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National Capital Region

Proceedings of the National Peer Review Meeting on Assessment of the Risk Posed to Wild Atlantic Salmon Population Abundance and Genetic Character by Direct Genetic Interaction with Escapes from East Coast Atlantic Salmon Aquaculture

Meeting date: June 6-9, 2023
Location: Halifax, Nova Scotia

Chairpersons: Brittany Beauchamp and Paul Snelgrove
Editors: Emily Ryall, Mark Coulson, Brittany Beauchamp

Fisheries and Oceans Canada
200 Kent Street
Ottawa, ON, K1A 0E6

April 2024

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

These proceedings summarize the relevant discussions and key conclusions that resulted from the Fisheries and Oceans Canada (DFO) Canadian Science Advisory Secretariat (CSAS) National Peer Review Meeting to assess the risk posed to wild Atlantic Salmon population abundance and genetic character by direct genetic interaction with escapes from East Coast Atlantic Salmon aquaculture. This meeting was held in person in Halifax, Nova Scotia from June 6-9, 2023. The science advice will inform policy and regulatory reviews, assist in developing a consistent risk management approach in the different regions, inform siting advice and introductions and transfer decisions, and inform the development of standards (for example, for marine net pens used in salmonid aquaculture). The conclusions and advice resulting from this meeting are provided in the form of a Science Advisory Report, which is available on the CSAS website. Supporting Research Documents reviewed and discussed at the meeting will also be made available on the CSAS website.

INTRODUCTION AND CONTEXT

A Canadian Science Advisory Secretariat (CSAS) National Peer Review Meeting was held in Halifax, Nova Scotia from June 6-9, 2023 to undertake an assessment of the risk posed to wild Atlantic Salmon population abundance and genetic character by direct genetic interaction with escapes from East Coast Atlantic Salmon aquaculture.

Participants introduced themselves (Appendix 3). The Chairs provided an overview of CSAS policies (including conflict of interest), reviewed the Terms of Reference (Appendix 1) that served as the foundation for this CSAS process, and reviewed the agenda (Appendix 2).

The Objective of the meeting, as listed in the Terms of Reference, was to provide peer-reviewed scientific advice through a semi-quantitative risk assessment of the risk posed to wild Atlantic Salmon population abundance and genetic character by direct genetic interaction with farm escapees from East Coast Atlantic Salmon aquaculture. This advice includes a characterization of sources of uncertainty and an assessment of potential mitigation options aimed at reducing risk.

Fisheries and Oceans Canada (DFO) experts drafted two Working Papers to meet the objective of the meeting. Working Paper 1 was titled, *Assessment of the risk posed to wild Atlantic Salmon population abundance and genetic character by direct genetic interaction with escapes from East Coast Atlantic Salmon aquaculture*. Working Paper 2 was titled, *Mitigation options for reducing the risk of direct genetic interactions between farm escapes and wild Atlantic Salmon populations in Atlantic Canada*.

CONTEXT AND CLIENT DRIVERS FOR THIS SCIENCE ADVICE

PRESENTATION

Presenter: Christopher Hendry

Escaped farmed Atlantic Salmon have been documented as a potential threat to wild Atlantic Salmon populations through introgression and hybridization. Farm escapees can, in some instances, account for a substantive proportion of Atlantic Salmon in rivers and can affect both the abundance and genetic character of wild Atlantic Salmon populations.

In the three Atlantic provinces where Atlantic Salmon are farmed in coastal waters (Newfoundland and Labrador (NL), Nova Scotia (NS), and New Brunswick (NB)), the individual province is the lead regulator for aquaculture activities. However, the sustainable management of fisheries and aquaculture, and the protection of fish and fish habitat, are a part of the mandate of DFO.

DFO provides management advice to the provinces on new or expanded aquaculture sites and production increases, and shares responsibility with the provinces for issuing permits for the introduction and transfer (I&T) of fish into marine farm cages. To support this role, the DFO Aquaculture Directorate has sought peer-reviewed science advice on the risks posed by escaped farmed Atlantic Salmon to the abundance and genetic character of wild Atlantic Salmon through direct genetic interactions, as well as to inform management options to reduce the risk to wild Atlantic Salmon.

