WGS mink analysis and RE: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

From: Clair, Veronic [BCCDC] <veronic.clair@bccdc.ca>
To: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Cc: Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>, Sekirov, Inna [BCCDC] <inna.sekirov@bccdc.ca>
Sent: February 12, 2021 1:06:51 PM PST

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Hi Bonnie,

s.13; s.17

A policy director from MAFF has reached out to know when we might be able to share the answers. I have indicated that I could not give a precise timeline.

Best,

Veronic

From: Newhouse, Emily [FH]
Sent: February 12, 2021 12:46 PM
To: Brodkin, Elizabeth Dr. [FH]; Henry, Bonnie [EXT]
Cc: Clair, Veronic [BCCDC]
Subject: mink clade community transmission

Hello Elizabeth and Bonnie,

s.13; s.17

We can share the full report if it is of interest, once available.

Regards,
Emily

Emily Newhouse, MD, MPH, FRCPC
Medical Health Officer
Fraser Health

Administrative assistant:
Christy Burkett
Ph: 604-930-5405, ext 765638
christy.burkett@fraserhealth.ca

FW: Final draft for review ASAP re: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

From: Clair, Veronic [BCCDC] <veronic.clair@bccdc.ca>
To: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Sent: February 12, 2021 1:12:32 PM PST
Attachments: Mink questions for Health and CDC DRAFT Final Feb 8.docx

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Hi Bonnie,

Here is the document with the draft answers.

Thanks

Veronic

From: Clair, Veronic [BCCDC]
Sent: Monday, February 8, 2021 2:14 PM
To: Henry, Bonnie [EXT] <bonnie.henry@gov.bc.ca>
Cc: Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>; Sekirov, Inna [BCCDC] <inna.sekirov@bccdc.ca>
Subject: Final draft for review ASAP re: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

Hi Bonnie,

Please find attached the final draft of the answer to the Assistant Deputy Minister of Agriculture, Food and Fisheries (MAFF).
The original request for answer was to you and me. Let me know if you want to review or if I can send it as such to Jennifer.

s.13; s.17

Thank you very much again for being our PHO and for all your work.
Best,

Veronic

Dr. Veronic Clair, MD, MSc, CCFP, FRCPC, PhD
Physician Epidemiologist

BC Centre for Disease Control
veronic.clair@bccdc.ca

I respectfully acknowledge that I live and work on the unceded territory of the xʷməθkwəy̓əm, Skwxwú7mesh, Stó:lō and Səl̓ilwətaʔ/Selilwitulh Nations.

From: Clair, Veronic [BCCDC]
Sent: Thursday, February 04, 2021 11:19 AM
To: 'McGuire, Jennifer AGRI:EX'; Henry, Bonnie [EXT]
Cc: Hrycuik, Lorie [EXT]; Anderson, Arlene AGRI:EX
Subject: RE: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

Hi,
BC CDC drafted an answer which was circulated early this week. Extensive feedback was obtained during a meeting on Tuesday involving most members of the One Health working group working on mink farms and COVID. s.13; s.17
s.13; s.17

I hope to receive all feedback and provide the document with the answers back to you early next week.

Best,

Veronic

Dr. Veronic Clair, MD, MSc, CCFP, FRCPC, PhD
Physician Epidemiologist
BC Centre for Disease Control
veronic.clair@bccdc.ca

I respectfully acknowledge that I live and work on the unceded territory of the xʷməθkwəy̓əm, Skwxwú7mesh, Stó:lō and Səl̓ilwətaʔ/Selilwitulh Nations.

From: McGuire, Jennifer AGRI:EX [mailto:Jennifer.Mcguire@gov.bc.ca]
Sent: Thursday, February 04, 2021 11:07 AM
To: Clair, Veronic [BCCDC]; Henry, Bonnie [EXT]
Cc: Hrycuik, Lorie [EXT]; Anderson, Arlene AGRI:EX
Subject: RE: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

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Hello Dr Henry and Dr Clair,

My minister office is interested in the mink farming risk to humans – and is seeking an opinion from health professionals. Your opinion is important to inform now urgent decisions regarding the mink farming sector. When can the ministry expect to receive a response?
Thank you

Jennifer McGuire, P.Ag.
Assistant Deputy Minister
Agriculture Science and Policy Division
Ministry of Agriculture, Food and Fisheries
Ph: 778-698-8521 Cell: 250-361-5944

From: McGuire, Jennifer AGRI:EX
Sent: January 31, 2021 7:42 PM
To: 'Clair, Veronic [BCCDC]' <veronic.clair@bccdc.ca>; Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>

Cc: Hrycuik, Lorie HLTH:EX <Lorie.Hrycuik@gov.bc.ca>; Anderson, Arlene AGRI:EX <Arlene.Anderson@gov.bc.ca>
Subject: RE: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

Hello Dr. Clair

The Pathway Document was prepared by AGRI staff to for the purpose of organizing the information that had been provided to AGRI by CDC.

I understand the time demand and constraints.
Thank you for your attention as time permits.

Jennifer McGuire, P.Ag.
Assistant Deputy Minister
Agriculture Science and Policy Division
Ministry of Agriculture, Food and Fisheries
Ph: 778-698-8521 Cell: 250-361-5944

From: Clair, Veronic [BCCDC] <veronic.clair@bccdc.ca>
Sent: January 29, 2021 10:06 AM
To: McGuire, Jennifer AGRI:EX <Jennifer.Mcguire@gov.bc.ca>; Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Cc: Hrycuik, Lorie HLTH:EX <Lorie.Hrycuik@gov.bc.ca>; Anderson, Arlene AGRI:EX <Arlene.Anderson@gov.bc.ca>
Subject: Re: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Thank you for your email and involving us in this assessment.

The BC CDC works very closely with Fraser Health, WorkSafe and across several ministries, including the Ministry of Agriculture, Food and Fisheries to s.13; s.17 s.13; s.17 I would qualify the current level of risk management as effective, and evolving as the situation and evidence evolves.

Answering the list of questions you provided will take some time, in order to ensure agreement across relevant health stakeholders, including the health authority managing more closely the s.13; s.17 s.13; s.17 on the ground.

Thank you for circulating the pathway document. I don't recall seeing this specific document before. Can you clarify where this document comes from and who contributed to filling it out?

Best,

Dr. Veronic Clair, MD, MSc, CCFP, FRCPC, PhD
Physician Epidemiologist
BC Centre for Disease Control
veronic.clair@bccdc.ca

From: McGuire, Jennifer AGRI:EX <Jennifer.Mcguire@gov.bc.ca>
Sent: January 28, 2021 8:32 PM
To: Henry, Bonnie [EXT]; Clair, Veronic [BCCDC]
Cc: Hrycuik, Lorie [EXT]; Anderson, Arlene AGRI:EX
Subject: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

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Dr. Bonnie Henry
Provincial Health Officer
Office of the PHO
Bonnie.Henry@gov.bc.ca

and

Dr. Veronic Clair, MD, MSc, CCFP, FRCPC, PhD
Physician Epidemiologist
BC Centre for Disease Control
veronic.clair@bccdc.ca

Hello Dr. Henry and Dr. Clair,

The Ministry of Agriculture, Food and Fisheries is currently assessing all options of s.17 s.17 activities as well as seeking to understand where mitigation/actions should be taken to address unacceptable s.17

Please find attached a list of questions which we seeking to understand the PHO & CDC perspectives on the s.13; s.17 s.13; s.17 in light of COVID-19 and potential other infectious respiratory diseases (should they occur in the future). The questions are in the context of current, projected and future infectious respiratory diseases.

s.17 currently at low s.17 ; within a weeks s.13; s.17 s.13; s.17 will then increase potentially 4 times by April/May. Ministry staff would appreciate discussing the questions with you should clarification be needed, at your earliest convenience. Your responses are important to inform the ministry review of this sector.

Thank-you for all that you are doing for the province of BC!

Thank you

Jennifer McGuire, P.Ag.
Assistant Deputy Minister
Agriculture Science and Policy Division
Ministry of Agriculture, Food and Fisheries
Ph: 778-698-8521 Cell: 250-361-5944

Mink questions for Health and BCCDC

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1. From your perspective, how high is the risk to human health due to SARS-CoV-2 transmission on mink farms?

A cross-government, multi-agency team in BC (One Health Committee, BC Centre for Disease Control, Ministry of Agriculture, Food and Fisheries, Ministry of Environment, Ministry of Forests, Lands, Natural Resource Operations and Rural Development , WorkSafe BC, Fraser Health Authority, Canadian Food Inspection Agency) has been working together since mid-2020 to assess risks and develop mitigation measures to prevent/address potential SARS-Cov-2 transmission into mink herds and limit the potential spread to humans or other animals (domestic and wild). With the occurrence of infected mink herds, the work of this group was escalated to implement control and mitigation measures, surveillance, and increase our understanding of the evidence, risks and mitigation strategies applied in other jurisdictions. This group's work has informed the following answers from HLTH.

The main risks to human health include:

a. The risk of emergence of one or more mutations in the SARS-CoV- 2 virus of public health significance in mink, or wildlife infected from minks (including the risk of emergence of a reservoir with ongoing transmission and opportunities for mutations), leading to a mink related variant of concern (VoC).
b. The risk of sustained onward transmission of mink related VoCs in humans

These risks can be mitigated through:

a. Preventing transmission to captive mink herds, including through
    - active surveillance of infection status in farm workers
    - implementation of robust Covid-19 safety plans on farms
b. Active surveillance of infection among mink herds
c. If a mink herd becomes infected
    - Monitoring of mutations arising in mink if a herd is infected
    - Decreasing the opportunity for viral replication in the herd
    - Preventing transmission of the virus back to workers and to other animals through implementation of robust Covid-19 safety plans on farms
    - Prevention of transmission to the general population through robust isolation protocols for any affected farm workers
d. Ongoing surveillance of wildlife

The European CDC assesses the health risk associated with transmission of currently existing mink variants as follows:

- "low for the general population and moderate for medically-vulnerable individuals, which is no different to other SARS-CoV-2 strains (not related to mink);
- low for the general population in areas with a high concentration of mink farms and moderate-to-high for medically-vulnerable individuals living in the same areas;
- moderate for non-medically vulnerable individuals with occupational exposure and very high for medically-vulnerable individuals with occupational exposure." (European Centre for Disease Prevention and Control 2020)

The ECDC risk assessment is based on the strains found in Europe, which included cluster 5 and had demonstrated mink to human transmission.

As of early February, considering the mitigation measures available, the level of risk as estimated by the One Health Committee, using a similar interpretation of risk levels as in the CFIA Rapid Qualitative Risk Assessment (RQRA): SARS Coronavirus 2 (Canadian Food Inspection Agency 2020), previously circulated to the Ministry of Agriculture, Food and Fisheries and which informed the generation of the pathway document, is summarized in the next paragraph.

Currently, the above multi-agency teams are working with the industry to implement ongoing human and mink viral surveillance as well as to enhance Covid-19 safety plans on farms. Once the above mitigation measures are well implemented, assuming continued cooperation of industry, we estimate the risk of a SARS-CoV-2 variant virus of concern arising at a mink farm, and then being transmitted back to a worker and onward to the general population or wildlife, in a way that would significantly threaten the health of the population, as low and acceptable; however, there is a significant degree of uncertainty.

Of note, there are recent viral genetic sequencing data, from mink and associated human SARS-Cov-2 infections in BC, currently being analysed by the BCCDC Public Health Laboratory and will be integrated into additional evaluation of the evolving situation by the One Health Committee, when available. Further information on the different aspect of this risk assessment is detailed subsequently.

A. Risk of mutations of significance arising from affected mink farms in BC

With mitigation measures in place and adhered to, we estimate the risk of a mutation of significance arising at an infected mink farm, as low and acceptable, with some uncertainty.

The assessment is due to the relatively small number of mutations of significance that have arisen in other countries with a much larger mink farming industry and viruses circulating for longer duration in mink herds.

The most concerning variant associated with mink worldwide has been the Cluster 5 variant from Denmark, which had suspected changes to antigenicity, vaccine effectiveness, and/or transmissibility. This variant is no longer considered to be circulating. Numerous other mink-associated mutations have been documented but have not been as concerning as the cluster 5 variant.

Information from the USA indicates that infected mink herds are clearing infections. No clusters of concerning mutations have been found in the USA. This information is limited to the states where infections have been recognized and for which genomic assessment was available. It is suspected that infections have gone undetected in several other states.

In BC, the whole genome sequencing (WGS) results on samples taken from both farms show evidence of mutations, including mutations in the spike protein. These mutations were not present as clusters and at this point there is no evidence that the individual changes observed are likely to impact immunogenicity of the strain or its susceptibility to immune responses generated by infections with other strains. Additional details are presented in Appendix 1. Further analyses are pending, but unlikely to change the interpretation

significantly. It is possible that in minks not sampled other mutation arose undetected. However, there is no indication of transmission of such unrecognized mutations to workers or wildlife at this point.

The remaining adult mink on the first infected premises are being tested regularly to assess for evidence of ongoing infection or not, and to perform WGS if virus is found in sufficient quantity in samples. There is indication that the herd is clearing the infection and there is insufficient virus to perform further WGS from recent samples. Introduction of uninfected animals to that herd, for breeding or as a result of breeding, would pose a risk of renewed transmission if the herd and the environment still has viable virus (circulating in mink or remaining as a contaminant on the premises). The probability of live circulating virus at this point is considered low.

All mink on the second infected premises have been euthanized.

There is some very low residual risk of transmission of a mutation of concern back to workers from manipulation of infected material (from carcasses, manure, pelts, etc.) on both farms, even if there could still be a risk of transmission of the virus back to the workers handling those materials. The risk will be mitigated by the procedures to be followed as per the safety plans.

The risk of the SARS-CoV-2 virus from the infected premises to overflow and infect wild animals and then generate a reservoir of ongoing transmission and viral replication is considered very low with moderate uncertainty. Wildlife surveillance for SARS CoV-2 is underway and will provide further indication of the risk, with all samples to date negative for the virus. There is no risk of transmission of virus from the mink farms environment to the population surrounding the farms. The virus was not found in environmental sources outside of the premises (not airborne to surrounding areas), based on a prior study (de Rooij et al. 2021).

B. Risk of mutations of significance arising from currently uninfected mink farms in BC

The Public Health Agency of Canada and the Canadian Food Inspection Agency estimated that the probability of one mink worker to be infected with COVID-19 during the week of January 3rd at 13.2%. This is based on an estimated relatively low number of workers per 1,000 breeder mink females. Of note, this does not take into account the large number of undiagnosed human infections, estimated to be about 4 to 10 times as much as the diagnosed ones, with an early estimate in BC of 8 times higher (Skowronski et al. 2020). The number of mink workers will increase significantly with the breeding season from what we understand from sources in the mink industry. The incidence of COVID-19 in the Fraser Health Authority has been declining in the last several weeks, but the importation of variants of concerns into BC may significantly change the dynamic of the epidemic in BC, and could result in a much increased incidence. There is uncertainty about the impact those variants will have in BC, and if control measures will continue to be effective in mitigating spread.

Regardless, the probability at any given time that at least one mink worker may become infected with COVID-19 is still sufficient to warrant implementing several mitigation strategies to prevent transmission of the infection to mink herds.

There is a currently moderate uncertainty about the effective and consistent use of PPE on the uninfected premises. This is being addressed in part with WorkSafe and public health (Fraser Health - FH) inspections and review of Safety Plans and determination of the BC recommended level of PPE for various scenarios on

uninfected premises. AGSafe provides fit testing and training relative to PPE usage. WorkSafe BC plans to continue with periodic workplace health and safety inspections throughout the breeding season and beyond as part of the enforcement activity.

BC CDC in collaboration with FH is implementing a voluntary screening program for mink farm workers with weekly PCR testing from gargle samples. This is likely to reduce the probability of an infected worker continuing to work on the farm while infectious, even if asymptomatic, pre-symptomatic or mildly symptomatic. The testing program, even with full participation, will not remove the risk completely. It is estimated that such a testing program can decrease the risk of transmission of infection to other humans by about 60%. It is difficult to estimate what that would be in relation to transmission to mink, or whether the estimate would still be precise in relation to transmission of the emerging variants of concern strains of SARS-CoV-2, but these measures should significantly reduce the risk.

There is still a risk of a worker being infectious and not detected via the testing program, therefore it is imperative that farms maintain appropriate overall COVID-19 Safety Plan protocols including the use of PPE when interacting with minks, including their food supply as well as when workers are in close proximity to each other.

However, assessing and putting in place controls for the transmission of the virus between workers and between workers and mink, such as enhanced cleaning and sanitation, maintaining physical distancing, and the use of PPE, even complemented by PCR screening, will not reduce the risk of transmission of infection to the herd completely. Other mitigation measures must be in place. Another major mitigation strategy involves surveillance of the mink herd to detect infection at an early stage. Early detection would enable genomic surveillance for mutations, and trigger further actions such as quarantine of the premises, increase in PPE and other safety plan measures to prevent transmission back to workers, and enhanced surveillance of workers to assess if transmission of the virus from mink to humans is occurring.

Continued work is ongoing by the farms, Fraser Health, WorksafeBC, and Agsafe to establish, communicate, and ensure implementation of the necessary risk and control measures. However, while mitigation measures are in place, the execution of these safety plans needs to be monitored especially in light of staff increases for breeding season, increased handling of mink during breeding season, staff turnover, as well as potential language barriers with temporary and/or migrant workers.

With an appropriate COVID safety plan in place, screening and surveillance programs of humans and animals, and inspections, the risk would remain low, in spite of the upcoming mink breeding season and related increase in mink herd size. The herd size is still considered small compared to other countries where mutations have arisen.

Based on the mitigation measures being implemented and continued cooperation from the farms, the risk of a mutation of concern arising and spreading to a worker is low, with some uncertainty, and is considered very low for spreading to the general population or wildlife, with more uncertainty related to the wildlife spread. The risk is considered acceptable.

This assessment would remain as such during the upcoming mink breeding season, as long as all recommended mitigation measures are implemented and monitored, and that the mink industry continues

with strong cooperation with public health measures, including the testing program and strict isolation, as needed. This assessment may be revised with future evidence or changes in epidemiology.

Summary and conclusions of risk assessment (as of early Feb 2021)

- The risk of a mutation of concern from mink is currently considered low, with some uncertainties, remaining acceptable in BC.
- We agree with assessments from other jurisdictions that with workers using proper personal protective equipment, adhering to WorkSafe MAGRI and Public Health protocols for managing mink, with supervision of the implementation of the safety plans, the risk of spread of a mutation of concern is very low and would still be low during breeding season and onward. If the epidemic is significantly changed by the current variants of concern the risk also increases, however with these mitigation measures in place we consider the risk as acceptable.
- Vaccination of the BC population will help to further mitigate the risk and potentially limit the concern of mutations of significance.
- This risk assessment reflects current information and may be revised with new evidence at a subsequent date.

2. Is the potential of SARS-CoV-2 spread via this pathway of concern to the Ministry of Health (HLTH)?

Public health is concerned about the development of variants of concern resulting from mutations from any pathways, including mink. Human variants of concern have been detected and present a known risk that may affect the epidemic. Because of different selection pressures in animals, the large congregate populations of mink, as well as potential for recombination with other animal viruses, there is a difficult-to-quantify risk of development of variants of concern in mink, which are highly susceptible to Sars-Cov-2. Continued surveillance, implementation and monitoring of safety plans are crucial.

There was sufficient concern from work safety and health agencies in BC to invest significant efforts in understanding the risk and acting quickly to implement detection, prevention, and control strategies for mink farms and mink farm workers in BC. See Fraser Health's public health order to this effect.

3. From your perspective, what special steps, if any, should the Ministry of Agriculture, Food and Fisheries (AFF) take to minimize the risk?

In the short-term:
s.13

4. In the mink breeding season, the mink populations on farm increase by 3-to-4 times. In your estimation, to what degree would this increase transmission risk?

Population size and density will increase overall risk, although it is difficult to quantify the degree. The types of interactions between mink workers and the mink are also key factors in transmission risk. The pelting process and euthanasia are interactions considered to be aerosol generating (high risk). However, research found that even in the area surrounding the minks (not where pelting or euthanasia was occurring) airborne inhalable dust contained significant amount of viruses. Dispersion of the virus was found to be limited and air samples collected beyond farm premises did not detect SARS-CoV-2 (de Rooij et al. 2021). Research has shown a negligible risk of *environmental exposure* for nearby communities even in the event of an outbreak.

The virus appears to have a predilection for older animals, as such, while there is increased risk with increasing numbers of animals, kits may be less susceptible to clinically significant infection or shed less virus.

Farms are already participating in an animal disease surveillance program; this program will likely be expanded for greater sensitivity of disease detection in the coming weeks.

Infected mink workers are the primary source of risk to mink. The breeding season increases risk of transmission to the herd because additional workers are required. This is due to increased probability of an infected worker being present on farm (purely from a probabilistic perspective), and pose a risk of both infecting other workers, as well as mink. Additionally, some farms recruit temporary workers for this period, and these workers are likely to be less experienced in the work and less experienced in biosecurity and personal protective equipment-related procedures, meaning the risk of transmission may be additionally increased.

Risk of transmission is dependent on the level of COVID-19 cases in mink workers' communities and the extent to which mink farmers adhere to and successfully implement recommended COVID-19 safety strategies and biosecurity protocols.

On farms not known to be infected, we are requiring the use of medical-grade masks and eye protection for all activities where workers are in the close proximity of mink. We are requiring the usage of respirators or

equivalent during pelting and euthanasia. On farms with documented infection, all activities involving mink will require respirators or equivalent.

As referenced above, a human testing program is currently being rolled out across farms, involving all employees submitting a self-collected saline gargle test once weekly. This program is currently voluntary and industry has expressed willingness to participate. However, sufficient risk mitigation is dependent on high compliance with this program.

Infected service personnel including feed and bedding delivery drivers, repair personnel and veterinarians that may have contact with live mink also pose a risk of transmission. These risks can be mitigated through appropriate farm biosecurity protocols that limit access to mink and require appropriate PPE and mitigation measures to reduce risk if contact with live animals or their feed supply is required.

The risk during breeding season is acceptable and manageable as long as mitigation measures are implemented and monitored. Farms have been permitted to continue breeding in affected and non-affected premises.

5. In your estimation, to what degree would the combination of an increase in SARS-CoV-2 numbers in the Fraser Valley along with the breeding season on mink farms, elevate the probability of SARS-CoV-2 transmission between humans and mink?

With an increase in SARS-CoV-2 case rates in the Fraser Valley, along with the size of worker population required for breeding season, a Covid-19 case among mink workers would be highly likely. The risk of transmission to the mink, and/or subsequent transmission of a mink-related strain back to workers, will be highly dependent on participation of farms in active testing of their workers and mink, appropriate symptom screening of workers, compliance with isolation and quarantine direction, and adherence to rigorous Covid-19 safety plans, both in reference to human-human interactions and human-mink interactions.

6. In the event of this combination would the elevated probability increase HLTH's concern for SARS-CoV-2 spreading and/or justify additional risk reduction steps?

There are a variety of mitigation measures available as described above, and these can be scaled up if needed. Given current knowledge, the mitigation strategies are likely effective and in the event of additional detection of positive mink herds, the same mitigation steps would apply. s.13

s.13

Thus far, as described above, most mutations on mink farms have not suggested additional risk in terms of increased transmissibility, or reduced response to vaccine or other biological agents. No mink-related strain

worldwide has become a VoC. There is a high degree of uncertainty as to the likelihood of selection pressures within infected mink generating a VoC. If a new VoC were to be documented in association with mink farms, this would likely substantially revise the risk assessment.

7. In your estimation, would the mutation probability of SARS-CoV-2 in the farmed mink population increase dramatically as a result of population increases due to the mink breeding season?

With a larger mink population, there will be a larger number of susceptible minks, providing additional opportunity for individual mutations and additional opportunity for cumulative mutations. The probability of Sars-CoV-2 mutation into a variant of concern would likely increase substantially, but it is difficult to quantify the degree. It may also depend to some extent on transmission patterns within the herd, which may differ from farm to farm depending on infrastructure and protocols.

8. What other concerns might you have regarding SARS-CoV-2 transmission and the mink breeding on farms?

As referenced above, there is an additional theoretical risk associated with transmission of the virus to wild animals in the vicinity of infected farms, particularly if mink escape from farms and contact wild animals. This could result in the establishment of an animal reservoir for SARS-CoV-2, which is associated with long-term risks of recombination and future spillover events into humans. From the experience of other jurisdictions, this appears to be less likely. The low density of wild mink and their solitary and territorial nature limit opportunities for spread of SARS-CoV-2 from escaped farmed mink and also limit the likelihood of establishing a reservoir or for the development of mutations of concern in wildlife populations (Canadian Food Inspection Agency 2020; Delahay et al. 2020). Caution needs to be taken on farms during breeding season when increased handling of mink allows for more possibilities of mink escaping. The overall risk due to this issue does not change the overall risk assessment.

While there is a risk of transmission from a worker to a mink herd, with mitigation measures in place the risk is acceptable. Even with increased incidence of COVID-19 in the Fraser Valley the risk of transmission continues to be manageable due to mitigation and surveillance strategies. The risk of a mutation of significance arising in breeding season and spreading to the general population is low, but with a significant uncertainty. The risk of an animal reservoir for SARS-CoV-2 is low but with significant uncertainty, and is not significantly changed with the breeding season.

s.13

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Skowronski, Danuta M., Inna Sekirov, Suzana Sabaiduc, Macy Zou, Muhammad Morshed, David Lawrence, …, and Mel Krajden. 2020. *Low SARS-CoV-2 Sero-Prevalence Based on Anonymized Residual Sero-Survey before and after First Wave Measures in British Columbia, Canada, March-May 2020*. *preprint*. Infectious Diseases (except HIV/AIDS). doi: 10.1101/2020.07.13.20153148

Appendix 1. Summary of mutations found and comparison to previously identified mutations

To date, the most significant SARS-CoV-2 variant of public health concern from mink is the cluster 5 variant that was detected in mink in Denmark; the cluster 5 variant was subsequently detected in 12 people (European Centre for Disease Prevention and Control 2020). The concern with this cluster was that it may affect antigenicity. Cluster 5 is currently considered controlled as it has not been detected since September. This cluster has not arisen in association with affected mink farms in BC. Further, no other variants with the same pattern of mutation clusters have arisen in the BC mink whose viruses have been sequenced to date.

A Y453F mutation in the spike protein was first noted in mink in Denmark (214 animals) and in the Netherlands. There was no epidemiological link between the countries for these cases, so the mutation is considered to have arisen independently. Subsequently this mutation has been reported in mink in other countries. The Y453F mutation has been shown to have increased affinity to ACE-2 receptor, without challenging antibody neutralization (Bayarri-Olmos et al. 2021). Y453F was observed at variable frequencies in 18 mink from Farm 1, 2 mink from Farm 2 (low frequencies) and no humans associated with Farm 1 or in the community.

Mink-related strains reported by Denmark additionally carry a deletion of two amino acids (69-70) in the spike protein. The deletion of 69-70 has been found in humans unrelated to mink farms. It seems to increase infectivity (Kemp et al. 2020). The 69-70 deletion has been found in the B.1.1.7 variants of concern first uncovered in the UK. That particular variant of concern has 17 mutations in amino acid, including 8 in the spike protein. This mutation has not been found in relation to mink farms in BC.

Some other spike protein mutations have been identified in minks in the infected premises (3). N501T was observed at variable frequencies in 16 mink from Farm 1, 2 mink from Farm 2 (low frequencies) and no humans associated with Farm 1 or in the community. F486L was observed at variable frequencies in 13 mink from Farm 1, 3 mink from Farm 2 (up to 40% in one mink) and no humans associated with Farm 1 or in the community.

One spike mutation, A222V, was observed at variable frequency in minks in the first infected farm. It was found at a frequency of close to 36% in one human initially identified as a SARS-CoV-2 active case of the Farm 1 outbreak, and at a frequency of 100% in one additional human SARS-CoV-2 case identified subsequently in association with Farm 1 outbreak. It has also been observed in several patients in the community at between ~30% to 100% frequency in their genomes. This mutation has previously been reported in different places around the world without mink association. From the genetic sequencing data on mink and associated human SARS-CoV-2 infections on the first infected premises, it was not possible to ascertain if transmission occurred from infected mink to mink workers.

A non-spike mutation previously seen in mink has also been found in BC. In the original set of 5 humans and 5 mink viruses associated with Farm 1, H182Y mutation, in orf3a gene, was found at variable frequencies in all 5 mink and 4/5 humans. It continues to be found at variable frequencies in all but 1 other mink from Farm 1, as well as at 100% in 5/8 additional humans associated with farm 1. H182Y mutation is also found at nearly 100% frequency in all mink collected from farm 2. It has also been observed at between ~50% to 100% frequency in several patients in the community. There is no temporal analysis at this point to ascertain if it was present in humans before it was found on farm 1.

Compared to mink herds in the Netherlands and Denmark, the 2 affected mink herds in BC are very small, and the virus has been circulating in mink for a shorter period. No clusters of mutations of concern have been identified in association with the BC affected mink farms. As mentioned above, new viral genetic sequencing results are just becoming available and will be assessed for significance to public health. If transmission from the infected premises to workers and beyond was found to have arisen from the infected premises, the estimate of the risk would increase. However, the transmission would have arisen in a context where safety measures were not yet implemented to the level they would be with a future outbreak. Therefore, we would still qualify the risk as low.

Appendix 2: Risk mitigation factors and measures implemented or under consideration:

- *If infection is detected with a mutation of concern, other options can be considered such as reducing the size of the herd, decreasing opportunities for viral replication and mutations*.
- *Immune protection*: A mink worker with a previous COVID-19 infection is most likely to have some immunity and protection against reinfection. The risk of reinfection and transmission of a mutation of concern from previously infected workers is low, although variant strains may be more likely to cause a reinfection. Once vaccination is available, immunization of workers would provide some protection from developing an infection. Current mRNA vaccines have high but not complete efficacy at preventing infections, although infections in vaccinated individuals tend to have reduced severity and reduced symptoms. The efficacy will be variable for other vaccines depending on the result of the associated trials.
- *COVID-19 safety plan and the use of appropriate PPE:* Risks can be mitigated through the implementation and adherence to COVID-19 safety plans including consistent and appropriate use of PPE.
- *Ongoing SARS-CoV-2 testing of workers:* Weekly testing of workers will allow for rapid detection of new infections and monitoring changes in CT values for previously infected individuals.
- *Ongoing SARS*-CoV-2 testing of mink samples from each farm: allows for detection of infected herd if a human infection is missed.
- *Quarantine of infected workers and close contacts:* a 14-day quarantine period has been demonstrated to decrease risk of secondary transmission by 91-99%.
- *Implementing biosecurity measures with a strong emphasis on biocontainment to reduce opportunities of transmission from farms:* This could include ensuring integrity of mink cages and fences to prevent mink from escaping, additional measures to reduce risk from rodents (pest control) as well as measures for feral cats and wildlife on the site, etc….)
- *Quarantine of the farms:* stop movement order on animals, animal by-products, and things from the infected farms.
- *Genomic surveillance of viruses in infected human and mink:* conducting WGS and analyzing and comparing data from SARS-CoV-2 infections in mink and mink workers will allow for early detection of variant(s) of concern.
- *Ongoing surveillance of wildlife for SARS-CoV-2 to inform risk.*
- *Vaccination of mink kits and/or breeders as appropriate when a mink vaccine is available:* The current thought is that the Zoetis vaccine for mink in the US may be available to US producers by late March or early April. If this is the case, an emergency drug release could be used to import vaccine for CDN mink producers. This information was garnered from CFIA's expert personal communication with the US Fur Commission Research Committee that is assisting with the vaccine trials in the US in farmed mink.

Question about Mink Farms

From:	MacDonald, Alex HLTH:EX <Alex.MacDonald@gov.bc.ca>
To:	Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Cc:	Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Sent:	February 16, 2021 11:58:31 AM PST
Attachments:	193469 IN Options for fur farming in BC_FINAL2.docx, APPENDIX C Fur Animal Welfare Requirements in Legislation.docx

Hi Bonnie,
I had a conversation with Minister Popham's office about mink farming and they are headed into the breeding time where they re-stock populations on the mink farms.
MLP wants to know if there are any public health concerns/considerations or recommendations/guidance coming for this industry.
I've copied a couple notes they attached just in case you wanted a deep dive into the world of fur farming.
-Alex

RE: Question about Mink Farms

From: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
To: MacDonald, Alex HLTH:EX <Alex.MacDonald@gov.bc.ca>
Cc: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Sent: February 16, 2021 12:01:38 PM PST

Yes, there has been a lot of work done by BCCDC (Dr Veronic Clair and Dr Erin Fraser our PH Vet) with the Provincial Vet and the Ag team and both WorkSafeBC and FH in inspections, investigations, mitigation etc. We have a number of documents and plans for the farms. What were you looking for exactly? We can connect Minister Popham with BCCDC?
B

Dr Bonnie Henry
Provincial Health Officer
Office of the PHO
Ministry of Health
s.15; s.19
Mailing address: PO Box 9648, STN PROV GOVT
Victoria, BC
V8W 9P4
Bonnie.henry@gov.bc.ca

Phone: s.17; s.19

I gratefully acknowledge that I live and work on the traditional unceded territory of the Lekwungen Peoples, specifically the Songhees and Esquimalt First Nations. Hay'sxw'qu Si'em

Warning: This email is intended only for the use of the individual or organization to whom it is addressed. It may contain information that is privileged or confidential. Any distribution, disclosure, copying, or other use by anyone else is strictly prohibited. If you have received this in error, please telephone or e-mail the sender immediately and delete the message.

From: MacDonald, Alex HLTH:EX <Alex.MacDonald@gov.bc.ca>
Sent: February 16, 2021 11:59 AM
To: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Cc: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Subject: Question about Mink Farms

Hi Bonnie,
I had a conversation with Minister Popham's office about mink farming and they are headed into the breeding time where they re-stock populations on the mink farms.
MLP wants to know if there are any public health concerns/considerations or recommendations/guidance coming for this industry.
I've copied a couple notes they attached just in case you wanted a deep dive into the world of fur farming.
-Alex

RE: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

From: Emerson, Brian P HLTH:EX
To: Clair, Veronic [BCCDC] <veronic.clair@bccdc.ca>, Hrycuik, Lorie HLTH:EX <Lorie.Hrycuik@gov.bc.ca>
Sent: February 16, 2021 5:12:54 PM PST

There is no PHO order in the works of which I am aware. As this is a local issue it would most likely by an MHO order, unless there have been discussions between Bonnie and FH that have not been mentioned to me.

Thanks.

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

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From: Clair, Veronic [BCCDC] <veronic.clair@bccdc.ca>
Sent: February 16, 2021 4:57 PM
To: Hrycuik, Lorie HLTH:EX <Lorie.Hrycuik@gov.bc.ca>
Cc: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Subject: RE: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

Hi Lori,

I am not aware of the PHO developing an order. Brian might know more about PHO orders in the work.
All active mink farms are in FH. FH had issued an order already that is still in place.

The answers to MAFF questions were sent to Bonnie on Monday last week. Then recirculated at the end of the week. She indicated her intention to review over the weekend. But I have not heard back.

I am not sure if you or Brian want to check on the status of her review or even if Brian can offer to review on her behalf.

Best,

Veronic

Dr. Veronic Clair, MD, MSc, CCFP, FRCPC, PhD
Physician Epidemiologist
BC Centre for Disease Control
veronic.clair@bccdc.ca

I respectfully acknowledge that I live and work on the unceded territory of the xʷməθkwəy̓əm, Skwxwú7mesh, Stó:lō and Səl̓ilwətaʔ/Selilwitulh Nations.

From: Hrycuik, Lorie HLTH:EX [mailto:Lorie.Hrycuik@gov.bc.ca]
Sent: Tuesday, February 16, 2021 3:30 PM
To: Clair, Veronic [BCCDC]
Cc: Emerson, Brian [EXT]
Subject: RE: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

EXTERNAL SENDER. If you suspect this message is malicious, please forward to spam@phsa.ca and **do not** open attachments or click on links.

Veronic, Jennifer just called to ask if a PHO order was being developed on mink farms based on information provided by BCCDC. I said I would look into and let her know. The information was provided to Jennifer by her Minister's office.

Lorie

Lorie Hrycuik
Executive Lead, Population & Public Health Division
Ministry of Health
Phone: (778) 974-3766 | Lorie.Hrycuik@gov.bc.ca

From: Clair, Veronic [BCCDC] <veronic.clair@bccdc.ca>
Sent: February 4, 2021 11:19 AM
To: McGuire, Jennifer AGRI:EX <Jennifer.Mcguire@gov.bc.ca>; Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Cc: Hrycuik, Lorie HLTH:EX <Lorie.Hrycuik@gov.bc.ca>; Anderson, Arlene AGRI:EX <Arlene.Anderson@gov.bc.ca>
Subject: RE: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Hi,
BC CDC drafted an answer which was circulated early this week. Extensive feedback was obtained during a meeting on Tuesday involving most members of the One Health working group working on mink farms and COVID.s.13; s.17
s.13; s.17

I hope to receive all feedback and provide the document with the answers back to you early next week.

Best,

Veronic

Dr. Veronic Clair, MD, MSc, CCFP, FRCPC, PhD
Physician Epidemiologist
BC Centre for Disease Control
veronic.clair@bccdc.ca

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From: McGuire, Jennifer AGRI:EX [mailto:Jennifer.Mcguire@gov.bc.ca]
Sent: Thursday, February 04, 2021 11:07 AM
To: Clair, Veronic [BCCDC]; Henry, Bonnie [EXT]
Cc: Hrycuik, Lorie [EXT]; Anderson, Arlene AGRI:EX
Subject: RE: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

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Hello Dr Henry and Dr Clair,

My minister office is interested in the mink farming risk to humans – and is seeking an opinion from health professionals. Your opinion is important to inform now urgent decisions regarding the mink farming sector. When can the ministry expect to receive a response?
Thank you

Jennifer McGuire, P.Ag.

Assistant Deputy Minister
Agriculture Science and Policy Division
Ministry of Agriculture, Food and Fisheries
Ph: 778-698-8521 Cell: 250-361-5944

From: McGuire, Jennifer AGRI:EX
Sent: January 31, 2021 7:42 PM
To: 'Clair, Veronic [BCCDC]' <veronic.clair@bccdc.ca>; Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Cc: Hrycuik, Lorie HLTH:EX <Lorie.Hrycuik@gov.bc.ca>; Anderson, Arlene AGRI:EX <Arlene.Anderson@gov.bc.ca>
Subject: RE: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

Hello Dr. Clair

The Pathway Document was prepared by AGRI staff to for the purpose of organizing the information that had been provided to AGRI by CDC.

I understand the time demand and constraints.
Thank you for your attention as time permits.

Jennifer McGuire, P.Ag.
Assistant Deputy Minister
Agriculture Science and Policy Division
Ministry of Agriculture, Food and Fisheries
Ph: 778-698-8521 Cell: 250-361-5944

From: Clair, Veronic [BCCDC] <veronic.clair@bccdc.ca>
Sent: January 29, 2021 10:06 AM
To: McGuire, Jennifer AGRI:EX <Jennifer.Mcguire@gov.bc.ca>; Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Cc: Hrycuik, Lorie HLTH:EX <Lorie.Hrycuik@gov.bc.ca>; Anderson, Arlene AGRI:EX <Arlene.Anderson@gov.bc.ca>
Subject: Re: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Thank you for your email and involving us in this assessment.

The BC CDC works very closely with Fraser Health, WorkSafe and across several ministries, including the Ministry of Agriculture, Food and Fisheries t[s.13; s.17]
I would qualify the current level of risk management as effective, and evolving as the situation and evidence evolves.

Answering the list of questions you provided will take some time, in order to ensure agreement across relevant health stakeholders, including the health authority managing more closely[s.17]
on the ground.

Thank you for circulating the pathway document. I don't recall seeing this specific document before. Can you clarify where this document comes from and who contributed to filling it out?

Best,

Dr. Veronic Clair, MD, MSc, CCFP, FRCPC, PhD
Physician Epidemiologist
BC Centre for Disease Control
veronic.clair@bccdc.ca

From: McGuire, Jennifer AGRI:EX <Jennifer.Mcguire@gov.bc.ca>
Sent: January 28, 2021 8:32 PM
To: Henry, Bonnie [EXT]; Clair, Veronic [BCCDC]
Cc: Hrycuik, Lorie [EXT]; Anderson, Arlene AGRI:EX
Subject: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

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Dr. Bonnie Henry
Provincial Health Officer
Office of the PHO
Bonnie.Henry@gov.bc.ca

and

Dr. Veronic Clair, MD, MSc, CCFP, FRCPC, PhD
Physician Epidemiologist
BC Centre for Disease Control
veronic.clair@bccdc.ca

Hello Dr. Henry and Dr. Clair,

The Ministry of Agriculture, Food and Fisheries is currently assessing all options of s.17 s.17 ıctivities as well as seeking to understand where mitigation/actions should be taken to address unacceptable s.17

Please find attached a list of questions which we seeking to understand the PHO & CDC perspectives on the s.13; s.17 s.13; s.17 in light of COVID-19 and potential other infectious respiratory diseases (should they occur in the future). The questions are in the context of current, projected and future infectious respiratory diseases.

s.17 currently at low s.17 ; within a weeks s.13; s.17 s.13 will then increase potentially 4 times by April/May. Ministry staff would appreciate discussing the questions with you should clarification be needed, at your earliest convenience. Your responses are important to inform the ministry review of this sector.

Thank-you for all that you are doing for the province of BC!

Thank you

Jennifer McGuire, P.Ag.
Assistant Deputy Minister
Agriculture Science and Policy Division
Ministry of Agriculture, Food and Fisheries
Ph: 778-698-8521 Cell: 250-361-5944

RE: Question about Mink Farms

From: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
To: MacDonald, Alex HLTH:EX <Alex.MacDonald@gov.bc.ca>
Cc: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>, Clair, Veronic [BCCDC] <veronic.clair@bccdc.ca>, XT:HLTH Brodkin, Elizabeth <elizabeth.brodkin@fraserhealth.ca>
Sent: March 1, 2021 4:19:55 PM PST
Attachments: 193469 IN Options for fur farming in BC_FINAL2.docx

Hello Alex,
I have been having more discussions with my colleagues from Fraser Health and BCCDC (copied here) on the increasing public health risk from mink farms that we are now experiencing. There have been additional cases and s.13 Can you help us set up a meeting with MAFF about this and the evidence to support s.13; s.17 Or should we be contacting them directly?
Thanks,
Bonnie

Dr Bonnie Henry
Provincial Health Officer
Office of the PHO
Ministry of Health
s.15; s.19
Mailing address: PO Box 9648, STN PROV GOVT
Victoria, BC
V8W 9P4
Bonnie.henry@gov.bc.ca

Phone s.17; s.19

I gratefully acknowledge that I live and work on the traditional unceded territory of the Lekwungen Peoples, specifically the Songhees and Esquimalt First Nations. Hay'sxw'qu Si'em

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From: MacDonald, Alex HLTH:EX <Alex.MacDonald@gov.bc.ca>
Sent: February 16, 2021 11:59 AM
To: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Cc: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Subject: Question about Mink Farms

Hi Bonnie,
I had a conversation with Minister Popham's office about mink farming and they are headed into the breeding time where they re-stock populations on the mink farms.
MLP wants to know if there are any public health concerns/considerations or recommendations/guidance coming for this industry.
I've copied a couple notes they attached just in case you wanted a deep dive into the world of fur farming.
-Alex

RE: Final draft for review ASAP re: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

From: Henry, Bonnie HLTH:EX
To: Clair, Veronic [BCCDC] <veronic.clair@bccdc.ca>
Cc: Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>
Sent: March 1, 2021 4:51:08 PM PST
Attachments: 193469 IN Options for fur farming in BC_FINAL2.docx

I am sorry Veronic, just been so flooded and I assumed this had gone. But yes, please do send and Emily I heard from Elizabeth that you were having increasing concerns.s.13

s.13 Emily I would appreciate your thoughts.
My best,
Bonnie

Dr Bonnie Henry
Provincial Health Officer
Office of the PHO
Ministry of Health
s.15; s.19
Mailing address: PO Box 9648, STN PROV GOVT
Victoria, BC
V8W 9P4
Bonnie.henry@gov.bc.ca

Phones.17; s.19

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From: Clair, Veronic [BCCDC] <veronic.clair@bccdc.ca>
Sent: March 1, 2021 4:42 PM
To: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Cc: Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>
Subject: RE: Final draft for review ASAP re: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Hi Bonnie,

You had not provided an answer as to releasing that document to MAFF, so it was not sent to them.

I had not heard from FH a discussion to s.13; s.17

I am aware of new cases on mink farm workers, but not workers that interacted with minks and no mink with sign of infection and no SARS-CoV-2 found in mink submitted for samples as of late last week.
I am adding Emily, as she is the one who most worked on those answers and is most involved with managing the risk on the ground with the mink farms. She is usually off on Mondays.

Should we wait until we have the discussion you asked Alex to setup before making further decisions on that document?

Or do you want me to send it as a document accurate as of the date I send it to you, with potential revision as the situation evolves?

Best,

Veronic

Dr. Veronic Clair, MD, MSc, CCFP, FRCPC, PhD
Physician Epidemiologist
BC Centre for Disease Control
veronic.clair@bccdc.ca

I respectfully acknowledge that I live and work on the unceded territory of the xʷməθkwəy̓əm, Skwxwú7mesh, Stó:lō and Səl̓ilwətaʔ/Selilwitulh Nations.

From: Henry, Bonnie HLTH:EX [mailto:Bonnie.Henry@gov.bc.ca]
Sent: Monday, March 01, 2021 4:22 PM
To: Clair, Veronic [BCCDC]
Subject: FW: Final draft for review ASAP re: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

EXTERNAL SENDER. If you suspect this message is malicious, please forward to spam@phsa.ca and **do not** open attachments or click on links.

Forgive me but did I reply to you on this? I hope I did and that this has been sent.[s.13; s.17]
[s.13; s.17]
[s.13; s.17] I copied you on a not about that just now.
Thanks!
Bonnie

Dr Bonnie Henry
Provincial Health Officer
Office of the PHO
Ministry of Health
[s.15; s.19]
Mailing address: PO Box 9648, STN PROV GOVT
Victoria, BC
V8W 9P4
Bonnie.henry@gov.bc.ca

Phone[s.17; s.19]

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From: Clair, Veronic [BCCDC] <veronic.clair@bccdc.ca>
Sent: February 12, 2021 1:13 PM
To: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Subject: FW: Final draft for review ASAP re: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Hi Bonnie,

Here is the document with the draft answers.

Thanks

Veronic

From: Clair, Veronic [BCCDC]
Sent: Monday, February 8, 2021 2:14 PM
To: Henry, Bonnie [EXT] <bonnie.henry@gov.bc.ca>
Cc: Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>; Sekirov, Inna [BCCDC] <inna.sekirov@bccdc.ca>
Subject: Final draft for review ASAP re: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

Hi Bonnie,

Please find attached the final draft of the answer to the Assistant Deputy Minister of Agriculture, Food and Fisheries (MAFF).
The original request for answer was to you and me. Let me know if you want to review or if I can send it as such to Jennifer.

s.13; s.17

Thank you very much again for being our PHO and for all your work.
Best,

Veronic

Dr. Veronic Clair, MD, MSc, CCFP, FRCPC, PhD
Physician Epidemiologist
BC Centre for Disease Control
veronic.clair@bccdc.ca

I respectfully acknowledge that I live and work on the unceded territory of the xʷməθkwəy̓əm, Skwxwú7mesh, Stó:lō and Səl̓ilwətaʔ/Selilwitulh Nations.

From: Clair, Veronic [BCCDC]
Sent: Thursday, February 04, 2021 11:19 AM
To: 'McGuire, Jennifer AGRI:EX'; Henry, Bonnie [EXT]
Cc: Hrycuik, Lorie [EXT]; Anderson, Arlene AGRI:EX
Subject: RE: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

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s.13; s.17

I hope to receive all feedback and provide the document with the answers back to you early next week.

Best,

Veronic

Dr. Veronic Clair, MD, MSc, CCFP, FRCPC, PhD
Physician Epidemiologist
BC Centre for Disease Control
veronic.clair@bccdc.ca

I respectfully acknowledge that I live and work on the unceded territory of the xʷməθkwəy̓əm, Skwxwú7mesh, Stó:lō and Səl̓ilwətaʔ/Selilwitulh Nations.

From: McGuire, Jennifer AGRI:EX [mailto:Jennifer.Mcguire@gov.bc.ca]
Sent: Thursday, February 04, 2021 11:07 AM
To: Clair, Veronic [BCCDC]; Henry, Bonnie [EXT]
Cc: Hrycuik, Lorie [EXT]; Anderson, Arlene AGRI:EX
Subject: RE: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

EXTERNAL SENDER. If you suspect this message is malicious, please forward to spam@phsa.ca and **do not** open attachments or click on links.

Hello Dr Henry and Dr Clair,

My minister office is interested in the mink farming risk to humans – and is seeking an opinion from health professionals. Your opinion is important to inform now urgent decisions regarding the mink farming sector. When can the ministry expect to receive a response?
Thank you

Jennifer McGuire, P.Ag.
Assistant Deputy Minister
Agriculture Science and Policy Division
Ministry of Agriculture, Food and Fisheries
Ph: 778-698-8521 Cell: 250-361-5944

From: McGuire, Jennifer AGRI:EX
Sent: January 31, 2021 7:42 PM
To: 'Clair, Veronic [BCCDC]' <veronic.clair@bccdc.ca>; Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Cc: Hrycuik, Lorie HLTH:EX <Lorie.Hrycuik@gov.bc.ca>; Anderson, Arlene AGRI:EX <Arlene.Anderson@gov.bc.ca>
Subject: RE: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

Hello Dr. Clair

The Pathway Document was prepared by AGRI staff to for the purpose of organizing the information that had been provided to AGRI by CDC.

I understand the time demand and constraints.
Thank you for your attention as time permits.

Jennifer McGuire, P.Ag.
Assistant Deputy Minister
Agriculture Science and Policy Division
Ministry of Agriculture, Food and Fisheries
Ph: 778-698-8521 Cell: 250-361-5944

From: Clair, Veronic [BCCDC] <veronic.clair@bccdc.ca>
Sent: January 29, 2021 10:06 AM
To: McGuire, Jennifer AGRI:EX <Jennifer.Mcguire@gov.bc.ca>; Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Cc: Hrycuik, Lorie HLTH:EX <Lorie.Hrycuik@gov.bc.ca>; Anderson, Arlene AGRI:EX <Arlene.Anderson@gov.bc.ca>
Subject: Re: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Thank you for your email and involving us in this assessment.

The BC CDC works very closely with Fraser Health, WorkSafe and across several ministries, including the Ministry of Agriculture, Food and Fisheries to s.13; s.17 s.13; I would qualify the current level of risk management as effective, and evolving as the situation and evidence evolves.

Answering the list of questions you provided will take some time, in order to ensure agreement across relevant health stakeholders, including the health authority managing more closely the s.17 s.17 on the ground.

Thank you for circulating the pathway document. I don't recall seeing this specific document before. Can you clarify where this document comes from and who contributed to filling it out?

Best,

Dr. Veronic Clair, MD, MSc, CCFP, FRCPC, PhD
Physician Epidemiologist
BC Centre for Disease Control
veronic.clair@bccdc.ca

From: McGuire, Jennifer AGRI:EX <Jennifer.Mcguire@gov.bc.ca>
Sent: January 28, 2021 8:32 PM
To: Henry, Bonnie [EXT]; Clair, Veronic [BCCDC]

Cc: Hrycuik, Lorie [EXT]; Anderson, Arlene AGRI:EX
Subject: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

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Dr. Bonnie Henry
Provincial Health Officer
Office of the PHO
Bonnie.Henry@gov.bc.ca

and

Dr. Veronic Clair, MD, MSc, CCFP, FRCPC, PhD
Physician Epidemiologist
BC Centre for Disease Control
veronic.clair@bccdc.ca

Hello Dr. Henry and Dr. Clair,

The Ministry of Agriculture, Food and Fisheries is currently assessing all options of s.17 s.17 activities as well as seeking to understand where mitigation/actions should be taken to address unacceptable s.17

Please find attached a list of questions which we seeking to understand the PHO & CDC perspectives on the s.13; s.17 s.13; s.17 in light of COVID-19 and potential other infectious respiratory diseases (should they occur in the future). The questions are in the context of current, projected and future infectious respiratory diseases.

s.17 . . is currently at low s.17 within a weeks s.13; s.17 s.13; s.17 will then increase potentially 4 times by April/May. Ministry staff would appreciate discussing the questions with you should clarification be needed, at your earliest convenience. Your responses are important to inform the ministry review of this sector.

Thank-you for all that you are doing for the province of BC!

Thank you

Jennifer McGuire, P.Ag.
Assistant Deputy Minister
Agriculture Science and Policy Division
Ministry of Agriculture, Food and Fisheries
Ph: 778-698-8521 Cell: 250-361-5944

RE: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

From:	Clair, Veronic [BCCDC] <veronic.clair@bccdc.ca>
To:	McGuire, Jennifer AFF:EX <Jennifer.Mcguire@gov.bc.ca>
Cc:	Hrycuik, Lorie HLTH:EX <Lorie.Hrycuik@gov.bc.ca>, Anderson, Arlene AFF:EX <Arlene.Anderson@gov.bc.ca>, Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>, Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>
Sent:	March 1, 2021 5:40:57 PM PST
Attachments:	Interim answers to MAFF mink questions Final.docx

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Hi Jennifer,

Please find attached the document with answers to the questions sent to Dr. Bonnie Henry and myself.
s.13; s.17

Best,

Veronic

Dr. Veronic Clair, MD, MSc, CCFP, FRCPC, PhD
Physician Epidemiologist
BC Centre for Disease Control
veronic.clair@bccdc.ca

I respectfully acknowledge that I live and work on the unceded territory of the xʷməθkwəy̓əm, Skwxwú7mesh, Stó:lō and Səl̓ilwətaʔ/Selilwitulh Nations.

From: McGuire, Jennifer AGRI:EX [mailto:Jennifer.Mcguire@gov.bc.ca]
Sent: Thursday, January 28, 2021 8:32 PM
To: Henry, Bonnie [EXT]; Clair, Veronic [BCCDC]
Cc: Hrycuik, Lorie [EXT]; Anderson, Arlene AGRI:EX
Subject: Questions for CDC and PHO re: human health risk related to mink farms dur to COVID-19

EXTERNAL SENDER. If you suspect this message is malicious, please forward to spam@phsa.ca and **do not** open attachments or click on links.

Dr. Bonnie Henry
Provincial Health Officer
Office of the PHO
Bonnie.Henry@gov.bc.ca

and

Dr. Veronic Clair, MD, MSc, CCFP, FRCPC, PhD
Physician Epidemiologist
BC Centre for Disease Control
veronic.clair@bccdc.ca

Hello Dr. Henry and Dr. Clair,

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Please find attached a list of questions which we seeking to understand the PHO & CDC perspectives on the s.13; s.17 s.13; s.17 in light of COVID-19 and potential other infectious respiratory diseases (should they occur in the future). The questions are in the context of current, projected and future infectious respiratory diseases.

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Thank-you for all that you are doing for the province of BC!

Thank you

Jennifer McGuire, P.Ag.
Assistant Deputy Minister
Agriculture Science and Policy Division
Ministry of Agriculture, Food and Fisheries
Ph: 778-698-8521 Cell: 250-361-5944

RE: mink farm questions and concerns

From: Gunvaldsen, Rayna AFF:EX <Rayna.Gunvaldsen@gov.bc.ca>
To: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Sent: March 17, 2021 9:27:44 PM PDT

Thanks so much Bonnie, I would certainly appreciate the chance to chat. Looks like I can be flexible anytime after 10am tomorrow.
rayna

From: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Sent: March 17, 2021 7:29 PM
To: Gunvaldsen, Rayna AFF:EX <Rayna.Gunvaldsen@gov.bc.ca>
Subject: Re: mink farm questions and concerns

Best to talk Rayna.
Perhaps later tomorrow?
s.13; s.17; s.22

Bonnie

Dr Bonnie Henry
Provincial Health Officer
Ministry of Health
Bonnie.henry@gov.bc.ca
s.17; s.19

> On Mar 17, 2021, at 6:34 PM, Gunvaldsen, Rayna AFF:EX <Rayna.Gunvaldsen@gov.bc.ca> wrote:
>
> Hi Bonnie, I'm hoping to get your help in better understanding the change in risk to public health from the mink farms. As you know, I've been working with the wonderful team from BCCDC and Fraser Health on the risks and mitigation options for SARS-CoV-2 in mink farms for some time.s.13; s.22
> s.13; s.17; s.22

If you wanted to chat directly on any of this, I'd be available whenever you need. Otherwise, I look forward to another good discussion with everyone on Friday. Thanks Bonnie.
Take care.

Rayna E. Gunvaldsen BSA DVM MSc
Chief Veterinarian
Animal Welfare and Dairy Program Veterinarian
BC Ministry of Agriculture, Food, and Fisheries

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s.14 ; s.17

Page 040 of 656 to/à Page 053 of 656

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Page 054 of 656

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s.13 ; s.14 ; s.17

Page 057 of 656

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s.14 ; s.17

Page 058 of 656

Withheld pursuant to/removed as

s.14

Page 059 of 656 to/à Page 061 of 656

Withheld pursuant to/removed as

s.13 ; s.14 ; s.17

Page 062 of 656 to/à Page 120 of 656

Withheld pursuant to/removed as

s.14 ; s.16

Page 121 of 656 to/à Page 125 of 656

Withheld pursuant to/removed as

s.14 ; s.17

Page 126 of 656

Withheld pursuant to/removed as

s.14

RE: MInk COVID-19 Human Health Risk Assessment and Surveillance Information

From: Clair, Veronic [BCCDC] <veronic.clair@bccdc.ca>
To: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>, Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>
Sent: March 30, 2021 3:39:44 PM PDT
Attachments: s.17

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Hi Brian,
FH has the most up-to-date and complete epi data. Concerns arising from this would be the most relevant basis for an order.
If Emily would like, I can share the FH Gantt chart, but we do not have a written narrative of it.

