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Maritimes Region

Proceedings of the Maritimes Region Regional Peer Review on the Recovery Potential Assessment for Atlantic Salmon (*Salmo salar*) Outer Bay of Fundy Designatable Unit

February 19-22, 2013
Fredericton, New Brunswick

Chairpersons: Ross Claytor and Lei Harris
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Canada

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 Maritimes Region Peer Review Process was held on 19-22 February 2013 at the Fredericton Inn, Fredericton, New Brunswick, in order to conduct a Recovery Potential Assessment for Atlantic Salmon (Outer Bay of Fundy (OBoF) Designatable Unit (DU)). Participation included DFO employees from Science, Ecosystem Management, Fisheries and Aquaculture Management, Policy and Economics, Provinces of New Brunswick and Nova Scotia, Aboriginal communities/organizations, fishing and aquaculture industries, non-governmental organizations, and academics. The meeting addressed several terms of reference that addressed the primary purpose of the meeting: to assess the recovery potential of the Outer Bay of Fundy DU of Atlantic Salmon. To that end, the following topics were addressed as presentations and discussion: Assessment of Current/Recent Species Status, Allowable Harm Assessment, Scenarios for Mitigation and Alternative to Activities, Scope for Management to Facilitate Recovery, and the Assessment of Habitat Use. Publications to come out of this meeting include the Proceedings, Science Advisory Report and several Research Documents.

Compte rendu de l'examen régional par les pairs de la région des Maritimes sur l'évaluation du potentiel de rétablissement pour le saumon de l'Atlantique (*Salmo salar*) de l'unité désignable de l'extérieur de la baie de Fundy

SOMMAIRE

Un processus d'examen par les pairs de la région des Maritimes a eu lieu du 19 au 22 février 2013 au Fredericton Inn, à Fredericton, au Nouveau-Brunswick, afin d'effectuer une évaluation du potentiel de rétablissement pour le saumon de l'Atlantique (unité désignable de l'extérieur de la baie de Fundy). Parmi les participants, on retrouvait les employés du Secteur des sciences de Pêches et Océans Canada, de la Gestion des écosystèmes, de la Gestion des pêches et de l'aquaculture, de Politiques et services économiques, des provinces du Nouveau-Brunswick et de la Nouvelle-Écosse, des collectivités et organisations autochtones et des industries de la pêche et de l'aquaculture, en plus des organisations non gouvernementales et des universitaires. La réunion a abordé plusieurs cadres de référence liés au principal objectif de la réunion, soit d'évaluer le potentiel de rétablissement pour le saumon de l'Atlantique de l'unité désignable de l'extérieur de la baie de Fundy. À cette fin, les sujets suivants ont été abordés dans le cadre des présentations et des discussions : l'évaluation de la situation actuelle ou récente de l'espèce, l'évaluation des dommages admissibles, les Scénarios des mesures d'atténuation et des solutions de rechange, le document Évaluer la possibilité de prendre des mesures de gestion pour faciliter le rétablissement et l'évaluation de l'utilisation de l'habitat. Parmi les publications émises après cette réunion, on retrouve le compte rendu, l'avis scientifique et plusieurs documents de recherche.

INTRODUCTION

Ross Claytor and Lei Harris, the meeting Co-Chairs, thanked participants (Appendix 1) for attending this DFO Science peer-review and advisory meeting to conduct a Recovery Potential Assessment (RPA) for the Outer Bay of Fundy (OBoF) Designatable Unit (DU) of Atlantic Salmon (*Salmo salar*). The co-chair noted that copies of the Terms of Reference (Appendix 2) and the Working Papers were available at the back of the room.

When the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), which is an independent scientific advisory body, designates an aquatic species like salmon as Endangered or Threatened, Fisheries and Oceans Canada (DFO) is required to undertake a number of activities related to the federal *Species at Risk Act* (SARA) listing process, and, subsequently, for recovery planning. These activities involve various parts of DFO, but are generally coordinated by the DFO Species at Risk Management Division. These various activities of the department require scientific information on the status and trajectory of the species, threats to its survival and recovery, mitigation measures and alternatives, and the overall feasibility of recovery. Formulation of this scientific advice is typically developed through an RPA. The Terms of Reference for an RPA have been standardized across the country to capture the requirements for the full range of aquatic species – they were not developed specifically for this meeting.

The primary goals of the meeting were:

- To peer-review the information presented to ensure that it is accurate, complete, and an appropriate basis for decision-making.
- To develop science advice to DFO Management in the form of a Science Advisory Report, specifically to address the Terms of Reference with the best available information.
- To assess the recovery potential of the Outer Bay of Fundy DU of Atlantic salmon by use of the following assessments: assess current/recent species status, assess the habitat use, scope for management to facilitate recovery, scenarios for mitigation and alternative to activities, and allowable harm assessment.

The Agenda (Appendix 3) was modified as a result of a winter storm delaying the start of the meeting by a full day.

The information basis for this review was five Working Papers that were provided prior to the meeting, as well as information that would be presented throughout the week. Several external reviewers had been invited to assist with the peer-review process: Gerald Chaput, DFO Science in the Gulf Region; Martha Robertson, DFO Science in the Newfoundland Region; Jonathan Carr, Atlantic Salmon Federation; and Rick Cunjak, University of New Brunswick/Canadian Rivers Institute.

There are no observers within DFO Science advisory meetings, so all participants were welcomed and encouraged to participate actively in the discussion and contribute knowledge to the process. Participants were asked to remain respectful and constructive in their comments, as participation in this meeting was intended to assist with the objective evaluation of the information presented and not to represent or advocate a specific position or agenda. This was important because DFO Science advisory meetings operate by consensus, which means that an effort is made to work towards an absence of opposition to the main conclusions of the meeting, though opposition would only be considered based on alternative valid interpretations of the science information presented and not on perceived socio-economic consequences.

DAY 1

REVIEW OF SARA AND OBoF ATLANTIC SALMON

Presenter: Kim Robichaud-LeBlanc

Rapporteur: Stephanie Ratelle

Presentation Highlights

The following items were explained to the group: role of the Species at Risk (SAR) Recovery Planner; goals of SARA; SAR listing process; timelines for the process; Recovery Strategy; Action Planning (measures to implement the Recovery Strategy); and SARA public registry.

SARA is administered by Environment Canada (terrestrial and avian), Parks Canada Agency (species within federal parks) and DFO (aquatic species).Steps of the SARA process were reviewed. COSEWIC assessed OBoF salmon in 2010 and designated it an Endangered status (facing imminent disappearance).

The decision timeline was reviewed. The RPA is to be conducted in February 2013, socio-economic analysis in the Summer of 2013 and the consultation phase will take place in the Fall 2013/Winter 2014. A regional listing recommendation will be sent to the Minister of Fisheries and Oceans in the Spring of 2014 and a listing decision would be expected in the Spring of 2015.

Of note is that SARA covers only species 'IN CANADA" regardless of a species' range being international in scope. Thus, SARA only provides for the protection of the species in Canadian waters, although the government works with international groups to protect listed species (e.g., Canada-U.S. SAR Working Group).

Discussion

There was no discussion following the presentation.

RPA FOR OBoF ATLANTIC SALMON: BACKGROUND INFORMATION

Presenter: Corey Clarke

Rapporteur: Stephanie Ratelle

Presentation Highlights

An overview of the Atlantic salmon life cycle was given and described as a standard diadromous life cycle. Specific OBoF traits were described and included: OBoF salmon typically smolt at age 2 and return as 2 Sea Winter (SW) adults; the grilse or 1SW salmon are predominantly male; and OBoF salmon can spawn in sequential or alternate years. The range of the OBoF DU is the largest DU in the Maritimes Provinces of Canada. The DU includes 21 rivers: Saint John River (SJR) above the Mactaquac Dam (including 19 tributaries) is considered 1 river; 10 rivers below the Mactaquac Dam (includes 10 tributaries of the Jemseg River); and 10 Rivers in the Outer Fundy Complex. These salmon differ from Inner Bay of Fundy (IBoF) since the OBoF are predominantly 2SW adult fish and migrate into the North Atlantic, whereas the IBoF salmon are predominantly 1SW and have a more local migration into the Gulf of Maine and Bay of Fundy. The OBoF population has a unique sub-group known locally as the Serpentine River salmon and these are an early-run component of the SJR salmon; they return in the late-Fall of their second year at sea (thought to overwinter in the estuary) and migrate back to the headwaters of the SJR. They are also described as having a unique phenotype: small 2SW salmon, almost slink-like in body form and colouration (appear almost kelt-like).

Objectives of the next few days were presented and described as: provide review of relevant information; provide assessment of information in context of recovery; review ‘completeness’ of information; and review assessment for OBoF salmon.

Discussion

There was no discussion following the presentation.

REVIEW OF THE RECOVERY POTENTIAL ASSESSMENT OF THE OUTER BAY OF FUNDY POPULATION OF ATLANTIC SALMON (*SALMO SALAR*): STATUS AND TRENDS

Presenter: Ross Jones

Rapporteur: Danielle MacDonald

Reviewer(s): Gerald Chaput, Martha Robertson, Jonathan Carr and Rick Cunjak

Terms of Reference

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.