The risk assessment advice may also be used to inform policy and regulatory reviews, assist in developing a consistent risk management approach in the different regions, inform siting advice and I&T decisions, and inform the development of standards (for example, for marine net pens used in salmonid aquaculture).

DISCUSSION

The presenter clarified that an "acceptable level of risk" to wild salmon would be determined by DFO's Aquaculture Directorate through internal discussion using science advice, while also focusing on DFO's mandate as well as environmental and socioeconomic factors. They also emphasized that the purpose of the meeting was not to define acceptable levels of risk, but to provide information and advice to inform related decision-making processes.

GENOMIC INTROGRESSION OF FARMED SALMON INTO WILD SALMON POPULATIONS ACROSS NORTH AMERICA

PRESENTATION

Presenter: Ian Bradbury

Wild Atlantic salmon populations continue to decline in many regions, and repeated studies have identified genetic interactions with escaped farmed salmon as a significant threat. Over the last decade, a wealth of studies have addressed genetic interactions with aquaculture escapees, spanning much of the natural range of the species. The goal of this presentation was to summarize the state of understanding of the impacts from escaped farmed salmon on wild salmon populations by drawing from studies spanning the North Atlantic, and to highlight the clear consensus achieved with respect to prevalence and range of impacts. Existing monitoring data suggest escapees, or their offspring, were present in the wild environment during all years surveyed, even in the absence of reported escape events. As a result, studies have provided evidence of hybridization and introgression between wild and farmed salmon in every location they have examined, including Norway, Scotland, Iceland, and Canada. For example, data for 18 NL rivers (2014-2021) suggest levels of introgression ranged from 0-77% with an average of 18% across rivers and years with 50% of rivers showing large (>10% introgression) genetic changes. In Norway, only one third of rivers seem unaffected by introgression and 28% of rivers showed large genetic changes as of 2020. For both Norway and Canada, the magnitude of farming intensity was positively associated with genetic impacts. New evidence also suggests that precocial male maturation can fast-track genetic impacts, allowing genetic change over shorter time periods than otherwise possible. These studies have repeatedly shown that outbreeding of wild salmon with domesticated farmed salmon disrupts local adaptation, changes wild phenotypes, and results in reductions in population productivity. A diverse body of work supports these conclusions, including individual-based modeling, wild population monitoring, laboratory experiments, and field experiments. Taken as a whole, the literature clearly supports the conclusions that introgression with escapees happens everywhere farmed salmon and wild salmon coexist, that it can happen rapidly, that the magnitude of introgression relates to the intensity of aquaculture production, and that it results in a loss of adaptive diversity and demographic decline in affected populations.

DISCUSSION

The discussion elaborated on how researchers have documented European x North American hybrids and their offspring in rivers near aquaculture facilities in eastern Canada since the 1990s, even though fertile salmon with European ancestry have not been approved for marine net-pens in Atlantic Canada, and it is unlikely that salmon from European farms naturally strayed to North Atlantic waters. It was further noted the presence of these hybrids provides evidence of interbreeding between farm escapees and wild Atlantic Salmon and that aquaculture producers in eastern Canada have farmed salmon with European ancestry.

Participants discussed an observation from Norway that the longer that farm escapees spend in the wild, the more likely they will successfully interbreed with wild salmon. The authors noted that studies have found that if farmed salmon escape, their offspring can mature quickly (precocious parr) and interbreed with wild salmon, increasing the speed and severity of changes to the wild population.

WORKING PAPER 1: ASSESSMENT OF THE RISK POSED TO WILD ATLANTIC SALMON POPULATION ABUNDANCE AND GENETIC CHARACTER BY DIRECT GENETIC INTERACTION WITH ESCAPES FROM EAST COAST ATLANTIC SALMON AQUACULTURE

PRESENTATION

Presenters: Mark Coulson

Fisheries and Oceans Canada, under the Aquaculture Science Environmental Risk Assessment Initiative, conducted a risk assessment to determine the potential risks of direct genetic interactions on wild Atlantic Salmon abundance and genetic character from Atlantic Salmon farm escapes in eastern Canada.