I am still trying to get a WGS report, hopefully tomorrow.

s.13; s.17

Would you like a call about all of that?

Best,

Veronic

From: Emerson, Brian P HLTH:EX [mailto:Brian.Emerson@gov.bc.ca]
Sent: Tuesday, March 30, 2021 2:31 PM
To: Clair, Veronic [BCCDC]; Newhouse, Emily [FH]
Subject: MInk COVID-19 Human Health Risk Assessment and Surveillance Information

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Hi Veronic and Emily.

s.17

I have been drawn in to support Bonnie or the Chief Veterinarian[s.17]
Key to this would be a clearly articulated public health rationale. An important component of that would be the surveillance information about infected mink and humans on the farm.

I understand from Bonnie that you have this information and the health risk assessment, is that correct? If so could you send to me.

Thanks.

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C[s.17] F. 250.952. 1713 brian.emerson@gov.bc.ca

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Withheld pursuant to/removed as

s.13 ; s.17

Public Health England

Protecting and improving the nation's health

Human Animal Infections and Risk Surveillance (HAIRS) group

Qualitative assessment of the risk that SARS-CoV-2 infection in UK captive *Mustelinae* populations presents to the UK human population

Page 137 of 656 to/à Page 173 of 656

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RAPID RISK ASSESSMENT

Detection of new SARS-CoV-2 variants related to mink

12 November 2020

Copyright

Suggested citation: European Centre for Disease Prevention and Control. Detection of new SARS-CoV-2 variants related to mink – 12 November 2020. ECDC: Stockholm; 2020.

© European Centre for Disease Prevention and Control, Stockholm, 2020

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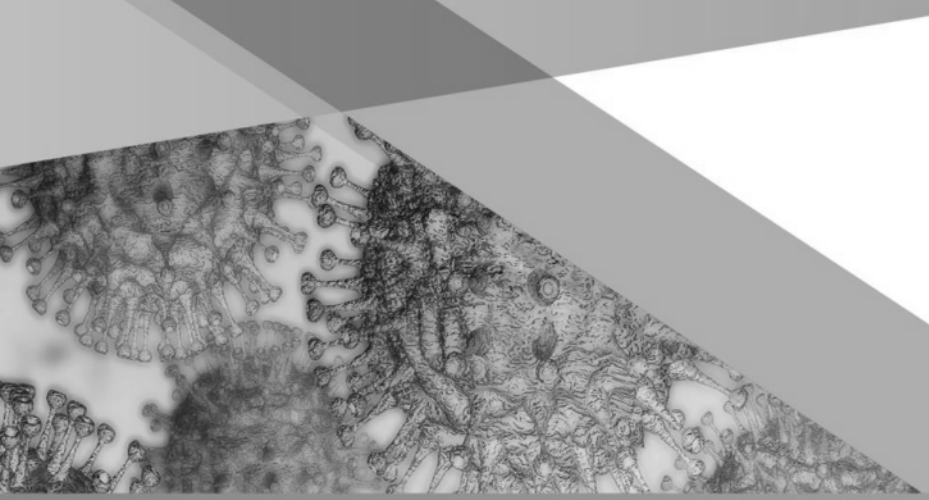
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s.13 ; s.17



RAPID RISK ASSESSMENT

Risk related to the spread of new SARS-CoV-2 variants of concern in the EU/EEA – first update

21 January 2021

Copyright

Suggested citation: European Centre for Disease Prevention and Control. Risk related to spread of new SARS-CoV-2 variants of concern in the EU/EEA, first update – 21 January 2021. ECDC: Stockholm; 2021.

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RE: MInk COVID-19 Human Health Risk Assessment and Surveillance Information

From: Clair, Veronic [BCCDC] <veronic.clair@bccdc.ca>
To: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Sent: March 30, 2021 4:00:24 PM PDT

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Hi Brian, do you have a few minutes now? My cell number is s.15

From: Clair, Veronic [BCCDC]
Sent: Tuesday, March 30, 2021 3:43 PM
To: Emerson, Brian [EXT]; Newhouse, Emily [FH]
Subject: RE: MInk COVID-19 Human Health Risk Assessment and Surveillance Information

With the link for the US CDC page: https://www.cdc.gov/coronavirus/2019-ncov/daily-life-coping/animals.html

---

From: Clair, Veronic [BCCDC]
Sent: Tuesday, March 30, 2021 3:40 PM
To: Emerson, Brian [EXT]; Newhouse, Emily [FH]
Subject: RE: MInk COVID-19 Human Health Risk Assessment and Surveillance Information

Hi Brian,
FH has the most up-to-date and complete epi data. Concerns arising from this would be the most relevant basis for an order.
If Emily would like, I can share the FH Gantt chart, but we do not have a written narrative of it.

I am still trying to get a WGS report, hopefully tomorrow.

s.13; s.17

Would you like a call about all of that?

Best,

Veronic

From: Emerson, Brian P HLTH:EX [mailto:Brian.Emerson@gov.bc.ca]
Sent: Tuesday, March 30, 2021 2:31 PM
To: Clair, Veronic [BCCDC]; Newhouse, Emily [FH]
Subject: MInk COVID-19 Human Health Risk Assessment and Surveillance Information

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Hi Veronic and Emily.

I understand s.17

I have been drawn in to support Bonnie or the Chief Veterinarian s.17 that might be needed. Key to this would be a clearly articulated public health rationale. An important component of that would be the surveillance information about infected mink and humans on the farm.

I understand from Bonnie that you have this information and the health risk assessment, is that correct? If so could you send to me.

Thanks.

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 Cs.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

FYI: Mink IB

From: Youngs, Kirsten R GCPE:EX <Kirsten.Youngs@gov.bc.ca>
To: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Sent: May 16, 2021 12:07:40 PM PDT
Attachments: IB_MInk Farm Quarantine DRAFT May 21.docx

FYI – likely to go tomorrow from Agriculture.

From: Boelens, Robert GCPE:EX <Robert.Boelens@gov.bc.ca>
Sent: May 14, 2021 8:20 AM
To: Youngs, Kirsten R GCPE:EX <Kirsten.Youngs@gov.bc.ca>
Cc: Cotton, Brian GCPE:EX <Brian.Cotton@gov.bc.ca>
Subject: Mink IB - FYI

Good Morning K, the attached is likely to go out today or early next week, pending testing confirmation from the national lab, and posting of results to the OIE (intl animal health reporting) web site.

Robert Boelens
Government Communications and Public Engagement
Ministry of Agriculture, Food and Fisheries
250 356-1674
Robert.Boelens@gov.bc.ca

BRITISH COLUMBIA

INFORMATION BULLETIN

Ministry of Agriculture Food and Fisheries

[release number]
[Date]

Mink farm placed under quarantine orders in the Fraser Valley

VICTORIA - A Fraser Valley mink farm has been placed under quarantine with restrictions prohibiting the movement of animals and materials from the property, following one mink on the farm testing positive for SARS-CoV-2, the virus that causes COVID-19 in humans.

Two additional mink are suspect positive for the virus, pending the confirmation of the testing. A plan is in place to provide feed and care to the mink during the outbreak that respects the conditions of the quarantine and maintains both worker and mink safety. No workers on the farm have tested positive for COVID-19 to date, and all have received or been offered their first dose of vaccination.

20 mink were tested for the virus as part of the Province's general surveillance procedures with the one positive test result confirmed on May 1X. The farm has approximately 17,000 animals, the remainder of which appear healthy, and are not displaying any symptoms of illness. It is not currently known how the mink contracted the virus and the ministry is currently working with stakeholders to identify potential sources.

This is the third mink farm in B.C. to have mink test positive for COVID-19 since the start of the pandemic. Genetic analysis of SARS-CoV-2 has been completed in samples from the first two farms with the results showing the people and animals were infected with an identical or nearly identical strain. The strain detected in those cases had been circulating in people in B.C., indicating COVID-19 spread from people to animals and not the other way around.

The locations of all farms are not being released as per Section 16.1 of the Animal Health Act, which prohibits the disclosure of information that would identify a specific place where an animal is located.

Contact:

Government Communications
Ministry of Agriculture, Food and Fisheries
250 882 2485

Draft

update on the most recent infected premise

From: Clair, Veronic [BCCDC] <veronic.clair@bccdc.ca>
To: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Cc: Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>, Coombe, Michelle AFF:EX <Michelle.Coombe@gov.bc.ca>, XT:Naus, Monika HLTH:IN <monika.naus@bccdc.ca>, Fraser, Erin [BCCDC] <Erin.Fraser@bccdc.ca>, Sekirov, Inna [BCCDC] <inna.sekirov@bccdc.ca>
Sent: May 27, 2021 9:11:36 AM PDT

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Hi Bonnie,

On the call last week, I mentioned briefly the lineage that was found in the more recently infected premise. Here is some more information. There is nothing in this update that the group feels needs action at the moment, this is for your information only.

The lineage found in the last human case, and the first mink on s.3 is B.1.618. Other WGS results are still pending. The lineage is a rare lineage, present in very few cases in Fraser Health, all linked to an Abbotsford Hospital outbreak. The hospital outbreak started before the mink worker was identified with that lineage. The B.1.618 lineage has been found in India. It is a lineage considered worthy of monitoring in BC. It has not been deemed a variant of concern nor a variant of interest by WHO or other organization. It might be associated with some immune escape and increased ACE 2 inhibitor binding affinity. I have included more information on the B.1.618 lineage below (in number 2), as well as a more detailed description of what is known of the outbreak so far (in number 1), with potential interpretation of these findings.

Please let me know if you have any question. Emily is happy to answer any question on the human epidemiology and Michelle worked on the animal and environmental testing and epidemiological investigation, while Inna helped with the WGS information.

Best,

Veronic

s.3

Mink cases:
Of 13 mink carcasses who died between April 29th and May 5 2021, one tested positive for SARS-CoV-2. It was reported as presumptive positive on May 11, and the farm was put on quarantine as of that date. No clinical signs compatible with SARS-CoV-2 infection were noted in the mink herd and mortality rate was not considered higher than expected for the pregnancy and whelping stage of the production cycle (all 13 mortalities were in females). Subsequent testing on the farm included: mink mortalities from the week of May 6th to 11 (2+ out of 7), live mink tested on May 14th (2+ out of 65, one from each from the different barn location on the farm).

s.3

This timeline of mink cases is compatible with a relatively long incubation period (perhaps up to 14 days) with the mink dying approximately 15 to 25 days after developing the infection, resulting in the virus still being detectable in the deceased mink. So a scenario of human to mink transmission leading to the initial mortality in that timeframe is plausible. Alternatively, it could correspond with two shorter incubation period (one missing chain of transmission) then leading to a mink that died while still carrying sufficient virus material to test positive. That missing chain of transmission would have most likely been through another worker, another mink or a feral cat on the farm. Repeat live animal and environmental testing is planned for this week. It should provide more information on the speed of the spread among that herd.

Environmental sampling results around the infected cases cages

Environmental samples were collected on May 14th. There were 14 positive or indeterminate cage samples out of 65 cage sampled, and 2 of 12 manure samples.

s.3

- The sample taken from the cage of the positive mink was positive
- 8/10 swabs taken on cages around the case's cage were positive or indeterminate
- The 2/22 manure samples from the automated manure disposal system in the loafing barn were positive or indeterminate.

s.3

- The sample taken from the cage of the positive mink was positive
- 4 cage swabs around the case cage were positive or indeterminate
- All 10 manure samples from the automated manure disposal system were negative

These results support good sensitivity and specificity of environmental sampling for area where there is virus, when taken in cages close to infected mink. The manure samples, at this farm with their manure systems, might be less sensitive.

2. B.1.618 lineage information

The B.1.618 lineage has been found in India, is considered a lineage worthy of monitoring in BC. It has not been deemed a variant of concern nor a variant of interest by WHO or other organization. One pre-print study suggest a 2.3 and 2.7 fold decrease in neutralization antibody capacity respectively for sera from previously infected individual or vaccine generated antibodies. This suggests potentially some mild immune escape, with level of antibody titers still above 1:500, suspected to correlate with preserved protection. It is a higher level of antibody neutralization titer than what many generate after natural infection. In comparison, the decrease in antibody neutralization capacity was from none to 6 folds for the B.1.1.7, 3 to 13 folds for the B.1.351 and 2.5 folds for the P.1, as per reported in one study. This lineage might be associated with increased affinity to ACE2 receptors. This suggests potentially some immune escape, which seems perhaps comparable to the P1. This could have contributed to the initial mink worker contracting the infection just at the cusp of the 2 weeks after his first dose of vaccine. It could have contributed to other workers being more susceptible to that lineage despite immunization, while not developing symptoms or sufficiently high viral load to be detectable on gargle samples.

Dr. Veronic Clair, MD, MSc, CCFP, FRCPC, PhD
Physician Epidemiologist
BC Centre for Disease Control
veronic.clair@bccdc.ca

I respectfully acknowledge that I live and work on the unceded territory of the xʷməθkwəy̓əm, Skwxwú7mesh, Stó:lō and Səl̓ilwətaʔ/Selilwitulh Nations.

FW: Mink Farms

From: Holoiday, Leah GCPE:EX <Leah.Holoiday@gov.bc.ca>
To: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Sent: June 15, 2021 11:48:03 AM PDT

Hi Dr. Henry – here is what I sent Ian, Jeff and MO on mink farms.

Leah

From: Holoiday, Leah GCPE:EX
Sent: June 15, 2021 11:43 AM
To: Ferrier, Jeffrey GCPE:EX <Jeffrey.Ferrier@gov.bc.ca>; Rongve, Ian HLTH:EX <Ian.Rongve@gov.bc.ca>
Subject: Mink Farms

Here is a media response from on Ag for Mink.

Could you first point me to some general info - how many in B.C., where, how many people do they employ, what do they bring to the B.C. economy.

- There are nine B.C. mink farms, all located in the Fraser Valley, with approximately 150 workers.
- The locations of mink farms are not being released as per Section 16.1 of the Animal Health Act, which prohibits the disclosure of information that would identify a specific place where an animal is located.
- In 2018, B.C. farm cash receipts for mink totalled more than $12.8 million.

How often are they inspected and what do inspectors look for - disease? Animal care? Any concerns about how the animals are kept and then killed? Any charges been brought under Animal Health Act? Qualifications of fur farm inspectors? Have all farms submitted health management plans? Is government satisfied that each animal is checked daily - is that a requirement?

- The Ministry of Health has been working with Fraser Health, the Ministry of Agriculture, Food and Fisheries and WorkSafe BC to ensure all mink farms in B.C. have robust COVID safety plans in place, and we have established surveillance for infections in mink and in the farm workers. We have had a national risk assessment and local risk assessment that shows with these safety measures in place, risk is manageable.
- Ministry of Agriculture, Food and Fisheries staff continue to be in contact with each of the province's licensed mink farms to ensure that all necessary precautions are being taken to reduce the risk of spreading COVID-19 through human to animal or animal to human transmission.
- Fraser Health and WorkSafeBC are actively working with all licenced mink farms to ensure that COVID-19 safety protocols are being followed. This includes onsite inspections.
- Ministry of Agriculture, Food and Fisheries staff continue to regularly be in contact at the infected premises to ensure the conditions of the quarantine order are being followed.
- All B.C. mink farms were inspected by ministry staff in the summer and fall of 2020, and will be inspected again in 2021
- Inspections ensure that the farm meets all application federal, provincial and municipal land use regulations. Inspections also ensure that the National Farm Animal Care Council, Code of Practice for the Care and Handling of Farmed Mink is adhered to (such as housing, pens, nest boxes, bedding, environment, and feed.)
- There were no charges laid against fur farms in 2020.
- Ministry staff will continue to share information with, and ensure that best practice guidelines are met by, B.C.'s licensed fur farms.

Is a ban being considered, especially as organizations such as BC SPCA, infectious disease experts and UBCIC have called for the farms to be shut down. Biosecurity measures apparently didn't work as there have been three outbreaks? Also, is fur farming acceptable to British Columbians especially as it goes against global trends? Why is the B.C. government subsidizing the industry? $6.5 million since 2014?

- The B.C. government continues to place our immediate focus and response on efforts to keep people safe from COVID-19 and are taking direction from the Public Health Officer with respect to COVID transmission at mink farms. As our response and recovery from the pandemic increases, we will have the opportunity to better research, review and

understand the susceptibility of mink to COVID-19, how other jurisdictions are responding to it, and the best course forward for B.C.

- The statement made by the BC SPCA mistakenly characterizes AgriStability claim payments as subsidies.
- The AgriStability program is a business risk management tool, similar to insurance, which helps protect net farm income against drops in market prices, production and increases in expenses.
- AgriStability is a partnership between the federal and provincial government and paid only when there is a minimum 30-percent decrease in a margin compared to the average previous five years margins.
- The AgriStability program only covers losses that are due to events that are beyond a farm's control, such as fluctuations in global commodity prices.
- The purpose of the program is to help farmers manage severe losses which may jeopardize the viability of their farm businesses.
- Program participants pay a fee based on their individual margin size.
- Under World Trade Organization rules, AgriStability payments are not considered subsidies.
- The AgriStability program is available across Canada for all agricultural commodity producers, except cannabis, and is not specific to fur farming.

Leah Holoiday
COVID-19 Communications
250 880 2378

FW: FUR FARMS

From: Ferrier, Jeffrey GCPE:EX <Jeffrey.Ferrier@gov.bc.ca>
To: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Sent: June 15, 2021 11:50:21 AM PDT
Attachments: image001.jpg, IN_COVID Mink Farm_May 21.docx, KMs_Mink farms.docx, IN_Fur Fams_April 21.docx

As promised

From: Cotton, Brian GCPE:EX <Brian.Cotton@gov.bc.ca>
Sent: June 15, 2021 11:45 AM
To: Ferrier, Jeffrey GCPE:EX <Jeffrey.Ferrier@gov.bc.ca>
Subject: RE: FUR FARMS

Here you go. KMs were just put together for our own estimates and used for a media request last week. Two INs - one specific to mink outbreaks and one a bit more general.

From: Ferrier, Jeffrey GCPE:EX <Jeffrey.Ferrier@gov.bc.ca>
Sent: June 15, 2021 11:42 AM
To: Cotton, Brian GCPE:EX <Brian.Cotton@gov.bc.ca>
Subject: FUR FARMS

MD being asked about fur farms in estimates. Do you have an IN?

BRITISH COLUMBIA

Jeffrey Ferrier (he/him/his)
Executive Director, Health Communications, Government of British Columbia

604-362-6109 | jeffrey.ferrier@gov.bc.ca

I gratefully acknowledge that I live and work on the traditional unceded territory of the Lekwungen Peoples, specifically the Songhees and Esquimalt First Nations.

DRAFT ADVICE TO MINISTER

CONFIDENTIAL ISSUES NOTE Ministry of Agriculture, Food and Fisheries Date: May 18, 2021 Minister Responsible: Lana Popham	**Covid+ Mink Farm Results**

ADVICE AND RECOMMENDED RESPONSE:

- **A Fraser Valley mink farm was placed under quarantine with restrictions prohibiting the movement of animals and materials from the property, following one mink on the farm testing positive for SARS-CoV-2, the virus that causes COVID-19 in humans on May 17.**

- **The quarantine prohibits the movement of animals, animal by-products, equipment, or materials like feed and bedding was placed on the farm.**

- **A plan is in place to provide feed and care to the mink during the outbreak, that considers the conditions of the quarantine and maintains both worker and mink safety. No workers on the farm have tested positive for COVID-19 to date, and all have received or been offered their first dose of vaccination.**

- **The Chief Veterinarian's role and jurisdiction focuses on animal health, and from the current information, the quarantined mink do not pose a health risk to other mink farms.**

- **The locations of the farms are not being released as per Section 16.1 of the Animal Health Act, which prohibits the disclosure of information that would identify a specific place where an animal is located**

Preventative Measures

- **Ministry of Agriculture staff were in contact with each of the province's licensed mink farms to ensure that all necessary precautions were being taken to reduce the risk of spreading COVID-19 through human to animal or animal to human transmission.**

- **Despite the best practices and precautions in place on the farm, as in other parts of our community, sometimes transmissions still occur.**

DRAFT ADVICE TO MINISTER

- **Ministry staff performed inspections at each of the province's licensed mink farms last fall to ensure compliance with all standard animal welfare and biosecurity measures as well as enhanced COVID-19 practices.**

- **B.C. mink farmers are also being proactive in their response to this situation and have enacted increased sanitation and enhanced biosecurity measures.**

- **Ministry staff will continue to share information with, and ensure that best practice guidelines are met by, our licensed fur farms.**

BACKGROUND:

In the week of May 12, samples from 13 mink from a Fraser Valley mink farm were tested for the virus as part of the Ministry's general surveillance procedures with one positive test result confirmed on May 17. Two additional mink are suspect positive for the virus, pending the confirmation of the testing.

The farm has approximately 17,000 animals, the remainder of which appear healthy, and are not displaying symptoms of illness. It is not currently known how the mink contracted the virus and the ministry is currently working with stakeholders to identify potential sources.

This is the third mink farm in the Fraser Valley to have mink test positive for COVID-19 since the start of the pandemic. In December 2020, two other mink farms were placed under quarantine for positive cases. Fraser Health Authority determined eight workers at one farm had tested positive for Covid-19. The farms remain under quarantine, with one of them returning to normal operations, and the second choosing to not currently breed mink.

Genetic analysis of SARS-CoV-2 has been completed in samples from the first two farms with the results showing the people and animals were infected with an identical or nearly identical strain. The strain detected in those cases had been circulating in people in B.C., indicating COVID-19 spread from people to animals and not the other way around.

SARS-CoV-2 is the virus that causes the disease COVID-19 in humans and this virus can also infect mink. Mink can get sick from this virus (respiratory or gastrointestinal signs), they can die, or have no signs at all. The most likely source of virus introduction to farmed mink is infected humans coming into close on-farm contact with mink or their feed. In some other countries mutated strains of the virus have been found in mink that have been infected and these mutated strains have then been transmitted back to humans who had contact with the infected animals. There is concern that these mutated viruses could lead to changes in transmissibility of the virus, the severity of illness it causes, or the effectiveness of any treatment or vaccine.

Key Messages – Mink farmins

MINK FARMING OVERVIEW

- The B.C. government continues to place our immediate focus and response on efforts to keep people safe from COVID-19 and are taking direction from the Public Health Officer with respect to COVID transmission at mink farms.

- As our response and recovery from the pandemic increases, we will have the opportunity to better research, review and understand the susceptibility of mink to COVID-19, how other jurisdictions are responding to it, and the best course forward for B.C. This is still an open question as to how we handle this long-term.

- There are nine B.C. mink farms, all located in the Fraser Valley, with approximately 150 workers.

- In 2019, B.C. farm cash receipts for mink totalled $4.7 million, down from $12.8 million in 2018.

INSPECTION SUMMARY

- The Ministry of Health has been working with Fraser Health, the Ministry of Agriculture, Food and Fisheries and WorkSafe BC to ensure all mink farms in B.C. have COVID safety plans in place, and established surveillance for potential COVID-19 infections in mink and in the farm workers.

- Provincial government employees are in contact with each of the province's licensed mink farms to ensure all necessary precautions are being taken to reduce the risk of spreading COVID-19 through human to animal or animal to human

transmission, including having an on-site presence at infected premises.

- All B.C. mink farms were inspected by ministry staff in the summer and fall of 2020 and will be inspected again in 2021.
- Inspections ensure the farm meets all applicable federal, provincial and municipal land use regulations. Inspections also ensure the National Farm Animal Care Council, Code of Practice for the Care and Handling of Farmed Mink is adhered to (such as housing, pens, nest boxes, bedding, environment, and feed.)

AGRISTABILITY (Subsidizing fur farm claim)

- The statement made by the BC SPCA mistakenly characterizes AgriStability claim payments as subsidies.
- The AgriStability program is a business risk management tool, similar to insurance, which helps protect net farm income against drops in market prices, production and increases in expenses.
- AgriStability is a partnership between the federal and provincial government and paid only when there is a minimum 30-percent decrease in a margin compared to the average previous five years margins.
- The AgriStability program only covers losses that are due to events that are beyond a farm's control, such as fluctuations in global commodity prices.
- The purpose of the program is to help farmers manage severe losses which may jeopardize the viability of their farm businesses
- Program participants pay a fee based on their individual margin size.

- Under World Trade Organization rules, AgriStability payments are not considered subsidies.
- The AgriStability program is available across Canada for all agricultural commodity producers, except cannabis, and is not specific to fur farming.

ADVICE TO MINISTER

CONFIDENTIAL ISSUES NOTE Ministry of Agriculture, Food and Fisheries Date:April 2021 Minister Responsible: Lana Popham	**Opposition to Fur Farms**

ADVICE AND RECOMMENDED RESPONSE:

- **Ministry staff performed inspections at each of the province's licensed mink farms in the fall of 2020 to ensure compliance with all license requirements including animal health and welfare, as well as all standard biosecurity measures and enhanced COVID-19 practices.**

- **Under the Fur Farm Regulation (2015), operators are responsible for meeting animal health and welfare requirements for areas including health management plans, general health, food and water, pens and structure design.**

- **Charges under B.C.'s Prevention of Cruelty to Animals Act can be laid against anyone who causes suffering or distress to an animal In British Columbia, including owners, managers and employees in the agriculture sector and on fur farms.**

- **The maximum penalties that can be levied under provincial legislation against a person who is convicted of causing distress to an animal is $75,000 and up to 24 months imprisonment.**

- **The susceptibility of mink to COVID-19 is a relatively new discovery and looking at the relevant science and reviewing how other jurisdictions are dealing with outbreaks. Keeping people and animals safe from COVID-19 remains our highest priority.**

If asked about COVID-19 and mink farms

- **B.C.'s chief veterinarian continues to have the two Fraser Valley farms that had mink test positive with SARS-CoV-2 under a quarantine order.**

- **This prohibits the movement of animals and materials from the property to minimize the risk of the virus spreading.**

- **Ministry of Agriculture, Food and Fisheries staff continue to be in**

contact with each of the province's licensed mink farms to ensure that all necessary precautions are being taken to reduce the risk of spreading COVID-19 through human to animal or animal to human transmission.

- **Fraser Health and WorkSafeBC are actively working with all licenced mink farms to ensure that COVID-19 safety protocols are being followed. This includes onsite inspections.**
- **Ministry of Agriculture, Food and Fisheries staff continue to regularly be on site at the two infected premises to ensure the conditions of the quarantine order are being followed.**

KEY FACTS:

Public support for fur farmers and fashion that uses fur is divided, with several animal welfare and rights organizations campaigning for the abolition of fur farms in B.C. for decades, including The Fur-Bearers and the BC SPCA. The BC Union of Indian Chiefs also expressed support for ending fur farming for mink.

Following the outbreak of Covid-19 on mink farms in Europe, USA and in BC, efforts to increase public support and lobby the province to ban fur-farms have increased, as campaign leaders have expressed the risk of viral mutation as another reason to support the end of fur-farming in B.C.

Two mink farms in B.C. that had Covid 19+ cases in December were placed under quarantine and remain under a quarantine order. The owners of the two mink farms, like other mink farms in B.C., have harvested animals over the winter. Farms have proceeded with breeding while following all COVID health and safety protocols. No animals on the farms are currently testing positive for COVID. The locations of both mink farms are not being released as per Section 16.1 of the Animal Health Act, which prohibits the disclosure of information that would identify a specific place where an animal is located.

RE: BFFBC request to disallow new fur farm applications in BC

From: Ethier, Tom AFF:EX <Tom.Ethier@gov.bc.ca>
To: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>, McGuire, Jennifer AFF:EX <Jennifer.Mcguire@gov.bc.ca>
Cc: Clair, Veronic [BCCDC] <veronic.clair@bccdc.ca>, van Baarsen, Amanda HLTH:EX <Amanda.vanBaarsen@gov.bc.ca>, MacDonald, Alex HLTH:EX <Alex.MacDonald@gov.bc.ca>
Sent: June 16, 2021 1:12:02 PM PDT
Attachments: bffbc Jun 14 2021 draft response.docx

Hi Dr. Henry,

Attached is a suggested draft that you may want to use in shaping your response. As you will see there are no new applications – although we have heard of some interest.

Might be useful to touch base soon on where the team is at on the risk assessment. Let me know if that makes sense and I will get something set up. Cheers, Tom

---

From: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Sent: June 14, 2021 2:04 PM
To: Ethier, Tom AFF:EX <Tom.Ethier@gov.bc.ca>; McGuire, Jennifer AFF:EX <Jennifer.Mcguire@gov.bc.ca>
Cc: Clair, Veronic [BCCDC] <veronic.clair@bccdc.ca>; van Baarsen, Amanda HLTH:EX <Amanda.vanBaarsen@gov.bc.ca>; MacDonald, Alex HLTH:EX <Alex.MacDonald@gov.bc.ca>
Subject: FW: BFFBC request to disallow new fur farm applications in BC

Just received this and am following up as I don't know the answers. Is it true that there have been new farm applications?
I would appreciate your assistance in drafting a reply.
Thanks!
Bonnie

Dr Bonnie Henry
Provincial Health Officer
Office of the PHO
Ministry of Health
s.15; s.19
Mailing address: PO Box 9648, STN PROV GOVT
Victoria, BC
V8W 9P4
Bonnie.henry@gov.bc.ca

Phone: s.17; s.19

I gratefully acknowledge that I live and work on the traditional unceded territory of the Lekwungen Peoples, specifically the Songhees and Esquimalt First Nations. Hay'sxw'qu Si'em

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From: s.3
Sent: June 14, 2021 1:58 PM
To: Dix.MLA, Adrian LASS:EX <Adrian.Dix.MLA@leg.bc.ca>; Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Subject: BFFBC request to disallow new fur farm applications in BC

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Dear Ms. Henry and Hon. Dix,

Re: Disallowing New Fur Farm Applications in British Columbia

We are writing on behalf of the organization 'Ban Fur Farms BC' (BFFBC). Our mission is to encourage the implementation of a ban on all fur farming in British Columbia; due to public health risks associated with the COVID-19 pandemic, as well as significant environmental and animal concerns.

Three outbreaks on fur farms have occurred thus far within British Columbia and despite this, fur farms were approved to proceed with breeding season this year, even with some farms still under quarantine. The Ministry of Agriculture has taken little-to-no action to mitigate future outbreaks. In fact, a recent FOI request reveals that furthermore to their inaction, the Ministry of Agriculture is entertaining the potential establishment of two *new* fur farms (in Prince George and Langley) amidst the COVID-19 pandemic.

Reiterating several of the key points brought forth in the January 11, 2021 letter penned by David Suzuki, Ian Duncan, Daniel Coombs, Sarah Otto, and Ken Langelier:

"Mink are highly susceptible to this virus, leading to dozens of fur farm workers and hundreds of animals contracting and becoming sick from the SARS-CoV-2 virus in BC. Not only have outbreaks on mink farms across the globe led to substantial animal suffering, but they have also expanded the reservoir size for this virus, increasing the risk of mutations and spread back to humans and other wildlife." Ms. Henry, you have already commented that the SARS-CoV-2 virus on mink farms is of "great concern."

It is clear from her comments in Legislature from June 3, Hon. Popham will not be taking any action with regards to fur farms from a Ministry of Agriculture point of view and is standing by on direction from Public Health. *Hon. Popham: "As far as making decisions around mink operations and COVID and shutting farms down or not, we take our guidance from the Public Health Officer on that."*

As such, we are requesting that you provide directive to Hon. Lana Popham, and immediately disallow any new fur farm applications to be submitted to the Ministry of Agriculture.

"The dangerous implications of keeping captive wild animals in crowded conditions near humans and domesticated animals should be all too clear given the virus's origins, " continues the aforementioned January 2021 letter. " Reports from the World Health Organization have acknowledged that the spread of SARS-CoV-2 on fur farms has the potential to impact not only mink but also the people who work with them, their families, and our communities within British Columbia".

As the Province makes significant strides within the COVID-19 pandemic, it is of urgent nature that we acknowledge the risks posed by fur farms and halt the processes that may potentially lead to new fur farms, and in turn, new variants, outbreaks, and another myriad of public health crises.

Sincerely,

s.3

June 14, 2021

DRAFT - For PHO signature

File:
Ref:

s.3

Thank you for your letter of June 14, 2021 expressing concern for fur farms and COVID-19 in B.C. These issues are active matters within the Ministry of Health, the Ministry of Agriculture, Food and Fisheries, and the Ministry of Environment and Climate Change Strategy.

I have confirmed with the Ministry of Agriculture, Food and Fisheries that while interest has been expressed in the potential establishment of two new fur farms; to date, no applications have been received.

SARS-CoV-2 virus on mink farms is still of concern which is why the Ministry of Health and Ministry of Agriculture, Food and Fisheries continue to work closely with the existing fur farms in monitoring the health and well-being of their workers and the animals.

Thank you for writing and sharing your concerns with us during these unprecedented times.

another round of mink farm inspections

From: Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>
To: XT:HLTH Brodkin, Elizabeth <elizabeth.brodkin@fraserhealth.ca>, Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Sent: June 18, 2021 12:43:46 PM PDT

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Hi Bonnie and Elizabeth,

As you probably are aware we are close to finishing the mink risk assessment process and I believe the results should be to government in a couple weeks.

s.13; s.17

It's hard to make our inspections truly "unannounced" since there is sufficient time to put on PPE from when we get there to when we get to the more biosecure areas (and once we inspect one farm, they tell everyone else to expect us). Really it's only what we can see from the driveway that is an unbiased assessment.

So with that in mind, do you think another round of inspections would still be helpful in making the overall assessment? I do think we probably have confidence already that we can't expect tight adherence to protocols without rigorous enforcement. But if you think it would be valuable to document the degree of apparent compliance at this point, we'd be happy to send the inspector out at the end of the month.

One other update s.3 has had a very puzzling pattern of infection. We continue to have intermittent positives on mortality and live sampling, but never more than 1 or 2 animals at a time. The rate of infection in the herd, based on the positivity rate, is no more than 5%. Our latest samples had high Ct values as well. We're not aware of other jurisdictions who have had this pattern, and are wondering if there was either a previously undetected outbreak of Covid in the breeding animals or perhaps more limited spread because of more distance between cages than other farms. Genotyping of the cases has not had mutations of concern. s.13; s.17

s.13; s.17

Regards,
Emily

Emily Newhouse, MD, MPH, FRCPC
Medical Health Officer
Fraser Health

Administrative assistant:
Christy Burkett
Ph: 604-930-5405, ext 765638
christy.burkett@fraserhealth.ca

Re: Follow-Up Discussion re: Mink Farms in BC

From:	Clair, Veronic [BCCDC] <veronic.clair@bccdc.ca>
To:	McGuire, Jennifer AFF:EX <Jennifer.Mcguire@gov.bc.ca>
Cc:	Gunvaldsen, Rayna AFF:EX <Rayna.Gunvaldsen@gov.bc.ca>, XT:HLTH Brodkin, Elizabeth <elizabeth.brodkin@fraserhealth.ca>, Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>, Singal, Mayank [BCCDC] <mayank.singal@bccdc.ca>, Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>, Ethier, Tom AFF:EX <Tom.Ethier@gov.bc.ca>
Sent:	July 2, 2021 12:04:06 PM PDT
Attachments:	DRAFT Joint_RQRA_MINK SARS-CoV-2 Final_ June 30th.pdf, DRAFT Hazard Profile J-RQRA_SARS-CoV-2 Final June 30.pdf

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Hi Jennifer,

We have completed a final draft of the Joint-Rapid Qualitative Risk Assessement (J-RQRA) and associated Hazard Profile.
Those documents have just been circulated for review to a small group outside of those who contributed to creating these documents.
Dr. Henry probably has not had a chance to review them yet.

I have included those as drafts in attachment, confidentially, as I understand a meeting is being booked to discuss those on July 7th in the morning.

Best,

Veronic

From: Clair, Veronic [BCCDC]
Sent: April 19, 2021 9:01 AM
To: 'McGuire, Jennifer AFF:EX'
Cc: Gunvaldsen, Rayna AFF:EX; Brodkin, Elizabeth Dr. [FH]; Newhouse, Emily [FH]; Viney, Ursula E AFF:EX; Ethier, Tom AFF:EX
Subject: RE: Follow-Up Discussion re: Mink Farms in BC

Hi,
Yes, we have been strategizing on how to do this in the best manner possible. I had started updating the prior draft risk assessment and then though it would be best to have input from national experts. So, I have approach the group in CFIA and PHAC that led the national rapid qualitative risk assessment (RQRA). They agreed to support us in generating an updated risk assessment for BC. The process involves first a meeting to set up the questions to answer, the pathway that are relevant, the mitigation factors to include and how. Then it uses a Delphi process to support ranking of the risks and associated uncertainties, with experts meeting to discuss the rating and share insight, followed by a re-ranking and new discussion. This process might take a month and a bit, followed by the write up and review of the final RQRA by the group.

I have started to discuss with our local experts as to how and when to move forward with the BC RQRA.[s.13; s.17]
s.13; s.17

Best,

From: McGuire, Jennifer AFF:EX [mailto:Jennifer.Mcguire@gov.bc.ca]
Sent: Sunday, April 18, 2021 2:06 PM
To: Clair, Veronic [BCCDC]
Cc: Gunvaldsen, Rayna AFF:EX; Brodkin, Elizabeth Dr. [FH]; Newhouse, Emily [FH]; Viney, Ursula E AFF:EX; Ethier, Tom AFF:EX
Subject: RE: Follow-Up Discussion re: Mink Farms in BC

EXTERNAL SENDER. If you suspect this message is malicious, please forward to spam@phsa.ca and **do not** open attachments or click on links.

Hello Dr Clair,

Following the April 1st meeting with Dr Henry, An action from that meeting was that the risk assessment on mink farms was to be updated to reflect new information and a revised health risk assessment.

Curious as to the timing of the production of this updated risk assessment or even a preliminary risk assessment statement from Health?

AFF is assessing policy options for this sector and the health risk assessment is a significant factor in determining the policy options.

Thank you

Jennifer McGuire, P.Ag.
Assistant Deputy Minister, Science Policy and Inspections Division
Ministry of Agriculture, Food and Fisheries
Ph: 778-698-8521 Cell: 250-361-5944

JOINT RAPID QUALITATIVE RISK ASSESSMENT (J-RQRA):

Public Health Risk associated with SARS Coronavirus 2 (SARS-CoV-2) in Farmed Mink in British Columbia

Iteration #1: June 29, 2021

DRAFT

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[This assessment was conducted by a multi-jurisdictional expert group. The methodology is intended to be used in situations where policy decisions need to be made in the face of high uncertainty. Given the minimal data available on surveillance, research, epidemiology and risk behaviours specifically related to SARS-CoV-2 in animals, the assessment was primarily informed by the group's collective professional knowledge on such topics as infectious diseases, virology, epidemiology, industry practices, and human-animal interactions. Assumptions, and sources of variability and uncertainty are detailed in the document. The findings and conclusions represent the consensual, but not necessarily unanimous, opinions of the group participants, and do not represent the views of the participants' respective organizations.]

Participants and Affiliations

Lead: Veronic Clair, Physician Epidemiologist, British Columbia Centre for Disease Control

Project Coordinator: Daniela Michel, Operations Coordinator, British Columbia Centre for Disease Control

Expert group:

Organization	Participant Name	Participant Title
British Columbia Centre for Disease Control	Elaine Chan	Field Epidemiologist
	Erin Fraser	Public Health Veterinarian
	Inna Sekirov	Medical Microbiologist
Fraser Health Authority	Emily Newhouse	Medical Health Officer
BC Ministry of Agriculture, Food and Fisheries	Rayna Gunvaldsen	Chief Veterinarian
BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development	Caeley Thacker	Wildlife Veterinarian
BC Ministry of Environment and Climate Change	Michael Schwalb	Senior Policy Specialist
Public Health Agency of Canada	Logan Flockhart	Epidemiologist
	Linda Vrbova	Senior Epidemiologist
Canadian Food Inspection Agency	Sharon Calvin	Specialist Risk Assessment Senior Veterinarian Science Specialist
	Indervesh Dahiya	Veterinary Program Officer
	Brad Pickering	Research Scientist

DRAFT

1. Executive Summary

Purpose

This iterative, joint rapid qualitative risk assessment (J-RQRA) assesses the risk of emergence of a variant of interest (VOI) from an infected mink herd, spreading in the general population and potentially becoming a variant of concern (VOC) for public health. This risk assessment hopes to provide decision-makers with relevant estimated risk probabilities and uncertainties, to inform risk management decisions. Experts recognize that risk management decisions must include other considerations such as risk tolerability and the feasibility of mitigation measures, among other factors.

Event summary

Between December 2020 and May 2021, SARS-CoV-2 was detected in mink on three mink farms in the Fraser Valley of British Columbia, Canada. Human-to-mink transmission is suspected as the source of virus introduction onto the farms. Whole genome sequencing (WGS) analysis and interpretation are ongoing. The affected farms were placed under quarantine. Two of the three farms are currently free from disease, but all farms remain under quarantine until the sites are considered fully decontaminated. Under the Public Health Act, a Class Order applying to all active mink farms in the Fraser Health Authority mandated a series of measures to enhance monitoring and control of SARS-CoV-2 on mink farms, including safety plans, enhanced personal protective equipment (PPE), and participation in testing programs, including weekly mink mortality viral testing. On April 15, 2021, public health issued an Order that permitted only vaccinated mink farmworkers to have duties that put them in close contact with mink.

Risk Framing

The scope of the assessment is limited to the mink farms in the Fraser Health Authority and British Columbia. The outcome of interest is the circulation of a mink-induced SARS-CoV-2 VOI in the community that could potentially increase transmission, cause more severe disease in humans, escape vaccines, or significantly decrease the effectiveness of therapeutic and diagnostic technologies, compared to what is seen with currently circulating variants. The pathways assessed are human-mink-human and human-mink-wildlife-human. Two timeframes are assessed: 1) short term: completion of the current production cycle, up to before the start of the next breeding season; and 2) long term: the next 5 years.

Methods

A multi-jurisdictional expert group jointly completed all steps of the J-RQRA process. The expert group developed a detailed hazard profile and agreed on scenario pathway diagrams used to create the risk questions. Then, using a modified Delphi approach, the expert group assessed probability, impact, and uncertainty estimates. Probabilities along the scenario pathways were combined as per accepted qualitative risk assessment methodologies.

Key assumptions

Several assumptions were made by the expert group that influence the final results. There is often a high degree of uncertainty related to the assumptions. They are important to highlight because changes

to the assumptions may affect the final estimates, and significant changes may indicate the need for re-assessment in some circumstances. Assumptions are listed in detail here.

Probability level, impact and uncertainties
The combined assessment of probability and the assessment of consequence the emergence and circulation of a VOI in the community of mink/wildlife origin are as follows:

1. What is the likelihood and impact of emergence and circulation of a SARS-CoV-2 variant of interest (VOI) in the community due to virus evolution in mink or 'wildlife after exposure to mink' during completion of **THIS CYCLE**, compared to what is seen with currently circulating variants and evolving public health measures?

   Probability: very unlikely (VOI in wildlife pathway) to very unlikely/unlikely (VOI in mink pathway)
   Uncertainty: moderate (VOI in mink pathway) to high (VOI in wildlife pathway)

   Impact: minor to moderate at the local/regional level, and slightly less at the provincial level
   Uncertainty: moderate to high

2. What is the likelihood and impact of emergence and circulation of a SARS-CoV-2 variant of interest (VOI) in the community due to virus evolution in mink or 'wildlife after exposure to mink' **WITHIN THE NEXT 5 YEARS**, compared to what is seen with currently circulating variants and evolving public health measures?

   Probability: very unlikely (VOI in wildlife pathway) to unlikely (VOI in mink pathway)
   Uncertainty: moderate (VOI in mink pathway) to high (VOI in wildlife pathway)

   Impact: minor to moderate at the local/regional level, and slightly less at the provincial level
   Uncertainty: moderate to high

The combined probability estimates for both time frames of the human-mink-human pathway are driven primarily by the probability of the evolution of the virus into a VOI in a mink herd (A3 in the risk pathway). There was a higher level of uncertainty associated with the key probability (A3) in the five-year assessment due to the higher uncertainty in the expected number of mink herd outbreaks per year as time goes on and higher uncertainty regarding the evolution of a VOI. The risk assessment for the next five years assumed limited control measures (see assumptions section).

In the pathway involving wildlife for both the current cycle and in the next five years, most steps were estimated as less probable than for the direct pathway from mink to humans, with a similar level of uncertainties. The mode of the overall probability for the human-mink-wildlife-human pathway during both periods was very low, regardless of the spread scenario in wildlife (limited spread or reservoir). These estimates were driven primarily by 1): the probability of evolution of the virus into a VOI in wildlife (B5) that was assessed as very unlikely to occur; and 2) the probability that a person would contract the virus from wildlife was assessed at very unlikely (B6). Experts expressed it is more likely that a VOI will arise in humans rather than in mink.

If there was emergence and circulation of a VOI in the community that was of mink/wildlife origin, the magnitude of the impact on the health of the population above the current/ongoing pandemic impacts for this cycle are likely to be minor to moderate at the local/regional level, and slightly less at the provincial level. The uncertainty associated with this is moderate to high. The magnitude of the impact at the five-year timeframe is likely to be similar but with a higher level of uncertainty.

Discussion

This is the most comprehensive provincial risk assessment related to mink farming to date. It is based on a comprehensive hazard profile. Both have been undertaken in collaboration with national experts. The previous national rapid qualitative risk assessment was performed early in the pandemic. Therefore, this assessment and accompanying hazard profile are based on significantly more scientific knowledge and on-the-ground experience accumulated since the previous assessment. Still, because of the moderate to high uncertainty for both the probability and impact estimates, it is important to continue monitoring the situation in mink farms, the overall pandemic, and the scientific literature, reassessing the risk when needed.

Depending on the tolerability of the risk and associated uncertainties, the level of mitigation measures can be increased or lowered compared to what has been assumed to be in place in this risk assessment. Expected benefits from mitigation measures need to be balanced with their acceptability, feasibility and timeliness, recognizing that these measures can affect the industry's profitability or pose operational challenges to the many sectors involved.

2. Event Summary

The SARS-CoV-2 pandemic has been ongoing since early 2020 and has affected nearly every country in the world. Although SARS-CoV-2 likely originated from an animal source, the current pandemic is being sustained through human-to-human transmission (OIE Q&A). Spillover of the virus from humans to animals has been documented in companion animals (cats, dogs, and ferrets), zoo animals (large cats, gorillas, and otters), and farmed mink (OIE events in animals). Several other species have been shown to be susceptible under experimental conditions (Government of Canada).

Outbreaks of SARS-CoV-2 have occurred in mink farms in several countries, including: the Netherlands, Denmark, Spain, France, Italy, Sweden, Greece, Poland, Lithuania, Latvia, the USA, and Canada (OIE events in animals). Most of the affected mink farms around the world reported SARS-CoV-2 infection among workers and it is hypothesized that the mink herds were infected through human-mink transmission (FAO/OIE/WHO, 2021). Once in the mink, mink-to-mink transmission occurs readily, and mink-to-human and mink-to-cat transmission has also been documented in some places (Fenollar et al., 2021; van Aart et al., 2021).

Within Canada, infected mink herds have only been detected in British Columbia. Between December 2020 and May 2021, SARS-CoV-2 was detected in mink on three mink farms in the Fraser Valley of British Columbia, Canada. Similar to what has been seen globally, human-to-mink transmission is suspected as the source of virus introduction onto the farms. None of the farms experienced high mortality rates in mink: mink infection of the first farm was detected after finding the virus first in humans on the farm, mink infection on the second farm was detected after noticing a slight increase in clinical signs and mink mortality (3%), while no infections in human contacts have been confirmed, and mink infection on the last farm was detected through the mink mortality testing surveillance program in place.

The affected farms were placed under quarantine. The first farm was deemed free of disease as of February 24, 2021, after successive sampling revealed negative results. The second farm voluntarily opted to euthanize all mink on the premises. Successive testing of the third farm is in progress. All farms will remain under quarantine until the sites are considered fully decontaminated as per protocols of the Government of British Columbia.

Whole genome sequencing (WGS) analysis and interpretation are ongoing. To date, the WGS analysis found that the mink cases on all farms originated from strains of SARS-CoV-2 already circulating in the BC community. None of the emergent clades found on the farms are considered to be variants of concern, nor variants of interest. The SARS-CoV-2 genomes sampled from mink in BC do not exhibit unusual mutational profiles and do not show higher than expected levels of divergence.

Under the Public Health Act, a Class Order applying to all active mink farms in the Fraser Health Authority mandated a series of measures to enhance monitoring and control of SARS-CoV-2 on mink farms, including safety plans, enhanced personal protective equipment (PPE), and participation in testing programs, including weekly mink mortality viral testing. After an initial mandatory viral and serological testing of workers to detect current or past COVID-19 infection, there had been no mandatory human testing. However, mink farm workers are participating in voluntary COVID-19 testing, from once a week to three times a week depending on the situation.

Two cases of SARS-CoV-2-infected workers with direct mink contact have been detected that have not resulted in transmission of infection to the herd; ascertained by intensive live mink testing after detection of human cases. The live mink testing after identification of an infected worker who had

contact with minks was to increase the probability of detecting a SARS-CoV-2 infection in the herd as early as possible, because of the low number of weekly mortality available from those farms, during that part of the mink production cycle.

There was a s.22 for which the initial investigation failed to uncover contact with mink. As there was no information that s.22 had contact with mink, s.22 infection did not trigger live animal testing. Subsequently, the herd was found infected, confirming an infection in a third farm. The herd was infected with the same rare strain that caused s.22 infection, confirming a link between s.22 infection and the herd's infection.

At time of writing, BC is experiencing a substantial decrease in its third wave of human COVID-19 cases (refer to BCCDC website for COVID data). From March to May 2021, all mink workers and their household members were offered the Pfizer COVID-19 vaccine, some had already received the AstraZeneca before being offered the Pfizer, because of earlier eligibility from other criteria. On April 15, 2021, public health issued an Order that permitted only vaccinated mink farm workers to have duties that put them in close contact with mink; almost all mink farm workers chose to receive vaccine. All mink workers have now been offered a second dose of vaccine.

Further details can be found in the Hazard Profile on SARS-CoV-2 in Farmed Mink in British Columbia.

3. Risk Framing

As a result of the events related to SARS-CoV-2 infection in mink to date and the likely ongoing circulation of SARS-CoV-2 in the human population at some level for years to come, concerns were raised within the government of BC on the emergence a variant of interest (VOI[1]) from an infected mink herd, potentially leading to a variant of concern (VOC)[2] for public health.

There remains a lot of uncertainty related to SARS-CoV-2 at the human-animal-environment interface, the evidence is rapidly evolving, and it involves multiple disciplines. Therefore, this iterative, joint rapid qualitative risk assessment (J-RQRA) process was initiated. It is intended to inform recommendations on industry operation, based on decision-makers' degree of acceptance of the risk remaining after risk mitigation measures recommended by public health are implemented. As it would be very unlikely that a variant can be assessed as a VOC in the mink herd, because the characteristics of the virus impact on the herd is not likely to be the same as the impact in a human host, it was decided to assess the probability of a VOI arising. It is easier to identify a VOI from mutation(s) that have been associated with concerning features uncovered from WGS of mink samples. Confirming that the mutations reach the level of a VOC would not be possible until it circulates in humans. The probability of a VOI arising is

[1] As per the Public Health Agency of Canada VOI definition, "A SARS-CoV-2 variant is a VOI if it has a genome with mutations associated with changes in epidemiology, antigenicity, or virulence, or changes that potentially have a negative impact on available diagnostics, vaccines, therapeutics, or public health measures; and is known to cause community transmission/multiple COVID-19 cases/clusters in Canada or has been detected in multiple countries; or is otherwise assessed to be a VOI by WHO; or is otherwise assessed to be a VOI by the CSVSG."

[2] As per the Public Health Agency of Canada VOC definition, "A SARS-CoV-2 variant is a VOC if, through a comparative assessment, it has been demonstrated to be associated with one or more of the following: increased transmissibility or detrimental change in COVID-19 epidemiology; increased virulence or change in clinical disease presentation; decreased effectiveness of available diagnostics, vaccines, therapeutics, or public health measures; or is otherwise assessed to be a VOC by WHO; or is otherwise assessed to be a VOC by the CSVSG."

higher than that of a VOC, providing a more conservative estimate of the more concerning situation of full evolution to a VOC.

The scope of the assessment is limited to the mink farms and communities in the Fraser Health Authority and British Columbia. The outcome of interest is the circulation of a mink-induced SARS-CoV-2 VOI in the community potentially increasing transmission, causing more severe disease in humans, escaping vaccines, or decreasing significantly the effectiveness of therapeutic and diagnostic technologies, compared to what is seen with currently circulating variants. Two timeframes will be assessed, including:

- Short term: completion of this cycle, up to before the start of the next breeding season (March-April 2022)
- Long term: the next 5 years[3]

The source of risk being assessed is a SARS-CoV-2 infection in a mink herd, or wildlife in the area surrounding a mink farm, generating genetic mutations with concerning features for public health[4]. However, since the source of infection in a mink herd is most likely to be an infected mink farm worker, the pathways assessed are **human-mink-human** and **human-mink-wildlife-human**.

Based on this risk framing, the assessment addresses the following specific risk questions:

1. What is the likelihood and impact of emergence and circulation of a SARS-CoV-2 variant of interest (VOI)[4] in the community due to virus evolution in mink or 'wildlife after exposure to mink' during completion of **this cycle**, compared to what is seen with currently circulating variants and evolving public health measures?

2. What is the likelihood and impact of emergence and circulation of a SARS-CoV-2 variant of interest (VOI) in the community due to virus evolution in mink or 'wildlife after exposure to mink' within the next **5 years**, compared to what is seen with currently circulating variants and evolving public health measures?

3. Method

A multi-jurisdictional expert group was formed to jointly complete all steps of the J-RQRA process. This assessment is not meant to provide specific scientific literature support for the probability or uncertainty estimates. The group shared background knowledge within a jointly-drafted hazard profile, and participated in the risk framing process and development of the assumptions for the assessment. A scenario pathway diagram was created based on the risk questions (see Figure 1), and probabilities along these pathways were identified.

Probability and impact estimates were assessed qualitatively using a modified Delphi approach with the expert group: experts were individually surveyed for their initial estimates, the results were discussed as

[3] Recognizing the uncertainty over this long timeframe, and that as time goes on a lot more will be known about the virus epidemiology, diseases, associated vaccines and therapeutics, and ability of the industry to sustain required risk mitigation measures.

[4] Potentially increasing transmission, causing more severe disease in humans, escaping vaccines, or decreasing significantly the effectiveness of therapeutic and diagnostic technologies.

a group, and experts were then given the opportunity to modify their responses to the survey as they saw fit. The level of uncertainty associated with each probability and impact estimate was also assessed, and comments were provided by experts to justify their rationale for the estimate and describe sources of variability and uncertainty (see Table 1, Table 2, and Table 3 for definitions of estimates).

Table 1 - Likelihood Definitions

Likelihood of event occurring	Descriptive Definition
Negligible	The situation described in the question is almost certain not to occur but could occur under exceptional circumstances. **The likelihood is virtually zero.**
Very low	The situation described in the question is **very unlikely to occur**.
Low	The situation described in the question is **unlikely to occur.**
Moderate	The situation described in the question **may occur**.
High	The situation described in the question is **likely to occur**.

Table 2 – Uncertainty categories[5]

Uncertainty category	Interpretation
Low	There are reliable data and information available; strong evidence is provided in multiple references, and authors report similar conclusions. Several experts have multiple experiences of the event, and there is a high level of agreement between experts.
Moderate	There are some gaps in availability or reliability of data or information; evidence is provided in a small number of references, and/or authors report conclusions that vary from one another. Experts have limited experience of the event and/or there is a moderate level of agreement between experts.
High	There are scarce or no reliable data or information available, and/or authors report conclusions that vary considerably between them. Very few experts have experience of the event and/or there is a very low level of agreement between experts. Results are based on educated guess or crude speculation.
Too high to allow assessment	The estimate is just as likely to be negligible as high, and estimates would not provide any useful information to risk managers at this stage. [If at least half of voters choose this option, then no estimates will be reported for that component of the pathway, though other components of the pathway may still be estimated to provide a maximum estimate for the overall pathway.]

Table 3. Description of the magnitude of the effects

Magnitude of the effect	Description of the effect
Indiscernible	Not usually distinguishable from normal day-to-day variation
Minor	Marginal, but insignificant and/or reversible
Moderate	Noticeable and important consequences on the health of the population and health system, but usually reversible
Significant	Serious and substantive consequences on the health of the population and health system, but usually reversible
Severe	Extremely serious and/or irreversible

[5] Adapted from: Tripartite JRA Operational Tool; and Fournie G, Jones BA, Beauvais W, Lubroth J, Njeumi F, Cameron A & Pfeiffer DU, 2014. The risk of rinderpest re-introduction in post-eradication era. *Prev Vet Med* 113 (2): 175-184.

