows the Ontario Government to summarize actions, set priorities and consider socio-economic factors. Progress is reviewed at 5-year intervals. There are permitting provisions in the ESA to provide flexibility and allow activities necessary for human health and safety or species recovery, and those that benefit the species or provide a significant social or economic benefit to Ontario (***Slide 16***). General regulation 242/08 allows exemptions for activities otherwise prohibited by the Act, subject to restrictions and conditions (***Slide 17***).

On 11 June 2009, COSSARO reported a change in status of Lake Sturgeon in the Great Lakes-Upper St. Lawrence and Northwestern Ontario populations from Special Concern to Threatened (***Slides 18 to 20***). The Upper St. Lawrence population includes the Ontario portions of COSEWIC DU8, while Northwestern Ontario population includes parts of DUs 4 to 6. Status of the Southern Hudson Bay-James Bay population, which includes much of COSEWIC DU7, remains unchanged at Special Concern.

The change to Threatened status means that species and habitat protection provisions of the ESA now apply to the Great Lakes-Upper St. Lawrence and Northwestern Ontario Lake Sturgeon populations (***Slide 21***). For example, targeted fishing for the species is now prohibited, fish caught incidentally must be released immediately, and these areas are now closed to recreational fishing for Lake Sturgeon. Targeted catch and release angling of the species can continue in the Southern Hudson Bay and James Bay drainages, provided any requirements of the *Ontario Fishery Regulations and Fish and Water Conservation Act* are met.

The recovery strategy for Ontario Lake Sturgeon populations must be completed by September 2011 (***Slide 22***). Preparation of a provincial management plan for the three populations is ongoing prior to listing, with the involvement of key stakeholders and Aboriginal communities, to aid with recovery strategy development. Ontario is considering how best to streamline its approach to recovery strategy preparation.

Waterpower agreements are to be developed before the recovery strategy is completed (***Slide 23***). These agreements must provide for mitigation of adverse effects on the species. The Minister must be of the opinion that operation will not jeopardize survival and recovery of the species in Ontario. The effects of operation must be monitored and adaptive management must be undertaken to mitigate any adverse effects. The Ontario Species at Risk Stewardship Fund provides financial support for research and has supported a number of projects related to the protection and recovery of Lake Sturgeon (***Slide 24***).

Questions (Q), Answers (A):

Q: What has been the success of the Norval Dam Fish Ladder project, which received stewardship funding?

A: This is a new project and the results are not yet available.

Q: How are consultations on Aboriginal and Treaty Rights under Section 35 handled?

A: That process is separate from the Provincial species recovery process but under the ESA there is a requirement to include Aboriginal traditional knowledge that is available

Q: The governments of Canada and Ontario both have species at risk legislation. Does one take precedence over the other?

A: Both likely apply.

Q: Are there criteria associated with the immediate release of caught sturgeon?

A: Don't know.

Q: Is there collaboration between provinces in the management of Lake Sturgeon?

A: There is consultation among provinces on shared populations.

Q: Aboriginal rights will supersede provincial legislation. How will sturgeon fishermen working on the index fishing program in Saskatchewan be compensated once sturgeon are listed as endangered?

A: The Federal Government is working closely with the provinces on Lake Sturgeon recovery. Federal recovery strategies consider the impacts of activities and the socioeconomics of listing decisions and can recommend exemptions.

Q The value of Aboriginal traditional knowledge must be recognized, and it must be collected and incorporated into recovery strategies etc. in a fair and transparent manner. How is traditional knowledge incorporated into the Ontario recovery strategies?

A: The value of Aboriginal traditional knowledge is recognized and is incorporated during strategy development.

2.12 Winnipeg River sturgeon assessment program 2007-2009

Mary Duda, Ontario Ministry of Natural Resources, Kenora, ON

Mary described studies of Lake Sturgeon that are being conducted in the Winnipeg River from Lake of the Woods, ON downstream to Pointe du Bois, MB (DU5) in partnership with First Nations (***Appendix 15: Slides 2 and 4***). This work has benefited from the exchange of traditional knowledge and from the participation of Aboriginal elders, biologists, and students. It has also developed the First Nations' capacity to participate in sturgeon conservation and recovery.

Few historical data exist on the status of the sturgeon fishery in this stretch of the Winnipeg River (***Slide 3***). There is evidence of subsistence and commercial harvests in the 1900s. Commercial harvests from Tetu Lake declined sharply in the 1960s and were suspended ca. 1970 in response to concerns about mercury contamination. Since 1889, the system has been impacted by a series of dam developments and by channel alterations, paper mills, and sewage discharges (***Slide 5***). Improvements have been made to effluent from mills and sewage treatment facilities.

Field programs to improve understanding of sturgeon population dynamics and seasonal habitat use in the river were begun in 2007 and are ongoing (***Slide 6***). Juvenile and adult fish have been collected using gillnets, and eggs using egg mats. Fish have been weighed and measured and marked with Floy and PIT tags. Fin samples have been taken for age determination and genetic samples for population studies. Larger-scale studies have used a modified version of Ontario's fall walleye index netting program (**FWIN**) to establish fish distributions and relative abundance. Work is being conducted in two main areas, between the Whitedog and Norman dams and below the Whitedog Dam.

Despite thousands of hours of spring and summer gillnetting for adult sturgeon in 2008 and 2009, and the benefit of traditional knowledge, only adult two sturgeon have been captured between the Whitedog and Norman dams (***Slide 8***—red dots indicate sampling sites). One of them subsequently ventured downstream to Lac du Bonnet, MB. Significant effort has also been expended targeting deeper sites for juvenile sturgeon and placing egg mats at potential spawning sites, without success. Sampling has been more successful below the Whitedog Dam to the Manitoba border (***Slide 9***). Adults (n = 53) have been caught in the spring below the Whitedog and Caribou Falls dams, and below North Boundary and South Boundary falls. They have also been caught (n = 4) in summer within and downstream from Tetu Lake. Juvenile catch success has been better, with 358 fish captured. Two spawning sites have been confirmed with egg mats and others are suspected.

Work is ongoing to identify spawning locations and timing (***Slide 10***). Correlation of the flow regime at Caribou Falls to age class strength has found low recruitment during low flow years, and vice versa (***Slide 11***). The prevalence of year-class failures indicates the need to enhance spawning habitat. Discussions are underway with Ontario Power Generation to see if the flow regime can be altered over the spawning period during low flow years to mimic high flow years and thereby improve hatching success and recruitment. Preliminary estimates for 2008 and 2009 suggest a juvenile population of about 2000 fish below the falls (***Slide 12***). These studies will continue in 2010, with the addition of telemetry studies of fish movements.

Questions (Q) :

None.

2.13 The business of sustainability

Joe Hunter, Sustainable Sturgeon Culture, Emo, ON

Joe described the operations of his sturgeon hatchery and provided a photographic record of the steps involved in sturgeon culture (***Appendix 16***). The Manitou Fish Hatchery was constructed in 1993 under a research and development program involving the Rainy River First Nations and Ontario Hydro Technology Division, as a prototype for Lake Sturgeon culture (***Appendix 16: Slide 2***). The first sturgeon were released in 1996. At that time the hatchery was a grow-out operation that reared fingerlings for release. Because the hatchery used a flow through system that drew water at ambient temperature from the Rainy River, growth rates were not optimal. In 1997, the hatchery was converted to a recirculating aquaculture facility so optimal temperatures for growth (18°C) could be maintained year-round. The facility was operated by the Rainy River First Nations until 2003, when it was privatized and renamed Sustainable Sturgeon Culture.

The impetus for the hatchery project was the observation by fishermen that they were no longer catching small sturgeon in their nets. The elders raised these concerns with the leadership, prompting them to investigate hatchery development. This led to cooperation with Ontario Hydro.

As soon as fish are caught in gillnets they are examined to determine their sex and reproductive condition. Spawners collected for gamete capture are injected with hormones following capture and held in the hatchery for 7 to 10 days. The injections stimulate eggs and sperm (milt) production in a predictable time—36 to 44 h depending upon the temperature, eliminating the need for regular handling to assess spawning readiness. Eggs and sperm are collected when they are free flowing, using methods that are quick and minimally intrusive. The sperm is collected using a tube inserted in the vent and flows by gravity into a collecting cup (***Slide 3***). When they begin dropping eggs the females are anaesthetized in a bath containing clove oil to facilitate handling (***Slide 4***). It is preferred over MS222, which has a narrow window of tolerance and longer recovery time. The anaesthetized fish are placed on a table, the oviduct is cleared with a small incision above the vent, and the eggs are squeezed out into a bowl (***Slides 5 to 7***). To reduce stress on the fish not all eggs are removed. The incision is closed with 4 or 5 stitches (***Slides 8 and 9***). The fish recover quickly from the anaesthetic when they are returned to fresh water. They are then held for a few days to ensure that the incision heals properly.

The eggs are collected in a bowl and fertilized using “dry method”, whereby there is no water present (***Slide 10***). The eggs from each female are fertilized by sperm from two different males. To prevent eggs from adhering to surfaces they are hand washed/mixed in a slurry of bentonite clay for 35 minutes (***Slide 11***). The eggs are then placed in incubation jars (***Slides 12 and 13***). At 14 to 15°C they hatch in 7 days. The hatchery supplies primarily fertilized eggs, and hatches just a few for a project in Kenora. Eggs are exported from the hatchery 4 days after fertilization, once the neural ridge (backbone) begins to form.

Education awareness is encouraged at the hatchery and tours are welcome (***Slides 14 to 19***). The hatchery supplies eggs to the White Earth Tribe in Minnesota who raise and release the fish. At the end of the spawning season extra yolk-sac fry, generally 150,000 to 400,000, are released into the Rainy River. Each spring the fishermen show respect for the life-giving force of the sturgeon and its surroundings with offerings of tobacco, and in the fall the elders offer prayers during the symbolic release of sturgeon. Concern over the condition of the river where the fish were being released has led to the Rainy River Watershed Program, which works to protect, conserve, and revitalize the Rainy River watershed (***Slide 20***).

Questions (Q), Answers (A):

Q: How far afield are the eggs sent?

A: Eggs are sent primarily to the Red Lake and White Earth tribes in Minnesota and to the Dalles First Nation in Kenora. In 2003, two million eggs were sent to China. Others have been supplied to commercial hatchery operations involved in developing caviar markets.

Q: Daily water fluctuations at Cumberland House, SK from operation of the E.B. Campbell Dam are quite significant. About 45,000 sturgeon fingerlings have been released into the

Cumberland Delta. Of these fish about 500 were injected with dye to try and learn whether the juveniles caught are the ones released. Are there other techniques that can be used for this purpose?

A: PIT tags can be used to mark small fish and might be worth trying.

2.14 Ochiichagwe'babigo'ining Lake Sturgeon Stewardship Project

Ryan Haines, Ryan Haines Consulting, Kenora, ON

Ryan worked with the Dalles First Nation in 2008 and 2009 to conduct an independent study of habitat use by Lake Sturgeon between the Norman and White Dog dams on the Winnipeg River, ON (***Appendix 17; Slide 2***). This study was discussed briefly by Mary Duda, and followed the design used by the Ontario Ministry of Natural Resources (**OMNR)** on other reaches of the Winnipeg River in Ontario (see Section 2.12). Egg mats and large-mesh gillnets were deployed in May and June to assess potential spawning habitats, and gill-nets were set in July and August to assess habitat use by adult and juvenile sturgeon (***Slide 3***). Nets were set for over 2,000 h each year. Success was very limited. Only one adult sturgeon was caught each year, both below the Norman Dam (***Slide 4; see also Appendix 15, Slides 8 and 9***). No juveniles or eggs were located. One male, aged 17 and possibly newly mature, was captured in June and then recaptured in mid-September near Lac du Bonnet, Manitoba about 170 km downstream. Enroute it would have passed through the turbines or over the spillways of four hydro dams. Sturgeon CPUE (fish per lift of a 45 m of 8-12" mesh gillnet) was highest in the Namakan Reservoir and comparable to the Winnipeg River at Sturgeon Falls (***Slides 5 and 6***). It was very low in the Winnipeg River in the Kenora and Caribou areas.