The assessment was conducted in three main steps: first, a likelihood assessment, which included three consecutive assessment steps (escape, freshwater entry, and spawning between farmed and wild salmon); second, an assessment of the consequences to abundance and genetic character for wild Atlantic Salmon designatable units (DUs); and third, an estimation of risk.

Atlantic Salmon have been domesticated in Eastern Canada for more than approximately 15 generations and, during this time, they have become genetically and phenotypically differentiated from wild salmon. As a result of these changes, farmed salmon are maladapted to the wild, resulting in potential for negative genetic impacts to wild populations of salmon through interbreeding, leading to lasting, heritable fitness declines to the wild population. For Atlantic Salmon, this issue has been so pervasive that it has emerged as a model for studying genetic interactions between farmed and wild organisms. In all countries where Atlantic Salmon farming operations co-occur with wild Atlantic Salmon populations, direct genetic interactions (between wild and escaped farmed salmon) is a concern. The large body of evidence demonstrating that escaped farmed Atlantic Salmon can migrate to freshwater and spawn with wild conspecifics, resulting in hybridization and introgression was noted. However, variability in observed levels of hybridization and introgression among rivers suggests that levels of introgression leading to impacts on abundance and/or genetic character are river-dependent, and that not all interactions may result in such impacts. Regardless, these interactions are cause for concern to the health and sustainability of wild Atlantic Salmon populations, especially for those that are currently threatened or endangered.

The assessment concluded that the risk to wild Atlantic Salmon DUs varied by area. Under current farm management practices, levels of risk to wild Atlantic Salmon abundance and genetic character ranged from low to high depending upon the DU considered. Risk was lowest for Nova Scotia Southern Uplands East and South Newfoundland East, either due to a relative lack of farms in the immediate area or the use of sterile (triploid) farmed salmon. Risk was highest for the Outer Bay of Fundy and South Newfoundland West, the two areas where the majority of unsterilized (diploid) production occurs. Simulations suggest that escapee reductions of 75-95% may be required to reduce the risk level to low.

The conclusions of this risk assessment should be considered with respect to wild Atlantic Salmon conservation and should be revised as new and relevant information becomes available, such as changes to industry practices or production levels.

DISCUSSION

A participant asked for clarification on how production values were determined for input into the dispersal model. The authors explained that farm-specific production was modelled in NL as the maximum licensed level of production, in NS as the maximum number of salmon permitted for transfer to the site through the DFO I&T process, and in NB as the number of fish in farms for each year they were stocked, as provided by the Province of NB.

A participant asked how the authors defined “wild” Atlantic salmon populations. The authors explained they used the definition from Canada’s Wild Atlantic Salmon Conservation Policy which states, “Atlantic salmon are considered “wild” if they have spent their entire life cycle in the wild and originate from parents who were also produced by natural spawning and continuously lived in the wild.” After some discussion over the best definition to use, the group agreed that the definition used should be included in the Research Document and Science Advisory Report (SAR).

A participant noted that in Iceland, estimates of the number of farm escapees has been improved by considering known information about fish vaccination, fish feed rates, and harvesting numbers.

A participant also noted that the impact of farm escapees on wild populations is much greater following a large escape event in comparison to small, regular escapes and that the model could be improved if it incorporated a baseline level of escapes that is punctuated by occasional higher level escapes. The authors agreed this approach would be better, but indicated the model currently does not allow for this type of scenario.

Participants discussed the challenges in predicting the exact magnitude of impacts for a given river based on the predicted number of escapees given the variability in the model runs. The ‘Uncertainties’ section of the paper addresses this limitation. However, we know that the model predicts impacts fairly consistently above 10% farm escapees in the river, and that the magnitude of impacts increases as this proportion increases. The group agreed that the Research Document should include an appendix with model outputs for individual rivers.

The group also discussed categories and percentages associated with the likelihood and consequence rankings. One participant questioned whether the terminology is consistent with other international risk assessments and if risk category labels could be removed to simplify the presentation of information. The authors explained the terminology used is consistent with other international risk assessments, and with other aquaculture-related risk assessments undertaken by DFO. Further, the risk category labels are required because this risk assessment is not fully quantitative and therefore still relies on qualitative rankings.

Following discussion, participants agreed that the authors of the draft document should edit the map illustrating the location of each DU to update specific farm locations and improve the overall colour scheme.

