

Written Submission to the FOPO committee. May 2022
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Thank you Mr Chair & members of the committee for inviting me to speak today.

I am a viral ecologist and geneticist at the University of British Columbia. I've been working on salmon viruses with a team of scientists from the Pacific Salmon Foundation, and DFO for the past 5 years. Much of my research has focussed on a virus called Piscine orthoreovirus, abbreviated as PRV.

I'm writing my submission focusing on PRV today because I think it highlights some of the issues that have been raised by witnesses to the committee on the issue of impartial and independent science advice.

On paper, DFO sets a very high standard for itself within the Science Advice for Government Effectiveness principles (often referred to as SAGE principles). However, in my experience, I have witnessed striking examples where DFO have failed to meet these standards in regards to the management of Piscine orthoreovirus (or PRV).

Below I give evidence which shows that DFO managers have repeatedly:

- ignored scientific research
- misrepresented research in advice to DFO decision-makers
- prevented the Minister from receiving accurate information regarding research on PRV

Consequently, the Minister cannot rely on DFO managers to provide her with objective and accurate scientific advice on PRV to inform her decisions.

The PRV Case Study

The story begins in Norway in the late 1990s. There were outbreaks of a new heart disease in Norwegian Atlantic salmon farms and it was suspected that a virus might be the cause. It wasn't until 10 years later (in 2010) that PRV was discovered and characterized in Atlantic salmon that were suffering from disease^[1].

Thanks to some of the impressive research within DFO, it didn't take long for scientists to realize that this virus was also present in British Columbia. In 2011, PRV was detected by Dr. Kristi Miller's lab in farmed Chinook salmon that were suffering with a disease called jaundice/anemia (also known as jaundice syndrome). In fact, Kristi Miller was the first to link the virus to jaundice-like disease in Pacific salmon. As recently reported in the Globe and Mail, the public were kept in the dark about this research for ten years^[2]. The study has still not been published in a scientific journal – although a draft of the manuscript has been released to the public thanks to the Information Commissioner's investigation, which found DFO's refusal to release her work unlawful. Had this work not been held back from the scientific community, perhaps some of the impact on salmon in BC from this virus may have been prevented.

Luckily there have been many other published studies on this virus since its discovery in BC. In 2013, independent scientists published the first genomes of PRV from Western Canada.

Since this initial work, various strains of PRV have been linked with similar diseases in other species of salmon all around the world^[3-10]. There's now overwhelming evidence that PRV poses a risk to wild Pacific salmon, and salmon farming is amplifying those risks^[5,11]. I'll review some of this evidence below, but the take home message is that salmon farms are a source of infection to wild salmon, and infections are linked to disease, poor health and poor survival.

Dr Miller's research on the health of wild salmon is fundamentally different to much of the work that came before. In wild salmon, we rarely observe diseased fish in the natural environment – instead, evidence suggests they are removed by predators^[12]. By applying cutting edge DNA technologies, Dr Miller's team are able to monitor the presence of the pathogens themselves. and if pathogens are co-localised with signs of disease:

- In 2017 Dr Emiliano Di Cicco, working closely with Kristi Miller, and her team found that PRV is associated with heart disease on Atlantic salmon farms in BC^[3].
- In 2018 Dr Miller's team found that PRV is associated with the rupture of red blood cells in Chinook salmon^[5], which is a mechanism explaining the jaundice/anemia symptoms in the farmed Chinook salmon in the blocked study. Early signs of this same disease have also even been observed in juvenile wild salmon infected with PRV^[13].

Viruses leave a genetic fingerprint. My own work uses viral genome sequencing to track the movements of viruses. Last year, I led a study which found that PRV was introduced from Norway to BC about 30 years ago^[11]. This is very similar to the work you might have heard about that tracks the movement of COVID variants around the world.

We know that PRV is exceedingly common on salmon farms in BC and the genetic fingerprint of the virus shows that viral variants have moved between farmed and wild salmon. We also demonstrated that wild salmon close to farms are more likely to be infected.

