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Proceedings of the regional Recovery Potential Assessment of Silver Chub (*Macrhybopsis storeriana*)

5 March 2013
Burlington, ON

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Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

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SUMMARY

A regional science peer-review meeting was held in Burlington, Ontario and via teleconference/WebEx on 5 March 2013. The purpose of the meeting was to assess the recovery potential of Silver Chub (*Macrhybopsis storeriana*) based on the Fisheries and Oceans Canada (DFO) Recovery Potential Assessment (RPA) framework. The resulting RPA Science Advisory Report provides the information and scientific advice required for the Department to meet various requirements of SARA for this species including permitting and development of recovery strategies. Meeting participants included DFO (Central and Arctic and National Capital regions), Ontario Ministry of Natural Resources (OMNR), U.S. Geological Survey, and an independent contractor.

This proceedings report summarizes the relevant discussions from the peer-review meeting and presents revisions to be made to the associated research documents.The Science Advisory Report and the supporting Research Documents, resulting from this advisory meeting, are published on the DFO Canadian Science Advisory Secretariat (CSAS) Website.

Compte rendu de l'évaluation du potentiel de rétablissement (ÉPR) à l'échelle régionale du méné à grandes écailles (*Macrhybopsis storeriana*)

SOMMAIRE

Une réunion régionale d'examen scientifique par les pairs s'est tenue le 5 mars 2013 à Burlington, en Ontario, et par téléconférence et WebEx pour évaluer le potentiel de rétablissement du méné à grandes écailles (*Macrhybopsis storeriana*) à partir du cadre national d'évaluation du potentiel de rétablissement (EPR) de Pêches et Océans Canada (MPO). L'avis scientifique découlant de l'EPR fournit les renseignements et l'avis scientifique dont le Ministère a besoin pour respecter les diverses exigences de la LEP à l'égard de cette espèce, notamment l'attribution de permis et l'élaboration de programmes de rétablissement. Les participants à la réunion étaient des experts du MPO (régions de la capitale nationale, du Centre et de l'Arctique), du ministère des Richesses naturelles de l'Ontario, du U.S. Geological Survey ainsi qu'un entrepreneur indépendant.

Le présent compte rendu résume les discussions pertinentes de la réunion d'examen par les pairs et présente les modifications qui seront apportées aux documents de recherche connexes. L'avis scientifique et les documents de recherche à l'appui découlant de la présente réunion de consultation scientifique seront publiés sur le site web du Secrétariat canadien de consultation scientifique du MPO.

INTRODUCTION

In April 1985, the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) recommended that Silver Chub be designated as Special Concern. This status was reconfirmed in May 2001. In 2012, COSEWIC separated the populations into two separate designatable units: 1) the Saskatchewan - Nelson River populations; and 2) the Great Lakes - Upper St. Lawrence populations. The Saskatchewan - Nelson River populations were not considered to be at risk, while the Great Lakes-Upper St. Lawrence population was uplisted from Special Concern to Endangered in May 2012 due to its substantial decline in abundance over the previous three generations (COSEWIC 2012). The species was assessed because it is at a high risk of extinction from several threats including habitat degradation, invasive species interactions, and climate change. Subsequent to the original COSEWIC designation, Silver Chub was listed on Schedule 3 of the federal *Species at Risk Act* (SARA). Silver Chub is currently assessed as Threatened under Ontario's *Endangered Species Act* (2007). A Recovery Potential Assessment (RPA) process has been developed by Fisheries and Oceans Canada (DFO) to provide information and scientific advice needed to fulfill SARA requirements including the development of recovery strategies and authorizations to carry out activities that would otherwise violate SARA (DFO 2007b).

The purpose of the meeting, as described in the Terms of Reference (Appendix 1), was to assess the recovery potential of Silver Chub. The RPA is a science-based peer review process that assesses the current status of the species by addressing 27 steps in the RPA framework outlined in the Summary section of the Revised Protocol for Conducting Recovery Potential Assessments (DFO 2007a, b). The current state of knowledge about Silver Chub habitat requirements, the scope for human-induced mortality, and scenarios for mitigation and alternatives to activities that negatively impact the species and its habitat, is included in the Science Advisory Report. A peer-review meeting was held on 5 March 2013 to discuss the Silver Chub RPA.

Meeting participants included DFO (Central and Arctic Region), OMNR, U.S. Geological Survey, and a contractor who was the senior author of one of the research documents (Appendix 2). The meeting followed the agenda outlined in Appendix 3.

DETAILED DISCUSSION

The meeting chair provided the participants with an introduction to the RPA process and explained the purpose of the meeting. This included information on where the RPA process fits with respect to the COSEWIC assessment and SARA listing process for Silver Chub. This included the intent of the meeting and how the products of the meeting might be used. Terms of Reference were outlined. Draft research documents entitled "Information in support of a Recovery Potential Assessment of Silver Chub (*Macrhybopsis storeriana*) in Ontario" and "Recovery Potential Modelling of Silver Chub (*Macrhybopsis storeriana*) in Ontario" had been developed by DFO and provided to participants in advance of the meeting. Additionally, participants had been provided with all the known Ontario Silver Chub records that were used to generate the Population Status Assessment. The draft research documents and catch records were the basis for discussion, and participants were encouraged to add to or change the material, as needed, to ensure that the best and most up-to-date information was included.

SPECIES DESCRIPTION

Presenter: Lynn Bouvier

This presentation included information on the description of Silver Chub, including body shape, morphological characteristics, and colour. Characteristics distinguishing Silver Chub from similar species were outlined. A participant mentioned that there was potential for overlap of Silver Chub with Hornyhead Chub (*Nocomis biguttatus*) and River Chub (*Nocomis micropogon*) in the Detroit River should Silver Chub use the river for migration or spawning. Records of Silver Chub from Lake St. Clair suggest that the Detroit River may be used as a migration corridor.

Age and growth information was presented. No questions were raised regarding age and growth.

An overview of studies on Silver Chub diet across its range, and across age classes was presented. Data from 2011 indicated that a large proportion of Silver Chub stomachs (close to 100%) contained Zebra Mussel (*Dreissena polymorpha*), and a lower percentage of *Hexagenia* nymphs than seen in the historic surveys. A participant noted that they had preliminary results from a more recent stomach content analysis that they would make available for addition to the research document. Another participant inquired as to when the Silver Chub were collected for the 2000 stomach content analysis, as feeding may change seasonally. The response was that specimens were collected in multiple seasons. A participant inquired as to what Silver Chub were feeding on in Manitoba. No Silver Chub stomachs have been examined for prey items in Manitoba.