Abstract

As a part of the RPA process that was triggered by the recent COSEWIC designation of OBoF salmon population as Endangered, this Working Paper updates the status, trends and life history information that were last provided in Jones et al. (2010) for the COSEWIC (2010) review. New information related to the current range, distribution and densities of wild origin juvenile salmon, from an extensive electrofishing survey completed in 2009, was also provided. Options for abundance and distribution recovery targets for DU 16 are also presented.

Adult salmon counts and estimates of returns to counting facilities (e.g., fishway, counting fence, etc.) are evaluated against conservation requirements that were determined for each index river based on accessible habitat area and the biological characteristic information of the returning adult salmon. Estimates of emigrating juvenile salmon (i.e., pre-smolt, smolt, etc.) using rotary screw traps, as well as mean parr densities by electrofishing, on two tributaries of the SJR are assessed against reference levels.

Overall, the available data on salmon in DU 16 indicates that populations are persisting at low abundance levels. The 1SW and Multi-Sea Winter MSW returns to counting facilities were the lowest on record in 2012. Wild smolt to 1SW and 2SW salmon return rates were both less than 0.4% on the Nashwaak River. In the past 5 years, estimated adult abundance on the SJR upriver of Mactaquac and on the Nashwaak River has averaged about 7% (2-13%) and 22% (3-37%) of the respective conservation requirements. The estimated egg deposition upriver of Mactaquac has declined at rates in excess of 80% over the last 15 years while Nashwaak egg deposition has also declined, but to a lesser degree (27-50%), over the same time period. Pre-smolt and smolt estimates contributing to the 2012 smolt class for the Tobique River were the highest since monitoring commenced in 2011, and the minimum smolt abundance estimate on

the Nashwaak River was higher than 2011 but below the previous 5 year mean. Juvenile densities in the Tobique and Nashwaak rivers were considerably below reference values (Elson's norm) in 2012. Adult returns to other non-SJR rivers within the DU were extremely low, and declining rates in excess of 80% over the last 15 years were predicted for the Magaguadavic River. Predicted declines are about 65% when total escapement of 1SW and MSW returning adults to DU 16 are considered over the last 15 years. Electrofishing surveys of nearly 200 sites within most of the rivers or tributaries within the DU revealed that juveniles are still common in most of the drainages, but at low densities. The systems with the highest mean densities were all tributaries of the SJR, which included the Shikatehawk, Little Presquile, Keswick, Nashwaak, Canaan and Hammond systems and the OBoF complex, which includes Poccologan, Dennis and Digedegaush.

Discussion

Discussion revolved around centralized themes as follows:

Hatchery Related Issues: Hatchery practices and its potential effects were discussed. In addition to what was presented, there was also concern that the progeny of hatchery fish were resulting in a higher grilse ratio than the Multi-Sea Winter (MSW) adult return rate. This would not match with the wild life-history traits for the SJR above Mactaquac Dam. In the last 15 years, this skewed ratio is very evident. It was recommended to look at changes in hatchery practices and to determine if the combined hatchery and wild decline is being driven by hatchery effects. There was recommendation to separate the two origins in the analysis to get perspective on what is really happening. Return rates of hatchery smolts were also considered and caution suggested if there has been a shift from 1-year versus 2-year old smolts as adult returns. There was a recommendation to consider this in the analysis.

Electrofishing and Juvenile Abundance Data: During the discussions it was suggested that additional data were also available from other sources for the Magaguadavic River (Atlantic Salmon Federation) and the Hammond River (35 year time series). It was suggested that these data be included in the analysis, although the author cautioned that additional data would have to meet the same criteria as data already included in the analysis and, most importantly, the origin (wild or hatchery) of the fish captured would need to have been positively identified.

Serpentine Stock: There was discussion about the proof that the Serpentine stock above Mactaquac still existed or ever did. Explanation about the phenotypic criteria and scale reading confirmation was given (smaller salmon at maturity, historically first to arrive at Mactaquac Dam in the spring, overwinter in the estuary). Genetic confirmation would be discussed during the genetic paper presentation. It was decided to leave the reference to this unique component.

Landlocked salmon: Increased presence of landlocked salmon at the Mactaquac Biodiversity Facility's migration channel and the presence of four captured at the Nashwaak fence lead to concerns about their increased presence in the system. Participants were concerned that landlocks could integrate with wild salmon stocks. If landlocked salmon numbers are exceeding diadromous numbers there is concern that these could be a potential threat. It was decided to include the numbers of the landlocked salmon (wild and hatchery origin) in the paper and to discuss their impacts during the threats portion of the RPA.

Research Recommendations

There were no further research recommendations made.

REVIEW OF THE RECOVERY POTENTIAL ASSESSMENT FOR THE OUTER BAY OF FUNDY POPULATION OF ATLANTIC SALMON (*SALMO SALAR*): RECOVERY TARGETS

Presenter: Ross Jones

Rapporteurs: Danielle MacDonald and Stephanie Ratelle

Reviewer(s): Jonathan Carr, Martha Robertson, Gerald Chaput, and Rick Cunjak

Terms of Reference

Assess Current/Recent Species/Status

4. Estimate expected population and distribution targets for recovery, according to DFO guidelines (DFO 2005, DFO 2011).

Abstract

Consistent with approaches taken for other maritime Atlantic salmon recovery potential assessments, the recovery targets for OBoF salmon have both an abundance and distribution target. Abundance targets, as described in the previous section, are set at the standard 2.4 eggs per m^2 of productive habitat and total approximately 100 million eggs for the entire Canadian OBoF DU. Following DFO guidelines, Distribution targets in this case include the Serpentine river for its known unique life history traits and then prioritize remaining habitat by access, size, wild salmon abundance and impact by known threats. Those rivers might include the Canaan, Hammond, Kennebecasis, Keswick, Nashwaak, Tobique, and Shikatehawk. Becaguimec and Little and Big Presquile.

Discussion

There was discussion about the recovery target (RT) and how it should be represented for the DU. The RT is currently based on an Egg Conservation Target of: 2.4 eggs/m^2 of suitable habitat. The issues raised around the RT were:

How many salmon and grilse would be required to meet this target?

Discussion centered around clarifying whether the recovery target would be best described as the number of eggs required per square metre of habitat or how many fish would be required to meet this target. The consensus was that it is best described in terms of the numbers of salmon and grilse required since this is a number that can be used from a management standpoint and is easier to describe than the end point which is the number of eggs. It was noted when discussing the numbers of fish required to meet this target that there is not a one-to-one replacement in this DU so calculating the fish numbers will require more calculations and assumptions. Calculations should be based on life history, fecundity and proportions of females by age groups to give more accurate data on how many fish are required. In addition to this, one could consider the requirements of life history types (1SW and MSW) to produce the eggs so that a management perspective is provided. Some assumptions that should be stated in the Science Advisory Report include: all habitat is accounted for with the methodology used; life history characteristics remain static; and we do not know the absolute error around our target estimates. Sources of uncertainty need to be identified and should be clear based on the assumptions. In addition, there are no error estimates around the RT estimates currently and this leaves some uncertainty in the target.

> *__Decision__:* Change the recovery target to fish needed to produce eggs to meet 2.4 eggs/m^2. Identify the RT as number of fish/age group (1SW vs. MSW) needed to

produce the required 97,000,000 eggs for the DU. Be careful of error around the target There are no error estimates around the estimates right now and this leaves some uncertainty in the target. There is currently no accepted method to determine the error.

What habitat is being considered in the DU? Currently and previously accessible habitat? Is there a long-term and a short term goal for recovery?

The RT is based on Canadian currently-accessible and previously-accessible habitat. There was a great deal of discussion around how the habitat units were calculated and whether all suitable habitat (whether currently accessible or not) was included. Some of the group was unsure about the inclusion of previously accessible habitat since the egg requirements for the DU would be increased and salmon cannot currently access the habitat required to meet that RT. There were two RT goals presented: 1) short term target for accessible habitat; and 2) long term target that would include accessible and previously accessible habitat. It was noted that the previously-accessible habitat is important in the calculations. An example provided was if a dam was constructed in front of 90% of the habitat and only the habitat below was considered, it could look like you are meeting the recovery target when, in fact, you are not. It was also discussed that not all rivers in the DU had complete habitat information, and it was recommended to borrow calculations for rivers with unknown characteristics from similar rivers with known characteristics to come up with total for the whole DU. The RT is set for the DU and will not be done on a river-by-river basis. Therefore, management and recovery goals would be for the entire DU.

> *Decision:* Option 1 will be used to describe the current egg requirements and will consider only the Canadian currently-accessible habitat which results in a short-term target of 54.4 million eggs within the 22.62 million m^2 of productive habitat and a long-term egg target of approximately 97,000,000 eggs for 40.46 million m^2 of productive habitat. Previously-accessible habitat will be considered in the long term if habitat is lost.

