



Fisheries and Oceans
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Ecosystems and
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Sciences des écosystèmes
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Canadian Science Advisory Secretariat (CSAS)

Proceedings Series 2019/022

National Capital Region and Pacific Region

Proceedings of the National Science Peer Review of the Assessment of Risk to Fraser River Sockeye Salmon due to piscine orthoreovirus (PRV) transfer from Atlantic Salmon Farms Located in the Discovery Islands Area, British Columbia

Meeting dates: January 28-30, 2019

Location: Vancouver, British Columbia

Co-Chairpersons: Gilles Olivier and Craig Stephen

Editor: Lily Weber

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Fisheries and Oceans Canada
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Ottawa, ON, K1A 0E6

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.

Published by:

Fisheries and Oceans Canada
Canadian Science Advisory Secretariat
200 Kent Street
Ottawa ON K1A 0E6

[http://www.dfo-mpo.gc.ca/csas-sccs/
csas-sccs@dfo-mpo.gc.ca](http://www.dfo-mpo.gc.ca/csas-sccs/csas-sccs@dfo-mpo.gc.ca)



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ISSN 1701-1280

Correct citation for this publication:

DFO. 2019. Proceedings of the National Science Peer Review of the Assessment of Risk to Fraser River Sockeye Salmon due to piscine orthoreovirus (PRV) transfer from Atlantic Salmon Farms located in the Discovery Islands Area, British Columbia; January 28-30, 2019. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2019/022.

Aussi disponible en français :

MPO. 2019. Compte rendu de l'examen scientifique national par les pairs sur l'évaluation du risque pour le saumon rouge du fleuve Fraser causés attribuable au transfert de l'orthoréovirus pisciaire (PRV) à partir des fermes d'élevage de saumon atlantique situées dans la région des îles Discovery (Colombie-Britannique); 28-30 janvier 2019. Secr. can. Sci. sci. du MPO, Compte rendu 2019/022.

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SUMMARY

Fisheries and Oceans Canada (DFO), under the *Sustainable Aquaculture Program*, is committed to deliver environmental risk assessments to support science-based decision making related to aquaculture activities. DFO's Aquaculture Management Directorate requested for peer-reviewed science advice through the Canadian Science Advisory Secretariat (CSAS) on the risks to Fraser River Sockeye Salmon due to pathogen transfer from marine Atlantic Salmon farms located in the Discovery Islands area in British Columbia. This request supports DFO's role in the management of aquaculture in British Columbia and aligns with recommendations in the final report of the Commission of Inquiry into the Decline of Sockeye Salmon in the Fraser River, including recommendations 18 and 19 on risks to wild fish populations related to pathogen transfer from farms and other fish health related recommendations. The advice was provided, as part of the *Aquaculture Science Environmental Risk Assessment Initiative*, through a series of pathogen transfer risk assessments, with this sixth assessment focusing on piscine orthoreovirus (PRV).

A CSAS peer-review meeting was held from January 28 to 30, 2019 in Vancouver, British Columbia, with the objective of providing science advice based on the review of the relevant scientific knowledge presented in the pathogen characterization working paper and related risk assessment working paper. Meeting participants included experts from DFO, provincial jurisdictions, industry, First Nations, environmental non-governmental organizations, and invited experts from abroad.

This Proceedings Report summarizes the key information presented at the meeting, as well as the relevant meeting discussions and conclusions reached. The science advice resulting from this meeting is published in the Science Advisory Report series on the DFO CSAS website. The two working papers presented at the meeting are published in the Research Document series.

INTRODUCTION

Fisheries and Oceans Canada (DFO), under the *Sustainable Aquaculture Program*, is committed to deliver environmental risk assessments to support science-based decision making related to aquaculture activities. The *Aquaculture Science Environmental Risk Assessment Initiative* was implemented to assess the risks of aquaculture activities to wild fish and the environment. A previous DFO CSAS peer review process validated *The Aquaculture Pathways of Effects* (POE) model and the underlying scientific evidence for aquaculture activities and stressors (DFO, 2010).

The first series of risk assessments conducted under the *Initiative* is focusing on the release of pathogens, and regionally focusing on Atlantic salmon aquaculture activities in the Discovery Islands area of British Columbia.