The distribution of Silver Chub in North America, and associated conservation status was summarized.

One participant suggested that it would very interesting to do a genetic study to determine how the Great Lakes populations compare with the Mississippi River and Lake Winnipeg populations. The presenter indicated that the need for a genetic analysis was discussed in the Sources of Uncertainty section but indicated that this point would be expanded to include a description of which populations should be included in the analysis.

CURRENT STATUS

Presenter: Lynn Bouvier

This presentation included an overview on the current status of Silver Chub populations, based on current and historic catch data. Population delineations were based on the movement ability of Silver Chub, and whether it would be reasonable to assume that Silver Chub were moving from one basin to another, or through the Detroit River to Lake St. Clair. Also, similarities in habitat characteristics and threats that were affecting Silver Chub were considered. For the purposes of the RPA, the Ontario distribution of Silver Chub was categorized into five populations: Lake St. Clair, Lake Erie (western, central and eastern basins), and Lake Huron. Collection records presented as distribution maps were provided.

Western basin

Catch records were summarized for the western basin of Lake Erie, indicating that, besides a spike in abundance from 1996-1999, the population has been declining. A participant commented that a recent trend in the Ohio waters of Lake Erie has been a decrease in

nearshore sampling and an increase in offshore sampling, and questioned whether the trend in decreased Silver Chub abundance was an artifact of altering the sampling effort.

In 2008, there was a large spike in age 1 Silver Chub collected by the participant. Sampling was conducted along the southern shore of Lake Erie at 3, 4.5, and 6 m depths, with most of the Silver Chub captured at 4.5 m. These areas are no longer well sampled because of low water levels and debris on the lakebed. There are also issues with the vessel not handling well in high wind conditions. Another participant asked whether a different ship was being used, or whether the lake conditions dictated how sampling was conducted. The participant explained that a different ship came online in 2003 or 2004. The participant agreed to obtain the information regarding year of ship change. This new ship has a lot of bow, and blows around in the wind, but lower lake levels are also a factor. Another participant suggested that data could be examined to look at the change in effort and how it might relate to lower water levels. The initial participant responded that, in the context of Gizzard Shad (*Dorosoma cepedianum*) research, the relationship between nearshore sampling effort and water level was not very strong, suggesting that other factors besides just lake level are affecting catch rates. A participant wondered what additional analyses could be done to explore this further, as it is an important point. One response was to examine how a trend in catch relates to the proportion of catch in nearshore areas. Another participant suggested that absolute abundance as a function of the proportion of the effort that was below a certain depth be investigated. If there was a relationship between those two variables, it would corroborate the possibility that the declining population trend is a result of a shift in the locations sampled. Another participant agreed that effort could be stratified by depth. A question was asked regarding appropriate stratification depth for an analysis. The response was that 6 m was the cut-off depth used by agencies (>6 m offshore, <6 m nearshore). It was recommended that the analysis should be done. A participant re-iterated that this was an important point. The species occurs in rivers, which are energetic environments. If they are similar in lakes in terms of requiring energetic environments, their abundance would be higher in the nearshore areas, with more wave energy, and perhaps better habitat. The presenter suggested that a spatial analysis could also be conducted, as coordinates for all sampling locations since 1998 were available.

While presenting the 2012 trawl data from the western basin of Lake Erie, a participant commented that most of the capture locations where in nearshore waters less than 6 or 7 m. The presenter suggested that it would interesting to overlay a bathymetric map of Lake Erie over the sampling effort maps to get a better visual representation of depths. A participant who was looking at an online bathymetric map commented that apart from a few sites near Pelee Island, the collections were made in nearshore areas of the western basin.

An additional comment was made regarding two sites south of Ambassador and Willow beaches where large numbers of Silver Chub were captured in June 2012 within 30 minutes of each other. It was suggested that this was a spawning aggregation, as it was very unusual to catch this many fish. A similar event occurred in Ohio near the mouth of Sandusky Bay. Another participant suggested that aggregations during spawning season may influence the number of sites where Silver Chub are captured if aggregations occur at a small number of sites. Looking at the spring and fall data separately, most of the spring fish were caught at the mouth of the Detroit River, while they were more dispersed in the fall. The presenter asked whether additional data from other years was available. The response was that there was nine years of trawling data (2004-2011) in 19 Canadian and six Michigan sites, and one year of data from 2012 that was collected in more of a grid pattern. This additional data will be provided for inclusion in the research document.

While presenting a multi-scale environmental classification study, a participant asked whether the model was based on trawling data. The response was that it was based on trawling,

nearshore electrofishing and seining combined. The participant then commented that the abundance predictions seemed to contradict the expectation of higher abundances in the nearshore areas, as the model is showing there is no suitable habitat in these areas. The presenter also commented that along the Canadian shoreline, there's a band of zero predicted abundances, and it was unknown what variable was creating that band. The presenter informed the group that an inquiry had been sent to the principal researcher to determine which variable was driving these areas where no Silver Chub were predicted, and to ascertain whether there was a depth cut-off below which Silver Chub would not be present. Another participant suggested that the model might be influenced by the bias of less sampling having occurred in the nearshore areas. It was further suggested that the model had a depth preference suitability built in that seemed to be eliminating all of the nearshore areas. The presenter said that an attempt was made to match up the zero predicted abundance areas with bathymetry, but that it did not seem to match. Not sure what is driving the band.

A comment was made on the seasonal distribution of Silver Chub and movement to the mouth of the Detroit River in the spring. It makes sense for fish to be congregating around river mouths or areas with flow. It would be interesting to look at trawl data more closely. There is no data available for congregations of Silver Chub in Manitoba. A conclusion was made to look into congregations, and model for abundance distribution.

Central basin

Catch data was then presented for the central basin of Lake Erie. A participant asked if the gillnet survey protocol had changed over the years. The response was that it does not appear to have changed, but this will be confirmed. The participant commented that the data supports a decline in abundance as the downward trend seen in the central basin is similar to that presented for the western basin, without the consideration of a change in sampling effort over time. The presenter commented that since 1998, sampling sites have been in the same locations, sampling has occurred during the same time of year. Another participant added that, to their knowledge, the same gillnet had been used by the OMNR since at least 1988, and that Ohio Division of Wildlife has used a slightly different design, but same gear since the mid-1980s. These gillnetting may better represent the trend of Silver Chub abundance decline over time than the trawl data because sampling effort has remained consistent.