Probabilities along the pathways were combined as per accepted methodologies in qualitative risk assessments. It is important to remember that probabilities represent values between zero and one; therefore, the lowest value was adopted for dependent events (i.e., for conditional probabilities along a pathway, where probabilities would be multiplied if they were quantitative) and the highest value for independent events (i.e., for probabilities of different pathways, where probabilities would be added) (Cox, 2008; Cudmore et al., 2012; Gale et al., 2010). However, qualitative assessments cannot be as precise as quantitative assessments, and it is important to remember that for dependent events, this method of combining probabilities may over-estimate the probability, and for independent events, this may under-estimate the probability if the events are not mutually exclusive (i.e., could occur concurrently). In this risk assessment, the events in the pathway are dependent, therefore the lowest probability is adopted to qualify the overall probability for each pathway. The probability modes for each step along the pathways are shown in Figure 2. The combined probability estimates are described in the section "Combining Probabilities".

The methodology for combining qualitative uncertainty rankings in risk assessments is not as clearly defined as for combining probabilities. Some authors report uncertainty for every step without combination (Jones et al., 2015; Peeler & Thrush, 2009), others adopt the highest uncertainty (Mandrak et al., 2012) while finally others adopt the highest uncertainty associated with the lowest likelihood for dependent events (Cudmore et al., 2012; Mimeault et al., 2017). In this assessment, the mode for uncertainty estimates was reported separately for each step in Figure 2, and the sources of highest uncertainty are discussed in the conclusions. For the human-mink-human pathway, the overall uncertainty is considered to be the highest uncertainty associated with the lowest likelihood for dependent events. For the human-mink-wildlife-human pathway, the uncertainty is associated with the spread scenario and so the highest uncertainty of the two spread scenarios was chosen.

The conclusions provide the overall likelihood for each risk question using the descriptive definition. The primary rationale for each pathway is explained, along with a description of the level of uncertainty and the key sources of uncertainty and variability. The estimate of the magnitude of the impact on the health of the population above the current/ongoing pandemic impacts is then given for each risk question, along with the rationale and description of uncertainty and variability. The conclusion also outlines potential additional mitigation measures and considerations.

This assessment may be updated as more information becomes available, or as assumptions change.

4. Key Assumptions

A number of assumptions were made by the expert group that influence the final results. There is often a high degree of uncertainty related to the assumptions. They are important to highlight because changes to the assumptions may have an effect (positive or negative) on the final estimates, and significant changes may indicate the need for re-assessment in some circumstances.

Assumptions regarding context

- Over the 5 year time period, there will continue to be circulation of SARS-CoV-2 in humans in BC at some level

- There will be ongoing importation of variants from countries with various levels of immunity
- The international border will reopen within the short-term assessment timeframe
- Society will re-open likely in mid-July

Assumptions regarding pathogen characteristics, epidemiology, and scenario pathway

- Humans are assumed to be the original source of an outbreak on a mink farm
- The virus spread and recovery timeline on a mink farm will remain similar to what has been observed so far, which is a rapid spread throughout the herd resulting in most mink in the herd being infected
- Wild birds are not susceptible to infection
- For the purposes of this assessment, it is assumed that the emergence of a VOI will arise fully evolved in mink, not that a VOI later develops in humans from a mink strain
- Exposure of the general public would occur via infected farm workers (or possibly wildlife), but not directly from the mink

Assumptions regarding mitigating measures in place

Mink

- Mink vaccination:
    - This cycle – assume not available
    - 5 years – assumed to be available and in use in some countries, though efficacy in preventing infection or severe disease in mink is uncertain, cost and affordability in the context of mink farming is unknown and therefore use, benefits and risks in BC are uncertain
- Environmental testing: ongoing
- Mandatory clinical reporting of the herd symptoms and mortality: ongoing
- Mortality testing: ongoing
- Circumstances needing live animal testing: ongoing

Worker

- Worker immunization:
    - This cycle – assume fully vaccinated as of June 2021
    - 5 years – assume fully vaccinated
    - We assume that migrant workers will have to be fully immunized before being allowed to work with minks
- PPE and other work procedures (E.g. use of mask in common indoor areas while at work for any work, in break, or while working with mink regardless of area and distancing):
    - This cycle – as per current protocol
    - 5 years – worker to abstain from working if they present with COVID-19 symptoms, medical masks and eye protection when working on the farm, decrease in usage of other PPE and protocols implemented for COVID-19, return to pre-COVID safety measures, no mandatory distancing between workers in common areas,
- Participation in testing (test type, frequency):
    - This cycle – same as now

- 5 years – Public health initiated testing will occur in humans if another positive case is found in humans, mink or the environment; closing of self-referred testing centre (COVID-19 testing for clinical symptoms carried by clinicians; various option for self-test available; industry driven point of care testing of workers will be optional)

Operator

- This cycle – same as now
- 5 years – return to regular inspections, regular operations

Wildlife and domestic animal infection monitoring sustainability

- This cycle – continued sampling around a positive premise
- 5 years – likely not a long-term option using current process

Community

- 75% of general population immunized, ongoing assessment of efficacy with vaccination program able to adjust to address weaning effectiveness, if applicable
- Extensive community genomic surveillance for this cycle with further increase based on mink-related outbreak
- Genomic surveillance at community level decreased in 5 years but still occurring, and can be scaled up if needed in relation to outbreaks in mink farms

5. Scenario Pathway Diagram

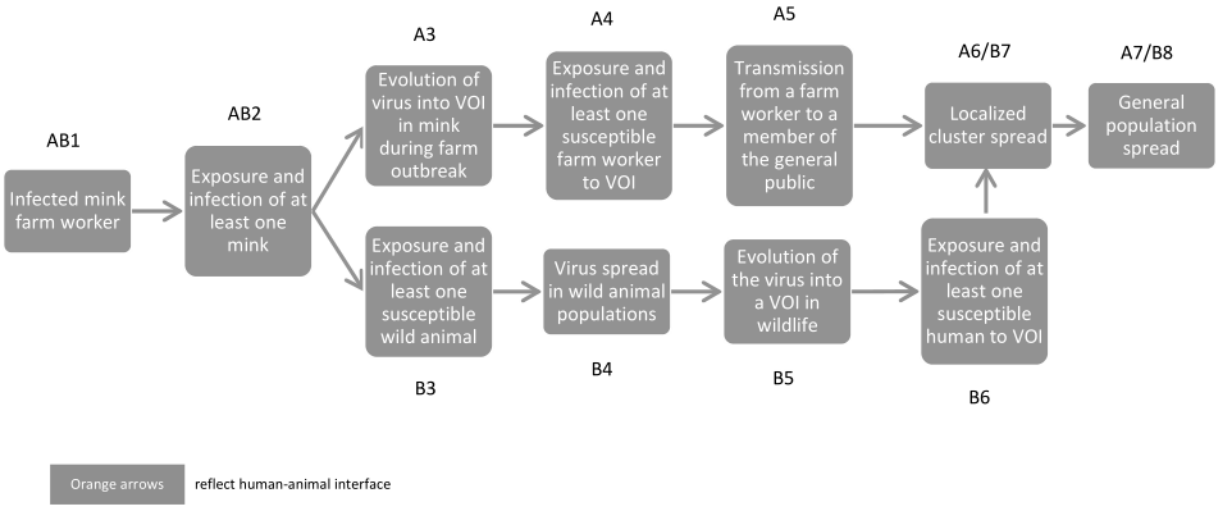


Figure 1: Scenario pathway diagram illustrating the potential emergence and circulation of a SARS-CoV-2 variant of interest (VOI) in the community due to virus evolution in mink (pathway A) or wildlife after exposure to mink (pathway B). Numbers represent the corresponding probabilities within the pathways, which are assessed in Table 1.

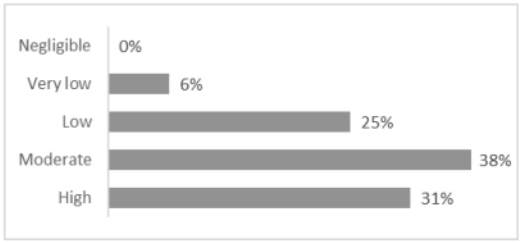
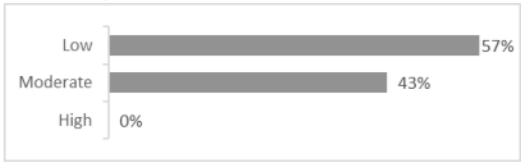
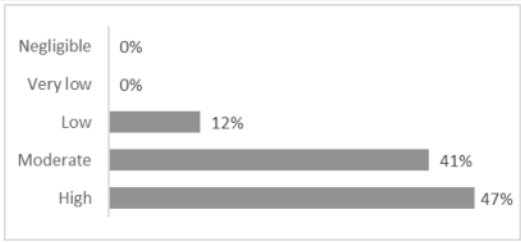
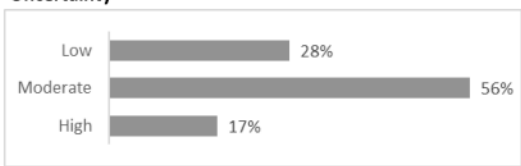
Probability Questions

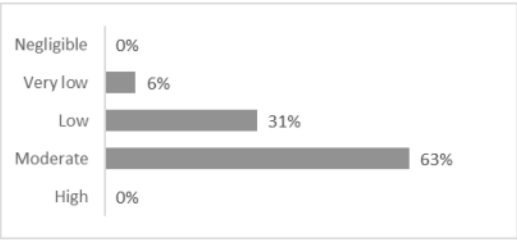
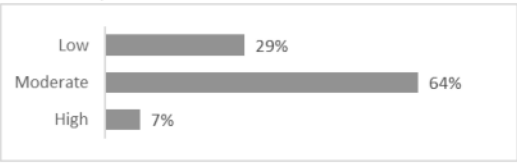
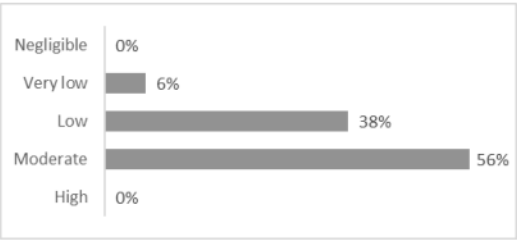
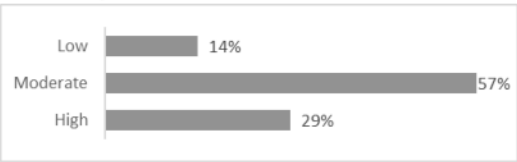
- AB1: What is the probability of at least one more infected mink farm worker during the timeframe?
- AB2: When an infected worker is present on a farm, what is the probability of infecting a mink herd, given the control measures assumed to be in place during the timeframe?
- A3: a. How many farms do you think will be infected (per year) during the timeframe?
  b. What is the probability that the virus evolves into a variant of interest (VOI) assuming 2 more farms become infected during this cycle/ 2 per year within the next 5 years, with the control measures assumed to be in place?
- A4: If a VOI has emerged in a mink herd, what is the probability of a farm worker contracting the VOI, given the control measures assumed to be in place during the timeframe?
- A5: If a farm worker has been infected by a mink-derived VOI, what is the probability of transmission from the farm worker to someone else given the control measures assumed to be in place during the timeframe?
- B3: If a mink farm has been affected, what is the probability of transmission from a mink to a wild animal, given the control measures assumed to be in place during the timeframe?
- B4: If a wild animal has been infected, what is the probability of the development of an ongoing virus reservoir in wild animals during the timeframe?
- B5: a. What is the probability that the virus from mink evolves into a VOI in wildlife during the timeframe, *assuming development of a reservoir in wildlife*?
  b. What is the probability that the virus from mink evolves into a VOI in wildlife during the timeframe, *assuming limited/transient spread in wildlife*?
- B6: a. If a VOI has evolved in wildlife, what is the probability of at least one person contracting the VOI from wildlife during the timeframe, *assuming development of a reservoir in wildlife*?
  b. If a VOI has evolved in wildlife, what is the probability of at least one person contracting the VOI from wildlife during the timeframe, *assuming limited/transient spread in wildlife*?
- A6/B7: If there has been at least one transmission of the VOI from one human to another, what is the probability of localized human spread of the VOI during the timeframe?
- A7/B8: If there has been localized human spread of the VOI, what is the probability of widespread transmission of the VOI in the general human population during the timeframe?

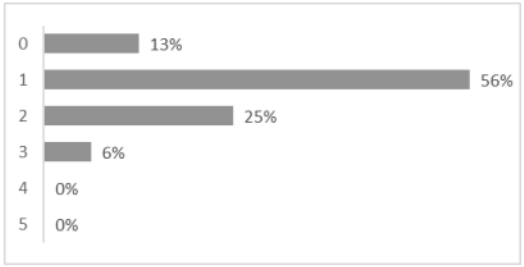
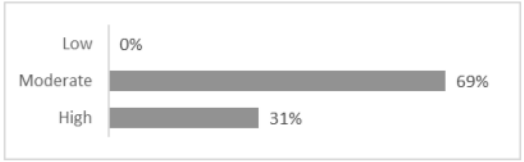
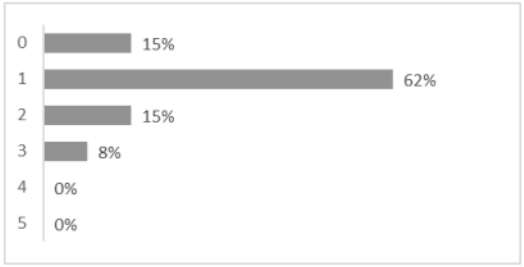
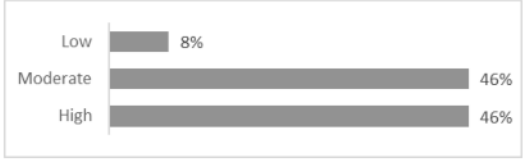
6. Assessment of Probability

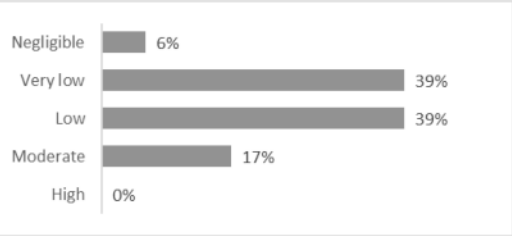
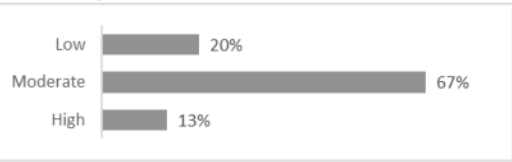
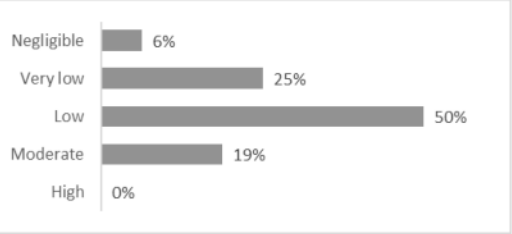
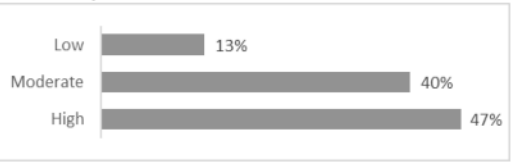
The probabilities from the scenario pathway diagram were assessed by the expert group for the two timeframes: this cycle, and 5 years. The results are presented in Table 1 (see the methods section for definitions of estimates). Variability is included within the range in the estimates. Uncertainty estimates and rationale are given for each probability estimate.

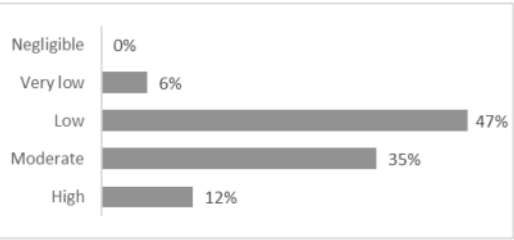
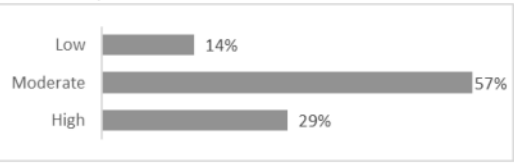
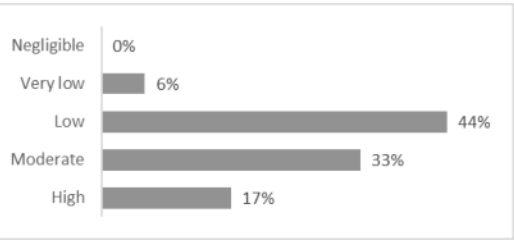
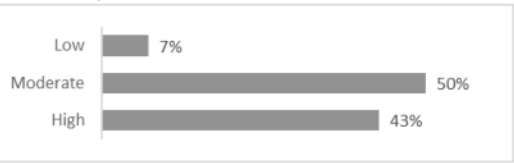
Table 4: Assessment of individual probabilities in scenario pathways

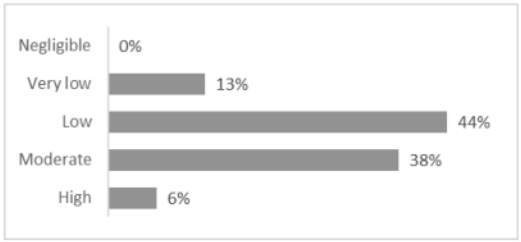
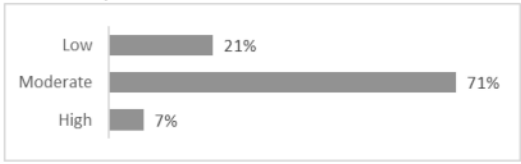
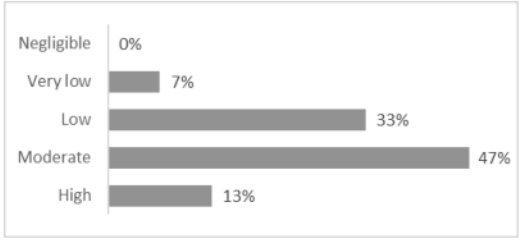
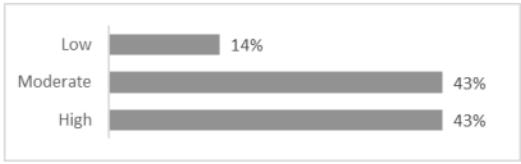
Time	Estimate	Rationale
AB1: What is the probability of at least one more infected mink farm worker during the timeframe?		
This cycle	 **Uncertainty** 	-**Probability:** At least one more infected mink farm worker **may occur** during the remainder of this cycle. -The current vaccines do not achieve sterilizing immunity; therefore, although disease will decrease, infection and shedding may still occur. -The rate of community transmission is decreasing rapidly, though this may change as businesses re-open and social contact increases. -There is a possibility of variants with immune escape properties infecting fully immunized workers. -The largest operations use migrant workers, but they will already have been received for some worker currently on-farm, and would be administered to other temporary foreign workers at the beginning of their quarantine by the provincial temporary foreign worker program as long as a quarantine is required and the program is able to support this. -The **uncertainty** around this probability was assessed as **low**. -Factors affecting variability and uncertainty include: extent of community transmission, efficacy of vaccines, vaccine coverage needed to see ongoing low circulation, characteristics of future variants regarding immune escape, behaviour of workers outside the workplace, sensitivity and compliance with infection monitoring and early detection of infection in workers, availability of replacement workers, and paid sick leave.
5 years	 **Uncertainty** 	-**Probability:** At least one more infected mink farm worker is **likely to occur** within the next 5 years. -Vaccine protection will likely continue to be less than 100% and it is assumed that COVID-19 will continue to circulate in the human population over the next 5 years, although it may be at a lower prevalence and it may not be as serious of a disease. -Vaccination combined with decreased surveillance may result in more circulation of mild and undetected cases in the future. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: same as current cycle, plus: extent of community transmission over this timeframe, and ongoing compliance of mink workers with vaccination requirements.

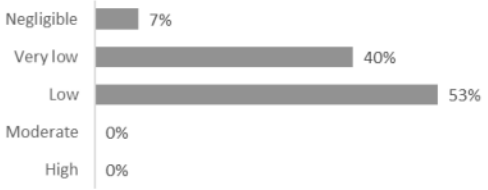
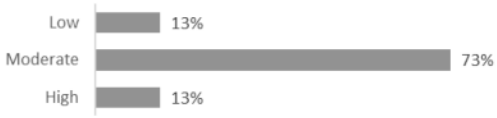
Time	Estimate	Rationale
AB2: When an infected worker is present on a farm, what is the probability of infecting a mink herd, given the control measures assumed to be in place during the timeframe?		
This cycle	 **Uncertainty** 	-**Probability:** If an infected worker is present on a farm during the remainder of this cycle, infection of the mink herd **may occur**. -There have been numerous examples around the world of workers transmitting infection to mink, despite some controls in place; however, there have also been examples in BC of infected workers that did not result in transmission to mink. -Vaccinated individuals may have a lower level of viral shedding. There is evidence of preserved 2-dose vaccine effectiveness above 85% for many variants, and of large decrease in onward transmission from someone infected with COVID-19 after full immunization with an mRNA vaccine. -During this cycle, farms will likely maintain a relatively high level of implementation of the stringent safety plan required of them, though compliance with biosecurity measures can be difficult to sustain and biosecurity breaches do occur. Compliance may decrease as time goes on if there is a perceived decrease in risk. -Human surveillance efforts are intended to identify workers that are infected, even if asymptomatic, and restrict them from working with the mink. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: compliance with and efficacy of PPE, biosecurity and human surveillance; extent of worker contact with mink; and degree of viral shedding in vaccinated individuals.
5 years	 **Uncertainty** 	-**Probability:** If an infected worker is present on a farm within the next 5 years, infection of the mink herd **may occur**. -The availability of a mink vaccine may be limited at first. The cost of the vaccine may be prohibitive to some producers unless compensated. -The mink vaccine will likely be effective at preventing disease and reducing shedding, but there is a lot of uncertainty regarding the level of efficacy at preventing infection. -The mink cycle results in new susceptible individuals every year, with mink typically being vaccinated in the summer. If kits are born in April-June, this may mean a couple months every cycle where mink are unvaccinated. Kits might have some protection by maternal antibodies of immunized mother, if mink vaccines are given to the herd ahead of whelping. -PPE and testing are challenging to maintain long term. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: same as current cycle, plus: potential variation in use of a mink vaccine, efficacy of vaccination in mink and length of immunity, and protection of mink vaccine against new variants arising in humans.

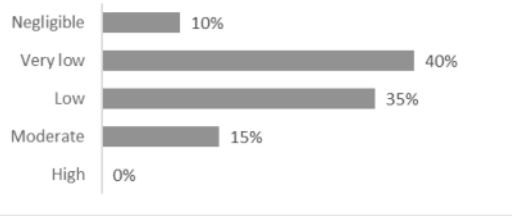
Time	Estimate	Rationale
A3a: How many farms do you think will be infected (per year) during the timeframe?		
This cycle	 **Uncertainty** 	-Although at least one infected worker may occur and may transmit infection to the herd, **the most likely scenario is that only one or a small number of mink herds would be infected during the remainder of this cycle.** This is based on the mitigating measures in place, decreasing community transmission, increasing vaccination, and the nature of the mink industry in BC (i.e., farms are relatively small and isolated). -Two farms were infected in the fall prior to the implementation of mitigating measures. Despite much higher community infection rates this spring than in the fall, only one farm has been infected. -Based on this result, the scenario estimate of two infected farms used for the rest of the questions is considered to be on the high end of what is expected. The following estimates may therefore slightly over-estimate the probability. -The **uncertainty** around this estimate was assessed as **moderate**. -The exact number depends on a lot of factors (as described for the previous probabilities) and so is difficult to predict. In addition to the previously-listed uncertainties, there is uncertainty on whether previously infected farms can be re-infected during same production cycle.
5 years	 **Uncertainty** 	-Those estimating “zero” indicated an expected yearly average between zero and one. -Mink vaccine may slowly start to compensate for other measures that will be reduced (e.g. PPE, testing, waning immunity since human vaccine), but it will be unlikely to fully mitigate risk. -Otherwise, this is much the same as during the current cycle, except the uncertainty increases as time goes on. -The **uncertainty** around this estimate was assessed as **moderate to high**.

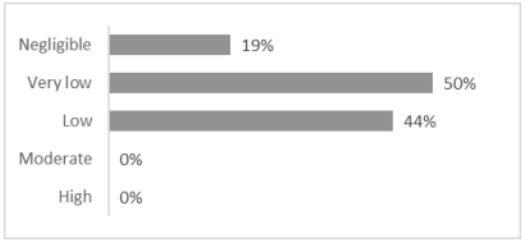
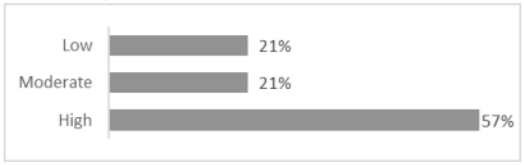
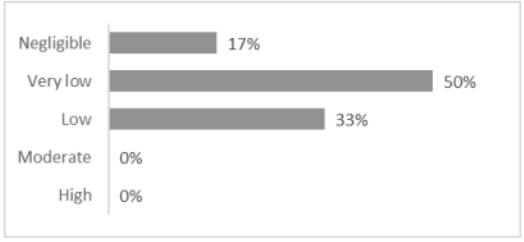
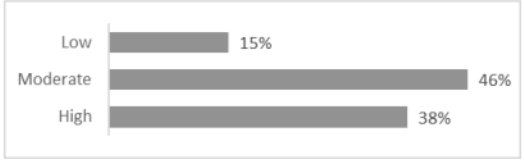
Time	Estimate	Rationale
A3b: What is the probability that the virus evolves into a variant of interest (VOI) given an expected number of farm outbreaks of 2 more during this cycle or 2/year within the next 5 years, with the control measures assumed to be in place?		
This cycle	 **Uncertainty** 	-**Probability:** Evolution of the virus into a VOI in a mink herd is **unlikely to very unlikely to occur** during the remainder of this cycle, with the small number of mink herds expected to be infected. -While there is a theoretical risk of a VOI emerging, the mutations detected and reported globally in mink to date have not led to the creation of a VOI. Cluster 5, which arose in the dense outbreak situation in Denmark, has not continued circulating in humans. Most mink-defining mutations are not of particular concern and have arisen in humans or circulated in humans without further generating VOI in humans either, despite the millions of infections in humans worldwide. -Infections in mink herds tend to clear relatively rapidly, in a matter of weeks, not several months. With current measures, infected herds should be detected and managed quickly. The result is a small number of accumulated mutations (less than 3). VOIs usually need large numbers of mutations to significantly affect transmission, severity or immune escape. It is unlikely/ very unlikely that enough mutations could occur within a single farm (without sequential infection from farm to farm), for the genetic changes to be sufficient to constitute a new VOI. -Even if several mutations were to accumulate, they usually tend to favour host specific adaptation which might not be advantageous in other hosts, such as humans. It is more likely that a VOI (from the perspective of humans) will arise in humans rather than in mink. -Very few VOIs and VOCs have arisen even in humans, despite the millions of human cases seen worldwide. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: compliance with control measures and testing, which mutations result in a VOI, and the future epidemiological patterns of infection in mink herds.
5 years	 **Uncertainty** 	-**Probability:** Evolution of the virus into a VOI in a mink herd is **unlikely to occur** within the next 5 years, with the small number of mink herds expected to be infected per year. -Similar rationale to the current cycle. -There is a slightly higher likelihood that as time goes on, restrictions relax and more mink or equipment are moved between farms causing larger outbreaks. However, mink vaccination will likely reduce shedding and spread within and between herds, even if it does not reduce infection. -The **uncertainty** around this probability was assessed as **high**. -Factors affecting variability and uncertainty include: same as current cycle, plus: potential variation in use of a mink vaccine, efficacy of vaccination in mink and length of immunity, and the effect of new variants arising in humans on mink infection. There is higher uncertainty on whether control measures and mink testing continue as time goes on.

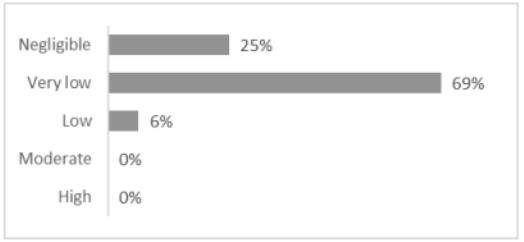
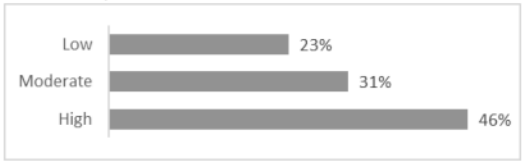
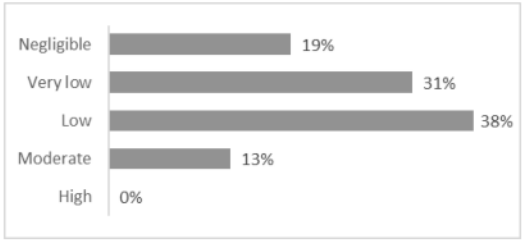
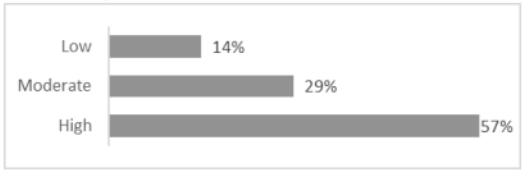
Time	Estimate	Rationale
A4: If a VOI has emerged in a mink herd, what is the probability of a farm worker contracting the VOI, given the control measures assumed to be in place during the timeframe?		
This cycle	 **Uncertainty** 	-**Probability:** If a VOI emerges in mink during this cycle, it is **unlikely** that a farm worker will contract the virus, but it may occur. Experts were divided, with two ratings selected almost as often, especially if the full distribution is taken into account. -Although transmission back to humans has been observed in Europe, it was in the context of very high number of mink farms and mink densities, no vaccine, lack of stringent safety plans, and lack of awareness and understanding by the industry of the consequences of the lack of prevention measures on their business. There have also been numerous outbreaks in mink herds that have not appeared to result in transmission back to humans. -It is likely that the stringent safety plans will be followed to the end of this cycle. Although there would be a need to ensure that these safety plan requirements remain for this industry while they might be lifted for other industries. -Vaccination will not provide 100% protection against infection, but it will reduce the likelihood. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: characteristics of the VOI that arises (e.g. transmissibility, vaccine protection), compliance with PPE, the season and extent of contact between workers and mink, human vaccine efficacy, and epidemiology of mink outbreaks to date.
5 years	 **Uncertainty** 	-**Probability:** If a VOI emerges in mink within the next 5 years, it is **unlikely** that a farm worker will contract the virus, **but it may occur**. Experts were divided, with two ratings selected almost as often, especially if the full distribution is taken into account. -PPE and testing will decrease over time, but vaccination of mink is likely to reduce viral shedding and onward transmission. Therefore, the probability remains similar between the two timeframes. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: same as current cycle, plus: potential variation in use of a mink vaccine, and efficacy of vaccination in mink.

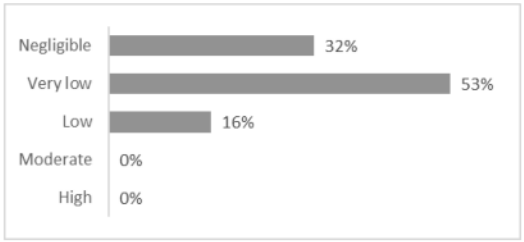
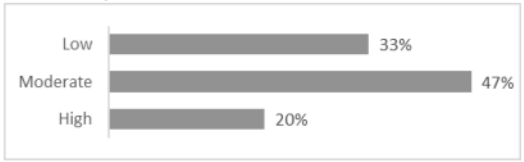
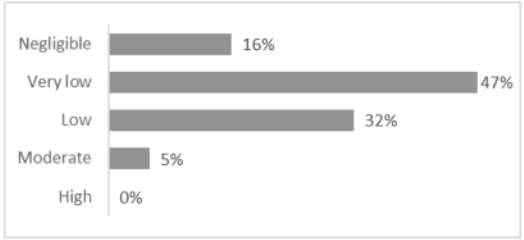
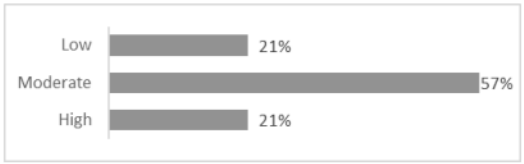
Time	Estimate	Rationale
A5: If a farm worker has been infected by a mink-derived VOI, what is the probability of transmission from the farm worker to someone else given the control measures assumed to be in place during the timeframe?		
This cycle	 **Uncertainty** 	-**Probability:** If a farm worker has been infected with a mink-derived VOI during this cycle, it is **unlikely** that they will transmit the virus to someone else. -It is less likely that there will be transmission outside the household, but **transmission within the household may occur**. Spread within a household is difficult to prevent and is more likely. -Vaccination of workers will likely decrease viral shedding and vaccination of family members may decrease susceptibility to infection. However, vaccination may also reduce symptomatic disease and hence detection prior to spread. -There has been little evidence of transmission between workers in outbreaks to date, since enhanced measures and vaccination. Transmission on farms so far has mostly been from outside work, or prior to enhanced measures. -With frequent testing of workers, early detection and isolation is likely to reduce spread and seems to have contributed to prevent outbreaks on farms as several workers were found infected with the surveillance system, without onward transmission. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: characteristics of the VOI that arises (e.g. transmissibility, vaccine protection), within household versus outside household contact, state of re-opening and restrictions in place, and human vaccine efficacy.
5 years	 **Uncertainty** 	-**Probability:** If a farm worker has been infected with a mink-derived VOI within the next 5 years, transmission of the virus to someone else **may occur**. -Decreased testing of workers means that infection may not be caught as early. - With the removal of COVID restrictions and increased social contact, there will be increased opportunities for transmission to occur in both public and home environments, which might be counteracted by the effect of vaccination. -However, low incidence rates in the community may result in high capacity for case ascertainment and rapid control measures to contain the cases. -The **uncertainty** around this probability was assessed as **moderate to high**. -Factors affecting variability and uncertainty include: same as current cycle, plus: availability of variant vaccine boosters, and uptake of vaccination by the general population over time.

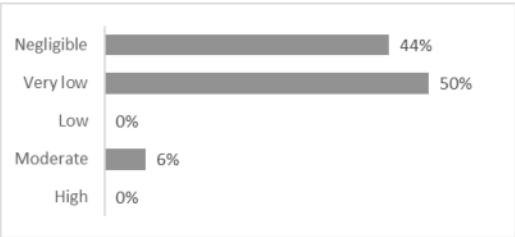
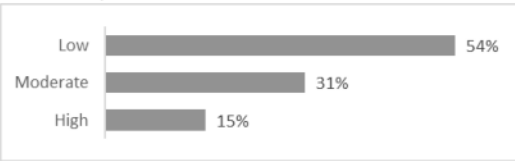
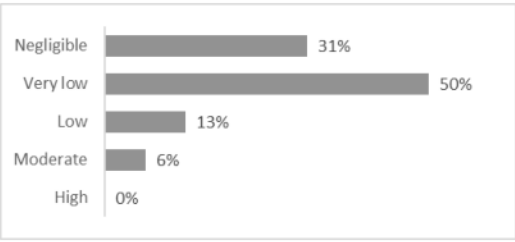
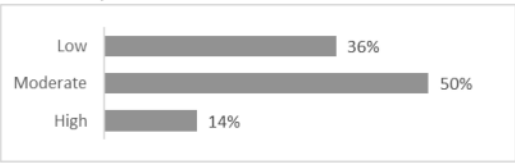
Time	Estimate	Rationale
B3: If a mink farm has been affected, what is the probability of transmission from a mink to a wild animal, given the control measures assumed to be in place during the timeframe?		
This cycle	 **Uncertainty** 	-**Probability:** If a mink farm has been affected during this cycle, it is **unlikely to very unlikely** that the virus will be transmitted from a mink to a wild animal. -Some wildlife species have been demonstrated to be susceptible to the virus under experimental conditions. Given the cases of natural infection in farmed mink, domestic cats and zoo felids, wild mustelids and felids are most likely to be susceptible. -There has been only one documented instance of transmission from farmed mink to a wild animal (not including escaped mink that remain associated with the farm), which was documented by the US. This wild mink was reported to have exposure to an improperly-managed compost pile. -Controls are in place on mink farms to prevent mink escape and entry of other animals and to manage carcass disposal (composting in some cases) and mink manure. -Fairly extensive perimeter testing of wildlife around one of BC's infected premises did not detect infection in wildlife, neither acute nor evidence of prior infection. -The nature of wildlife makes it unlikely, especially in BC, due to factors such as the species around farms and wildlife density. Animals that are most likely to come into contact with farmed mink are wild birds that access the sheds looking for food, barn cats/feral cats, coyotes, racoons, rodents and escaped/wild mink. Birds are assumed to be resistant to infection. There has been natural infection documented in cats and mink, while susceptibility has been demonstrated experimentally for some rodents. These animals may mechanically transmit contamination from manure, feed, etc., on their feet/paws, on feathers and fur; however, it is unlikely this would be of any significant viral load. They could carry contaminated feed products away from the site that are then consumed by wildlife. However, the feed that is supplied to mink is primarily in a mash which does not lend itself to being carried from the site to any significant degree. Direct contact of these animals with other wild animals is a possibility; however, escaped/wild mink are not likely to interact with other mink/wildlife to any degree being solitary in nature. Cats and rodents may be a more significant concern for interaction with other wildlife; however, rodents in the wild are short lived. Cats are unlikely to interact and socialize with wildlife unless they are preying on wildlife or the prey of wildlife. Neither interaction is likely to be sustained nor occurring within a close enough distance for transmission of an infectious dose. Animals would need to be infectious at the time of exposure in order to transmit the virus. The virus does not persist for a long duration in the environment in spring, summer and fall. It is more persistent in cool, damp, dark conditions under moderate relative humidity. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: the habitat surrounding the farm, time of year (dispersal of young or for mating), attractants on the farm, ability for mink to escape from the farm, mink disease dynamics, susceptibility of various wildlife species (especially Canadian bat species), and susceptibility of various species to variants.

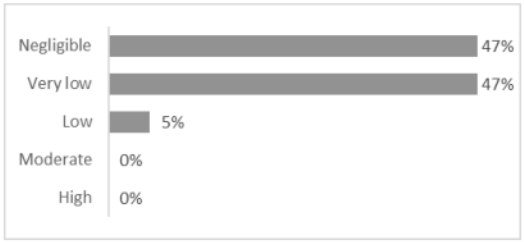
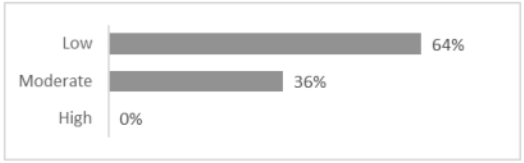
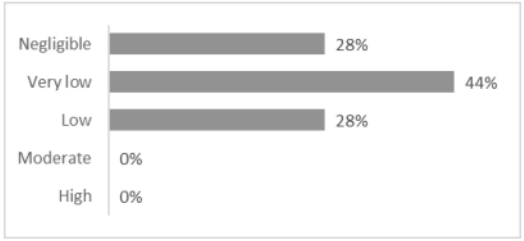
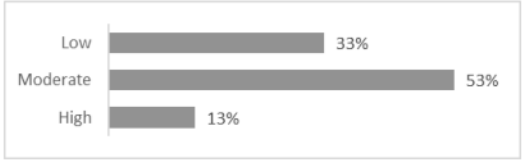
Time	Estimate	Rationale
5 years	 **Uncertainty** 	-**Probability:** If a mink farm has been affected within the next 5 years, it is **unlikely to very unlikely** that the virus will be transmitted from a mink to a wild animal. -The rationale is similar to other timeframe. -Mink vaccination over this time period would likely decrease viral shedding and reduce this probability. -Although the mode is lower than for the shorter timeframe, the range is higher. -The **uncertainty** around this probability was assessed as **moderate to high**. -Factors affecting variability and uncertainty include: same as current cycle, plus: potential variation in use of a mink vaccine, characteristics of the circulating virus, and efficacy of mink vaccine.

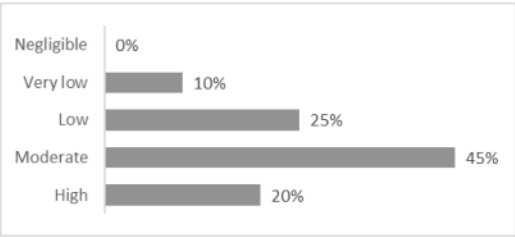
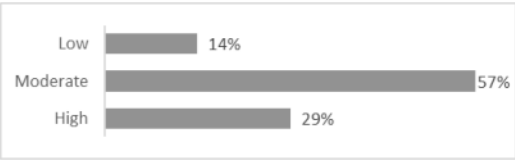
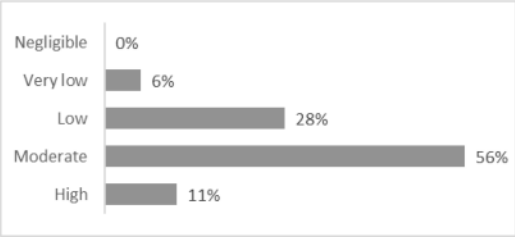
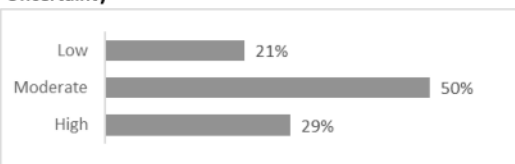
Time	Estimate	Rationale
B4: If a wild animal has been infected, what is the probability of the development of an ongoing virus reservoir in wild animals during the timeframe?		
This cycle	 **Uncertainty** 	-**Probability:** If a wild animal has been infected by mink, it is **very unlikely** that an ongoing virus reservoir would develop in wildlife during this cycle. -Reports of wildlife reservoirs have not been confirmed in current research. -The development of a reservoir would require a relatively large and stable population of wildlife in the vicinity of the premises to maintain an infection. The species of animals most likely to be infected are rodents and perhaps wild/escaped mink. There is only experimental evidence of susceptibility in rodents. Rodents have relatively short lifespans, the other are quite solitary in nature. -For an animal species to act as a reservoir, rather than a transiently-infected species, the virus has to be well adapted to spread efficiently in that species. This virus is well-adapted to humans, and it is unlikely that it would spread efficiently and continuously in a wild animal population in the absence of significant mutation. -Infections in animals have so far resulted in virus shedding for a relatively short period of time, and no long-term carrier state has been identified. -The virus seems to transmit best in enclosed/partially enclosed indoor spaces with high density of people/animals. -Big brown bats are not susceptible to infection under experimental conditions, but more information is needed on many BC bat species' susceptibility because they tend to live in colonies where transmission would be more likely. -This is a relatively short time frame to establish a reservoir. -The **uncertainty** around this probability was assessed as **high**. -Factors affecting variability and uncertainty include: wildlife species affected and their behaviours, and lack of knowledge about which species are susceptible and can shed the virus (especially as the virus changes).
5 years	 **Uncertainty** 	-**Probability:** If a wild animal has been infected by mink, it is **very unlikely** that an ongoing virus reservoir would develop in wildlife within the next 5 years. -The rationale is similar to other timeframe. -With a longer timeframe, there is more opportunity for reservoir development, but ongoing human adaptation of the virus over the next 5 years would make this less likely. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: same as current cycle.

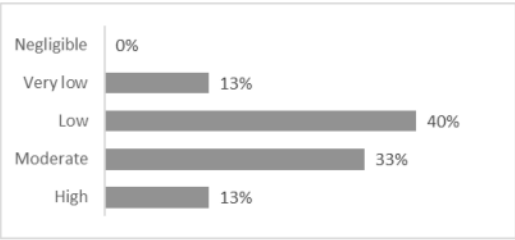
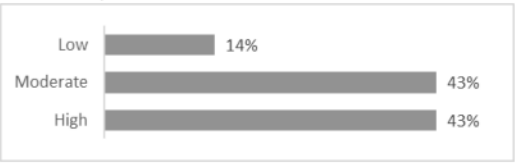
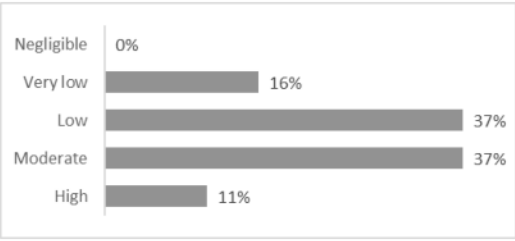
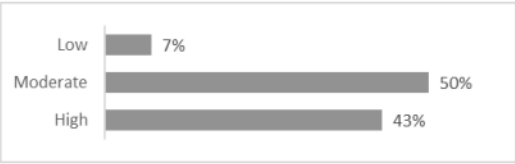
Time	Estimate	Rationale
B5a: What is the probability that the virus from mink evolves into a VOI in wildlife during the timeframe, *assuming development of a reservoir in wildlife*?		
This cycle	 **Uncertainty** 	-**Probability:** Even with the development of a wildlife reservoir, it is **very unlikely** that a virus transmitted from mink to wildlife would evolve into a VOI during this cycle. -There is no evidence of this occurring to date. -Low wildlife population density would not support rapid mutation. -The selection pressure in animals would be to create a variant that is more transmissible in animals or more virulent in animals, not necessarily in people. -The establishment of a wildlife reservoir and evolution of a VOI are unlikely to happen quickly. -The **uncertainty** around this probability was assessed as **high**. -Factors affecting variability and uncertainty include: characteristics of the wildlife reservoir (e.g., species affected), and transmission dynamics in various species.
5 years	 **Uncertainty** 	-**Probability:** Even with the development of a wildlife reservoir, it is **unlikely to very unlikely** that a virus transmitted from mink to wildlife would evolve into a VOI within the next 5 years. -The rationale is similar to other timeframe, but there is more time for cumulative mutations to be acquired. -The **uncertainty** around this probability was assessed as **high**. -Factors affecting variability and uncertainty include: same as current cycle.

Time	Estimate	Rationale
B6a: If a VOI has evolved in wildlife, what is the probability of at least one person contracting the VOI from wildlife during the timeframe, *assuming development of a reservoir in wildlife*?		
This cycle	 **Uncertainty** 	-**Probability:** If a VOI has evolved in wildlife, it is **very unlikely** that a person would contract the virus from wildlife during this cycle, even with the development of a wildlife reservoir. -There has been no documented transmission from wildlife back to humans (other than the suspicion of the SARS-CoV-2 virus origin in wildlife). -There are relatively low rates of contact with wildlife, particularly the kinds of wildlife that would appear to be most susceptible (i.e. Mustelids such as otters, martens, and wolverines). If transmission mechanisms are similar to current circulating strains, it would be highly unlikely that a person would be within 6 feet of an infected wild animal with the exception of special high risk populations including wildlife biologists/vets, wildlife rehabilitation specialists, hunters/trappers where specific handling and biosecurity precautions would most likely be used if a known reservoir exists -The most likely types of contact would be unlikely to result in significant viral load transfer. -Community vaccination will reduce likelihood of infection. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: characteristics of the wildlife reservoir (e.g., species affected), characteristics of the VOI, type of human-animal interaction, human vaccine efficacy, and extent of shedding by susceptible wildlife species.
5 years	 **Uncertainty** 	-**Probability:** If a VOI has evolved in wildlife, it is **very unlikely** that a person would contract the virus from wildlife within the next 5 years, even with the development of a wildlife reservoir. -The rationale is similar to other timeframe, but there is more time for contact to occur. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: same as current cycle.

Time	Estimate	Rationale
B5b: What is the probability that the virus from mink evolves into a VOI in wildlife during the timeframe, *assuming limited/transient spread in wildlife*?		
This cycle	 **Uncertainty** 	-**Probability:** If there is limited/transient spread in wildlife, evolution of the virus into a VOI during this cycle is **very unlikely to almost certain not to occur**. -Much of the rationale for B5a is also applicable, but the emergence of a variant is dependent on ongoing transmission, so limited/transient spread in wildlife should result in even lower probability of a VOI than ongoing transmission in wildlife. -The **uncertainty** around this probability was assessed as **low**. -Factors affecting variability and uncertainty include: species affected, and transmission dynamics in various species.
5 years	 **Uncertainty** 	-**Probability:** If there is limited/transient spread in wildlife, evolution of the virus into a VOI within the next 5 years is **very unlikely to occur**. -The rationale is similar to other timeframe, but there is more time for cumulative mutations to be acquired. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: same as current cycle.

Time	Estimate	Rationale
B6b: If a VOI has evolved in wildlife, what is the probability of at least one person contracting the VOI from wildlife during the timeframe, *assuming limited/transient spread in wildlife*?		
This cycle	 **Uncertainty** 	-**Probability:** If there has been limited/transient spread in wildlife and a VOI has evolved, a person contracting the VOI from wildlife during this cycle is **very unlikely to almost certain not to occur**. -Much of the rationale for B6a is also applicable, but there will be an even lower likelihood of human contact with fewer animals infected. -The **uncertainty** around this probability was assessed as **low**. -Factors affecting variability and uncertainty include: species affected, characteristics of the VOI, type of human-animal interaction, human vaccine efficacy, and extent of shedding by susceptible wildlife species.
5 years	 **Uncertainty** 	-**Probability:** If there has been limited/transient spread in wildlife and a VOI has evolved, a person contracting the VOI from wildlife within the next 5 years is **very unlikely to occur**. -The rationale is similar to other timeframe, but there is more time for contact to occur. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: same as current cycle.

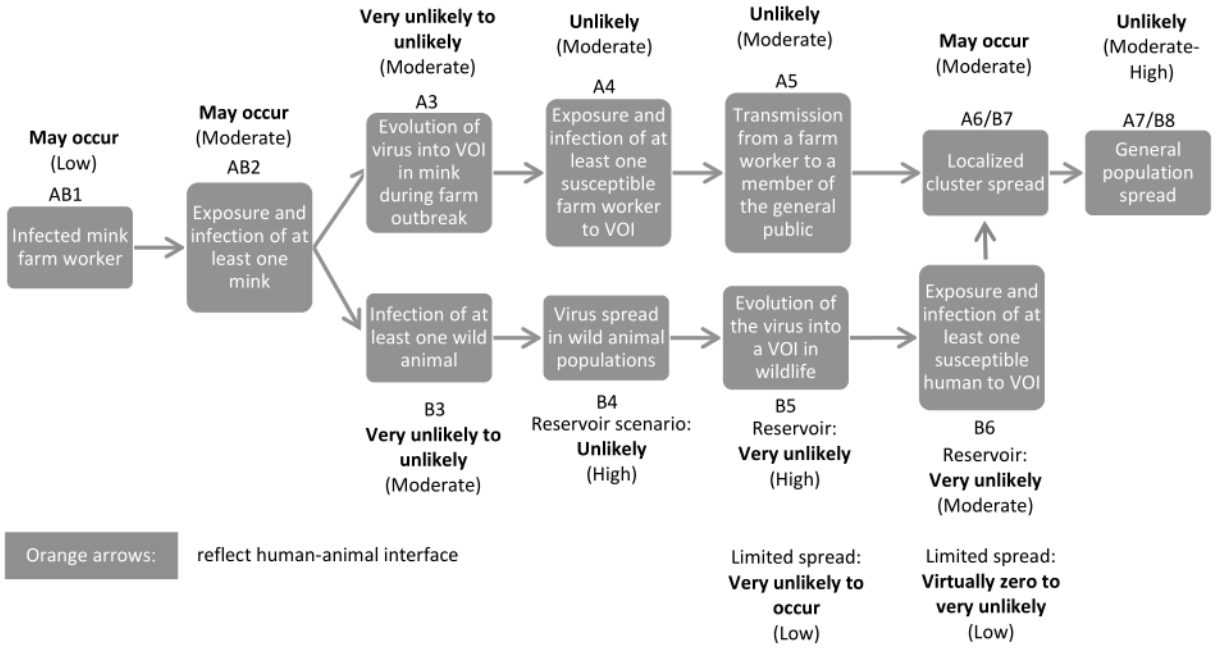
Time	Estimate	Rationale
A6/B7: If there has been at least one transmission of the VOI from one human to another, what is the probability of localized human spread of the VOI during the timeframe?		
This cycle	 **Uncertainty** 	-**Probability:** If there has been at least one transmission of the VOI from one human to another, localized human spread **may occur** during the remainder of this cycle. -Generally, SARS-CoV-2 is highly transmissible among humans. -Other than the first few highly publicized spread events internationally, there has been no report of widespread transmission of mink-related mutations in humans. Not all VOI will be more transmissible in the face of such a highly immunized population as we have in BC for the one dose and nearly complete uptake of the second dose. -It is possible that there will be a decrease in implementation of the measures due to perception of safety from the reopening plan and immunization. Communication with the industry and maintaining the Public Health Order on the farms until the end of this cycle will decrease the likelihood of that happening. However, human behaviour is such that there will be those that defy public health guidance/orders and either spread an infection they have or come into contact with someone that is infected. -Reduced community transmission will help allow the resources for timely and comprehensive contact tracing and response to limit spread. Also all SARS-CoV-2 genomes are being sequenced in BC so rapid identification of variants will be possible. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: characteristics of the VOI that arises (e.g. transmissibility, vaccine protection), compliance with control measures, vaccine coverage in the community, state of re-opening and restrictions in place, degree of contact between individuals (such as living conditions), and human vaccine efficacy.
5 years	 **Uncertainty** 	-**Probability:** If there has been at least one transmission of the VOI from one human to another, localized human spread **may occur** within the next 5 years. -The rationale is similar to other timeframe, but there is more time for spread to occur. -Unlikely to get good compliance with isolation and other measures in this long timeframe. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: same as current cycle, plus: availability of variant vaccine boosters, and uptake of vaccination by the general population over time.

Time	Estimate	Rationale
A7/B8: If there has been localized human spread of the VOI, what is the probability of widespread transmission of the VOI in the general human population during the timeframe?		
This cycle	 **Uncertainty** 	-**Probability:** If there has been localized human spread of the VOI, widespread transmission is **unlikely to occur** during the remainder of this cycle. -There has been very limited community spread of variants identified to date that developed in mink. -Experience to date suggests that not all VOI will spread widely, even if they cluster. -Current measures in BC have been effective in rapid identification and control of the spread of infection from mink workers; however, it is almost impossible to fully trace once there is localized transmission in the Lower Mainland. -Low and declining incidence rates in the province and FHA will allow the resources for rapid contact tracing and containment. -Lower likelihood than localized spread. -The **uncertainty** around this probability was assessed as **moderate to high**. -Factors affecting variability and uncertainty include: characteristics of the VOI that arises (e.g. transmissibility, vaccine protection), compliance with control measures, vaccine coverage in the community, state of re-opening and restrictions in place, degree of contact between individuals (such as living conditions), and human vaccine efficacy.
5 years	 **Uncertainty** 	-**Probability:** If there has been localized human spread of the VOI, widespread transmission is **unlikely but may occur** within the next 5 years. -The rationale is similar to other timeframe, but there is more time for spread to occur. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: same as current cycle, plus: availability of variant vaccine boosters, and uptake of vaccination by the general population over time.

7. Combining Probabilities

Illustration of the probabilities along the pathways

a) This cycle: **probability modes** (uncertainty modes)



b) 5 years: **probability modes** (uncertainty modes)

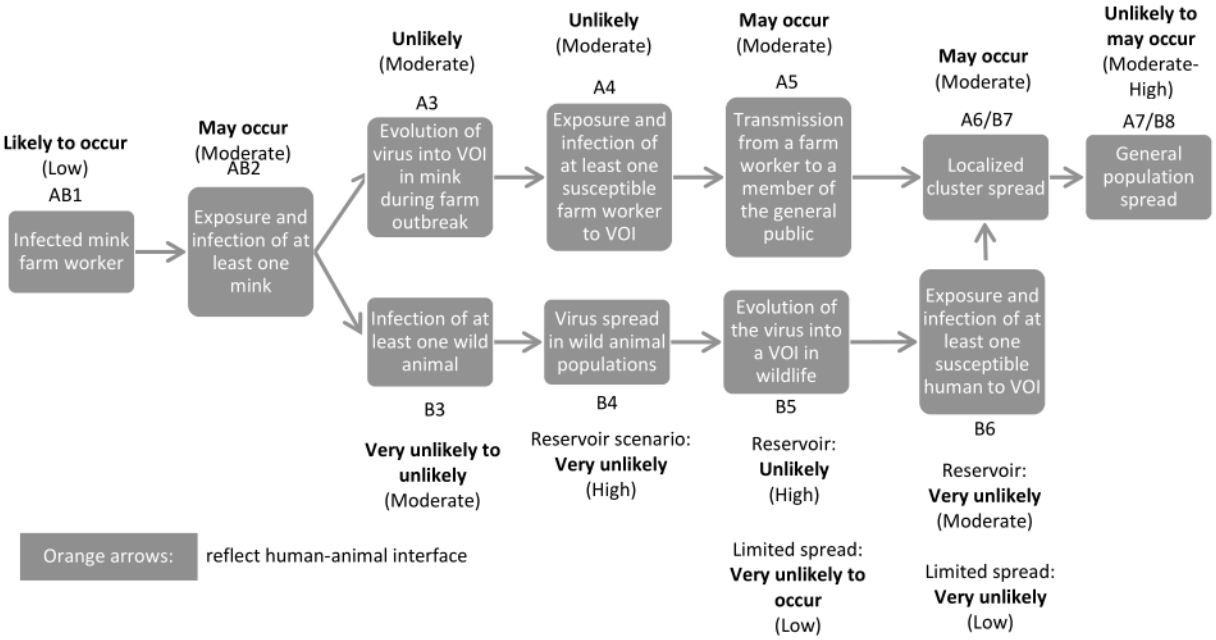


Figure 2: The modes of the probability estimates from the expert survey are shown for each step of the scenario pathway diagram, during this cycle (a) and within the next 5 years (b). Two wildlife spread scenarios were included: development of a reservoir versus limited/transient spread.