Our most recent work has shown that increasing rates of PRV positivity in a population are associated with decreasing survival for Chinook salmon. Body condition (in terms of weight, a key health metric for wild fish) decreases as PRV infections become more intense in individuals^[14]. This evidence suggests that pathogens from salmon farms are having a negative effect on the health of wild Pacific salmon..

DFO ignore evidence and make fundamental scientific errors

Despite all this evidence, most of which was gathered by DFO scientists themselves, DFO have largely proceeded as if these findings did not exist, and conclude that farms pose minimal risk^[15]. The ramification of this is that our at risk wild Chinook salmon stocks have not received the protection that they need.

While Dr. Miller's study was being hidden, DFO managers actively supported other scientists to work with the salmon farming industry to undermine her findings, making claims that PRV does

not cause disease^[16-19]. These disease challenge studies conclude that PRV is not a cause of disease in Pacific or Atlantic salmon. We caution that absence of disease in a small number of studies that use laboratory fish, buffered from environmental stresses, and that wholly ignore the ecology of the host species, is not reliable evidence that a virus is benign. My scientific evaluation is that none of this work rules out the possibility or negates existing evidence that PRV can, and does cause disease in salmon.

Here is a specific example. DFO scientists sent an isolate of PRV from BC to Norway, to determine if the lineage of PRV in BC could cause disease in Atlantic salmon. The BC isolate was experimentally determined to cause heart lesions in a published paper, these are considered the hallmark for PRV-related disease in Atlantic salmon^[4]. That study experimentally corroborates the epidemiological association of PRV with disease on both Chinook and Atlantic salmon farms in BC^[3,5]. Yet, since DFO's assessment (FGR s.56 Disease Agent Assessment Form) specifically asks if PRV has "been demonstrated to cause disease in Canada," it appears that - due to a technicality - the above evidence is not sufficient for DFO to classify PRV as a disease agent. To illustrate the flaws in this line of thinking, we note that if similar thresholds were used in human medicine, SARS-CoV-2 would also not be classified as a disease agent in Canada, since the only human challenge trial was conducted in the UK^[20] (also resulting in only mild to moderate disease). For some reason, DFO requires disease relationships to be proven within Canada. Can you imagine if we used similar thresholds in human medicine?

Another example, DFO's CSAS review found that PRV cannot be the cause of disease because it can be found in healthy fish without high mortality on farms. The CSAS review states that "The absence of associated mortality or pathology in infected groups exhibiting high viral loads also indicates that the Pacific PRV is non-pathogenic." ^[21]. This is just like saying that COVID does not cause disease because some infected individuals are asymptomatic.

Making such fundamental errors in reasoning makes me very concerned that DFO is not providing evidence-based science in line with their scientific integrity principles.

DFO's science advice relies on a selection of industry-funded lab studies, which place a high bar in their definition of what constitutes "disease". Meanwhile, research which does find evidence of harm is ignored or suppressed. This raises questions whether conflict of interest could have influenced how CSAS reviews were designed, interpreted and reported.

Before passing away earlier this year, one of Canada's top fishery scientists Jeffrey Hutchings posed the question "Are we interested in preventing disease, or the semantics of whether (disease) events meet the right definitions?". I think this simple question is a powerful statement on how DFO have mismanaged this issue.

DFO management altered advice to the Minister's questions on PRV ahead of May 28 FOPO Prep Meeting

Correspondence contained by ATIP documents (which I have also submitted) show that DFO managers entirely removed Dr. Miller's statements (see ATIP A-2021-00351, pp. 000210-

000214 for the full statement) from a briefing note prepared for the Minister's office regarding the manuscript Dr Miller and myself co-authored on PRV^[11]. Dr. Miller was asked to review the significance of our work, and provided an in-depth review explaining the importance and significance of the research, most notably the key message that PRV is transmitted from farms to wild Chinook salmon. However, the answer supplied to the minister removed key details (see ATIP A-2021-00267, p. 000608), instead relying on the conclusions of the previous CSAS report concerning sockeye salmon, which found the virus posed minimal risk. This is despite the fact that there is a growing body of evidence which strongly suggests that PRV poses a risk to Chinook salmon. DFO's advice to the Minister disregards Dr Miller's input entirely and effectively amounts to telling the Minister "nothing to see here".