There was also discussion about the guidelines for selecting Priority Rivers in the DU. Reviewers recommended making sure that there was a geographic distribution of rivers in the DU; some rivers should be above the dam, some below the dam and some in the outer complex. It was recommended to provide guidelines for prioritizing rivers and that there needs to be more explanation around “habitats with the highest productive capacity and accessible amounts”. Geographic distributions should also be a guideline in selecting rivers. Of concern was that the rivers currently selected in the Working Paper cannot meet the egg deposition requirements for the DU, as there are not enough habitat units available.

> *Decision:* The priority rivers chosen were: below Mactaquac (Canaan, Hammond, Kennebecasis, Keswick and Nashwaak); above Mactaquac (considered as one river: Tobique; Shikatehawk; Becaguimec; and Little and Big Presquile); and Outer Fundy complex (add the Digdeguash).

There was concern that these rivers would not provide sufficient enough habitat to achieve the RT. It was recommended to add a table in the Working Paper with the habitat available in each of the priority rivers and see what percentage of the egg target can be met. The distribution of target rivers might be more appropriately outlined in the critical/important habitat process.

PATTERNS OF WITHIN AND AMONG-POPULATION GENETIC VARIATION IN OBoF ATLANTIC SALMON (*SALMO SALAR*) WITH SPECIAL EMPHASIS ON THE SAINT JOHN RIVER SYSTEM

Presenter: Patrick O'Reilly

Rapporteurs: Danielle MacDonald and Stephanie Ratelle

Reviewers: Gerald Chaput, Jonathan Carr, and Martha Robertson

Abstract

Although a number of factors are likely involved in historic and more recent reductions in anadromous runs in OBoF salmon, there has been considerable focus on the direct role of hydroelectric facilities on the SJR system, and possible associated effects of large-scale mitigation stocking that commenced in the early-1970s, including loss of within-population genetic variation and the homogenization of putative tributary stocks above Mactaquac Dam, and the resulting loss of local adaptation.

This Working Paper will report on results of analyses of two molecular genetic datasets (originally collected for other purposes); one involving eight small sample collections obtained from the OBoF salmon analyzed at a limited set of seven microsatellite loci and another involving only two OBoF salmon locations, but analyzed at a larger set of 17 microsatellite loci. Both datasets include at least one tributary of the SJR above and one below Mactaquac Dam, including multiple reference populations from other DUs.

Overall, little evidence of marked reductions in genetic diversity in tributaries above Mactaquac Dam (potentially impacted by reductions in census and effective population sizes) relative to those below Mactaquac Dam was found. Indeed, levels of variation within OBoF salmon sample collections overall are comparable to those obtained from large populations in the Gaspé-Southern Gulf of St. Lawrence DU and elsewhere, and considerably greater than many sample collections obtained from the IBOF salmon and the Southern Upland salmon DUs.

Additionally, statistically significant differences in allele frequency distributions were observed between two sets of sample collections obtained from locations above Mactaquac Dam, suggesting that potentially heightened stocking-mediated gene flow may not have completely homogenized populations above Mactaquac Dam. On the other hand, levels of genetic structuring across tributaries above Mactaquac Dam were lower (approximately half) compared to sample collections obtained from tributaries below Mactaquac Dam. Although these results may reflect the effects of stocking-related increases in gene flow among upper SJR tributaries, similar patterns (greater differentiation among lower river tributaries compared to upper river tributaries) have also been observed in other large (and less impacted) river systems, indicating that it is also possible that patterns in the SJR system may reflect natural biological processes.

Results presented here, and similar findings on the impacts of stocking on homogenization and loss of local adaptation in other Endangered populations of Atlantic Salmon (discussed in the Working Paper), indicate that although the potential risks of hatchery stocking on wild populations are substantial, findings of even large-scale, long-term stocking, involving local and/or non-local salmon, cannot alone be taken as evidence that complete homogenization of wild populations has taken place, extensive loss of local adaptation and fitness has occurred and that conservation measures aimed at protecting remaining salmon populations are not warranted.

Discussion

Since 1967, a more homogenized population of salmon above Mactaquac Dam has been created. The only specific element that was selected for was the early run component for the Tobique. The Canaan and Nashwaak really reflect what the river would look like with no human intervention. The rivers, without dams and supplementation, would/could all have branched out into long distinct phylogenetic branches. The author pointed out that there are still significant differences among the rivers above Mactaquac even though these have been supplemented with hatchery reared fish or early run fish that were placed there as a management/mitigation technique in the past. It is possible that without having done this that the significant differences would be larger.

It was noted that the phylogenetic tree could be used for distribution considerations. The recovery distribution objectives seem to coincide with the phylogenetic tree branching; the same rivers aimed to be geographically covered are the same ones that branch out distinctly on the phylogenetic tree. An exception would be the Salmon River Victoria which was not considered since it is above Tobique. The phylogenetic tree seems to branch out into the 4-5 sections geographically that are aimed to be included as areas in the Science Advisory Report. It was agreed that the genetic data shows the importance of the geographic distribution of the rivers.

Research Recommendations

- In the past , landlocked salmon from Skiff and Oromocto Lakes were once crossed with sea-run salmon from SJR (in the 1980s) and there could be some remnants in the population. It was recommended to consider looking at this in the future.
- Expand on the current study and include more samples from various tributaries to look at the difference between tributaries (adjacent) versus geographic location from the mouth of the river (upriver versus downriver).
- In the distribution target, incorporate geographic importance of bifurcated tributaries and not just distances from the mouth of the rivers.
- Take a conservative approach: there are no large differences between Tobique and Serpentine populations, but this could be a function of the test resolution or that stocks have been homogenized.

REVIEW OF THE RECOVERY POTENTIAL ASSESSMENT FOR THE OUTER BAY OF FUNDY POPULATION OF ATLANTIC SALMON (*SALMO SALAR*): LIFE HISTORY PARAMETER VALUES PART I

Presenter: Gregor MacAskill

Rapporteur: Stephanie Ratelle

Reviewer(s): Gerald Chaput, Martha Robertson, and Jonathan Carr

Terms of Reference

Assess Current/Recent Species/Status

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.
3. Estimate expected population and distribution targets for recovery, according to DFO guidelines (DFO 2005, DFO 2011).

Abstract

The purpose of this presentation was to provide information about the population dynamics and viability of OBoF salmon in support of recovery planning for the DU. It covers the topics in the Terms of Reference for the RPA for OBoF salmon related to estimation of age- and stage-specific life history parameters (mortality rates and stage transition probabilities), past and present population dynamics and viability of these populations, and scenario analyses to help identify and prioritize among recovery actions.

Analyses were presented for the Nashwaak River and the Tobique River salmon populations. For the Nashwaak River population, life history parameter estimates were obtained by fitting a life history model to population-specific data including annual estimates of juvenile densities, egg depositions, number and age composition of emigrating smolts and numbers of returning adults. The resulting estimates of age- and stage-specific mortality rates, as well as age-specific probabilities of undergoing smoltification and of maturing, were used to estimate smolt abundance and smolt-to-adult return rates from the 1970s to present. The results indicated that at-sea survival for salmon maturing after two winters at sea has decreased by a factor of about two to three, whereas recent increases in the return rates for salmon maturing after one winter at sea are nearer the historical values. Maximum lifetime reproductive rates decreased from an average of 2.49 in the 1970s to 1.13 in the 2000s for the Nashwaak River population. This was estimated to be 0.18 for the Tobique River population using data from 1989 to 2005. Based on these values, in the absence of human intervention or a change in these rates, the Tobique River population is expected to extirpate, whereas, although the Nashwaak River population has an equilibrium population size greater than zero, it has very little capacity to rebuild and is at risk of extirpation from random variability and stochastic events.

Population viability Analysis (PVA) indicated that relatively small increases in either freshwater productivity or at-sea survival are expected to markedly decrease extinction probabilities, although larger changes in at-sea survival is required to restore populations to levels above their conservation requirements. In contrast with IBoF salmon populations, for which at-sea survival is so low that recovery actions in fresh water are expected to have little effect on overall viability, recovery actions focused on improving freshwater productivity are expected to increase population viability for OBoF salmon. A sensitivity analysis about the effect of starting population size on population viability highlights the risks associated with delaying recovery actions; recovery is expected to become more difficult if abundance continues to decline, as is expected for these populations (downstream of Mactaquac Dam) with the continued passage of time.

Discussion

Initially, there was question regarding the particular model chosen for the analysis and this was followed by considerable discussion about the inputs into the chosen model. The various inputs in question included: 1) electrofishing scalar used is a common scalar for all the life stages rather than specific to the life stages. Survival estimates are robust where good data exists but when dependent on the scalar, the transition points (i.e., intermediate juvenile stages) like egg-to-fry and egg-to-parr survival is affected; 2) angling catch to estimate escapement and use of fixed versus variable exploitation rate; and 3) use of adjusted versus unadjusted densities.

> *Decision*: Authors decided to revisit the model that evening based on reviewer suggestions that included: using a different scalar (e.g., habitat available); using a variable angling exploitation rate; looking at correlation analysis; and using the unadjusted densities to run the model to see how it affects survival estimates.