DFO's Aquaculture Management Directorate has requested formal peer-reviewed science advice on the risks to Fraser River Sockeye Salmon due to pathogen transfer from marine Atlantic Salmon farms located in the Discovery Islands area in British Columbia. This request supports DFO's role in the management of aquaculture in British Columbia and aligns with recommendations in the final report of the Commission of Inquiry into the Decline of Sockeye Salmon in the Fraser River, including recommendations 18 and 19 on risks to wild fish populations related to pathogen transfer from farms and other fish health related recommendations (Cohen, 2012).

A CSAS National Science peer-review meeting was held from January 28 to 30, 2019, in Vancouver, with the purpose of providing advice on the risk to Fraser River Sockeye Salmon due to piscine orthoreovirus (PRV) transfer from Atlantic Salmon farms located in the Discovery Islands area of British Columbia. The Terms of Reference for the meeting is included in Appendix 1.

To formulate the science advice, the meeting participants peer-reviewed two working papers. The first working paper titled "Characterization of piscine orthoreovirus (PRV) and associated diseases to inform pathogen transfer risk assessments in British Columbia" by Polinski and Garver (2019) informed the second working paper titled "Assessment of the risk to Fraser River Sockeye Salmon due to piscine orthoreovirus (PRV) on Atlantic Salmon farms in the Discovery Islands area, British Columbia" by Mimeault et al. (2019).

Meeting participants (Appendix 2) included experts from DFO, provincial jurisdictions, industry, First Nations, environmental non-governmental organizations, and national and international experts. The two working papers along with the meeting agenda (Appendix 3) were distributed to all participants prior to the meeting. Formal reviewers, identified by the Steering Committee prior to the meeting, provided comments on the working papers and presented their comments and recommendations at the meeting. Participants discussed and reviewed all aspects of the working papers and formulated the summary bullets and conclusions of scientific advice for the Science Advisory Report (DFO, 2019).

This Proceedings Report summarizes the key information presented, as well as the key meeting discussions and conclusions reached during the formal Canadian Science Advisory Secretariat (CSAS) peer-review process held January 28 to 30, 2019 in Vancouver, British Columbia. The science advice resulting from this meeting is published in the Science Advisory Report series on the DFO CSAS website. The technical details supporting the advice are included in the pathogen characterization and risk assessment working papers presented at the meeting and are published in the Research Document series.

CSAS OVERVIEW, MEETING PROCEDURES AND TERMS OF REFERENCE REVIEW

Presenter: Gilles Olivier (Co-Chairperson), Fisheries and Oceans Canada

The meeting co-chair, Gilles Olivier (DFO) provided an overview of DFO's Science Advisory Process, including the role of DFO's Canadian Science Advisory Secretariat (CSAS) and explained the role of meeting participants as reviewers. He explained that the process must follow the Government of Canada's *Scientific Advice for Government Effectiveness* (SAGE) principles. He emphasized that final scientific advice has to be reached by consensus and based strictly on scientific data and information as done for all CSAS processes. Finally, he reviewed the objectives listed in the Terms of Reference (Appendix 1), stated the ground rules for the meeting, and listed the expected publications.

In response to questions from participants, the following clarifications were provided:

- New means and tools of communicating science to engage the public more broadly are proactively being looked into.
- The goal of the working papers is to have them published in the public realm as research documents within a four month time frame. It was clarified the Science Advisory Report (SAR) will be written in plain language as means of communication to government decision makers and more broadly the public.

RISK ASSESSMENT PROCESS AND LINKAGES WITH THE WORKING PAPERS

Presenter: Ingrid Burgetz, Fisheries and Oceans Canada

Ingrid Burgetz provided an overview of the Conceptual Model for the risk assessment process and explained how the working papers helped inform the determination of risk to Fraser River Sockeye Salmon (FRSS) abundance and diversity due to PRV on Atlantic Salmon farms in the Discovery Islands area, British Columbia. This peer-reviewed science advice formulated from this CSAS meeting is used to inform Risk Management for decision making processes. The working papers integrate the available scientific literature and data in order to characterize and assess the likelihood of FRSS becoming infected due to the interaction with farmed Atlantic Salmon in the Discovery Islands area and the consequence to the abundance and diversity should that infection occur.

In response to questions from participants, the following clarifications were provided:

- The definitions of likelihood in the risk assessment have been updated for clarity since the last CSAS peer review risk assessment.
- The risk tolerances in the matrices in the assessment were defined by management with consideration to the Wild Salmon Policy. Socio-economic considerations are not a part of this National CSAS process. The science advice is one component considered in the overall decision making process.