Eastern basin

Catch data from the eastern basin of Lake Erie was presented, and differences in habitat (e.g., deeper water) were noted. There were no comments or questions.

Lake St. Clair

While presenting catch data for Lake St. Clair, a participant asked if any of the other participants had any theories as to why Silver Chub abundance declined around the same time the abundance in the western basin of Lake Erie increased. One response was that there is very little data from Lake St. Clair, and the relationship between Lake St. Clair fishes and Great Lakes fishes is unknown. It is problematic that Silver Chub have never been caught in the Detroit River, the connecting channel between the two lakes. The participant noted that the decrease in turbidity from the western basin of Lake Erie in the late 1990s seems to correspond with increase Silver Chub catch rates. However, there are many confounding variables to consider. In 1988, Zebra Mussel became established and were responsible for increased water clarity, and perhaps acted as a food source. The presenter commented that the original data set for Lake St. Clair could not be obtained; therefore, location of sampling was unknown. A participant suggested that a retired biologist be contacted in an effort to obtain the original data.

Another participant asked if Silver Chub had been collected by Michigan Department of Natural Resources (DNR). No Silver Chub were collected by Michigan DNR from 1996-2001.

Lake Huron

The presenter summarized the collection record of Silver Chub from Lake Huron. A participant stated that, historically, the St. Clair River had not been well sampled, but DFO has sampled it extensively over the past 6 or 7 years. Silver Chub has not been collected, and the thought is that these two individuals were strays from lower down in the system (Lake St. Clair or the western basin of Lake Erie). The St. Clair River would be a draw if Silver Chub preferred faster flowing water. The presenter commented that there are fast rivers in this area, but Silver Chub do not seem to occupy these habitats. A participant noted that when Silver Chub were most abundant in the early 1990s, there was not very much sampling completed in these rivers. It was not until after the Silver Chub abundance in the western basin of Lake Erie declined that these systems were sampled.

POPULATION STATUS ASSESSMENT

An explanation of Population Status Assessment was given by the presenter. Each population was ranked in terms of abundance expressed as a Relative Abundance Index, a Population Trajectory, and given a level of Certainty. All population status assessments, except Lake Huron, were ranked as 'Poor' using qualitative analysis. The population status for Lake Huron was ranked as 'Unknown' using expert opinion. There were no questions or comments on this section.

HABITAT REQUIREMENTS

Presenter: Lynn Bouvier

The presenter outlined habitat requirements, including water temperature, water depth, turbidity, and substrate, using all available data sources. From this information, a Functions, Features and Attributes table was created. Functions correspond to a biological requirement of Silver Chub. For example, individuals in the spawning to fertilization life stage require habitat for reproduction purposes. Features are considered to be the structural components of the habitat necessary for the survival or recovery of the species. Attributes describe how the features support the function for each life stage. By combining habitat attributes from the scientific literature with habitat attributes from current records (2002 to present), an attribute that will be used in the delineation of critical habitat was created.

While discussing the adult stage, a participant suggested that water temperature information was too broad in the way it was applied, and they questioned whether six months of 7.2-10°C water was required, and questioned if the focus should be on the 21-26°C range for spawning or feeding. Another participant explained that the author was attempting to establish growing degree days, but that the analysis was not performed. It was agreed that a range of temperatures is not useful without a link to degree days. A participant suggested that 7.2°C was not critical for life history, as the western basin of Lake Erie will be below that at certain times of the year. It was suggested that perhaps information on metabolic rates with water temperature and feeding would be more appropriate. Additionally, seasonality of diet information with associated water temperatures could be related to growth. A question was raised regarding the upper temperature value. It was agreed that it was appropriate, and within the range of temperatures the species experiences elsewhere. A comment was raised by another participant regarding the purpose of identifying a range of temperatures, arguing to exclude the lower temperature limit, as it would exclude all habitats for a certain time of the year. Another

participant suggested that an upper temperature limit be retained, as there is likely an upper temperature threshold above which Silver Chub could not survive. The presenter commented that characteristics that are not limiting for the species should not be included in the table. If temperature is not limiting, then it does not need to be included in the table, but rather should be included in the text. A participant suggested that the function be changed to spawning, and then to focus on Kinney's point about growth and reproduction, and target higher water temperature. A question was raised whether sampling has occurred in suitable locations where temperatures were above 26°C, and the species has not been found. This was followed by a question regarding water temperatures in Manitoba and elsewhere. The response was that the Assiniboine River in Manitoba approaches the high 20s (°C) in the summer, and noted that the range of Silver Chub extends south to the Gulf of Mexico, so we can assume they can survive in water temperature greater than 30°C in that part of their range. There is a minimum temperature required for spawning, probably about 21°C, as it is a number that comes up repeatedly in various references, and is common for several small-bodied cyprinids. The presenter suggested that temperature be removed from the adult life stage section of the table, and included in the spawning section. A participant mentioned that Silver Chub is described as a warmwater species, so to be in deeper water where a thermocline exists might be limiting, but this is currently unknown. It was agreed that it was more appropriate to move the 19-23°C range in the spawning section of the table. A participant noted that text, such as a "normal environmental regime", had been recently used in recovery strategies, so in protecting habitat or identifying critical habitat, this regime should be maintained so you do not allow activities to occur that would result in temperatures greater or less than the 'normal range'. This tactic would be suited to riverine systems, where effluent would enter the system and raise temperatures above the preferred temperatures. A participant questioned that if a certain temperature range is not present, is the habitat still critical. A response was that it might still be critical, but just not for temperature. The participant noted that there is a potential for exclusion from protection.

While discussing water depth, the presenter suggested that we should look more specifically for numbers caught at different depths. A participant suggested that the minimum depth was probably too deep. While Silver Chub have not been collected in Lake St. Clair for several years, seining would have occurred there in depths of 1-2 m. An additional comment was made that depths at which Silver Chub have been collected might be more reflective of sampling effort than critical habitat, and that CPUE should be stratified by depth instead of average depth. The participant questioned if the 2012 depth data represented all sampling sites or those where Silver Chub had been captured. The response was that the depth data was just for sites where Silver Chub had been captured. Another participant stated that for the last two years, a student at the University of Toledo, in collaboration with government agencies, has developed a nearshore sampling program using trapnets and electrofishing. This sampling has occurred in areas not deeper than 3-4 m, and in hundreds of hours of sampling, the student has caught very few Silver Chub. The participant agreed to forward the data to the group for inclusion in the research document. Another participant added that recent seining in water 1.5 m deep at historic Channel Darter sites on the northern shore of the western basin of Lake Erie had resulted in the capture of thousands of fishes, but no Silver Chub. Additionally, seining by the OMNR Lake Erie Management Unit along the south shore Lake St. Clair and north shore of the western basin of Lake Erie failed to catch Silver Chub. With respect to maximum depth, 24 m is one of the deepest points in center of central basin of Lake Erie and does not represent typical Silver Chub habitat. It was then reiterated that looking at abundance stratified by depth, or frequency by depth be investigated. A clear cut-off depth might become apparent.