DAY 2

REVIEW OF LIFE HISTORY PARAMETER VALUES PART I: NOTES FROM THE CO-CHAIR

Presenter: Ross Claytor

Objectives of Model

1. Estimation of life history parameter values.
2. Ideal for recovery planning for endangered species: they allow evaluation of how much key life history parameters must be changed in order for populations to recover.
3. Models are not right or wrong, just more useful or less useful.
4. The objective is to compare past life history parameter values to current values by answering the question: how have the population dynamics changed so that the population is now at- risk?
5. To analyze the past (1973-82) and present (2000-09) population dynamics.
6. Determine how much at-sea survival has changed.
7. Evaluate whether freshwater production has changed.
8. Determine whether populations may be viable at low abundance levels, or whether they are expected to extirpate.
9. Obtain parameter estimates for the population projection model.

Sequence of Modeling Inputs

1. Egg to smolt survival:
    a) Beverton – Holt
        i) Slope at origin
        ii) Asymptotic carrying capacity
    b) Lifetime egg per smolt production
2. Overlaying these identifies equilibrium points.
3. Nashwaak and Tobique have sufficient data (concentrate on Nashwaak)
4. Data inputs are:
    a) Adults
        i) Recreational catch
        ii) Fence Counts
        iii) Age composition
    b) Smolt
        i) Abundance
        ii) Age composition
    c) Juveniles
        i) Fry densities
        ii) Parr densities
        iii) Age composition

Issues

An electrofishing scalar (catchability) is estimated and this is the key to comparing past and present dynamics.

Assumptions

First, it is assumed that the population is closed (i.e., straying from other populations is not a significant influence on population dynamics). This is likely given that other populations in the inner and outer Bay of Fundy are at low levels relative to past abundance.

Second, it was assumed thta equivalent survival rates in freshwater for all progeny of Atlantic Salmon, regardless of parental origin (hatchery- or wild-origin spawners as well as crosses between these groups).

Third, survival in the marine environment is assumed to be independent of survival in freshwater (as suggested by previous research on the timing of density dependence in Atlantic Salmon in the Maritimes; Gibson 2006).

Fourth, fishing mortality is not included in the model because all commercial salmon fisheries in the region have been closed since 1985, with the recreational fishery being closed in 1990. No significant sources of incidental mortality in other fisheries have been identified.

Fifth, improvements in passage mortality are assumed only to increase the survival of migrating juveniles, an assumption made because the predesign studies for construction focused on this life stage.

Do any issues remain about these assumptions?

Previously identified Data issues

Scalar h:

The parameter h, which can be estimated within the model, is used to scale the parr density to the total abundance. Estimating the parameter, rather than using the measured number of habitat units, corrects for potential issues that would arise if the electrofishing sites fished each year were not representative of the entire river.

Assumption:

An implicit assumption made here is that the density of all age classes of parr can be scaled up to their respective abundances using a single value of h. This assumption is made because a set of age-specific catchabilities and mortalities would be completely confounded (covariance of 1) in the model without some sort of auxiliary information about one parameter or the other.

Consequence of assumption:

1. The eggs and smolt production values during the counting fence years are the critical anchoring points, the transition parameters in between are all relative parameters.
2. End points not affected but anything in-between is sensitive.
3. Correlations among parameters would allow an assessment of how important this consequence is.
4. Disadvantage – difficulty if recovery targeting specific life history stages.

Two Data input issues:

1. Angling catch - fixed exploitation rate not corrected for effort is used.
2. Adjusted densities for fry and parr were used. The adjustment for fry made an appreciable change (2x?).

Issue resolution:

The effect of the fry adjustment would allow sensitivity of the model to this adjustment to be assessed. Alternative model runs suggested to test assumptions of current model resolve the issue of fry adjustment and using angling catch not corrected for effort.

q:

To give an indication of which method (estimating a q or using a constant exploitation) would be more consistent with the fry densities:

1. Calculate a "q" for large and small salmon for the years for which we have counts and catches, and then average them over years to get one value for large and small salmon.
2. Calculate the large and small escapement for the years we have the recreational catch data based on the q's and effort data.
3. Do a regression of the fry densities on the escapement calculated as above and as done in the WP and compare the fits.

Survey adjustment:

1. Model runs without adjustment for juvenile survey method.
2. The PVA and equilibrium conditions analyses are fine for analyzing current conditions and associated trajectories.

Steps:

1. Review the rationale for adjustment outside the model.
2. Identify alternative models.
3. Define criteria for which data are used and for deciding which models would appear alone or as alternatives in the Science Advisory Report.
4. Present results from models.
5. Identify how actions would differ depending on model.

Discussion

It was noted that the first assumption of the model is that population is closed; however, the Nashwaak might not meet this assumption as there are likely strays into this river. The fourth assumption assumes that there has been no recent significant mortality from commercial fishing. It was recommended to look at data from the early-1970s for past abundance when there was commercial fishing to ensure that the assumption is valid. This is a source of uncertainty in the model. Two other assumptions: 1) electrofishing scalar is the same for all age groups; and 2) mortality rate for parr aged 1 older is constant over all age groups. It was also noted that the density dependent function is only expressed between fry and age-1parr. Recreational fishery mortality is included in the model, although the commercial fishery is not included.

The model uses catch which is not equal to harvest since the actual number of animals caught are not necessarily killed. The equation: Catch-harvest= Escapement was given, and it was explained that the model uses catch. The catch statistics were adopted from Marshall et al. (2014), and where there were gaps in the time series the numbers were adjusted and calculated.

> *Decision*: There are major sources of uncertainty in the data, particularly with the recreational fishery (fixed exploitation versus effort). The adult abundance and egg deposition was not derived in this RPA. There may be some basis in the literature on

using catch (fixed rate), rather than effort data. It was recommended to explore and see which one fits the model best. Estimates of egg survival might be low and will affect smolt and vice versa but the model will not show how the parr stage mortality rate will be affected.

Steps to resolve uncertainty in the model

1. Rationale on using adjusted versus unadjusted juvenile densities: It was suggested that there are several permutations that could be tried with the model. A main issue is the juvenile data (adjusted). The adjusted values do change the estimates greatly so it may be better to run the two time series with adjusted and unadjusted (change juvenile data set and use all 10 sites).

   Decision: Look at both models and see which one fits the best, and depend on model output to guide the decision. Is there a possibility of rejecting both models? If there is huge sensitivity to an input that cannot be explained, the model may need to be rejected (e.g. egg deposition, adult returns, angling data fixed versus effort: plausibility/logistics). Sensitivity will start with electrofishing data to compare parameter values.
2. The angling catch data has too many uncertainties, so there is preference to use the counting fence data. Keep the fixed angling rates and state it as an explicit assumption.
3. The team decided to work together immediately to resolve the carrying capacity issues using fry to include density dependence to calculate the smolt production. Can close–the-loop using the counting fence data and calculate a ratio of eggs to fry.
4. Results of updated model using adjusted versus unadjusted: the electrofishing scalar is higher with unadjusted values, freshwater carrying capacity (from 28.01 to 77.7, adjusted to unadjusted) and standard deviations are very inflated (+/- of 86.4). The Equilibrium analysis is also vastly different from the unadjusted values.

   Conclusion: The model has a better fit with the adjusted data, so the Science Advisory Report should move forward with the original models.
5. Identify alternative models: see above.
6. Define criteria for which data are used and for deciding which models would appear alone or as alternatives in the Science Advisory Report.
7. Present results from models.
8. Identify how actions would differ depending on model.

REVIEW OF RECOVERY POTENTIAL ASSESSMENT FOR THE OUTER BAY OF FUNDY POPULATION OF ATLANTIC SALMON (*SALMO SALAR*): HABITAT CONSIDERATIONS

Presenter: Corey Clarke

Rapporteur: Stephanie Ratelle

Reviewer(s): Gerald Chaput, Martha Robertson, Jonathan Carr, and Rick Cunjak

Terms of Reference

Assess Current/Recent Species/Status

6. Evaluate residence requirements for the species, if any.

Assess the Habitat Use

7. Provide functional descriptions (as defined in DFO 2007a) 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.
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.
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.

Abstract

This Working Paper addresses the ‘habitat considerations’ pertinent to the formulation of advice on the recovery potential of OBoF salmon DU 16. Considerations include: habitat requirements; spatial extent of the habitat; spatial constraints; habitat suitability; options for habitat allocation; residence requirements; and research recommendations.

Adult Atlantic Salmon require appropriate river discharge and unimpeded access to reach spawning areas, as well as holding pools and coarse gravel/cobble substrate on which to spawn. Eggs, alevins and juveniles require clean, uncontaminated water with a pH generally greater than 5.3 (Amiro 2006) for appropriate development, as well as steady, continuous water flow and areas with appropriate cover during winter and summer to deal with temperature extremes. Smolts need appropriate water temperature, photoperiod and river discharge as cues to migrate and require unimpeded access throughout the length of the river. Immature and mature salmon in the marine environment require access to sufficient prey resources to support rapid growth.