CHARACTERIZATION OF PISCINE ORTHOREOVIRUS

Authors: Kyle Garver and Mark Polinski, Fisheries and Oceans Canada

Presenter: Mark Polinski

Mark Polinski provided an overview of the relevant information summarized in the working paper, "Characterization of piscine orthoreovirus (PRV) and associated diseases to inform pathogen transfer risk assessments in British Columbia" by Polinski and Garver (2019).

FORMAL REVIEWS

Formal reviewers provided written reviews including editorial suggestions to enhance the clarity and ensure the use of neutral language.

Reviewer and presenter 1: Espen Rimstad, Norwegian University of Life Sciences (NMBU)

Espen Rimstad commended the authors on a thorough presentation of the current knowledge of piscine orthoreovirus and infection of salmonid fish species. The characterization working paper has a Pacific Canada centric point of view, appropriate for the regional focus of the risk assessment, yet may lend to an underestimate of the severity of PRV in other areas of the world. Due to the narrow scope of the paper, the totality of the biology of PRV was not thoroughly considered particularly that PRV has segmented genome and its potential for genome reassortment. Nevertheless given the homogenous nature of PRV-1 in British Columbia PRV genome reassortment often marked rapid change in the genome is highly unlikely. The reviewer noted due to the inability to culture and isolate PRV in establish cell lines, the traditionally used term “isolate” should be clearly defined and there should be inclusion of further literature to support infection pressures for HSMI development.

Reviewer and presenter 2: Niccolo Vendramin, Technical University of Denmark

Niccolo Vendramin provided a thorough review and highlighted suggested changes to the document. He suggested to incorporate: PRV is a segmented non-enveloped RNA virus and IPNV can be used as a proxy for the stability of PRV in the environment and update detection figure to reflect current findings of PRV-3 in Germany and France and PRV-1 in Denmark and Sweden. The reviewer also noted when referring to the term dose, it should be explained that RNA levels measured by qPCR do not differentiate between full virions, ISVP (infective subviral particles) and core particles of which only two are infectious.

Reviewer 3: Ted Meyers, Alaska Department of Fish and Game

Ted Meyers was not present at the meeting, however, he provided a written review which was read out. He commended the authors on a comprehensive review of the PRV literature and the status of the PRV-1 strain detected in the Pacific Northwest. His comments are minor and editorial in nature. He suggested to clarify that erythrocytic inclusion body syndrome (EIBS) has a history of occurrence in Coho and Chinook Salmon in the Pacific Northwest and there is a likelihood that EIBS may be caused by unknown strain of PRV and can be supported by Takano et al. (2016). He had concerns with the term “isolation” and suggested using the term “purified isolate” instead. The statement regarding vertical (parent to egg) transmission is vague and should be clarified that the surface egg associated virus does not undergo vertical transmission rather the egg shell surface acts as a fomite for horizontal contact and transmission when an alevin hatches.

DISCUSSION

Discussions following Reviewer 1:

There were discussions to be more explicit with terminology and to clarify the definitions of cardiopathy and disease in the glossary. It was highlighted that the term “disease” is in reference to clinical disease.

Participants discussed heart lesions in the field routinely associated with PRV, however, it was noted that in BC, heart inflammation can be caused by agents other than PRV and in fact heart inflammation can be observed in the absence of PRV. The homogenous nature or limited diversity observed among BC PRV in comparison with Norwegian PRV may suggest the BC-PRV has a shortened evolutionary history than in Norway or alternatively that the differential genetic diversities between regions are a consequence of different selective pressures.

Discussions following Reviewer 2:

It was debated whether mortality is observable in wild fish and whether assumptions can be made on the impact of a disease in wild populations. Nevertheless; it was noted that numerous examples of wild fish die-off events due to viral infections have been documented, suggesting that diseases are

observable in wild fish populations in some instances. It was also highlighted there is a series of surveys specifically looking at viruses in Norway finding high prevalence of PRV-1 in wild salmon.

Discussions following Reviewer 3:

It was clarified that the pathologies HSMI, anemia and EIBS are not just associated with PRV, and when PRV infection was induced in a laboratory study, it did not cause EIBS or anemia.

For transparency, there should be a description of the criteria for PCR tests used in the laboratories studies referenced in the characterization working paper to better interpret the information presented.