Human-mink-human pathway

This cycle

The risk assessment for this cycle assumes the current control measures remain in place for the rest of this cycle. Under this assumption and others, as detailed previously, experts think it is likely that another mink farm worker will becomes infected during this cycle. Then, if a mink worker is infected, it may lead to infecting the herd. Most experts consulted (69%) think there would be none to only one further mink farm infected. Therefore, the assumption of two more mink farms becoming infected, used for the following steps of the pathway, is a higher/worst-case estimate than what most experts think will occur. Even assuming two more mink herds become infected during this cycle, the vast majority of expert's report it will be unlikely to very unlikely for the virus to evolve into a VOI in mink during this cycle (78% or 39% for each of those probability estimates).

Assuming the virus evolves into a VOI in mink, experts mostly think it is unlikely the virus will be transmitted back to a worker. In the next step of the pathway, assuming the VOI was transmitted to a worker, 44% of experts consider it unlikely that it would lead to onward transmission to other people, while 38% think it may occur. If transmission to other people occurs, it would be more likely to occur within the household. If household spreads occurs, further spread in the community would depend on the effectiveness of quarantining those contacts, contact tracing efforts, and household members, as well as community members level of protection from vaccine or prior infection.

Using the rules of combining dependent (i.e., conditional) probabilities outlined in the Method section, the overall probability of the human-mink-human pathway (pathway A) is no higher than the lowest value of the conditional probabilities. The mode of the overall probability for the human-mink-human pathway during this cycle is therefore very low to low (see Figure 2a). **During this cycle, this risk assessment estimates that it is unlikely to very unlikely that a mink VOI would arise and trigger onward transmission of that VOI outside of mink workers.** This is driven primarily by probability A3: evolution of the virus into a VOI in a mink herd, estimated at unlikely to very unlikely to occur during the remainder of this cycle. A key factor in that assessment is the expectation that only a small number of mink herds would be infected until the end of this cycle. The probability of the whole pathway occurring is likely lower, because all the other steps would need to occur in addition to the unlikely to very unlikely event of A3. The probability of the whole pathway to occur would mean that in addition to step A3, three other moderate probability steps and three other low probability steps would have to occur as well.

There is generally a moderate level of uncertainty associated with this estimate, though there is slightly higher uncertainty specifically associated with the probability that the VOI, should it occur, would result in widespread transmission. Sources of variation and uncertainty for probability A3 include: the expected levels of compliance with control measures and testing during the remainder of this cycle, the characteristics of the mutations that will result in a VOI, the future epidemiological patterns of infection in mink herds, and whether previously infected farms can be re-infected during the same production cycle. Other sources of variability and uncertainty along the pathway include: extent of community transmission, behaviour of workers outside the workplace, availability of replacement workers and paid sick leave, extent of worker contact with mink throughout the season, characteristics of the VOI that arises (e.g. transmissibility, vaccine protection), within household versus outside household contact, state of re-opening and restrictions in place, vaccine coverage in the community, degree of contact

between individuals (such as living conditions), efficacy of human vaccines, vaccine coverage needed to see ongoing low circulation in the population, degree of viral shedding in vaccinated individuals, the epidemiological details of past mink outbreaks, and the efficacy of PPE, biosecurity, and human surveillance.

5 years

The risk assessment for the next 5 years assumes limited control measures. The main remaining measures would be modified safety plans including wearing a medical mask and eye protection when working on the farm, abstaining from working with COVID-19 compatible symptoms, ongoing mink mortality and environmental testing, and allowing only fully immunized workers to work on the farms. We assume workers will have to obtain further immunization as needed to promote ongoing effectiveness. Respirators would no longer be mandated in mink areas, there would be a decrease in PPE requirement, and no mandatory social distancing between workers. The BC CDC will not continue supporting the viral testing of workers. There was no assumption made on the industry starting their own testing program or not. There was no assumption made about using or not using a mink vaccine, its effectiveness or affordability. Experts were asked to use their judgment in how they expect it will be used and with what effect.

Under these assumptions and others, as detailed previously, experts think it is likely that at least one mink farm worker will become infected per year. Then, if a mink worker is infected, it may lead to infecting the herd. Most experts consulted (72%) think there would be an average of none to only one further mink farm infected per year. Therefore, the assumption of two more mink farms becoming infected per year, used for the following steps of the pathway, is a more pessimistic estimate than what most experts think will occur. Even assuming two more mink herds become infected per year, only 19% think that a VOI might develop in one of those herds, with 75% thinking it would be unlikely (50%) to very unlikely (25%) for that to occur.

Assuming the virus evolves into a VOI, experts were divided as to the probability of the virus to infect at least one worker (50% thinking it may occur or is likely to occur, and 50% thinking it would be unlikely to very unlikely to occur). For this to lead to a localized spread of the VOI, the probabilities estimate most selected was “may occur” at 56%. And if that occurred, experts were divided about the probability that it would lead to widespread transmission in the community with the same proportion thinking it is unlikely to occur and may occur (37% each).

The mode of the overall probability for the human-mink-human pathway (pathway A) within the next 5 years is low (see Figure 2b). **This risk assessment estimates that it is unlikely that a mink VOI would arise and trigger onward transmission of that VOI outside of mink workers within the next 5 years.** This is driven primarily by probability A3: evolution of the virus into a VOI in a mink herd is unlikely to occur within the next 5 years, with the small number of mink herds expected to be infected per year. However, there is a high level of uncertainty associated with this key probability, due to the higher uncertainty in the expected number of mink herd outbreaks per year as time goes on and higher uncertainty regarding evolution of a VOI.

Sources of variation and uncertainty in probability A3 are similar to the current cycle, in addition to variation in use of a mink vaccine, efficacy of vaccination in mink, length of immunity in mink, and the effect of new variants arising in humans on mink infection. Additional sources of variability and

uncertainty for the pathway during this timeframe include: more variability in extent of community transmission and ongoing compliance, uptake of vaccination by the general population over time, and availability of variant vaccine boosters.

Human-mink-wildlife-human pathway

This cycle

In the pathway involving wildlife for this cycle, most steps were estimated as less probable than for the direct pathway from mink to humans, with similar level of uncertainties. The mode of the overall probability for the human-mink-wildlife-human pathway during this cycle is very low, regardless of the spread scenario in wildlife (limited spread or reservoir; see Figure 2a). **Regardless of the wildlife spread scenario (limited spread or reservoir), for this cycle, this risk assessment estimates that it is very unlikely that a VOI would arise in wildlife and trigger onward transmission of that VOI outside of mink workers.** This is driven primarily by probability B5: evolution of the virus into a VOI in wildlife during this cycle is very unlikely to occur. However, it is also very unlikely that a person would contract the virus from wildlife (B6). The uncertainty associated with the development of a virus reservoir in wildlife (assuming at least one animal is infected) is high; however, if there is only limited or transient spread in wildlife, then there is low uncertainty regarding the probability of virus evolution and exposure of humans.

Sources of variation and uncertainty in probability B5 and B6 include: the wildlife species affected, characteristics of the VOI that develops, type of human-wildlife interaction, transmission dynamics in various species, extent of shedding by susceptible wildlife species, and human vaccine efficacy. Since this pathway also involves mink and community spread, other sources of variability and uncertainty are similar to the other pathway, with the addition of: the habitat surrounding the farm, time of year (dispersal of young or for mating), attractants on the farm, ability for mink to escape from the farm, mink disease dynamics, susceptibility of various wildlife species (especially Canadian bat species), and susceptibility of various species to variants.

5 years

In the pathway involving wildlife in the next 5 years, most steps were estimated as less probable than for the direct pathway from mink to humans, with similar level of uncertainties. The mode of the overall probability for the human-mink-wildlife-human pathway did not change for the longer timeframe. The probability is very low, regardless of the spread scenario in wildlife (limited spread or reservoir; see Figure 2b). **Within the next 5 years, regardless of the wildlife spread scenario (limited spread or reservoir), this risk assessment estimates that it is very unlikely that a VOI would arise in wildlife and trigger onward transmission of that VOI outside of mink workers.** There is a slightly higher probability of evolution of the virus in wildlife during this timeframe in the reservoir scenario (B5a), but this is still considered unlikely and the development of a reservoir in the first place is very unlikely even in this timeframe (B4). It is also still considered very unlikely that a person would contract the virus from wildlife (B6). There is a slightly higher level of uncertainty associated with this pathway, though this is not necessarily reflected in all of the modes.

Sources of variability and uncertainty are generally the same as with the current cycle; however, potential variation in use of a mink vaccine, efficacy of such a vaccine, and characteristics of the circulating virus may affect the probability of transmission from mink to wildlife. Other sources of variability and uncertainty overlap with the other pathway.

Combined pathways

This cycle

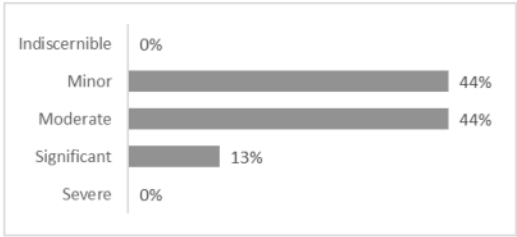
Using the rules of combining independent probabilities outlined in the Method section, the overall probability of either of the above pathways (human- mink-human or human-mink-wildlife-human) occurring during this cycle, the highest one is used. In this case, the total probability is estimated as low to very low based on the human-mink-human pathway. Although these pathways are not mutually exclusive, the very low probability of the wildlife pathway is unlikely to significantly affect this conclusion.

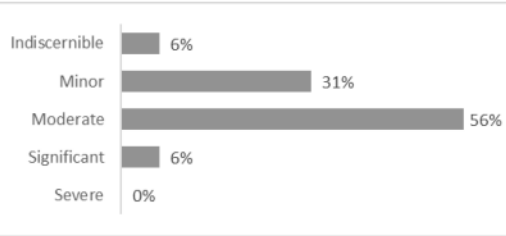
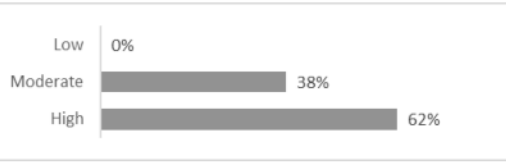
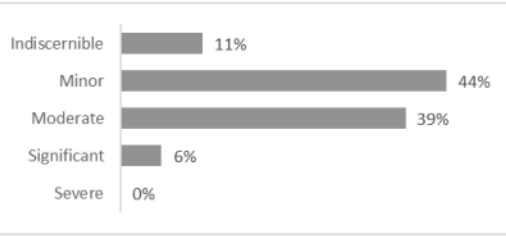
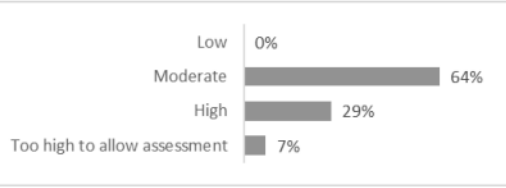
5 years

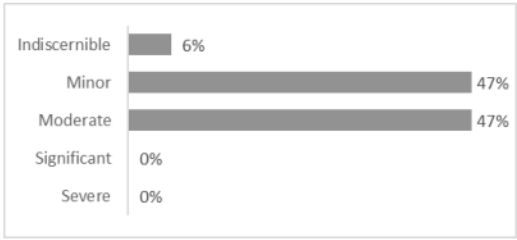
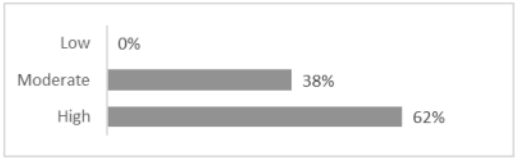
Although the overall probability for the human-mink-wildlife-human pathway did not change for the longer timeframe, the overall probability for the human-mink-human pathway increased to “low”. Therefore, the combined probability of either of the pathways occurring is low based on the human-mink-human pathway.

8. Assessment of Consequence

If there was emergence and circulation of a VOI in the community that was of mink/wildlife origin, the magnitude of the impact on the health of the population above the current/ongoing pandemic impacts for this cycle are likely to **be minor (marginal) to moderate (noticeable and important, but usually reversible) at the local/regional level, and slightly less at the provincial level.** The uncertainty associated with this is moderate to high. The magnitude of the impact at the 5 year timeframe is likely to be similar, but with a higher level of uncertainty.

Time	Estimate	Rationale
I1: (emergence+circulation of VOI in the community, VOI of mink/wildlife origin) What would be the magnitude of the impact on the health of the population above the current/ongoing pandemic impacts *at a local/regional level*?		
This cycle	 **Uncertainty** 	**-Impact:** If there was emergence and circulation of a VOI in the community of mink/wildlife origin, the magnitude of the impact on the health of the population above the current/ongoing pandemic impacts for this cycle are likely to vary from **marginal (minor) to noticeable and important, but usually reversible (moderate)** at the local/regional level. -VOIs and VOCs are much more likely to occur in humans than in mink. VOIs are not necessarily immune escape VOIs: they can be VOIs influencing transmission or disease severity, but still be controlled by vaccines. Even if a VOI were to emerge, there is no reason to believe it would be worse than concurrent/other VOIs/VOCs circulating or not yet emerged from the human population. -The province has responded in a measured manner to VOCs and they have not changed drastically the approach to the pandemic. So it is more likely that further VOIs will affect only marginally the pandemic response, and even if they have more than a marginal impact they would be reversible. -Variants emerging are monitored, and booster vaccines able to address more variants in the works. -Effects might be more serious in the short-term, but would likely be able to be mitigated over time. -However, the work needed to investigate the event and potential impacts on the local population and economy could be noticeable and important. -The **uncertainty** around this estimate was assessed as **moderate to high**. -Factors affecting variability and uncertainties include: characteristics of the VOI, uptake of vaccination in the community, extent of community spread, and impact of vaccines on disease severity.

Time	Estimate	Rationale
5 years	 **Uncertainty** 	**-Impact:** If there was emergence and circulation of a VOI in the community of mink/wildlife origin, the magnitude of the impact on the health of the population above the ongoing pandemic impacts within the next 5 years are likely to be **noticeable and important (moderate), but usually reversible** at the local/regional level. -Similar rationale to the current cycle. -The impact may be slightly reduced if we have more knowledge of vaccine adaptation and we can more quickly respond to any VOI/VOC. -On the one hand, there could be less concern regarding the impact of the virus in general (if the pandemic is more controlled, people are generally well-protected and hospitals are not overwhelmed). On the other hand, if there is less concern over evolution of variants in people, there may be more concern regarding evolution in other species. -The **uncertainty** around this estimate was assessed as **high**. -Factors affecting variability and uncertainties are the same as current cycle.
I2: (emergence+circulation of VOI in the community, VOI of mink/wildlife origin) What would be the magnitude of the impact on the health of the population above the current/ongoing pandemic impacts *at a provincial level*?		
This cycle	 **Uncertainty** 	**-Impact:** If there was emergence and circulation of a VOI in the community of mink/wildlife origin, the magnitude of the impact on the health of the population above the current/ongoing pandemic impacts for this cycle are likely to vary from **marginal (minor) to noticeable and important, but usually reversible (moderate)** at the provincial level. -The impacts are unlikely to substantially differ provincially and locally/regionally. -There are likely to be impacts on public health resources at the provincial level in needing to investigate the VOI i.e. assess how well it spreads, increased morbidity/mortality, viral characterization. -The **uncertainty** around this estimate was assessed as **moderate**. -Factors affecting variability and uncertainties are the same as at the local/regional level.

Time	Estimate	Rationale
5 years	 **Uncertainty** 	**-Impact:** If there was emergence and circulation of a VOI in the community of mink/wildlife origin, the magnitude of the impact on the health of the population above the current/ongoing pandemic impacts within the next 5 years are likely to vary from **marginal (minor) to noticeable and important, but usually reversible (moderate)** at the provincial level. -Similar rationale to the current cycle. -The **uncertainty** around this estimate was assessed as **high**. -Factors affecting variability and uncertainties are the same as current cycle.

Summary Information Gaps

The following information gaps were identified during the course of this assessment:

- Susceptibility of mink and other species to the variants of concern detected in humans
- Susceptibility of various wildlife species to SARS-CoV-2, especially to infection under natural conditions
- Extent of shedding by susceptible wildlife species
- Genetic selection pressures for SARS-CoV-2 in mink
- Effectiveness and duration of immunity from natural infection in mink herds from circulating SARS-CoV-2 strains
- Protection of mink vaccine against new variants arising in humans
- Mink vaccine effect on disease transmission in mink and between humans and minks, as well as on promoting the emergence of an immune escape variant
- Length of protection from mink immunization
- Environmental testing sensitivity to detect infection in mink herd
- The future epidemiological patterns of infection in mink herds
- Process needed to neutralize virus from mink at various stages of processing of carcasses and pelts
- Efficacy of human vaccines against variants of concern
- Vaccine coverage needed to see ongoing low circulation in the community
- Degree of viral shedding in vaccinated individuals
- Efficacy of PPE, biosecurity, and human surveillance
- Ability to identify mutations that are more likely to result in a VOI (in human and in mink)

9. Conclusions

Question 1

What is the likelihood and impact of emergence and circulation of a SARS-CoV-2 variant of interest (VOI) in the community due to virus evolution in mink or 'wildlife after exposure to mink' DURING COMPLETION OF THIS CYCLE, compared to what is seen with currently circulating variants and evolving public health measures?

Experts think that the emergence and circulation of a SARS-CoV-2 VOI in the community due to virus evolution in mink or 'wildlife after exposure to mink' during completion of this cycle is **unlikely to very unlikely to occur**. However, uncertainties associated with the different probability estimates vary from low to moderate/high. If there was emergence and circulation of a VOI in the community that was of mink/wildlife origin, the magnitude of the impact on the health of the population above the current/ongoing pandemic impacts for this cycle are likely to be **minor to moderate** at the local/regional level, and slightly less at the provincial level.

The risk assessment for this cycle assumes the current control measures remain in place for the rest of the cycle, among other assumptions. If the situation evolves differently than assumed, the risk can be different. Even if a mink worker becomes infected and infects a herd despite vaccination and safety

plans in place, the most likely scenario is that only one or a small number of mink herds would be infected during the remainder of this cycle. This is based on the mitigating measures in place, decreasing community transmission, vaccination, and the nature of the mink industry in BC. Under this scenario, evolution of the virus into a VOI in a mink herd is not likely. There may be a small number of accumulated mutations during virus circulation in mink, but this is not usually sufficient to result in a VOI. Also, mutations usually tend to favour host specific adaptation which might not be advantageous for transmission to other hosts, such as humans. It is more likely that a VOI (from the perspective of humans) will arise in humans rather than in mink.

There is a moderate level of uncertainty associated with this estimate. Key sources of uncertainty and variability, among many detailed in section 6, include: the expected levels of compliance with control measures and testing during the remainder of this cycle, which VOI characteristics will arise (type of mutations and suspected impact from these mutations - affecting immunity, transmission, severity of disease or effectiveness of vaccines or therapeutics), the future epidemiological patterns of infection in mink herds, and whether previously infected farms can be re-infected during the same production cycle.

The likelihood of emergence and circulation in the community due to virus evolution in wildlife (after exposure to mink) is even lower. Even if transmission to wildlife around mink farms were to occur, which has rarely been seen to date, the most likely scenario is limited or transient spread in wildlife. Development of a reservoir requires many factors related to population size and density, contact between individuals, and adaptation of the virus to spread efficiently in that species. For even the worst-case spread scenario, though, it is very unlikely that the virus would evolve into a VOI and be transmitted back to people given the: low population density of known susceptible species, long timeframe required for reservoir development, low rates of human contact with susceptible wild species, and precautions taken by specific groups of people who may have contact with wildlife.

The uncertainty associated with the development of a virus reservoir in wildlife (assuming at least one animal is infected) is **high**; however, if there is only limited or transient spread in wildlife, then there is low uncertainty regarding the probability of virus evolution and exposure of humans. Key sources of uncertainty and variability, among many listed in section 6, include: the wildlife species affected, characteristics of the VOI that develops, type of human-wildlife interaction, transmission dynamics in various species, extent of shedding by susceptible wildlife species, and human vaccine efficacy.

VOIs and VOCs are much more likely to occur in humans than in mink. Variants emerging are monitored, and booster vaccines able to address more variants are in the works. Effects might be more serious in the short-term, especially regarding the work needed to investigate the event and/or potential local control measures, but would likely be able to be mitigated over time.

The uncertainty associated with this impact estimate is **moderate to high**. Key sources of uncertainty and variability include: characteristics of the VOI, uptake of vaccination in the community, extent of community spread, and impact of vaccines on disease severity.

Question 2

What is the likelihood and impact of emergence and circulation of a SARS-CoV-2 variant of interest (VOI) in the community due to virus evolution in mink or 'wildlife after exposure to mink' WITHIN THE NEXT 5 YEARS, compared to what is seen with currently circulating variants and evolving public health measures?

The assumptions were different for the next 5 years versus this cycle, but there was a lot of uncertainty regarding these assumptions and they should be reviewed over time. Although some control measures may decrease (e.g., PPE and testing) over this timeframe, it was assumed that some mink vaccination will be in place, even if it is not universal and its efficacy is unknown. With these assumptions, experts think that the emergence and circulation of a SARS-CoV-2 VOI in the community due to virus evolution in mink or 'wildlife after exposure to mink' within the next 5 years is **unlikely**.

Much of the rationale is similar to this cycle. It was still expected that, at most, only a small number of mink herds would be infected per year, and that this is unlikely to result in evolution of a VOI. The slight reduction in restrictions is likely to be compensated for by vaccination of mink, which will likely reduce shedding and spread within and between herds, even if it does not reduce infection.

There is a moderate to high level of uncertainty associated with this estimate, primarily due to uncertainty in the number of herds infected per year and the probability of virus evolution in mink over this timeframe. Key sources of uncertainty and variability are similar to this cycle, but also include: variation in use of a mink vaccine, efficacy of vaccination in mink, length of immunity in mink, and the effect of new variants arising in humans on mink infection.

The wildlife pathway remains very unlikely, even for the longer timeframe. Most of the rationale is similar to this cycle. With a longer timeframe, there is more opportunity for reservoir development, but ongoing human adaptation of the virus over the next 5 years would make this less likely.

As with the current cycle, uncertainty associated with the wildlife reservoir scenario is high. However, if there is only limited or transient spread in wildlife, then the uncertainty regarding the probability of virus evolution and exposure of humans is moderate. Key sources of uncertainty and variability are similar to this cycle; however, potential variation in use of a mink vaccine, efficacy of such a vaccine, and characteristics of the circulating virus may affect the probability of transmission from mink to wildlife in this timeframe.

The magnitude of the impact at the 5 year timeframe is likely to be similar to this cycle, but with a higher level of uncertainty. The impact may be slightly reduced if we have more knowledge of vaccine adaptation and we can more quickly respond to any VOI/VOC. However, the incremental impact may be perceived as higher if the situation is more controlled in humans.

The uncertainty associated with this impact estimate is high. Key sources of uncertainty and variability are similar to the current cycle.

Discussion

This is the most comprehensive provincial risk assessment related to mink farming to date. It is based on a comprehensive hazard profile. Both have been undertaken in collaboration with national experts. The previous national rapid qualitative risk assessment was performed early in the pandemic. Therefore, this

assessment and accompanying hazard profile include a lot of information and on the ground experience accumulated since the previous assessment. However, because of the moderate to high uncertainty for both the probability and impact estimates, it is important to continue monitoring the situation in mink farms, as well as what can be learned from the scientific literature. Further scientific knowledge and on the ground experience around the pandemic, variants, animal-human interface, environmental sampling reliability can change the risk level and trigger changes in control measures in response.

Depending on the tolerability of the risk and associated uncertainties, the level of mitigation measures can be increased or lowered compared to what has been assumed to be in place in this risk assessment. Over the next five years, measures that were dropped could be reinstated. Further mitigation measures, at any time, could include:

- Limiting the number of animals or changes in animal density (to potentially decrease the transmission and number of viral replications, which could decrease the opportunity to accumulate clusters of mutations) such as
    - prohibiting the next cycle of reproduction while allowing operators to maintain their breeding animals (to keep the genetic assets each farm has developed)
    - prohibiting expansion of current mink farms (prohibiting the increases in number of breeding animals or kits allowed)
    - prohibiting the creation of new farms
    - euthanizing herd(s), however, if there is already an infection with a concerning mutation in a herd, this could temporarily increase human exposure
- Strengthening the monitoring of the industry at the industry's expense (recognizing the limited feasibility of current regulatory agency in maintaining close monitoring without further resources) and/or implementing stricter fines or closures with breaches of mandated measures
- Assessing the need for new regulations regarding products, materials or people that can move onto and off of the farm (feeds, carcasses, manure, new breeding stock, and other) even when a farm is not under quarantine.
- Mandating on-going, and potentially industry managed, human surveillance
- Mandating mink immunization

Alternatively, if there is sufficient comfort with the level of risk, mitigation measures like a lower level of PPE and ongoing animal surveillance could be reduced.

Expected benefits from these measures need to be balanced with their acceptability, feasibility and timeliness, recognizing that these measures can affect profitability of the industry or pose operational challenges to the many sectors involved.

The province could consider disseminating the results of this risk assessment to various stakeholders and engage in consultation regarding potential responses. Critics of mink farming have voiced their view in the media. Public communication of the BC specific mink farming SARS-CoV-2 risk assessment and hazard profile could provide an expert perspective on the situation, and inform the general population from a different perspective. A high profile decision regarding further mitigation measures would benefit from careful risk communication.

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HAZARD PROFILE

SARS-CoV-2 in Farmed Mink in British Columbia

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Version of: 2021-06-30

This hazard profile provides information related to SARS-CoV-2 at the human-animal-environment interface in British Columbia. It is intended to accompany a Joint Rapid Qualitative Risk Assessment (J-RQRA) being conducted in relation to the infection of farmed mink. It describes the health event, causative agent and its genetic variation, and reviews the relevant aspects of epidemiology, persistence, pathogenesis, diagnosis, industry characteristic, and prevention and control measures. It also reviews information relevant to impacts on animal health, public health, and the environment, but does not provide an estimate of the magnitude of these impacts. Finally, research gaps are highlighted. This hazard profile is not intended as a risk assessment or a systematic literature review. It applies only to the specific context in which the J-RQRA will be conducted, and draws on data that are related only to the health event concerned.

1. Health event description

A One Health Working Group was established in October 2020 to assess and manage the risk of SARS-CoV-2 to human and animal health from mink farming in BC. The group has met regularly ever since and work collaboratively to manage all aspect of the risk from mink farming.

SARS-CoV-2 was detected in mink on two mink farms in British Columbia (BC) in December 2020 and in one farm in May 2021. The first outbreak was confirmed on December 8th in a mink farm rearing 15,000 animals. When initial sampling of the mink took place, the animals did not display any signs of infection, but an increased mortality (1%) was observed in the days following sampling. Human-to-animal transmission was suspected as introduction of the infection into mink farms. There was a total of 20 human cases associated with this outbreak (11 farm workers, 6 close contacts of farm workers, and 3 contacts of close contacts). Farm processes were adjusted and further work safety protocols put in place. Pelting proceeded under those modified processes and protocols. After two sets of 65 samples, taken two weeks apart, were found to be all-negative, the herd was deemed free of disease as of February 24, 2021. The farm remains under quarantine until the site is considered fully decontaminated as per protocols of the Government of British Columbia. Serial viral sampling of the herd and the environment continues. Farms employees received fit testing and appropriate guidance on the use of respirators.

Effective December 14, a class order applying to all active mink farms, under the public health act, mandated a series of measures to enhance monitoring and control of SARS-CoV-2 on mink farms. The order required submission of COVID-19 safety plans and modification of those safety plans in line with public health recommendations. Additional requirements included stringent use of PPE. N95s or equivalent protection was required for all activities in close proximity to mink, while medical masks were required for other activities on farm. Enhanced PPE requirements were in place for farms with infected herds. At that time, all mink workers continuing to work with mink had to be screened for COVID-19 infection by PCR and serology. The serology tests were repeated approximately a month later. No COVID-19 infection current or past were detected via that screening.

The order also required participation in an animal surveillance program, with submission of mink mortalities on a weekly basis to detect potential new infections. Fraser Health and WorkSafe BC

carried out serial inspections, including unannounced ones, to assess and enforce compliance with safety plans. A screening program with regular PCR testing was put into place in mid-February 2021 to detect COVID-19 infections in mink farm workers and mink herds in the province. This constitutes testing naturally occurring mink mortalities and euthanized animals, as well as screening mink workers at least once per week.

On 23 December, a second outbreak was confirmed in a farm rearing 950 mink. Samples were collected from mink following an increase in clinical signs and mink mortality (3%) on the farm. This farm opted to euthanize all mink on the premises, without it being requested by public or animal health authorities, but because the operator preferred to stop operation at that point. No human SARS-CoV-2 cases were detected in workers on the farm, by either PCR or serological testing, and no human cases of COVID-19 with connection to the farm have been associated with this outbreak to date. The farm remains under quarantine until the site is considered fully decontaminated as per protocols of the Government of British Columbia.

Whole genome sequencing (WGS) analysis and interpretation are ongoing. To date, the WGS analysis found that the mink cases on both farms originated from one of the background strains of SARS-CoV-2 circulating in the BC community. Four clades were found in circulation between the two farms, three in association with farm 1 and one in association with farm 2. None of the emergent clades is considered a variant of interest nor a variant of concern. As described in section 2, the genomes sampled from mink in BC do not exhibit unusual mutational profiles and do not show higher than expected levels of divergence.

In April 2021, all mink workers and their household members were offered the Pfizer COVID-19 vaccine. Mink farm workers were invited for their first dose as of March 17, 2021, and household members of mink farm workers were invited for their first dose, if not already eligible by age, in late April 2021. On April 15, 2021, public health issued an order that permitted only vaccinated mink farm workers to have duties that put them in close contact with mink; almost all mink farm workers chose to receive vaccine. In addition, in May and June, all mink workers were offered a second dose of mRNA vaccine.

As of June 25th, despite immunization,s.22 human cases of COVID-19 infection in mink farm workers on previously uninfected farms were detected through the screening program, and one from the self-referred community testing centres. Most of theses.22 workers had received one dose of vaccine, while some had none and some had two. Some of these workers had definitive acquisition from the community, but others have unclear acquisition.s.22 of these workers reported no contact with mink, although some had been involved in feed preparation.s.22 workers reported having been in close proximity to mink during their infectious period. For these "close contact" instances, live sampling of the mink was performed for three weeks following, with no evidence of mink infection.s.22

s.22

s.22

On May 14th, 2021, one out of seven mink carcasses, of animals who died from the first week of May, tested positive for SARS-CoV-2, prompting the declaration of an outbreak in a third farm. Since then, a small proportion of the live mink, mortality and environmental samples from that farm have harbored the virus, across multiple separate sheds. This site had demonstrated good participation in twice to three times a week testing of workers prior and during the outbreak.

s.22 another worker on that s.22 had a lab result classified as indeterminate, with negative results on subsequent samples on s.22 did not have a direct link with the previous case, and no direct contact with mink.

Whole genome sequencing results from mink cases on the premises showed they were infected with the B.1.618 lineage. The lineage was a match with the positive case from 6 weeks prior. This is a rare lineage in BC. The B.1.618 lineage has been found in India and is considered a lineage worthy of monitoring in BC. It shares some mutations with the B.1.167.2 (Delta) VOC, and might be associated with some immune escape from prior infection but not for vaccines (Tada et al., 2021). As of June 17th, it had not been deemed a variant of concern nor a variant of interest by WHO or other organizations.

It is notable that the herd on the third farm became infected despite twice-weekly screening of workers, and strong COVID-19 safety plans; the farm reported good adherence to PPE. s.22 in the infected worker could have played a role in sub-optimal adherence to safety measures and inconsistencies in the epidemiological investigation findings over time.

BC is currently experiencing a decrease in its third wave of human COVID-19 cases (refer to BCCDC website for COVID data), while the Delta VOC is increasing in proportion compared to the other VOCs.

2. Causative agent and genetic variation

SARS-CoV-2 is an enveloped, positive-sense, non-segmented, single-stranded RNA virus in the *Betacoronavirus* genus of the *Coronaviridae* family.

The World Health Organization (WHO) recently convened a study on the origins of SARS-CoV-2. Though there is still a lot of uncertainty about this and further studies are required, the group qualitatively estimated that the most likely scenario is that SARS-CoV-2 was transmitted from an animal reservoir to an animal host, followed by subsequent spread within that intermediate host (spillover host), and then transmission to humans. The initial reservoir may have been either bats or pangolins, since the most highly related coronaviruses to SARS-CoV-2 have been found in these species. However, these viruses are not sufficiently similar to SARS-CoV-2 to serve as its direct progenitor. As has occurred with several other emerging viruses, the ancestral virus of SARS-CoV-2 may then have gone through an intermediary step involving an amplifying host that has more frequent contact with humans, such as a farmed wildlife (World Health Organization, 2021).

The virus has been evolving over the course of the pandemic in humans, and there have been various mutations and variants associated with mink. The nature of virus mutation is associated with several factors, including the parent strain, transmission rate, and selection pressure.

In the early part of the pandemic, researchers in Brazil estimated the median SARS-CoV-2 mutation rate in humans to be 1.13×10^{-3} substitutions per site per year, translating to an average genome accumulating 33 mutations per year, or approximately 1 mutation every 12 days (Candido et al., 2020). This will be specific to the variant, transmission rate, and selection pressure in that time and place – parameters which would be variable in different geographic regions depending on public health measures, compliance, population density, etc. These parameters affect virus transmission rates and opportunities for mutation. Furthermore, given the very uneven distribution of sequencing efforts and genome deposition across the globe, estimates of mutation frequencies are inherently skewed towards regions with higher sequencing rates. As such, it is hard to predict whether the derived estimates are as representative of a place such as India, with high transmission rates and disease burden, yet <0.1% of virus sequenced (GISAID), as they are of Australia, with lower case burdens and close to 60% of cases sequenced and deposited for analysis. Within the existing mutation rate estimates, there is significant variability in the mutation rates of different sites of the viral genome (Vilar & Isom, 2021), implicated in host receptor binding, host cell entry and viral replication. However, the derived estimates were within the range of evolutionary rates estimated for other human coronaviruses.

While sequence diversity in Netherlands mink farms is suggestive of a more rapid mutation rate in mink (i.e., 2 mutations every two weeks), there are multiple potential reasons for this. It could be the result of host adaptation or rapid transmission rates in a high-density environment, or it could be an artifact of unknown introduction times skewing the calculations (Oude Munnink et al., 2020). One analysis of mink sequences estimates the most common ancestor to date to April 2020 (van Dorp, Tan, et al., 2020); the fact that many of the observed mutations arise independently on the background of different SARS-CoV-2 lineages is suggestive of host-specific adaptation and a lower likelihood of their persistence in a human population. A more rapid viral mutation rate is expected upon species jump, as the host adaptation is underway – it is expected that a similar phenomenon has occurred upon SARS-CoV-2 transition into humans, however the initial adaptive mutations were already fixed in the population at the time when the first SARS-CoV-2 samples were being sequenced. There is still a lot of uncertainty regarding SARS-CoV-2 mutation rates in humans and mink under different circumstances.

In most instances, mutations have no or little direct impact (FAO/OIE/WHO, 2021), and their effects can depend on the genetic background in which they occur. A recent investigation of over 46,000 SARS-CoV-2 genomes from humans supports this assertion, with no evidence of selection on the variants circulating in the first year of the pandemic (van Dorp, Richard, et al., 2020). In mink, there is evidence of positive selective pressure on several recurrent mutations (van Dorp, Tan, et al., 2020). Many of these mutations, however, are already present at low levels in human populations, and it is unclear that viral adaptation to mink would have negative or positive implications for human infection dynamics (van Dorp, Tan, et al., 2020). Mutations of significance are those likely to affect transmission, disease severity, or vaccine or treatment

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effectiveness in humans. Mutations of significance found so far in humans include several convergent changes in the spike protein region, the protein involved in entry into cells, and the target of vaccines and therapeutics. There are changes in other areas potentially affecting within cell dynamics and clearance of viral particles via autophagy. There is some evidence of selective pressure on the virus from immunocompromised human hosts, especially involving long-term viral shedding, as contributors to the sporadic emergence of more heavily mutated variants as well in the VOC lineages (Harvey et al., 2021).

To date, the most significant SARS-CoV-2 variant to arise from mink is the cluster 5 variant that was detected in mink in Denmark; the cluster 5 variant was subsequently detected in 12 people in Denmark (European Centre for Disease Prevention and Control 2020). The cluster 5 variant includes four mutations (Y453F, I692V, M1229I, S1147L), and one deletion (69–70 del) in the S protein (see Table 1). The concern with this cluster was that it might affect antigenicity. Cluster 5 is currently considered controlled, as it has not been detected since September 2020. Hoffmann et al. (2021) found that when all Cluster 5 changes were present, entry of the virus into certain human cell lines was reduced, and they hypothesize that this could explain why it did not spread efficiently among humans. This cluster has not arisen in association with affected mink farms in BC or any mink farms outside of Denmark. WHO did not declare this variant a variant of concern, since there was no evidence it fulfilled criteria for this label, with no evidence of increased severity, transmissibility or decreased effectiveness of vaccine or therapeutics.

Table 1: Details about the mutations found in the 'cluster 5' variant in Denmark

Mutation / Deletion	**Is this mutation observed in humans not in relation to mink?**	**Potential impact**
Y453F	Yes - has arisen multiple times in several sublineages (COG-UK), including from humans in South Africa, Belarus, Russia and Switzerland (European Food Safety Authority, 2021)	Has been shown to have increased affinity to ACE-2 receptors, without challenging antibody neutralization (Bayarri-Olmos et al. 2021; Starr et al., 2020), although one pre-printed study demonstrated potential for evasion of cellular immunity (Motozono et al., 2021). Overall this mutation has not been seen in rising proportion, providing reassurance as to its lack of significant impact on transmission, or immune escape (Alam et al., 2021).
I692V	No (COG-UK; GISAID)	Not anticipated to have a significant effect on viral infectivity or antibody susceptibility because localised relatively far from the receptor binding motif (COG-UK)
M1229I	Yes (COG-UK; COG-UK 2)	Not anticipated to have a significant effect on viral infectivity or antibody susceptibility because localised relatively far from the receptor binding motif (COG-UK)
S1147L	Yes (Guruprasad, 2021) (COG-UK 2)	Little to no data on the impact of this mutation. It is located on the S2 protein, which mediates membrane fusion.
69–70 del	Yes (in B.1.1.7 variant) (GISAID; COG-UK 2)	May increase receptor binding

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Another mutation frequently found in mink is the N501T. A recent review of this mutation in mink in the US concluded that the N501T mutation occurred two months earlier in humans than in mink in the US, and the novel N501T-G142D variant and N501T-G142D-F486L variant were found in humans prior to mink. The result of this study indicates that the novel variants may have evolved during human infection and then transmitted to mink populations in the US (Cai & Cai, 2021).

To date, it seems that most mink related viral mutations confer no significant advantage in terms of transmissibility or immune escape, nor change in severity (Konishi, 2021; van Dorp, Tan, et al., 2020; Zhang et al., 2021)

Scientific publications and risk assessment carried out by various public health organizations (ECDC, WHO) recognize the risk of novel mutation or accumulation of mutations in hosts other than humans, including in mink, but also in companion animals, calling for immunization of the world population, but also of susceptible host species, with monitoring (Ghorbani et al., 2021).

In BC, the WGS results on samples taken from both infected farms show evidence of multiple mutations in many structural and non-structural proteins, including mutations in the spike protein. The spike mutations were not fixed as clusters in the sequenced mink viruses, with no more than 1 spike mutation associated with the mink outbreak fixed at 90% or above in each of the mink (although combinations of mutations at lower frequency did occur). At this point, there is no evidence that the genetic changes observed are likely to impact transmissibility, severity or immune escape potential of the virus. Analyzed mink samples were presumed to be from the later part of the outbreak in mink, as mink mortality on one farm increased at the time of their collection; on the other farm the outbreak did not run its course, with animals being rapidly euthanized after the detection of the infection in the herd. The mutations observed, at various frequencies in the mink +/- human samples, include:

- **Y453F** – this mutation in the spike protein was first noted in mink in Denmark (214 animals) and in the Netherlands. There was no epidemiological link between the countries for these cases, so the mutation is considered to have arisen independently. Subsequently this mutation has been reported in mink in other countries. It is presumed to be a mink-defining mutation[1] with respect to virus origin. The Y453F mutation has been shown to have increased affinity to ACE-2 receptor, without challenging antibody neutralization (Bayarri-Olmos et al. 2021), although one pre-printed and one report suggested the potential for evasion of cellular immunity. Y453F was observed at variable frequencies in 18 mink from Farm 1 (<10% to 100% frequencies), two mink from Farm 2 (<10% frequencies) and in no humans associated with Farm 1 or in the community (Harris et al., 2021; Motozono et al., 2021).

- **N501T** – is a spike protein mutation that was observed at variable frequencies in 16 mink from Farm 1 (<10% to 90% frequencies), two mink from Farm 2 (<10% frequencies) and

[1] A mink defining mutation is a mutation that has been found to recur frequently in mink, hypothesized as the result of host specific adaptation.

no humans associated with Farm 1 or in the community. It is also considered a mink-defining mutation, with respect to virus origin. It has also been found circulating in humans in the United States, before infecting mink (Cai & Cai, 2021).

- **F486L** – is a spike protein mutation that was observed at variable frequencies in 13 mink from Farm 1 (<10% to ~50% frequencies), three mink from Farm 2 (<10% to up to 40% in one mink) and no humans associated with Farm 1 or in the community. It is not considered a mink-defining mutation and did not appear to confer an advantage to the virus in mink.

- **A222V** – is a spike protein mutation that was observed at variable frequency in minks in the first infected farm, but not on the second farm. While not a mink-defining mutation, it was a sub-clade defining mutation for one of the clades associated with the Farm 1 outbreak. It was found at a frequency of close to 36% in one human initially identified as a SARS-CoV-2 active case of the Farm 1 outbreak, and at a frequency of 100% in one additional human SARS-CoV-2 case identified subsequently in association with the Farm 1 outbreak. It has also been observed in several patients in the community at between ~30% to 100% frequency in their genomes. This mutation has previously been reported in different places around the world without mink association. In a recent pre-print (Vilar & Isom, 2021), it has been noted to be a residue with a relatively high mutation rate in several countries, mainly in Europe. In BC, it was noted predominantly on the background of the mink farm outbreak-associated strain, but was also found on the background of 16 additional strains, from presumed spontaneous mutations. It, however, has not been found in sequenced human strains since March 2021. From the genetic sequencing data on mink and associated human SARS-CoV-2 infections on the first infected premises, it was not possible to ascertain if strains bearing this mutation have been transmitted from mink to human or have arisen in humans spontaneously.

- **H182Y** – is a non-spike mutation (in orf3a gene) previously seen in mink farm outbreaks elsewhere, that has also been found in BC. It is not considered a mink-defining mutation, but it was a clade-defining mutation for another clade associated with the mink outbreak on farm 1. In the original set of five humans and five mink viruses associated with Farm 1, this mutation was found at variable frequencies in all five minks and four of the five humans. It continues to be found at variable frequencies in all but one other mink from Farm 1, as well as at 100% in 5/8 additional humans associated with farm 1. H182Y mutation is also found at nearly 100% frequency in all mink collected from Farm 2. It has also been observed at between ~50% to 100% frequency in several patients in the community, although it has not been seen in any human cases since December 2020. In BC, it was found predominantly on the background of a lineage associated with the Farm 1 and Farm 2 outbreaks, but one additional case of an unrelated lineage with this mutation has been detected, demonstrating potential for spontaneous mutation of this residue in a human host. From the genetic sequencing data on mink and associated human SARS-CoV-2 infections on the first infected premises, it was not possible to ascertain if strains bearing this mutation have been transmitted from mink to human or have arisen in humans spontaneously.

In conclusion, in BC, mink outbreaks have evolved on the background of a SARS-CoV-2 strain circulating in the community. Strains associated with both outbreaks could be further subdivided into three (Farm 1) and four (Farm 2) subclades each, while two clades were identified in association with farm 3 (as of June 4th). The human and mink strains associated with the outbreaks differed by 0-3 SNPs, a rate of mutation that could be observed both in human and mink hosts in an outbreak of estimated duration of >2 weeks, such as the estimate for outbreak on Farm 1, based on symptoms onset and laboratory data gathered during the outbreak investigation. Subclades 1.2 and 1.3 associated with the Farm 1 outbreak have been found circulating in the community cases not known to be directly associated with the outbreak, however this is not conclusive of human-mink-human transmission, as the clade-defining mutations for these lineages were not also mink-defining mutations and are presumed to have been able to originate directly in human hosts associated with the outbreak and further transmitted into the community without a mink intermediary. Regardless of origins, clade-defining mutations for these clades have not been observed in community circulating strains of this lineage since either December 2020 (H182Y) or March 2021 (A222V). Two mink-defining mutations (N501T and Y453F) have been observed to arise during the mink outbreak, however they were not observed in any human cases in BC.

3. Epidemiology

SARS-CoV-2 is primarily transmitted by human-to-human transmission through respiratory droplets, aerosols, fecal-oral route, and fomites. Most of the transmission occurs in close contact. There is evidence of transmission at the human-animal interface; however, the significance of this transmission is difficult to interpret, especially given the uncertainties regarding the origins of SARS-CoV-2 and the role of various species. It is capable of causing a reverse zoonosis as several animals in contact with infected humans have tested positive for SARS-CoV-2 (e.g. mink, dogs, domestic cats, lions, tigers, snow leopards, pumas, ferrets, gorillas, otters) or after experimental infection (mice, voles, dogs, cats, ferrets, hamsters, rabbits, raccoon dogs, primates, tree shrew, fruit bats, white-tailed deer)(Canada, 2021; FAO/OIE/WHO, 2021). Interestingly, it has been noted that mink recovered from SARS-CoV-2 infection and with evidence of successful seroconversion can still experience subsequent infection episodes (Rasmussen et al., 2021).

Big brown bats (*Eptesicus fuscus*), a common North American bat species, were found to not be susceptible to experimental infection with SARS-CoV-2 (Hall et al., 2020).

SARS-CoV-2 is currently globally distributed in humans, including across Canada. Outbreaks have occurred in mink farms in several countries, including: the Netherlands, Denmark, Spain, France, Italy, Sweden, Greece, Poland, Lithuania, Latvia, the USA, and Canada (OIE, 2021).

Most of the affected mink farms around the world reported SARS-CoV-2 infection among workers and it is hypothesized that the mink farms were infected through human-mink transmission (FAO/OIE/WHO, 2021).

Animal-to-human and animal-to-animal transmission has been documented within farmed mink outbreaks in several countries. The Netherlands and Denmark have reported human cases of infection with strains of SARS-CoV-2 that had mutated in mink (Fenollar et al., 2021). Epidemiological as well as experimental data suggest that SARS-CoV-2 is transmitted between animals primarily via respiratory droplets and direct or indirect contacts. Currently, there is no

evidence that animals - including farmed fur animals - play a substantial role in the spread of SARS-CoV-2 to people (FAO/OIE/WHO, 2021).

The susceptibility of wildlife in Canada to SARS-CoV-2 is still highly uncertain. It has not been detected in any wildlife species in Canada to date. In BC, wildlife surveillance was conducted in the vicinity of infected mink premises (57 animals sampled, all tested negative for SARS-CoV-2). The only free-ranging wild animal shown to be infected was a wild mink near an affected mink farm in the US (OIE, 2021). Escaped mink have also been found to be infected (Shriner et al., 2021). There are a low number of wild mustelids in the immediate vicinity of mink farms in BC. Wild mink are solitary and territorial in nature, decreasing the likelihood of sustained transmission.

4. Pathogenesis

A lot of useful information on pathogenesis was summarized in the PHAC Emerging Pathogen Risk Assessment (Canada, 2021)[2]:

> "The minimum infectious dose of SARS-CoV-2 in humans is unknown (WHO 2020; US DHS 2020). One study estimated the dose to be approximately 300 virions (upper estimate) (Basu 2020), whereas another study estimated the dose to be 300 to 2,000 virions (Prentiss et al. 2020); these estimates are within the estimated influenza A infectious dose range of 300 to 9,000 virions (Prentiss et al. 2020). In animal studies, doses in the range of 100 to 630 virions could establish infection (Karimzadeh et al. 2021). It has also been suggested that the inoculum size is directly correlated with the risk of disease severity (Guallar et al. 2020; Gandhi et al. 2020a; Gandhi et al. 2020b; Hausdorff and Flores 2020; Burgess et al. 2020).
>
> The average COVID-19 incubation period in humans is 4.0 to 7.2 days (CDC 2020a; CDC 2020b; WHO 2020; Banka et al. 2020; Lu et al. 2020; Wassie et al. 2020; PHAC Modelling Group Report [August 7, 2020]). According to the WHO and the CDC, the incubation period ranges from 1 to 14 days (WHO 2020; CDC 2021); in fact, most infected individuals who do become symptomatic will do so within 11.5 days post-infection (CDC 2021). However, longer incubation periods of up to 34 days have also been reported (PHAC Modelling Group Report [Apr. 16, 2020]; Banka et al. 2020; Qui et al. 2020; Cheng et al. 2021).
>
> The timing of peak infectiousness in humans varies by study, and ranges from zero to two days prior to symptom onset (He et. 2020; Lu et al. 2020), two to three days before and after symptom onset (Ferretti et al. 2020), or within the first week of symptom onset (Cevik et al. 2020). Patients with mild to moderate illness are usually less infectious or no longer infectious from day 8 to day 11 after symptom onset (Bullard et al. 2020; Wölfel et al. 2020; Perera et al. 2020; Walsh et al. 2020; CDC 2020c; ECDC 2020). However, three patients with mild illness have been reported to be infectious for 15, 24 and 37 days, respectively (Vaught et al. 2021; Mendes-Corea et al. 2021). Furthermore, patients with severe illness and/or who are elderly and/or immunocompromised may be infectious for

[2] References within quoted text are given as in-text links only.

longer, with reported periods of infectiousness up to, and even exceeding, eight months after symptom onset or diagnosis (Folgueira et al. 2020; van Kampen et al. 2020; McPhie et al. 2020; CDC 2020c; ECDC 2020; Fontana et al. 2020; Li et al. 2020; Avanzato et al. 2020; Abe et al. 2020; Choi et al. 2020; Mileto et al. 2020; Aydillo et al. 2020; Baang et al. 2021; Khatamzas et al. 2021; Sepulcri et al. 2021; Beran et al. 2021).

Viable virus has been isolated from asymptomatic patients (Arons et al. 2020) and asymptomatic individuals can infect others (WHO 2020; CDC 2020; ECDC 2020; Qiu et al. 2020; Ravindra et al. 2020; Luo et al. 2020; Wilmes et al. 2020). According to the CDC, asymptomatic individuals are 75% as infectious as symptomatic individuals (CDC 2020; Johansson et al. 2021). Although the actual extent to which pre-symptomatic and asymptomatic transmission occurs is unknown (WHO 2020; CDC 2020), it has been estimated that at least 50% of infections are the combined result of pre-symptomatic and asymptomatic transmission (Moghadas et al. 2020; CDC 2020b; Johansson et al. 2021)."

Lythgoe et al. (2021) used a within-host evolutionary approach to estimate that infections go through a transmission bottleneck of 1-8 viruses. This suggests that the number of viruses needed to establish an infection may be smaller than the infectious dose mentioned above.

A mink worker with a previous COVID-19 infection is most likely to have some immunity and protection against reinfection. This is especially true if there is no mutation in key parts/regions of the virus linked to immune response. In BC, vaccination is available to mink workers and their household members, which should provide some protection from developing an infection (see Prevention and control section for further details).

There is still a lot of uncertainty regarding incubation period, shedding, and immunity in animals. An experimental study of mink found that infectious virus was present in nasal washes of inoculated mink from 2-8 days post-inoculation, and from in-contact mink from 5-11 days post-exposure (Shuai et al., 2020). Experiments in ferrets have detected shedding of similar duration (Kim et al., 2020; Schlottau et al., 2020; Shi et al., 2020).

The length of time a SARS-CoV-2 infection needs to infect most of the herd without subsequent ongoing circulation in a mink herd remains to be fully determined, but expert opinion estimates it might be a few weeks. This is compatible with what was observed in the one outbreak in BC where it seems the majority of the herd contracted the infection rapidly, with indeterminate or too high CT values to be able to carry WGS some weeks after the peak of mortality, suggesting there was no longer a high amount of viral shedding and potentially only residual viral fragments. However, it could have also been longer, as samples were taken approximately 4 weeks after the detection of the first case. There can be immunity in the mink herd generated from a prior SARS-CoV-2 infection, decreasing the chances of subsequent re-infection of the herd, but colleagues in the United States reported a documented reinfection of a herd within a few months, which was cleared again without generating an endemic reservoir.

Mink farms have an annual production cycle, which means the majority of the mink herd is comprised of new individuals each year.

5. Industry characteristics

There are ten licensed mink farms in BC, nine of which are located in the Fraser Health Authority boundaries (primarily District of Langley) and in the Fraser Valley Regional District (Abbotsford, Chilliwack). None of the municipalities in these regions fit Statistics Canada's classification of a rural community. Workers and operators are likely to use the services located in urban centres.

The herds in BC are relatively small compared to the herds in the Netherlands and Denmark (Table 2), and the virus has been circulating for a shorter period. The infrastructure in Canada for mink farming is also quite different as Canada is less reliant on centralized feed manufacturers and pelting facilities, which are present in the Netherlands and Denmark. These centralized services can result in common contact and the opportunity for the transmission of pathogens among sites. There is some movement of staff between farms in Canada but to a much lesser extent than in Denmark or other countries, where, for example, large feed suppliers go on many farms.

However, BC farms still have some limited interconnections. Several of the mink farm owners have more than one location of operation, and staff and equipment might be shared in typical operations. The farms may interact to a limited degree for feed preparation and delivery. Finally, during normal operation, they may share breeding stock and/or send pelts to other locations for processing. There are only a few farms in BC with the necessary equipment to complete processing of mink pelts. Some producers perform the initial skinning of the animal and send these raw unprocessed pelts to other farms in BC or facilities in the US to complete the pelting process. Theoretically, this means that there could be a very small potential for sequential infection in the future, with additional risks of accumulated mutations.

Raw unprocessed pelts contaminated with SARS-CoV-2 could serve as a potential risk for transmission to workers and or other mink if moved between premises (OIE, March 2021). The US mink industry has implemented measures to address these risks including measures to contain/package raw mink pelts from infected mink premises for transport to processing facilities and holding mink pelts for 14 days at 20ºC following boarding and drying pelts to reduce viral load prior to shipping for auction.

Table 2. Size of the mink industry in various locations (Radke, 2020)

Region	Annual pelt production (millions)
Denmark	14
Netherlands	4
Canada	.9
BC	.25
Fraser Health	.25

The number of employees on a farm changes seasonally. Many farms are family run and employ both full and part time staff in small numbers. A single person can care for approximately 1000 mink and stable staff levels range from 1-25 depending on farm size. The total number of mink

workers in the province can increase to about 150 workers during pelting season. Some employees on mink farms in BC live in congregate settings on farms at some times during the production cycle (e.g. pelting season Nov-Dec). Some BC mink farms employ temporary foreign workers during some periods of the production cycle (i.e. pelting, breeding, and whelping). Temporary foreign workers might not have been immunized against COVID-19 before arrival and would need time to develop an adequate immune response to a vaccine if administered once they are in Canada. Times in the production cycle where interaction between people and mink is increased are breeding (March), whelping (May), weaning/processing (July), and pelting (Nov/Dec).

Mink are primarily housed in open sided sheds that are unheated; mink are exposed to natural daylight and environmental conditions while protected from rain, snow and direct sunlight. Cages are primarily constructed of metal (wire mesh); wood and/or plastic may also be used in the construction of side panels between cages to separate mink. Nest boxes are often constructed of wood. Mink in adjacent cages are unable to contact one another directly, but the distance between cages is a couple of centimetres allowing indirect contact between animals.

Carcasses are not always processed on farm, and sometimes used as bait (for crab). If infected carcasses are moved outside the farm without adequate safeguards, it could provide a pathway to spread the virus outside of the wildlife in the immediate vicinity of the farm or outside of farm workers. Carcass disposal is through rendering, on farm composting, or as crab bait (minimal). Each farm would be different depending on size, land base, etc., and likely disposal of pelted carcasses and normal mortality may be different possibly due to numbers – thousands during pelting; a handful per month during the rest of the year. Once a farm is under quarantine, movement of carcasses are limited to scenarios where they would not normally pose a public health or animal health risk.

While no BC specific data is available about farmed mink escaping and living in the wild, a study in Eastern Canada in 2017 concluded that 33% of sampled free-ranging mink were either escaped domestic mink, domestic-wild hybrids, or were introgressed[3] to domestic of wild parental groups. In BC, farms have perimeter fences (including a buried portion under the ground) in place to prevent escapes and from an initial scan there are few reports of low number of mink escaping from farms in the BC context. Mink are solitary in nature, not interacting much with their wild counterparts when released, with most usually coming back to the farm for food sources. There is an ongoing concern of mink release or other actions against mink farms from activists, as occurred in other jurisdictions[4].