Barriers to population recovery were also considered, including the hydro dams at each end of the river reach and the pulp and paper mill, which operated for 80 years before closing in 2005 (***Slides 7 and 8***). The effects of spillway flows on recruitment and unidirectional movement downstream were of concern. Mary Duda (see above Section 2.12) has been studying the effects of spillway flows. Laser ablation mass spectrometry is being used, in cooperation with the University of Manitoba Department of Geology, to measure elements in the aging structures that may have originated from the mill. These elements, which will have originated from the sulphur liquor released by the milling process, could then be used to identify fish downstream that had originated close to the mill and when they were last in that area. Water quality downstream of the paper mill is also a concern. In the late 1970s flocculent material from the milling operation accumulated in deepwater areas of the river, where juvenile sturgeon are typically found (***Slide 9***). Studies are underway to learn whether the water quality has improved since the 1970s and with mill closure. First Nation elders identified the 1950s as the final period of decline for Lake Sturgeon, after which people no longer fished for them in the area (***Slide 10***). During that time the Whitedog Dam was constructed and the Dalles Rapids, a potential sturgeon spawning habitat, was modified by blasting and excavation.

Work is ongoing with the elders to establish historical population levels for recovery planning (***Slides 11 and 12***). Further field research is planned for the fall of 2010 to assess habitat use in the Black Sturgeon Lakes. Shoreline habitats that may be considered for development are being assessed for their sturgeon spawning potential and need for rehabilitation. The Dalles First Nation is working collaboratively with government on sturgeon recovery efforts. Scientists are encouraged to engage First Nations in a true partnership role and to undertake consultations that are collaborative and multi-faceted.

Questions (Q):
None.

2.15 Winnipeg River trends, Nutimik-Numao reach

Ken Kansas, Manitoba Water Stewardship, Lac du Bonnet, MB

Ken described annual monitoring since 1984 of Lake Sturgeon in the Nutimik to Numao reach of the Winnipeg River by Manitoba Water Stewardship (***Appendix 18; Slide 2***). From 1984 to 2003 the methodology was not standardized (***Slide 4***). Sampling was conducted at sites from upstream of Pointe du Bois to downstream of McArthur Falls. A range of gillnet mesh sizes (i.e., 100 yd panels of 5.5”, 9”, 12” stretched mesh) and six different types of external tags were used. The tagging process was cumbersome and hard on the fish. The catch per unit effort (CPUE) and population estimates both suggested a downward trend in the population. Pelvic fin rays were removed from the fish for aging until 2001. This practice was discontinued to avoid injuring the fish and because over 300 samples had already been collected to establish length at age relationships.

Since 2004 the methodology has been standardized (***Slides 3 and 5***). PIT tags have been used and the time out of water during tagging has been reduced to a minute. The location (Nutimik-Numao reach), duration, and timing (June) of sampling have also been standardized. Jolly-Seber population estimates have been generated from PIT tag data (2004-present) but the confidence intervals will remain wide until more years of data have been collected. Over this period, the juvenile catch has increased, the number of older fish in 12” mesh has dropped and stabilized, and the long-term CPUE is similar to that in 1984-2003 (***Slide 6***). The juvenile size range is well represented and about 30% of the catch consists of mature fish—both bode well for the future health of the stock (***Slide 7***). A gap in sturgeon year-class strength from 1979-1985 suggests that recruitment failures may have occurred during that period (***Slide 8***). In 2010 age structures may again be collected, likely from age 10 and younger fish. Population estimates show a significant drop in the Nutimik-Numao population ca. 1991, followed by a relatively stable population level (***Slide 9***). Recent Jolly-Seber estimates from PIT tags also show a relatively stable population, albeit with wide confidence limits.

This work will be continued in the future using the current sampling protocols (***Slide 9***). PIT tag retention will be studied, aging structures collected, and a Winnipeg River tagging database developed so all researchers on the river can share data more easily. Lake Sturgeon in the McArthur Falls to Pine Falls and Ontario Border to Pointe du Bois reaches of the Winnipeg River may also be sampled to fill gaps in scientific knowledge of the species in the river.

Questions (Q), Answers (A), Comments (C), Response (R):

C: Scientific researchers should make greater use of traditional knowledge in the design of their studies and interpretation of the results. Traditional knowledge should be collected through a formal process that properly compensates holders of the information.

R: I respect and hear you.

C: Sturgeon spawn when the poplar leaves are as big as your thumb. Researchers should hire local Aboriginal people who know how to catch the fish and understand their seasonal movements.

C: The Great Lakes Lake Sturgeon tagging database may offer useful information for developing a Winnipeg River tagging database.

2.16 Nelson River Sturgeon Board

Don Macdonald, Manitoba Water Stewardship, Thompson, MB

The Nelson River Sturgeon Board, which was established in 1991, involves 7 First Nations communities and concentrates its efforts on the area between Cross Lake and the Kelsey Generating Station (***Appendix 19; Slides 2 and 3***). The Landing River, Bladder Rapids and Sea Falls areas--all riverine, are the main areas of focus (***Slide 4***). Playgreen Lake stocks likely declined about the same time as the Lake Winnipeg Fishery. In the early 1990s the spawning population at Landing River, between Sipiwesk Lake and the Kelsey GS, was lost.

Sturgeon spawn has been collected since 1994 for hatchery rearing and stocking (***Slide 6***). The fish are intercepted in the Nelson River mainstem enroute to spawning sites and held in pools until they begin to express eggs. They are not injected with hormones in case they are not preparing to spawn. The main rear-out facility is located near Jenpeg, with easy road access to Norway House and Cross Lake (***Slide 7***). Fish are also reared at the Grand Rapids Fish Hatchery. The annual success of rearing has varied widely. To date about 30,000 fish have been stocked into the upper Nelson River and about 16,000 into the middle Nelson River (***Slide 8***). The stocking program generates intense interest in the communities and schools and has worked well for opening a dialogue with people about Lake Sturgeon conservation.

Over the past 3 years, the Board has also been mapping bottom habitats using Ponar dredges to gather substrate and benthic invertebrates (***Slides 9 to 12***). This work is being funded by the Habitat Stewardship Program. Samples have been taken along the midline of the Nelson River between Cross and Split lakes, with cross-channel sampling transects in areas that are heavily used by sturgeon. Current keeps the main channel of the Nelson River relatively silt-free, exposing the sand, cobble and rock bottom. There is lot of drowned wood and erosion nearshore, where currents are lower. These nearshore areas support many benthic organisms and appear to attract small sturgeon.

An index netting and tagging program has been conducted since 1994 (***Slides 13 to 15***). To estimate the number of fish present and number that can be harvested without damaging the population, a mark-recapture program was conducted in the 100 km reach of the Nelson River downstream from Sipiwesk Lake. This program operated from 1994 through 1997. Gillnets (5.5”, 8”, 10”, and 12” stretched mesh) were set at consistent locations, the fish were measured for total length (TL) and round weight, and each one received a Floy tag. A spine from the left pectoral fin was removed for age determination and as a marker in case of tag loss. A new mark-recapture study funded by the Habitat Stewardship Program has been ongoing since 2006. The same sampling protocols are being followed but the fish are receiving both Floy and PIT tags. So far, very little tag loss has been observed. Most fish caught have been younger than the Kelsey Generating Station. Some Aboriginal fishermen have opposed the capture, handling, and marking of the surgeon--particularly the fin clips. However, most now understand the value of these studies. After the spine is removed the front rays thicken to form a new spine, so this damage is not permanent.

The Peterson and Jolly-Seber methods have produced similar population estimates (***Slides 16 and 17***). High subsistence harvest events have affected the annual Peterson estimates, which suggest that the population declined between 1993 and 2001. The estimate is a relative indicator since it reflects the study area rather than the river as a whole. Recent estimates suggest an increase in the population, largely from small fish recruiting into the fishery (***Slides 18 and 19***). The source of these small fish is uncertain. It could be from lower domestic fishing efforts, stocking, etc. The Board does not have the manpower to set and follow egg mats. Attempts to capture small juvenile fish over sand bottoms in the Nelson River, as Cam Barth has done in the Winnipeg River (see Section 2.6), have not been successful. The nets may be collapsing in the high current.

Questions (Q), Answers (A):

Q: Do we have the scientific and traditional knowledge necessary to take care of sturgeon given the existing and possible future effects of hydro developments (e.g., Keeyask) on the nature of the Nelson River?

A: We are gaining understanding of what is happening related to existing developments. I cannot comment on the Keeyask Development until I see the Environmental Impact Statement. Complex fish and complex changes require mitigation.

2.17 Projects and progress by the Saskatchewan River Sturgeon Management Board

Rob Wallace, Saskatchewan Environment, Saskatoon, SK

Rob spoke on behalf of the Saskatchewan River Sturgeon Management Board (**SRSMB**), which is working cooperatively on projects to ensure there is a self sustaining sturgeon population in the Saskatchewan River between the E.B. Campbell and Grand Rapids dams that is capable of supporting the traditional uses of local Aboriginal people (***Appendix 20; Slides 1 and 2***). These dams were constructed about 1960 and 1967, respectively. The SRSMB was formed in 1998 and includes representatives of communities, resource agencies, and utilities in Saskatchewan and Manitoba (***Slide 3***). Since the late 1950s, biologists and resource users have reported changes in the river and sturgeon fishery (***Slides 4 and 5***). These observations prompted the development of a recovery plan for this sturgeon population (Wallace 1991). Since the 1960s there has been a loss of rapids spawning habitat, and habitat quality has deteriorated. These changes and overharvesting have reduced the population to perhaps 10% of its 1960 level. This decline has prompted new rules on flow maintenance by the hydroelectric facilities, a voluntary moratorium on commercial fishing, and the immediate release of sturgeon caught by sport anglers. A number of studies have been conducted to improve understanding of the species and aid recovery efforts.

Lake Sturgeon were radio-tagged at 6 sites and tracked over 4 years to follow their movements along a 250 km stretch of the lower Saskatchewan River (***Slide 6***). They found either long distance movements or very little movement, and confirmed that the population is shared by Saskatchewan and Manitoba. Another project examined fast water habitat for evidence of spawning (***Slides 7 and 8***). This information was used in habitat models and to inform mitigation actions, such as new minimum flow requirements for the E.B. Campbell Dam. Tobin or Iskowa Rapids are now gone, but spawning may occur in the E.B. Campbell Dam tailrace. Spawning was confirmed in the Torch River and at Bigstone Rapids.

Eggs were collected from Bigstone Rapids Lake Sturgeon in 1999 and 2000 for rearing at the Grand Rapids Fish hatchery (***Slide 9***). Concerns were raised about removing eggs from the population that was already depressed, so genetic studies were undertaken. They found genetic differences among the stocks around Lake Winnipeg but not within the Saskatchewan River. Subsequently, in 2003 to 2007 eggs and milt were collected near Nipawin, upstream of the E.B. Campbell Dam, and reared at the Nipawin Hatchery. About 206,000 fry and 88,000 fingerlings were stocked, 10% above and 90% below the E.B. Campbell Dam.

People are being educated about the sturgeon through the *Sturgeon in the Schools p*rogram, some community meetings, and a TV show by Nelson Bird (***Slide 10***). Posters and brochures have also been posted along the river and on the SRSMB website.

Index fishing has been conducted annually since 1996 at traditional fishing sites in Saskatchewan from Torch River to the Manitoba Border, and in Manitoba from Big Bend to Summerberry (***Slide 11***). In Saskatchewan this work involves 8 to 12 crews and the tagging and record keeping are done by local project workers. In Manitoba it involves 4 crews and the tagging and record keeping are done by staff. The fish are double tagged using PIT and Floy tags, so tag losses can be detected. Population estimates suggest the abundance has declined by 90% from estimates in 1960 (***Slide 12***). The current population is stable or possibly slowly declining.