It was clarified that all papers written in this series of risk assessment are targeted to address the DFO's Aquaculture Management Directorate request for formal peer-reviewed science advice on the risks to Fraser River Sockeye Salmon due to pathogen transfer from marine Atlantic Salmon farms located in the Discovery Islands area in British Columbia.

It was discussed that in commercial hatcheries and enhancement facilities there were no mortality differences found between PRV-1 positive and PRV-1 negative salmon.

Three 'in press' and 'in preparation' papers were referenced in the working paper. Some participants expressed concerns for not having the opportunity to review them prior to the meeting. These papers were distributed at the end of the first day of the meeting to all participants thus allowing further discussion during the remaining two days of the peer review meeting.

There was discussion regarding sampling times in order to detect potential PRV caused pathology, and whether pathology would have been detected if histopathological samples had been taken at an intermediate time point. However, it was noted that in subsequent studies, a lack of pathology signifying HSMI was corroborated despite histological sampling encompassing the exponential, peak, and persistent phases of PRV infection.

It was stated that in some of the referenced studies involving BC-PRV, the fish were not sampled during the correct time period to see the associated pathology of PRV.

There was agreement to clarify the terms wild type, infection, disease and consequence stated throughout the working paper.

CONSENSUS

Meeting participants reached consensus on the following:

- The conclusion summary bullets from the characterization of PRV presentation were revised to reach consensus by all the participants and will be incorporated into the Science Advisory Report (SAR).
- The authors will be responsible for revising the piscine orthoreovirus characterization working paper. Comments and recommendations from formal reviewers and from the meeting are to be considered, and incorporation of these elements in the working paper left to the authors to address with final review and approval by the co-chairs.

PISCINE ORTHOREOVIRUS RISK ASSESSMENT

Author and presenter: Caroline Mimeault, Fisheries and Oceans Canada

Caroline Mimeault provided an overview of the relevant information used to inform the PRV risk assessment and uncertainties associated with the estimation of risk summarized in "Assessment of the risk to Fraser River Sockeye Salmon due to piscine orthoreovirus (PRV) on Atlantic Salmon farms in the Discovery Islands area, British Columbia" by Mimeault et al. (2019).

FORMAL REVIEWS

Reviewer and presenter 1: Ian Gardner; Atlantic Veterinary College UPEI

Ian Gardner first commended the authors and highlighted the strengths of the assessment, identified necessary changes to the document and future considerations. It was suggested to only include definitions in the glossary referenced in the body of the text and to link relevant definitions. Ian suggested there needs be greater transparency and a standardized protocol for eliciting expert opinions.

For future reports the quality of evidence in observational field studies needs to be considered and the STROBE reporting guidelines should be followed (Moore and Berger, 2014). It was highlighted that a standardized approach should be used to summarize and aggregate prevalence data.

Reviewer and presenter 2: Mark Powell, Institute of Marine Research Norway

Mark Powell highlighted this risk assessment articulates the purpose and how the assessment has been undertaken in a clear and concise manner. However, he had a few questions regarding what informs the data which are summarized below.

As the Fish Health Audit and Surveillance Program does not include screening for PRV, it is difficult to determine the risk associated with each site as there are unknowns regarding the origin and the shedding rate of PRV. To better support the release assessment it was suggested to include dead fish as a potential fomite as they can shed the virus. It was also suggested to use proxy data from Salmonid alphavirus (SAV) and IPNV to fill in some of the unknowns regarding the survival of PRV in the water column and outside of the host.

There needs to be further information provided regarding the migration biology, detection methods and exposure of the virus to explain the apparent higher PRV prevalence in Shuswap and Chilko stocks.

It was highlighted there are no data to support the definition provided for the term cardiopathy in BC salmon. The term *chronic* should be updated to have a specific toxicological meaning.

Reviewer 3: Edmund Peeler, written review Center for Environment Fisheries and Aquaculture Science (CEFAS)

Edmund Peeler was not present at the meeting, however, he provided a written review which was read to the participants during the meeting. To summarize, he firstly commended the authors for a well written and structured risk assessment. He suggested to provided greater clarity about the methodology, and in particular the formulation of the risk question. It was noted that the authors identified all the necessary information and highlighted the data gaps. The authors relied on PRV working paper for much of the evidence, and provided clear, balanced and objective summaries of the data. It was highlighted that one key paper (Morton et al. 2017) was not fully discussed; however, given other evidence the conclusions of this paper is unlikely to alter the consequence assessment. The estimates of likelihood of the hazard, its consequences and uncertainty are clearly based on the available data. There are aspects of the method (e.g., dependencies between stages of the assessment) and the data (e.g., hypotheses to explain the low prevalence of PRV in Sockeye Salmon) that could have been discussed more fully.