REVIEWER PRESENTATIONS AND DISCUSSION

Reviewers: Eric Verspoor and Monica Solberg

The external reviewers approved of the risk assessment and recommended further research and field observations be carried out in future to improve model accuracy and validate the model assumptions and outputs. They also suggested that a supplementary table be included in the Research Document to list the predicted incidence (number and percentage) of escapees at the individual river level. Such a table could provide a starting point for monitoring rivers to facilitate mitigation and validate the risk assessment.

The reviewers highlighted that the risk assessment demonstrated that, based on the assumptions outlined and the dispersal model, there was a strong likelihood that direct genetic interactions between escaped farmed and wild Atlantic salmon were occurring and that any remaining knowledge gaps or uncertainties should not be seen as a barrier to adopting further/stronger mitigation options.

A participant noted that from the perspective of First Nation members living near the Conne River in Newfoundland and Labrador, the introduction of aquaculture facilities in the area and subsequent escape events have resulted in impacts to the wild Atlantic Salmon populations.

The group discussed the term “genetic diversity” and how diversity can technically increase through introgression associated with gene flow from escaped farmed fish. The participants agreed that the Research Document and SAR should use “genetic character” rather than “genetic diversity”.

Participants acknowledged that the report assessed the risk of direct genetic interactions between wild and farm escapees using the best available information and modeling, and that estimates of several key parameters likely represent underestimates, which would most likely lead to an underestimation of the impact/risk. The authors agreed to highlight these instances more clearly and state in the Research Document why they may be underestimates.

The group discussed that, despite the lack of data specific to NB and NS, there are sufficient available data from NL, Scotland, and Norway to suggest that sexually mature escaped salmon will end up in rivers and successfully spawn with wild populations.

Participants discussed and compared the consequences of a loss of genetic character versus a loss in abundance in their assessment. The authors explained that the outcomes of the two are not equal and that a loss of a portion of the population with specific alleles represents a distinct loss whereas a loss of abundance is not as severe because it could reverse itself over time. The authors further explained that the two (abundance and genetic character) complement each other in terms of different aspects of the impacts.

The group discussed how immature farm escapees can mature in the wild and that any future plans for mitigation should include that possibility.

Participants discussed potential differences between reported escaped and actual escaped farmed salmon and concluded that obtaining more accurate estimates could improve/refine the risk assessment model outputs.

They also noted that other (environmental, indirect genetic, human-related) impacts “are” important, rather than “could be” important. They therefore agreed that a statement should be added to the meeting documents to indicate that these factors should be considered in addition to the direct genetic impacts (for example: sea lice, competition, behavioural interactions, climate change, etc.), but that their consideration is beyond the scope of this process.

Participants questioned whether the model should include some specific aquaculture sites, considering they potentially represent “outliers” based on the fact they are not stocked. The authors clarified that they included only facilities with documented introductions/transfers in the last decade and that they did their due diligence in designating sites as active or not.

The group noted that the research only considers marine cages and not freshwater hatcheries but the Terms of Reference do not specify one over the other. There was consensus that incorporating only marine cages was reasonable; however, the authors agreed to add a statement to the Research Document to state explicitly why only marine cages were included.

There was a discussion on existing mitigation efforts in the Maritimes region and whether they have made a difference in the status of wild Atlantic Salmon populations. Participants agreed it is not always possible to know the effect of existing mitigation measures given that this effect would require independent verification and monitoring to assess efficacy of measures and the fact there are multiple other factors affecting wild salmon.

The authors highlighted that the discovery of introgression in wild salmon populations from genetic screening provides a source of validation of the model. A participant commented that there are adult salmon counting facilities on several rivers that could be used to further validate the dispersal model (NL: Garnish River; Mar: Magaguadavic & Mactaquac).

A participant suggested there were no data specific to NB documenting sexually mature farm escapees in rivers, representing a data gap that could potentially influence model outputs. The authors countered this concern by highlighting evidence of sexually mature escapes in NB based on the presence of introgression, including altered allele frequencies with changes from wild to farm types, Q values (a zero-one bounded proportional representation of genetic background produced from genetic assignment software) shifting toward aquaculture, and the presence of European Salmon genes in wild populations. Furthermore, the authors highlighted the model does, in fact, incorporate a proportion of sexually immature escapees.