Based largely on New Brunswick Department of Natural Resources digital spatial data, air photos and ortho-photo maps, there is an estimated 49.7 km^2 of productive habitat available to salmon within DU 16 Canada and U.S., 81% of which is within Canada. Of the combined Canada-USA area, 91% is within the SJR basin; 10% is attributed to ten smaller basins westward to, and including the St. Croix Canada-U.S. boundary waters. Within the SJR, 21.5 km^2 is upriver of Mactaquac Dam and 23.2 km^2 is downriver of Mactaquac Dam. The estuarine habitat within the mainstem of the SJR basin is 140 km in length; the marine habitat is widespread from the Bay of Fundy and Gulf of Maine, to the Atlantic coasts of Nova Scotia, Newfoundland, Labrador and Greenland, including the Labrador Sea.

The upper portion of accessible productive habitat (21.5 km^2) of the SJR is fragmented by four major hydroelectric dams (Mactaquac, Beechwood, Tinker, and Tobique Narrows) and headponds within Canadian jurisdiction. Each has provisions for upstream but not downstream fish passage. Three dams and flowages (headponds/reservoirs) with upstream, but mostly no downstream passage facilities, obstruct salmon accessing the majority of habitat in the St. Croix River; one dam with an ineffective downstream by-pass and adjacent pool and weir fishway is located at tide-head on the Magaguadavic River.

Freshwater habitat suitability is largely judged on current abundances of juveniles at electrofishing sites, and to a lesser extent, the availability of stream gradients measured from ortho-photo maps. The assessment of the habitat's future suitability under biologically-based recovery objectives is problematic given increasing river temperatures, decreasing stream discharges, new ecosystems/ fish communities established within headponds and some rivers, and escapes from the aquaculture industry. These elements add new uncertainties to the prediction or measurement of success without considering new 'norms' for juvenile abundance and possibly, revisions to current conservation requirements.

Options for allocation of 'important' habitat assume that hydroelectric dams and open pen aquaculture will persist. Similarly, the effects of climate change, urbanization, forestry and agriculture and, the spread and increase in abundance of 'warm' water fish non-native predators of salmon will likely increase and therefore there is likely only to be a decrease in pliable salmon habitat. With this in mind, prioritization criteria for important habitat are suggested to favor habitat that is as accessible, productive, and free of known threat impacts as possible. Prioritization should where possible, seek to preserve a cross section of today's population characteristics in the faint hope that robustness and adaptive potential of populations will be available for persistence and possible recovery. Under these criteria, productive habitat on the SJR downstream of the Mactaquac Dam would receive highest priority.

Research recommendations are provided even though most are only likely to exaggerate existing simplistic approaches, in the identification of habitat important or manageable for maintenance or recovery of salmon. Some, however, may contribute to more realistic expectations and possibly conservation requirements.

Discussion

The group was reminded that the habitat table in the document must be definitively quantified. The priority rivers must also be clearly outlined as these will be put forward for Critical Habitat delineation. There was further discussion on which rivers to bring forward and to consider the SJR and its tributaries above the Mactaquac Dam as one river (unit). Other rivers and their characteristics were discussed. It was noted that when choosing the priority rivers, the criteria being considered were known for some rivers and not for others. This could result in some rivers being left off of the priority list, not because they lack suitable habitat, but because of a lack of information about them.

There was considerable discussion about the residence delineation. The definition of residence, as defined in SARA, was presented to the group as: "a dwelling-place, such as a den, nest or other similar area or place, that is occupied or habitually occupied by one or more individuals during all or part of their life cycles, including breeding, rearing, staging, wintering, feeding or hibernating." The criteria for consideration was described based on DFO's Draft Operational Guidelines for the Identification of Residence and Preparation of a Residence Statement for an Aquatic Species at Risk (unpublished report) which uses the following four conditions to determine when the concept of a residence applies to an aquatic species:

1. there is a discrete dwelling-place that has structural form and function similar to a den or nest;
2. an individual of the species has made an investment in the creation, modification or protection of the dwelling-place;
3. the dwelling-place has the functional capacity to support the successful performance of an essential life-cycle process such as spawning, breeding, nursing and rearing; and
4. the dwelling place is occupied by one or more individuals at one or more parts of its life cycle.

Home stones created much discussion since they would include use by various life stages, various sizes of rock, and use at different times of the year. If home stones met the above criteria, it could result in most of the river being delineated as a residence. It was explained that SARA protects both critical habitat and residences. A residence is meant to be something that the species builds, protects and modifies. The group decided that a home stone really does not fit the criteria as a residence since they are neither built nor modified by the salmon. The group agreed that a salmon redd would meet the residence definition.

Habitat use should also be broken out by life stage of use in the habitat table to include all juvenile stages as well as adult stages (spawners, kelts, etc.). When describing habitat attributes, the sizes of the cobble/rock should be included for the various life stages since it will differ from juvenile to adult use. In addition, the micro, macro and meso habitat attributes were discussed as consideration in the habitat table in the document. The importance of other species in the habitat was discussed since they may be contributing not only as prey species, but contributing to habitat qualities like marine derived nutrients (in the case of diadromous species). The impact of these missing from salmonid habitat should be considered since the dams or other obstructions may be precluding these and other elements that would have contributed to habitat that sustained salmon.

> *Decision*: 1) Science Advisory Report table will include more information with actual values rather than functional values; 2) refinement of habitat with identification of cool water seeps and temperature profiling of the various systems; 3) look at Oromocto River as a potential priority river; 4) remove home stones from the residence delineation. Leave pools out. Redds meet the residence definition; and 5) need to adjust abstract to reflect that we are not discounting any rivers while identifying Priority Rivers.

REVIEW OF RECOVERY POTENTIAL ASSESSMENT FOR THE OUTER BAY OF FUNDY POPULATION OF ATLANTIC SALMON (*SALMO SALAR*): THREATS TO POPULATIONS

Presenter: Corey Clarke

Rapporteurs: Stephanie Ratelle and Shane O'Neil

Reviewer(s): Gerald Chaput, Martha Robertson, Jonathan Carr, and Rick Cunjak

Terms of Reference

Assess the Habitat Use

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.
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

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.

Abstract

This Working Paper provides a review of major threats currently thought to impact the persistence of Atlantic Salmon in the OBoF DU. Over 90% of the wild salmon and habitat in this unit lie in the SJR and its tributaries which, aside from the St. Lawrence, compose the largest river in North Eastern North America. Thus, the status of the entire DU population weighs heavily on, or is driven by, the status of the SJR. The impacts of threats to salmon vary in dimensions of space, time, and severity. As such, attempts have been made to provide dimensional context for each threat although limitations of available data were encountered. Nearly all threats discussed here have been documented for their effect on salmon populations, although many have not been directly reported for their effects on OBoF salmon. The information presented here intends to provide only a summary of knowledge on the extent and magnitude each threat poses to this population in either the freshwater or marine environment.

To the extent of available data, each threat has been assigned a rank of concern relative to other threats to the population. Threats thought to be most limiting population recovery rank of highest concern. Following science advice for improving threats assessments for SAR, a proposal is made for assessing a threat’s cumulative impact on each river. Understanding the extent and magnitude of cumulative impacts on each river can support processes to allocate important habitat and prioritize recovery actions if/when implemented.

The threats of highest concern in the freshwater environment, and highest overall for the population, stem from the series of hydro dams facing migrating salmon; the most significant structure being the Mactaquac Dam on the SJR, above which lies nearly half of the entire population’s habitat. The dam relies on manual operations to truck salmon above the dam to complete upstream migrations. Aside from the barriers to upstream migration, hydro dams on the SJR have been documented to cause up to 45% additive mortality in downstream migrating smolts, affect flow and temperature regimes critical for migration, and harbor a growing abundance and diversity of native and non-native predators to salmon within reservoirs and tailraces.

Marine threats of highest concern include potential effects stemming from salmon farming operations adjacent to estuarine migration corridors and possible shifts in oceanic conditions caused by changes in climate. These shifts may be resulting in unfavorable temperature, current, and predator/prey conditions which contribute to reductions in survival during the salmon’s marine life phase. Aquaculture operations, although less studied in Atlantic Canada than elsewhere, appear to affect wild salmon in several ways including altered pathogen/predator/prey dynamics for wild salmon and through the interactions of wild and escaped farmed salmon.

Discussion

Overall, the group agreed that there are many threats that impact OBoF salmon. It was recommended that some of the threats be broken out into components instead of trying to assess a broad category. Some of the broad category threats and the components discussed or added to the current document were:

- Aquaculture: escapes, disease, sea-lice.
- Disease: natural versus non-natural causes.
- Hydro-dams: migration barriers that affect flow and temperature regimes in the rivers.
- Forestry: herbicide and pesticide use, erosion, and sedimentation.
- Socio-economic impacts as a threat to salmon: cuts to enforcement activities, loss of public engagement and interest, increased poaching.
- Hatcheries: stocking and effluent.
- Contaminants: point sources into rivers and the ocean from industry.

- Military activities: to be better described by a Department of Natural Defence biologist and provided to the group.

There was discussion about the scoring system used to evaluate the threats. A matrix table was recommended instead of the rating table that was used in the Working Paper. A new matrix table was to be developed for the next day so the group could assess the threats based on the new matrix. Participants were asked to review the threats in context of the new matrix tables, as well as to review threats with several components that may need to be separated out. These would be reviewed when the meeting resumed on Day 3.