DISCUSSION

Participants suggested to report Ct values for positive detections.

There were discussions regarding the prevalence of PRV detections in Shuswap and Chilko stocks. It was noted that the apparent higher prevalence in those stocks needed to be addressed as it

suggests there are stock specific differences. It was also discussed that given the small number of fish screened for PRV in some stocks, and none in others, PRV may also be present in other stocks.

Participants noted that industry has not always screened for PRV. Companies started screening fish in hatcheries to inform disinfection of facilities and most hatcheries have been negative for multiple years. It was suggested to include additional information that may influence the observed changes in PRV prevalence.

For the infection assessment step it was discussed there is high uncertainty associated with the ranking as there is reliance on cohabitation studies and there are data gaps. The authors clarified that this step of the assessment is highly reliant on the timing and duration of time Fraser River Sockeye Salmon are exposed to Atlantic Salmon farms.

For the consequence assessment of the juveniles, it was debated whether there is a degree of uncertainty associated with the negligible rating as there were concerns the study cited (Garver et al., 2016) did not sample at the possible peak PRV infection of red blood cells.

For the consequence assessment for the adults the uncertainty level associated with the negligible ranking was discussed. A minority of participants expressed the uncertainties should be one step higher than presented in the risk assessment. This was based on their assessment of the quantity of publications and results, and the appropriateness of using laboratory study results to estimate the consequences of PRV-1 infection in wild Sockeye Salmon. Participants did not reach consensus on this uncertainty ranking.

For transparency, it was agreed to include the uncertainty rankings by their associated likelihood and consequence rankings in the summary bullets of the Science Advisory Report.

A few participants raised concerns that histopathology cannot fully characterize the pathological effect and there were a lack of controls in the laboratory studies cited which could lead to inconsistencies in the data being interpreted.

Participants highlighted it should be clearly stated throughout the documents when referring to juveniles and adults and using laboratory studies with juveniles as a proxy.

CONSENSUS

Meeting participants reached consensus on the following:

- Overall there was consensus on the likelihood assessment and consequence assessment rankings. However, participants could not reach consensus on the associated uncertainty levels for the consequence assessment.
- It was agreed upon that the range of uncertainties discussed for the consequence assessment will be highlighted in the Science Advisory Report for transparency.
- The summary bullets were developed as a group to reflect the working papers, overall process and summary of the meeting. Consensus and agreement were reached on these bullets.

CONCLUSIONS AND CONSIDERATIONS

Both working papers were accepted as research documents pending modifications reflecting the discussions and consensus reached at the peer-review meeting. Participants agreed that once modifications to the pathogen characterization paper will have been incorporated by the authors it would be reviewed by Dr. Kristi Miller-Saunders and Dr. Zac Waddington. The modifications to the risk assessments will be reviewed by Dr. Mark Powell and Dr. Espen Rimstad. The meeting co-chairs will then review and approve the final versions of both working papers.

Participants were provided the opportunity to make recommendations for consideration for future CSAS peer-review processes. Participants firstly commended the authors and chairpersons for the hard work throughout the process. Some participants expressed the need for a better mechanism of expressing where the uncertainties lie in the risk assessments as it is a critical element. Some participants expressed that the *in press* articles and unpublished papers were provided late and should be provided earlier for transparency and a more efficient review. The majority of the participants noted there were a sufficient range of expertise involved in the process although some expressed disappointment that additional key individuals should have been in attendance. Finally, the majority of participants expressed positive thoughts about the outcome of the meeting, highlighting the benefits of the collaborative approach and the method in which concerns were addressed.

SCIENCE ADVISORY REPORT DEVELOPMENT

A Science Advisory Report will be developed as a result of the CSAS peer-review meeting to provide a summary of the science advice for Aquaculture Management on the risk of piscine orthoreovirus attributable to Atlantic Salmon farms located in the Discovery Islands area to Fraser River Sockeye Salmon. The Science Advisory Report is a formal documentation of the advice produced at the meeting and includes the main components of two supporting research documents: 1) the pathogen characterization research document and 2) pathogen risk assessment research document. A draft of the Science Advisory Report was reviewed by all meeting participants for the purpose of commentary and real-time editing as a group for consensus. This portion of the meeting was focused on writing and completing the summary section of the Science Advisory Report. Summary bullets were developed and agreed upon during the meeting. They aim to explain the purpose and procedure of this risk assessment process, and highlight key information from each of the pathogen characterization and pathogen risk assessment papers, including the overall conclusion on risk.