Further habitat assessment is underway in Saskatchewan by DFO (Doug Watkinson, see Section 2.18) and the Saskatchewan Watershed Authority (M. Pollock, see Section 2.20) (***Slide 13***). Ron Campbell of Manitoba Water Stewardship is also beginning studies of traditional Lake Sturgeon habitat in Moose Lake and its tributaries.

The SRSMB Management Plan (North/South Consultants Inc. 2002) identifies a number of management strategies and goals (***Slide 14***). These strategies include monitoring by index fishing, stocking to increase recruitment, education to decrease mortality during fish handling, and habitat assessment. The goals in 2002 were to stabilize the existing spawning population within 5 years; to achieve a measureable increase in the spawning population within 20 y; to improve community support for voluntary measures that ensure harvest levels are sustainable;

and, within the next 5 y, to determine the long-term population objective and most effective way to achieve it. With the exception of increasing the spawning population, these goals have largely been met.

Targets proposed in 2006 included: aiming for the 1960 abundance, sizes, and ages; the sizes, age, and reproduction recommended by the Great Lakes Fishery Trust; doubling the population in 10-20 y; and providing for Aboriginal harvests of 300 or 600 fish (~2x current harvest) (***Slide 15***). The minimum viable population estimate requires 500 spawning females each year. At present there may only be 62 to 90 females spawning in a particular year.

Questions (Q), Answers (A):

Q: Cumberland Lake, the largest freshwater delta in North America, has been altered by the construction and operation of dams on the river. Both flooding and flow have decreased in the lower Saskatchewan River, and the water level in Cumberland Lake has dropped. These changes have reduced and damaged sturgeon habitat and populations. When will actions be taken to remediate these changes so that the effects on the delta and on the sturgeon habitat are reduced and populations rebound?

R: It is a wonderful and complex area, with both natural and man-made changes occurring.

Q: Does the Government of Saskatchewan have a recovery strategy for the North Saskatchewan River?

A: Not to my knowledge.

C: The E.B Campbell and François-Finlay dams have altered sturgeon habitat in the lower Saskatchewan River and Delta and destroyed the Cumberland House fishing industry. How can these habitats be recovered while the dams exist? If the Lake Sturgeon is listed under SARA, can the community apply for funding?

C: Government and industry need to provide more research funding to Aboriginal organizations, and to hire local Aboriginal people to participate in their scientific studies. It is important to take an ecosystem approach to research that considers all pieces of the puzzle.

2.18 Habitat assessment on the Saskatchewan River downstream of E.B. Campbell Hydroelectric Station

Doug Watkinson, Fisheries and Oceans Canada, Winnipeg, MB

Doug described studies to assess habitat loss downstream of E.B. Campbell Dam on the lower Saskatchewan River (***Appendix 21; Slides 2 to 4***). When E.B Campbell Dam was built water was diverted from the old rapids along a manmade channel to the powerhouse. The dam is a peaking facility that releases water stored in its upstream reservoir as required to meet electricity demands. Flows vary widely and change quickly and, in the past, flow was sometimes entirely shut off. In response to concerns over habitat loss, DFO now requires a minimum flow of 73 m^3/s. Three sections of river were studied. The first is a high gradient section, characterized by high water velocities and larger cobble/gravel/boulder substrates (***Slide 3***). It extends from just below the dam to about 6.3 km downstream. The second section extends from 6.3 to about 18.2 km downstream (***Slide 4***). It has an intermediate gradient and water velocities, with relatively stable gravel/sand bars and rocky shores. The third section extends from about 18.2 km downstream (***Slides 5***). It has slower velocities and sand substrate.

Summer water levels below the dam can fall and rise by 1.5 m over the course of a day (***Slide 6***). They typically fall after midnight and rise by 9 am. This leads to fish stranding (e.g., Walleye *Sander vitreus*, Yellow Perch *Perca flavescens*, White Sucker *Catostomus commersoni*), shoreline erosion and impoverishment of the littoral zone (***Slides 7 to 9***). These changes are most apparent at low to moderate flows and less so at high flows.

Habitat mapping was conducted at each of the three study sections. Data were collected on water depth and substrate, and acoustic Doppler current profiles were taken across the river at various sections (***Slides 10 to 14***). These data were used to build two-dimensional hydraulic models. Using the models and a rating curve, it was possible to quantify changes in the wetted habitat area under different discharges (***Slides 15 to 17***). Having wet channel is important for the production of both invertebrates and fish, and large fluctuations in the wetted area seldom benefit production. These data were also used to build habitat suitability indices, calculate weighted useable areas, and determine the discharge that would maximize habitat available to each life stage of a particular species (***Slides 18 and 19***). A discharge of 450 m^3/s, for example, may maximize the useable area of sturgeon spawning habitat (***Slide 20***).

Significant changes in the hydrograph have occurred due to upstream water use and loss in Alberta and Saskatchewan (***Slide 21***). Impoundment for hydroelectric development has shifted seasonal flow from summer to winter and increased daily fluctuations. Biologically significant periods (BSP) were defined and habitat changes at median (50% **exceedance**) to low flows (100% exceedance) were studied (***Slide 22***; BSP1 = winter; BSP2 = early spring; BSP3 = late spring-early summer; BSP4 = later summer and fall). Discharge has increased in BSP1 (winter) and declined during the rest of the year. The biggest declines have occurred during BSP3, which is the period of sturgeon spawning.

The study did not catch any sturgeon. It was conducted after sturgeon had completed spawning and did not target the species. There are lots of fish downstream of the dam facility (***Slides 23 to 28***). Fish species caught at the reference site between the Forks and François-Findlay Dam were generally represented by a range of age/size classes. In contrast, fish caught immediately below the E.B. Campbell Dam were generally adults (e.g., Suckers *Catostomus* spp. and redhorse *Moxostoma* spp.), although Walleye were present. This difference may relate to spawning success, stranding mortality, downstream drift, a lack of downstream drift from Toban Lake, or to some other factor(s) (***Slide 29***).

Questions (Q), Answers (A), and Comments (C):

C: Fishermen in Cumberland House have asked for index fishing between François-Finlay and EB Campbell dams but the province has not allowed it.

C: Historically there were large sturgeon between the François-Finlay and E.B. Campbell dams. It is good to see evidence of fish stranding documented. Stranding has been a concern to fishermen for some time and should be prevented.

R: North/South Consultants Inc. has been conducting a study that will provide quantitative information on stranding.

Q: Are there plans to conduct a similar study below the François-Findlay dam?
A: Not at this time

2.19 Mapping Lake Sturgeon habitat on the North Saskatchewan River using Aboriginal traditional knowledge from Cumberland House Cree Nation

Brian Scribe, Federation of Saskatchewan Indian Nations, Saskatoon, SK

Brian described work funded by DFO's Aboriginal Fund for Species at Risk (AFSAR) to gather Aboriginal traditional knowledge (**ATK**) of Lake Sturgeon habitat use in the lower Saskatchewan River (***Appendix 22***). There is concern among the First Nations regarding the collection of their traditional knowledge. Guidelines for collecting ATK have been developed by the Federation of Saskatchewan Indian Nations (**FSIN**) (***Appendix 22; Slides 3 to 5***). Culturally appropriate research methods for the collection of ATK are being developed and applied including focus groups, oral testimony interviews, community surveys, field visits/ground-truthing, and video journaling. Where people prefer, their information is being collected in the Swampy Cree language and translated into English. The information is geo-referenced on maps as it is collected and, in future, may be archived in a GIS database held by the Cumberland House First Nation.

The study area is the 9500 km^2 Saskatchewan River Delta, which provides important habitat for many species and is used extensively by First Nations and Métis harvesters (***Slides 10 to 12***). A framework for ATK collection that covers various species has been developed (***Slides 13 and 14***). The protocol is to contact the leadership before approaching elders for information. The collection and availability of ATK is limited by the resources available to First Nations for this work and by lack of capacity. This project is helping to address both of these issues. Fish habitat stewardship research can be used to address the need for research and capacity building (***Slides 15 and 20***). It is important to document the elder's traditional knowledge before it is lost.

Lake Sturgeon have been an important resource for people living along the lower Saskatchewan River (***Slides 17 and 18***). They are a traditional source of food and materials and once supported an important commercial fishery. Overharvesting and habitat changes have caused a drastic reduction in the sturgeon population in the lower Saskatchewan River during the last half of the 20th century.

Raymond Dussion continued with the presentation. Information from the elders is being transcribed onto Map Source, as the researchers lack GIS technology. Google Map has been very useful for identifying locations during discussions with elders. It allows changes in scale and the use of satellite imagery, making locations easier to recognize. Sturgeon spawning and fishing areas have been mapped. More resources are needed to capture ATK before it is gone, and to compensate elders for providing information. Sturgeon are still being harvested and some are sold. This study has only interviewed people from Cumberland House First Nation. Residents of Cumberland House should also be interviewed as they hold different knowledge. Cumberland Lake is now very shallow (***Slide 23***), and formerly important sturgeon spawning habitat is now dry during the spawning season (***Slide 24 and 25***).

Comments (C) and Responses (R):

C: It is important that studies capture the views and information from Métis people in the community of Cumberland House, as well as from the Cumberland House First Nations.

C: Métis people in Manitoba have also been impacted by hydro development and share the interest of First Nations in species' recovery. Under Section 35 of the *Constitution Act* of 1982, Métis should also be included in any consultations. The Manitoba Métis Federation is the point of first contact for consultations with Métis in Manitoba.

C: Some traditional knowledge studies in Saskatchewan include both First Nations and Métis elders.

C: Fox Lake has found satellite maps to be a very useful tool when when conducting traditional knowledge interviews.

R: Saskatchewan Geomatics may be approached to provide satellite maps of the lower Saskatchewan River.

C: Aboriginal residents in the Berens River areas along the east side of Lake Winnipeg are concerned that the quality of fish habitat in the lake has been deteriorating. Berens River still has the traditional clan system with specific rituals. Sturgeon are important to the people and their culture. The sturgeon clan has a traditional role in community health, gathering medicinal products from the land and practicing traditional healing techniques. It is important for Aboriginal communities and fishermen to establish partnerships with government to work toward species recovery.

2.20 Investigating the impact of flow management on Saskatchewan River Lake Sturgeon populations

Michael Pollock, Saskatchewan Watershed Authority, Saskatoon, SK

Mike described work that the Saskatchewan Watershed Authority (**SWA**) has conducted and is planning on Lake Sturgeon habitat use and flow management in the Saskatchewan River (***Appendix 23***). The SWA owns and operates 45 dams in Saskatchewan, and is mandated to ensure the province has a reliable water supply (***Appendix 23; Slides 2 and 3***). It conducts comprehensive instream flow studies to identify potential impacts of flow management and develop solutions. The flow regime is managed to maintain an ecologically sound environment and to support economically and aesthetically important activities.

The Gardiner Dam, which is operated by the SWA, has many of the same flow regime challenges as the E.B. Campbell Dam (***Slide 4***). It provides water for recreation, irrigation, industrial and domestic use, and power generation and plays an important role in flood and drought control (***Slide 5***). Its environmental effects include a reversed hydrograph, impacts on water quality, and daily changes in flow albeit lower than those downstream of the E.B. Campbell Dam (***Slide 6***).

Aquatic life depends on many environmental cues such as water temperature, day light hours, water quality, and connectivity many of which are linked with flow (***Slide 7***). Restoring and/or maintaining natural flow conditions will help to correct and/or prevent disruption of these cues and any consequent damage to Lake Sturgeon. Populations of this long-lived, late maturing fish species have declined significantly throughout their range (***Slide 8***). Habitat destruction, degradation, and fragmentation continue to threaten sturgeon survival and recovery (***Slide 9***).