[3]Introgression is the transfer of genetic material from one species into the gene pool of another by the repeated backcrossing of an interspecific hybrid with one of its parent species

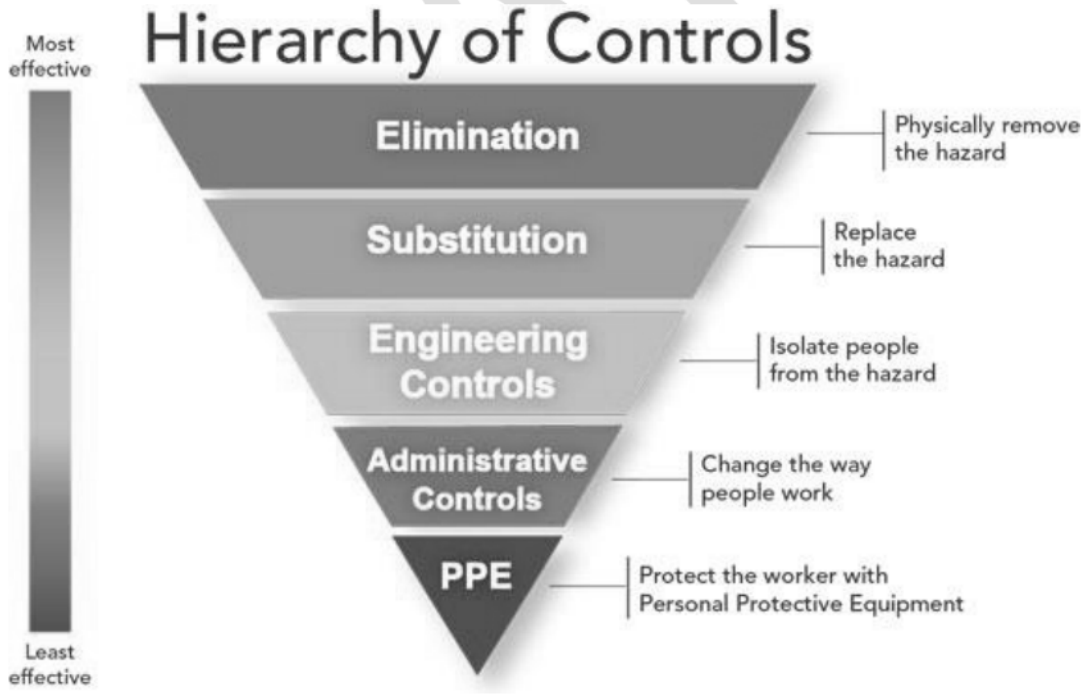
[4] Media reports: https://www.chicagotribune.com/news/breaking/ct-animal-activist-mink-sentencing-met-20160229-story.html; https://www.theguardian.com/uk-news/2018/feb/20/police-admit-officers-role-in-mass-release-of-mink-by-protesters; https://lfpress.com/news/local-news/animal-activist-charged-in-mink-stink

Biosecurity protocols have been enhanced significantly with expert support from a mink related biosafety group.

6. Prevention and control

Prevention of public health and workplace hazard is frequently approached through the framework of the Hierarchy of Controls (figure 2). Based on that framework, the most effective way to prevent hazard from generating negative consequences is to remove the hazard. Fully removing the hazard is not always possible, and in some circumstances, such as disposing of an infected herd, might generate increased exposure to the hazard. Surveillance can assist in temporarily removing the hazard, by removing infected workers from the farm, and minimizing infected workers' and infected farms' interaction with others. Hazards are frequently managed through engineering and administrative controls, and personal protective equipment, implemented as part of safety plans. Immunization is also an effective control measure. Those measures are discussed below, as well as some challenges.

Figure 2. Hierarchy of controls



Source: https://www.cdc.gov/niosh/topics/hierarchy/images/HierarchyControls.jpg

Human surveillance

Laboratory testing to detect acute SARS-CoV-2 infection in humans and in mink relies on the same molecular principles. Testing of humans has been well described previously. Briefly, molecular methods, which are the gold standard of acute SARS-CoV-2 diagnostic testing, have high analytical sensitivity and specificity in detecting even small amounts of SARS-CoV-2 virus. Sensitivity can be compromised by the quality of specimen collection, timing of collection relative to viral shedding and the type of specimen collected (e.g. upper vs. lower respiratory tract samples in cases with predominantly lower respiratory tract disease, and environmental sample vs. human and animal samples).

In BC, diagnostic tests for COVID-19 in humans are conducted using real-time reverse transcription-PCR (rRT-PCR). Samples are collected either via nasopharyngeal (NP) swab – the general gold standard method of specimen collection (Goldfarb et al., 2021; Public Health Ontario, 2020) – or saline mouth rinse-gargle ("saline gargle"). Saline gargle has been both analytically and clinically validated against NP swabs in BC (McLennan, Goldfarb, Donoghue, & Hoang, 2020). The clinical validation showed interpretation of nucleic acid test results to be equivalent between NP swab and saline gargle, with saline gargle having a sensitivity of 98% (Goldfarb et al., 2021). In a multicenter comparison of self-collected saline gargle to a provider-collected nasopharyngeal swab in Toronto, Kandel et al. (2021) also found similar sensitivity between the two methods for the detection of SARS-CoV-2: adjusted sensitivity of 0.90 [95% CI 0.86-0.94] for saline gargle, with the percent agreement between NP swab and saline gargle being 0.99 [κ, 0.93; 95% CI, 0.86–0.96]. While the clinical validation by Goldfarb and colleagues only included individuals who were symptomatic, the study by Kandel and colleagues (2021) was conducted with a study population where approximately 25% of individuals who tested positive for SARS-CoV-2 were asymptomatic. Similar saline gargle collection methods have also been used in India (Mittal et al., 2020), Germany (Malecki, Lüsebrink, Teves, & Wendel, 2021), and Japan (Saito et al., 2020).

Viral shedding in asymptomatic or pre-symptomatic individuals has been well documented, which provides opportunities for asymptomatic surveillance programs. The relative sensitivity of asymptomatic screening is still to be determined in vaccinated populations (such as the current state of mink farms in BC).

A voluntary COVID-19 testing program among mink farm workers in BC employing self-collected saline gargles has been implemented. Saline gargles were selected due to their comparable sensitivity to NP swabs, greater acceptability and ease of use compared to NP swabs, and capacity for self-collection following training by public health nurses, allowing the long-term testing to be less public health resource intensive. Gargle samples are self-collected by workers and transported by medical courier to the BCCDC public health laboratory for testing. On the occasion when indeterminate results are returned via saline gargle, individuals are asked to retest by NP swab.

All active mink farms have been participating in the voluntary testing program since February 24, 2021, with the first farm participating since January 14, 2021. As of May 19, 2021, after the

discovery of a third infected farm, most farms provide samples twice weekly, while one farm participates once per week. Uptake among workers is generally high, with the weekly average of active workers tested at each farm ranging from 86-100% since epidemiological week 8 when all farms began participating. One or two workers have had recurrent challenges in providing a valid specimen for testing via saline gargle, and there have been instances where samples have leaked in transit or were not properly labeled, leading them to be rejected and not processed. Otherwise, for most workers, use of the saline gargle collection method has been straightforward and has consistently returned valid results.

There is an expected reduction in the number of secondary infections in humans by 90% with twice a week PCR screening, based on modeling studies (Larremore, Toomre, & Parker, 2021).

Mink mortality and environmental surveillance

In BC, the mink farms are under a public health order that mandates surveillance. Each farm submits all their natural mortalities or animals euthanized due to illness to a maximum of five per week. Suspect results will initiate live animal sampling while positive results will trigger a quarantine and a full investigation.

Molecular testing of environmental samples is presumed to be inherently both less sensitive and potentially less specific (with respect to source attribution), than live or mortality sampling, as well as lacking markers of sample quality. The main advantage of environmental surveillance is its potential to detect infection early and complement other forms of surveillance. In BC and elsewhere, so far, it seems to be sensitive and correlating well with mink cages around infected animals' area (de Rooij et al., 2021). It can also assist in monitoring the presence of virus fragment on infected farms, which persist much longer than viable virus. BC is studying the degradation and persistence of viral fragment on the infected farms to assist in removing farms from quarantine and learn more about the properties of environmental samples. On infected premises, environmental samples are taken repeatedly on a 14-day basis (one incubation period) for the first eight weeks, then on a monthly basis (two incubation periods) thereafter until there are two consecutive sets of negative samples or for a six-month period, whichever comes first.

Environmental sampling is a tool that is still under development and needs to be interpreted with caution. It can help to understand how the virus is or is not decaying in the environment, though there is the potential for prolonged environmental contamination by dead virus remnants. Negative results from these samples cannot prove, on their own, that there is no virus remaining, since the virus can be unevenly distributed in the environment and there can be other materials present in the environment that can sometimes interfere with the test. Continuing mortality surveillance and adding environmental surveillance across the farm could help to monitor the rest of the herd in a minimally invasive way.

Positive human, environmental, and mink samples with sufficient viral load are amenable to whole genome sequencing (WGS), which can help inform epidemiological linkages, and monitor for mutations of concern arising in mink and circulating in workers and the community. WGS of the most recent samples are pending.

Viral persistence on farms and mink carcasses

SARS-CoV-2 virus can survive on various surfaces in the environment in respiratory secretions, urine, and feces. On affected farms in the Netherlands, SARS-CoV-2 was detected, at low levels, in air samples collected close to the mink, on mink fur, on flies, on the foot of a seagull, and in gutter water (Boklund et al., 2021).

Since viruses cannot replicate outside a living host, viral load degrades over time. Time and temperature are important factors affecting the length of virus survival, as are other factors such as humidity, pH, UV light, and the presence of organic material. As an enveloped virus, SARS-CoV-2 is more susceptible to environmental influences that affect the integrity of the lipid envelope than non-enveloped viruses. Cool temperatures, moderate humidity, neutral pH, protection from UV light and the presence of organic material will favor virus survival.

Using the model developed by Guillier et al. (2020), the time required to reach a 5 log reduction in virus titer (i.e., 99.999% reduction) for coronaviruses in general at 20°C is 13-18 days, depending on humidity (with 95% confidence intervals ranging from about 9-24 days). Newer studies specifically on SARS-CoV-2 suggest that this would be sufficient in most cases, though worst-case situations (e.g., high virus concentration in dark conditions) might require longer. At 4°C (at the same RH), the duration is 26-37 days, depending on humidity (with 95% confidence intervals ranging from about 19-49 days).

However, many aspects of these survival studies are not representative of real life. Surface characteristics of the substrate (porosity, texture, surface charge, the presence of hydrophobic groups, and metal ions among other factors) can influence survival and recovery of viruses during testing and under environmental conditions. Deposition solutions (cell culture media, PBS, PBS and serum albumin, saliva, mucus, etc.) used during testing also affect virus survival with albumin and saliva often providing extended survival times. The initial load of virus is also an important consideration in determining the period of survival. Due to all of these factors, it is difficult to compare the results of experimental studies with each other, and to a natural situation. Therefore, results should be interpreted with caution. Approaches used for cleaning and disinfecting or decontaminating infrastructure on infected mink farms must account for these variables and provide a sufficient margin of safety.

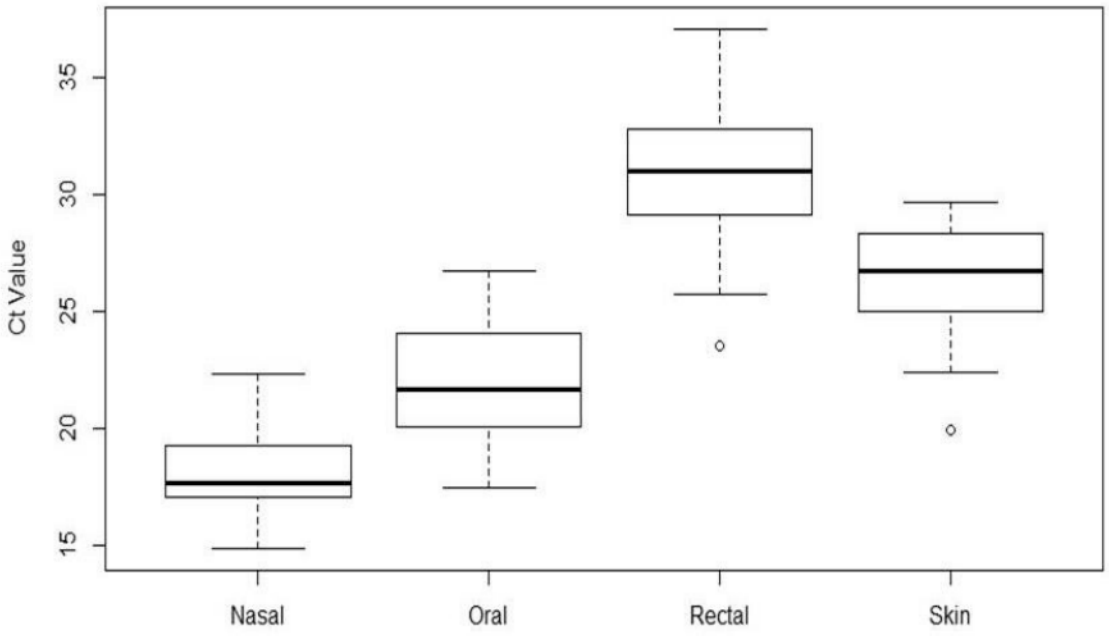
In studies on mink farm outbreaks of SARS-CoV-2 in Europe, the virus was not found in environmental sources outside of the premises (i.e., not airborne to surrounding areas) (de Rooij et al. 2021).

In BC, viral fragments, frequently at high CT-values, tended to persist for weeks to months in the first two infected premises, even after there were no longer any mink found to be positive via PCR testing, suggesting that it is likely sensitive at detecting SARS-CoV-2 RNA at lower concentrations.

In term of sampling on carcasses, from the first two outbreaks, among a sample of 25 animals which were sampled by nasal, oral, skin (subcutaneous tissue), and rectal swab AND were COVID positive on those nasal swabs, 22 were also positive on skin swabs. Ct values for skin

were lower than oral and nasal swabs but higher than rectal swabs (figure 1). This is not sufficient to conclude on the ability of unprocessed skins from infected mink to transmit SARS-CoV-2. More studies are needed.

Figure 1. Viral detection from various specimen collection location on mink carcasses



Wildlife surveillance

A wildlife surveillance program to assess potential SARS-CoV-2 transmission to free-ranging animals from the infected premises was implemented by the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD), as the provincial agency responsible for wildlife management. Sampling of free-ranging animals was conducted in a 1 to 3 km radius around each of the first two infected farms, following guidance from other provincial and international jurisdictions. Sampling effort focused on appropriate habitat expected to be used by target wild species in the mustelid family. Wild or escaped farmed Mink (*Neovison vison*), River Otter (*Lontra canadensis*) and smaller species of Weasels (*Mustela spp*) were expected to be present and considered to be most likely to have positive results for virus detection.

A provincial trapping permit under the BC Wildlife Act was issued to contractors and outlined methods for capture. During operations there were over 70 traps deployed as a maximum. Trapping operations were flexible and adaptable, with changes made due to weather conditions, catch success, identified opportunities, and occurrence of animal/furbearer spoor. All animals trapped were humanely euthanized according to provincial and international standards as soon after capture as possible and transported to the Animal Health Centre of the Ministry of Agriculture and Fisheries in Abbotsford. Two swabs were collected from each animal (oral and rectal) and the carcass was frozen at -20C.

Through this wildlife surveillance project, 65 animals of nine different species were sampled surrounding the first two farms. Species trapped were: Brown Rat (*Rattus norvegicus*, introduced), Muskrat (*Ondatra zibethicus*, native), Eastern Grey Squirrel (*Sciurus carolinensis*, introduced), Raccoon (*Procyon lotor*, native), American Mink (*Neovison vison*, native), Feral Cat (*Felis catus*, introduced), River Otter (*Lontra canadensis*, native), Beaver (*Castor canadensis*, native) and Virginia Opossum (*Didelphis virginiana,* introduced).

All animals submitted were negative for SARS-CoV-2 virus. The surveillance model used was determined to be effective; however, the largest contributing factor to its success was our access to experienced contractors and the generous support and collaboration of the *BC COVID-19 One Health Working Group* and individuals in the Chilliwack agricultural and local community. A project report, including further details on sampling design and effort is currently being finalized (BC SARS-CoV-2 Wildlife Surveillance Report; in draft).

At the time of writing, surveillance around the third farm has begun and results are still pending.

Immunization

Mink workers need to be immunized against COVID-19 to be allowed to work on mink farms, as per a Fraser Health Public Health Order. Immunization of mink workers by a mRNA vaccine is expected to decrease infection (symptomatic or asymptomatic) by 60 to 80% with one dose, and by more than 90% with two doses, when those vaccines were studied against the most prevalent strains before variants of concern emerged. There has also been reporting of unpublished data of 100% efficacy of the Pfizer vaccine in a study of 800 people in South Africa, which found only 9 cases (all among placebo group), with 6 of those being carriers of the B.1.351 variant (NCCID presentation to NACI, May 5th 2021). A living evidence review (COVID-19 Evidence Network, 2021), updated June 1st, states that the Pfizer vaccine effectiveness against the B.1.1.7 (Alpha) VOC first detected in the United Kingdom is comparable to that of phase 3 trials of that vaccine, with a decreased infection of 46-60% 14 days after the first dose, and 70 to 94% 14 to 21 days after the second dose, in a population with 80% or more of the cases caused by the B.1.1.7. For the B.1.351 (Beta) VOC first detected in South Africa, no data is available for infection rates; however, a decrease of symptomatic infection of 43% was detected 35-41 days after the first dose, while 7 days after the second dose the decrease of symptomatic infection is 88%. There is some evidence, from two case-control studies, that the Pfizer vaccine offers good protection against infection and severe disease from the B.1.351 strain (Abu-Raddad, Chemaitelly, & Butt, 2021; Kustin et al., 2021). Much less is known about the protection of the Pfizer vaccine against other variants of concern. For Moderna, a 58.9% reduction of infection 15-41 days after the first dose has been observed for the B.1.1.7 VOC, and an 85.7% decrease of infection 7-15 days after the second dose. Moderna offers similar protection to symptomatic infection from the B 1.135 VOC as Pfizer.

Preliminary results from BC in the 70 years-and-older population has shown that a single dose of mRNA vaccine reduced the risk of SARS-CoV-2 in adults by about two thirds, with protection only minimally reduced against B.1.1.7 and P.1. Vaccine effectiveness was negligible during the period of 0-13 day's post-vaccination (14%) and increased to 75% at 35-41 days after dose 1. At

21 days and over, a single dose of mRNA vaccine was also significantly protective in variant-specific analyses with 67% effectiveness against B.1.1.7 and 61% against P.1 (Skowronski et al., 2021).

A few studies show that viral load may be lower (CT values higher) in those who were vaccinated and infected compared to unvaccinated and infected individuals, against the B.1.1.7 and the previously dominant strain (Pritchard et al., 2021). Decreased viral load in cases seems associated with decreased transmission (Public Health Agency of Canada, 2021). Two UK studies support a decrease in secondary transmission to household contacts, for the Pfizer or the Astra-Zeneca vaccines. One study suggests a 30% decrease, however it is not clear if the decrease is from decreased transmission from health care workers not getting infected, or because health care workers transmitted less after being immunized (Shah et al., 2021). The other study found that the likelihood of household transmission decreased by 40 to 50% in households where the index case was vaccinated at least 21 days prior to testing positive, compared to non-immunized index cases (Harris et al., 2021).

An experimental vaccine for SARS-CoV-2 in mink has been developed and will be used on many mink farms in the US in June of 2021. The Canadian Center of Veterinary Biologics will allow restricted emergency use of the experimental vaccine through a permitting process; no commercial license has been issued pursuant to the Health of Animals Act and Regulations. The vaccine must be used under the direction of a licensed veterinarian and with appropriate biosecurity, active infection monitoring and personal protective equipment for farm workers. As of June 29th, 2021, approximately 100 000 doses have been made available by the vaccine manufacturer for Canada. Applications have been submitted by veterinarians from multiple provinces for the vaccine. The applications will be reviewed and a permit issued only after approval from the provincial Chief Veterinary Officer if all conditions of the permit are met. Antibody titers in animal studies of this vaccine show an excellent response to the vaccine available for animals. Once vaccination is available for mink, it should provide mink some protection from developing an infection for a portion of their lifespan. Kits cannot receive a first dose of vaccine until a certain point of maturity. Vaccination of kits would occur at 6 to 8 weeks of age and then 3 to 4 weeks later at 9 to 12 weeks of age. That is the current plan for the recently developed mink vaccine and the approach to other mink vaccines. Maternal antibodies (IgG in humans) to SARS-CoV-2 have been demonstrated in neonatal cord blood (Flannery et al., 2021). It is presumed that this would also occur in mink. As such, maternal antibodies, either as a result of vaccination or from natural infection, would confer some protection to adults and kits in subsequent years thereby reducing this period of susceptibility. Antibody titers in animal studies of this vaccine show an excellent response to the vaccine available for animals. However, too little is known to conclude on the impact mink vaccines will have on disease spread in the herd, rate of mutation accumulation or type of mutation accumulation, and transmission back to humans. The risks and benefits of mink vaccination for disease control still need to be further assessed.

Safety plans

Mink farms in BC are under a PHO order, currently, like all other workplaces, and must have COVID-19 safety plans to prevent the transmission of COVID-19, including daily symptoms

check on workers. As described above, mink farms are currently required to use intensive PPE during all work on farm, most onerous of which is the requirement for N95 or equivalent respirators during all work in close proximity to mink or while performing activities generating bioaerosols when there is no evidence of infection in the herd. Respirators are required at all time on farm if the herd is infected. Workers in close proximity to mink are also required to use goggles or face shields, washable coveralls or Tyvek suits, as well as boots that can be sanitized. Work that is not in close proximity to mink on uninfected farms requires medical grade masks.

A systematic review (Chu et al., 2020) "identified 172 observational studies across 16 countries and six continents, with no randomised controlled trials and 44 relevant comparative studies in health-care and non-health-care settings (n=25 697 patients). Transmission of viruses was lower with physical distancing of 1 m or more, compared with a distance of less than 1 m (n=10 736, pooled adjusted odds ratio [aOR] 0·18, 95% CI 0·09 to 0·38; risk difference [RD] −10·2%, 95% CI −11·5 to −7·5; moderate certainty); protection was increased as distance was lengthened (change in relative risk [RR] 2·02 per m; pinteraction=0·041; moderate certainty). Face mask use could result in a large reduction in risk of infection (n=2647; aOR 0·15, 95% CI 0·07 to 0·34, RD −14·3%, −15·9 to −10·7; low certainty), with stronger associations with N95 or similar respirators compared with disposable surgical masks or similar (e.g., reusable 12–16-layer cotton masks; pinteraction=0·090; posterior probability >95%, low certainty). Eye protection also was associated with less infection (n=3713; aOR 0·22, 95% CI 0·12 to 0·39, RD −10·6%, 95% CI −12·5 to −7·7; low certainty). Unadjusted studies and subgroup and sensitivity analyses showed similar findings."

Challenges

We have observed a herd getting infected despite all the safety protocols in place, plus bi-weekly PCR testing and immunization. However, in the latest infected premises, the worker was infected early after the second vaccine dose. Encouragingly, we have not observed an outbreak in mink workers. Some variants of concern in BC present with some immune escape features related to infection after one dose. However, even after one dose, vaccines do not seem to offer significantly less protection against severe outcome than observed for previously circulating VOC and the protection is better after two doses. As of June 2021, second dose delivery is well underway among the eligible population in BC.

It may also be challenging to maintain participation in frequent worker screening. As vaccination rates increase, episodes of COVID-19 infection are much more likely to be mild or completely asymptomatic, meaning workers are less likely to self-identify a need for testing. Weekly or biweekly screening may have lower acceptability to workers and employers once community COVID-19 rates decline and their perceptions of risk become lower.

As the mink farms in BC are located in a highly populous area, contact tracing is unlikely to be able to fully contain transmission of mink strains out into the broader community if infected farm workers have secondary cases (either due to late identification or lack of full compliance with isolation instructions).

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Despite the protection and control measures in effect on BC mink farms, it is generally recognized in the Occupational Health and Safety field that PPE and administrative controls are less effective and can be very costly as well as unsustainable in the long run. Alternatively, as workers and industry gain experience with applying higher levels of personnel protection on a routine basis, it may be the risk will be managed on many premises yet be higher in premises with a larger turnover of workers or that use temporary staff. Irrespective of either of these scenarios, breaches in appropriate biosecurity including the appropriate use of PPE should be expected.

The only way to completely remove the risk of clinically significant mutations arising from mink farming in BC is to phase out the industry. Maintaining a smaller stock of mink, such as preserving the breeding stock only, would allow for decrease viral replication in any given mink outbreak, as well as decrease mink and human contact, since the stages of breeding, whelping and pelting that require more human handling would be paused.

In the next several years, there will likely be new technologies decreasing the risk of infection, severe disease, or transmission, and improving the ability to remain protected against immune escape variants.

7. Impact

Animal health impacts

Clinical signs in mink have been observed on some affected farms around the world, including respiratory or gastro-intestinal signs (rarely); however, in most instances the only indication of virus circulation has been animal mortality levels slightly above baseline (FAO/OIE/WHO, 2021). Discussion with US APHIS colleagues regarding outbreaks in Utah indicated that there were a variety of clinical signs including: inappetance, lethargy, ocular discharge, nasal discharge, coughing, and wheezing. Boklund et al. (2021) found that a third of mink farms in Denmark did not show clinical signs at initial investigation. However, personal communication with the researchers revealed that over half of those that did not show clinical signs and were followed-up (a median of 21 days later) had developed clinical signs within that time (Boklund, personal communication, 23 February 2021).

Generally, affected animals have been spread throughout the farms (Oreshkova et al., 2020). The virus appears to have a predilection for older animals, as such, while there is increased risk with increasing numbers of animals, kits may be less susceptible to clinically significant infection or shed less virus.

Effects could be seen from the costs associated with control measures taken to prevent further spread, such as improvements to fences, personal protective equipment, cleaning and disinfection. The need for increased labour to handle the outbreak, as well as absenteeism due to illness or fear of becoming ill, would likely be one of the greatest expenses. Since the BC mink industry is small, these costs may be a challenge.

Affected farms may experience trade restrictions. An OIE Ad Hoc Group on COVID-19 and Safe Trade in Animals and Animal Products determined that raw mink furskins currently cannot be considered as a safe commodity for international trade, meaning that they recommend that some sort of control be applied prior to trade (OIE, March 2021).

There is the possibility of public perception and animal welfare risks. There are instances of protests near farms and farmed mink being released from pens by protesters.

Public health impacts

A public health emergency was declared in BC on March 17, 2020 in response to the first community transmissions recorded in the province. Emergency measures were implemented in an effort to reduce the spread of the virus, and these continue to be in effect as needed. As of the June 5th Situation Report, BC has recorded 145,768 cases of SARS-CoV-2 since the first confirmed case on January 15th. 7,795 (5.34%) of positive cases have resulted in hospitalization. The median age of all hospitalized people is 63. 1,789 (1.22%) of positive cases have resulted in death with a median age of 84. More details on age profile and severe outcomes are available from the BCCDC data webpage. BC has transitioned to whole genome sequencing on all positive samples to detect VOC and support outbreak responses. As of the June 18th VOC Report, 90% of all tested samples were confirmed VOCs. Sample prevalence of VOCs province wide was 44% for B.1.1.7 (Alpha), 40% P.1 (Gamma) and 6% B.1.617 (Delta). The economic effects of the pandemic are significant and far-reaching; however, they are out of scope for this report.

Environmental impact, impact on biodiversity

If SARS-CoV-2 were to establish in wild populations, the effects of a wild animal reservoir of SARS-CoV-2 in Canada could be significant, depending on the species affected, the morbidity and mortality experienced, and the extent of contact that species has with humans and other animals. If it affected a rare wildlife species, it could present a conservation concern (e.g., some pine marten populations). However a detailed assessment of the impact on biodiversity is out of scope of this hazard profile.

8. Research gaps

- Susceptibility of mink and other species to the variants of concern detected in humans
- Susceptibility of various wildlife species to SARS-CoV-2, especially to infection under natural conditions
- Extent of shedding by susceptible wildlife species
- Genetic selection pressures for SARS-CoV-2 in mink
- Effectiveness and duration of immunity from natural infection in mink herds from circulating SARS-CoV-2 strains
- Protection of mink vaccine against new variants arising in humans

- Mink vaccine effect on disease transmission in mink and between humans and minks, as well as on promoting the emergence of an immune escape variant
- Length of protection from mink immunization
- Environmental testing sensitivity to detect infection in mink herd
- The future epidemiological patterns of infection in mink herds
- Process needed to neutralize virus from mink at various stages of processing of carcasses and pelts
- Efficacy of human vaccines against variants or concern
- Vaccine coverage needed to see ongoing low circulation in the community
- Degree of viral shedding in vaccinated individuals
- Efficacy of PPE, biosecurity, and human surveillance
- Ability to identify mutations that are more likely to result in a VOI (in human and in mink)

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Appendix A – COVID-19 in animals

COVID-19 and Animals*

Animals species with reports of natural (and experimental where available) SARS-CoV-2 infection:

Species	Evidence[1]	Susceptibility[2]	Clinical signs[3]	Seroconversion	Transmission
Cats	C,E,O	high	yes (some cases)	yes	yes, to other cats
Big cats (tigers, lions, pumas, snow leopards)	C	high	yes (most cases)	yes	yes, to other big cats
Mink	C,E	high	yes (some cases)	yes	yes, to other mink and to people[4]
Ferrets	C,E	high	yes (some cases)	yes	yes, to other ferrets
Gorillas	C	high	yes	unknown	yes, to other gorillas
Asian small-clawed otters	C	high[8]	yes	unknown	unknown
Dogs	C,E,O	low	yes (some cases)	yes	no

Results of experimental studies on other animal species:

Species	Evidence[1]	Susceptibility[2]	Clinical signs[3]	Seroconversion	Transmission
Hamsters[9]	E	high	yes (some cases)	yes	yes, to other hamsters
Deer mice[9]	E	high	no	yes	yes, to other deer mice
Other non-human primates[5]	E	high	varies by species	yes/unknown	varies by species
Tree shrews[6]	E	high	yes (some cases)	unknown	unknown
New Zealand white rabbits	E	high	no	yes	unknown
Raccoon dogs[7]	E	high	no	yes	yes, to other raccoon dogs
Egyptian fruit bats	E	high	no	unknown	yes, to other fruit bats
White-tailed deer	E	high	no	yes	yes, to other deer
Bank voles[9]	E	medium to high[8]	no	yes	no
Bushy-tailed woodrats[9]	E	medium to high[8]	no	yes	unknown
Striped skunks	E	medium[8]	no	yes	unknown
Laboratory mice	E	low[8,12]	no	unknown	unknown
Cattle	E	extremely low[10]	no[10]	yes[10]	no
Swine	E	extremely low[11]	yes[11]	yes[11]	no
Raccoons	E	extremely low[8]	no	yes	no
Poultry (chickens, ducks, geese, quail, turkeys)	E,O	none	n/a	n/a	n/a
House mice	E	none	n/a	n/a	n/a
Big brown bats	E	none	n/a	n/a	n/a
Cottontail rabbits	E	none	n/a	n/a	n/a
Fox squirrels	E	none	n/a	n/a	n/a
Wyoming ground squirrels	E	none	n/a	n/a	n/a
Black-tailed prairie dogs	E	none	n/a	n/a	n/a

***Based on limited information available as of May 27, 2021. Animal species not listed do not yet have any evidence available.**

[1]C-Case report; E-Experimental finding; O-Observational study
[2]Based on January 2021 update of OIE technical factsheet
[3]Clinical signs may include non-specific signs (e.g. fever, lethargy) and/or respiratory signs with or without gastrointestinal signs
[4]Zoonotic transmission has been reported in the Netherlands, Denmark, and Poland
[5]Includes several species (e.g. macaques, marmosets, baboons, African green monkeys) and information may differ by species where noted
[6]Closely related to primates
[7]Member of *Canid* family
[8]Expert opinion based on limited information to date
[9]Member of *Cricetidae* family
[10]Very low-level susceptibility in experimental setting with no clinical signs but seroconversion and low-level viral shedding
[11]Very low-level susceptibility in experimental setting with mild clinical signs and low-levels of antibodies but no viral shedding
[12] Susceptible to certain variants of SARS-CoV-2

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DRAFT

RE: Discussion with Dr. Henry and DM Tom Ethier Re: Risk Assessment

From: Clair, Veronic [BCCDC] <veronic.clair@bccdc.ca>
To: Ethier, Tom AFF:EX <Tom.Ethier@gov.bc.ca>, Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>, McGuire, Jennifer AFF:EX <Jennifer.Mcguire@gov.bc.ca>, XT:HLTH Brodkin, Elizabeth <elizabeth.brodkin@fraserhealth.ca>, Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>, Singal, Mayank [BCCDC] <mayank.singal@bccdc.ca>
Sent: July 7, 2021 10:42:18 AM PDT
Attachments: Briefing note risk management options mink farming (1).doc

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Hi,

As discussed this morning, attached is a briefing note with some risk management options based on the risk assessment.

Best,

Veronic

-----Original Appointment-----
From: Ethier, Tom AFF:EX <Tom.Ethier@gov.bc.ca>
Sent: Friday, July 02, 2021 12:32 PM
To: Ethier, Tom AFF:EX; Henry, Bonnie [EXT]; McGuire, Jennifer AFF:EX; Brodkin, Elizabeth Dr. [FH]; Newhouse, Emily [FH]; Clair, Veronic [BCCDC]; Singal, Mayank [BCCDC]
Subject: Discussion with Dr. Henry and DM Tom Ethier Re: Risk Assessment
When: Wednesday, July 07, 2021 8:15 AM-8:45 AM (UTC-08:00) Pacific Time (US & Canada).
Where: s.15; s.17 | Participant ID s.15; s.17

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BC COMMUNICABLE DISEASE CENTRE

OPTIONS FOR THE MANAGEMENT OF THE SARS-COV-2 RISK FROM MINK FARMING IN BC

DATE: June 30th 2021
PREPARED FOR: Dr Bonnie Henry
PREPARED BY: Veronic Clair in consultation with Emily Newhouse

PURPOSE: Provide risk management options based on the finding of the Joint Rapid Qualitative Risk Assessment (J-RQRA) and Hazard Profile

BACKGROUND:
Mink are very susceptible to SARS-CoV-2, with the potential for the virus to mutate in mink, as a host-specific adaptation as well as from expected ongoing viral evolution. Three mink farms in BC have been infected with SARS-CoV-2, with none generating concerning mutations. An Intersectoral OneHealth working group has successfully mitigated the risk in BC, to date, through collaboration on implementation of biosafety requirements, surveillance, inspection, and outbreak management. A comprehensive risk assessment and hazard profile have been completed by an expert group from BC, the Public Health Agency of Canada (PHAC) and the Canadian Food Inspection Agency (CFIA). It is important to consider the implication of the findings from those documents on the ongoing management of the risk, recognizing the uncertainties related to the risk. Further background information is available in the aforementioned documents.

KEY CONSIDERATIONS:
As per the J-RQRA, the combined assessment of probability and consequence of the emergence and circulation of a VOI in the community of mink/wildlife origin are as follows:

1. What is the likelihood and impact of emergence and circulation of a SARS-CoV-2 variant of interest (VOI) in the community due to virus evolution in mink or 'wildlife after exposure to mink' during completion of **THIS CYCLE**, compared to what is seen with currently circulating variants and evolving public health measures?

   Probability: very unlikely (VOI in wildlife pathway) to very unlikely/unlikely (VOI in mink pathway)
   Uncertainty: moderate (VOI in mink pathway) to high (VOI in wildlife pathway)

   Impact: minor to moderate at the local/regional level, and slightly less at the provincial level
   Uncertainty: moderate to high

2. What is the likelihood and impact of emergence and circulation of a SARS-CoV-2 variant of interest (VOI) in the community due to virus evolution in mink or 'wildlife after exposure to mink' **WITHIN THE NEXT 5 YEARS**, compared to what is seen with currently circulating variants and evolving public health measures?

   Probability: very unlikely (VOI in wildlife pathway) to unlikely (VOI in mink pathway)
   Uncertainty: moderate (VOI in mink pathway) to high (VOI in wildlife pathway)

   Impact: minor to moderate at the local/regional level, and slightly less at the provincial level
   Uncertainty: moderate to high

The probability estimates of the the emergence and circulation of a VOI in the community of mink/wildlife origin are very unlikely to unlikely, with minor to moderate impact, and moderate to high uncertainty. These estimates are based on the assumption of high level of compliance with stringeant safety and PPE requirement for this cycle and less so for the next five years, but with potentially other factors mitigating the risk over that longer time frame. Impacts have been assessed in the context of most recent knowledge of the

DRAFT

likely efficacy of vaccines and the relative contribution of a VOI from mink to human risk as compared to existing human sources of VOI. It is reassuring that to date, there are no known VOI of mink origin circulating, despite ongoing mink farming worldwide.

There are indications that compliance with current recommended use of medical mask on farm is decreasing. This is not surprising considering a general population sense that the risk from COVID is substantially decreased with immunization against the disease and the known difficulty in many industries with compliance with PPE requirements.

EQUITY ASSESSMENT AND JURISDICTIONAL SCAN:

The other Canadian provinces with mink farming have not uncovered mink outbreaks. However, surveillance and regulatory oversight appear substantially less than in BC. As far as we could ascertain, other provinces intend to allow their industry to continue operating under safety measures less onerous than in BC. However, mink farms in other provinces did not appear to be in a region with such close integration with a metropolitan area.

Several jurisdictions who banned fur farming had planned to do so before the COVID pandemic. The Netherland had such plans, which were accelerated by the pandemic when they experienced widespread SARS-CoV-2 mink outbreaks. As of the last jurisdictional scan from earlier this year, France and Poland are the only two countries, who reported mink outbreaks, who announced or are debating a ban on mink farming. The USA, Spain, Sweden, Greece, Lithuania, and Ireland have each experienced at least one mink outbreak without publically announcing or debating a ban on mink farming. Most have implemented enhanced surveillance, although there is little detail available.

RISK MANAGEMENT OPTIONS

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Option 3A: Allowing the industry to operate at its current size, with a moratorium on establishing new farms or expanding production in the existing farms, continuing with mortality and/or environmental sampling of the herd to detect outbreak early (enabling implementation of increased safety measures rapidly), and allowing a slight decrease in safety measures compared to current safety plans

s.13

RECOMMENDATION: OPTION 3A

s.13

FW: Mink and SARS-CoV-2 risk assessment and hazard profile

From: Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>
To: Parker, Esther HLTH:EX <Esther.Parker@gov.bc.ca>
Sent: July 13, 2021 10:00:21 AM PDT
Attachments: Joint_RQRA_MINK SARS-CoV-2 Final_ June 30th.docx, Hazard Profile J-RQRA_SARS-CoV-2 Final June 30.docx

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From: Clair, Veronic [BCCDC] <veronic.clair@bccdc.ca>
Sent: Wednesday, June 30, 2021 4:08 PM
To: Henry, Bonnie [EXT] <bonnie.henry@gov.bc.ca>
Cc: Gustafson, Reka [BCCDC] <reka.gustafson@phsa.ca>; Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>; Naus, Monika [BCCDC] <Monika.Naus@bccdc.ca>
Subject: Mink and SARS-CoV-2 risk assessment and hazard profile

Hi Bonnie,

Please see attached the final version of the Joint Rapid Qualitative Risk Assessment, and Hazard Profile produced in collaboration with the expert working group. I was hesitant to circulate these documents without giving you a chance to glance at them, especially the executive summary of the risk assessment.

Please let me know if you have any comments or if you would like me to circulate PDF versions of those documents to the MAFF deputy ministers (Jennifer and Tom).

s.13; s.17

Warm regards,

Veronic

Dr. Veronic Clair, MD, MSc, CCFP, FRCPC, PhD
Physician Epidemiologist
BC Centre for Disease Control
veronic.clair@bccdc.ca

I respectfully acknowledge that I live and work on the unceded territory of the xʷməθkwəy̓əm, Skwxwú7mesh, Stó:lō and Səl̓ilwətaʔ/Selilwitulh Nations.

JOINT RAPID QUALITATIVE RISK ASSESSMENT (J-RQRA):

Public Health Risk associated with SARS Coronavirus 2 (SARS-CoV-2) in Farmed Mink in British Columbia

Iteration #1: June 29, 2021

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[This assessment was conducted by a multi-jurisdictional expert group. The methodology is intended to be used in situations where policy decisions need to be made in the face of high uncertainty. Given the minimal data available on surveillance, research, epidemiology and risk behaviours specifically related to SARS-CoV-2 in animals, the assessment was primarily informed by the group's collective professional knowledge on such topics as infectious diseases, virology, epidemiology, industry practices, and human-animal interactions. Assumptions, and sources of variability and uncertainty are detailed in the document. The findings and conclusions represent the consensual, but not necessarily unanimous, opinions of the group participants, and do not represent the views of the participants' respective organizations.]

Participants and Affiliations

Lead: Veronic Clair, Physician Epidemiologist, British Columbia Centre for Disease Control

Project Coordinator: Daniela Michel, Operations Coordinator, British Columbia Centre for Disease Control

Expert group:

Organization	Participant Name	Participant Title
British Columbia Centre for Disease Control	Elaine Chan	Field Epidemiologist
	Erin Fraser	Public Health Veterinarian
	Inna Sekirov	Medical Microbiologist
Fraser Health Authority	Emily Newhouse	Medical Health Officer
BC Ministry of Agriculture, Food and Fisheries	Rayna Gunvaldsen	Chief Veterinarian
BC Ministry of Forests, Lands, Natural Resource Operations and Rural Development	Caeley Thacker	Wildlife Veterinarian
BC Ministry of Environment and Climate Change	Michael Schwalb	Senior Policy Specialist
Public Health Agency of Canada	Logan Flockhart	Epidemiologist
	Linda Vrbova	Senior Epidemiologist
Canadian Food Inspection Agency	Sharon Calvin	Specialist Risk Assessment Senior Veterinarian Science Specialist
	Indervesh Dahiya	Veterinary Program Officer
	Brad Pickering	Research Scientist

1. Executive Summary

Purpose

This iterative, joint rapid qualitative risk assessment (J-RQRA) assesses the risk of emergence of a variant of interest (VOI) from an infected mink herd, spreading in the general population and potentially becoming a variant of concern (VOC) for public health. This risk assessment hopes to provide decision-makers with relevant estimated risk probabilities and uncertainties, to inform risk management decisions. Experts recognize that risk management decisions must include other considerations such as risk tolerability and the feasibility of mitigation measures, among other factors.

Event summary

Between December 2020 and May 2021, SARS-CoV-2 was detected in mink on three mink farms in the Fraser Valley of British Columbia, Canada. Human-to-mink transmission is suspected as the source of virus introduction onto the farms. Whole genome sequencing (WGS) analysis and interpretation are ongoing. The affected farms were placed under quarantine. Two of the three farms are currently free from disease, but all farms remain under quarantine until the sites are considered fully decontaminated. Under the Public Health Act, a Class Order applying to all active mink farms in the Fraser Health Authority mandated a series of measures to enhance monitoring and control of SARS-CoV-2 on mink farms, including safety plans, enhanced personal protective equipment (PPE), and participation in testing programs, including weekly mink mortality viral testing. On April 15, 2021, public health issued an Order that permitted only vaccinated mink farmworkers to have duties that put them in close contact with mink.

Risk Framing

The scope of the assessment is limited to the mink farms in the Fraser Health Authority and British Columbia. The outcome of interest is the circulation of a mink-induced SARS-CoV-2 VOI in the community that could potentially increase transmission, cause more severe disease in humans, escape vaccines, or significantly decrease the effectiveness of therapeutic and diagnostic technologies, compared to what is seen with currently circulating variants. The pathways assessed are human-mink-human and human-mink-wildlife-human. Two timeframes are assessed: 1) short term: completion of the current production cycle, up to before the start of the next breeding season; and 2) long term: the next 5 years.

Methods

A multi-jurisdictional expert group jointly completed all steps of the J-RQRA process. The expert group developed a detailed hazard profile and agreed on scenario pathway diagrams used to create the risk questions. Then, using a modified Delphi approach, the expert group assessed probability, impact, and uncertainty estimates. Probabilities along the scenario pathways were combined as per accepted qualitative risk assessment methodologies.

Key assumptions

Several assumptions were made by the expert group that influence the final results. There is often a high degree of uncertainty related to the assumptions. They are important to highlight because changes to the assumptions may affect the final estimates, and significant changes may indicate the need for re-assessment in some circumstances. Assumptions are listed in detail here.

Probability level, impact and uncertainties

The combined assessment of probability and the assessment of consequence the emergence and circulation of a VOI in the community of mink/wildlife origin are as follows:

1. What is the likelihood and impact of emergence and circulation of a SARS-CoV-2 variant of interest (VOI) in the community due to virus evolution in mink or 'wildlife after exposure to mink' during completion of **THIS CYCLE**, compared to what is seen with currently circulating variants and evolving public health measures?

   Probability: very unlikely (VOI in wildlife pathway) to very unlikely/unlikely (VOI in mink pathway)
   Uncertainty: moderate (VOI in mink pathway) to high (VOI in wildlife pathway)

   Impact: minor to moderate at the local/regional level, and slightly less at the provincial level
   Uncertainty: moderate to high

2. What is the likelihood and impact of emergence and circulation of a SARS-CoV-2 variant of interest (VOI) in the community due to virus evolution in mink or 'wildlife after exposure to mink' **WITHIN THE NEXT 5 YEARS**, compared to what is seen with currently circulating variants and evolving public health measures?

   Probability: very unlikely (VOI in wildlife pathway) to unlikely (VOI in mink pathway)
   Uncertainty: moderate (VOI in mink pathway) to high (VOI in wildlife pathway)

   Impact: minor to moderate at the local/regional level, and slightly less at the provincial level
   Uncertainty: moderate to high

The combined probability estimates for both time frames of the human-mink-human pathway are driven primarily by the probability of the evolution of the virus into a VOI in a mink herd (A3 in the risk pathway). There was a higher level of uncertainty associated with the key probability (A3) in the five-year assessment due to the higher uncertainty in the expected number of mink herd outbreaks per year as time goes on and higher uncertainty regarding the evolution of a VOI. The risk assessment for the next five years assumed limited control measures (see assumptions section).

In the pathway involving wildlife for both the current cycle and in the next five years, most steps were estimated as less probable than for the direct pathway from mink to humans, with a similar level of uncertainties. The mode of the overall probability for the human-mink-wildlife-human pathway during both periods was very low, regardless of the spread scenario in wildlife (limited spread or reservoir). These estimates were driven primarily by

1): the probability of evolution of the virus into a VOI in wildlife (B5) that was assessed as very unlikely to occur; and 2) the probability that a person would contract the virus from wildlife was assessed at very unlikely (B6). Experts expressed it is more likely that a VOI will arise in humans rather than in mink.

If there was emergence and circulation of a VOI in the community that was of mink/wildlife origin, the magnitude of the impact on the health of the population above the current/ongoing pandemic impacts for this cycle are likely to be minor to moderate at the local/regional level, and slightly less at the provincial level. The uncertainty associated with this is moderate to high. The magnitude of the impact at the five-year timeframe is likely to be similar but with a higher level of uncertainty.

Discussion

This is the most comprehensive provincial risk assessment related to mink farming to date. It is based on a comprehensive hazard profile. Both have been undertaken in collaboration with national experts. The previous national rapid qualitative risk assessment was performed early in the pandemic. Therefore, this assessment and accompanying hazard profile are based on significantly more scientific knowledge and on-the-ground experience accumulated since the previous assessment. Still, because of the moderate to high uncertainty for both the probability and impact estimates, it is important to continue monitoring the situation in mink farms, the overall pandemic, and the scientific literature, reassessing the risk when needed.

Depending on the tolerability of the risk and associated uncertainties, the level of mitigation measures can be increased or lowered compared to what has been assumed to be in place in this risk assessment. Expected benefits from mitigation measures need to be balanced with their acceptability, feasibility and timeliness, recognizing that these measures can affect the industry's profitability or pose operational challenges to the many sectors involved.

2. Event Summary

The SARS-CoV-2 pandemic has been ongoing since early 2020 and has affected nearly every country in the world. Although SARS-CoV-2 likely originated from an animal source, the current pandemic is being sustained through human-to-human transmission (OIE Q&A). Spillover of the virus from humans to animals has been documented in companion animals (cats, dogs, and ferrets), zoo animals (large cats, gorillas, and otters), and farmed mink (OIE events in animals). Several other species have been shown to be susceptible under experimental conditions (Government of Canada).

Outbreaks of SARS-CoV-2 have occurred in mink farms in several countries, including: the Netherlands, Denmark, Spain, France, Italy, Sweden, Greece, Poland, Lithuania, Latvia, the USA, and Canada (OIE events in animals). Most of the affected mink farms around the world reported SARS-CoV-2 infection among workers and it is hypothesized that the mink herds were infected through human-mink transmission (FAO/OIE/WHO, 2021). Once in the mink, mink-to-mink transmission occurs readily, and mink-to-human and mink-to-cat transmission has also been documented in some places (Fenollar et al., 2021; van Aart et al., 2021).

Within Canada, infected mink herds have only been detected in British Columbia. Between December 2020 and May 2021, SARS-CoV-2 was detected in mink on three mink farms in the Fraser Valley of British Columbia, Canada. Similar to what has been seen globally, human-to-mink transmission is suspected as the source of virus introduction onto the farms. None of the farms experienced high mortality rates in mink: mink infection of the first farm was detected after finding the virus first in humans on the farm, mink infection on the second farm was detected after noticing a slight increase in clinical signs and mink mortality (3%), while no infections in human contacts have been confirmed, and mink infection on the last farm was detected through the mink mortality testing surveillance program in place.

The affected farms were placed under quarantine. The first farm was deemed free of disease as of February 24, 2021, after successive sampling revealed negative results. The second farm voluntarily opted to euthanize all mink on the premises. Successive testing of the third farm is in progress. All farms will remain under quarantine until the sites are considered fully decontaminated as per protocols of the Government of British Columbia.

Whole genome sequencing (WGS) analysis and interpretation are ongoing. To date, the WGS analysis found that the mink cases on all farms originated from strains of SARS-CoV-2 already circulating in the BC community. None of the emergent clades found on the farms are considered to be variants of concern, nor variants of interest. The SARS-CoV-2 genomes sampled from mink in BC do not exhibit unusual mutational profiles and do not show higher than expected levels of divergence.

Under the Public Health Act, a Class Order applying to all active mink farms in the Fraser Health Authority mandated a series of measures to enhance monitoring and control of SARS-CoV-2 on mink farms, including safety plans, enhanced personal protective equipment (PPE), and participation in testing programs, including weekly mink mortality viral testing. After an initial mandatory viral and serological testing of workers to detect current or past COVID-19 infection, there had been no mandatory human testing. However, mink farm workers are participating in voluntary COVID-19 testing, from once a week to three times a week depending on the situation.

Two cases of SARS-CoV-2-infected workers with direct mink contact have been detected that have not resulted in transmission of infection to the herd; ascertained by intensive live mink testing after detection of human cases. The live mink testing after identification of an infected worker who

had contact with minks was to increase the probability of detecting a SARS-CoV-2 infection in the herd as early as possible, because of the low number of weekly mortality available from those farms, during that part of the mink production cycle.

There was a s.22 nfected worker, for which the initial investigation failed to uncover contact with mink. As there was no information that s.2 had contact with mink s.22 infection did not trigger live animal testing. Subsequently, the herd was found infected, confirming an infection in a third farm. The herd was infected with the same rare strain that caused s.2 infection, confirming a link between his infection and the herd's infection.

At time of writing, BC is experiencing a substantial decrease in its third wave of human COVID-19 cases (refer to BCCDC website for COVID data). From March to May 2021, all mink workers and their household members were offered the Pfizer COVID-19 vaccine, some had already received the AstraZeneca before being offered the Pfizer, because of earlier eligibility from other criteria. On April 15, 2021, public health issued an Order that permitted only vaccinated mink farm workers to have duties that put them in close contact with mink; almost all mink farm workers chose to receive vaccine. All mink workers have now been offered a second dose of vaccine.

Further details can be found in the Hazard Profile on SARS-CoV-2 in Farmed Mink in British Columbia.

3. Risk Framing

As a result of the events related to SARS-CoV-2 infection in mink to date and the likely ongoing circulation of SARS-CoV-2 in the human population at some level for years to come, concerns were raised within the government of BC on the emergence a variant of interest (VOI[1]) from an infected mink herd, potentially leading to a variant of concern (VOC)[2] for public health.

There remains a lot of uncertainty related to SARS-CoV-2 at the human-animal-environment interface, the evidence is rapidly evolving, and it involves multiple disciplines. Therefore, this iterative, joint rapid qualitative risk assessment (J-RQRA) process was initiated. It is intended to inform recommendations on industry operation, based on decision-makers' degree of acceptance of the risk remaining after risk mitigation measures recommended by public health are implemented. As it would be very unlikely that a variant can be assessed as a VOC in the mink herd, because the characteristics of the virus impact on the herd is not likely to be the same as the impact in a human host, it was decided to assess the probability of a VOI arising. It is easier to identify a VOI from mutation(s) that have been associated with concerning features uncovered from WGS of mink samples.

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[1] As per the Public Health Agency of Canada VOI definition, "A SARS-CoV-2 variant is a VOI if it
has a genome with mutations associated with changes in epidemiology, antigenicity, or virulence, or changes that potentially have a negative impact on available diagnostics, vaccines, therapeutics, or public health measures;
and is known to cause community transmission/multiple COVID-19 cases/clusters in Canada or has been detected in multiple countries; or is otherwise assessed to be a VOI by WHO; or is otherwise assessed to be a VOI by the CSVSG."

[2] As per the Public Health Agency of Canada VOC definition, "A SARS-CoV-2 variant is a VOC if, through a comparative assessment, it has been demonstrated to be associated with one or more of the following: increased transmissibility or detrimental change in COVID-19 epidemiology; increased virulence or change in clinical disease presentation; decreased effectiveness of available diagnostics, vaccines, therapeutics, or public health measures; or is otherwise assessed to be a VOC by WHO; or is otherwise assessed to be a VOC by the CSVSG."

Confirming that the mutations reach the level of a VOC would not be possible until it circulates in humans. The probability of a VOI arising is higher than that of a VOC, providing a more conservative estimate of the more concerning situation of full evolution to a VOC.

The scope of the assessment is limited to the mink farms and communities in the Fraser Health Authority and British Columbia. The outcome of interest is the circulation of a mink-induced SARS-CoV-2 VOI in the community potentially increasing transmission, causing more severe disease in humans, escaping vaccines, or decreasing significantly the effectiveness of therapeutic and diagnostic technologies, compared to what is seen with currently circulating variants. Two timeframes will be assessed, including:

- Short term: completion of this cycle, up to before the start of the next breeding season (March-April 2022)
- Long term: the next 5 years[3]

The source of risk being assessed is a SARS-CoV-2 infection in a mink herd, or wildlife in the area surrounding a mink farm, generating genetic mutations with concerning features for public health[4]. However, since the source of infection in a mink herd is most likely to be an infected mink farm worker, the pathways assessed are **human-mink-human** and **human-mink-wildlife-human**.

Based on this risk framing, the assessment addresses the following specific risk questions:

1. What is the likelihood and impact of emergence and circulation of a SARS-CoV-2 variant of interest (VOI)[4] in the community due to virus evolution in mink or 'wildlife after exposure to mink' during completion of **this cycle**, compared to what is seen with currently circulating variants and evolving public health measures?

2. What is the likelihood and impact of emergence and circulation of a SARS-CoV-2 variant of interest (VOI) in the community due to virus evolution in mink or 'wildlife after exposure to mink' within the next **5 years**, compared to what is seen with currently circulating variants and evolving public health measures?

3. Method

A multi-jurisdictional expert group was formed to jointly complete all steps of the J-RQRA process. This assessment is not meant to provide specific scientific literature support for the probability or uncertainty estimates. The group shared background knowledge within a jointly-drafted hazard profile, and participated in the risk framing process and development of the assumptions for the assessment. A scenario pathway diagram was created based on the risk questions (see **Error! Reference source not found.**), and probabilities along these pathways were identified.

[3] Recognizing the uncertainty over this long timeframe, and that as time goes on a lot more will be known about the virus epidemiology, diseases, associated vaccines and therapeutics, and ability of the industry to sustain required risk mitigation measures.

[4] Potentially increasing transmission, causing more severe disease in humans, escaping vaccines, or decreasing significantly the effectiveness of therapeutic and diagnostic technologies.

Probability and impact estimates were assessed qualitatively using a modified Delphi approach with the expert group: experts were individually surveyed for their initial estimates, the results were discussed as a group, and experts were then given the opportunity to modify their responses to the survey as they saw fit. The level of uncertainty associated with each probability and impact estimate was also assessed, and comments were provided by experts to justify their rationale for the estimate and describe sources of variability and uncertainty (see Table 1, Table 2, and Table 3 for definitions of estimates).

Table 1 - Likelihood Definitions

Likelihood of event occurring	Descriptive Definition
Negligible	The situation described in the question is almost certain not to occur but could occur under exceptional circumstances. **The likelihood is virtually zero.**
Very low	The situation described in the question is **very unlikely to occur**.
Low	The situation described in the question is **unlikely to occur.**
Moderate	The situation described in the question **may occur**.
High	The situation described in the question is **likely to occur**.