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APPENDIX 1: TERMS OF REFERENCE

Assessment of the Risk to Fraser River Sockeye Salmon due to Piscine Orthoreovirus (PRV) transfer from Atlantic Salmon Farms Located in the Discovery Islands Area, British Columbia

National Peer Review – National Capital Region and Pacific Region

January 28-30, 2019

Vancouver, BC

Chairperson: Gilles Olivier and Craig Stephen

Context

Fisheries and Oceans Canada (DFO), under the *Sustainable Aquaculture Program*, is committed to deliver environmental risk assessments to support science-based decision making related to aquaculture activities. The *Aquaculture Science Environmental Risk Assessment Initiative* was implemented to assess the risks of aquaculture activities to wild fish and the environment. The risks associated with each environmental stressor validated in the Pathways of effects for finfish and shellfish aquaculture (DFO, 2010) will be assessed as per the *Aquaculture Science Environmental Risk Assessment Framework* ensuring a systematic, consistent and transparent process.

The first series of risk assessments to be conducted under the initiative will focus on the pathway related to the release of pathogens, and regionally focusing on Atlantic salmon aquaculture activities in the Discovery Islands area of British Columbia. The risks associated with other environmental stressors resulting from aquaculture activities will be assessed in future processes.

DFO's Aquaculture Management Directorate has requested CSAS advice on the risks to Fraser River sockeye salmon due to pathogen transfer from marine Atlantic salmon farms located in the Discovery Islands area in British Columbia. This request supports DFO's role in the management of aquaculture in British Columbia and aligns with recommendations in the final report of the Commission of Inquiry into the Decline of Sockeye Salmon in the Fraser River, including recommendations 18 and 19 on risks to wild fish populations related to pathogen transfer from farms and other fish health related recommendations (Cohen, 2012).

The advice will be provided through a series of pathogen transfer risk assessments; this sixth risk assessment is focusing on Piscine Orthoreovirus (PRV).

The risks associated with other pathogens also known to cause disease and detected on marine Atlantic salmon farms in the Discovery Islands area will be assessed in subsequent processes, including a synthesis of all assessed pathogens.

Objective

The objective of the meeting is to provide advice on the risk to Fraser River sockeye salmon due to PRV transfer from Atlantic salmon farms located in the Discovery Islands area of British Columbia. The science advice will include a review of all the scientific knowledge, as summarized in the working paper, related to the characteristics of pathogen infection and disease, susceptibility, prevalence and infection dynamics, and in particular for British Columbia for:

- Piscine Orthoreovirus and associated pathology (Working Paper 1);

Based on this scientific knowledge, the science advice will also include:

-
- a review of the qualitative Environmental Risk Assessment on Fraser River sockeye salmon abundance and diversity due to PRV transfer from Atlantic salmon farms located in the Discovery Islands area (Working Paper 2);
 - a review of the uncertainties associated with the estimation of the risk to Fraser River sockeye salmon abundance and diversity (Working Paper 2); and
 - if risk assessment outcomes warrant, provide advice on additional measures that would reduce the risk to Fraser River sockeye salmon abundance and diversity due to PRV transfer from Atlantic salmon farms in the Discovery Islands area.

Expected Publications

- CSAS Research Documents:
 1. Characterization of Piscine Orthoreovirus (PRV) and associated pathology
 2. Qualitative environmental risk assessment of Piscine Orthoreovirus (PRV) transfer from Discovery Islands Atlantic salmon farms to Fraser River sockeye salmon
- Science Advisory Report
- Proceedings

Expected Participation

- Fisheries and Oceans Canada (DFO): Aquaculture Management (NCR and Pacific); Ecosystems and Oceans Science; and Ecosystem and Fisheries Management (Pacific)
- Indigenous Nations
- Academia
- Aquaculture industry
- Canadian Food Inspection Agency (CFIA)
- Environmental non-government organizations
- Ministry of Agriculture, Province of British Columbia

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APPENDIX 2: MEETING PARTICIPANTS