Over the past 3 years the SWA has studied the potential impact of current water management on Lake Sturgeon habitat and recovery in the Torch, Saskatchewan, North Saskatchewan, and South Saskatchewan rivers (***Slide 10***). The long-term objective of this and future work is to manage flows such that they meet provincial water needs without harming fish. In the spring and summer of 2007, field studies were conducted at Torch River tributary of the Saskatchewan River mainstem (***Slides 11 and 13***). Sturgeon were not caught but the Aboriginal index fishery has shown them to be present. Suitable spawning habitat for Lake Sturgeon was abundant in the Torch River. Habitat use in the upper 50 km of the river is affected by the Candle Lake Dam. This control structure at the lake exit has minimal impact on the lower 250 km of the Torch River.

In 2008 habitat was characterized at 15 sites on the Saskatchewan, North Saskatchewan, and South Saskatchewan rivers that historically supported Lake Sturgeon (***Slides 14 to 18***). The study objectives were to categorize these habitats, examine how they are affected by changes in flow, and to estimate the food resources they provide for sturgeon. At each location a 1 km stretch of river was mapped for substrate and bathymetry (***Slide 15***). Historical flow data were used to understand the relationship between flow discharge, water elevation, and wetted area (***Slide 16***). Forage available to sturgeon at each site was determined by examining the diversity, abundance, and substrate associations of the invertebrate communities (***Slide 17***). Bathymetry, historical flow records, and discharge vs. stage curves were used to calculate the average annual emergence (%) at each site and relative stranding between sites (***Slide 18***). This information was not related directly to sturgeon habitat, rather it provided a general sense of which stretches of the river were most susceptible to emergence.

In 2009 detailed bathymetric and substrate analyses were conducted at 5 of the sites sampled in 2008 (***Slides 19 and 20***). These data will be used to develop a detailed model for predicting the impact of flow on specific habitat types (***Slide 21***). The economic and operational impacts of any proposed flow regime alterations will then be assessed using SaskPower's hydroelectric optimization model. Sturgeon were tagged to follow their movements, habitat use, and migration patterns; and for estimating population size and home range (***Slides 22 to 24***). Thirty-seven fish had radio-tags implanted in their body cavity with the antennae protruding. These and other fish (>64) also received a Floy tag and a PIT tag. The fish were anaesthetized for surgery using MS222, which was buffered to avoid gill burning. During surgery the gills were irrigated alternately with anaesthetic solution or plain water to maintain the proper breathing rate. All of the fish survived surgery and are still being tracked. The tagged sturgeon will be tracked weekly over the next 3 to 5 years by receivers at three stationary tracking towers and using mobile receivers carried by plane, car, or snowmobile. The fish—mostly spawning sized, showed little movement during winter but began moving upstream in March. During tagging tissue samples were taken for genetic and stable isotope analyses. Photographs were also taken to record individual markings so fish could be identified in the event of tag loss.

In 2010 and beyond, a large mark-recapture study is planned, wherein the fish will be tagged with Floy and PIT tags (***Slides 25 to 28***). The data will be used to estimate population size and set recovery targets. Further tissue sampling is also planned for genetic and stable isotope analyses (^{13}C, ^{15}N) to examine population structure and feeding, respectively. The genetic analyses will examine diversity, effective population size, and discrete breeding populations. The isotope analyses will identify preferred prey and examine dietary differences related to age, season, or region.

This research is part of a proactive approach on the part of the SWA to gain understanding of how flow management affects Lake Sturgeon populations in the Saskatchewan River watershed. This information will enable the SWA to initiate or respond to recovery plans for the species, and to work effectively with DFO to meet species recovery goals.

Questions (Q), Answers (A):

Q: How is this study funded?

A: Funding has been provided by DFO, Environment Canada, the Government of Saskatchewan, Canadian Wildlife Federation, and SaskPower (**see Slide 29**). DFO has also contributed equipment, and the universities of Regina and Saskatchewan are involved in cooperative work.

Q: Fish at the Torch River are sometimes very dark in colour. How long does it take for fish to change colour?

A: Colours can change over a few days in response to changing light conditions.

2.21 Species at risk process in Alberta and sturgeon: Lake Sturgeon update

Terry Clayton, Alberta Sustainable Resource Development (ASRD), Lethbridge, AB; Daryl Watters, Alberta Sustainable Resource Development, Edmonton, AB; and Shane Petry, Fisheries and Oceans Canada, Lethbridge, AB.

Daryl described how the Province of Alberta identifies and recovers species at risk (***Appendix 24***): In Alberta, general status assessments are conducted to determine which species are at risk. These assessments consider the population size and trend, number of occurrences, distribution and trend, threats to the population and its habitat, and the species' status elsewhere (***Appendix 24; Slide 3***). Detailed status reports are then prepared by species experts (***Slide 5***). These are reviewed by the Scientific Subcommittee (SSC) which may also consider additional information. The SSC status recommendation is then reviewed by the Endangered Species Conservation Committee (ESCC) which recommends status to the Minister of Sustainable Resource Development. After considering this recommendation the Minister may approve *Endangered* or *Threatened* species for listing and protection under Schedule 6 of the Wildlife Regulations (***Slides 6 to 8***). In 2007, the Lake Sturgeon was listed as *Threatened* in Alberta.

Recovery teams develop a recovery plan, within 1 year for species listed as *Endangered*, 2 y for those listed as *Threatened* (***Slide 9***). The goal of whether to maintain or restore populations depends upon the species. The recovery team develops the content of the recovery plan and assesses the biological and technical feasibility of recovery. The Alberta Recovery Plans consist of a recovery strategy and an action plan. The strategy describes the species' biology and threats to the species and its habitat. It also recommends an approach to recovering the species. The action plan outlines specific tasks that should be undertaken to achieve recovery.

The socioeconomic costs and benefits of the action plan are considered, and the public is consulted before a recovery plan is approved.

The goal of the Alberta Recovery Program is “to maintain or restore species identified as *Threatened* or *Endangered* to viable, naturally self-sustaining levels within Alberta” (***Slides 10 to 24***). Species with a naturally limited distribution and/or population are maintained, while those reduced by human activities are stabilized to ensure their survival and enhanced wherever possible to recover their habitat and/or abundance. For fish species, the recovery team helps the area fish biologist prepare the recovery plan, reviews its implementation periodically, and review/revises the plan at the end of its lifespan (5 y). Implementation of the recovery plan is guided by the species’ lead (**ASRD** Biologist), who may be assisted by Government, non-governmental organizations, and individuals. There has been strong interest on the part of stakeholders in Alberta in the recovery of Lake Sturgeon. More information is available on Alberta species at risk on the Alberta Sustainable Resource Development website (http://www.srd.alberta.ca/BioDiversityStewardship/SpeciesAtRisk/Default.aspx).

Shane described past and ongoing research on Lake Sturgeon in the North Saskatchewan and South Saskatchewan rivers in Alberta (***Appendix 25; Slides 2 to 5***). Research to date on sturgeon in Alberta has involved extensive Floy and PIT tagging of sturgeon in both rivers with the help of volunteers. Most fish are captured by angling, and these annual efforts are ongoing. In 2010 a radio-tagging study of 55 fish is planned for the North Saskatchewan River, downstream of Edmonton. The work will involve an M.Sc. student from the University of Alberta. Three sizes of tags will be used so adults (25), juveniles (25) and small juveniles can be tagged. The study will follow habitat use and examine why few older fish are found in the river. Roving creel surveys will be conducted—largely on the North Saskatchewan River, and some egg mats may be deployed in both rivers. In 2010, acoustic tagging may be conducted on fish in the South Saskatchewan River to follow habitat use and identify spawning habitats.

Questions (Q), Answers (A):

Q: Has traditional knowledge been included in these studies?

A: Indians have not traditionally fished for sturgeon in the South Saskatchewan River, and we have not found First Nations who netted sturgeon from the North Saskatchewan River. The commercial fishery closed in 1940, and there are few records of commercial sturgeon harvests.

C: The sturgeon population in the South Saskatchewan River in the reach extending from about 40 km upstream to 100 km downstream of Medicine Hat has been estimated using Floy tags at 8500 fish. This estimate has been increasing since 1968. The population estimate based on Floy tag mark-recapture data from the North Saskatchewan River in Alberta is lower, about 1400 fish. PIT tag data there yield a higher number but the record is shorter and uncertainty higher. Floy tag losses have been estimated at 15-25%. There is no evidence of PIT tag loss, so these tags should provide a better estimate over the long term.

Q: What is the average size of these sturgeon?

A: About 9 kg (20 lb) in the North Saskatchewan and 6.8 kg (15 lb) in the South Saskatchewan.

End of Day Discussion

Following the Alberta presentation, there was a period of open discussion. Key questions/points raised were as follows:

- Has anyone studied how many different kinds of Lake Sturgeon are there?

- Every kind of knowledge should be used to recover sturgeon. Developers who caused the problem should be held responsible for the damages and be made to pay the cost of recovering the resource. People must put aside their differences and work together toward recovery.

- The process of recovery will be slow. People affected by the decline of sturgeon have received nothing from Hydro for having their resources impacted. This is a big matter as it affects their life. The Churchill, Burntwood, and Nelson rivers have all been affected, and the people.

- Mary Head read a letter from concerned citizens to the Government of Manitoba and the Saskatchewan Watershed Authority detailing concerns about the state of the Saskatchewan River Delta. She emphasized the need for a holistic, cumulative approach to research and environmental impact assessment that includes greater Aboriginal involvement.

- To ensure that important letters of concern such as these get the attention they deserve it is often worthwhile to involve advisory bodies such as the Saskatchewan River Sturgeon Management Board and to address them directly to the appropriate government Minister.

- Dam impacts can be far-reaching and extend both upstream and downstream.

- Concern was expressed that Government is not willing to listen about Lake Winnipeg habitat concerns. A sturgeon hatchery is needed near where sturgeon live. Deep areas near the mouth of the Pigeon River provide summer habitat for Lake Sturgeon. Fishermen on the east side of Lake Winnipeg recognize two types of Lake Sturgeon on the basis of morphological and colour differences, one uses Lake Winnipeg and the other remains in the rivers. We need to concentrate on what we have to do as Canadians to recover the Lake Sturgeon. Government must be willing to do what is necessary. Senior government officials should have attended this meeting to demonstrate their willingness to participate in sturgeon recovery and listen to the “grassroots” people.

- Good message. People need to work together.

- Fish in the scientific studies are seldom over 23 kg (50 lbs) and appear to average 9 to 13.5 kg (20-30 lbs). This is much smaller than some of the ones the elders used to catch. In 9 days of index fishing on the lower Saskatchewan River 137 sturgeon were caught. Sturgeon catches are determined by seasonal timing and the type of nets used. Researchers should consider sampling for sturgeon when the leaves begin to form, as that is the time when Aboriginal peoples used to catch them. It is good to have this group speaking for the sturgeon. When Northern Pike (*Esox lucius*) spawn upstream of the E.B. Campbell Dam in Tobin Lake, the fish downstream of the dam have usually finished spawning. Shutting off water downstream to facilitate pike spawning upstream is wrong. It is bad for the fish downstream and should not be allowed. There should be a compromise that enables both the pike upstream and sturgeon downstream to spawn successfully. Water fluctuations should also be managed to prevent stranding of fish downstream of the dam.

- Useful information for Lake Sturgeon recovery might be transferred from the White Sturgeon (*Acipenser transmontanus*) in British Columbia.

2.22 A paradigm shift in hydroelectric development: integrating ecohydraulic aspects in Dunvegan Hydro

Chris Katopodis, Fisheries and Oceans Canada, Winnipeg, MB

Chris used the Dunvegan Hydro Project on Alberta's Peace River to illustrate the potential ecological and economic benefits of integrating ecological considerations into engineering designs (***Appendix 26; Slide 2***). This new area of design engineering is known as ecohydraulics. The incorporation of ecoyhydraulic considerations, beginning at the conceptual design stage, can result in considerably different water project design, construction, and operation than in the past.

The project proponent initially approached DFO with a traditional hydroelectric design. DFO then worked with the company to redesign the project to incorporate measures that mitigate impacts to fish. The first step in this process was to identify the fish and fish habitat issues (***Slide 3***). The primary issues for this project included maintaining fish passage and thereby habitat connectivity, compensation for the limited areas of habitat affected by the project, and monitoring to inform adaptive management both for this project and to improve future projects.