Table 2 – Uncertainty categories[5]

Uncertainty category	Interpretation
Low	There are reliable data and information available; strong evidence is provided in multiple references, and authors report similar conclusions. Several experts have multiple experiences of the event, and there is a high level of agreement between experts.
Moderate	There are some gaps in availability or reliability of data or information; evidence is provided in a small number of references, and/or authors report conclusions that vary from one another. Experts have limited experience of the event and/or there is a moderate level of agreement between experts.
High	There are scarce or no reliable data or information available, and/or authors report conclusions that vary considerably between them. Very few experts have experience of the event and/or there is a very low level of agreement between experts. Results are based on educated guess or crude speculation.
Too high to allow assessment	The estimate is just as likely to be negligible as high, and estimates would not provide any useful information to risk managers at this stage. [If at least half of voters choose this option, then no estimates will be reported for that component of the pathway,

[5] Adapted from: Tripartite JRA Operational Tool; and Fournie G, Jones BA, Beauvais W, Lubroth J, Njeumi F, Cameron A & Pfeiffer DU, 2014. The risk of rinderpest re-introduction in post-eradication era. *Prev Vet Med* 113 (2): 175-184.

	though other components of the pathway may still be estimated to provide a maximum estimate for the overall pathway.]

Table 3. Description of the magnitude of the effects

Magnitude of the effect	Description of the effect
Indiscernible	Not usually distinguishable from normal day-to-day variation
Minor	Marginal, but insignificant and/or reversible
Moderate	Noticeable and important consequences on the health of the population and health system, but usually reversible
Significant	Serious and substantive consequences on the health of the population and health system, but usually reversible
Severe	Extremely serious and/or irreversible

Probabilities along the pathways were combined as per accepted methodologies in qualitative risk assessments. It is important to remember that probabilities represent values between zero and one; therefore, the lowest value was adopted for dependent events (i.e., for conditional probabilities along a pathway, where probabilities would be multiplied if they were quantitative) and the highest value for independent events (i.e., for probabilities of different pathways, where probabilities would be added) (Cox, 2008; Cudmore et al., 2012; Gale et al., 2010). However, qualitative assessments cannot be as precise as quantitative assessments, and it is important to remember that for dependent events, this method of combining probabilities may over-estimate the probability, and for independent events, this may under-estimate the probability if the events are not mutually exclusive (i.e., could occur concurrently). In this risk assessment, the events in the pathway are dependent, therefore the lowest probability is adopted to qualify the overall probability for each pathway. The probability modes for each step along the pathways are shown in

Figure 2. The combined probability estimates are described in the section “

Combining Probabilities".

The methodology for combining qualitative uncertainty rankings in risk assessments is not as clearly defined as for combining probabilities. Some authors report uncertainty for every step without combination (Jones et al., 2015; Peeler & Thrush, 2009), others adopt the highest uncertainty (Mandrak et al., 2012) while finally others adopt the highest uncertainty associated with the lowest likelihood for dependent events (Cudmore et al., 2012; Mimeault et al., 2017). In this assessment, the mode for uncertainty estimates was reported separately for each step in

Figure 2, and the sources of highest uncertainty are discussed in the conclusions. For the human-mink-human pathway, the overall uncertainty is considered to be the highest uncertainty associated with the lowest likelihood for dependent events. For the human-mink-wildlife-human pathway, the uncertainty is associated with the spread scenario and so the highest uncertainty of the two spread scenarios was chosen.

The conclusions provide the overall likelihood for each risk question using the descriptive definition. The primary rationale for each pathway is explained, along with a description of the level of uncertainty and the key sources of uncertainty and variability. The estimate of the magnitude of the impact on the health of the population above the current/ongoing pandemic impacts is then given for each risk question, along with the rationale and description of uncertainty and variability. The conclusion also outlines potential additional mitigation measures and considerations.

This assessment may be updated as more information becomes available, or as assumptions change.

4. Key Assumptions

A number of assumptions were made by the expert group that influence the final results. There is often a high degree of uncertainty related to the assumptions. They are important to highlight because changes to the assumptions may have an effect (positive or negative) on the final estimates, and significant changes may indicate the need for re-assessment in some circumstances.

Assumptions regarding context

- Over the 5 year time period, there will continue to be circulation of SARS-CoV-2 in humans in BC at some level
- There will be ongoing importation of variants from countries with various levels of immunity
- The international border will reopen within the short-term assessment timeframe
- Society will re-open likely in mid-July

Assumptions regarding pathogen characteristics, epidemiology, and scenario pathway

- Humans are assumed to be the original source of an outbreak on a mink farm
- The virus spread and recovery timeline on a mink farm will remain similar to what has been observed so far, which is a rapid spread throughout the herd resulting in most mink in the herd being infected
- Wild birds are not susceptible to infection
- For the purposes of this assessment, it is assumed that the emergence of a VOI will arise fully evolved in mink, not that a VOI later develops in humans from a mink strain
- Exposure of the general public would occur via infected farm workers (or possibly wildlife), but not directly from the mink

Assumptions regarding mitigating measures in place

Mink

- Mink vaccination:
    - This cycle – assume not available
    - 5 years – assumed to be available and in use in some countries, though efficacy in preventing infection or severe disease in mink is uncertain, cost and affordability in the context of mink farming is unknown and therefore use, benefits and risks in BC are uncertain
- Environmental testing: ongoing
- Mandatory clinical reporting of the herd symptoms and mortality: ongoing
- Mortality testing: ongoing
- Circumstances needing live animal testing: ongoing

Worker

- Worker immunization:
    - This cycle – assume fully vaccinated as of June 2021
    - 5 years – assume fully vaccinated
    - We assume that migrant workers will have to be fully immunized before being allowed to work with minks
- PPE and other work procedures (E.g. use of mask in common indoor areas while at work for any work, in break, or while working with mink regardless of area and distancing):
    - This cycle – as per current protocol
    - 5 years – worker to abstain from working if they present with COVID-19 symptoms, medical masks and eye protection when working on the farm, decrease in usage of

other PPE and protocols implemented for COVID-19, return to pre-COVID safety measures, no mandatory distancing between workers in common areas,

- Participation in testing (test type, frequency):
    - This cycle – same as now
    - 5 years – Public health initiated testing will occur in humans if another positive case is found in humans, mink or the environment; closing of self-referred testing centre (COVID-19 testing for clinical symptoms carried by clinicians; various option for self-test available; industry driven point of care testing of workers will be optional)

Operator

- This cycle – same as now
- 5 years – return to regular inspections, regular operations

Wildlife and domestic animal infection monitoring sustainability

- This cycle – continued sampling around a positive premise
- 5 years – likely not a long-term option using current process

Community

- 75% of general population immunized, ongoing assessment of efficacy with vaccination program able to adjust to address weaning effectiveness, if applicable
- Extensive community genomic surveillance for this cycle with further increase based on mink-related outbreak
- Genomic surveillance at community level decreased in 5 years but still occurring, and can be scaled up if needed in relation to outbreaks in mink farms

5. Scenario Pathway Diagram

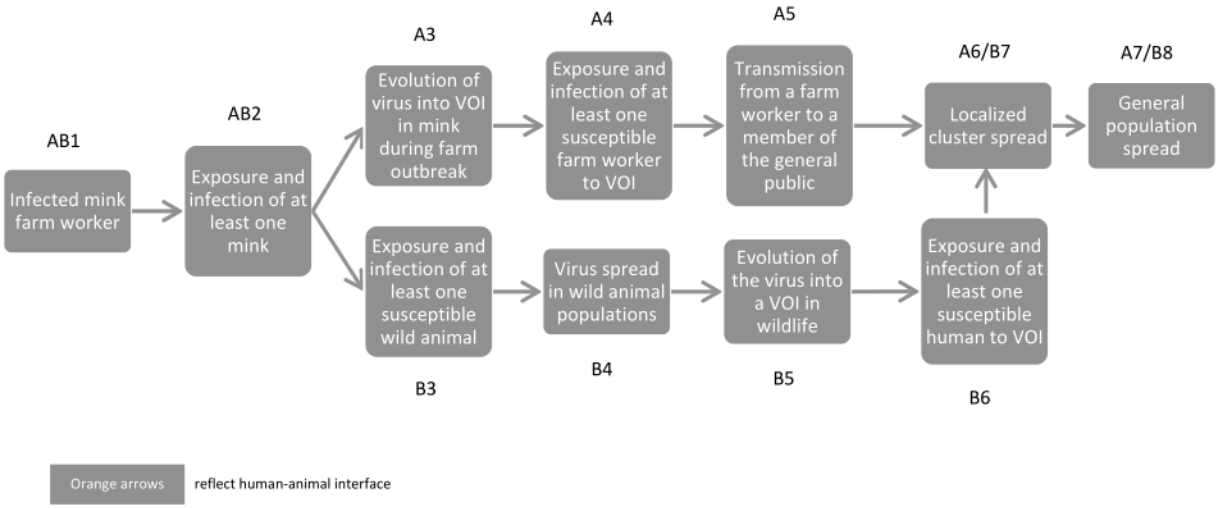


Figure 1: Scenario pathway diagram illustrating the potential emergence and circulation of a SARS-CoV-2 variant of interest (VOI) in the community due to virus evolution in mink (pathway A) or wildlife after exposure to mink (pathway B). Numbers represent the corresponding probabilities within the pathways, which are assessed in Table 4.

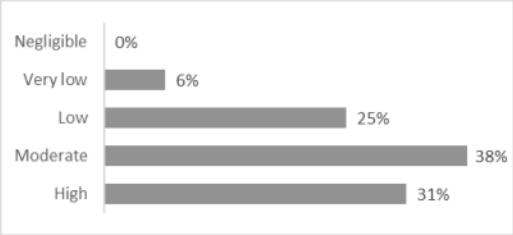
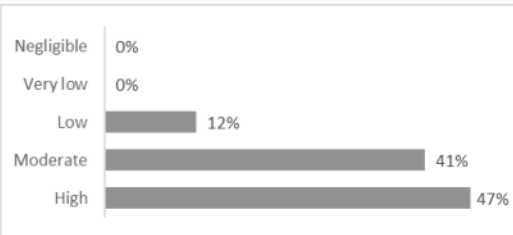
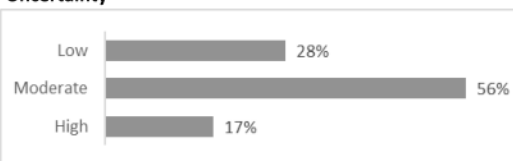
Probability Questions

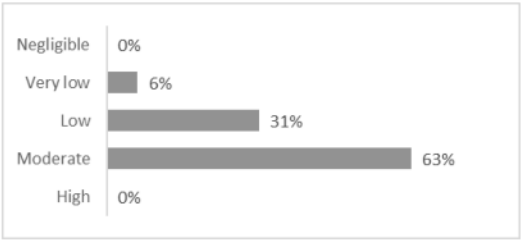
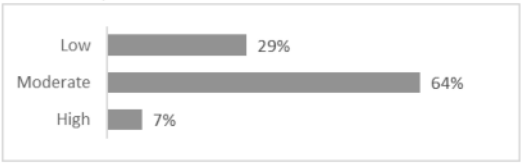
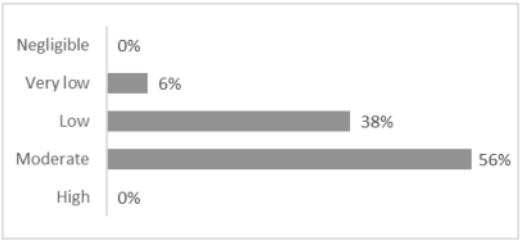
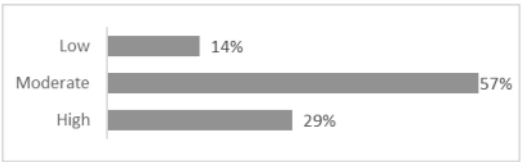
- AB1: What is the probability of at least one more infected mink farm worker during the timeframe?
- AB2: When an infected worker is present on a farm, what is the probability of infecting a mink herd, given the control measures assumed to be in place during the timeframe?
- A3: a. How many farms do you think will be infected (per year) during the timeframe?
  b. What is the probability that the virus evolves into a variant of interest (VOI) assuming 2 more farms become infected during this cycle/ 2 per year within the next 5 years, with the control measures assumed to be in place?
- A4: If a VOI has emerged in a mink herd, what is the probability of a farm worker contracting the VOI, given the control measures assumed to be in place during the timeframe?
- A5: If a farm worker has been infected by a mink-derived VOI, what is the probability of transmission from the farm worker to someone else given the control measures assumed to be in place during the timeframe?
- B3: If a mink farm has been affected, what is the probability of transmission from a mink to a wild animal, given the control measures assumed to be in place during the timeframe?
- B4: If a wild animal has been infected, what is the probability of the development of an ongoing virus reservoir in wild animals during the timeframe?
- B5: a. What is the probability that the virus from mink evolves into a VOI in wildlife during the timeframe, *assuming development of a reservoir in wildlife*?
  b. What is the probability that the virus from mink evolves into a VOI in wildlife during the timeframe, *assuming limited/transient spread in wildlife*?
- B6: a. If a VOI has evolved in wildlife, what is the probability of at least one person contracting the VOI from wildlife during the timeframe, *assuming development of a reservoir in wildlife*?
  b. If a VOI has evolved in wildlife, what is the probability of at least one person contracting the VOI from wildlife during the timeframe, *assuming limited/transient spread in wildlife*?
- A6/B7: If there has been at least one transmission of the VOI from one human to another, what is the probability of localized human spread of the VOI during the timeframe?
- A7/B8: If there has been localized human spread of the VOI, what is the probability of widespread transmission of the VOI in the general human population during the timeframe?

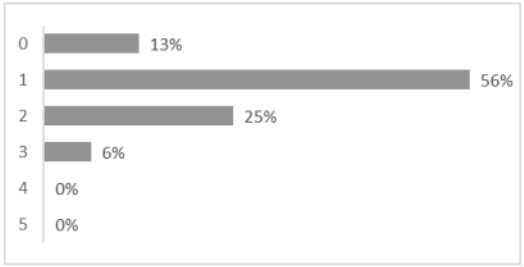
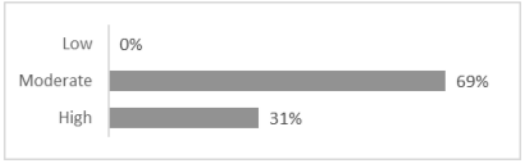
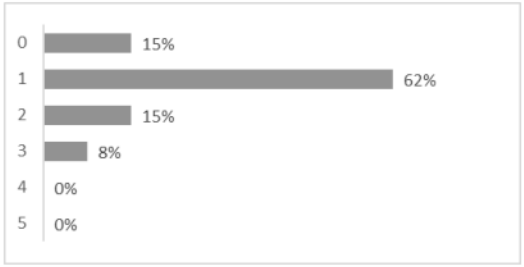
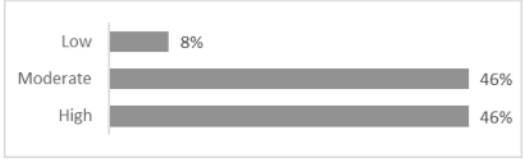
6. Assessment of Probability

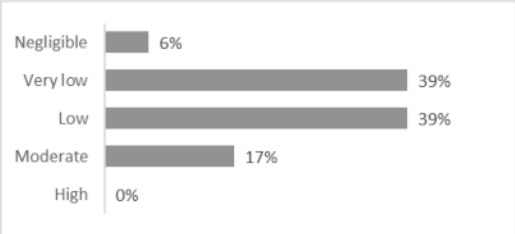
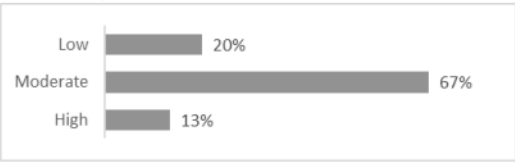
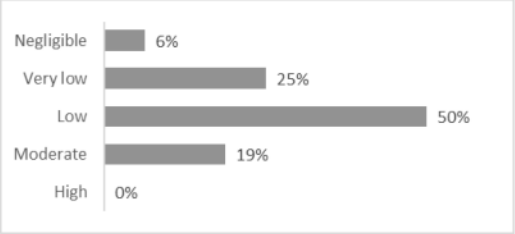
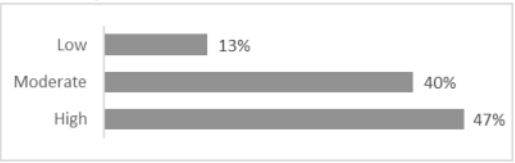
The probabilities from the scenario pathway diagram were assessed by the expert group for the two timeframes: this cycle, and 5 years. The results are presented in Table 4 (see the methods section for definitions of estimates). Variability is included within the range in the estimates. Uncertainty estimates and rationale are given for each probability estimate.

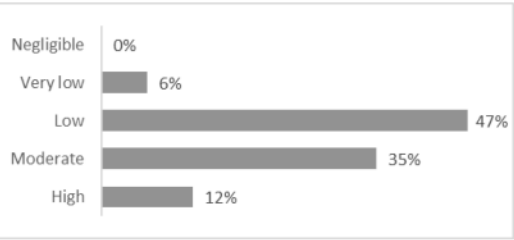
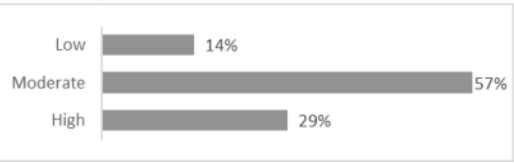
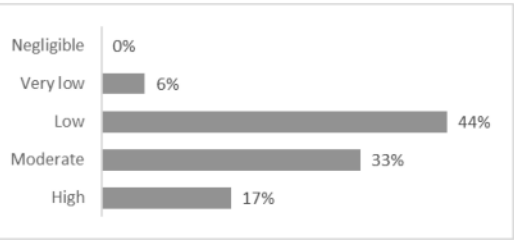
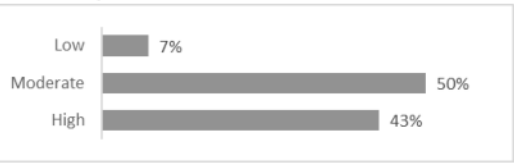
Table 4: Assessment of individual probabilities in scenario pathways

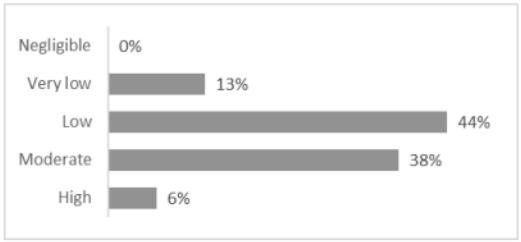
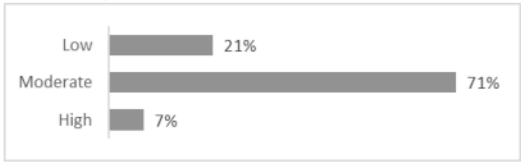
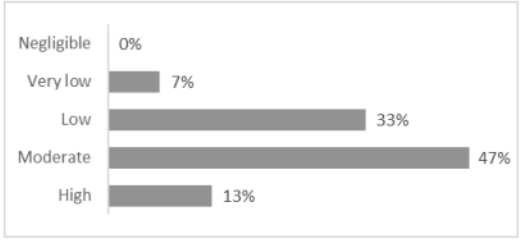
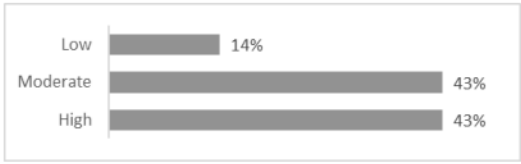
Time	Estimate	Rationale
AB1: What is the probability of at least one more infected mink farm worker during the timeframe?		
This cycle	 **Uncertainty** 	-**Probability:** At least one more infected mink farm worker **may occur** during the remainder of this cycle. -The current vaccines do not achieve sterilizing immunity; therefore, although disease will decrease, infection and shedding may still occur. -The rate of community transmission is decreasing rapidly, though this may change as businesses re-open and social contact increases. -There is a possibility of variants with immune escape properties infecting fully immunized workers. -The largest operations use migrant workers, but they will already have been received for some worker currently on-farm, and would be administered to other temporary foreign workers at the beginning of their quarantine by the provincial temporary foreign worker program as long as a quarantine is required and the program is able to support this. -The **uncertainty** around this probability was assessed as **low**. -Factors affecting variability and uncertainty include: extent of community transmission, efficacy of vaccines, vaccine coverage needed to see ongoing low circulation, characteristics of future variants regarding immune escape, behaviour of workers outside the workplace, sensitivity and compliance with infection monitoring and early detection of infection in workers, availability of replacement workers, and paid sick leave.
5 years	 **Uncertainty** 	-**Probability:** At least one more infected mink farm worker is **likely to occur** within the next 5 years. -Vaccine protection will likely continue to be less than 100% and it is assumed that COVID-19 will continue to circulate in the human population over the next 5 years, although it may be at a lower prevalence and it may not be as serious of a disease. -Vaccination combined with decreased surveillance may result in more circulation of mild and undetected cases in the future. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: same as current cycle, plus: extent of community transmission over this timeframe, and ongoing compliance of mink workers with vaccination requirements.

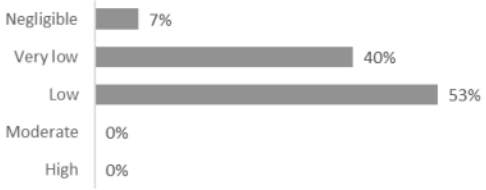
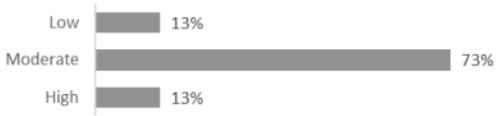
Time	Estimate	Rationale
AB2: When an infected worker is present on a farm, what is the probability of infecting a mink herd, given the control measures assumed to be in place during the timeframe?		
This cycle	 **Uncertainty** 	-**Probability:** If an infected worker is present on a farm during the remainder of this cycle, infection of the mink herd **may occur**. -There have been numerous examples around the world of workers transmitting infection to mink, despite some controls in place; however, there have also been examples in BC of infected workers that did not result in transmission to mink. -Vaccinated individuals may have a lower level of viral shedding. There is evidence of preserved 2-dose vaccine effectiveness above 85% for many variants, and of large decrease in onward transmission from someone infected with COVID-19 after full immunization with an mRNA vaccine. -During this cycle, farms will likely maintain a relatively high level of implementation of the stringent safety plan required of them, though compliance with biosecurity measures can be difficult to sustain and biosecurity breaches do occur. Compliance may decrease as time goes on if there is a perceived decrease in risk. -Human surveillance efforts are intended to identify workers that are infected, even if asymptomatic, and restrict them from working with the mink. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: compliance with and efficacy of PPE, biosecurity and human surveillance; extent of worker contact with mink; and degree of viral shedding in vaccinated individuals.
5 years	 **Uncertainty** 	-**Probability:** If an infected worker is present on a farm within the next 5 years, infection of the mink herd **may occur**. -The availability of a mink vaccine may be limited at first. The cost of the vaccine may be prohibitive to some producers unless compensated. -The mink vaccine will likely be effective at preventing disease and reducing shedding, but there is a lot of uncertainty regarding the level of efficacy at preventing infection. -The mink cycle results in new susceptible individuals every year, with mink typically being vaccinated in the summer. If kits are born in April-June, this may mean a couple months every cycle where mink are unvaccinated. Kits might have some protection by maternal antibodies of immunized mother, if mink vaccines are given to the herd ahead of whelping. -PPE and testing are challenging to maintain long term. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: same as current cycle, plus: potential variation in use of a mink vaccine, efficacy of vaccination in mink and length of immunity, and protection of mink vaccine against new variants arising in humans.

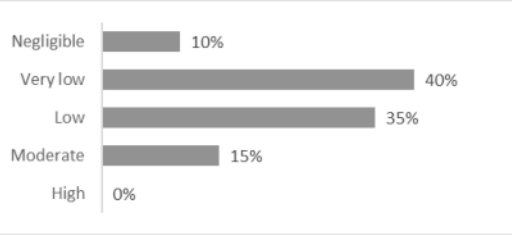
Time	Estimate	Rationale
A3a: How many farms do you think will be infected (per year) during the timeframe?		
This cycle	 **Uncertainty** 	-Although at least one infected worker may occur and may transmit infection to the herd, **the most likely scenario is that only one or a small number of mink herds would be infected during the remainder of this cycle.** This is based on the mitigating measures in place, decreasing community transmission, increasing vaccination, and the nature of the mink industry in BC (i.e., farms are relatively small and isolated). -Two farms were infected in the fall prior to the implementation of mitigating measures. Despite much higher community infection rates this spring than in the fall, only one farm has been infected. -Based on this result, the scenario estimate of two infected farms used for the rest of the questions is considered to be on the high end of what is expected. The following estimates may therefore slightly over-estimate the probability. -The **uncertainty** around this estimate was assessed as **moderate**. -The exact number depends on a lot of factors (as described for the previous probabilities) and so is difficult to predict. In addition to the previously-listed uncertainties, there is uncertainty on whether previously infected farms can be re-infected during same production cycle.
5 years	 **Uncertainty** 	-Those estimating “zero” indicated an expected yearly average between zero and one. -Mink vaccine may slowly start to compensate for other measures that will be reduced (e.g. PPE, testing, waning immunity since human vaccine), but it will be unlikely to fully mitigate risk. -Otherwise, this is much the same as during the current cycle, except the uncertainty increases as time goes on. -The **uncertainty** around this estimate was assessed as **moderate to high**.

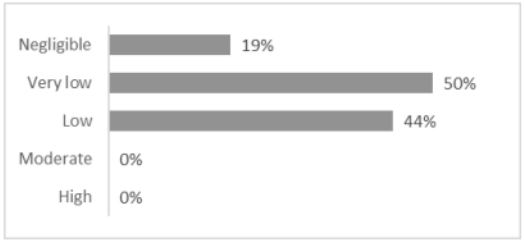
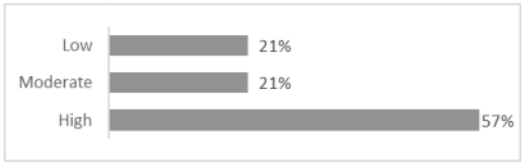
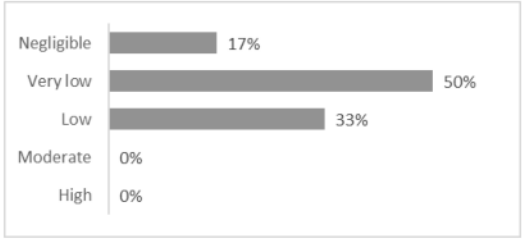
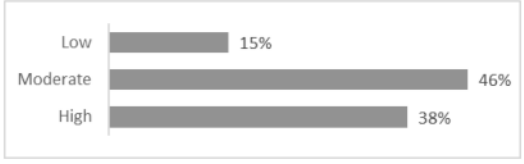
Time	Estimate	Rationale
A3b: What is the probability that the virus evolves into a variant of interest (VOI) given an expected number of farm outbreaks of 2 more during this cycle or 2/year within the next 5 years, with the control measures assumed to be in place?		
This cycle	 **Uncertainty** 	-**Probability:** Evolution of the virus into a VOI in a mink herd is **unlikely to very unlikely to occur** during the remainder of this cycle, with the small number of mink herds expected to be infected. -While there is a theoretical risk of a VOI emerging, the mutations detected and reported globally in mink to date have not led to the creation of a VOI. Cluster 5, which arose in the dense outbreak situation in Denmark, has not continued circulating in humans. Most mink-defining mutations are not of particular concern and have arisen in humans or circulated in humans without further generating VOI in humans either, despite the millions of infections in humans worldwide. -Infections in mink herds tend to clear relatively rapidly, in a matter of weeks, not several months. With current measures, infected herds should be detected and managed quickly. The result is a small number of accumulated mutations (less than 3). VOIs usually need large numbers of mutations to significantly affect transmission, severity or immune escape. It is unlikely/ very unlikely that enough mutations could occur within a single farm (without sequential infection from farm to farm), for the genetic changes to be sufficient to constitute a new VOI. -Even if several mutations were to accumulate, they usually tend to favour host specific adaptation which might not be advantageous in other hosts, such as humans. It is more likely that a VOI (from the perspective of humans) will arise in humans rather than in mink. -Very few VOIs and VOCs have arisen even in humans, despite the millions of human cases seen worldwide. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: compliance with control measures and testing, which mutations result in a VOI, and the future epidemiological patterns of infection in mink herds.
5 years	 **Uncertainty** 	-**Probability:** Evolution of the virus into a VOI in a mink herd is **unlikely to occur** within the next 5 years, with the small number of mink herds expected to be infected per year. -Similar rationale to the current cycle. -There is a slightly higher likelihood that as time goes on, restrictions relax and more mink or equipment are moved between farms causing larger outbreaks. However, mink vaccination will likely reduce shedding and spread within and between herds, even if it does not reduce infection. -The **uncertainty** around this probability was assessed as **high**. -Factors affecting variability and uncertainty include: same as current cycle, plus: potential variation in use of a mink vaccine, efficacy of vaccination in mink and length of immunity, and the effect of new variants arising in humans on mink infection. There is higher uncertainty on whether control measures and mink testing continue as time goes on.

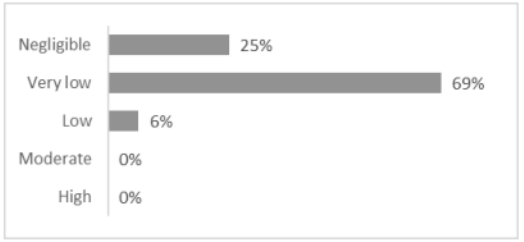
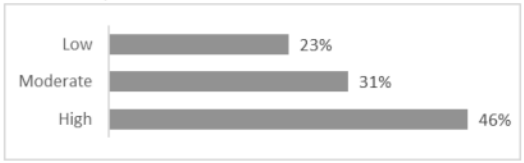
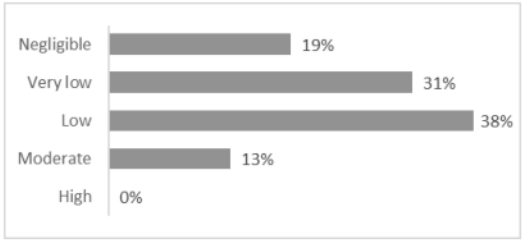
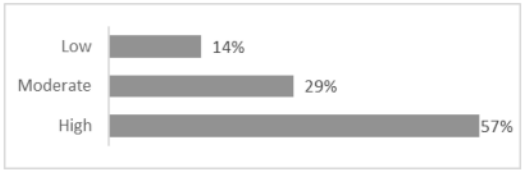
Time	Estimate	Rationale
A4: If a VOI has emerged in a mink herd, what is the probability of a farm worker contracting the VOI, given the control measures assumed to be in place during the timeframe?		
This cycle	 **Uncertainty** 	-**Probability:** If a VOI emerges in mink during this cycle, it is **unlikely** that a farm worker will contract the virus, but it may occur. Experts were divided, with two ratings selected almost as often, especially if the full distribution is taken into account. -Although transmission back to humans has been observed in Europe, it was in the context of very high number of mink farms and mink densities, no vaccine, lack of stringent safety plans, and lack of awareness and understanding by the industry of the consequences of the lack of prevention measures on their business. There have also been numerous outbreaks in mink herds that have not appeared to result in transmission back to humans. -It is likely that the stringent safety plans will be followed to the end of this cycle. Although there would be a need to ensure that these safety plan requirements remain for this industry while they might be lifted for other industries. -Vaccination will not provide 100% protection against infection, but it will reduce the likelihood. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: characteristics of the VOI that arises (e.g. transmissibility, vaccine protection), compliance with PPE, the season and extent of contact between workers and mink, human vaccine efficacy, and epidemiology of mink outbreaks to date.
5 years	 **Uncertainty** 	-**Probability:** If a VOI emerges in mink within the next 5 years, it is **unlikely** that a farm worker will contract the virus, **but it may occur**. Experts were divided, with two ratings selected almost as often, especially if the full distribution is taken into account. -PPE and testing will decrease over time, but vaccination of mink is likely to reduce viral shedding and onward transmission. Therefore, the probability remains similar between the two timeframes. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: same as current cycle, plus: potential variation in use of a mink vaccine, and efficacy of vaccination in mink.

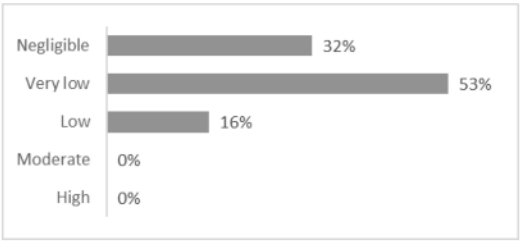
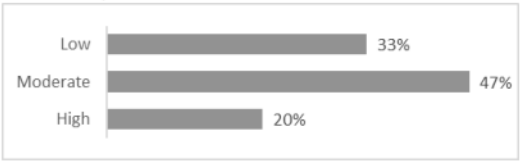
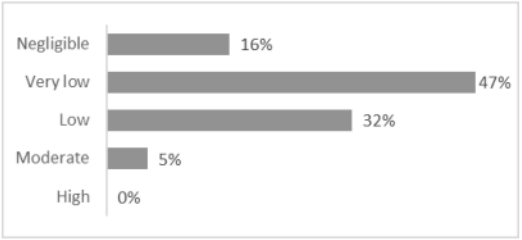
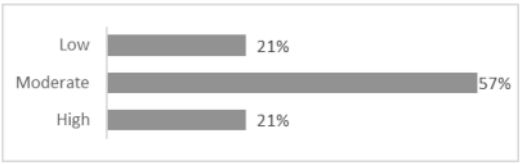
Time	Estimate	Rationale
A5: If a farm worker has been infected by a mink-derived VOI, what is the probability of transmission from the farm worker to someone else given the control measures assumed to be in place during the timeframe?		
This cycle	 **Uncertainty** 	-**Probability:** If a farm worker has been infected with a mink-derived VOI during this cycle, it is **unlikely** that they will transmit the virus to someone else. -It is less likely that there will be transmission outside the household, but **transmission within the household may occur**. Spread within a household is difficult to prevent and is more likely. -Vaccination of workers will likely decrease viral shedding and vaccination of family members may decrease susceptibility to infection. However, vaccination may also reduce symptomatic disease and hence detection prior to spread. -There has been little evidence of transmission between workers in outbreaks to date, since enhanced measures and vaccination. Transmission on farms so far has mostly been from outside work, or prior to enhanced measures. -With frequent testing of workers, early detection and isolation is likely to reduce spread and seems to have contributed to prevent outbreaks on farms as several workers were found infected with the surveillance system, without onward transmission. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: characteristics of the VOI that arises (e.g. transmissibility, vaccine protection), within household versus outside household contact, state of re-opening and restrictions in place, and human vaccine efficacy.
5 years	 **Uncertainty** 	-**Probability:** If a farm worker has been infected with a mink-derived VOI within the next 5 years, transmission of the virus to someone else **may occur**. -Decreased testing of workers means that infection may not be caught as early. - With the removal of COVID restrictions and increased social contact, there will be increased opportunities for transmission to occur in both public and home environments, which might be counteracted by the effect of vaccination. -However, low incidence rates in the community may result in high capacity for case ascertainment and rapid control measures to contain the cases. -The **uncertainty** around this probability was assessed as **moderate to high**. -Factors affecting variability and uncertainty include: same as current cycle, plus: availability of variant vaccine boosters, and uptake of vaccination by the general population over time.

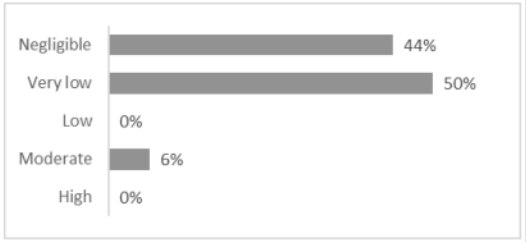
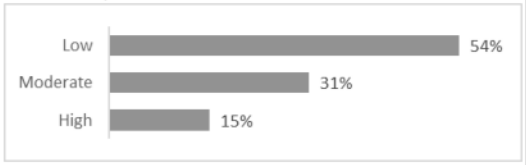
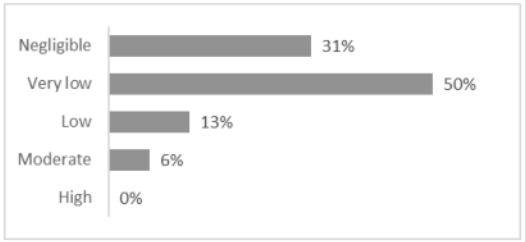
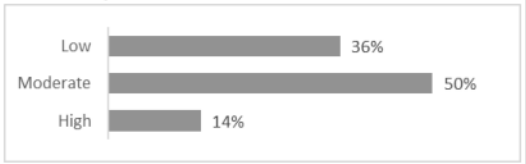
Time	Estimate	Rationale
B3: If a mink farm has been affected, what is the probability of transmission from a mink to a wild animal, given the control measures assumed to be in place during the timeframe?		
This cycle	 **Uncertainty** 	-**Probability:** If a mink farm has been affected during this cycle, it is **unlikely to very unlikely** that the virus will be transmitted from a mink to a wild animal. -Some wildlife species have been demonstrated to be susceptible to the virus under experimental conditions. Given the cases of natural infection in farmed mink, domestic cats and zoo felids, wild mustelids and felids are most likely to be susceptible. -There has been only one documented instance of transmission from farmed mink to a wild animal (not including escaped mink that remain associated with the farm), which was documented by the US. This wild mink was reported to have exposure to an improperly-managed compost pile. -Controls are in place on mink farms to prevent mink escape and entry of other animals and to manage carcass disposal (composting in some cases) and mink manure. -Fairly extensive perimeter testing of wildlife around one of BC's infected premises did not detect infection in wildlife, neither acute nor evidence of prior infection. -The nature of wildlife makes it unlikely, especially in BC, due to factors such as the species around farms and wildlife density. Animals that are most likely to come into contact with farmed mink are wild birds that access the sheds looking for food, barn cats/feral cats, coyotes, racoons, rodents and escaped/wild mink. Birds are assumed to be resistant to infection. There has been natural infection documented in cats and mink, while susceptibility has been demonstrated experimentally for some rodents. These animals may mechanically transmit contamination from manure, feed, etc., on their feet/paws, on feathers and fur; however, it is unlikely this would be of any significant viral load. They could carry contaminated feed products away from the site that are then consumed by wildlife. However, the feed that is supplied to mink is primarily in a mash which does not lend itself to being carried from the site to any significant degree. Direct contact of these animals with other wild animals is a possibility; however, escaped/wild mink are not likely to interact with other mink/wildlife to any degree being solitary in nature. Cats and rodents may be a more significant concern for interaction with other wildlife; however, rodents in the wild are short lived. Cats are unlikely to interact and socialize with wildlife unless they are preying on wildlife or the prey of wildlife. Neither interaction is likely to be sustained nor occurring within a close enough distance for transmission of an infectious dose. Animals would need to be infectious at the time of exposure in order to transmit the virus. The virus does not persist for a long duration in the environment in spring, summer and fall. It is more persistent in cool, damp, dark conditions under moderate relative humidity. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: the habitat surrounding the farm, time of year (dispersal of young or for mating), attractants on the farm, ability for mink to escape from the farm, mink disease dynamics, susceptibility of various wildlife species (especially Canadian bat species), and susceptibility of various species to variants.

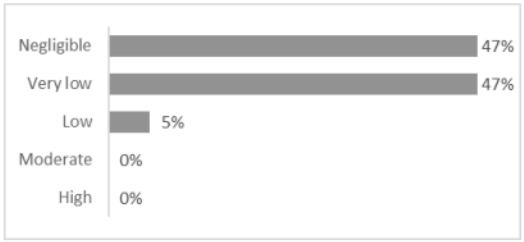
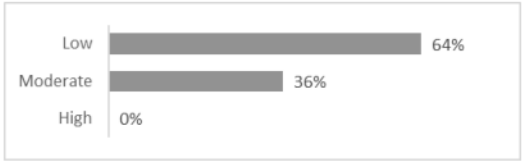
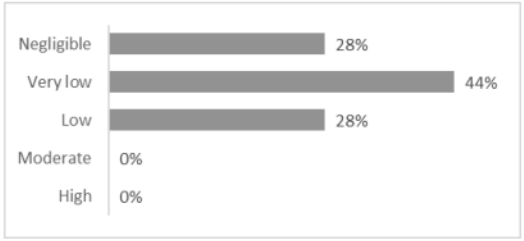
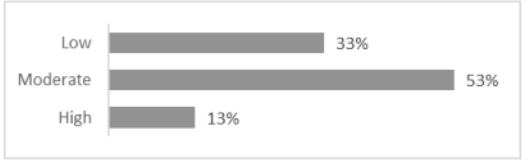
Time	Estimate	Rationale
5 years	 **Uncertainty** 	-**Probability:** If a mink farm has been affected within the next 5 years, it is **unlikely to very unlikely** that the virus will be transmitted from a mink to a wild animal. -The rationale is similar to other timeframe. -Mink vaccination over this time period would likely decrease viral shedding and reduce this probability. -Although the mode is lower than for the shorter timeframe, the range is higher. -The **uncertainty** around this probability was assessed as **moderate to high**. -Factors affecting variability and uncertainty include: same as current cycle, plus: potential variation in use of a mink vaccine, characteristics of the circulating virus, and efficacy of mink vaccine.

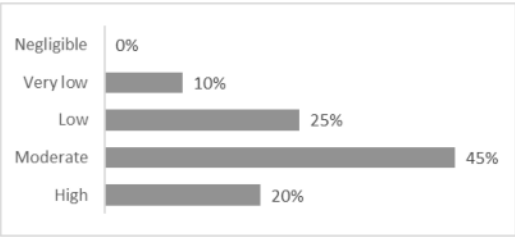
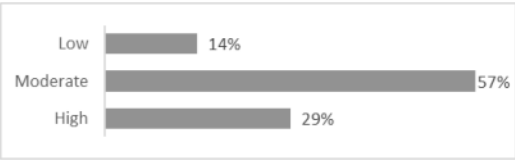
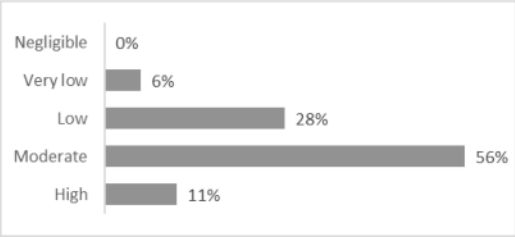
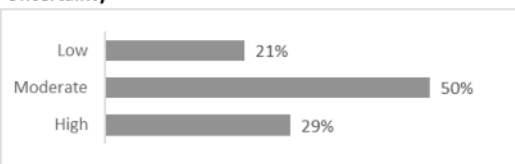
Time	Estimate	Rationale
B4: If a wild animal has been infected, what is the probability of the development of an ongoing virus reservoir in wild animals during the timeframe?		
This cycle	 **Uncertainty** 	-**Probability:** If a wild animal has been infected by mink, it is **very unlikely** that an ongoing virus reservoir would develop in wildlife during this cycle. -Reports of wildlife reservoirs have not been confirmed in current research. -The development of a reservoir would require a relatively large and stable population of wildlife in the vicinity of the premises to maintain an infection. The species of animals most likely to be infected are rodents and perhaps wild/escaped mink. There is only experimental evidence of susceptibility in rodents. Rodents have relatively short lifespans, the other are quite solitary in nature. -For an animal species to act as a reservoir, rather than a transiently-infected species, the virus has to be well adapted to spread efficiently in that species. This virus is well-adapted to humans, and it is unlikely that it would spread efficiently and continuously in a wild animal population in the absence of significant mutation. -Infections in animals have so far resulted in virus shedding for a relatively short period of time, and no long-term carrier state has been identified. -The virus seems to transmit best in enclosed/partially enclosed indoor spaces with high density of people/animals. -Big brown bats are not susceptible to infection under experimental conditions, but more information is needed on many BC bat species' susceptibility because they tend to live in colonies where transmission would be more likely. -This is a relatively short time frame to establish a reservoir. -The **uncertainty** around this probability was assessed as **high**. -Factors affecting variability and uncertainty include: wildlife species affected and their behaviours, and lack of knowledge about which species are susceptible and can shed the virus (especially as the virus changes).
5 years	 **Uncertainty** 	-**Probability:** If a wild animal has been infected by mink, it is **very unlikely** that an ongoing virus reservoir would develop in wildlife within the next 5 years. -The rationale is similar to other timeframe. -With a longer timeframe, there is more opportunity for reservoir development, but ongoing human adaptation of the virus over the next 5 years would make this less likely. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: same as current cycle.

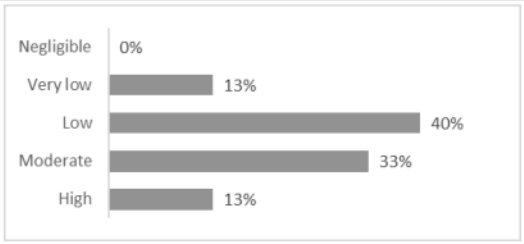
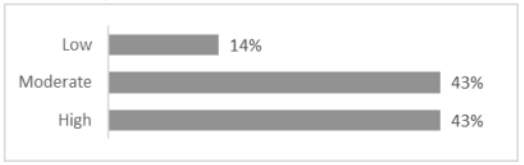
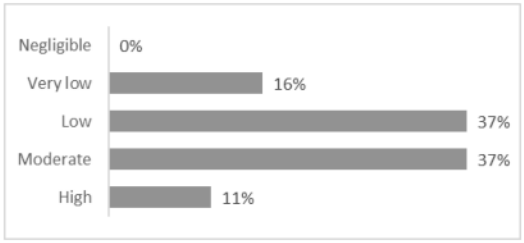
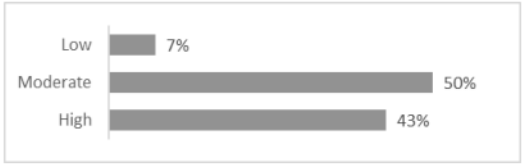
Time	Estimate	Rationale
B5a: What is the probability that the virus from mink evolves into a VOI in wildlife during the timeframe, *assuming development of a reservoir in wildlife*?		
This cycle	 **Uncertainty** 	-**Probability:** Even with the development of a wildlife reservoir, it is **very unlikely** that a virus transmitted from mink to wildlife would evolve into a VOI during this cycle. -There is no evidence of this occurring to date. -Low wildlife population density would not support rapid mutation. -The selection pressure in animals would be to create a variant that is more transmissible in animals or more virulent in animals, not necessarily in people. -The establishment of a wildlife reservoir and evolution of a VOI are unlikely to happen quickly. -The **uncertainty** around this probability was assessed as **high**. -Factors affecting variability and uncertainty include: characteristics of the wildlife reservoir (e.g., species affected), and transmission dynamics in various species.
5 years	 **Uncertainty** 	-**Probability:** Even with the development of a wildlife reservoir, it is **unlikely to very unlikely** that a virus transmitted from mink to wildlife would evolve into a VOI within the next 5 years. -The rationale is similar to other timeframe, but there is more time for cumulative mutations to be acquired. -The **uncertainty** around this probability was assessed as **high**. -Factors affecting variability and uncertainty include: same as current cycle.

Time	Estimate	Rationale
B6a: If a VOI has evolved in wildlife, what is the probability of at least one person contracting the VOI from wildlife during the timeframe, *assuming development of a reservoir in wildlife*?		
This cycle	 **Uncertainty** 	-**Probability:** If a VOI has evolved in wildlife, it is **very unlikely** that a person would contract the virus from wildlife during this cycle, even with the development of a wildlife reservoir. -There has been no documented transmission from wildlife back to humans (other than the suspicion of the SARS-CoV-2 virus origin in wildlife). -There are relatively low rates of contact with wildlife, particularly the kinds of wildlife that would appear to be most susceptible (i.e. Mustelids such as otters, martens, and wolverines). If transmission mechanisms are similar to current circulating strains, it would be highly unlikely that a person would be within 6 feet of an infected wild animal with the exception of special high risk populations including wildlife biologists/vets, wildlife rehabilitation specialists, hunters/trappers where specific handling and biosecurity precautions would most likely be used if a known reservoir exists -The most likely types of contact would be unlikely to result in significant viral load transfer. -Community vaccination will reduce likelihood of infection. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: characteristics of the wildlife reservoir (e.g., species affected), characteristics of the VOI, type of human-animal interaction, human vaccine efficacy, and extent of shedding by susceptible wildlife species.
5 years	 **Uncertainty** 	-**Probability:** If a VOI has evolved in wildlife, it is **very unlikely** that a person would contract the virus from wildlife within the next 5 years, even with the development of a wildlife reservoir. -The rationale is similar to other timeframe, but there is more time for contact to occur. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: same as current cycle.

Time	Estimate	Rationale
B5b: What is the probability that the virus from mink evolves into a VOI in wildlife during the timeframe, *assuming limited/transient spread in wildlife*?		
This cycle	 **Uncertainty** 	-**Probability:** If there is limited/transient spread in wildlife, evolution of the virus into a VOI during this cycle is **very unlikely to almost certain not to occur**. -Much of the rationale for B5a is also applicable, but the emergence of a variant is dependent on ongoing transmission, so limited/transient spread in wildlife should result in even lower probability of a VOI than ongoing transmission in wildlife. -The **uncertainty** around this probability was assessed as **low**. -Factors affecting variability and uncertainty include: species affected, and transmission dynamics in various species.
5 years	 **Uncertainty** 	-**Probability:** If there is limited/transient spread in wildlife, evolution of the virus into a VOI within the next 5 years is **very unlikely to occur**. -The rationale is similar to other timeframe, but there is more time for cumulative mutations to be acquired. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: same as current cycle.

Time	Estimate	Rationale
B6b: If a VOI has evolved in wildlife, what is the probability of at least one person contracting the VOI from wildlife during the timeframe, *assuming limited/transient spread in wildlife*?		
This cycle	 **Uncertainty** 	-**Probability:** If there has been limited/transient spread in wildlife and a VOI has evolved, a person contracting the VOI from wildlife during this cycle is **very unlikely to almost certain not to occur**. -Much of the rationale for B6a is also applicable, but there will be an even lower likelihood of human contact with fewer animals infected. -The **uncertainty** around this probability was assessed as **low**. -Factors affecting variability and uncertainty include: species affected, characteristics of the VOI, type of human-animal interaction, human vaccine efficacy, and extent of shedding by susceptible wildlife species.
5 years	 **Uncertainty** 	-**Probability:** If there has been limited/transient spread in wildlife and a VOI has evolved, a person contracting the VOI from wildlife within the next 5 years is **very unlikely to occur**. -The rationale is similar to other timeframe, but there is more time for contact to occur. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: same as current cycle.

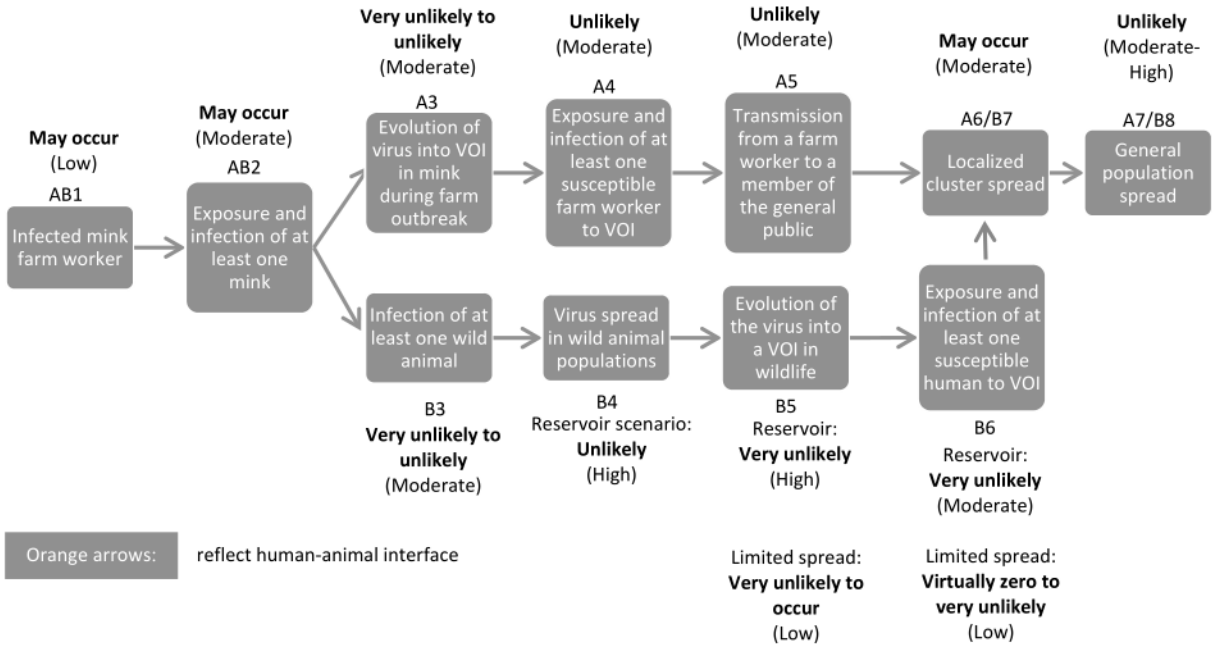
Time	Estimate	Rationale
A6/B7: If there has been at least one transmission of the VOI from one human to another, what is the probability of localized human spread of the VOI during the timeframe?		
This cycle	 **Uncertainty** 	-**Probability:** If there has been at least one transmission of the VOI from one human to another, localized human spread **may occur** during the remainder of this cycle. -Generally, SARS-CoV-2 is highly transmissible among humans. -Other than the first few highly publicized spread events internationally, there has been no report of widespread transmission of mink-related mutations in humans. Not all VOI will be more transmissible in the face of such a highly immunized population as we have in BC for the one dose and nearly complete uptake of the second dose. -It is possible that there will be a decrease in implementation of the measures due to perception of safety from the reopening plan and immunization. Communication with the industry and maintaining the Public Health Order on the farms until the end of this cycle will decrease the likelihood of that happening. However, human behaviour is such that there will be those that defy public health guidance/orders and either spread an infection they have or come into contact with someone that is infected. -Reduced community transmission will help allow the resources for timely and comprehensive contact tracing and response to limit spread. Also all SARS-CoV-2 genomes are being sequenced in BC so rapid identification of variants will be possible. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: characteristics of the VOI that arises (e.g. transmissibility, vaccine protection), compliance with control measures, vaccine coverage in the community, state of re-opening and restrictions in place, degree of contact between individuals (such as living conditions), and human vaccine efficacy.
5 years	 **Uncertainty** 	-**Probability:** If there has been at least one transmission of the VOI from one human to another, localized human spread **may occur** within the next 5 years. -The rationale is similar to other timeframe, but there is more time for spread to occur. -Unlikely to get good compliance with isolation and other measures in this long timeframe. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: same as current cycle, plus: availability of variant vaccine boosters, and uptake of vaccination by the general population over time.

Time	Estimate	Rationale
A7/B8: If there has been localized human spread of the VOI, what is the probability of widespread transmission of the VOI in the general human population during the timeframe?		
This cycle	 **Uncertainty** 	-**Probability:** If there has been localized human spread of the VOI, widespread transmission is **unlikely to occur** during the remainder of this cycle. -There has been very limited community spread of variants identified to date that developed in mink. -Experience to date suggests that not all VOI will spread widely, even if they cluster. -Current measures in BC have been effective in rapid identification and control of the spread of infection from mink workers; however, it is almost impossible to fully trace once there is localized transmission in the Lower Mainland. -Low and declining incidence rates in the province and FHA will allow the resources for rapid contact tracing and containment. -Lower likelihood than localized spread. -The **uncertainty** around this probability was assessed as **moderate to high**. -Factors affecting variability and uncertainty include: characteristics of the VOI that arises (e.g. transmissibility, vaccine protection), compliance with control measures, vaccine coverage in the community, state of re-opening and restrictions in place, degree of contact between individuals (such as living conditions), and human vaccine efficacy.
5 years	 **Uncertainty** 	-**Probability:** If there has been localized human spread of the VOI, widespread transmission is **unlikely but may occur** within the next 5 years. -The rationale is similar to other timeframe, but there is more time for spread to occur. -The **uncertainty** around this probability was assessed as **moderate**. -Factors affecting variability and uncertainty include: same as current cycle, plus: availability of variant vaccine boosters, and uptake of vaccination by the general population over time.