While discussing turbidity, the presenter questioned whether it should be included in the Functions, Features and Attributes table as Silver Chub are thought to be turbidity-tolerant. Also the presenter raised the question, whether it was acceptable to use minimum and maximum

Secchi depths as cut-offs. A participant agreed that the species was turbidity-tolerant, and that if there is a threshold it is unknown. There is insufficient information to suggest a minimum and maximum turbidity threshold. It is likely that turbidity is not a limiting factor that would lead to the delineation of critical habitat for Silver Chub. The presenter stated that the two options would be to delete the turbidity entry for the last column of the table, or to delete the turbidity section altogether. A participant suggested keeping it in, but eliminating it from the last column, and to provide an explanation in the text. Another participant suggested that CPUE be stratified by Secchi depth to look for a correlation, similar to depth. An additional comment was made suggesting that Silver Chub are most common in the western basin of Lake Erie because it is the most turbid basin. The western basin is also shallower and warmer than the other two basins. Another participant suggested that a clearer picture of turbidity tolerance might be achieved by looking strictly at autumn data, because spring and early summer catches were near the mouth of the Detroit River where Secchi depth values are higher. The range of Secchi depths would be greater in the fall, as dispersal in the lake would be greater. It was agreed that this would be investigated.

While discussing substrate, the presenter noted that it is not generally a variable recorded while sampling in open water. Thus, substrate preferences remain largely unknown. It was suggested that substrate is important in open water systems, especially because Silver Chub consume benthic prey items, but information to infer a preference is not available. A participant commented that in the Assiniboine River in Manitoba abundances of Silver Chub are highest in reaches with mostly sand substrates.

While discussing the spawning life stage, a participant asked which tributaries of Lake Erie had Silver Chub used for spawning purposes. The response was that the tributaries were on the United States side of the lake. The reference was the spawning atlas for Great Lakes fishes, but a participant added that there is a great deal of uncertainty as to where Lake Erie fishes spawn.

While discussing the egg to juvenile life stage, a question was raised about spawning, and whether length information was available for the individuals included in the egg count studies. The document suggests that fecundity is decreasing, but there is no context around the size of fish that were sampled. The response was that length data for the most recent egg count study was available, and that length was most likely available for the historic egg count study. The presenter agreed that length information for these two studies would be incorporated into the next version of the document.

RECOVERY POTENTIAL MODELLING

Presenter: Jennifer Young

The presenter gave an overview of the recovery potential modeling, including Life Cycle and Parameter Estimates, Sensitivity, Allowable Harm, Recovery Targets (Abundance and Habitat), and Uncertainties. While discussing growth, a participant asked how the von Bertalanffy growth curve was fit. The response was that it was fit to both the Mandrak and Kinney data. Using only Mandrak data, which lacked YOY data, the curve would have been quite different. So, growth appears to be similar from the 1950s to present.

Population trajectory was then discussed. Poisson distributions were fitted to raw data to obtain confidence intervals that did not include zero. Logged abundances from 2000-2012 were used to calculate population growth rate (20% annual decline). Data from 2007-2012 were also fit, and it seems possible that the trajectory is now stable, albeit at much lower levels than before the populations declined. However, the confidence interval around these data is quite large, leading to a great deal of uncertainty. One participant added that the interagency trawling data for the western basin of Lake Erie (instead of the gillnetting data) was used, as the sample size

was much larger. Additionally, trawling is a more effective method for catching Silver Chub, as opposed to gillnetting, which has lower efficiency. A fecundity-at-size relationship was obtained through several conversions. There were no questions/comments regarding parameter estimates.

Population Sensitivity

The presenter outlined the purposes of considering Population Sensitivity, which included determining how population growth rate is affected, which age or stage class is most sensitive to changes, which stages are most susceptible to harm, and what is the most effective mitigation for recovery. An Elasticity Analysis was used for this purpose. Elasticity is a measure of relative changes in population growth rate resulting from proportional changes in vital rates. An example was given. Deterministic and stochastic models were both presented. A participant added that reproduction for older stages, as well as survival of older adults, is more important in a declining population.

Allowable Harm

The presenter defined harm as the actions which jeopardize the survival or recovery of the species. Recently, harm was divided into two types of harm to provide better advice. Chronic Harm is harm that reduces the population growth rate over the long term through changes in vital rates (survival, fecundity, longevity, growth). Allowable Chronic Harm does not cause the long-term population growth rate to decline. Allowable Chronic Harm is based on population growth and is estimated using elasticities. The second kind of harm is Transient Harm, which is a one-time removal of individuals that reduces the mean population growth rate over a specific time-frame. Using a simulation method, seven matrices were created with random parameters. Survival was reduced in one matrix by X% to simulate a one-time removal of X% of abundance. Mean growth rate is then compared before and after the removal. This is repeated several thousand times to get a distribution of changes for various removal rates. Population size must be known to determine how many fish can be removed.

The presenter outlined the parameters for science advice on allowable harm. There were no questions or comments regarding the allowable harm section.

Recovery Targets

The presenter outlined three types of targets that can be used: abundance, distribution, and habitat. A principal of demographic sustainability is used and a population viability analysis (Minimum Viable Population, or MVP) is performed. MVP is the smallest population size that achieves persistence criteria. Components of MVP criteria, COSEWIC population viability thresholds, and literature timeframes were summarized. An explanation of the MVP approach, criteria, and effects of catastrophes was then given. Examples of MPV and times to extirpation were also given. A participant asked for the lowest MPV in relation to time to extirpation. The response was 2500. Habitat targets were then presented in terms of the amount of habitat needed to support a recovered population. The MPV is multiplied by the Area per Individual (API) to produce an Estimate of Minimum Area for Population Viability (MAPV). Estimates were calculated using a range of thresholds. A participant added that DFO modellers wanted to include McKenna's model to determine the amount of area in the western basin where they predicted to have greater than zero abundance, and then that area would be used to compare whether there was enough area that was already determined to be suitable through that model and compare that to the area in DFO's model. This will be included if the data is obtained in a timely manner. As it stands, it appears there is ample space available.