Habitat connections need to be maintained, whether they are up or down stream, lateral from the main channel to and from side channels or floodplains, or vertical (***Slide 4***). The Bennett Dam in British Columbia regulates flows in this reach of the Peace River. Two-dimensional ecohydraulic models were developed for the Dunvegan site to predict velocities in the river channel. The objective was to locate areas where the current is low enough (i.e., <1 m/s) for fish to locate a fish passage facility (***Slide 5***). The modelling exercise was conducted for a range of flow and operating scenarios to predict how currents would change (***Slides 6 to 8***). Suitable current velocities were identified close to shore at each end of the dam site.

Effective fish passage facilities must enable fish to bypass the facility <u>and</u> attract fish to use them. To do this, water that had already been used by the turbines to produce power was directed to produce currents that attract fish to the upstream fish passage facilities (***Slide 9***). The design also addressed the need for downstream fish passage that avoided the turbines (***Slide 10***). Bypass discharges of 10 to 20 m^3/s attracted fish but increasing discharges offered little additional attraction (***Slide 11***). Trash racks with finer bar racks on top were installed to prevent entrainment and damage of fish by turbines (***Slide 11***). By rounding the leading edges of the racks the gap between racks could be reduced without reducing flow relative to racks with squared-off leading edges. This offered protection for a wider size range of fish (i.e., >20 cm). High fish-survival turbines were also used.

To facilitate upstream fish movement a variety of ecohydraulic designs were evaluated, including culverts that simulate natural stream conditions and baffled fishways (***Slides 13 and 15***). Baffled fishways with a 20:1 slope work efficiently for fish passage (***Slides 16 and 17***). The re-designed Dunvegan Hydro Project used a smaller spillway, with some spill redirected to the fishway. It had a fishway at each bank for upstream movement; 10 fish bypasses for downstream movement; and 8 fish exclusion bar racks to reduce turbine mortality (***Slide 18***). Spilling water through the fishways and bypasses, instead of over the spillways, improves fish passage without reducing the amount of water available for power generation. Having numerous bypasses enables adaptive management, as some bypasses may be more effective than others, so spill can be directed preferentially to them.

Ecohydraulic modelling has also been used to design fish passage around the cofferdams that will be required for several years during construction of the dam (***Slides 19 and 20***). These cofferdams will restrict flow during construction, increasing flow velocities. By adjusting the design of the leading edge high velocity barriers can be mitigated.

Science-based monitoring is a key aspect of optimizing the Dunvegan project for fish and power production, and for validating assessments, assumptions, and models (***Slides 21 to 23***). The Dunvegan fish passage design is innovative and intended to operate during the open water season with high fish survival. It includes high fish survival turbines and partial protection of Burbot (*Lota lota*), which move downstream in winter. It reflects the need to pass a wide range of size-classes and species. It also offers flexibility in hydraulic conditions within a range of feasible hydroelectric operating scenarios, and is amenable to adaptive flow management. The redesign actually increased power production from 80 MW to 100 MW, so the environmental mitigation was also cost-effective.

Ecohydraulic research is ongoing to improve understanding of how fish respond to different fish passage designs (***Slide 24***). Rounding the leading edge of bar racks to improve flow efficiency at narrower gaps is one simple innovation (***Slide 25***). Turbines are also being designed that reduce the mortality among entrained fish (***Slide 26***). A new national network has been funded for 5 years to address ecohydrological issues (***Slide 28***). When designing mitigation measures, the adaptability of the biota must be kept in mind, as illustrated by the video of a crab that exits water where flow is too high and returns where current is lower.

Questions (Q), Answers (A):

Q: Would the licensing process for the Keeyask Hydro Project go better if DFO engineers were involved in the design process?

A: This was suggested at the outset but might cause regulatory problems in the future

Q: This question was directed to Sask Power. Are there fish passage facilities at the François-Finlay and E.B. Campbell dams on the Saskatchewan River, and are they are designed for sturgeon passage?

A: E.B. Campbell dam does not offer fish passage. Information on the fish racks will be provided. In 2016 the dam's water licence will be reviewed, at which time there will likely be more detailed discussions.

Q: Do we know how many sturgeon pass through turbines? Does the powerhouse attract sturgeon, as elders have observed them to congregate in this area?

A: An audience member said he was studying downstream entrainment.

R: It is important to understand the scale of this problem, so solutions are not designed for problems that do not exist.

C: Minor adjustments to dam design seem to offer real benefits. There seems to be a big opportunity to make these small adjustments and mitigate existing impacts.

A: Yes. There are many opportunities for mitigation. By gaining understanding of what fish need it is possible to optimize designs. For example, providing the necessary flow at the right place and time can afford fish passage without wasting flow that could be used for power production. With better ecological information it will also be possible to design successful mitigation for existing impacts.

2.23 Manitoba Hydro Lake Sturgeon stewardship and enhancement program

Shelley Matkowski, Manitoba Hydro, Winnipeg, MB

Shelley described Manitoba Hydro's participation in efforts to recover Lake Sturgeon. MB Hydro recognizes that its activities have and will affect Lake Sturgeon as hydroelectric developments, like sturgeon, use rapids habitats. The company also recognizes the importance of Lake Sturgeon, particularly to Aboriginal peoples. Consequently, MB Hydro has been funding research needed to focus sturgeon recovery activities. MB Hydro has six generating stations on the Winnipeg River, including Pointe du Bois GS which is in the planning phase for modernization (***Appendix 27; Slide 2***). It also has the Grand Rapids GS near the mouth of the Saskatchewan River, and five generating stations on the Nelson River. Two new stations, Keeyask and Conawapa, are planned for the Nelson River system. MB Hydro also has two control structures on South Indian Lake that divert water from the Churchill River into the Nelson River system. Wuskwatim GS is under construction on the Burntwood River, and there is a tiny GS on the Laurie River.

MB Hydro began doing sturgeon research in the late 1980s, with individual projects on the Nelson River. When sturgeon boards were formed for the Saskatchewan and Nelson rivers the corporation became involved with their work. In the 1990s MB Hydro began funding academic research on Lake Sturgeon biology and ecology. To focus these various efforts MB Hydro has developed its Lake Sturgeon Stewardship and Enhancement program (***Slides 3 and 4***). Its purposes are to fill information gaps on populations (e.g., lower two reaches of Winnipeg River) and to identify limiting factors. This research will be used to assess the effects of generating stations on Lake Sturgeon and their habitat and to develop mitigation techniques such as spawning enhancements that can be incorporated into hydroelectric designs and monitored for effectiveness. Efforts are also being made to educate the public regarding Lake Sturgeon to facilitate recovery efforts.

There are various delivery mechanisms for these projects (***Slide 5***). For future projects such as Keeyask and Conawapa, MB Hydro is working to reach a design balance that enables hydroelectric generating stations and Lake Sturgeon to coexist (***Slide 6***). Both scientific and traditional knowledge are being gathered for this purpose (see Sections 2.9 and 2.10). Funding is also being provided for academic research, including the Winnipeg River work discussed earlier (***Slide 7***) (see Sections 2.4, 2.6, and 2.7). Studies of sturgeon spawning below existing hydro facilities on the Winnipeg River are ongoing (***Slide 8***). This work has led to construction of an artificial spawning shoal below the Pointe du Bois GS that is now being monitored for its use by Lake Sturgeon (see Section 2.8). More shoal construction is planned. The sturgeon management boards are also a key component of the sturgeon stewardship and enhancement program (***Slide 9***) (see also Sections 2.16 and 2.17). Both the Nelson River and Saskatchewan River sturgeon management boards have worked to fill information gaps, identify limiting factors, and mitigate impacts through stocking and voluntary harvest reductions. Their annual index fisheries monitor the effectiveness of these programs and they have a strong educational component. MB Hydro owns the Grand Rapids Hatchery, which is operated by the province and rears Lake Sturgeon for stocking in the upper Nelson River by the Nelson River Sturgeon Co-Management Board **(NRSB)** (***Slide 10***). Some of the fish are also used for academic research (see Section 2.7). The facility may be used to rear fish for conservation aquaculture related to future developments such as Keeyask. The Silas Ross Memorial Sturgeon Rearing facility at the Jenpeg GS is used to rear fry from the Grand Rapids Hatchery into fingerlings for release. This facility also plays an important role in public education, and for training purposes.

These are cooperative recovery actions involving other groups and agencies (***Slide 11***). Recovery agreements with partners are considered by MB Hydro to be important as long-term commitments to sustainable development and for developing relationships with First Nations.

Questions (Q), Answers (A):

C: Fox Lake is not a part of the NRSMB but is working with five other communities to develop another management board and to develop a sturgeon rearing facility closer to their communities. It is important to incorporate Aboriginal traditional knowledge in environmental assessments and sturgeon co-management. MB Hydro has come a long way in the last 10 years but has a long way to go. Fox Lake is committed to sturgeon recovery.

R: Thank-you.

Q: How can the Sagkeeng First Nation get involved in the Winnipeg River research?

A: The attempt to establish a sturgeon management board for the Winnipeg River system was not successful. There is an ongoing process for Aboriginal involvement related to Pointe du Bois modernization, which would be a good opportunity for Sagkeeng to become involved. Manitoba Hydro will consider this question further and reply to the Chief and Council.

Q: What would be top of the wish list for Manitoba Hydro development-related research in Nelson River?

A: More research is needed on mitigation measures.

Q: Does water quality on the Nelson River meet Canadian Water Quality Guidelines?

A: I am not familiar with the data but both Manitoba Hydro and Environment Canada have long-term monitoring programs. The guidelines are likely exceeded some times at some locations.

Q: Rivers from Saskatchewan, Manitoba, Ontario and the United States drain water that contains contaminants into the Nelson River, which is also being affected by global warming. Water flow and quality in the Nelson River have changed so that now fishermen only have 2 hours to set and pull nets. Sediment is building up at the mouth of the Nelson River, and water in the river is warming. This is destroying Mother Nature. What is DFO doing about these problems?

A: The Nelson River is downstream of many impacts. More information is needed so that a better balance can be achieved between the developments people want and the natural environment they value.

Q: How serious is Manitoba Hydro about preserving sturgeon? Conawapa, where a future dam has been proposed, is a sturgeon spawning ground. How will loss of spawning habitat and fish passage be dealt with?

A: These projects won't go ahead unless sturgeon are taken care of. This requires understanding of what the fish need, whether fish are there, how they are being affected by existing developments, and how best to mitigate any impacts.

C: The Manitoba Government and DFO permit developments but do not compensate people affected by their decisions.

2.24 Recovery potential assessment for western Hudson Bay Lake Sturgeon

Tom Pratt, Fisheries and Oceans Canada, Sault Ste. Marie, ON

Tom described what Recovery Potential Assessments (RPA) are and provided an update on those for endangered populations of Lake Sturgeon in Canada. Readers are referred to ***Appendix 28*** (***Slides 3 to 17***) for detailed notes on the RPAs.

When COSEWIC recommends threatened or endangered status DFO Science is asked to provide advice (***Slide 2***). One aspect of this is the RPA. Components of this assessment include a summary of the species biology and ecology, information on historic and current abundance and trends, and information to support the identification of critical habitat (***Slide 3***). The assessment also develops recovery targets, identifies threats to survival and recovery, and identifies mitigation and alternatives (***Slide 4***). All of this information is used to conduct an **allowable harm** assessment that identifies how much more scope there is for mortality in a particular population (***Slide 5***). This process includes a series of meetings that include representatives of the First Nations and Federal and Provincial governments, stakeholders, and academics (***Slide 6***). It is consensus-driven, and reaching agreement can be a challenge given differing viewpoints.

For the RPA, Western Hudson Bay (DU2) was subdivided into MU1 and MU2, which are situated above and below the Missi Falls Control Structure, respectively (***Slide 7***). The only abundance estimate for Lake Sturgeon in this DU is for a small area at the confluence of the Churchill and Little Churchill rivers.