7. Combining Probabilities

Illustration of the probabilities along the pathways

a) This cycle: **probability modes** (uncertainty modes)



b) 5 years: **probability modes** (uncertainty modes)

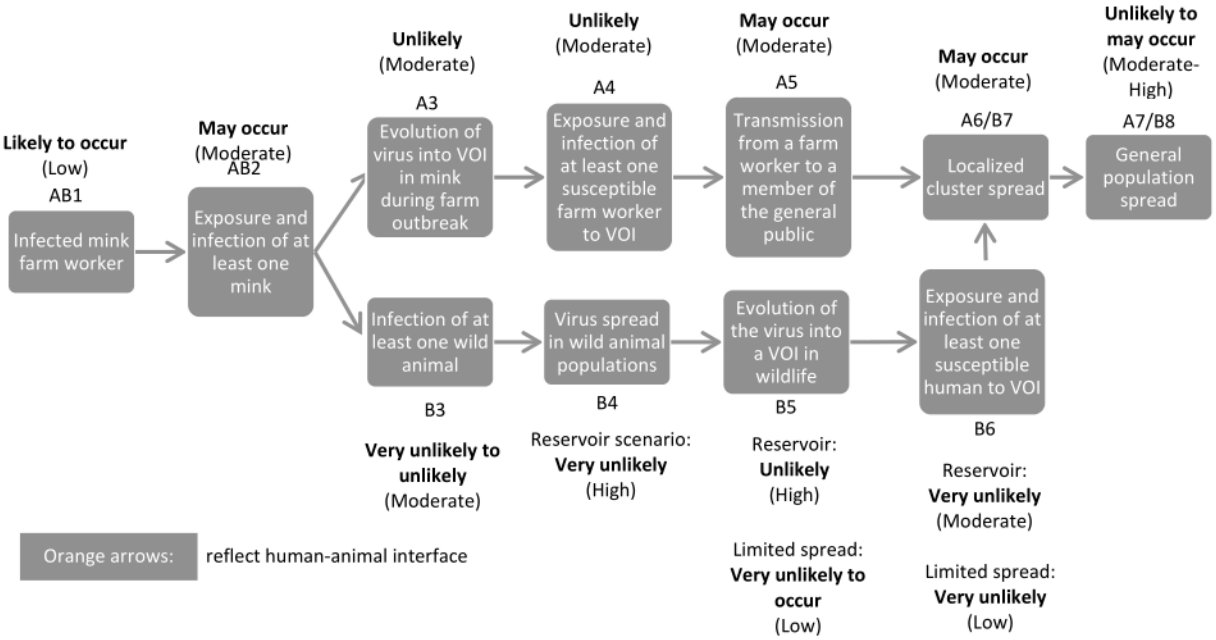


Figure 2: The modes of the probability estimates from the expert survey are shown for each step of the scenario pathway diagram, during this cycle (a) and within the next 5 years (b). Two wildlife spread scenarios were included: development of a reservoir versus limited/transient spread.

Human-mink-human pathway

This cycle

The risk assessment for this cycle assumes the current control measures remain in place for the rest of this cycle. Under this assumption and others, as detailed previously, experts think it is likely that another mink farm worker will becomes infected during this cycle. Then, if a mink worker is infected, it may lead to infecting the herd. Most experts consulted (69%) think there would be none to only one further mink farm infected. Therefore, the assumption of two more mink farms becoming infected, used for the following steps of the pathway, is a higher/worst-case estimate than what most experts think will occur. Even assuming two more mink herds become infected during this cycle, the vast majority of expert's report it will be unlikely to very unlikely for the virus to evolve into a VOI in mink during this cycle (78% or 39% for each of those probability estimates).

Assuming the virus evolves into a VOI in mink, experts mostly think it is unlikely the virus will be transmitted back to a worker. In the next step of the pathway, assuming the VOI was transmitted to a worker, 44% of experts consider it unlikely that it would lead to onward transmission to other people, while 38% think it may occur. If transmission to other people occurs, it would be more likely to occur within the household. If household spreads occurs, further spread in the community would depend on the effectiveness of quarantining those contacts, contact tracing efforts, and household members, as well as community members level of protection from vaccine or prior infection.

Using the rules of combining dependent (i.e., conditional) probabilities outlined in the Method section, the overall probability of the human-mink-human pathway (pathway A) is no higher than the lowest value of the conditional probabilities. The mode of the overall probability for the human-mink-human pathway during this cycle is therefore very low to low (see

Figure 2a). **During this cycle, this risk assessment estimates that it is unlikely to very unlikely that a mink VOI would arise and trigger onward transmission of that VOI outside of mink workers.** This is driven primarily by probability A3: evolution of the virus into a VOI in a mink herd, estimated at unlikely to very unlikely to occur during the remainder of this cycle. A key factor in that assessment is the

expectation that only a small number of mink herds would be infected until the end of this cycle. The probability of the whole pathway occurring is likely lower, because all the other steps would need to occur in addition to the unlikely to very unlikely event of A3. The probability of the whole pathway to occur would mean that in addition to step A3, three other moderate probability steps and three other low probability steps would have to occur as well.

There is generally a moderate level of uncertainty associated with this estimate, though there is slightly higher uncertainty specifically associated with the probability that the VOI, should it occur, would result in widespread transmission. Sources of variation and uncertainty for probability A3 include: the expected levels of compliance with control measures and testing during the remainder of this cycle, the characteristics of the mutations that will result in a VOI, the future epidemiological patterns of infection in mink herds, and whether previously infected farms can be re-infected during the same production cycle. Other sources of variability and uncertainty along the pathway include: extent of community transmission, behaviour of workers outside the workplace, availability of replacement workers and paid sick leave, extent of worker contact with mink throughout the season, characteristics of the VOI that arises (e.g. transmissibility, vaccine protection), within household versus outside household contact, state of re-opening and restrictions in place, vaccine coverage in the community, degree of contact between individuals (such as living conditions), efficacy of human vaccines, vaccine coverage needed to see ongoing low circulation in the population, degree of viral shedding in vaccinated individuals, the epidemiological details of past mink outbreaks, and the efficacy of PPE, biosecurity, and human surveillance.

5 years

The risk assessment for the next 5 years assumes limited control measures. The main remaining measures would be modified safety plans including wearing a medical mask and eye protection when working on the farm, abstaining from working with COVID-19 compatible symptoms, ongoing mink mortality and environmental testing, and allowing only fully immunized workers to work on the farms. We assume workers will have to obtain further immunization as needed to promote ongoing effectiveness. Respirators would no longer be mandated in mink areas, there would be a decrease in PPE requirement, and no mandatory social distancing between workers. The BC CDC will not continue supporting the viral testing of workers. There was no assumption made on the industry starting their own testing program or not. There was no assumption made about using or not using a mink vaccine, its effectiveness or affordability. Experts were asked to use their judgment in how they expect it will be used and with what effect.

Under these assumptions and others, as detailed previously, experts think it is likely that at least one mink farm worker will become infected per year. Then, if a mink worker is infected, it may lead to infecting the herd. Most experts consulted (72%) think there would be an average of none to only one further mink farm infected per year. Therefore, the assumption of two more mink farms becoming infected per year, used for the following steps of the pathway, is a more pessimistic estimate than what most experts think will occur. Even assuming two more mink herds become infected per year, only 19% think that a VOI might develop in one of those herds, with 75% thinking it would be unlikely (50%) to very unlikely (25%) for that to occur.

Assuming the virus evolves into a VOI, experts were divided as to the probability of the virus to infect at least one worker (50% thinking it may occur or is likely to occur, and 50% thinking it would be unlikely to

very unlikely to occur). For this to lead to a localized spread of the VOI, the probabilities estimate most selected was “may occur” at 56%. And if that occurred, experts were divided about the probability that it would lead to widespread transmission in the community with the same proportion thinking it is unlikely to occur and may occur (37% each).

The mode of the overall probability for the human-mink-human pathway (pathway A) within the next 5 years is low (see

Figure 2b). **This risk assessment estimates that it is unlikely that a mink VOI would arise and trigger onward transmission of that VOI outside of mink workers within the next 5 years.** This is driven primarily by probability A3: evolution of the virus into a VOI in a mink herd is unlikely to occur within the next 5 years, with the small number of mink herds expected to be infected per year. However, there is a high level of uncertainty associated with this key probability, due to the higher uncertainty in the expected number of mink herd outbreaks per year as time goes on and higher uncertainty regarding evolution of a VOI.

Sources of variation and uncertainty in probability A3 are similar to the current cycle, in addition to variation in use of a mink vaccine, efficacy of vaccination in mink, length of immunity in mink, and the effect of new variants arising in humans on mink infection. Additional sources of variability and uncertainty for the pathway during this timeframe include: more variability in extent of community transmission and ongoing compliance, uptake of vaccination by the general population over time, and availability of variant vaccine boosters.

Human-mink-wildlife-human pathway

This cycle

In the pathway involving wildlife for this cycle, most steps were estimated as less probable than for the direct pathway from mink to humans, with similar level of uncertainties. The mode of the overall

probability for the human-mink-wildlife-human pathway during this cycle is very low, regardless of the spread scenario in wildlife (limited spread or reservoir; see

Figure 2a). **Regardless of the wildlife spread scenario (limited spread or reservoir), for this cycle, this risk assessment estimates that it is very unlikely that a VOI would arise in wildlife and trigger onward transmission of that VOI outside of mink workers.** This is driven primarily by probability B5: evolution of the virus into a VOI in wildlife during this cycle is very unlikely to occur. However, it is also very unlikely that a person would contract the virus from wildlife (B6). The uncertainty associated with the development of a virus reservoir in wildlife (assuming at least one animal is infected) is high; however, if there is only limited or transient spread in wildlife, then there is low uncertainty regarding the probability of virus evolution and exposure of humans.

Sources of variation and uncertainty in probability B5 and B6 include: the wildlife species affected, characteristics of the VOI that develops, type of human-wildlife interaction, transmission dynamics in various species, extent of shedding by susceptible wildlife species, and human vaccine efficacy. Since this pathway also involves mink and community spread, other sources of variability and uncertainty are similar to the other pathway, with the addition of: the habitat surrounding the farm, time of year (dispersal of young or for mating), attractants on the farm, ability for mink to escape from the farm, mink disease dynamics, susceptibility of various wildlife species (especially Canadian bat species), and susceptibility of various species to variants.

5 years

In the pathway involving wildlife in the next 5 years, most steps were estimated as less probable than for the direct pathway from mink to humans, with similar level of uncertainties. The mode of the overall probability for the human-mink-wildlife-human pathway did not change for the longer timeframe. The probability is very low, regardless of the spread scenario in wildlife (limited spread or reservoir; see

Figure 2b). **Within the next 5 years, regardless of the wildlife spread scenario (limited spread or reservoir), this risk assessment estimates that it is very unlikely that a VOI would arise in wildlife and trigger onward transmission of that VOI outside of mink workers.** There is a slightly higher probability of evolution of the virus in wildlife during this timeframe in the reservoir scenario (B5a), but this is still considered unlikely and the development of a reservoir in the first place is very unlikely even in this timeframe (B4). It is also still considered very unlikely that a person would contract the virus from wildlife (B6). There is a slightly higher level of uncertainty associated with this pathway, though this is not necessarily reflected in all of the modes.

Sources of variability and uncertainty are generally the same as with the current cycle; however, potential variation in use of a mink vaccine, efficacy of such a vaccine, and characteristics of the circulating virus may affect the probability of transmission from mink to wildlife. Other sources of variability and uncertainty overlap with the other pathway.

Combined pathways

This cycle

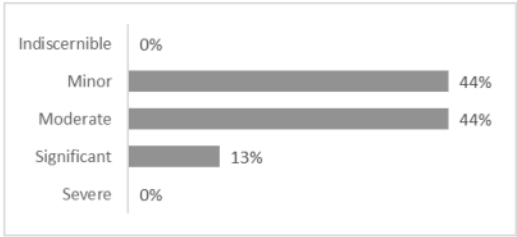
Using the rules of combining independent probabilities outlined in the Method section, the overall probability of either of the above pathways (human- mink-human or human-mink-wildlife-human) occurring during this cycle, the highest one is used. In this case, the total probability is estimated as low to very low based on the human-mink-human pathway. Although these pathways are not mutually exclusive, the very low probability of the wildlife pathway is unlikely to significantly affect this conclusion.

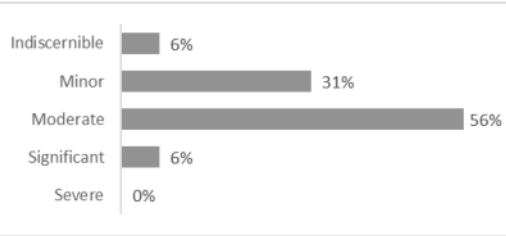
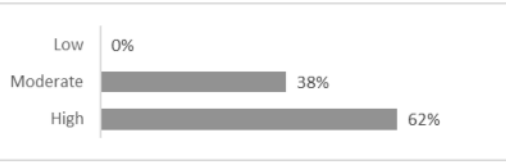
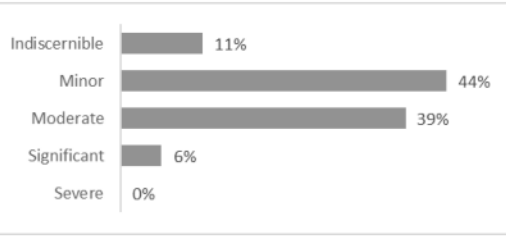
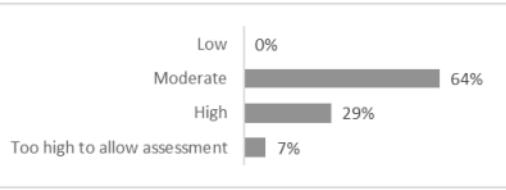
5 years

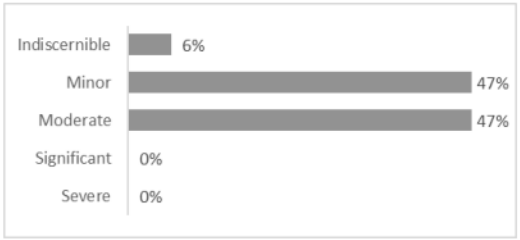
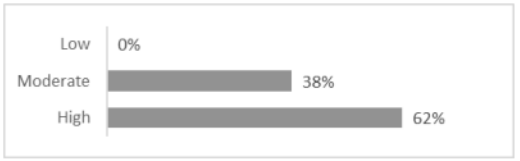
Although the overall probability for the human-mink-wildlife-human pathway did not change for the longer timeframe, the overall probability for the human-mink-human pathway increased to “low”. Therefore, the combined probability of either of the pathways occurring is low based on the human-mink-human pathway.

8. Assessment of Consequence

If there was emergence and circulation of a VOI in the community that was of mink/wildlife origin, the magnitude of the impact on the health of the population above the current/ongoing pandemic impacts for this cycle are likely to **be minor (marginal) to moderate (noticeable and important, but usually reversible) at the local/regional level, and slightly less at the provincial level.** The uncertainty associated with this is moderate to high. The magnitude of the impact at the 5 year timeframe is likely to be similar, but with a higher level of uncertainty.

Time	Estimate	Rationale
I1: (emergence+circulation of VOI in the community, VOI of mink/wildlife origin) What would be the magnitude of the impact on the health of the population above the current/ongoing pandemic impacts *at a local/regional level*?		
This cycle	 **Uncertainty** 	**-Impact:** If there was emergence and circulation of a VOI in the community of mink/wildlife origin, the magnitude of the impact on the health of the population above the current/ongoing pandemic impacts for this cycle are likely to vary from **marginal (minor) to noticeable and important, but usually reversible (moderate)** at the local/regional level. -VOIs and VOCs are much more likely to occur in humans than in mink. VOIs are not necessarily immune escape VOIs: they can be VOIs influencing transmission or disease severity, but still be controlled by vaccines. Even if a VOI were to emerge, there is no reason to believe it would be worse than concurrent/other VOIs/VOCs circulating or not yet emerged from the human population. -The province has responded in a measured manner to VOCs and they have not changed drastically the approach to the pandemic. So it is more likely that further VOIs will affect only marginally the pandemic response, and even if they have more than a marginal impact they would be reversible. -Variants emerging are monitored, and booster vaccines able to address more variants in the works. -Effects might be more serious in the short-term, but would likely be able to be mitigated over time. -However, the work needed to investigate the event and potential impacts on the local population and economy could be noticeable and important. -The **uncertainty** around this estimate was assessed as **moderate to high**. -Factors affecting variability and uncertainties include: characteristics of the VOI, uptake of vaccination in the community, extent of community spread, and impact of vaccines on disease severity.

Time	Estimate	Rationale
5 years	 **Uncertainty** 	**-Impact:** If there was emergence and circulation of a VOI in the community of mink/wildlife origin, the magnitude of the impact on the health of the population above the ongoing pandemic impacts within the next 5 years are likely to be **noticeable and important (moderate), but usually reversible** at the local/regional level. -Similar rationale to the current cycle. -The impact may be slightly reduced if we have more knowledge of vaccine adaptation and we can more quickly respond to any VOI/VOC. -On the one hand, there could be less concern regarding the impact of the virus in general (if the pandemic is more controlled, people are generally well-protected and hospitals are not overwhelmed). On the other hand, if there is less concern over evolution of variants in people, there may be more concern regarding evolution in other species. -The **uncertainty** around this estimate was assessed as **high**. -Factors affecting variability and uncertainties are the same as current cycle.
I2: (emergence+circulation of VOI in the community, VOI of mink/wildlife origin) What would be the magnitude of the impact on the health of the population above the current/ongoing pandemic impacts *at a provincial level*?		
This cycle	 **Uncertainty** 	**-Impact:** If there was emergence and circulation of a VOI in the community of mink/wildlife origin, the magnitude of the impact on the health of the population above the current/ongoing pandemic impacts for this cycle are likely to vary from **marginal (minor) to noticeable and important, but usually reversible (moderate)** at the provincial level. -The impacts are unlikely to substantially differ provincially and locally/regionally. -There are likely to be impacts on public health resources at the provincial level in needing to investigate the VOI i.e. assess how well it spreads, increased morbidity/mortality, viral characterization. -The **uncertainty** around this estimate was assessed as **moderate**. -Factors affecting variability and uncertainties are the same as at the local/regional level.

Time	Estimate	Rationale
5 years	 **Uncertainty** 	**-Impact:** If there was emergence and circulation of a VOI in the community of mink/wildlife origin, the magnitude of the impact on the health of the population above the current/ongoing pandemic impacts within the next 5 years are likely to vary from **marginal (minor) to noticeable and important, but usually reversible (moderate)** at the provincial level. -Similar rationale to the current cycle. -The **uncertainty** around this estimate was assessed as **high**. -Factors affecting variability and uncertainties are the same as current cycle.

Summary Information Gaps

The following information gaps were identified during the course of this assessment:

- Susceptibility of mink and other species to the variants of concern detected in humans
- Susceptibility of various wildlife species to SARS-CoV-2, especially to infection under natural conditions
- Extent of shedding by susceptible wildlife species
- Genetic selection pressures for SARS-CoV-2 in mink
- Effectiveness and duration of immunity from natural infection in mink herds from circulating SARS-CoV-2 strains
- Protection of mink vaccine against new variants arising in humans
- Mink vaccine effect on disease transmission in mink and between humans and minks, as well as on promoting the emergence of an immune escape variant
- Length of protection from mink immunization
- Environmental testing sensitivity to detect infection in mink herd
- The future epidemiological patterns of infection in mink herds
- Process needed to neutralize virus from mink at various stages of processing of carcasses and pelts
- Efficacy of human vaccines against variants of concern
- Vaccine coverage needed to see ongoing low circulation in the community
- Degree of viral shedding in vaccinated individuals
- Efficacy of PPE, biosecurity, and human surveillance
- Ability to identify mutations that are more likely to result in a VOI (in human and in mink)

9. Conclusions

Question 1

What is the likelihood and impact of emergence and circulation of a SARS-CoV-2 variant of interest (VOI) in the community due to virus evolution in mink or 'wildlife after exposure to mink' DURING COMPLETION OF THIS CYCLE, compared to what is seen with currently circulating variants and evolving public health measures?

Experts think that the emergence and circulation of a SARS-CoV-2 VOI in the community due to virus evolution in mink or 'wildlife after exposure to mink' during completion of this cycle is **unlikely to very unlikely to occur**. However, uncertainties associated with the different probability estimates vary from low to moderate/high. If there was emergence and circulation of a VOI in the community that was of mink/wildlife origin, the magnitude of the impact on the health of the population above the current/ongoing pandemic impacts for this cycle are likely to be **minor to moderate** at the local/regional level, and slightly less at the provincial level.

The risk assessment for this cycle assumes the current control measures remain in place for the rest of the cycle, among other assumptions. If the situation evolves differently than assumed, the risk can be different. Even if a mink worker becomes infected and infects a herd despite vaccination and safety

plans in place, the most likely scenario is that only one or a small number of mink herds would be infected during the remainder of this cycle. This is based on the mitigating measures in place, decreasing community transmission, vaccination, and the nature of the mink industry in BC. Under this scenario, evolution of the virus into a VOI in a mink herd is not likely. There may be a small number of accumulated mutations during virus circulation in mink, but this is not usually sufficient to result in a VOI. Also, mutations usually tend to favour host specific adaptation which might not be advantageous for transmission to other hosts, such as humans. It is more likely that a VOI (from the perspective of humans) will arise in humans rather than in mink.

There is a moderate level of uncertainty associated with this estimate. Key sources of uncertainty and variability, among many detailed in section 6, include: the expected levels of compliance with control measures and testing during the remainder of this cycle, which VOI characteristics will arise (type of mutations and suspected impact from these mutations - affecting immunity, transmission, severity of disease or effectiveness of vaccines or therapeutics), the future epidemiological patterns of infection in mink herds, and whether previously infected farms can be re-infected during the same production cycle.

The likelihood of emergence and circulation in the community due to virus evolution in wildlife (after exposure to mink) is even lower. Even if transmission to wildlife around mink farms were to occur, which has rarely been seen to date, the most likely scenario is limited or transient spread in wildlife. Development of a reservoir requires many factors related to population size and density, contact between individuals, and adaptation of the virus to spread efficiently in that species. For even the worst-case spread scenario, though, it is very unlikely that the virus would evolve into a VOI and be transmitted back to people given the: low population density of known susceptible species, long timeframe required for reservoir development, low rates of human contact with susceptible wild species, and precautions taken by specific groups of people who may have contact with wildlife.

The uncertainty associated with the development of a virus reservoir in wildlife (assuming at least one animal is infected) is **high**; however, if there is only limited or transient spread in wildlife, then there is low uncertainty regarding the probability of virus evolution and exposure of humans. Key sources of uncertainty and variability, among many listed in section 6, include: the wildlife species affected, characteristics of the VOI that develops, type of human-wildlife interaction, transmission dynamics in various species, extent of shedding by susceptible wildlife species, and human vaccine efficacy.

VOIs and VOCs are much more likely to occur in humans than in mink. Variants emerging are monitored, and booster vaccines able to address more variants are in the works. Effects might be more serious in the short-term, especially regarding the work needed to investigate the event and/or potential local control measures, but would likely be able to be mitigated over time.

The uncertainty associated with this impact estimate is **moderate to high**. Key sources of uncertainty and variability include: characteristics of the VOI, uptake of vaccination in the community, extent of community spread, and impact of vaccines on disease severity.

Question 2

What is the likelihood and impact of emergence and circulation of a SARS-CoV-2 variant of interest (VOI) in the community due to virus evolution in mink or 'wildlife after exposure to mink' WITHIN THE NEXT 5 YEARS, compared to what is seen with currently circulating variants and evolving public health measures?

The assumptions were different for the next 5 years versus this cycle, but there was a lot of uncertainty regarding these assumptions and they should be reviewed over time. Although some control measures may decrease (e.g., PPE and testing) over this timeframe, it was assumed that some mink vaccination will be in place, even if it is not universal and its efficacy is unknown. With these assumptions, experts think that the emergence and circulation of a SARS-CoV-2 VOI in the community due to virus evolution in mink or 'wildlife after exposure to mink' within the next 5 years is **unlikely**.

Much of the rationale is similar to this cycle. It was still expected that, at most, only a small number of mink herds would be infected per year, and that this is unlikely to result in evolution of a VOI. The slight reduction in restrictions is likely to be compensated for by vaccination of mink, which will likely reduce shedding and spread within and between herds, even if it does not reduce infection.

There is a moderate to high level of uncertainty associated with this estimate, primarily due to uncertainty in the number of herds infected per year and the probability of virus evolution in mink over this timeframe. Key sources of uncertainty and variability are similar to this cycle, but also include: variation in use of a mink vaccine, efficacy of vaccination in mink, length of immunity in mink, and the effect of new variants arising in humans on mink infection.

The wildlife pathway remains very unlikely, even for the longer timeframe. Most of the rationale is similar to this cycle. With a longer timeframe, there is more opportunity for reservoir development, but ongoing human adaptation of the virus over the next 5 years would make this less likely.

As with the current cycle, uncertainty associated with the wildlife reservoir scenario is high. However, if there is only limited or transient spread in wildlife, then the uncertainty regarding the probability of virus evolution and exposure of humans is moderate. Key sources of uncertainty and variability are similar to this cycle; however, potential variation in use of a mink vaccine, efficacy of such a vaccine, and characteristics of the circulating virus may affect the probability of transmission from mink to wildlife in this timeframe.

The magnitude of the impact at the 5 year timeframe is likely to be similar to this cycle, but with a higher level of uncertainty. The impact may be slightly reduced if we have more knowledge of vaccine adaptation and we can more quickly respond to any VOI/VOC. However, the incremental impact may be perceived as higher if the situation is more controlled in humans.

The uncertainty associated with this impact estimate is high. Key sources of uncertainty and variability are similar to the current cycle.

Discussion

This is the most comprehensive provincial risk assessment related to mink farming to date. It is based on a comprehensive hazard profile. Both have been undertaken in collaboration with national experts. The previous national rapid qualitative risk assessment was performed early in the pandemic. Therefore, this

assessment and accompanying hazard profile include a lot of information and on the ground experience accumulated since the previous assessment. However, because of the moderate to high uncertainty for both the probability and impact estimates, it is important to continue monitoring the situation in mink farms, as well as what can be learned from the scientific literature. Further scientific knowledge and on the ground experience around the pandemic, variants, animal-human interface, environmental sampling reliability can change the risk level and trigger changes in control measures in response.

Depending on the tolerability of the risk and associated uncertainties, the level of mitigation measures can be increased or lowered compared to what has been assumed to be in place in this risk assessment. Over the next five years, measures that were dropped could be reinstated. Further mitigation measures, at any time, could include:

- Limiting the number of animals or changes in animal density (to potentially decrease the transmission and number of viral replications, which could decrease the opportunity to accumulate clusters of mutations) such as
    - prohibiting the next cycle of reproduction while allowing operators to maintain their breeding animals (to keep the genetic assets each farm has developed)
    - prohibiting expansion of current mink farms (prohibiting the increases in number of breeding animals or kits allowed)
    - prohibiting the creation of new farms
    - euthanizing herd(s), however, if there is already an infection with a concerning mutation in a herd, this could temporarily increase human exposure
- Strengthening the monitoring of the industry at the industry's expense (recognizing the limited feasibility of current regulatory agency in maintaining close monitoring without further resources) and/or implementing stricter fines or closures with breaches of mandated measures
- Assessing the need for new regulations regarding products, materials or people that can move onto and off of the farm (feeds, carcasses, manure, new breeding stock, and other) even when a farm is not under quarantine.
- Mandating on-going, and potentially industry managed, human surveillance
- Mandating mink immunization

Alternatively, if there is sufficient comfort with the level of risk, mitigation measures like a lower level of PPE and ongoing animal surveillance could be reduced.

Expected benefits from these measures need to be balanced with their acceptability, feasibility and timeliness, recognizing that these measures can affect profitability of the industry or pose operational challenges to the many sectors involved.

The province could consider disseminating the results of this risk assessment to various stakeholders and engage in consultation regarding potential responses. Critics of mink farming have voiced their view in the media. Public communication of the BC specific mink farming SARS-CoV-2 risk assessment and hazard profile could provide an expert perspective on the situation, and inform the general population from a different perspective. A high profile decision regarding further mitigation measures would benefit from careful risk communication.

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HAZARD PROFILE

SARS-CoV-2 in Farmed Mink in British Columbia

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Version of: 2021-06-30

This hazard profile provides information related to SARS-CoV-2 at the human-animal-environment interface in British Columbia. It is intended to accompany a Joint Rapid Qualitative Risk Assessment (J-RQRA) being conducted in relation to the infection of farmed mink. It describes the health event, causative agent and its genetic variation, and reviews the relevant aspects of epidemiology, persistence, pathogenesis, diagnosis, industry characteristic, and prevention and control measures. It also reviews information relevant to impacts on animal health, public health, and the environment, but does not provide an estimate of the magnitude of these impacts. Finally, research gaps are highlighted. This hazard profile is not intended as a risk assessment or a systematic literature review. It applies only to the specific context in which the J-RQRA will be conducted, and draws on data that are related only to the health event concerned.

1. Health event description

A One Health Working Group was established in October 2020 to assess and manage the risk of SARS-CoV-2 to human and animal health from mink farming in BC. The group has met regularly ever since and work collaboratively to manage all aspect of the risk from mink farming.

SARS-CoV-2 was detected in mink on two mink farms in British Columbia (BC) in December 2020 and in one farm in May 2021. The first outbreak was confirmed on December 8th in a mink farm rearing 15,000 animals. When initial sampling of the mink took place, the animals did not display any signs of infection, but an increased mortality (1%) was observed in the days following sampling. Human-to-animal transmission was suspected as introduction of the infection into mink farms. There was a total of 20 human cases associated with this outbreak (11 farm workers, 6 close contacts of farm workers, and 3 contacts of close contacts). Farm processes were adjusted and further work safety protocols put in place. Pelting proceeded under those modified processes and protocols. After two sets of 65 samples, taken two weeks apart, were found to be all-negative, the herd was deemed free of disease as of February 24, 2021. The farm remains under quarantine until the site is considered fully decontaminated as per protocols of the Government of British Columbia. Serial viral sampling of the herd and the environment continues. Farms employees received fit testing and appropriate guidance on the use of respirators.

Effective December 14, a class order applying to all active mink farms, under the public health act, mandated a series of measures to enhance monitoring and control of SARS-CoV-2 on mink farms. The order required submission of COVID-19 safety plans and modification of those safety plans in line with public health recommendations. Additional requirements included stringent use of PPE. N95s or equivalent protection was required for all activities in close proximity to mink, while medical masks were required for other activities on farm. Enhanced PPE requirements were in place for farms with infected herds. At that time, all mink workers continuing to work with mink had to be screened for COVID-19 infection by PCR and serology. The serology tests were repeated approximately a month later. No COVID-19 infection current or past were detected via that screening.

The order also required participation in an animal surveillance program, with submission of mink mortalities on a weekly basis to detect potential new infections. Fraser Health and WorkSafe BC

carried out serial inspections, including unannounced ones, to assess and enforce compliance with safety plans. A screening program with regular PCR testing was put into place in mid-February 2021 to detect COVID-19 infections in mink farm workers and mink herds in the province. This constitutes testing naturally occurring mink mortalities and euthanized animals, as well as screening mink workers at least once per week.

On 23 December, a second outbreak was confirmed in a farm rearing 950 mink. Samples were collected from mink following an increase in clinical signs and mink mortality (3%) on the farm. This farm opted to euthanize all mink on the premises, without it being requested by public or animal health authorities, but because the operator preferred to stop operation at that point. No human SARS-CoV-2 cases were detected in workers on the farm, by either PCR or serological testing, and no human cases of COVID-19 with connection to the farm have been associated with this outbreak to date. The farm remains under quarantine until the site is considered fully decontaminated as per protocols of the Government of British Columbia.

Whole genome sequencing (WGS) analysis and interpretation are ongoing. To date, the WGS analysis found that the mink cases on both farms originated from one of the background strains of SARS-CoV-2 circulating in the BC community. Four clades were found in circulation between the two farms, three in association with farm 1 and one in association with farm 2. None of the emergent clades is considered a variant of interest nor a variant of concern. As described in section 2, the genomes sampled from mink in BC do not exhibit unusual mutational profiles and do not show higher than expected levels of divergence.

In April 2021, all mink workers and their household members were offered the Pfizer COVID-19 vaccine. Mink farm workers were invited for their first dose as of March 17, 2021, and household members of mink farm workers were invited for their first dose, if not already eligible by age, in late April 2021. On April 15, 2021, public health issued an order that permitted only vaccinated mink farm workers to have duties that put them in close contact with mink; almost all mink farm workers chose to receive vaccine. In addition, in May and June, all mink workers were offered a second dose of mRNA vaccine.

As of June 25th, despite immunization, s.22 human cases of COVID-19 infection in mink farm workers on previously uninfected farms were detected through the screening program. Most of these workers had received one dose of vaccine, while some had none and some had two. Some of these workers had definitive acquisition from the community, but others have unclear acquisition. s.22 of these workers reported no contact with mink, although some had been involved in feed preparation. s.22 workers had been in close proximity to mink during the workers' infectious period. For these "close contact" instances, live sampling of the mink was performed for three weeks following, with no evidence of mink infection. s.22

s.22

On May 14th, 2021, one out of seven mink carcasses, of animals who died from the first week of May, tested positive for SARS-CoV-2, prompting the declaration of an outbreak in a third farm. Since then, a small proportion of the live mink, mortality and environmental samples from that farm have harbored the virus, across multiple separate sheds. This site had demonstrated good participation in twice to three times a week testing of workers prior and during the outbreak.

s.22 , another worker on that s.22 infected farm had a lab result classified as indeterminate, with negative results on subsequent samples on s.22 did not have a direct link with the previous case, and no direct contact with mink.

Whole genome sequencing results from mink cases on the premises showed they were infected with the B.1.618 lineage. The lineage was a match with the positive case from 6 weeks prior. This is a rare lineage in BC. The B.1.618 lineage has been found in India and is considered a lineage worthy of monitoring in BC. It shares some mutations with the B.1.167.2 (Delta) VOC, and might be associated with some immune escape from prior infection but not for vaccines (Tada et al., 2021). As of June 17th, it had not been deemed a variant of concern nor a variant of interest by WHO or other organizations.

It is notable that the herd on the third farm became infected despite twice-weekly screening of workers, and strong COVID-19 safety plans; the farm reported good adherence to PPE.

s.22 in the infected worker could have played a role in sub-optimal adherence to safety measures and inconsistencies in the epidemiological investigation findings over time.

BC is currently experiencing a decrease in its third wave of human COVID-19 cases (refer to BCCDC website for COVID data), while the Delta VOC is increasing in proportion compared to the other VOCs.

2. Causative agent and genetic variation

SARS-CoV-2 is an enveloped, positive-sense, non-segmented, single-stranded RNA virus in the *Betacoronavirus* genus of the *Coronaviridae* family.

The World Health Organization (WHO) recently convened a study on the origins of SARS-CoV-2. Though there is still a lot of uncertainty about this and further studies are required, the group qualitatively estimated that the most likely scenario is that SARS-CoV-2 was transmitted from an animal reservoir to an animal host, followed by subsequent spread within that intermediate host (spillover host), and then transmission to humans. The initial reservoir may have been either bats or pangolins, since the most highly related coronaviruses to SARS-CoV-2 have been found in these species. However, these viruses are not sufficiently similar to SARS-CoV-2 to serve as its direct progenitor. As has occurred with several other emerging viruses, the ancestral virus of SARS-CoV-2 may then have gone through an intermediary step involving an amplifying host that has more frequent contact with humans, such as a farmed wildlife (World Health Organization, 2021).

The virus has been evolving over the course of the pandemic in humans, and there have been various mutations and variants associated with mink. The nature of virus mutation is associated with several factors, including the parent strain, transmission rate, and selection pressure.

In the early part of the pandemic, researchers in Brazil estimated the median SARS-CoV-2 mutation rate in humans to be 1.13×10^{-3} substitutions per site per year, translating to an average genome accumulating 33 mutations per year, or approximately 1 mutation every 12 days (Candido et al., 2020). This will be specific to the variant, transmission rate, and selection pressure in that time and place – parameters which would be variable in different geographic regions depending on public health measures, compliance, population density, etc. These parameters affect virus transmission rates and opportunities for mutation. Furthermore, given the very uneven distribution of sequencing efforts and genome deposition across the globe, estimates of mutation frequencies are inherently skewed towards regions with higher sequencing rates. As such, it is hard to predict whether the derived estimates are as representative of a place such as India, with high transmission rates and disease burden, yet <0.1% of virus sequenced (GISAID), as they are of Australia, with lower case burdens and close to 60% of cases sequenced and deposited for analysis. Within the existing mutation rate estimates, there is significant variability in the mutation rates of different sites of the viral genome (Vilar & Isom, 2021), implicated in host receptor binding, host cell entry and viral replication. However, the derived estimates were within the range of evolutionary rates estimated for other human coronaviruses.

While sequence diversity in Netherlands mink farms is suggestive of a more rapid mutation rate in mink (i.e., 2 mutations every two weeks), there are multiple potential reasons for this. It could be the result of host adaptation or rapid transmission rates in a high-density environment, or it could be an artifact of unknown introduction times skewing the calculations (Oude Munnink et al., 2020). One analysis of mink sequences estimates the most common ancestor to date to April 2020 (van Dorp, Tan, et al., 2020); the fact that many of the observed mutations arise independently on the background of different SARS-CoV-2 lineages is suggestive of host-specific adaptation and a lower likelihood of their persistence in a human population. A more rapid viral mutation rate is expected upon species jump, as the host adaptation is underway – it is expected that a similar phenomenon has occurred upon SARS-CoV-2 transition into humans, however the initial adaptive mutations were already fixed in the population at the time when the first SARS-CoV-2 samples were being sequenced. There is still a lot of uncertainty regarding SARS-CoV-2 mutation rates in humans and mink under different circumstances.

In most instances, mutations have no or little direct impact (FAO/OIE/WHO, 2021), and their effects can depend on the genetic background in which they occur. A recent investigation of over 46,000 SARS-CoV-2 genomes from humans supports this assertion, with no evidence of selection on the variants circulating in the first year of the pandemic (van Dorp, Richard, et al., 2020). In mink, there is evidence of positive selective pressure on several recurrent mutations (van Dorp, Tan, et al., 2020). Many of these mutations, however, are already present at low levels in human populations, and it is unclear that viral adaptation to mink would have negative or positive implications for human infection dynamics (van Dorp, Tan, et al., 2020). Mutations of significance are those likely to affect transmission, disease severity, or vaccine or treatment effectiveness in humans. Mutations of significance found so far in humans include several convergent changes in the spike protein region, the protein involved in entry into cells, and the target of vaccines and therapeutics. There are changes in other areas potentially affecting within cell dynamics and clearance of viral particles via autophagy. There is some evidence of selective

pressure on the virus from immunocompromised human hosts, especially involving long-term viral shedding, as contributors to the sporadic emergence of more heavily mutated variants as well in the VOC lineages (Harvey et al., 2021).

To date, the most significant SARS-CoV-2 variant to arise from mink is the cluster 5 variant that was detected in mink in Denmark; the cluster 5 variant was subsequently detected in 12 people in Denmark (European Centre for Disease Prevention and Control 2020). The cluster 5 variant includes four mutations (Y453F, I692V, M1229I, S1147L), and one deletion (69–70 del) in the S protein (see Table 1). The concern with this cluster was that it might affect antigenicity. Cluster 5 is currently considered controlled, as it has not been detected since September 2020. Hoffmann et al. (2021) found that when all Cluster 5 changes were present, entry of the virus into certain human cell lines was reduced, and they hypothesize that this could explain why it did not spread efficiently among humans. This cluster has not arisen in association with affected mink farms in BC or any mink farms outside of Denmark. WHO did not declare this variant a variant of concern, since there was no evidence it fulfilled criteria for this label, with no evidence of increased severity, transmissibility or decreased effectiveness of vaccine or therapeutics.

Table 1: Details about the mutations found in the 'cluster 5' variant in Denmark

Mutation / Deletion	**Is this mutation observed in humans not in relation to mink?**	**Potential impact**
Y453F	Yes - has arisen multiple times in several sublineages (COG-UK), including from humans in South Africa, Belarus, Russia and Switzerland (European Food Safety Authority, 2021)	Has been shown to have increased affinity to ACE-2 receptors, without challenging antibody neutralization (Bayarri-Olmos et al. 2021; Starr et al., 2020), although one pre-printed study demonstrated potential for evasion of cellular immunity (Motozono et al., 2021). Overall this mutation has not been seen in rising proportion, providing reassurance as to its lack of significant impact on transmission, or immune escape (Alam et al., 2021).
I692V	No (COG-UK; GISAID)	Not anticipated to have a significant effect on viral infectivity or antibody susceptibility because localised relatively far from the receptor binding motif (COG-UK)
M1229I	Yes (COG-UK; COG-UK 2)	Not anticipated to have a significant effect on viral infectivity or antibody susceptibility because localised relatively far from the receptor binding motif (COG-UK)
S1147L	Yes (Guruprasad, 2021) (COG-UK 2)	Little to no data on the impact of this mutation. It is located on the S2 protein, which mediates membrane fusion.
69–70 del	Yes (in B.1.1.7 variant) (GISAID; COG-UK 2)	May increase receptor binding

Another mutation frequently found in mink is the N501T. A recent review of this mutation in mink in the US concluded that the N501T mutation occurred two months earlier in humans than in mink in the US, and the novel N501T-G142D variant and N501T-G142D-F486L variant were found in humans prior to mink. The result of this study indicates that the novel variants may have

evolved during human infection and then transmitted to mink populations in the US (Cai & Cai, 2021).

To date, it seems that most mink related viral mutations confer no significant advantage in terms of transmissibility or immune escape, nor change in severity (Konishi, 2021; van Dorp, Tan, et al., 2020; Zhang et al., 2021)

Scientific publications and risk assessment carried out by various public health organizations (ECDC, WHO) recognize the risk of novel mutation or accumulation of mutations in hosts other than humans, including in mink, but also in companion animals, calling for immunization of the world population, but also of susceptible host species, with monitoring (Ghorbani et al., 2021).

In BC, the WGS results on samples taken from both infected farms show evidence of multiple mutations in many structural and non-structural proteins, including mutations in the spike protein. The spike mutations were not fixed as clusters in the sequenced mink viruses, with no more than 1 spike mutation associated with the mink outbreak fixed at 90% or above in each of the mink (although combinations of mutations at lower frequency did occur). At this point, there is no evidence that the genetic changes observed are likely to impact transmissibility, severity or immune escape potential of the virus. Analyzed mink samples were presumed to be from the later part of the outbreak in mink, as mink mortality on one farm increased at the time of their collection; on the other farm the outbreak did not run its course, with animals being rapidly euthanized after the detection of the infection in the herd. The mutations observed, at various frequencies in the mink +/- human samples, include:

- **Y453F** – this mutation in the spike protein was first noted in mink in Denmark (214 animals) and in the Netherlands. There was no epidemiological link between the countries for these cases, so the mutation is considered to have arisen independently. Subsequently this mutation has been reported in mink in other countries. It is presumed to be a mink-defining mutation[1] with respect to virus origin. The Y453F mutation has been shown to have increased affinity to ACE-2 receptor, without challenging antibody neutralization (Bayarri-Olmos et al. 2021), although one pre-printed and one report suggested the potential for evasion of cellular immunity. Y453F was observed at variable frequencies in 18 mink from Farm 1 (<10% to 100% frequencies), two mink from Farm 2 (<10% frequencies) and in no humans associated with Farm 1 or in the community (Harris et al., 2021; Motozono et al., 2021).

- **N501T** – is a spike protein mutation that was observed at variable frequencies in 16 mink from Farm 1 (<10% to 90% frequencies), two mink from Farm 2 (<10% frequencies) and no humans associated with Farm 1 or in the community. It is also considered a mink-defining mutation, with respect to virus origin. It has also been found circulating in humans in the United States, before infecting mink (Cai & Cai, 2021).

[1] A mink defining mutation is a mutation that has been found to recur frequently in mink, hypothesized as the result of host specific adaptation.

- **F486L** – is a spike protein mutation that was observed at variable frequencies in 13 mink from Farm 1 (<10% to ~50% frequencies), three mink from Farm 2 (<10% to up to 40% in one mink) and no humans associated with Farm 1 or in the community. It is not considered a mink-defining mutation and did not appear to confer an advantage to the virus in mink.

- **A222V** – is a spike protein mutation that was observed at variable frequency in minks in the first infected farm, but not on the second farm. While not a mink-defining mutation, it was a sub-clade defining mutation for one of the clades associated with the Farm 1 outbreak. It was found at a frequency of close to 36% in one human initially identified as a SARS-CoV-2 active case of the Farm 1 outbreak, and at a frequency of 100% in one additional human SARS-CoV-2 case identified subsequently in association with the Farm 1 outbreak. It has also been observed in several patients in the community at between ~30% to 100% frequency in their genomes. This mutation has previously been reported in different places around the world without mink association. In a recent pre-print (Vilar & Isom, 2021), it has been noted to be a residue with a relatively high mutation rate in several countries, mainly in Europe. In BC, it was noted predominantly on the background of the mink farm outbreak-associated strain, but was also found on the background of 16 additional strains, from presumed spontaneous mutations. It, however, has not been found in sequenced human strains since March 2021. From the genetic sequencing data on mink and associated human SARS-CoV-2 infections on the first infected premises, it was not possible to ascertain if strains bearing this mutation have been transmitted from mink to human or have arisen in humans spontaneously.

- **H182Y** – is a non-spike mutation (in orf3a gene) previously seen in mink farm outbreaks elsewhere, that has also been found in BC. It is not considered a mink-defining mutation, but it was a clade-defining mutation for another clade associated with the mink outbreak on farm 1. In the original set of five humans and five mink viruses associated with Farm 1, this mutation was found at variable frequencies in all five minks and four of the five humans. It continues to be found at variable frequencies in all but one other mink from Farm 1, as well as at 100% in 5/8 additional humans associated with farm 1. H182Y mutation is also found at nearly 100% frequency in all mink collected from Farm 2. It has also been observed at between ~50% to 100% frequency in several patients in the community, although it has not been seen in any human cases since December 2020. In BC, it was found predominantly on the background of a lineage associated with the Farm 1 and Farm 2 outbreaks, but one additional case of an unrelated lineage with this mutation has been detected, demonstrating potential for spontaneous mutation of this residue in a human host. From the genetic sequencing data on mink and associated human SARS-CoV-2 infections on the first infected premises, it was not possible to ascertain if strains bearing this mutation have been transmitted from mink to human or have arisen in humans spontaneously.

In conclusion, in BC, mink outbreaks have evolved on the background of a SARS-CoV-2 strain circulating in the community. Strains associated with both outbreaks could be further subdivided into three (Farm 1) and four (Farm 2) subclades each, while two clades were identified in association with farm 3 (as of June 4th). The human and mink strains associated with the

outbreaks differed by 0-3 SNPs, a rate of mutation that could be observed both in human and mink hosts in an outbreak of estimated duration of >2 weeks, such as the estimate for outbreak on Farm 1, based on symptoms onset and laboratory data gathered during the outbreak investigation. Subclades 1.2 and 1.3 associated with the Farm 1 outbreak have been found circulating in the community cases not known to be directly associated with the outbreak, however this is not conclusive of human-mink-human transmission, as the clade-defining mutations for these lineages were not also mink-defining mutations and are presumed to have been able to originate directly in human hosts associated with the outbreak and further transmitted into the community without a mink intermediary. Regardless of origins, clade-defining mutations for these clades have not been observed in community circulating strains of this lineage since either December 2020 (H182Y) or March 2021 (A222V). Two mink-defining mutations (N501T and Y453F) have been observed to arise during the mink outbreak, however they were not observed in any human cases in BC.

3. Epidemiology

SARS-CoV-2 is primarily transmitted by human-to-human transmission through respiratory droplets, aerosols, fecal-oral route, and fomites. Most of the transmission occurs in close contact. There is evidence of transmission at the human-animal interface; however, the significance of this transmission is difficult to interpret, especially given the uncertainties regarding the origins of SARS-CoV-2 and the role of various species. It is capable of causing a reverse zoonosis as several animals in contact with infected humans have tested positive for SARS-CoV-2 (e.g. mink, dogs, domestic cats, lions, tigers, snow leopards, pumas, ferrets, gorillas, otters) or after experimental infection (mice, voles, dogs, cats, ferrets, hamsters, rabbits, raccoon dogs, primates, tree shrew, fruit bats, white-tailed deer)(Canada, 2021; FAO/OIE/WHO, 2021). Interestingly, it has been noted that mink recovered from SARS-CoV-2 infection and with evidence of successful seroconversion can still experience subsequent infection episodes (Rasmussen et al., 2021).

Big brown bats (*Eptesicus fuscus*), a common North American bat species, were found to not be susceptible to experimental infection with SARS-CoV-2 (Hall et al., 2020).

SARS-CoV-2 is currently globally distributed in humans, including across Canada. Outbreaks have occurred in mink farms in several countries, including: the Netherlands, Denmark, Spain, France, Italy, Sweden, Greece, Poland, Lithuania, Latvia, the USA, and Canada (OIE, 2021).

Most of the affected mink farms around the world reported SARS-CoV-2 infection among workers and it is hypothesized that the mink farms were infected through human-mink transmission (FAO/OIE/WHO, 2021).

Animal-to-human and animal-to-animal transmission has been documented within farmed mink outbreaks in several countries. The Netherlands and Denmark have reported human cases of infection with strains of SARS-CoV-2 that had mutated in mink (Fenollar et al., 2021). Epidemiological as well as experimental data suggest that SARS-CoV-2 is transmitted between animals primarily via respiratory droplets and direct or indirect contacts. Currently, there is no evidence that animals - including farmed fur animals - play a substantial role in the spread of SARS-CoV-2 to people (FAO/OIE/WHO, 2021).

The susceptibility of wildlife in Canada to SARS-CoV-2 is still highly uncertain. It has not been detected in any wildlife species in Canada to date. In BC, wildlife surveillance was conducted in the vicinity of infected mink premises (57 animals sampled, all tested negative for SARS-CoV-2). The only free-ranging wild animal shown to be infected was a wild mink near an affected mink farm in the US (OIE, 2021). Escaped mink have also been found to be infected (Shriner et al., 2021). There are a low number of wild mustelids in the immediate vicinity of mink farms in BC. Wild mink are solitary and territorial in nature, decreasing the likelihood of sustained transmission.

4. Pathogenesis

A lot of useful information on pathogenesis was summarized in the PHAC Emerging Pathogen Risk Assessment (Canada, 2021)[2]:

> "The minimum infectious dose of SARS-CoV-2 in humans is unknown (WHO 2020; US DHS 2020). One study estimated the dose to be approximately 300 virions (upper estimate) (Basu 2020), whereas another study estimated the dose to be 300 to 2,000 virions (Prentiss et al. 2020); these estimates are within the estimated influenza A infectious dose range of 300 to 9,000 virions (Prentiss et al. 2020). In animal studies, doses in the range of 100 to 630 virions could establish infection (Karimzadeh et al. 2021). It has also been suggested that the inoculum size is directly correlated with the risk of disease severity (Guallar et al. 2020; Gandhi et al. 2020a; Gandhi et al. 2020b; Hausdorff and Flores 2020; Burgess et al. 2020).
>
> The average COVID-19 incubation period in humans is 4.0 to 7.2 days (CDC 2020a; CDC 2020b; WHO 2020; Banka et al. 2020; Lu et al. 2020; Wassie et al. 2020; PHAC Modelling Group Report [August 7, 2020]). According to the WHO and the CDC, the incubation period ranges from 1 to 14 days (WHO 2020; CDC 2021); in fact, most infected individuals who do become symptomatic will do so within 11.5 days post-infection (CDC 2021). However, longer incubation periods of up to 34 days have also been reported (PHAC Modelling Group Report [Apr. 16, 2020]; Banka et al. 2020; Qui et al. 2020; Cheng et al. 2021).
>
> The timing of peak infectiousness in humans varies by study, and ranges from zero to two days prior to symptom onset (He et. 2020; Lu et al. 2020), two to three days before and after symptom onset (Ferretti et al. 2020), or within the first week of symptom onset (Cevik et al. 2020). Patients with mild to moderate illness are usually less infectious or no longer infectious from day 8 to day 11 after symptom onset (Bullard et al. 2020; Wölfel et al. 2020; Perera et al. 2020; Walsh et al. 2020; CDC 2020c; ECDC 2020). However, three patients with mild illness have been reported to be infectious for 15, 24 and 37 days, respectively (Vaught et al. 2021; Mendes-Corea et al. 2021). Furthermore, patients with severe illness and/or who are elderly and/or immunocompromised may be infectious for longer, with reported periods of infectiousness up to, and even exceeding, eight months after symptom onset or diagnosis (Folgueira et al. 2020; van Kampen et al. 2020; McPhie et al. 2020; CDC 2020c; ECDC 2020; Fontana et al. 2020; Li et al. 2020; Avanzato et al.

[2] References within quoted text are given as in-text links only.

2020; Abe et al. 2020; Choi et al. 2020; Mileto et al. 2020; Aydillo et al. 2020; Baang et al. 2021; Khatamzas et al. 2021; Sepulcri et al. 2021; Beran et al. 2021).

Viable virus has been isolated from asymptomatic patients (Arons et al. 2020) and asymptomatic individuals can infect others (WHO 2020; CDC 2020; ECDC 2020; Qiu et al. 2020; Ravindra et al. 2020; Luo et al. 2020; Wilmes et al. 2020). According to the CDC, asymptomatic individuals are 75% as infectious as symptomatic individuals (CDC 2020; Johansson et al. 2021). Although the actual extent to which pre-symptomatic and asymptomatic transmission occurs is unknown (WHO 2020; CDC 2020), it has been estimated that at least 50% of infections are the combined result of pre-symptomatic and asymptomatic transmission (Moghadas et al. 2020; CDC 2020b; Johansson et al. 2021)."

Lythgoe et al. (2021) used a within-host evolutionary approach to estimate that infections go through a transmission bottleneck of 1-8 viruses. This suggests that the number of viruses needed to establish an infection may be smaller than the infectious dose mentioned above.

A mink worker with a previous COVID-19 infection is most likely to have some immunity and protection against reinfection. This is especially true if there is no mutation in key parts/regions of the virus linked to immune response. In BC, vaccination is available to mink workers and their household members, which should provide some protection from developing an infection (see Prevention and control section for further details).

There is still a lot of uncertainty regarding incubation period, shedding, and immunity in animals. An experimental study of mink found that infectious virus was present in nasal washes of inoculated mink from 2-8 days post-inoculation, and from in-contact mink from 5-11 days post-exposure (Shuai et al., 2020). Experiments in ferrets have detected shedding of similar duration (Kim et al., 2020; Schlottau et al., 2020; Shi et al., 2020).

The length of time a SARS-CoV-2 infection needs to infect most of the herd without subsequent ongoing circulation in a mink herd remains to be fully determined, but expert opinion estimates it might be a few weeks. This is compatible with what was observed in the one outbreak in BC where it seems the majority of the herd contracted the infection rapidly, with indeterminate or too high CT values to be able to carry WGS some weeks after the peak of mortality, suggesting there was no longer a high amount of viral shedding and potentially only residual viral fragments. However, it could have also been longer, as samples were taken approximately 4 weeks after the detection of the first case. There can be immunity in the mink herd generated from a prior SARS-CoV-2 infection, decreasing the chances of subsequent re-infection of the herd, but colleagues in the United States reported a documented reinfection of a herd within a few months, which was cleared again without generating an endemic reservoir.

Mink farms have an annual production cycle, which means the majority of the mink herd is comprised of new individuals each year.

5. Industry characteristics

There are ten licensed mink farms in BC, nine of which are located in the Fraser Health Authority boundaries (primarily District of Langley) and in the Fraser Valley Regional District

(Abbotsford, Chilliwack). None of the municipalities in these regions fit Statistics Canada's classification of a rural community. Workers and operators are likely to use the services located in urban centres.

The herds in BC are relatively small compared to the herds in the Netherlands and Denmark (Table 2), and the virus has been circulating for a shorter period. The infrastructure in Canada for mink farming is also quite different as Canada is less reliant on centralized feed manufacturers and pelting facilities, which are present in the Netherlands and Denmark. These centralized services can result in common contact and the opportunity for the transmission of pathogens among sites. There is some movement of staff between farms in Canada but to a much lesser extent than in Denmark or other countries, where, for example, large feed suppliers go on many farms.

However, BC farms still have some limited interconnections. Several of the mink farm owners have more than one location of operation, and staff and equipment might be shared in typical operations. The farms may interact to a limited degree for feed preparation and delivery. Finally, during normal operation, they may share breeding stock and/or send pelts to other locations for processing. There are only a few farms in BC with the necessary equipment to complete processing of mink pelts. Some producers perform the initial skinning of the animal and send these raw unprocessed pelts to other farms in BC or facilities in the US to complete the pelting process. Theoretically, this means that there could be a very small potential for sequential infection in the future, with additional risks of accumulated mutations.

Raw unprocessed pelts contaminated with SARS-CoV-2 could serve as a potential risk for transmission to workers and or other mink if moved between premises (OIE, March 2021). The US mink industry has implemented measures to address these risks including measures to contain/package raw mink pelts from infected mink premises for transport to processing facilities and holding mink pelts for 14 days at 20^{o}C following boarding and drying pelts to reduce viral load prior to shipping for auction.

Table 2. Size of the mink industry in various locations (Radke, 2020)

Region	Annual pelt production (millions)
Denmark	14
Netherlands	4
Canada	.9
BC	.25
Fraser Health	.25

The number of employees on a farm changes seasonally. Many farms are family run and employ both full and part time staff in small numbers. A single person can care for approximately 1000 mink and stable staff levels range from 1-25 depending on farm size. The total number of mink workers in the province can increase to about 150 workers during pelting season. Some employees on mink farms in BC live in congregate settings on farms at some times during the production cycle (e.g. pelting season Nov-Dec). Some BC mink farms employ temporary foreign workers during some periods of the production cycle (i.e. pelting, breeding, and whelping).