A widespread problem

This problem of political and industry influence seems to be prevalent across DFO. DFO have repeatedly lost in court because their management of pathogens on farms is unlawful, and their decision making lacks transparency.

Similar patterns of DFO disregarding inconvenient evidence with other pathogens such as Tenacibaculum and sea-lice have been documented. We heard about some of these examples in the Pacific Salmon Foundation's statement to the FOPO committee delivered by Dr Andrew Bateman. Reports have also emerged about concerns from within DFO itself, and these are not restricted to issues with the management of salmon farms.

- A DFO scientist told the [Globe and Mail](#) that Ottawa is too beholden to the fish farm industry.
- A survey by the Professional Institute of the Public Service of Canada found that in the past 3 years [30% of DFO respondents](#) "have experienced or witnessed situations where there was an interference with the department's science-based work by business or industry lobbyists."
- A leaked [letter](#) from the union representing DFO scientists described a pattern of DFO "undermining scientific peer review processes and credibility" including the outright withholding of science advice publication and this included detailed instances of interference from industry stakeholders.
- DFO [managers edited a key scientific report](#) on Thompson and Chilcotin steelhead to downplay risk to these populations.

Scientific Integrity

Based on my experience, I am concerned about the evidence-based decision making process currently used by DFO.

DFO has a conflict of duty – to promote salmon farming and conserve wild fisheries. DFOs [policy](#) is that decisions are made in a manner which upholds the public interest - but this does not appear to always be the case.

It is not just the external review of science where conflicts can arise. Greater transparency is needed in how science questions are prioritized, funded, and ultimately communicated (including internal communications).

Science Review

Canada is falling behind internationally. The US, the EU, Australia and New Zealand all incorporate independent science advice into fisheries management.

Science advice needs to be free from political and commercial interference. Based on what I have witnessed to date, this is currently not the case with DFO. I conclude that there is a need for an independent fisheries-science advisory body that would be able to review and weigh evidence, especially in light of conflicts of interest. The assessment and summary of information to decision makers needs to be free from vested interests.

The response from DFO officials will be that the CSAS process meets peer review standards. You've heard from previous witnesses some of the problems with the CSAS process. For instance, the CSAS review does not require participants to be external or independent. This contrasts with the science peer review system used by scientists to publish papers, where reviewers who have a conflict of interest are often excluded, especially if the conflict is financial. Would you ask a tobacco company to review the science on lung cancer?

In the aforementioned CSAS processes, not only did the industry have a vote at the table, but the numbers of individuals affiliated with the aquaculture industry and industry-funded science generally outweighed those that did not. Industry stakeholders are owed consultation, but this needs to be separate from the science review process and the flow of scientific information to decision makers.

Recommendations

Rather than propose my own recommendations, below I highlight previous recommendations which I believe would go some way to resolve some of the issues I described above.

- **Cohen commission - Recommendation 3:** "The Government of Canada should remove from the Department of Fisheries and Oceans' mandate the promotion of salmon farming as an industry and farmed salmon as a product."
- **Independent Expert Panel on Aquaculture Science - Recommendation 1:** "DFO should implement best practice in synthesizing available scientific evidence on aquaculture risks. This includes incorporation of Indigenous and local knowledge as well as the use of systematic reviews, external peer review and other universally accepted standards."
- **Independent Expert Panel on Aquaculture Science - Recommendation 4:** "DFO should establish an External Advisory Committee on Aquaculture."

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