Recovery targets for Lake Sturgeon abundance and habitat area in each designatable unit (DU) were based on modelling of Canadian sturgeon populations by Vélez-Espino and Koops (2009). (***Slide 8;*** Note: ASF = annual number of spawning females required for there to be a 99% chance of the population living another 250 years.). The model assumes an even sex ratio and that mature female sturgeon spawn every 5 years. The results suggest that DUs 1 and 2 this would each require 5,860 mature sturgeon (i.e., 5x2x586), while DUs 3-5 would each require 4,130 mature sturgeon. It remains to be seen whether these abundance targets are reasonable or achievable. The modelling results suggest that adults are the life stage most sensitive to harm (***Slide 9***). However, for populations to increase the survival rate of young-of-the-year must be increased. The years to recovery (***Slide 9***, y-axis—Note: the y-axes of the graphs have different scales) depend upon the percentage of the population remaining (***Slide 9***, x-axis) and the management scenario undertaken (e.g., reducing mortality of early adults--left graph; reducing mortality of adults and juveniles).

A threats table was developed for each DU to compare the probability and magnitude of threats affecting a particular MU (***Slide 10***). In DU1, for example, habitat loss from dams and impoundments and mortality from subsistence harvests were considered to pose the greatest threats to sturgeon recovery. A recovery potential table was also developed for each DU to summarize the conservation status, population trajectory, importance to species recovery and recovery potential of each MU (***Slides 11, 12, 14, 16***). In the upper Churchill River (MU1), for example, recovery potential was considered moderate; whereas in the lower Churchill River (MU2), where water levels fluctuate, it was considered low (***Slide 11***). The RPA then considers how key threats might be mitigated. In the case of habitat degradations due to dams, this could include changes to the water management regimes and the rehabilitation of habitats that are limiting species recovery. Education, conservation closure, and enforcement were recommended as means of mitigating threats to the species from harvesting. If recovery is to occur adult survival should not decline by more than 1.0 to 1.3%.

In the Saskatchewan River (DU2) recovery potential was considered high in MUs where suitable sturgeon habitat is available (***Slide 12***). Key threats are from habitat degradation by dams, agriculture, urbanization, and forestry (***Slide 13***). Depending upon the MU, little or no additional mortality should be allowed if the populations are to recover. Six MUs were identified in the Nelson River (DU3) (***Slide 14***). Of these, only the most downstream reach, MU5 below the Limestone Generating Station, is considered to have a high recovery potential. Key threats are from habitat degradation and fragmentation by hydroelectric development, and from exploitation (***Slide 15***). Depending upon the MU, little or no additional harm is allowable. Little is known about sturgeon populations in the Red and Assiniboine rivers and Lake Winnipeg (DU4) (***Slide 16***). The Red and Assiniboine rivers (MUs 1-3) have been stocked with sturgeon from different populations, so the recovery potential for the indigenous population(s) is compromised. Agriculture, urban development, habitat degradation and fragmentation, industrial activities, and exploitation all pose threats to fish in DU4 (***Slide 17***). Exploitation is primarily a threat in Lake Winnipeg, where sturgeon can be a by-catch of the commercial fishery. Again, there is little room for additional mortality (***Slide 18***). There are nine MUs in the Winnipeg River-English River (DU5)

(***Slide 19***). There are healthy sturgeon populations between some of the generating stations on these rivers but whether these populations can increase to meet recovery targets is unknown. Key threats include habitat degradation and fragmentation, industrial activities, and exploitation (***Slide 20***).

The RPA process benefits sturgeon recovery efforts by compiling up-to-date information on the species and its habitat, and on threats to the species and their mitigation (***Slides 21 and 22***). Modelling for the RPA has identified the importance of protecting adult sturgeon in order to preserve populations and of enhancing young-of-the-year survival to increase populations. It has also identified quantitative recovery targets. The proceedings document, 5 research documents, and 5 recovery potential assessments will be published on the Canadian Science Advisory Secretariat (CSAS) site (http://www.isdm-gdsi.gc.ca/csas-sccs/applications/publications/index-eng.asp) (***Slide 23***).

When considering species recovery it is important to put the data in context, as what appears to be a large recovery in the context of recent population levels may be very small in relation to historical population levels (***Slide 24***).

Questions (Q), Answers (A), Comments (C) and Responses (R):

Q: How is the conservation status determined?

A: It is based on the advice of the experts in the room.

Q: Have there been studies of tissue mercury concentrations in sturgeon?

A: Yes, in various locations. Larger, older fish tend to have higher levels of mercury in their flesh than do smaller, younger fish in the same system.

A: There have been lots of mercury studies conducted on the Nelson River system, but few tissue samples have been taken from Lake Sturgeon for analysis. The samples taken had relatively low levels of tissue mercury.

Q: There are many DUs and MUs for Lake Sturgeon. Will money be available to address all of these areas, and how will priority be determined?

A: If the Lake Sturgeon is listed under SARA a federal recovery strategy will be developed and it will prioritize where and what activities should be undertaken. The recovery teams involved in this work solicit advice from a broad group of stakeholders, so it is to them that you might best advocate where and how resources would be best allocated.

Q: Will DFO have more dialogue with the provinces on the issuance of permits that affect species at risk?

A: I do not know.

C: Shallow depth and thick ice in Cumberland Lake must affect the food chain that the Lake Sturgeon there rely upon. We should also be studying the food chain.

R: Yes. Food chain studies are an important aspect of critical habitat identification.

2.25 Recovery strategy development for the White Sturgeon in BC

Tola Coopper, Fisheries and Oceans Canada, Vancouver, BC

Tola described the recovery planning process for White Sturgeon, which is farther advanced than that for Lake Sturgeon and has dealt with many of the same issues that will be encountered with Lake Sturgeon (***Appendix 29, Slide 2***). The two sturgeon species have similar life histories and face similar threats, in particular hydroelectric development and exploitation. A recovery strategy must be developed for threatened or endangered species (***Slide 3; see also Section 2.1***).

The six White Sturgeon populations in British Columbia (BC) were designated Endangered by COSEWIC in 2003 (***Slide 4***). The Nechako, Upper Fraser, Kootenay, and Columbia populations were SARA listed in 2006. The Lower and Mid Fraser populations were not listed due to the socioeconomic value of the catch-release fishery, but are included in the recovery strategy. The species is widely distributed in BC, which shares the Columbia and Kootenay populations with the United States (***Slides 5 and 6***).

Development of the recovery strategy is ongoing. The National Recovery Team is Co-chaired by DFO and the Province of BC (***Slide 7***). This team also includes the Technical Working Group Chairs and representatives of the First Nations and United States. The four Technical Working Groups that do the background research are chaired by the Province or by industry. These groups include representatives of the First Nations and, where appropriate, representatives from the United States.

Population abundance of the SARA listed populations is low relative to those in the Lower and Mid Fraser River populations (***Slide 8***). The Upper Fraser River population is believed to be near its historic levels (***Slide 9***). But, because it is small, it is protected under SARA. The Nechacko River population is small, with natural spawning but little or no recruitment since 1967, and a projected decline from 150 mature females to only 25 by 2025 (***Slide 10***). River regulation by the Kenney Dam affects this population, as does loss of prey abundance due to lower salmon returns. The Columbia River population extends into the United States and has been impacted by a series of large dams on the river mainstem (***Slides 11 and 12***). While natural spawning has been observed there has been little or no recruitment since 1969 and abundance may decline by 50% in the next 25 years. The Kootenay River population, which has been affected by the Libby Dam, also shows evidence of natural spawning but little or no recruitment since ca. 1974 (***Slide 13***). White Sturgeon often congregate immediately downstream of dams. This can lead to reverse entrainment when these facilities shut down and the fish enter from downstream. Food variety and availability and flow may be attractants below the dams.

Sites of critical spawning, rearing, feeding, and overwintering habitats have been identified in the draft recovery strategy for the listed populations (***Slides 14 and 15***). Similar habitats identified for the Lower and Mid Fraser populations are referred to as “important habitats” because these populations are not listed under SARA. A variety of activities have the potential to destroy critical habitat (***Slide 16***). Successful recovery of the species will require the cooperation of many people and agencies, including hydroelectric operators and developers, since seasonal flow rates affect the suitability of critical habitat for sturgeon up and downstream of the dams.

Recruitment failures in White Sturgeon have been due to poor survival of young-of-the-year, which has been correlated with dam construction (***Slides 17 and 18***). This problem must be solved as otherwise populations can only be maintained by stocking. The recruitment failures may be related to predation of young or substrate alterations that change habitat suitability (***Slide 19***). Conservation aquaculture, which is funded entirely by BC Hydro, will continue until the recruitment problem can be solved (***Slide 20***). Yearling production has been very successful in achieving survival and growth in the wild.

The goal of the recovery strategy is "to ensure that each of the populations are sustainable throughout their natural range, are self-sustaining through natural reproduction, and increase or restore opportunities for beneficial use, if or when feasible" (***Slide 21***). A number of recovery approaches have been developed but the main one is for DFO and the other interested parties to work together to restore natural recruitment to populations affected by dams (***Slide 22***). Studies are ongoing to fill knowledge gaps identified in the draft recovery strategy, particularly related to recruitment failures and the impacts of conservation aquaculture (***Slide 23***).

The draft recovery strategy is in translation and should be posted in the summer of 2010 for comment (***Slide 24***). An action plan should be developed within 5 years, with implementation of the recovery strategy ongoing in the meantime. There are various implementation issues to be dealt with, largely related to increasing people's sensitivity as to how the species and its habitat must be treated (***Slide 25***).

Questions (Q), Answers (A):

Q: Do you know whether acoustics and vibrations are attracting sturgeon to the powerhouses?

A: This question and how to discourage sturgeon from congregating below powerhouses has been studied in the United States. They did not find evidence that sturgeon were attracted to or repelled by noise.

C: Acoustics can be used to stimulate growth.

Q: Is research being done on the natural reaches of the Fraser River for comparison?

A: Yes. Fish in the Lower and Mid Fraser are reproducing naturally although spawning sites have not been identified. Threats in these reaches are largely related to habitat loss.

C: Sturgeon may not congregate below dams because they prefer these habitats but because they have reached the limit of their upstream movement. Some of these fish may have been born above the dams and are trying to return upstream.

R: Some of the dams where sturgeon congregate were built at natural barriers to upstream movement.

Q: What is the membership in the White Sturgeon Recovery Team and in the Technical Working Groups?

A: The National Recovery Team consists of 12 to 15 people. It includes the Chairs and Co-chairs of the working groups and representatives from the United States. The Technical Working Group for each DU consists of 10 to 20 people, depending upon the location. It includes representatives from the First Nations, Province, Federal Government, industry, and species specialists. Depending upon the location it may also include representatives from the United States. The current Chairs are from Government (Provincial, Canada, United States) or industry.

Q: How effective is this design?
A: It is time consuming but works well, as otherwise there are too many people.
Q: What happens where there is no recruitment?
A: The population is maintained by stocking.
Q: Was there First Nations input to this presentation?
A: Yes. This is a cooperative process. They conduct about 50% of the current White Sturgeon research in cooperation with industry. The information they contribute is built into the presentation. First Nations were represented on all Technical Working Groups.

Final Comments (C):

C: It is good to see the engagement of First Nations in the recovery process for Lake Sturgeon, as this is such an important fish for the First Nations. More discussion is needed about Lake Sturgeon use of the lower reaches of rivers flowing into Lake Winnipeg, including the Red, Winnipeg, and Pigeon rivers. Allowable harm should be changed to conservation fishing.
C: Recovery planning talks must consider First Nations first and foremost.

3.0 STRATEGIC PLANNING

Following the presentations, there was a short breakout session wherein the participants divided into small groups to discuss who should be involved in the Lake Sturgeon Recovery Strategy and what needs to be done. The text that follows attempts to convey the points raised without weighting them by how many times each was mentioned.

Who should be involved in the sturgeon recovery strategy?