In summary, a growing population is most sensitive to YOY survival and fecundity in first year, while a stable or declining population is less sensitive to YOY survival, fecundity, and more sensitive to cumulative adult survival.

In terms of recovery targets, a MVP of ~444,000 adults requiring 84 km^2 of suitable habitat is needed. The time to extirpation was determined to be as early as 36 years (assuming past rate of decline and estimated abundance of 662,000). Key uncertainties were outlined, including, life history parameters (specifically mortality in the first year), the current trajectory (whether it is still in steep decline or has stabilized), and refined abundance, which is a less uncertain estimate.

REVIEW OF THREATS

Presenter: Lynn Bouvier

The presenter gave an overview of the threats identified in the research document, including, habitat removal and alteration, nutrient loading, turbidity and sediment loading, contaminants and toxic substances, exotic species, incidental harvest and climate change.

While discussing a study on the effects of habitat removal and alteration, a participant suggested that alteration near river mouths could be included. A response was that because Silver Chub have been largely excluded from nearshore sampling, it was not included. A participant commented that it is unknown whether Silver Chub spawn in open water, and that is should be changed accordingly. Silver Chub may have transitioned to open water spawning, but this is unknown. Another participant stated that additional impacts such as dredging to offshore areas, and exploration and gas well drilling could also be threats. Another comment was made regarding dredging of the Detroit River continuing south into the western basin of Lake Erie.

While discussing nutrient loading, a participant confirmed that a direct impact of dredging would be anoxia, which would exclude Silver Chub from those areas or cause mortality. This would also have an indirect impact by affecting Silver Chub prey. Another participant commented that in 2012, there was an extensive fish kill near Port Stanley, Ontario along the north shore of the central basin due to anoxia.

There were no questions or comments while the presenter summarized effects of Turbidity and Sediment Loading, and Contaminants and Toxic Substances.

While summarizing effects of Invasive Species, a participant indicated that since 2002, Round Goby populations in the western and central basins of Lake Erie have been declining, with 2012 having the lowest catches in the time series. The participant also noted that Silver Chub co-existed with dreissenid mussels in Lake Erie for ten years with no changes to the Silver Chub population, but that Silver Chub populations experienced a large increase right around the time the Round Goby arrived in Lake Erie. With dreissenid shell fragments found in a high percentage of Silver Chub stomachs, the participant suggested that facilitation might be occurring, with Round Goby crushing the mussel shells, and Silver Chub picking up what was left, as Silver Chub are incapable of breaking mussel shells themselves. The participant also suggested that a potential egg predator on Silver Chub could be White Perch, whose numbers have been increasing over the last decade. The participant indicated a desire to undertake a laboratory experiment comparing Silver Chub which have been exposed to dreissenid mussels with those which have not. Another participant suggested that Round Goby were not feeding on Silver Chub eggs, as their eggs, and possibly larvae, are semi-pelagic, and therefore unavailable to a benthic species such as Round Goby. Another participant suggested that competition between Round Goby and Silver Chub for food might be buffered by high abundance of dreissenid mussels, thereby reducing it.

There were no questions of comments during the presentation of effects of Incidental Harvest or Climate Change.

THREAT LEVEL ASSESSMENT

Presenter: Lynn Bouvier

The presenter summarized the Threat Level Assessment, indicating that each population was ranked in terms of Threat Likelihood (Known, Likely, Unlikely, or Unknown); Threat Impact (High, Medium, Low, or Unknown); and Certainty associated with Threat Impact (Causative Studies, Correlative Studies, or Expert Opinion).

Lake St. Clair

For Nutrient Loading, a participant asked why the Threat Impact of Nutrient Loading would be High but Turbidity and Sediment Loading be low if they are related, especially with respect to phosphorus. The response was that the nutrient effect is the potential anoxia, whereas Sediment Loading would be the physical effect, not the chemical effect. The participant then asked if sediment was mostly affecting areas along the shoreline rather than the whole lake. The response was that the shoreline areas are the only areas where Silver Chub was known to occur in the lake, and that the south shore receives sediment from the Thames River. However, there is no direct link between turbidity and Silver Chub abundance. The decision was to rank Threat Likelihood as 'Low', and Threat Impact 'High', with a certainty of '3'.

For Contaminants and Toxic Substances, it was suggested that there are no known impacts of contaminants and toxins on Silver Chub. The Threat Impact was changed to 'Medium'.

For Invasive Species, a participant asked whether any native species had affected Silver Chub or if a change in the fish community occurred when the Silver Chub population bottomed out. No native species were mentioned in the response, but the invasive White Perch was mentioned as a possible predator. The presenter stated that no specific threat impacting Silver Chub was identified. A participant suggested that data from other fish captured could be examined, and asked another participant if any correlations were evident. The participant would put together some associations and present them shortly. After much discussion involving Invasive Species in the western basin of Lake Erie (see below section), the Threat Likelihood remained as 'Known', but the Threat Impact was changed to 'Unknown'.

For Incidental Harvest, the presenter inquired as to whether there was ever a commercial fishery on the lake. A participant stated that there was an aboriginal fishery at the mouth of Thames River for Walleye (*Sander vitreus*) using trapnets which would not affect Silver Chub. The Threat Likelihood was changed to 'Unlikely', with a 'Low' Threat Impact and certainty of '3', due to lack of information.

Lake Erie – Western Basin

For Habitat Removal and Alteration, a participant did not recall seeing dredging projects for the Detroit River, but did see some in Lake St. Clair. Dredging in the Detroit River will be further investigated. Another participant suggested that if it did occur the Threat Impact would be dependent on the size of the occurrence. Based on the modeling information, the MAPV required is not that large (84 km^2) compared to the size of western basin. It would be difficult to assign a 'High' for Threat Impact. Threat Likelihood remained as 'Likely' based on future projects, but Threat Likelihood was changed from 'High' to 'Low'.

For Invasive Species, a participant worked up data quickly and presented cursory associations. The participant indicated that invasive Alewife was very low in abundance in western Lake Erie.