The discussion highlighted the importance of not getting caught up in regional specificity given the consistent patterns observed in the risk assessment and published studies for the broader North Atlantic.

One participant highlighted that the draft Risk Assessment paper incorrectly states that aquaculture facilities in NS must report breaches over 50 salmon escapes. In reality, they must report all breaches, and breaches with 50 or more escapes trigger a third party audit. The authors agreed to correct this error in the document.

The group discussed model assumption of a farm escapee dispersal distance upper limit of 200 km and the authors clarified that they incorporated a decay rate (i.e., less fish are expected to travel greater distances) rather than a flat, equal dispersal rate. They also explored higher dispersal upper limits (up to 500 km) and the impact of farm escapes remained above the 10% invasion at all distances. Participants agreed that inclusion of a brief explanation of the model parameters would improve the Research Document.

One participant raised concern that the model overestimated farmed salmon stocking numbers in NL, and therefore overestimated escape rates, potentially overestimating the risk of impact of farm escapes; however, the authors pointed out that the model uses production values only to arrive at an estimated number of escapees. They suggested that the sensitivity analyses, which included escape rates from 0.1 to 0.8 escapees per tonne of production (and therefore an 8-fold difference in number of escapees in rivers), likely accounted for potential discrepancies in production numbers within this range of values. The authors agreed to follow up with the province to determine if/how they could more realistically incorporate production values into the model as much as possible.

Participants from Norway noted evidence that certain environmental circumstances increase the occurrence of introgression in some rivers over others, including: greater accessibility of the river (i.e. no obstructions or changes in elevation), increased water outflow, and a smaller population of wild salmon.

WORKING PAPER 2: MITIGATION OPTIONS FOR REDUCING THE RISK OF DIRECT GENETIC INTERACTIONS BETWEEN FARM ESCAPES AND WILD ATLANTIC SALMON POPULATIONS IN ATLANTIC CANADA

PRESENTATION

Presenters: Mark Coulson

In support of the risk assessment, the document provided a summary of potential current, commercial-scale mitigation measures. This review includes an examination of the reasons for escape in Canada and other jurisdictions, and also addresses physical, biological and regulatory containment, marine recapture, freshwater monitoring, and the use of sterile farmed salmon. Where possible, the review summarizes the efficacy of these actions.

Preventing escapees and thus mitigating potential genetic interactions would mutually benefit both the farm producer and wild species. Although many mitigation measures can be employed to reduce the numbers of escaped Atlantic Salmon, some risk of escape from open cage systems will always exist. Measures to reduce the numbers of escapes, such as requirements to maintain farm structures, will aid in reducing escapes noting that equipment failure is one of the most common causes of escape. However, certain storm events may result in escapes that even well-maintained equipment could not prevent. Not all potential mitigation measures are equally effective and nor will one mitigation measure alone necessarily eliminate risk. Furthermore, implementation frameworks for these different measures will likely differ depending on the requirement for regulatory changes or the state of the specific technology considered. As with other complex issues, the cumulative effects of multiple measures will likely contribute to an effective reduction in escapes. Given the range of risk assessment outcomes, management decisions on which measures to implement should consider the goals of escape management for the individual farm or area.

DISCUSSION

One participant questioned the mention of “opportunistic recapture” of farm escapees in the review, what it means in Canada, and if it aligns with reports from Norway in which participants understood that anglers are encouraged to recapture escapees. The authors explained that in Canada, opportunistic recapture refers to situations where wild fish population monitoring or stock assessment activities encounter farm escapees.

Participants from Norway explained that in Norway, recapture of farm escapees occurs through a national monitoring program, while information about dispersal and recapture rates has been retrieved following deliberate release of tagged fish and recapture via anglers. In the monitoring program, local anglers, as well as personnel with specific training identify farmed salmon escapees based on morphology, which are later verified by scale reading.

Participants from Norway further explained that experiments with release and recapture of farmed fish has shown that recapture success depends on the life stage of the escaped fish, the timing of release in relation to wild population spawning activities, the release location of the release (releases closer to the coast result in higher recapture than releases further from the coast).