DAY 3

CONTINUED: REVIEW OF RECOVERY POTENTIAL ASSESSMENT FOR THE OUTER BAY OF FUNDY POPULATION OF ATLANTIC SALMON (*SALMO SALAR*): THREATS TO POPULATIONS

Group Discussion Lead: Lei Harris

Rapporteur: Shane O'Neil

Discussion (Continued from previous Day 2)

Aquaculture threats were further discussed and more information was provided by participants with respect to effluent flushing/management and the number of aquaculture sites operated annually. There was discussion about breaking out effluent separately from aquaculture and treating it as a separate threat. This would be considered a near-shore impact of aquaculture. The group suggested running it separately through the matrix to see if it would change the overall impact of aquaculture. This would be tried when the matrix exercise occurred.

Other pollutant sources were identified by participants and included municipal effluent point sources, effluent from potash mining and potential effluent from future fracking activities. Some changes to effluent treatment and regulation (provincial) are likely to result in a reduction in the threat levels for some of the currently identified threats (like hatchery effluent).

The group was asked to bring up other material regarding threats that had not previously been considered or if there was rational for rating changes for some of the existing threats. The following item was raised: it would be helpful if forestry was presented as historical versus current management plans and practices (there are different levels of effects depending on if it is private versus crown lands). There is a management system in place so it would be appropriate to ask how effective the system is. The amount of clear cut is 1.8% on private lands for example. More information was to be provided to the author.

It was indicated that a new matrix table was developed the evening before and that its use did result in some rating changes for some of the threats. It was decided that a sub-group would review the new matrix table during the review of the Science Advisory Report material and present their findings to the group following the review of mitigation measures.

MITIGATION AND ALTERNATIVES

Rapporteurs: Danielle MacDonald and Shane O'Neil

Group discussions took place.

Terms of Reference

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).

Presentation Highlights

Rob MacIntosh, of the DFO Policy & Economics Branch, gave a brief overview of mitigation measures on behalf of Koren Spence of the DFO Species at Risk Management Division. He described that mitigation aids in recovery planning for the species and how this aids the DFO Species at Risk Management Division in developing management scenarios and how the information also guides the Socio Economic Assessment (SEA). A base case would include current management and anything on the table. Two to three management scenarios could be considered: 1) if species not listed what recovery actions could still take place; 2) if species was listed what management measures would be considered; and 3) additional recovery measures that might be included.

Additional Threats and/or Management Mitigation Recommendations

The identified threats or sources of mortality discussed were:

- **<u>Recreational Atlantic salmon fishery</u>:** A current management measure taken is that recreational seasons in this entire DU have been closed (including hook and release) since 1998. ***It is recommended to continue with closures. Expectation:*** reduce accidental mortalities and prevent further removals. Jurisdiction: DFO
- **<u>Aboriginal Food, Social, and Ceremonial (FSC) fishery</u>:** Currently there are no allocations within the DU. No improvements available but continue at status quo. Contributions to recovery: no authorized removal. Jurisdiction: DFO
- **<u>By-catch in recreational fisheries directed at other species</u>:** Salmon must be returned to the water alive. ***Recommended improvements to current management measures:*** Further refine gear, season, and area restrictions. This would further minimize accidental by-catch Jurisdiction: DFO/New Brunswick Deparmment of Natural Resources (NBDNR). Example given: a large area between Heartland and Beechwood had been closed for years, but was recently opened for fishing other species. A management measure to protect salmon that was taken was to keep the areas closed where there was likely to be by-catch. Another example on Tobique: a large area on this river was closed last year in July after talking with DFO Conservation & Protection officers. No trout should be found in this area, so a closure would not limit trout catch but would protect salmon being distributed to this area.
- **<u>Illegal fishing</u>:** Current measures taken include compliance monitoring. Both DFO and NBDNR enforcement monitor activities and enforce the fisheries regulations. ***Additional***

mitigation recommendations include: outreach; promote reporting of illegal activities; increased enforcement efforts; improvements to surveillance gear; and increased penalties. ***Expectations:*** increased awareness of status, deterrent to illegal fishing and increased community stewardship. ***Recommended Mitigation measure:*** to keep the Tobique salmon protection barrier operating each season to protect the salmon from illegal fishing activity.

- **St. Pierre and Miquelon commercial fishery:** The current issue is that there is a marine gill net fishery in this NAFO area. There are plans in place to work with St. Pierre and Miquelon to do DNA analyses in order to determine origin of catch. ***Recommended Mitigation measure:*** it was recommended to try and have a closure of this fishery, as a potential mitigation measure.
- **Labrador resident subsistence fishery:** Currently residence can keep four (1SW and MSW) as a by-catch in the Arctic Char and trout fishery. ***Recommended Mitigation measure:*** maintain current restrictions. The jurisdiction would need to be determined.
- **Greenland fishery:** This fishery is under management of the North Atlantic Salmon Conservation Organization (NASCO). One measure that could continue is to maintain Canadian funding to keep this fishery at subsistence levels. Greenland captures approximately 40 tonnes of Canadian-origin Atlantic Salmon annually (in 2010). A ***research recommendation*** is to look at a construction to determine what proportion of this is OBoF salmon. Exploitation rates can be used to determine what percentage of the Salmon Fishing Area (SFA) 23 MSW is captured in that fishery. There was thought that this would likely rate as a medium or high threat category in the matrix depending on the matrix and the exploitation level. ***Recommended Mitigation measure:*** a closure of this fishery to be proposed.
- **By-catch in commercial fisheries:** This is currently of low concern. Live release from most gear types is possible. There are also channel width management schemes and types of gear that can be used as additional measures. ***Recommended Mitigation measure:*** to look at timing of fishing (done on tidal cycles as an example), gear types, etc., to help further reduce the effect of by-catch.
- **Gaspereau fisheries on the Oromocto River:** ***Recommended Mitigation measure:*** fishery restrictions should be put in place to limit the risk of capture or killing of salmon smolts. This is an annual discussion at the Gaspereau/Shad Advisory Committee meetings.
- **Illegal marine harvest of salmon:** This was thought to be an issue by some. The management measures in place now seem to preclude most instances of this as at one time illegally-harvested salmon were seen periodically. Now there are no reports and no charges or convictions. In the mitigation table it is covered as increased enforcement.
- **Target Aboriginal fishery in Labrador:** This fishery can remove 30-40 tonnes per year. It was ***recommended*** to add this to the threats table.
- **Invasive species:** It was ***recommended*** to add this to the threats table. The New Brunswick Department of Natural Resources should review their current retention regulations on invasive species. Some of the invasive species have been here a long time and others, like muskellunge, are newer invasive species. Small mouth bass was raised as a concern in some areas since current NBDNR management practices protect small mouth bass in areas that are important for salmon. The New Brunswick Department of Natural Resources indicated that they are looking at changing some of their management practices to allow for retention of bass in the areas where salmon and trout are known to occur. There are now reports of largemouth bass in the St. Croix River, which is a new concern. Federal Aquatic Invasive Species (AIS) regulations are being worked on as well.

There was subsequent discussion about issues that can arise if the proposed mitigation measures become threats themselves; for example, hook-and-release angling closures. Some expressed concern that this measure takes people away from the river and contributes to public apathy. Some suggested that the long term effects of hook-and-release fishing could do some good and that it would bring people back to the river and interested in salmon. Members of DFO Fisheries Management asked the group if the Department should consider opening a hook-and-release fishery when we are at less than 10% of the spawning requirements. Management suggested that if the species were to be listed there would be no allowable harm and that hook-and-release would never be approved. It was recommended to capture societal issues in the Science Advisory Report. This would include methods to maintain interest among all users groups. The federal and provincial governments, in collaboration with the Recovery Team (if listed), could address this.

Aquaculture Mitigation Measures

Presenter: Gerald Cline

Presentation Highlights

A table was presented that included threats and sources of mortality that may be caused by aquaculture. These included:

1. Changes to biological communities
2. Disease
3. Sea Lice
4. Escapes from marine salmonid aquaculture
5. Escapes from freshwater salmonid aquaculture
6. Genetics

Alternative Recommendations/Discussions

1. **<u>Sea Lice</u>:** ***Recommend:*** 1) industry, government, researchers and public share sea-lice data. ***Expectation:*** Will allow research to establish targeted studies; 2) mandatory reporting of sea-lice loading to DFO and perhaps stakeholders. Currently data is not shared with DFO; and 3) Further testing of regions away from farms to determine sea-lice loading in those areas.
2. **<u>Land-based aquaculture</u>:** ***Recommend:*** more research in this area. ***Benefit*** would be the elimination of escapes into marine environment.
3. **<u>Sea-water Aquaculture Escapes</u>:** ***Recommend:*** 1) improved transparency in enforcement and reporting of suspected breaches of containment; and 2) potential use of land-based facilities to eliminate escapes into marine environments.
4. **<u>Fresh water aquaculture escapes</u>:** ***Recommend:*** 1) inspections of fresh water hatcheries to make sure they are compliant with triple screening; and 2) installation of netting over open ponds to prevent escapes facilitated by birds or other animals.
5. **<u>Fresh and marine escapes</u>:** some rivers have no monitoring for escapes. ***Recommend*** river monitoring and scientific investigations when a breach takes place and is reported. ***Note***: regarding aquaculture escapes, reporting is not mitigation; it’s what is done after the reporting that is mitigation.
6. **<u>Changes to Biological communities</u>:** ***Recommend:*** 1) consideration that all new licenses be suspended until studies can be done to determine the effects of aquaculture. This has been done on the West Coast with Cohen commission; 2) evaluate the Cohen Commission

report to see if anything of use for OBoF salmon; 3) reduce operations and reduce numbers of fish farmed in order to reduce densities of aquaculture fish; and 4) identify sites in the marine environment that may be in sensitive migratory areas and apply restrictions to site locations

7. **Disease: *Recommend:*** Canada Food Inspection Agency (CFIA) testing of wild fish for disease via a wild fish health surveillance program.