Alewife was only caught in two years, and could not be used in any analyses. Using data from 2004-2011, associations between Age 1 Silver Chub and several species were summarized. Of the invasive species discussed, there was a mild negative association with White Perch, but not convincing. The R^2 value was 0.18, and there was much scatter around the negatively sloped line. There was a positive association with Rainbow Smelt, but not convincing, with one high outlier driving it. For native species, the most convincing association was a negative one with YOY Walleye. The participant did not expect YOY Walleye to prey on Silver Chub until they reached a length of 180 mm, while the average length was 160 mm. If you were to lag Silver Chub one year to simulate effect of Walleye on age 1 Silver Chub, there would be no relationship. The participant suggested that Gizzard Shad could be an egg predator on Silver Chub. Another participant suggested that speculating on effects of invasive species on Walleye, and in turn on Silver Chub was beyond our scope. The participant then mentioned that the general trend in low numbers of Silver Chub in the western basin of Lake Erie, beginning in the early 2000s, coincided with the largest known Walleye year class (2003). With Walleye favouring soft-bodied fishes as prey, Silver Chub abundance could have been decreased as a result of a strong Walleye year class. Another participant stated that Walleye catch data in Lake Erie was highest from the late 1980s to almost 2000, but that this corresponded to the highest Silver Chub abundances. It was suggested that similar associations between Silver Chub and other strong Walleye year classes be investigated. It was determined that this might lead to more speculation, and should not be undertaken at this point.

There was much discussion centered on Threat Likelihood and Threat Impact of Invasive Species, which were initially ranked as ‘Known’ and ‘High’, respectively. One participant suggested a change in ranking if there was a positive association between Silver Chub and dreissenid mussels. With additional information introduced during this meeting, the impact of Round Goby might not be negative, as previously thought. A suggestion was made to change Threat Likelihood to ‘Unknown’, but this would suggest that no information is known to inform expert opinion. There is some information, but it is conflicting. Overall, it was agreed that dreissenid mussels were having a positive effect by supplying a food source for Silver Chub. Round Goby was also having a positive effect on Silver Chub by crushing the dreissenid mussels, thereby allowing Silver Chub access to the rest of the mussel. It was also suggested that competition for dreissenid mussels between Silver Chub and Round Goby was not an issue given the sheer number of mussels. Round Goby was not considered an egg predator, as Silver Chub eggs are semi-buoyant. It was reiterated that an earlier decline of Silver Chub in Lake Erie was due to Nutrient Loading and its impact on *Hexagenia* mayflies, which were a major food source for Silver Chub. A participant was leaning towards Unknown, at least until experiments could be undertaken. Threat Likelihood remained ‘Known’, but Threat Impact was changed to ‘Unknown’.

For Nutrient Loading, Threat Likelihood remained at ‘Known’, with a ‘High’ Threat Impact.

For Turbidity and Sediment Loading, Threat Likelihood remained at ‘Known’, with a ‘Low’ Threat Impact.

For Contaminants and Toxic Substances, Threat Likelihood remained at ‘Known’, with a ‘High’ Threat Impact.

For Incidental Harvest, a participant questioned the impact of a limited Rainbow Smelt trawl fishery. This issue will need further investigation. Threat Likelihood and Threat Impact remained ‘Known’ and ‘Low’, respectively.

Lake Erie – Central Basin

For Habitat Removal and Alteration, Threat Impact was changed to ‘Medium’.

For Nutrient Loading, Turbidity and Sediment Loading, and Contaminants and Toxic Substances, and Incidental Harvest, all Threat Likelihoods and Threat Impacts remained the same.

For Invasive Species, the Threat Impact was changed to ‘Unknown’, as in the western basin.

REVIEW OF PROJECTS & ACTIVITIES IN SILVER CHUB HABITAT

Presenter: Dave Balint

The presenter gave a summary and several examples of projects and activities from 2010-2013. These included shoreline work, in-lake works, water management such as municipal intakes, and structures in water. The process in which the projects were reviewed was summarized. Most projects received Letters of Advice by Conservation Authorities. Standard mitigation measures used by proponents were outlined, including timing windows to avoid sensitive fish life stages, sediment/erosion control, silt curtains, stabilization of disturbed areas, works above the high water mark, avoiding work during wet/rainy periods, and minimize disturbance of banks and control deleterious substances.

The presenter opened the next section of the presentation up for discussion of several topics. These included: additional feasible mitigation options that have not been considered; whether the number of works/projects/activities are likely to increase, decrease, or remain the same in Silver Chub habitat; whether specific projects are planned to occur in the next 5 years, or 10 years; the biological outcome (increase/decrease in population trajectory) if these projects were to occur with current, or additional mitigation; and whether the number/scale of projects/activities will differ significantly from what was presented. The presenter informed the group that these discussions were necessary for DFO-Policy to frame their socioeconomic analysis, which is the next step in the SARA listing process.

The presenter suggested there would be increase in the number of wind power projects, once the moratorium on wind turbines is lifted in the next year. A participant added that there are many potential locations (upwards of 100 project sites) in central and western Lake Erie, and that impacts could be substantial. The participant questioned what the biological outcomes would be if such projects were to occur, while another participant wondered if there would be additional mitigation under SARA than there would be under the *Endangered Species Act* (ESA) (Silver Chub is Threatened under ESA). With respect to biological outcomes, much of the literature on effects of wind turbines on fishes comes from marine environments. A participant suggested that the effects of construction, footprint, and connections to mainland of 100 turbines would jeopardize survival and recovery. Another participant suggested that long-term impacts, such as noise and habitat removal might be significant. Impacts beyond the physical footprint are not known. In terms of mitigation, no additional measures were suggested.

PATHWAYS OF EFFECTS & NON-HABITAT-RELATED THREATS

Presenter: Lynn Bouvier

The presenter gave an overview of the Pathways of Effects and gave an example. For those threats not covered under the Pathway of Effects (Invasive Species, and Incidental Harvest), additional Feasible Mitigation Methods or Alternatives to Activities were presented. There were no questions or comments regarding this presentation.

SOURCES OF UNCERTAINTY

Presenter: Lynn Bouvier

The presenter summarized Sources of Uncertainty involving Population Structure, Habitat, Recovery Potential Modeling, and Threats. There were no questions or comments regarding this presentation.

TERMS OF REFERENCE REVIEW

Presenter: Nick Mandrak

The presenter reminded the group that no new information can be added to the Science Advisory document that was not discussed at this meeting.

The terms of reference were reviewed to evaluate which were or were not addressed during the meeting. To the extent possible terms of reference 1, 2, 3, 4, 5, 6, 7, 9, 16, 17, 21, 22, and 27 were addressed during the meeting. The following terms of reference were either not addressed or were only partially addressed:

(8) Some information was provided on the spatial extent of the areas that are likely to have these habitat properties. A model and distribution maps have been provided. This is the extent to which spatial extent can be provided.