REVIEWER PRESENTATIONS AND DISCUSSION

Reviewers: Tillmann Benfey and Cyr Couturier

The reviewers provided an overview of the paper and provided suggestions to improve the content and its organization.

A participant from Norway explained Norway's experience farming and researching triploid fish over the past 15 years. Compared to diploid fish, triploids farmed in the same region of Norway had higher mortality and lower disease tolerance. In 2021, Norway paused any further triploid production based on poor fish welfare. Despite the challenges, farm triploids could offer potential in the future, following more research focused on identifying optimal husbandry and feeding conditions as well as time of sea-water transfer.

When asked about other methods used to induce sterility in farmed Atlantic Salmon in Norway, experts explained that ongoing experimental research focuses on producing sterile salmon using CRISPR genome editing technology. The aquaculture industry in Norway is not currently this method and CRISPR-modified fish are not legally allowed in the ocean.

One participant noted that Iceland is also exploring dnd gene editing to evaluate sterility options.

The group discussed how some aquaculture facilities in Atlantic Canada employ a mitigation measure that involves influencing the size to which post-smolts grow prior to transfer to net pens. By only transferring fish at a larger size, this practice aims to lower the risk of escape by reducing the time that farmed fish spend in net pens. However, it was noted that post-smolts grown to a larger size are more likely to mature early, meaning this protocol would result in the transfer of already maturing fish into sea cages, and therefore create a higher risk of sexually mature fish escaping compared to protocols previously used. Furthermore, participants noted that because this practice could allow an extra production cycle, and therefore more farmed fish in net pens within the same time period than it would have previously, it could also potentially increase the risk of escape. The authors agreed that the review should include this mitigation option, along with the caveats, and agreed to make this change in the paper.

The authors acknowledged that a good next step in the direct genetic interaction mitigation process would be to explore potential options for monitoring freshwater environments for escapees, including in remote areas. This approach would also allow validation and/or improvements to the dispersal model.

Participants noted that the mitigation paper could be improved by explaining why some jurisdictions were included over others (for example: BC, New Zealand, Chile). The authors agreed to make this change to the paper.

The group suggested that the potential use for eDNA in detecting the presence or absence of farm escapees in rivers should be included in the paper as a possible solution for collecting data from remote locations via drone and/or validating counting fence data. Some participants at the meeting who have worked on using eDNA in the context of farm escapees indicated that this approach is currently a work in progress in both Canada and Iceland.

Participants agreed with the reviewer's proposed reorganization of the paper and the authors agreed to make this change to the paper.

The authors emphasized that the mitigation options listed in the paper were for consideration and acknowledged that not all options may be feasible in all areas, if any at all. Some options may be dismissed and, if they are implemented, the authors emphasized the need to continuously monitor their efficacy.

One participant made the following suggestions and the authors agreed to consider making the changes to the paper:

- In Table 2 of the document, the participant suggested the authors emphasize the numbers of "reported escapees" are underestimates.

- On page 15, the participant noted that rather than human error "*playing a role*" in escapes, the paper should indicate human error is one of the *main reason*s for escapes.
- The Code of Containment for Maine should be described in the paper considering its proximity to Canadian Atlantic Salmon farms and its success in keeping track of farm escapes (which is based on pedigree information).
- The paper references that land-based closed containment Atlantic Salmon farms are being trialed and not available commercially, but this is untrue given that they are commercially available, just not at the scale of salmon raised in marine net pens.
- Additional studies pertaining to experimental recapture and opportunistic recapture of farm escapes in the Canadian context will be shared with the authors for inclusion as additional support for this section of the paper.

Participants from Norway validated the information in section 3.1.2 that outlined containment measures in Norway and explained that industry members have united to create a method to trace recaptured farm escapees back to their farm of origin through genetic analysis (through a combination of DNA and mineral analysis), and that this practice provides a good incentive for industry members to improve their containment measures.

SCIENCE ADVISORY REPORT DEVELOPMENT

Participants collaborated in real time to draft the Summary Bullets for the Science Advisory Report. The body of the Report should clarify all terminology in the Bullets. Consensus was achieved on all of the Bullets.