Responses to this question were not as detailed as those from the previous workshop (Hnytka and Stewart 2007), where more time was allotted for discussion, but the key recommendations were similar. Participants supported the inclusion of agencies and individuals who had the most knowledge to contribute, and of stakeholders with a direct interest in sturgeon. Particular emphasis was placed on the importance of involving First Nations and Métis in recovery planning, in part to ensure the incorporation of Aboriginal traditional knowledge. Aboriginal elders and students should be included in recovery planning. Scientists and regulators from the Federal and provincial governments; representatives of the sturgeon management boards; academics; harvesters (subsistence, commercial and sport); and representatives of industries that impact sturgeon should also be included in the recovery planning process. Care must be taken to keep the recovery teams to a workable size, and to avoid their work being jeopardized by groups with agendas other than sturgeon recovery.

What needs to be done?

The Lake Sturgeon and its habitat should be protected either by listing under SARA or other means. Work to recover the Lake Sturgeon should begin immediately, not await the SARA listing decision. Discussions may be required between DFO and the Provinces to achieve consensus on "ground rules" for how to approach sturgeon recovery. When recovery teams are established for the various DUs, field tours would help provide context for their work. Clear information is needed from First Nations and Aboriginal communities on who and how they should be engaged in recovery planning. Industries should be more involved in recovery planning for Lake Sturgeon. Information from Aboriginal traditional knowledge and scientific research on Lake Sturgeon should be gathered and integrated into the recovery strategy to support recovery planning. While existing scientific information from all sources can be compiled, consultations may be needed to gather traditional knowledge. Gathering information about the pre-development conditions of sturgeon habitats and populations may be important. Natural indicators identified by traditional knowledge (e.g., state of leaf formation) could provide important cues for when to adjust flow regimes to facilitate spawning below hydroelectric generating stations. Knowledge gaps, such as those related to the use of rivers on the east side of Lake Winnipeg by sturgeon, should be identified so they can be addressed.

Recovery efforts should focus on the health and recruitment of existing populations, and on impacts and threats that can be mitigated. The goal of recovery should be self-sustaining populations that are capable of meeting local needs. Accomplishing this goal will require habitat rehabilitation through flow management, spawning shoal rehabilitation and other measures. Harvesting, particularly of large adults must be eliminated or managed at levels that enable population growth. Alternative energy sources/locations should be sought when critical habitat for Lake Sturgeon will be impacted by proposed developments. Interest was expressed in more hatchery development to support stocking efforts and public education.

Stocking can be a useful management tool but should not be viewed as a long-term solution, as it does not solve the problems that cause population depletion. Sturgeon stocking guidelines should be developed that consider the risks and benefits of stocking, and provide the information necessary to optimize survival of the released fish. Research is needed to define the genetic relationships among sturgeon populations and subpopulations in DUs 1-5, and thereby better understand possible impacts of conservation stocking.

Further research is needed to improve understanding of sturgeon biology and habitat in these DUs. Learning more about the factors that limit the different life stages of sturgeon, particularly survival and recruitment from egg to age 1+, will be particularly important for the species' recovery. Ecohydrological research should be conducted to identify the habitat requirements of sturgeon during critical life history stages. This information should be applied to the design of new projects and used to mitigate the impacts of existing hydroelectric facilities. Seasonal flow regimes, for example, could be adjusted to improve the conditions for and survival of Lake Sturgeon and to improve conditions in the aquatic ecosystem as a whole.

Survey assessment techniques should be standardized so studies conducted in different areas are comparable and the power to detect true changes is greater. Monitoring of population trends should be improved to better inform management decisions. Knowledge of the carrying capacity and how population density may affect recovery may be important. Input on monitoring programs should be sought from local Fishery Officers. Threats to Lake Sturgeon should be identified and ranked. The potential impacts of invasive species on sturgeon should be assessed (e.g., spiny water flea on early life stages).

Recovery targets for the DUs and MUs need to be refined, and careful consideration must be given to allowable and incidental harm. Options for mitigation and compensations could be outlined. Consideration could also be given to what to do with sturgeon populations once they have recovered.

The two sturgeon workshops held to date have been effective for the broad exchange of information on Lake Sturgeon and species' recovery. Similar workshops should be held periodically to share new information from within and outside the region. Efforts to improve cooperation among those working to recover the Lake Sturgeon should be continued. Data sharing among researchers and managers is an important aspect of this cooperation. To facilitate recovery efforts a searchable archive of Lake Sturgeon information should be developed that includes related Aboriginal traditional knowledge information. [Editors Note: There is such an archive at the Freshwater Institute's Eric Marshall Aquatic Research Library. The collection includes many of the studies referenced by Dick *et al*. 2006.] Education and outreach related to Lake Sturgeon should be increased so the public is aware of the ecological and social importance of Lake Sturgeon, and better able to weigh the costs and benefits of activities and developments that impact the species and its habitat.

Funding should be increased to levels sufficient to achieve recovery of the species. Government, and industries that have altered sturgeon habitat, should fund organizations working to recover sturgeon populations. Resources should be made available for capacity building by First Nations and Métis, so they can increase their involvement in sturgeon recovery.

Penalties for the destruction of sturgeon and their habitat should be increased. Regulatory Agencies should have done, and be doing, more to prevent damage to sturgeon populations and habitats. Greater involvement by the Federal Government in Provincial licensing was suggested, as was the inclusion of First Nations and Métis in sturgeon management.

4.0 SUMMARY

The recent recognition of the imperilled status of both the Lake Sturgeon and its Pacific counterpart, the White Sturgeon, has been accompanied by a corresponding increase in research on sturgeon and their life history requirements as well as studies examining the potential for mitigating or avoiding current, past or future threats to the species. This is particularly the case for hydro dams that tend to be constructed at the base of rapids and, by the nature of their hydraulic operation, fragment habitat. As such, hydro operators including Manitoba Hydro, Quebec Hydro, Ontario Power Generation, B.C. Hydro and SaskPower, have been actively involved in much of the sturgeon research in Canada.

With the exceptions of commercial and sport harvesting, most factors responsible for decline of the sturgeon populations continue to pose obstacles to population recovery. Hydroelectric developments that have fragmented and altered sturgeon habitats on most of the large rivers are the key impediment to recovery. Current subsistence harvests are poorly known although some First Nations are voluntarily limiting their harvests. Improvements have been made to effluent from pulp mills and sewage treatment facilities.

Recent efforts to restore sturgeon habitat have focussed on spawning habitats downstream from hydro dams, where flows can change dramatically from one year to the next and hourly in response to peaking cycles. Flow rates during the spawning period are a key determinant of spawning location and success. Reproductive failures are common when flows during the spawning period are low and/or variable. Research is ongoing to understand the factors controlling spawning habitat selection and spawning success. This work has involved extensive habitat mapping, studies of sturgeon movements and habitat use, and expansion or construction of spawning beds. Remote sensing and modelling techniques are being used to overcome sampling difficulties in these high-velocity habitats; egg mats and drift traps are being used to confirm spawning and assess hatch success. A spawning habitat suitability model is being developed based on depth, substrate, water velocity, and flow direction so these data can be applied more widely to assess and mitigate potential impacts. Studies are also under way to assess minimum and optimal flow conditions for Lake Sturgeon spawning downstream of hydro peaking facilities.

Aquatic studies to assess potential environmental impacts of hydroelectric dam construction and modernization are also ongoing. Habitat use, spawning, movements, and abundance of Lake Sturgeon are being studied using both standard fisheries techniques (e.g., Ponar dredges, gillnets, egg mats, drift traps) and remote sensing (e.g., sonar acoustics, geo-referenced underwater videography, radio telemetry). Two and three-dimensional modelling is being used to better understand the physical attributes of sturgeon habitat. Laser ablation mass spectrometry of sturgeon aging structures may be useful for assessing the use of contaminated habitats.

The life history stages of sturgeon in large western Canadian rivers (Saskatchewan, Nelson, Winnipeg) often segregate themselves based on habitat. Habitat use appears to be most specialized among young-of-the-year, and to become more general with age. This segregation enables biologists to target fish of a particular life stage but it also leads to sampling biases. Habitat use (e.g., depth range, upstream/downstream distribution) by sturgeon varies among rivers in response to river size, impoundment, and other factors. Consequently data from one river or geographical area may not be directly transferable to another. This variability must be considered in management plans and recovery efforts. Heterogeneous habitat may be ideal for healthy populations as it enables each of the life stages to find appropriate habitat.

Habitat fragmentation by large hydro dams remains a key impediment to sturgeon recovery in western Canada. While sturgeon may be trapped and transported past these barriers, none of these habitats has been reconnected for Lake Sturgeon. Integrating ecological considerations into engineering designs at the outset of hydro project development can mitigate project-related impacts on fish without harming project economics. This new area of design engineering (ecohydraulics) may have useful application for hydroelectric projects that affect sturgeon.

Ongoing acoustic and/or radio telemetry studies are providing new information on seasonal movements and habitat use by large juvenile and adult Lake Sturgeon in the region. Work on smaller juveniles is planned. Individuals can remain sedentary for long periods but periodically will undertake long migrations, sometimes passing back and forth through strong rapids, entering brackish coastal waters to move between rivers, or crossing provincial boundaries. Tagging studies have found significant downstream emigration of sturgeon from reaches of river following impoundment, or their introduction into an impoundment. Some of these fish pass through the turbines or over the spillways enroute downstream.

Floy and PIT tags are also being applied to Lake Sturgeon for mark and recapture studies that follow their movements and can be used to generate population estimates and assess recruitment. Improving population estimates and repeating them to establish trends will be important for recovery assessment. Little is known about the causes or rates of mortality at different stages of the Lake Sturgeon life history. The rates of Floy and PIT tag loss are uncertain and introduce uncertainty into population estimates. Studies are planned to assess these loss rates and reduce uncertainty. Population indices generated by index netting programs are also being used to follow trends in relative abundance.

The genetic diversity of Lake Sturgeon populations must be maintained during recovery to ensure population fitness. This requires knowledge of population genetics so population inbreeding and crossbreeding can be avoided. Work to gather this information is ongoing. In the meantime stocking guidelines should be developed and implemented. Conservation stocking has been conducted in the Saskatchewan, Nelson, and Winnipeg rivers but does not solve the underlying causes of population depletion. Sturgeon culture operations are being used effectively to educate and engage the public in sturgeon recovery, and there is strong interest among Aboriginal groups in expanding these programs. Removing young-of-the-year from a system temporarily, rearing them in portable streamside rearing facilities until they are better equipped to avoid predation, and then returning them to their natal stream may be an alternative to traditional hatcheries and can avoid genetic and imprinting problems. Stocking programs may need to adjust acclimation and release techniques to improve young-of-the-year survival rates.

The recovery planning process for Lake Sturgeon can benefit from other ongoing sturgeon recovery efforts. Sturgeon management boards are working to recover sturgeon populations in the Saskatchewan and Nelson rivers; Alberta and Ontario are developing recovery strategies for the sturgeon populations within their jurisdictions. Both of these initiatives have knowledge and experience to contribute to Lake Sturgeon recovery planning. Lessons can also be learned from recovery planning for the White Sturgeon, which is farther advanced than that for Lake Sturgeon and has dealt with many of the same issues. The species have similar life histories and face similar threats, in particular hydroelectric development and exploitation.

The ongoing RPA process for Lake Sturgeon also benefits sturgeon recovery efforts by compiling up-to-date information on the species and its habitat, and on threats to the species and mitigation of these threats. Modelling for the RPA has identified the importance of protecting adult sturgeon in order to preserve populations and of enhancing young-of-the-year survival to increase populations. It has also identified quantitative recovery targets and allowable harm. When considering species recovery it is important to put the data in context, as what appears to be a large recovery in the context of recent population levels may be very small in relation to historical population levels.