(10) How the biological function(s) that specific habitat feature(s) provide to the species varies with the state or amount of the habitat, including carrying capacity limits, was not quantified beyond indicating amount of habitat required for minimum population (MAVP).

(11) Quantifying the presence and extent of spatial configuration constraints was not addressed, as it is not applicable in this situation.

(12) Providing advice on how much habitat of various qualities/properties exists at present was not covered, but if modeling data is obtained, this can be accomplished. This was covered indirectly by providing the model output of areas in the western basin of Lake Erie with predicted Silver Chub abundance values.

(13) Providing advice on the degree to which supply of suitable habitat meets the demands of the species both at present, and when the species reaches biologically based recovery targets for abundance and range and number of populations was partially addressed. The area required for a viable population was identified, but it hasn't been evaluated against what exists. Information on suitable habitat is missing, and there is a lack of data on broad spatial extent of western basin, as well as a lack of information regarding habitat preferences. This question could not be fully answered, but some advice related to supply and required minimum areas was provided.

(14) Providing advice on feasibility of restoring habitat to higher values was not addressed. This may not be applicable, as this might not be the primary threat beyond anoxia. It is beyond this group to provide advice on overcoming anoxia in Lake Erie.

(15) Providing advice on risks associated with habitat "allocation" decisions, if any options would be available at the time when specific areas are designated as critical habitat was not done directly. Some guidance with the areas is required.

(18) Quantifying to the extent possible the magnitude of each major potential source of mortality identified in the pre-COSEWIC assessment, the COSEWIC Status Report, information from DFO sectors, and other sources was not done because mortality is not known.

(19) Quantifying the likelihood that the current quantity and quality of habitat is sufficient to allow population increase, and would be sufficient to support a population that has reached its recovery targets was partially accomplished. Information on quality was provided. Information on quantity has not been provided.

(20) The group was not able to assess to the extent possible the magnitude by which current threats to habitats have reduced habitat quantity and quality.

(23) The group did not develop an inventory of activities that could increase the productivity or survivorship parameters.

(24) Lacking the necessary data, the group was not able to estimate the reduction in mortality rate expected by each of the mitigation measures in step 21 or alternatives in step 22 and the increase in productivity or survivorship associated with each measure in step 23.

(25) The group was able to project expected population trajectory (and uncertainties) over three generations, and to the time of reaching recovery targets when recovery is feasible; but not in relation to scenarios because lack of sufficient detail.

(26) The group was able to recommend parameter values for population productivity and starting mortality rates. The group was not able to recommend specialized features of population models that would be required to allow exploration of additional scenarios as part of the assessment of economic, social, and cultural impacts of listing the species. Sufficient data was not available to run projections.

REFERENCES

DFO. 2005. A framework for developing science advice on recovery targets for aquatic species in the context of the Species at Risk Act. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2005/054.

DFO. 2007. Revised Protocol for Conducting Recovery Potential Assessments. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2007/039.

DFO. 2011. A Complement to the 2005 Framework for Developing Science Advice on Recovery Targets in the Context of the *Species At Risk Act*. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2010/061.

APPENDIX 1: TERMS OF REFERENCE

Recovery Potential Assessment of Silver Chub (*Macrhybopsis storeriana*) from the Great Lakes – Upper St. Lawrence populations

Regional Peer Review Meeting – Central and Arctic Region

5 March 2013

Burlington, ON

Co-Chairpersons: Lynn Bouvier and Nicholas Mandrak

Context

When the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) designates aquatic species as threatened or endangered, Fisheries and Oceans Canada (DFO), as the responsible jurisdiction under the *Species at Risk Act* (SARA), is required to undertake a number of actions. Many of these actions require scientific information on the current status of Silver Chub from the Great Lakes – Upper St. Lawrence populations, threats to its survival and recovery, and the feasibility of its recovery. Formulation of this scientific advice has typically been developed through a Recovery Potential Assessment (RPA) that is conducted shortly after the COSEWIC assessment[1]. This timing allows for the consideration of peer-reviewed scientific analyses into SARA processes including recovery planning.

Silver Chub was originally assessed as Special Concern by COSEWIC in April 1985. This status was re-assessed and confirmed as Special Concern in May 2001. When the species was re-examined in May 2012, it was determined that two designatable units were present based on the occurrence of discrete populations in two separate Biogeographic Zones. The Great Lakes – Upper St. Lawrence populations were designated Endangered, while the Saskatchewan – Nelson River populations were designated Not at Risk. Silver Chub is currently listed as Special Concern on Schedule 1 of SARA.

In support of listing recommendations for the Great Lakes – Upper St. Lawrence populations of Silver Chub by the Minister, DFO Science has been asked to undertake an RPA, based on the National Frameworks (DFO 2007a and b). The advice in the RPA may be used to inform both scientific and socio-economic elements of the listing decision, as well as development of a recovery strategy and action plan, and to support decision-making with regards to the issuance of permits, agreements and related conditions, as per section 73, 74, 75, 77 and 78 of SARA. The advice generated via this process will also update and/or consolidate any existing advice regarding this designatable unit of Silver Chub.

Objectives

- To assess the recovery potential of Silver Chub (*Macrhybopsis storeriana*) from the Great Lakes – Upper St. Lawrence populations.

Assess current/recent species/ status

1. Evaluate present status for abundance and range and number of populations.
2. Evaluate recent species trajectory for abundance (i.e., numbers and biomass focusing on mature individuals) and range and number of populations.

[1] COSEWIC assessment and status report on Silver Chub (*Macrhybopsis storeriana*) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. (draft document)

3. Estimate, to the extent that information allows, the current or recent life-history parameters (total mortality, natural mortality, fecundity, maturity, recruitment, etc.) or reasonable surrogates; and associated uncertainties for all parameters.
4. Estimate expected population and distribution targets for recovery, according to DFO guidelines (DFO 2005, and 2011).
5. Project expected population trajectories over three generations (or other biologically reasonable time), and trajectories over time to the recovery target (if possible to achieve), given current parameters for population dynamics and associated uncertainties using DFO guidelines on long-term projections (Shelton *et al.* 2007).
6. Evaluate **residence requirements** for the species, if any.