NON-FISHERIES OR AQUACULTURE MANAGEMENT RELATED THREATS: MITIGATION FOR THREATS (MEDIUM AND ABOVE SEVERITY) TABLE

Group Discussion Lead: Ross Claytor

A table was presented to the group and discussions on the threats and decisions made about what to include in the table were captured in the table during the meeting. The table is included in the Science Advisory Report.

Included in the table:

1. Hydropower
2. Shifts in marine conditions (e.g., climate change, predator/prey)
3. Extreme temperature events (e.g. climate change, altering cover and flow)
4. Silt and sediment
5. Contaminants
6. Other dams (storage dams) and obstructions
7. Crossing infrastructure (Non-compliant roads/culverts)
8. Urbanization, Agriculture, forestry
9. Depressed population phenomenon

Discussion

Hydropower: some of the regulatory control of dams is changing with changes to the *Fisheries Act*. This may have other implications for other habitat protection measures that are not fully understood. There is a management plan for St. George hydro-electric dam (on Magaguadavic).

Crossing Infrastructure: the “formalization of best practices” seems out of context since “best practices” have been established. It may be more of a matter of compliance monitoring. There are certification processes for private and crown land forestry operators and those have standards that provide a level of protection. Compliance monitoring is key to ensuring that all the policies and practices are adhered to.

Shifts in marine conditions: some group members suggested that in order to reduce the threats of predation on the target species, an increased catch of predator species could be considered. Currently there is no evidence that food is limited in the marine environment. It was decided not to add this mitigation strategy.

Silt and sediment: it was recommended to add “increased use of best management practices” to the table. Current programs include certified water course installer program.

Recent changes to the *Fisheries Act* were discussed as some felt they may be a threat to the species recovery. It was noted that many of the items that would need enforcement or checks by DFO Conservation & Protection or DFO Habitat Management Program staff may not occur in the future and that the ramifications of this are not well understood.

Depressed population phenomenon: DFO Fisheries Management, DFO Habitat Management Program, and other regulations in place. The group considered making this threat high and not medium. There was concern that 2012 returns were indicative that the population is rapidly declining and that this further depressed state may prevent recovery.

Research Recommendations

Research is needed to identify potential conflicts and trade-offs. Identify a multi-species approach to mitigation or ecosystem approach to an Action Plan.

REVIEW OF RECOVERY POTENTIAL ASSESSMENT FOR THE OUTER BAY OF FUNDY POPULATION OF ATLANTIC SALMON (*SALMO SALAR*): POTENTIAL FOR RECOVERY AND ALLOWABLE HARM

Presenter: Gregor McAskill

Rapporteurs: Danielle MacDonald and Stephanie Ratelle

Reviewer(s): Gerald Chaput, Martha Robertson, Jonathan Carr

Presentation Highlights

Freshwater productivity on both the Nashwaak and Tobique were reviewed. The maximum reproduction rate (Nashwaak: 0.54 and Tobique:0.93) and carrying capacity (Nashwaak: 28.01 and Tobique: 9.31) suggest there are freshwater productivity issues. The egg-to-smolt survival for the Nashwaak is very low in comparison to other rivers in New Brunswick. The smolt-to-adult return rates showed declines in 1SW return rates during the 1970s and 1980s and increased during the 2000s. The 2SW return rate pattern was similar, with less of an increase during the 2000s, and the proportion of females in the 1SW has also increased.

Equilibrium Modelling (Part II)

There are two parts to the model: 1) freshwater production and 2) lifetime egg production per smolt

Scenario analysis using the equilibrium model: most of the emphasis is on the Nashwaak population but some effects of recovery activities produced for the Tobique population.

Lifetime eggs-per-smolth (EPS) models are similar to spawner-biomass-per-recruit (SPR) models used for marine fishes. Inputs into the model include: return rates from smolt to first spawning; post-spawning annual survival rates; probability of returning as an alternate or consecutive-year repeat spawner; and age-specific fecundities. Results were presented for future return rates.

Key indicators: Changes in return rates, sex ratios and fecundity change the number of eggs a smolt is expected to produce throughout its life. For the Nashwaak River, relative probability in the past (1973-1982) equaled 333 and recent (2000-2009) equaled 151. This is a clear drop in the lifetime egg production per smolt. The model only presents what is happening and does not provide causation for the events.

Maximum Lifetime reproductive rates: Nashwaak River past equals 2.49 and present equals 1.13; Tobique (1989-2005) equals 0.18. Numbers less than 1 are at critical capacity, so Tobique is analogous to being on life-support. Tobique will extirpate unless these rates change or are changed. Nashwaak is at risk of extirpation.

Equilibrium Analysis: equilibrium occurs where the rate at which eggs produce smolts equals the rate at which smolts produce eggs throughout their lives. For the Nashwaak, the equilibrium egg abundance was 20.8 in the past and is now 1.7.

Population response to alleviating threats (Tobique River): average dynamics, downstream passage survival estimates, increasing survival to 100% (primarily turbine mortality) and hypothetical scenarios (doubling freshwater carrying capacity parr: 18/unit and survival of other parr and return rates of 8% and 3%) were presented. With current circumstances, there is a poor outcome. If we can increase freshwater connectivity and marine survival, there is marked improvement. However, if only the freshwater aspect is improved, then we are close to carrying capacity. Avoiding extinction will require us to address more than just one of the three conditions above. Even by addressing two of the requirements there likely will not be recovery, but all three components would improve survival.

Population Viability Analysis (Part III)

Introduction to PVA, forward projections using current life history parameters, scenario analyses, effects of extreme environment events and further abundance declines and conclusions were presented.

The PVA is a forward projecting population model used to determine future population trajectories. The times to extinction and recovery are known to be highly uncertain.

Random variability: variances are assumed, but the sensitivity analyses are done. Extreme environmental events are included such as a mortality event. The examples of random variability in life history parameter values (1SW return rates, random scalar for Age-0 to Age-1 survival function, etc.) for the past and present in the Nashwaak were presented and there was no change in patterns over the time series.

Nashwaak PVA (Base case): the present dynamic, without any mitigation to the population at each stage, are predicted to move to extirpation. The probability of extinction and potential for recovery are imminent if the present dynamics where the opposite was true in the past dynamics. Clarification: what is the definition of recovery? Recovery relates to population ‘hovering’ around the conservation requirements (proportion of the population above the conservation requirement in a given year).

Nashwaak PVA (incorporating stochastic events: events causing mortality): the model includes extreme environmental events increasing extinction risks. The populations in the past were resilient to the amounts of variability and frequency of extreme events. The present (2000s) dynamic, with 10-year, 20% mortality, population approaches 0 and then it is more severe as mortality events were increased in severity. None of these scenarios ever result in extinction with past year dynamics.

Recovery scenario analyses: increases in freshwater productivity of 20%, 50% and 100% and increase EPS (intermediate steps) inputs: Nashwaak 1SW/MSW return rates, fecundity (large/small) and proportion of female (large/small). Marine parameters set to current levels versus past with intermediate levels and freshwater productivity increases as presented above were presented. An increase in freshwater productivity with no mortality events in present dynamics results in the number of eggs (millions) increase marginally whereas in the past dynamics it would have increased substantially. Larger changes in freshwater productivity or at-sea survival are required to increase populations to levels above their recovery targets.

Effects of further reductions in population size: the model evaluated the effects with starting population sizes of 100%, 50%, 25% and 10% of the 2008-2012 abundance. Time to extinction decreased with reductions in starting population size. Extinction probability is much higher when 2012 starting abundance is used (this scenario may be optimistic).

Nashwaak allowable harm scenario: decreases in freshwater productivity as well as decreases in at-sea survival. The presenter indicated they are planning to adjust the at-sea survival decreases to reflect a more realistic situation rather than the extremes of 30% and 50%. With these models, there is a recovery probability of 0% in 100 years in all cases. The extinction probability increases rapidly with increased levels of harm. Clarification: is the mortality event a one- time event or annual event? They are annual events analogous to turbine mortality or harvesting rates.