The Chairs presented an outline of the Science Advisory Report (SAR) for the meeting. Participants discussed and agreed on what figures to include and key points to include under the various sections. The Chairs confirmed that they would circulate the draft SAR to all participants for their review after the meeting.

EXPECTED PUBLICATIONS AND THEIR NEXT STEPS

Participants agreed to upgrade the two Working Papers to two Research Documents.

The Report authors and meeting Chairs will review the draft Science Advisory Report, Research Documents, and Proceedings against the agreed-to changes discussed during the meeting prior to their final publication.

APPENDIX 1: TERMS OF REFERENCE

Assessment of the risk posed to wild Atlantic Salmon population abundance and genetic character by direct genetic interaction with escapes from East Coast Atlantic Salmon aquaculture

National Advisory Meeting – National Capital Region

June 6-9, 2023
Halifax, NS

Co-Chairs: Brittany Beauchamp and Paul Snelgrove

Context

Escaped farmed Atlantic Salmon have been documented as a potential threat to wild Atlantic Salmon populations. Farm escapees can, in some instances, account for a large proportion of Atlantic Salmon in rivers and can affect both the abundance and genetic diversity of wild Atlantic Salmon populations.

In the three Atlantic provinces where Atlantic Salmon are farmed in coastal waters (Newfoundland and Labrador, Nova Scotia, and New Brunswick), the individual province is the lead regulator for aquaculture activities. However, the sustainable management of fisheries and aquaculture, and the protection of fish and fish habitat, are a part of the mandate of Fisheries and Oceans Canada (DFO).

DFO provides management advice to the provinces on new or expanded aquaculture sites and production increases, and shares responsibility with the provinces for issuing permits for the introduction and transfer (I&T) of fish into marine farm cages. To support this role, Aquaculture Directorate is seeking peer-reviewed science advice on the risks posed by escaped farmed Atlantic Salmon to the abundance and genetic diversity of wild Atlantic Salmon through direct genetic interactions, as well as to inform management options to reduce the risk to wild Atlantic Salmon.

The risk assessment advice may also be used to inform policy and regulatory reviews, assist in developing a consistent risk management approach in the different regions, inform siting advice and I&T decisions, and inform the development of standards (for example, for marine net pens used in salmonid aquaculture).

Objectives

The objective of the meeting is to provide peer-reviewed scientific advice through a semi-quantitative risk assessment of the risk posed to wild Atlantic Salmon population abundance and diversity by direct genetic interaction with escapes from East Coast Atlantic Salmon aquaculture.

The scientific advice will also include a characterization of sources of uncertainty and an assessment of potential mitigation options aimed at reducing risk.

Expected Publications

- Science Advisory Report
- Research Document
- Proceedings

Expected Participation

- International experts

- Academia
- Provinces
- Indigenous experts

APPENDIX 2: AGENDA

Agenda of the National CSAS Process

Assessment of the risk posed to wild Atlantic Salmon population abundance and genetic character by direct genetic interaction with escapes from East Coast Atlantic Salmon aquaculture

June 6-9, 2023

Admirals South Room – 4th Floor, Four Points by Sheraton

Halifax, Nova Scotia

Co-chairs: Paul Snelgrove and Brittany Beauchamp

Day 1 – June 06, 2023		
9:00 – 9:30	Welcome, Introductions, Housekeeping and Review of Agenda and Terms of Reference	Paul Snelgrove and Brittany Beauchamp (Co-Chairs)
9:30 – 9:40	Context and Client Drivers for this Science Advice	Chris Hendry
9:40 – 10:00	Genetic introgression into wild salmon populations across the North Atlantic	Ian Bradbury
10:00 – 10:30	**Working paper #1:** Assessment of the risk posed to wild Atlantic Salmon population abundance and genetic character by direct genetic interaction with escapes from East Coast Atlantic Salmon aquaculture Introduction, background, scope & sources of data (20 minutes) Questions and Discussion (10 minutes)	Mark Coulson Brendan Wringe Ian Bradbury
Break (20 Minutes)		
10:50 – 11:20	**Working paper #1: Continued** Likelihood & Consequence Assessments (20 minutes) Questions and Discussion (10 minutes)	Mark Coulson Brendan Wringe Ian Bradbury