Name	Affiliation
Ahmed Siah	BC Centre for Aquatic Health Sciences
Alistair Struthers	Fisheries and Oceans Canada
Barry Milligan	Cermaq Canada
Brian Riddell	Pacific Salmon Foundation
Caroline Mimeault	Fisheries and Oceans Canada
Chad Fuller	First Nations Fisheries Council of BC
Craig Stephen	Canadian Wildlife Health Cooperative
Erin Rechisky	Kintama Research
Espen Rimstad	Norwegian University of Life Sciences (NMBU)
France Boily	Fisheries and Oceans Canada
Gary Marty	BC Animal Health Centre
Gilles Olivier	Fisheries and Oceans Canada
Hamish Rodger	Fish Vet Group
Ian Gardner	Atlantic Veterinary College UPEI
Ingrid Burgetz	Fisheries and Oceans Canada
Jay Parsons	Fisheries and Oceans Canada
John Werring	David Suzuki Foundation
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Kyle Garver	Fisheries and Oceans Canada
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Nellie Gagne	Fisheries and Oceans Canada
Niccolo Vendramin	Technical University of Denmark
Simon Jones	Fisheries and Oceans Canada
Sonja Saksida	Veterinary Consultant
Stewart Johnson	Fisheries and Oceans Canada
Tim Hewison	Grieg Seafood
Tony Farrell	University of British Columbia
Zac Waddington	Fisheries and Oceans Canada

Formal reviewers who provided written comments for the CSAS National Science Peer Review of the assessment of the risk to Fraser River Sockeye Salmon due to piscine orthoreovirus (PRV) on Atlantic Salmon farms located in the Discovery Islands area, British Columbia.

Name	Affiliation
Edmund Peeler	Center for Environment Fisheries and Aquaculture Science (CEFAS)
Ted Meyers	Alaska Department of Fish and Game

APPENDIX 3: AGENDA

Agenda of the CSAS National Science Peer Review Process for the Assessment of the Risk to Fraser River Sockeye Salmon due to Piscine Orthoreovirus on Atlantic Salmon Farms Located in the Discovery Islands Area, British Columbia

January 28 to 30, 2018
Delta Hotels Vancouver Downtown Suites
550 W Hastings Street
Vancouver, British Columbia

DAY 1 Monday, January 28, 2019		
13:00 - 13:15	Welcome, Introductions, Housekeeping & Review of Agenda	Gilles Olivier & Craig Stephen (Chairs)
13:15-13:30	CSAS Overview & Meeting Procedures	Gilles Olivier
13:30-13:45	Review Terms of Reference	Craig Stephen
13:45-14:00	Risk assessment process and linkages with the working papers	Ingrid Burgetz
14:00-14:30	Presentation #1: Characterization of piscine orthoreovirus (PRV) and associated diseases to inform pathogen transfer risk assessments in British Columbia	Mark Polinski
BREAK		
14:45-15:45	Reviewer Presentations & Authors Response	Espen Rimstad, Niccolo Vendramin, <i>Ted Meyers</i>
15:45-16:45	Open Discussion & Preparation of Summary Bullets	Everyone
16:45-17:00	Summary & Adjournment	Gilles Olivier

DAY 2 Tuesday, January 29, 2019		
8:30-8:45	Review of Day 1	Craig Stephen
8:45-9:30	Presentation #2: Assessment of the risk to Fraser River Sockeye Salmon due to piscine orthoreovirus (PRV) on Atlantic Salmon farms in the Discovery Islands area, British Columbia	Caroline Mimeault
9:30-10:30	Reviewer Presentations & Author Response	Ian Gardner, Mark Powell, <i>Edmund Peeler</i>
BREAK		
10:45-12:00	Open Discussion & Preparation of Summary Bullets	Everyone
LUNCH		
13:00-14:00	Open Discussion & Preparation of Summary Bullets	Everyone
14:00-15:00	Science Advisory Report Development	Everyone
BREAK		
15:15-16:30	Science Advisory Report Development	Everyone
16:30-17:00	Summary & Adjournment	Gilles Olivier

DAY 3 Wednesday, January 30, 2019		
8:30-8:45	Review of Day 2	Craig Stephen
8:45-10:00	Science Advisory Report Development	Everyone
BREAK		
10:15-12:00	Science Advisory Report Development	Everyone
LUNCH		
13:00-14:30	Science Advisory Report Development	Everyone
14:30-15:15	Final Consensus	Craig Stephen & Gilles Olivier
BREAK		

Italicized names represent reviewer comments read at meeting