Presentation Conclusions

1. Populations are expected to extirpate in the absence of human intervention or a change in vital rates for some other reason (e.g. supportive rearing).
2. Small changes in survival markedly reduce extinction risk for the Nashwaak population.
3. Larger changes are needed for the Tobique population to reduce extinction risk due to lower estimated freshwater productivity and loss of about 45% of smolts during downstream migration.
4. Larger changes are required for both populations to reach the conservation requirements.
5. Estimates of the maximum survival from egg-to-smolt are low for both populations and the estimate of carrying capacity for Tobique smolts is very low.
6. Whether freshwater productivity has changed between the 1970s and 2000s is unclear.
7. Return rate temporal pattern for the Nashwaak population shows an increase in return rates in recent years (excluding 2012), with an increase in female proportion in the 1SW portion of the population.
8. The comparison of past (1970s) and present (2000s) viability highlights the loss of resiliency that the populations had in the past to environmental variability.
9. The conservation requirement was used as the recovery target when assessing the probability of recovery. In the analyses here, small increases in productivity and survival led to populations that were viable (conditional on model assumptions) at levels well below the conservation requirement.
10. While the conclusions about viability are relatively robust to under- or over-estimation of individual survival estimates, predictions about the effectiveness of individual recovery actions would be more sensitive to this source of uncertainty.
11. The extinction and recovery probabilities presented in this document should not be interpreted literally.

Comments and Discussion

The Nashwaak recovery scenarios were discussed. The presentation showed that changes in marine survival may be more achievable than changes in freshwater productivity. When analyzing marine survival rates you get a tripling in survival, but only a doubling if improving freshwater productivity. If freshwater production is doubled and marine survival is kept the same, will it produce the same results? It is slightly better by improving the marine survival.

Changes in sex ratio may be due not only to drift or change in selection at sea, as stated in the Working Paper. Sex ratios may also be shifting due to higher male precocity rates resulting in fewer male smolts leaving the river.

The Tobique River is modeled on sea-run salmon and not on the captive salmon that are released into the river to spawn. Some of the sea run salmon are trucked directly to the Tobique, while others ascend the fishway (free swim). There was concern raised over the validity of the model since fish are placed in the river. The authors explained that the return rates for Tobique are borrowed from the Nashwaak. Even though the time period differs from the Nashwaak, the values are still useful to work out what the expected case would be in terms of survival. The model then tells you what the expectations would be having a wild population in the recent parameters and what would need to change in order to have a viable population. The model indicates that intervention is required. It also shows that over the longer term populations may not be able to return to viable states after a long period of intervention. These scenarios are not meant to be prescriptive; they model gives examples of what could happen under different circumstances.

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APPENDICES

APPENDIX 1: LIST OF PARTICIPANTS

NAME	AFFILIATION
Ross Claytor	DFO/Maritimes PED
Lei Harris	DFO/Maritimes PED
Danielle MacDonald	DFO/Maritimes PED
Stephanie Ratelle	DFO/Maritimes PED
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Corey Clarke	DFO/Maritimes PED
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Rick Cunjak	UNB/Canadian Rivers Institute
Martha Robertson	DFO/Newfoundland
Gerald Chaput	DFO/Gulf
Kimberly Robichaud-Leblanc	DFO/Maritimes SARMD
Patrick O'Reilly	DFO/Maritimes PED
Kathryn Collet	New Brunswick Department of Natural Resources
Gabriel Atwin	Kingsclear First Nation
John Bagnell	AMEC
Anthony Bielecki	New Brunswick Power
Andy Smith	Department of National Defence
Barry Labillois	Maritime Aboriginal Peoples Council
Clayton Coppaway	Mi'kmaw Conservation Group
David Sawler	Fredericton Fish and Game Association
Eldon Young	DFO/ Conservation and Protection
Renee Estabrooks	J.D. Irving
Geoff Giffin	Atlantic Salmon Federation
John Gilbert	J.D. Irving
Vimy Glass	Government of Nova Scotia
Greg Stephens	DFO/Resource Management
Laura Buck	Fort Folly First Nation
Mary Sabine	New Brunswick Department of Natural Resources
Maureen Toner	New Brunswick Department of Natural Resources
Al McNeill	Nova Scotia Department of Fisheries and Aquaculture
Murray Hill	Nova Scotia Department of Fisheries and Aquaculture
Peter Salonius	Nashwaak Watershed Association
Phil Atwin	Kingsclear First Nation
Greg Macaskill	Gardner Pinfold
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Jeff Dionne	DFO Maritimes / SWNB Area Office
Karen Coombs	New Brunswick Department of Agriculture, Aquaculture and Fisheries
Keith Christmas	Unama'ki Institute of Natural Resources
Preston Bernard	PH Farmer Consulting Ltd.
Rod Currie	Fredericton Fish and Game Association
Robert MacIntosh	DFO/Policy and Economics
S. Mitchell	World Wildelife Fund Canada
Abby Pond	St. Croix International Waterway Commission
Tana Worcester	DFO/Centre for Science Advice, Maritimes
Troy Lyons	NB Environment and Local Government
Jonathan Carr	Atlantic Salmon Federation

APPENDIX 2: TERMS OF REFERENCE

Recovery Potential Assessment for Atlantic Salmon
(Outer Bay of Fundy Designatable Unit)

Regional Peer Review Meeting – Maritimes Region

19-22 February 2013

Fredericton Inn
Fredericton, New Brunswick

Chairpersons: Ross Claytor and Lei Harris

TERMS OF REFERENCE

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 the species, population or designable unit (DU), 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. This timing allows for the consideration of peer-reviewed scientific analyses into SARA processes including recovery planning.

The Outer Bay of Fundy DU of Atlantic Salmon was evaluated as Endangered by COSEWIC in November 2010. The rationale for designation is as follows: “This species requires rivers or streams that are generally clear, cool and well-oxygenated for reproduction and the first few years of rearing, but undertakes lengthy feeding migrations in the North Atlantic Ocean as older juveniles and adults. This population breeds in rivers tributary to the New Brunswick side of the Bay of Fundy, from the U.S. border to the SJR. Small (one-sea-winter) and large (multi-sea-winter) fish have both declined over the last 3 generations, approximately 57% and 82%, respectively, for a net decline of all mature individuals of about 64%; moreover, these declines represent continuations of greater declines extending far into the past. There is no likelihood of rescue, as neighbouring regions harbour severely depleted, genetically dissimilar populations. The population has historically suffered from dams that have impeded spawning migrations and flooded spawning and rearing habitats, and other human influences, such as pollution and logging, that have reduced or degraded freshwater habitats. Current threats include poor marine survival related to substantial but incompletely understood changes in marine ecosystems, and negative effects of interbreeding or ecological interactions with escaped domestic salmon from fish farms. The rivers used by this population are close to the largest concentration of salmon farms in Atlantic Canada.” There has been no previous RPA for this DU.

In support of listing recommendations for this DU by the Minister, DFO Science has been asked to undertake an RPA, based on the National Frameworks (DFO 2007a, DFO 2007b). 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 DU.

Objectives

To assess the recovery potential of the Outer Bay of Fundy DU of Atlantic Salmon.

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.
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, DFO 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
- Research Documents

Participation

- DFO Science
- DFO Ecosystem Management, DFO Fisheries and Aquaculture Management, and DFO Policy and Economics
- Parks Canada
- Province of New Brunswick
- Aboriginal communities/organizations

- Fishing and aquaculture industries
- Non-governmental organizations
- Academics

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APPENDIX 3: MEETING AGENDA

Recovery Potential Assessment for Atlantic Salmon
(Outer Bay of Fundy Designatable Unit)

Regional Peer Review Meeting – Maritimes Region

19-22 February 2013

Fredericton Inn
Fredericton, New Brunswick

Chairpersons: Ross Claytor and Lei Harris

DRAFT AGENDA

Tuesday, 19 February 2013

9:00-9:20	Introduction / Objectives
9:20-9:30	Background
9:30-10:30	Status and Trends
10:30-10:45	Break
10:45-12:00	Status and Trends
12:00-1:00	Lunch
1:00-2:15	Recovery Targets - Abundance - Distribution - Genetics
2:15-3:00	Population Model
3:00-3:15	Break
3:15-5:00 – 6:00?	Habitat Use and Residence Requirements

Wednesday, 20 February 2013

9:00-9:15	Review of Day 1
9:15-10:30	Identification of Important Habitat
10:30-10:45	Break
10:45-11:30	Identification of Important Habitat
11:30-12:00	Threats presentation
12:00-1:00	Lunch
1:00-3:00	Threats
3:00-3:15	Break
3:15-5:00 – 6:00?	Mitigation and Alternatives

Thursday, 21 February 2013

9:00-9:15	Review of Day 2

9:15-10:30	Potential for Recovery (and Allowable Harm)
10:30-10:45	Break
10:45-12:00	Potential for Recovery (and Allowable Harm)
12:00-1:00	Lunch
1:00-2:45	Review of Science Advisory Report
2:45-3:00	Break
3:00-5:00 – 6:00?	Review of Science Advisory Report

Friday, 22 February 2013

9:00-9:15	Review of Day 3
9:15-12:00	Review of Science Advisory Report
12:00	end