Day 1 – June 06, 2023		
11:20 – 11:50	**Working paper #1: Continued** Risk estimation, uncertainty & mitigation simulation (20 minutes) Questions and Discussion (10 minutes)	Mark Coulson Brendan Wringe Ian Bradbury
11:50 – 12:30	Reviewer Presentations (20 minutes each)	Eric Verspoor Monica Solberg
Lunch Break (1 Hour)		
1:30 – 2:50	Open Discussion	Everyone
Break (20 minutes)		
3:10 – 4:50	Open Discussion (continued)	Everyone
4:50 – 5:00	Summary and adjournment for Day 1	Co-Chairs

Day 2 – June 07, 2023		
9:00 – 9:20	Welcome and Review of Day 1	Brittany Beauchamp and Paul Snelgrove (Co-Chairs)
9:20 – 10:20	Open Discussion	Everyone
Break (20 Minutes)		
10:40 – 12:00	Open Discussion	Everyone
Lunch Break (1 Hour)		
1:00 – 1:40	**Working paper #2:** Mitigation options for reducing the risk of direct genetic interactions between farm escapes and wild Atlantic Salmon populations in Atlantic Canada.	Mark Coulson

Day 2 – June 07, 2023		
	(30 minutes) Questions (10 minutes)	
1:40 – 2:20	Reviewer Presentations (20 minutes each)	Tillmann Benfey Cyr Couturier
Break (20 Minutes)		
2:40 – 4:50	Open Discussion	Everyone
4:50 – 5:00	Summary and adjournment	Co-Chairs

Day 3 – June 08, 2023		
9:00 – 9:20	Welcome and Review of Day 2	Paul Snelgrove and Brittany Beauchamp (Co-Chairs)
9:20 – 10:30	Questions and Open Discussion	Everyone
Break (20 Minutes)		
10:50 – 12:00	Development of Summary Bullets	Everyone
Lunch (1 hour)		
1:00 – 2:30	Development of Summary Bullets (continued)	Everyone
Break (20 Minutes)		
2:50 – 4:50	Science Advisory Report Development	Everyone
4:50 – 5:00	Summary and adjournment	Co-Chairs

Day 4 – June 09, 2023		
9:00 – 9:20	Welcome and Review of Day 3	Brittany Beauchamp and Paul Snelgrove (Co-Chairs)

Day 4 – June 09, 2023		
9:20 – 10:30	Science Advisory Report Development (continued)	Everyone
Break (20 Minutes)		
10:50 – 12:00	Science Advisory Report Development (continued)	Everyone
Lunch (1 hour)		
1:00 – 2:30	Science Advisory Report Development (continued)	Everyone
2:30 – 3:00	Conclusions and Next Steps	Co-Chairs

APPENDIX 3: LIST OF PARTICIPANTS

Name	Affiliation
Elizabeth Barlow	Mi'kmaq Alsumk Mowimsikik Koqoey Association / Miawpukek First Nations
Brittany Beauchamp	DFO EOS (co-chair)
Tillmann Benfey	University of New Brunswick
Ian Bradbury	DFO EOS
Jon Carr	Atlantic Salmon Federation
Mark Coulson	DFO EOS
Cyr Couturier	Memorial University of Newfoundland
Chris Hendry	DFO AMD
Ian Fleming	Memorial University of Newfoundland
Thomas Fraser	Norwegian Institute of Marine Research
Nellie Gagné	DFO EOS
Kim Gill	Province of Prince Edward Island
Brian Glebe	retired DFO (attended June 6 only)
Ross Hinks	Miawpukek First Nation
Ragnar Johannsson	Marine and Freshwater Research Institute, Iceland
David Morin	DFO EOS
Emily Ryall	DFO EOS
Lisa Setterington	DFO EOS
Paul Snelgrove	Memorial University of Newfoundland (co-chair)
Monica Solberg	Norwegian Institute of Marine Research
Danielle St. Louis	Province of Nova Scotia
Peter Sykes	Province of New Brunswick

Name	Affiliation
Marc Trudel	DFO EOS
Eric Verspoor	UHI Inverness College, Scotland
Daryl Whelan	Government of Newfoundland and Labrador
Brendan Wringe	DFO EOS