The workshop highlighted the continuing need for cooperation and collaboration on sturgeon research and recovery efforts, and the need for continued information sharing by everyone with an interest in Lake Sturgeon. Participants supported the inclusion of agencies and individuals who had the most knowledge to contribute, and of stakeholders with a direct interest in sturgeon. Particular emphasis was placed on the importance of involving First Nations and Métis in recovery planning. Recovery efforts should focus on the health and recruitment of existing populations, and on mitigating impacts and threats to the species. The objective of recovery should be self-sustaining populations that are capable of meeting local needs. Recovery targets for the DUs and MUs need to be refined, and careful consideration must be given to allowable and incidental harm.

5.0 ACKNOWLEDGEMENTS

Many people of very different backgrounds and experience shared their knowledge of Lake Sturgeon with others at this workshop. Their willingness to share and learn can only benefit sturgeon recovery and we thank them for their contributions. The Workshop Steering Committee: Andries Blouw, Shelly Matkowski, Lennard Morin and Fred Hnytka helped provide the resources, scope and direction for the workshop. We are grateful to DFO's Species at Risk Program for funding the workshop and to Manitoba Hydro for providing refreshments during the workshop. Ross Thompson facilitated the workshop with humour and skill, ensuring that it ran smoothly and on time and that discussion of controversial topics was pleasant and civil. The assistance of Rachel Laurin of DFO Winnipeg, and Jacqueline Nunez of DFO Peterborough was invaluable for organizing and running the workshop. Winnipeg's Fort Garry Hotel, which hosted the workshop, provided expert management and hospitality, and comfortable accommodation for out-of-town guests. Tom Pratt and Sam Stephenson provided constructive reviews of the manuscript. We are grateful for all of these contributions.

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7.0 GLOSSARY

Acronyms

AFSAR = Aboriginal Fund for Species at Risk.

ASRD = Alberta Sustainable Resource Development, a department of the Alberta Provincial Government.

ATK = Aboriginal traditional knowledge.

CI = confidence interval (statistical)

COSSARO = Committee on the Status of Species at Risk in Ontario

COSEWIC = Committee on the Status of Endangered Wildlife in Canada

DFO = Fisheries and Oceans Canada, a department of the Government of Canada

ESA = *Endangered Species Act* (Ontario)

FL = fork length, the length of a fish from the tip of the snout to the fork in the tail

FSIN = Federation of Saskatchewan Indian Nations

FWIN = fall walleye index netting program

GS = generating station (hydroelectric)

HSI = habitat suitability index

NRSB = Nelson River Sturgeon Co-Management Board

OMNR = Ontario Ministry of Natural Resources

PIT = passive integrated transponder. PIT tags are tiny identification chips that are injected into specimens for permanent identification.

RPA = Recovery potential assessment.

SARA = *Species at Risk Act*, a Canadian legislation that protects biota at risk throughout Canada

SARO = Species at Risk in Ontario.

SRSMB = Saskatchewan River Sturgeon Management Board

SWA = Saskatchewan Watershed Authority

TL = total length, the length of a fish from tip of the snout to the tip of the tail

Definitions

Alleles are alternative forms of a gene that occupy the same position on a chromosome.

Allowable harm is a scientific assessment of the level of harm--including human induced mortality that a species can withstand without jeopardizing the survival or recovery of that species.

Critical habitat is the habitat that is necessary for the survival or recovery of a listed species and that is identified as the species' critical habitat in a recovery strategy or action plan.

Designatable units are significant and irreplaceable units of biodiversity that are recognized on the basis of: 1) established taxonomy, 2) genetic evidence, 3) range disjunction, and 4) biogeographic distinction.

Endangered species are in imminent danger of extinction

Exceedance is the amount by which something, especially a pollutant, exceeds a standard or permissible measurement.

Extirpated species no longer exist in the wild in a particular area.

Gametes are reproductive products including male sperm and female eggs.

Genetic drift is a random change in gene frequency in response to chance rather than selection.

Heterozygosity is a measure of genetic variability.

The age at **reproductive senescence** is the age at which an animal is no longer capable of reproducing.

Species of "**Special Concern**" are sensitive to human activities.

Threatened species require action to reduce the risk of extinction.

Thalweg is the deepest continuous path along a river channel.

Appendix 1. Participants in the 2010 Lake Sturgeon Research and Recovery Workshop.

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Appendix 2. Agenda for the Lake Sturgeon Research/Recovery Workshop.

Lake Sturgeon Research/ Recovery Workshop
March 10 –12, 2010
Hotel Fort Garry, Winnipeg
222 Broadway Ave.

AGENDA

Wednesday, March 10(Day 1):

08:30	Registration - Coffee	
09:00	Welcome – Introduction -Administration	Ross Thompson/ Fred Hnytka
09:30	Presentation “*Species at Risk Overview*”	Raymond Ratynski
10:00	Coffee Break	
10:15	Presentation *"Population Genetic Structure of Lake Sturgeon in the Great Lakes and its Implications for Stocking"*	Amy Welsh
10:45	Presentation *“Great Lakes Tribal Involvement in Lake Sturgeon Management - Little River Band of Ottawa Indians Case Study”*	Henry Quinlan
11:15	Presentation *“Lake Sturgeon in the Winnipeg River: Management Implications of New Information on Biology, Behaviour and Ecology”*	Steve Peake
12:00	Lunch	
1:00	Presentation *“Spatial distribution of juvenile Lake Sturgeon in a large fragmented river”*	Tim Haxton
1:30	Presentation *“Differences in distribution, size, condition and growth of Lake Sturgeon within an impounded reach of a large Canadian river”*	Cam Barth
2:00	Presentation *“Utilizing artificially propagated Lake Sturgeon for stocking programs: a review from the hatchery to the river”*	Cheryl Klassen
2:30	Presentation *“Lake Sturgeon studies at Pointe du Bois”*	Don MacDonell
3:00	Coffee Break	

3:15	Presentation *“Lake Sturgeon in the Nelson River from the Kelsey to the Kettle generating stations”*	Friederike Schneider- Vieira
3:45	Presentation *“Lake Sturgeon in the lower Nelson River below Kettle Generation Station including the Long Spruce and Limestone Forebays”*	Don MacDonell
4:15	Discussion	
4:45	Recap of Day 1/ Preview of Day 2	
5:00	Adjourn	

Thursday, March 11 (Day 2):

08:30	Registration – Coffee	
08:45	Welcome - Administration	Ross Thompson
09:00	Presentation *"The Status of Lake Sturgeon under Ontario's Endangered Species Act*	Stephen Casselman
09:30	Presentation *“Winnipeg River sturgeon assessment program 2007-2009”*	Mary Duda
10:00	Coffee Break	
10:15	Presentation *“The business of sustainability”*	Joe Hunter
10:45	Presentation *“Ochiichagwe’babigo’ining Ojibway Nation Lake Sturgeon Stewardship Project”*	Ryan Haines
11:15	Presentation *“Winnipeg River Trends, Nutimik-Numao Reach”*	Ken Kansas
11:45	Presentation *“Upper Nelson River Trends”*	Don Macdonald
12:15	Lunch	
1:15	Presentation *"Projects and progress by the Saskatchewan River Sturgeon Management Board"*	Rob Wallace
1:45	Presentation *“Habitat assessment on the Saskatchewan River downstream of E.B. Campbell Hydroelectric Station”*	Doug Watkinson

2:00	Presentation *“Mapping Lake Sturgeon habitat on the North Saskatchewan River using Aboriginal traditional knowledge from Cumberland House Cree Nation”*	Brian Scribe
2:30	Presentation *“Investigating the impact of flow management on Saskatchewan River Lake Sturgeon populations”*	Michael Pollock
3:00	Coffee Break	
3:15	Presentation *“Species at Risk process in Alberta” and “Sturgeon research in Alberta”*	Terry Clayton/Daryl Waters/ Shane Petry
3:45	Presentation *"A paradigm shift in hydroelectric development: integrating ecohydraulic aspects in Dunvegan Hydro"*	Chris Katopodis
4:15	Discussion	
4:45	Recap of Day 2/ Preview of Day 3	
5:00	Adjourn	

Friday, March 12(Day 3):

08:30	Registration – Coffee	
09:00	Welcome/ Administration	Ross Thompson
09:30	Presentation *“Manitoba Hydro Lake Sturgeon Stewardship and Enhancement Program”*	Shelly Matkowski
10:00	Coffee Break	
10:15	Presentation *“Recovery Potential Assessment for Lake Sturgeon”*	Tom Pratt
10:45	Presentation *“Recovery Strategy development for the White Sturgeon in BC”*	Tola Coopper
11:15	Discussion – Sturgeon Recovery planning/Next Steps	
11:45	Recap Day 3/Workshop Summary/Closing	
12:00	Adjourn	

Appendix 3. Summary of feedback comments on the Lake Sturgeon Recovery Planning workshop.

At the end of the workshop, participants were asked to respond to six questions to provide feedback on their experience at the workshop. Twenty-six people completed the forms, and their responses are summarized below:

Question 1. What I liked most….

A common thread of the respondent's comments was that they appreciated the participation from so many groups with different interests and the broad range of experience and ideas that were presented and exchanged. They appreciated the opportunity to learn from others and to meet and network with people interested in sturgeon—particularly from other jurisdictions. Several participants were pleased by the strong First Nations participation. Others were pleased to learn that their concerns about sturgeon were shared, and that a lot of work has been conducted on the species.

Question 2. What I liked least…

Ten respondents disliked the off-topic, sometimes-repetitive comments that followed some presentations. Several suggested that time limits should have been placed on these questions/discussions. Ringing cell phones were noted as an unpleasant distraction. Three people would have preferred more time for discussion and networking. Longer breaks and group meals were suggested as possible solutions. Several people were disturbed by what they learned from the presentations, in particular the number of sturgeon that had been cut or poked, and the state of the sturgeon population in the Nelson River between the Kelsey and Limestone generating stations. Several others would have preferred more emphasis on sturgeon recovery and less on scientific presentations. One person thought there should have been greater recognition of First Nations input in the presentations; another identified the need for resources to enable the Aboriginal perspective on recovery to be presented. Two respondents had no dislikes.

Question 3. Please do more…

The most common request was that more time be allotted for group discussions/ brainstorming and networking. Four respondents asked that more sturgeon researchers from other jurisdictions attend/present in future (e.g., Quebec Hydro). Three people wanted more discussion of recovery efforts and implementation, including funding opportunities. Several wanted more presentations and asked that copies be distributed. Interest was expressed in learning more about options to address hydraulic/structural issues associated with dams and fragmented habitats; in hearing more Aboriginal traditional knowledge; and in having a presentation by SaskPower. The need for clear information on how to engage First Nations in the recovery process was identified. Two respondents had no comments,

Question 4. Please do less…

Seven people wanted fewer off-topic comments. Several people wanted less discussion of scientific data and more on practical solutions. Several others wanted less harvesting and harm to sturgeon. One person recommended reassessing the recovery potential assessments. Eleven respondents had no comment.

Question 5. Next steps…

The need to move recovery planning forward now, even before the species is listed under SARA, was the unifying theme of most responses to this question. Forming recovery teams to begin this process and holding discussions with stakeholders within the DUs and MUs were the main recommendations. Several comments were more detailed. One emphasized the importance of raising the profile of Lake Sturgeon now, to ensure the public understands the species' cultural and ecological importance when new developments are being proposed. Another emphasized the need to facilitate and encourage provincial and industrial research and recovery initiatives. Six respondents identified the importance of engaging First Nations in sturgeon recovery planning at the outset. Several people looked forward to receiving a summary of the workshop with copies of the presentations. Individuals recommended that sturgeon recovery efforts continue to focus on education and the effects of habitat fragmentation by hydroelectric dams, and focus more on the lower Nelson River. Keeping people informed of the next steps was also identified as important. Two respondents had no comment.

Question 6. General comments:

Twelve of the respondents indicated that the workshop was a very worthwhile learning experience. Several people were frustrated with the repeated comments not related to sturgeon recovery. Several others thanked DFO for inviting them to participate in the workshop. Individuals emphasized the importance Lake Sturgeon to Aboriginal people, the ecological risks associated with altering river flows, and the importance of including native peoples in the recovery planning process. Seven respondents had no further comments.