Assess the Habitat Use

7. Provide functional descriptions (as defined in DFO 2007b) of the required properties of the aquatic habitat for successful completion of all life-history stages.
8. Provide information on the spatial extent of the areas that are likely to have these habitat properties.
9. Identify the activities most likely to threaten the habitat properties that give the sites their value, and provide information on the extent and consequences of these activities.
10. Quantify how the biological function(s) that specific habitat feature(s) provide to the species varies with the state or amount of the habitat, including carrying capacity limits, if any.
11. Quantify the presence and extent of spatial configuration constraints, if any, such as connectivity, barriers to access, etc.
12. Provide advice on how much habitat of various qualities / properties exists at present.
13. Provide advice on the degree to which supply of suitable habitat meets the demands of the species both at present, and when the species reaches biologically based recovery targets for abundance and range and number of populations.
14. Provide advice on feasibility of restoring habitat to higher values, if supply may not meet demand by the time recovery targets would be reached, in the context of all available options for achieving recovery targets for population size and range.
15. Provide advice on risks associated with habitat “allocation” decisions, if any options would be available at the time when specific areas are designated as critical habitat.
16. Provide advice on the extent to which various threats can alter the quality and/or quantity of habitat that is available.

Scope for Management to Facilitate Recovery

17. Assess the probability that the recovery targets can be achieved under current rates of parameters for population dynamics, and how that probability would vary with different mortality (especially lower) and productivity (especially higher) parameters.
18. Quantify to the extent possible the magnitude of each major potential source of mortality identified in the pre-COSEWIC assessment, the COSEWIC Status Report, information from DFO sectors, and other sources.
19. Quantify to the extent possible the likelihood that the current quantity and quality of habitat is sufficient to allow population increase, and would be sufficient to support a population that has reached its recovery targets.
20. Assess to the extent possible the magnitude by which current threats to habitats have reduced habitat quantity and quality.

Scenarios for Mitigation and Alternative to Activities

21. Using input from all DFO sectors and other sources as appropriate, develop an inventory of all feasible measures to minimize/mitigate the impacts of activities that are threats to the species and its habitat (steps 18 and 20).
22. Using input from all DFO sectors and other sources as appropriate, develop an inventory of all reasonable alternatives to the activities that are threats to the species and its habitat (steps 18 and 20).
23. Using input from all DFO sectors and other sources as appropriate, develop an inventory of activities that could increase the productivity or survivorship parameters (steps 3 and 17).
24. Estimate, to the extent possible, the reduction in mortality rate expected by each of the mitigation measures in step 21 or alternatives in step 22 and the increase in productivity or survivorship associated with each measure in step 23.
25. Project expected population trajectory (and uncertainties) over three generations (or other biologically reasonable time), and to the time of reaching recovery targets when recovery is feasible; given mortality rates and productivities associated with specific scenarios identified for exploration (as above). Include scenarios which provide as high a probability of survivorship and recovery as possible for biologically realistic parameter values.
26. Recommend parameter values for population productivity and starting mortality rates, and where necessary, specialized features of population models that would be required to allow exploration of additional scenarios as part of the assessment of economic, social, and cultural impacts of listing the species.

Allowable Harm Assessment

27. Evaluate maximum human-induced mortality which the species can sustain and not jeopardize survival or recovery of the species.

Expected Publications

- Science Advisory Report
- Proceedings
- Two Research Documents

Participation

- Fisheries and Oceans Canada (DFO) (Science, Ecosystems and Fisheries Management and Policy and Economics sectors, Habitat and Species at Risk programs)
- Ontario Ministry of Natural Resources
- Ohio Department of Natural Resources
- Conservation Authorities
- U.S. Geological Survey
- Other invited experts

References

COSEWIC. 2012. COSEWIC Status Report on Silver Chub, *Macrhybopsis storeriana*, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa, Ontario. xv + 34 p.

DFO. 2005. A framework for developing science advice on recovery targets for aquatic species in the context of the Species at Risk Act. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2005/054.

DFO. 2007a. Documenting habitat use of species at risk and quantifying habitat quality. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2007/038.

DFO. 2007b. Revised protocol for conducting recovery potential assessments. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2007/39. 11 p.

Shelton, P.A., B. Best, A. Cass, C. Cyr, D. Duplisea, J. Gibson, M. Hammill, S. Khwaja, M. Koops, K. Martin, B. O'Boyle, J. Rice, A. Sinclair, K. Smedbol, D. Swain, L. Velez-Espino, and C. Wood. 2007. Assessing recovery potential: long-term projections and their implications for socio-economic analysis. DFO Can. Sci. Advis. Sec. Res. Doc. 2007/045.

APPENDIX 2: MEETING PARTICIPANTS

Recovery Potential Assessment of Silver Chub (*Macrhybopsis storeriana)*

Regional Advisory Meeting – Central and Arctic Region

Canadian Centre for Inland Waters, Burlington, ON

5 March 2013

LIST OF PARTICIPANTS

Participant	Affiliation
Sheri Andres	Fisheries and Oceans Canada, Policy and Economics
Dave Balint	Fisheries and Oceans Canada, Species at Risk
Lynn Bouvier	Fisheries and Oceans Canada, Science
Amy Boyko	Fisheries and Oceans Canada, Species at Risk
Scott Gibson	Ontario Ministry of Natural Resources
Patrick Kocovsky	U.S. Geological Survey
Marten Koops	Fisheries and Oceans Canada, Science
Nick Mandrak	Fisheries and Oceans Canada, Science
Justine Mannion	Fisheries and Oceans Canada, Science
Bruce McCulloch	Contractor
Wendy Michaud	Rapporteur
Doug Watkinson	Fisheries and Oceans Canada, Science
Jennifer Young	Fisheries and Oceans Canada, Science

APPENDIX 3: AGENDA

Recovery Potential Assessment – Silver Chub
Regional Peer Review Meeting – Central and Arctic Region
Date: 5 March 2013

WebEx / CCIW R260

Chairpersons: Lynn Bouvier and Nicholas Mandrak

	Topic	**Presenter**
9:00	Welcome and Introductions	Nicholas Mandrak
	Purpose of Meeting	Nicholas Mandrak
	Species Description	Lynn Bouvier
	Population Status	Lynn Bouvier
	Habitat requirements	Lynn Bouvier
	Functions, Features and Attributes Table	Lynn Bouvier
	Recovery Potential Modeling	Jennifer Young
	Threat Status	Lynn Bouvier
	Review of Projects and Activities in Silver Chub Habitat	Dave Balint
	Pathways of Effect & Non-habitat Related Threats	Lynn Bouvier
	Sources of Uncertainty	Lynn Bouvier
	Review of Terms of Reference	Nicholas Mandrak
5:00	End of Day	