Temporary foreign workers might not have been immunized against COVID-19 before arrival and would need time to develop an adequate immune response to a vaccine if administered once they are in Canada. Times in the production cycle where interaction between people and mink is increased are breeding (March), whelping (May), weaning/processing (July), and pelting (Nov/Dec).

Mink are primarily housed in open sided sheds that are unheated; mink are exposed to natural daylight and environmental conditions while protected from rain, snow and direct sunlight. Cages are primarily constructed of metal (wire mesh); wood and/or plastic may also be used in the construction of side panels between cages to separate mink. Nest boxes are often constructed of wood. Mink in adjacent cages are unable to contact one another directly, but the distance between cages is a couple of centimetres allowing indirect contact between animals.

Carcasses are not always processed on farm, and sometimes used as bait (for crab). If infected carcasses are moved outside the farm without adequate safeguards, it could provide a pathway to spread the virus outside of the wildlife in the immediate vicinity of the farm or outside of farm workers. Carcass disposal is through rendering, on farm composting, or as crab bait (minimal). Each farm would be different depending on size, land base, etc., and likely disposal of pelted carcasses and normal mortality may be different possibly due to numbers – thousands during pelting; a handful per month during the rest of the year. Once a farm is under quarantine, movement of carcasses are limited to scenarios where they would not normally pose a public health or animal health risk.

While no BC specific data is available about farmed mink escaping and living in the wild, a study in Eastern Canada in 2017 concluded that 33% of sampled free-ranging mink were either escaped domestic mink, domestic-wild hybrids, or were introgressed[3] to domestic of wild parental groups. In BC, farms have perimeter fences (including a buried portion under the ground) in place to prevent escapes and from an initial scan there are few reports of low number of mink escaping from farms in the BC context. Mink are solitary in nature, not interacting much with their wild counterparts when released, with most usually coming back to the farm for food sources. There is an ongoing concern of mink release or other actions against mink farms from activists, as occurred in other jurisdictions[4].

Biosecurity protocols have been enhanced significantly with expert support from a mink related biosafety group.

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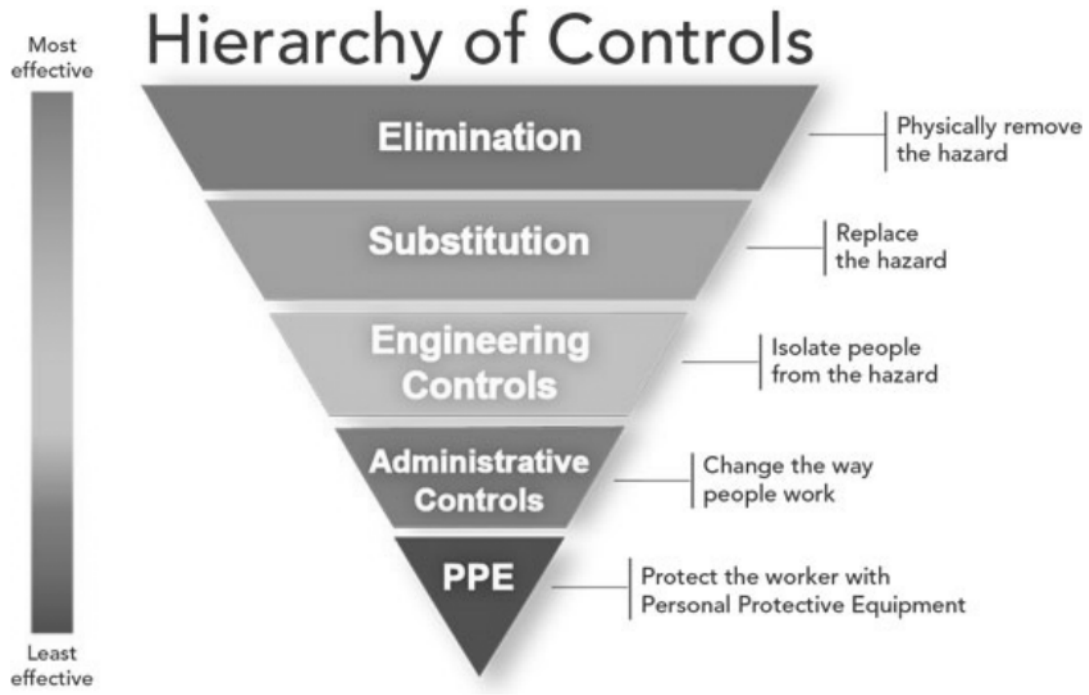
[3]Introgression is the transfer of genetic material from one species into the gene pool of another by the repeated backcrossing of an interspecific hybrid with one of its parent species

[4] Media reports: https://www.chicagotribune.com/news/breaking/ct-animal-activist-mink-sentencing-met-20160229-story.html; https://www.theguardian.com/uk-news/2018/feb/20/police-admit-officers-role-in-mass-release-of-mink-by-protesters; https://lfpress.com/news/local-news/animal-activist-charged-in-mink-stink

6. Prevention and control

Prevention of public health and workplace hazard is frequently approached through the framework of the Hierarchy of Controls (figure 2). Based on that framework, the most effective way to prevent hazard from generating negative consequences is to remove the hazard. Fully removing the hazard is not always possible, and in some circumstances, such as disposing of an infected herd, might generate increased exposure to the hazard. Surveillance can assist in temporarily removing the hazard, by removing infected workers from the farm, and minimizing infected workers' and infected farms' interaction with others. Hazards are frequently managed through engineering and administrative controls, and personal protective equipment, implemented as part of safety plans. Immunization is also an effective control measure. Those measures are discussed below, as well as some challenges.

Figure 2. Hierarchy of controls



Source: https://www.cdc.gov/niosh/topics/hierarchy/images/HierarchyControls.jpg

Human surveillance

Laboratory testing to detect acute SARS-CoV-2 infection in humans and in mink relies on the same molecular principles. Testing of humans has been well described previously. Briefly, molecular methods, which are the gold standard of acute SARS-CoV-2 diagnostic testing, have high analytical sensitivity and specificity in detecting even small amounts of SARS-CoV-2 virus.

Sensitivity can be compromised by the quality of specimen collection, timing of collection relative to viral shedding and the type of specimen collected (e.g. upper vs. lower respiratory tract samples in cases with predominantly lower respiratory tract disease, and environmental sample vs. human and animal samples).

In BC, diagnostic tests for COVID-19 in humans are conducted using real-time reverse transcription-PCR (rRT-PCR). Samples are collected either via nasopharyngeal (NP) swab – the general gold standard method of specimen collection (Goldfarb et al., 2021; Public Health Ontario, 2020) – or saline mouth rinse-gargle ("saline gargle"). Saline gargle has been both analytically and clinically validated against NP swabs in BC (McLennan, Goldfarb, Donoghue, & Hoang, 2020). The clinical validation showed interpretation of nucleic acid test results to be equivalent between NP swab and saline gargle, with saline gargle having a sensitivity of 98% (Goldfarb et al., 2021). In a multicenter comparison of self-collected saline gargle to a provider-collected nasopharyngeal swab in Toronto, Kandel et al. (2021) also found similar sensitivity between the two methods for the detection of SARS-CoV-2: adjusted sensitivity of 0.90 [95% CI 0.86-0.94] for saline gargle, with the percent agreement between NP swab and saline gargle being 0.99 [κ, 0.93; 95% CI, 0.86–0.96]. While the clinical validation by Goldfarb and colleagues only included individuals who were symptomatic, the study by Kandel and colleagues (2021) was conducted with a study population where approximately 25% of individuals who tested positive for SARS-CoV-2 were asymptomatic. Similar saline gargle collection methods have also been used in India (Mittal et al., 2020), Germany (Malecki, Lüsebrink, Teves, & Wendel, 2021), and Japan (Saito et al., 2020).

Viral shedding in asymptomatic or pre-symptomatic individuals has been well documented, which provides opportunities for asymptomatic surveillance programs. The relative sensitivity of asymptomatic screening is still to be determined in vaccinated populations (such as the current state of mink farms in BC).

A voluntary COVID-19 testing program among mink farm workers in BC employing self-collected saline gargles has been implemented. Saline gargles were selected due to their comparable sensitivity to NP swabs, greater acceptability and ease of use compared to NP swabs, and capacity for self-collection following training by public health nurses, allowing the long-term testing to be less public health resource intensive. Gargle samples are self-collected by workers and transported by medical courier to the BCCDC public health laboratory for testing. On the occasion when indeterminate results are returned via saline gargle, individuals are asked to retest by NP swab.

All active mink farms have been participating in the voluntary testing program since February 24, 2021, with the first farm participating since January 14, 2021. As of May 19, 2021, after the discovery of a third infected farm, most farms provide samples twice weekly, while one farm participates once per week. Uptake among workers is generally high, with the weekly average of active workers tested at each farm ranging from 86-100% since epidemiological week 8 when all farms began participating. One or two workers have had recurrent challenges in providing a valid specimen for testing via saline gargle, and there have been instances where samples have leaked in transit or were not properly labeled, leading them to be rejected and not processed. Otherwise,

for most workers, use of the saline gargle collection method has been straightforward and has consistently returned valid results.

There is an expected reduction in the number of secondary infections in humans by 90% with twice a week PCR screening, based on modeling studies (Larremore, Toomre, & Parker, 2021).

Mink mortality and environmental surveillance

In BC, the mink farms are under a public health order that mandates surveillance. Each farm submits all their natural mortalities or animals euthanized due to illness to a maximum of five per week. Suspect results will initiate live animal sampling while positive results will trigger a quarantine and a full investigation.

Molecular testing of environmental samples is presumed to be inherently both less sensitive and potentially less specific (with respect to source attribution), than live or mortality sampling, as well as lacking markers of sample quality. The main advantage of environmental surveillance is its potential to detect infection early and complement other forms of surveillance. In BC and elsewhere, so far, it seems to be sensitive and correlating well with mink cages around infected animals' area (de Rooij et al., 2021). It can also assist in monitoring the presence of virus fragment on infected farms, which persist much longer than viable virus. BC is studying the degradation and persistence of viral fragment on the infected farms to assist in removing farms from quarantine and learn more about the properties of environmental samples. On infected premises, environmental samples are taken repeatedly on a 14-day basis (one incubation period) for the first eight weeks, then on a monthly basis (two incubation periods) thereafter until there are two consecutive sets of negative samples or for a six-month period, whichever comes first.

Environmental sampling is a tool that is still under development and needs to be interpreted with caution. It can help to understand how the virus is or is not decaying in the environment, though there is the potential for prolonged environmental contamination by dead virus remnants. Negative results from these samples cannot prove, on their own, that there is no virus remaining, since the virus can be unevenly distributed in the environment and there can be other materials present in the environment that can sometimes interfere with the test. Continuing mortality surveillance and adding environmental surveillance across the farm could help to monitor the rest of the herd in a minimally invasive way.

Positive human, environmental, and mink samples with sufficient viral load are amenable to whole genome sequencing (WGS), which can help inform epidemiological linkages, and monitor for mutations of concern arising in mink and circulating in workers and the community. WGS of the most recent samples are pending.

Viral persistence on farms and mink carcasses

SARS-CoV-2 virus can survive on various surfaces in the environment in respiratory secretions, urine, and feces. On affected farms in the Netherlands, SARS-CoV-2 was detected, at low levels, in air samples collected close to the mink, on mink fur, on flies, on the foot of a seagull, and in gutter water (Boklund et al., 2021).

Since viruses cannot replicate outside a living host, viral load degrades over time. Time and temperature are important factors affecting the length of virus survival, as are other factors such as humidity, pH, UV light, and the presence of organic material. As an enveloped virus, SARS-CoV-2 is more susceptible to environmental influences that affect the integrity of the lipid envelope than non-enveloped viruses. Cool temperatures, moderate humidity, neutral pH, protection from UV light and the presence of organic material will favor virus survival.

Using the model developed by Guillier et al. (2020), the time required to reach a 5 log reduction in virus titer (i.e., 99.999% reduction) for coronaviruses in general at 20°C is 13-18 days, depending on humidity (with 95% confidence intervals ranging from about 9-24 days). Newer studies specifically on SARS-CoV-2 suggest that this would be sufficient in most cases, though worst-case situations (e.g., high virus concentration in dark conditions) might require longer. At 4°C (at the same RH), the duration is 26-37 days, depending on humidity (with 95% confidence intervals ranging from about 19-49 days).

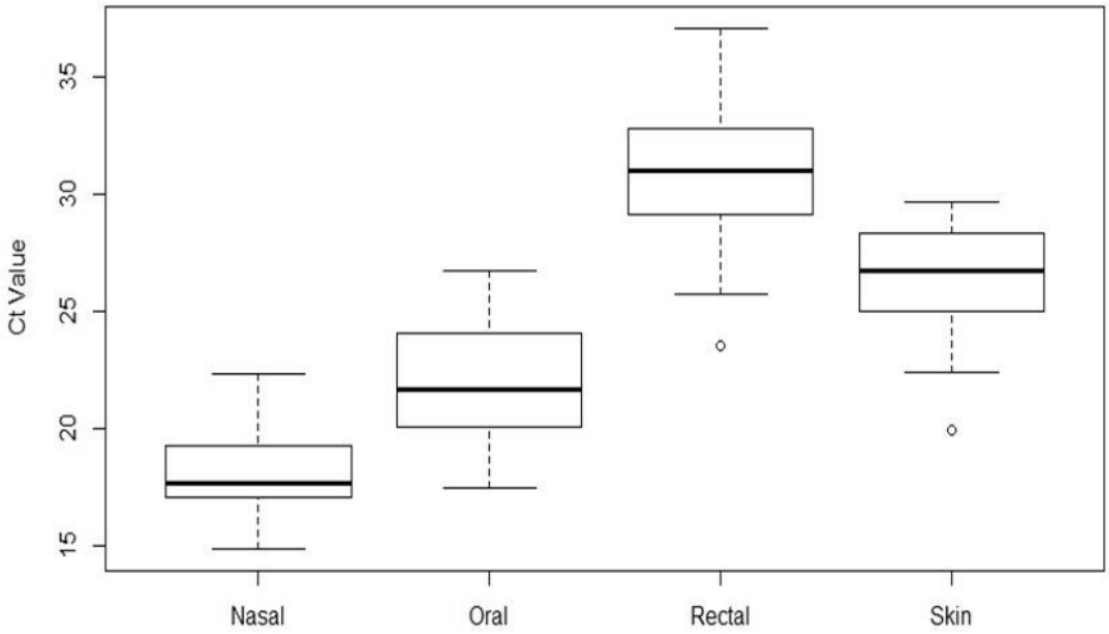
However, many aspects of these survival studies are not representative of real life. Surface characteristics of the substrate (porosity, texture, surface charge, the presence of hydrophobic groups, and metal ions among other factors) can influence survival and recovery of viruses during testing and under environmental conditions. Deposition solutions (cell culture media, PBS, PBS and serum albumin, saliva, mucus, etc.) used during testing also affect virus survival with albumin and saliva often providing extended survival times. The initial load of virus is also an important consideration in determining the period of survival. Due to all of these factors, it is difficult to compare the results of experimental studies with each other, and to a natural situation. Therefore, results should be interpreted with caution. Approaches used for cleaning and disinfecting or decontaminating infrastructure on infected mink farms must account for these variables and provide a sufficient margin of safety.

In studies on mink farm outbreaks of SARS-CoV-2 in Europe, the virus was not found in environmental sources outside of the premises (i.e., not airborne to surrounding areas) (de Rooij et al. 2021).

In BC, viral fragments, frequently at high CT-values, tended to persist for weeks to months in the first two infected premises, even after there were no longer any mink found to be positive via PCR testing, suggesting that it is likely sensitive at detecting SARS-CoV-2 RNA at lower concentrations.

In term of sampling on carcasses, from the first two outbreaks, among a sample of 25 animals which were sampled by nasal, oral, skin (subcutaneous tissue), and rectal swab AND were COVID positive on those nasal swabs, 22 were also positive on skin swabs. Ct values for skin were lower than oral and nasal swabs but higher than rectal swabs (figure 1). This is not sufficient to conclude on the ability of unprocessed skins from infected mink to transmit SARS-CoV-2. More studies are needed.

Figure 1. Viral detection from various specimen collection location on mink carcasses



Wildlife surveillance

A wildlife surveillance program to assess potential SARS-CoV-2 transmission to free-ranging animals from the infected premises was implemented by the Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD), as the provincial agency responsible for wildlife management. Sampling of free-ranging animals was conducted in a 1 to 3 km radius around each of the first two infected farms, following guidance from other provincial and international jurisdictions. Sampling effort focused on appropriate habitat expected to be used by target wild species in the mustelid family. Wild or escaped farmed Mink (*Neovison vison*), River Otter (*Lontra canadensis*) and smaller species of Weasels (*Mustela spp*) were expected to be present and considered to be most likely to have positive results for virus detection.

A provincial trapping permit under the BC Wildlife Act was issued to contractors and outlined methods for capture. During operations there were over 70 traps deployed as a maximum. Trapping operations were flexible and adaptable, with changes made due to weather conditions, catch success, identified opportunities, and occurrence of animal/furbearer spoor. All animals trapped were humanely euthanized according to provincial and international standards as soon after capture as possible and transported to the Animal Health Centre of the Ministry of Agriculture and Fisheries in Abbotsford. Two swabs were collected from each animal (oral and rectal) and the carcass was frozen at -20C.

Through this wildlife surveillance project, 65 animals of nine different species were sampled surrounding the first two farms. Species trapped were: Brown Rat (*Rattus norvegicus*, introduced), Muskrat (*Ondatra zibethicus*, native), Eastern Grey Squirrel (*Sciurus carolinensis*, introduced), Raccoon (*Procyon lotor*, native), American Mink (*Neovison vison*, native), Feral

Cat (*Felis catus*, introduced), River Otter (*Lontra canadensis*, native), Beaver (*Castor canadensis*, native) and Virginia Opossum (*Didelphis virginiana,* introduced).

All animals submitted were negative for SARS-CoV-2 virus. The surveillance model used was determined to be effective; however, the largest contributing factor to its success was our access to experienced contractors and the generous support and collaboration of the *BC COVID-19 One Health Working Group* and individuals in the Chilliwack agricultural and local community. A project report, including further details on sampling design and effort is currently being finalized (BC SARS-CoV-2 Wildlife Surveillance Report; in draft).

At the time of writing, surveillance around the third farm has begun and results are still pending.

Immunization

Mink workers need to be immunized against COVID-19 to be allowed to work on mink farms, as per a Fraser Health Public Health Order. Immunization of mink workers by a mRNA vaccine is expected to decrease infection (symptomatic or asymptomatic) by 60 to 80% with one dose, and by more than 90% with two doses, when those vaccines were studied against the most prevalent strains before variants of concern emerged. There has also been reporting of unpublished data of 100% efficacy of the Pfizer vaccine in a study of 800 people in South Africa, which found only 9 cases (all among placebo group), with 6 of those being carriers of the B.1.351 variant (NCCID presentation to NACI, May 5th 2021). A living evidence review (COVID-19 Evidence Network, 2021), updated June 1st, states that the Pfizer vaccine effectiveness against the B.1.1.7 (Alpha) VOC first detected in the United Kingdom is comparable to that of phase 3 trials of that vaccine, with a decreased infection of 46-60% 14 days after the first dose, and 70 to 94% 14 to 21 days after the second dose, in a population with 80% or more of the cases caused by the B.1.1.7. For the B.1.351 (Beta) VOC first detected in South Africa, no data is available for infection rates; however, a decrease of symptomatic infection of 43% was detected 35-41 days after the first dose, while 7 days after the second dose the decrease of symptomatic infection is 88%. There is some evidence, from two case-control studies, that the Pfizer vaccine offers good protection against infection and severe disease from the B.1.351 strain (Abu-Raddad, Chemaitelly, & Butt, 2021; Kustin et al., 2021). Much less is known about the protection of the Pfizer vaccine against other variants of concern. For Moderna, a 58.9% reduction of infection 15-41 days after the first dose has been observed for the B.1.1.7 VOC, and an 85.7% decrease of infection 7-15 days after the second dose. Moderna offers similar protection to symptomatic infection from the B 1.135 VOC as Pfizer.

Preliminary results from BC in the 70 years-and-older population has shown that a single dose of mRNA vaccine reduced the risk of SARS-CoV-2 in adults by about two thirds, with protection only minimally reduced against B.1.1.7 and P.1. Vaccine effectiveness was negligible during the period of 0-13 day's post-vaccination (14%) and increased to 75% at 35-41 days after dose 1. At 21 days and over, a single dose of mRNA vaccine was also significantly protective in variant-specific analyses with 67% effectiveness against B.1.1.7 and 61% against P.1 (Skowronski et al., 2021).

A few studies show that viral load may be lower (CT values higher) in those who were vaccinated and infected compared to unvaccinated and infected individuals, against the B.1.1.7 and the previously dominant strain (Pritchard et al., 2021). Decreased viral load in cases seems associated with decreased transmission (Public Health Agency of Canada, 2021). Two UK studies support a decrease in secondary transmission to household contacts, for the Pfizer or the Astra-Zeneca vaccines. One study suggests a 30% decrease, however it is not clear if the decrease is from decreased transmission from health care workers not getting infected, or because health care workers transmitted less after being immunized (Shah et al., 2021). The other study found that the likelihood of household transmission decreased by 40 to 50% in households where the index case was vaccinated at least 21 days prior to testing positive, compared to non-immunized index cases (Harris et al., 2021).

An experimental vaccine for SARS-CoV-2 in mink has been developed and will be used on many mink farms in the US in June of 2021. The Canadian Center of Veterinary Biologics will allow restricted emergency use of the experimental vaccine through a permitting process; no commercial license has been issued pursuant to the Health of Animals Act and Regulations. The vaccine must be used under the direction of a licensed veterinarian and with appropriate biosecurity, active infection monitoring and personal protective equipment for farm workers. As of June 29th, 2021, approximately 100 000 doses have been made available by the vaccine manufacturer for Canada. Applications have been submitted by veterinarians from multiple provinces for the vaccine. The applications will be reviewed and a permit issued only after approval from the provincial Chief Veterinary Officer if all conditions of the permit are met. Antibody titers in animal studies of this vaccine show an excellent response to the vaccine available for animals. Once vaccination is available for mink, it should provide mink some protection from developing an infection for a portion of their lifespan. Kits cannot receive a first dose of vaccine until a certain point of maturity. Vaccination of kits would occur at 6 to 8 weeks of age and then 3 to 4 weeks later at 9 to 12 weeks of age. That is the current plan for the recently developed mink vaccine and the approach to other mink vaccines. Maternal antibodies (IgG in humans) to SARS-CoV-2 have been demonstrated in neonatal cord blood (Flannery et al., 2021). It is presumed that this would also occur in mink. As such, maternal antibodies, either as a result of vaccination or from natural infection, would confer some protection to adults and kits in subsequent years thereby reducing this period of susceptibility. Antibody titers in animal studies of this vaccine show an excellent response to the vaccine available for animals. However, too little is known to conclude on the impact mink vaccines will have on disease spread in the herd, rate of mutation accumulation or type of mutation accumulation, and transmission back to humans. The risks and benefits of mink vaccination for disease control still need to be further assessed.

Safety plans

Mink farms in BC are under a PHO order, currently, like all other workplaces, and must have COVID-19 safety plans to prevent the transmission of COVID-19, including daily symptoms check on workers. As described above, mink farms are currently required to use intensive PPE during all work on farm, most onerous of which is the requirement for N95 or equivalent respirators during all work in close proximity to mink or while performing activities generating bioaerosols when there is no evidence of infection in the herd. Respirators are required at all time

on farm if the herd is infected. Workers in close proximity to mink are also required to use goggles or face shields, washable coveralls or Tyvek suits, as well as boots that can be sanitized. Work that is not in close proximity to mink on uninfected farms requires medical grade masks.

A systematic review (Chu et al., 2020) "identified 172 observational studies across 16 countries and six continents, with no randomised controlled trials and 44 relevant comparative studies in health-care and non-health-care settings (n=25 697 patients). Transmission of viruses was lower with physical distancing of 1 m or more, compared with a distance of less than 1 m (n=10 736, pooled adjusted odds ratio [aOR] 0·18, 95% CI 0·09 to 0·38; risk difference [RD] −10·2%, 95% CI −11·5 to −7·5; moderate certainty); protection was increased as distance was lengthened (change in relative risk [RR] 2·02 per m; pinteraction=0·041; moderate certainty). Face mask use could result in a large reduction in risk of infection (n=2647; aOR 0·15, 95% CI 0·07 to 0·34, RD −14·3%, −15·9 to −10·7; low certainty), with stronger associations with N95 or similar respirators compared with disposable surgical masks or similar (e.g., reusable 12–16-layer cotton masks; pinteraction=0·090; posterior probability >95%, low certainty). Eye protection also was associated with less infection (n=3713; aOR 0·22, 95% CI 0·12 to 0·39, RD −10·6%, 95% CI −12·5 to −7·7; low certainty). Unadjusted studies and subgroup and sensitivity analyses showed similar findings."

Challenges

We have observed a herd getting infected despite all the safety protocols in place, plus bi-weekly PCR testing and immunization. However, in the latest infected premises, the worker was infected early after the second vaccine dose. Encouragingly, we have not observed an outbreak in mink workers. Some variants of concern in BC present with some immune escape features related to infection after one dose. However, even after one dose, vaccines do not seem to offer significantly less protection against severe outcome than observed for previously circulating VOC and the protection is better after two doses. As of June 2021, second dose delivery is well underway among the eligible population in BC.

It may also be challenging to maintain participation in frequent worker screening. As vaccination rates increase, episodes of COVID-19 infection are much more likely to be mild or completely asymptomatic, meaning workers are less likely to self-identify a need for testing. Weekly or biweekly screening may have lower acceptability to workers and employers once community COVID-19 rates decline and their perceptions of risk become lower.

As the mink farms in BC are located in a highly populous area, contact tracing is unlikely to be able to fully contain transmission of mink strains out into the broader community if infected farm workers have secondary cases (either due to late identification or lack of full compliance with isolation instructions).

Despite the protection and control measures in effect on BC mink farms, it is generally recognized in the Occupational Health and Safety field that PPE and administrative controls are less effective and can be very costly as well as unsustainable in the long run. Alternatively, as workers and industry gain experience with applying higher levels of personnel protection on a routine basis, it may be the risk will be managed on many premises yet be higher in premises

with a larger turnover of workers or that use temporary staff. Irrespective of either of these scenarios, breaches in appropriate biosecurity including the appropriate use of PPE should be expected.

The only way to completely remove the risk of clinically significant mutations arising from mink farming in BC is to phase out the industry. Maintaining a smaller stock of mink, such as preserving the breeding stock only, would allow for decrease viral replication in any given mink outbreak, as well as decrease mink and human contact, since the stages of breeding, whelping and pelting that require more human handling would be paused.

In the next several years, there will likely be new technologies decreasing the risk of infection, severe disease, or transmission, and improving the ability to remain protected against immune escape variants.

7. Impact

Animal health impacts

Clinical signs in mink have been observed on some affected farms around the world, including respiratory or gastro-intestinal signs (rarely); however, in most instances the only indication of virus circulation has been animal mortality levels slightly above baseline (FAO/OIE/WHO, 2021). Discussion with US APHIS colleagues regarding outbreaks in Utah indicated that there were a variety of clinical signs including: inappetance, lethargy, ocular discharge, nasal discharge, coughing, and wheezing. Boklund et al. (2021) found that a third of mink farms in Denmark did not show clinical signs at initial investigation. However, personal communication with the researchers revealed that over half of those that did not show clinical signs and were followed-up (a median of 21 days later) had developed clinical signs within that time (Boklund, personal communication, 23 February 2021).

Generally, affected animals have been spread throughout the farms (Oreshkova et al., 2020). The virus appears to have a predilection for older animals, as such, while there is increased risk with increasing numbers of animals, kits may be less susceptible to clinically significant infection or shed less virus.

Effects could be seen from the costs associated with control measures taken to prevent further spread, such as improvements to fences, personal protective equipment, cleaning and disinfection. The need for increased labour to handle the outbreak, as well as absenteeism due to illness or fear of becoming ill, would likely be one of the greatest expenses. Since the BC mink industry is small, these costs may be a challenge.

Affected farms may experience trade restrictions. An OIE Ad Hoc Group on COVID-19 and Safe Trade in Animals and Animal Products determined that raw mink furskins currently cannot be considered as a safe commodity for international trade, meaning that they recommend that some sort of control be applied prior to trade (OIE, March 2021).

There is the possibility of public perception and animal welfare risks. There are instances of protests near farms and farmed mink being released from pens by protesters.

Public health impacts

A public health emergency was declared in BC on March 17, 2020 in response to the first community transmissions recorded in the province. Emergency measures were implemented in an effort to reduce the spread of the virus, and these continue to be in effect as needed. As of the June 5th Situation Report, BC has recorded 145,768 cases of SARS-CoV-2 since the first confirmed case on January 15th. 7,795 (5.34%) of positive cases have resulted in hospitalization. The median age of all hospitalized people is 63. 1,789 (1.22%) of positive cases have resulted in death with a median age of 84. More details on age profile and severe outcomes are available from the BCCDC data webpage. BC has transitioned to whole genome sequencing on all positive samples to detect VOC and support outbreak responses. As of the June 18th VOC Report, 90% of all tested samples were confirmed VOCs. Sample prevalence of VOCs province wide was 44% for B.1.1.7 (Alpha), 40% P.1 (Gamma) and 6% B.1.617 (Delta). The economic effects of the pandemic are significant and far-reaching; however, they are out of scope for this report.

Environmental impact, impact on biodiversity

If SARS-CoV-2 were to establish in wild populations, the effects of a wild animal reservoir of SARS-CoV-2 in Canada could be significant, depending on the species affected, the morbidity and mortality experienced, and the extent of contact that species has with humans and other animals. If it affected a rare wildlife species, it could present a conservation concern (e.g., some pine marten populations). However a detailed assessment of the impact on biodiversity is out of scope of this hazard profile.

8. Research gaps

- Susceptibility of mink and other species to the variants of concern detected in humans
- Susceptibility of various wildlife species to SARS-CoV-2, especially to infection under natural conditions
- Extent of shedding by susceptible wildlife species
- Genetic selection pressures for SARS-CoV-2 in mink
- Effectiveness and duration of immunity from natural infection in mink herds from circulating SARS-CoV-2 strains
- Protection of mink vaccine against new variants arising in humans
- Mink vaccine effect on disease transmission in mink and between humans and minks, as well as on promoting the emergence of an immune escape variant
- Length of protection from mink immunization
- Environmental testing sensitivity to detect infection in mink herd
- The future epidemiological patterns of infection in mink herds

- Process needed to neutralize virus from mink at various stages of processing of carcasses and pelts
- Efficacy of human vaccines against variants or concern
- Vaccine coverage needed to see ongoing low circulation in the community
- Degree of viral shedding in vaccinated individuals
- Efficacy of PPE, biosecurity, and human surveillance
- Ability to identify mutations that are more likely to result in a VOI (in human and in mink)

Appendix A – COVID-19 in animals

COVID-19 and Animals*

Animals species with reports of natural (and experimental where available) SARS-CoV-2 infection:

Species	Evidence[1]	Susceptibility[2]	Clinical signs[3]	Seroconversion	Transmission
Cats	C,E,O	high	yes (some cases)	yes	yes, to other cats
Big cats (tigers, lions, pumas, snow leopards)	C	high	yes (most cases)	yes	yes, to other big cats
Mink	C,E	high	yes (some cases)	yes	yes, to other mink and to people[4]
Ferrets	C,E	high	yes (some cases)	yes	yes, to other ferrets
Gorillas	C	high	yes	unknown	yes, to other gorillas
Asian small-clawed otters	C	high[8]	yes	unknown	unknown
Dogs	C,E,O	low	yes (some cases)	yes	no

Results of experimental studies on other animal species:

Species	Evidence[1]	Susceptibility[2]	Clinical signs[3]	Seroconversion	Transmission
Hamsters[9]	E	high	yes (some cases)	yes	yes, to other hamsters
Deer mice[9]	E	high	no	yes	yes, to other deer mice
Other non-human primates[5]	E	high	varies by species	yes/unknown	varies by species
Tree shrews[6]	E	high	yes (some cases)	unknown	unknown
New Zealand white rabbits	E	high	no	yes	unknown
Raccoon dogs[7]	E	high	no	yes	yes, to other raccoon dogs
Egyptian fruit bats	E	high	no	unknown	yes, to other fruit bats
White-tailed deer	E	high	no	yes	yes, to other deer
Bank voles[9]	E	medium to high[8]	no	yes	no
Bushy-tailed woodrats[9]	E	medium to high[8]	no	yes	unknown
Striped skunks	E	medium[8]	no	yes	unknown
Laboratory mice	E	low[8,12]	no	unknown	unknown
Cattle	E	extremely low[10]	no[10]	yes[10]	no
Swine	E	extremely low[11]	yes[11]	yes[11]	no
Raccoons	E	extremely low[8]	no	yes	no
Poultry (chickens, ducks, geese, quail, turkeys)	E,O	none	n/a	n/a	n/a
House mice	E	none	n/a	n/a	n/a
Big brown bats	E	none	n/a	n/a	n/a
Cottontail rabbits	E	none	n/a	n/a	n/a
Fox squirrels	E	none	n/a	n/a	n/a
Wyoming ground squirrels	E	none	n/a	n/a	n/a
Black-tailed prairie dogs	E	none	n/a	n/a	n/a

***Based on limited information available as of May 27, 2021. Animal species not listed do not yet have any evidence available.**

[1]C-Case report; E-Experimental finding; O-Observational study
[2]Based on January 2021 update of OIE technical factsheet
[3]Clinical signs may include non-specific signs (e.g. fever, lethargy) and/or respiratory signs with or without gastrointestinal signs
[4]Zoonotic transmission has been reported in the Netherlands, Denmark, and Poland
[5]Includes several species (e.g. macaques, marmosets, baboons, African green monkeys) and information may differ by species where noted
[6]Closely related to primates
[7]Member of *Canid* family
[8]Expert opinion based on limited information to date
[9]Member of *Cricetidae* family
[10]Very low-level susceptibility in experimental setting with no clinical signs but seroconversion and low-level viral shedding
[11]Very low-level susceptibility in experimental setting with mild clinical signs and low-levels of antibodies but no viral shedding
[12] Susceptible to certain variants of SARS-CoV-2

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FW: Mink and SARS-CoV-2 risk assessment and hazard profile

From: Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>
To: Parker, Esther HLTH:EX <Esther.Parker@gov.bc.ca>
Sent: July 13, 2021 10:00:29 AM PDT
Attachments: Briefing note risk management options mink farming.doc

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

From: Clair, Veronic [BCCDC] <veronic.clair@bccdc.ca>
Sent: Friday, July 02, 2021 11:22 AM
To: Henry, Bonnie [EXT] <bonnie.henry@gov.bc.ca>
Cc: Gustafson, Reka [BCCDC] <reka.gustafson@phsa.ca>; Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>; Naus, Monika [BCCDC] <Monika.Naus@bccdc.ca>; Fraser, Erin [BCCDC] <Erin.Fraser@bccdc.ca>; Singal, Mayank [BCCDC] <mayank.singal@bccdc.ca>
Subject: Re: Mink and SARS-CoV-2 risk assessment and hazard profile

Hi Bonnie,

Attached is the briefing note with risk management options and my recommendation for the mink industry. In the interest of time, since the MAFF is asking to schedule a meeting to discuss the risk assessment before s.22 I will sent it to them as final drafts.

Let me know if you think I should also send the briefing note to them.

Best,

Veronic

From: Clair, Veronic [BCCDC]
Sent: June 30, 2021 4:08 PM
To: Henry, Bonnie [EXT]
Cc: Gustafson, Reka [BCCDC]; Newhouse, Emily [FH]; Naus, Monika [BCCDC]
Subject: Mink and SARS-CoV-2 risk assessment and hazard profile

Hi Bonnie,

Please see attached the final version of the Joint Rapid Qualitative Risk Assessment, and Hazard Profile produced in collaboration with the expert working group. I was hesitant to circulate these documents without giving you a chance to glance at them, especially the executive summary of the risk assessment.

Please let me know if you have any comments or if you would like me to circulate PDF versions of those documents to the MAFF deputy ministers (Jennifer and Tom).

s.13; s.17

Warm regards,

Veronic

Dr. Veronic Clair, MD, MSc, CCFP, FRCPC, PhD
Physician Epidemiologist
BC Centre for Disease Control
veronic.clair@bccdc.ca

I respectfully acknowledge that I live and work on the unceded territory of the xʷməθkwəy̓əm, Skwxwú7mesh, Stó:lō and Səl̓ilwətaʔ/Selilwitulh Nations.

BC COMMUNICABLE DISEASE CENTRE

OPTIONS FOR THE MANAGEMENT OF THE SARS-COV-2 RISK FROM MINK FARMING IN BC

DATE: June 30th 2021
PREPARED FOR: Dr Bonnie Henry
PREPARED BY: Veronic Clair in consultation with Emily Newhouse

PURPOSE: Provide risk management options based on the finding of the Joint Rapid Qualitative Risk Assessment (J-RQRA) and Hazard Profile

BACKGROUND:
Mink are very susceptible to SARS-CoV-2, with the potential for the virus to mutate in mink, as a host-specific adaptation as well as from expected ongoing viral evolution. Three mink farms in BC have been infected with SARS-CoV-2, with none generating concerning mutations. An Intersectoral OneHealth working group has successfully mitigated the risk in BC, to date, through collaboration on implementation of biosafety requirements, surveillance, inspection, and outbreak management. A comprehensive risk assessment and hazard profile have been completed by an expert group from BC, the Public Health Agency of Canada (PHAC) and the Canadian Food Inspection Agency (CFIA). It is important to consider the implication of the findings from those documents on the ongoing management of the risk, recognizing the uncertainties related to the risk. Further background information is available in the aforementioned documents.

KEY CONSIDERATIONS:
As per the J-RQRA, the combined assessment of probability and consequence of the emergence and circulation of a VOI in the community of mink/wildlife origin are as follows:

1. What is the likelihood and impact of emergence and circulation of a SARS-CoV-2 variant of interest (VOI) in the community due to virus evolution in mink or 'wildlife after exposure to mink' during completion of **THIS CYCLE**, compared to what is seen with currently circulating variants and evolving public health measures?

   Probability: very unlikely (VOI in wildlife pathway) to very unlikely/unlikely (VOI in mink pathway)
   Uncertainty: moderate (VOI in mink pathway) to high (VOI in wildlife pathway)

   Impact: minor to moderate at the local/regional level, and slightly less at the provincial level
   Uncertainty: moderate to high

2. What is the likelihood and impact of emergence and circulation of a SARS-CoV-2 variant of interest (VOI) in the community due to virus evolution in mink or 'wildlife after exposure to mink' **WITHIN THE NEXT 5 YEARS**, compared to what is seen with currently circulating variants and evolving public health measures?

   Probability: very unlikely (VOI in wildlife pathway) to unlikely (VOI in mink pathway)
   Uncertainty: moderate (VOI in mink pathway) to high (VOI in wildlife pathway)

   Impact: minor to moderate at the local/regional level, and slightly less at the provincial level
   Uncertainty: moderate to high

Although the probability of the the emergence and circulation of a VOI in the community of mink/wildlife origin are very unlikely to unlikely, with minor to moderate impact but with moderate to high uncertainty. These estimates are based on the assumption of high level of compliance with stringeant safety and PPE requirement for this cycle and less so for the next five years, but with potentially other factors mitigating the risk over that longer time frame. Impacts have been assessed in the context of most recent knowledge of the

DRAFT

likely efficacy of vaccines and the relative contribution of a VOI from mink to human risk as compared to existing human sources of VOI. It is reassuring that to date, there are no known VOI of mink origin circulating, despite ongoing mink farming worldwide.

There are indications that compliance with current recommended use of medical mask on farm is decreasing. This is not surprising considering a general population sense that the risk from COVID is substantially decreased with immunization against the disease and the known difficulty in many industries with compliance with PPE requirements.

EQUITY ASSESSMENT AND JURISDICTIONAL SCAN:

The other Canadian provinces with mink farming have not uncovered mink outbreaks. However, surveillance and regulatory oversight appear substantially less than in BC. As far as we could ascertain, other provinces intend to allow their industry to continue operating under safety measures less onerous than in BC. However, mink farms in other provinces did not appear to be in a region with such close integration with a metropolitan area.

Several jurisdictions who banned fur farming had planned to do so before the COVID pandemic. The Netherland had such plans, which were accelerated by the pandemic when they experienced widespread SARS-CoV-2 mink outbreaks. As of the last jurisdictional scan from earlier this year, France and Poland are the only two countries, who reported mink outbreaks, who announced or are debating a ban on mink farming. The USA, Spain, Sweden, Greece, Lithuania, and Ireland have each experienced at least one mink outbreak without publically announcing or debating a ban on mink farming. Most have implemented enhanced surveillance, although there is little detail available.

RISK MANAGEMENT OPTIONS

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Option 3A: Allowing the industry to operate at its current size, with a moratorium on establishing new farms or expanding production in the existing farms, continuing with mortality and/or environmental sampling of the herd to detect outbreak early (enabling implementation of increased safety measures rapidly), and allowing a slight decrease in safety measures compared to current safety plans

s.13

RECOMMENDATION: OPTION 3A

s.13

RE: Risk assessment for Mink

From:	Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>
To:	Hrycuik, Lorie HLTH:EX <Lorie.Hrycuik@gov.bc.ca>, Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>, Gustafson, Reka HLTH:IN <reka.gustafson@phsa.ca>, XT:HLTH Galanis, Eleni <eleni.galanis@bccdc.ca>
Sent:	July 13, 2021 10:06:32 AM PDT
Attachments:	Briefing note risk management options mink farming.doc, Joint_RQRA_MINK SARS-CoV-2 Final_ June 30th.docx, Hazard Profile J-RQRA_SARS-CoV-2 Final June 30.docx

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Hi Lorie,

Attached are the relevant documents - hazard profile, risk assessment, and briefing note on management options.

Regards,
Emily

-----Original Message-----
From: Hrycuik, Lorie HLTH:EX <Lorie.Hrycuik@gov.bc.ca>
Sent: Tuesday, July 13, 2021 10:03 AM
To: Henry, Bonnie [EXT] <bonnie.henry@gov.bc.ca>; Gustafson, Reka [BCCDC] <reka.gustafson@phsa.ca>; Galanis, Eleni [BCCDC] <Eleni.Galanis@bccdc.ca>; Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>
Subject: RE: Risk assessment for Mink

EXTERNAL SENDER. If you suspect this message is malicious, please forward to spam@phsa.ca and do not open attachments or click on links.

Bonnie, the DMO has asked for material on this issue to support the Minister to meet with Minister Popham this coming Thursday. He is seeking background materials. They are due to DMO by 9 am tomorrow.

Lorie

Lorie Hrycuik
Executive Lead, Population & Public Health Division Ministry of Health
Phone: (778) 974-3766 | Lorie.Hrycuik@gov.bc.ca

-----Original Message-----
From: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Sent: July 13, 2021 8:59 AM
To: Gustafson, Reka HLTH:IN <reka.gustafson@phsa.ca>; XT:HLTH Galanis, Eleni <eleni.galanis@bccdc.ca>; Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>; Hrycuik, Lorie HLTH:EX <Lorie.Hrycuik@gov.bc.ca>
Subject: RE: Risk assessment for Mink

You can send that to me. Emily and I have been covering the mink file along with Veronic and now Mayank as he is back.

b

Dr Bonnie Henry
Provincial Health Officer
Office of the PHO
Ministry of Health
s.15; s.19
Mailing address: PO Box 9648, STN PROV GOVT Victoria, BC V8W 9P4 Bonnie.henry@gov.bc.ca

Phone: s.17; s.19

I gratefully acknowledge that I live and work on the traditional unceded territory of the Lekwungen Peoples, specifically the Songhees and Esquimalt First Nations. Hay'sxw'qu Si'em

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-----Original Message-----
From: Gustafson, Reka [BCCDC] <reka.gustafson@phsa.ca>
Sent: July 13, 2021 8:52 AM
To: XT:HLTH Galanis, Eleni <eleni.galanis@bccdc.ca>; Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>; Hrycuik, Lorie HLTH:EX <Lorie.Hrycuik@gov.bc.ca>; Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Subject: Risk assessment for Mink

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Hi Everyone,

The Minister's office has a question around the risk assessment related to Mink. Lorie, could you clarify the question, so we can sort out who best can respond?

Many thanks,

Reka

Sent from my iPhone

s.13

Ministry of Agriculture, Food and Fisheries and Ministry of Health
BRIEFING NOTE FOR MINISTERS FOR DECISION

Ref: XXXXX Date: July 9, 2021

Title: Continuation of mink farming with SARS-CoV-2 presence.

Issue: The risk to public health posed by SARS-CoV-2 outbreaks on mink farms in British Columbia (B.C.) and the virus mitigation strategies needed to allow the industry to continue.

Background:
Mink farming in B.C. is of increasing public concern. Animal welfare organizations and some virologists argue that the conditions under which farmed mink live and their susceptibility to the SARS-CoV-2 virus increase the chance that a viral mutation could occur in animals and be passed to humans, possibly impacting vaccine effectiveness. Concerns regarding the spread of the virus in farms and the impact of a mutated virus on vaccines have led to calls for mink culls and an end to mink farming internationally.

Between December 2020 and May 2021, SARS-CoV-2 was detected in mink on three mink farms in the B.C. Fraser Valley. Human-to-mink transmission is the suspected source of virus introduction onto the farms. The affected farms were placed under quarantine. Two of the three farms are currently free from disease, but all farms remain under quarantine until the sites are considered fully decontaminated. Under the *Public Health Act*, a Class Order applying to all active mink farms in the Fraser Health Authority (FHA) mandated a series of measures to enhance monitoring and control of SARS-CoV-2 on mink farms, including safety plans, enhanced personal protective equipment (PPE), and participation in testing programs, including weekly mink mortality viral testing. On April 15, 2021, public health issued an Order that permitted only vaccinated mink farmworkers to have duties that put them in close contact with mink.

The Ministry of Health (HLTH) and other agencies are working with the mink industry to implement ongoing human and animal virus surveillance and enhanced COVID-19 safety plans on farms. On an April 1, 2021 conference call with the Provincial Health Officer (PHO), B.C. Centre for Disease Control (CDC), FHA and Ministry of Agriculture, Food and Fisheries (AFF) staff, the risk mink farming presents to humans was determined to be moderate, however significant mitigation, continued compliance by the farmers, and ongoing monitoring was necessary to manage the risk. On a May 20, 2021 conference call with the PHO, CDC, FHA and AFF staff, the SARS-CoV-2 outbreak at a third mink farm could not be attributed with certainty to a specific source of the virus. Workers at this site had received a first dose of vaccine several weeks prior to this outbreak. The Delta strain of the virus (the strain which first emerged in India) was confirmed to be present at this farm.

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AFF currently acknowledges and regulates fur farming as an acceptable farm practice in B.C. The legislation governing the industry are the *Prevention of Cruelty to Animals Act*, the Animal Care Codes of Practice Regulation, the *Animal Health Act*, and the Fur Farm Regulation. The province has 11 licensed mink farms located in the Fraser Valley with an estimated 317,000 animals, one licensed mink farm in Sparwood (no animals), and one chinchilla farm with under 100 animals.

First Nations Considerations:
Under the modern treaty agreements, B.C. is required to notify each of the Treaty First Nations of proposed legislation if the respective Final Agreement provides that Treaty First Nation Government with law making authority in respect of the subject matter of the legislation. The Tsawwassen, Maa-nulth and Tla'amin Final Agreements all have law-making authority related to the regulation of business and land, which is the most analogous to the regulation of mink farming. None of the existing mink fur farms are located on First Nations lands, however, the proposed order prohibits future fur farms, which could include farms located on those lands. Therefore, the treaty requirement to notify the Treaty First Nations is likely triggered.

Additionally, the duty to consult Indigenous Peoples is triggered when contemplated Crown conduct has the potential to adversely affect asserted or proven Aboriginal rights, title, or treaty rights (Section 35 Rights). Aboriginal title includes the right to decide how the land will be used and includes the economic benefits of that land. As the prohibition on mink farming limits a particular use of land that an Aboriginal title holder may choose in the future, the proposed regulation could constitute an adverse effect on s. 35 Aboriginal title sufficient to trigger the duty to consult.

If an order is issued to prohibit future farm farms, this prohibition could have an impact on both Treaty and Section 35 rights. As a result, consultation with the 204 First Nations and Treaty First Nations must occur. However, an order for a cap on the number of animals and vaccinations do not trigger a duty to consult.

Discussion:
On June 29, 2021, a Joint Rapid Qualitative Risk Assessment (risk assessment) was released by a CDC led multi-jurisdictional expert group. This assessment evaluated the risk of emergence of a variant of interest (VOI) from an infected mink herd, spreading in the general population and potentially becoming a variant of concern (VOC) for public health. The risk assessment determined the risks posed by mink farms to be the following:

- Immediate (current breeding cycle)
    - Likelihood and impact of emergence and circulation of a SARS-CoV-2 VOI in the community due to virus evolution in mink: **very unlikely/unlikely with moderate uncertainty**

    - Likelihood and impact of emergence and circulation of a SARS-CoV-2 VOI in the community due to 'wildlife after exposure to mink': **very unlikely with high uncertainty**
    - Impact: **minor to moderate at the local/regional level and slightly less at the provincial level, with moderate to high uncertainty**
- Within the next five years
    - Likelihood and impact of emergence and circulation of a SARS-CoV-2 VOI in the community due to virus evolution in mink: **unlikely with moderate uncertainty**
    - Likelihood and impact of emergence and circulation of a SARS-CoV-2 VOI in the community due to 'wildlife after exposure to mink': **very unlikely with high uncertainty**
    - Impact: **minor to moderate at the local/regional level and slightly less at the provincial level, with moderate to high uncertainty**

Several assumptions influence the risk assessment provided above. These assumptions relate to the continued presence of SARS-CoV-2 in society, and the mitigation strategies adopted to respond to the virus. Changes to the assumptions may have an effect (positive or negative) on the final risk assessment, and significant changes may indicate the need for re-assessment in some circumstances. The assumptions regarding the virus mitigation strategies are the only area in which government can intervene to control the risks to public health. The mitigation strategies outlined in the risk assessment are as follows:

Mink

- Mink vaccination:
    - This cycle – assume not available
    - 5 years – assumed to be available and in use in some countries, though efficacy in preventing infection or severe disease in mink is uncertain, cost and affordability in the context of mink farming is unknown and therefore use, benefits and risks in B.C. are uncertain
- Environmental testing: ongoing
- Mandatory clinical reporting of the herd symptoms and mortality: ongoing
- Mortality testing: ongoing
- Circumstances needing live animal testing: ongoing

Worker

- Worker immunization:
    - This cycle – assume fully vaccinated as of June 2021
    - 5 years – assume fully vaccinated
    - We assume that migrant workers will have to be fully immunized before being allowed to work with minks
- PPE and other work procedures (E.g. use of mask in common indoor areas while at work for any work, in break, or while working with mink regardless of area and distancing):

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    - This cycle – as per current protocol
    - 5 years – worker to abstain from working if they present with COVID-19 symptoms, medical masks and eye protection when working on the farm, decrease in usage of other PPE and protocols implemented for COVID-19, return to pre-COVID safety measures, no mandatory distancing between workers in common areas
- Participation in testing (test type, frequency):
    - This cycle – same as now
    - 5 years – Public health initiated testing will occur in humans if another positive case is found in humans, mink or the environment; closing of self-referred testing centre (COVID-19 testing for clinical symptoms carried by clinicians; various option for self-test available; industry driven point of care testing of workers will be optional)

Operator

- This cycle – same as now
- 5 years – return to regular inspections, regular operations

Wildlife and domestic animal infection monitoring sustainability

- This cycle – continued sampling around a positive premise
- 5 years – likely not a long-term option using current process

Community

- 75% of general population immunized, ongoing assessment of efficacy with vaccination program able to adjust to address weaning effectiveness, if applicable
- Extensive community genomic surveillance for this cycle with further increase based on mink related outbreaks
- Genomic surveillance at community level decreased in 5 years but still occurring, and can be scaled up if needed in relation to outbreaks in mink farms

There is concern that mink farmers may not continue to show a high level of compliance with the SARS-CoV-2 mitigation strategies. Farmers may experience compliance fatigue and may not be motivated to maintain the high standards necessary to preserve a low risk to public health. For example, there are indications that compliance with the current recommended use of medical masks on farm is decreasing. As a result, it may be prudent for the government to legislate compliance with the mitigation strategies through legislative amendments or a *Public Health Act* Order by the PHO.

<<AFF to insert estimated govt resources, level of effort and costs required by the province to maintain oversight and monitoring of the sector>>>

Options:

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s.13; s.17

Option 2: **Implementation of new HLTH (PHO and Fraser Health) Orders and continuation of existing orders, including**:

- Requirement to continue mitigation strategies listed in the risk assessment (such as vaccinations for workers and animals, PPE requirements, testing, etc.),
- A cap on the mink herd size per farm to remain consistent with current herd size, and
- A prohibition on new mink farms.

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Recommendations.13

Approved / Not Approved

LANA POPHAM, Minister — Date Signed

ADRIAN DIX, Minister — Date Signed

Contact: Lauren Yawney, Senior Legislative Analyst, 236 478-3443

AFF	ADM	DM
DIR		

HLTH DIR	ADM	DM

DRAFT

FW: positive mink and Draft Joint decision note

From: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
To: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Sent: July 14, 2021 5:20:40 PM PDT
Attachments: 2021-07-14 DN Mink public health risk assessment.docx

This is the latest version and the fact two wild mink are now positive.
b

Dr Bonnie Henry
Provincial Health Officer
Office of the PHO
Ministry of Health
s.15; s.19
Mailing address: PO Box 9648, STN PROV GOVT
Victoria, BC
V8W 9P4
Bonnie.henry@gov.bc.ca

Phone: s.17; s.19

I gratefully acknowledge that I live and work on the traditional unceded territory of the Lekwungen Peoples, specifically the Songhees and Esquimalt First Nations. Hay'sxw'qu Si'em

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From: McGuire, Jennifer AFF:EX <Jennifer.Mcguire@gov.bc.ca>
Sent: July 14, 2021 10:15 AM
To: Ethier, Tom AFF:EX <Tom.Ethier@gov.bc.ca>; Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Subject: FW: positive mink and Draft Joint decision note

Hello Tom and Dr Henry,
New information regarding the wildlife surveillance. (see below)

Also attached is a slightly updated Decision Note s.14
The briefing for Ministers is scheduled for Thursday July 15 at 3pm. Comments from HLTH would be appreciated prior to the ministers meeting.
Thank you

Jennifer McGuire, P.Ag.
Assistant Deputy Minister, Science Policy and Inspections Division
Ministry of Agriculture, Food and Fisheries
Ph: 778-698-8521 Cell: 250-361-5944

From: Gunvaldsen, Rayna AFF:EX <Rayna.Gunvaldsen@gov.bc.ca>
Sent: July 14, 2021 10:03 AM
To: Chai, Shauna-Lee AFF:EX <Shauna-Lee.Chai@gov.bc.ca>; McGuire, Jennifer AFF:EX <Jennifer.Mcguire@gov.bc.ca>
Cc: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
Subject: positive mink

FYI – two mink trapped through wildlife surveillance around the currently infected premises have tested positive for SARS-CoV-2. I have no further information at this time, but I'll keep you posted as I know more.
Please let me know what questions you have and I'll make sure to get answers.

Thank you,
Rayna

Rayna E. Gunvaldsen BSA DVM MSc
Chief Veterinarian
Animal Welfare and Dairy Program Veterinarian
BC Ministry of Agriculture, Food, and Fisheries
Office: 604-556-3013
Cell: 604-226-6706

Page 443 of 656 to/à Page 459 of 656

Withheld pursuant to/removed as

s.14 ; s.17

RE: Joint Minister's Briefing - MLP/Minister Dix Re: Mink - MLP/MAD/Dr. Henry/Erik/Tom/Jennifer/Sam/Ellora

From: Emerson, Brian P HLTH:EX
To: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Sent: July 16, 2021 5:22:42 PM PDT

Hi Bonnie.

Just so you know s.14
s.14

My initial read of the preliminary analysis is that it is likely possible for you, or the FH MHO to order that any expansion of mink farming (either in the form of new farms or expansion to the number of mink that are currently farmed at existing farms in BC), is prohibited. This would depend on you being of the opinion that that mink farming endangers or is likely to endanger public health (e.g. mink farming is a "health hazard"); and you believe it is necessary to make an order to prevent further harm from the health hazard of mink farming.

Something to think about over the weekend.s.14

Thanks.

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

From: Ethier, Tom AFF:EX <Tom.Ethier@gov.bc.ca>
Sent: July 16, 2021 3:06 PM
To: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Cc: Dix, Adrian HLTH:EX <Adrian.Dix@gov.bc.ca>; Kristianson, Eric PREM:EX <Eric.Kristianson@gov.bc.ca>; MINCAL, AFF AFF:EX <MINCAL.AGRI@gov.bc.ca>; McGuire, Jennifer AFF:EX <Jennifer.Mcguire@gov.bc.ca>; Godfrey, Sam AFF:EX <Sam.Godfrey@gov.bc.ca>; Sundhu, Ellora AFF:EX <Ellora.Sundhu@gov.bc.ca>; Halicki, Ashley HLTH:EX <Ashley.Halicki@gov.bc.ca>; Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Subject: Re: Joint Minister's Briefing - MLP/Minister Dix Re: Mink - MLP/MAD/Dr. Henry/Erik/Tom/Jennifer/Sam/Ellora

Sorry Bonnie - Yes we can arrange a later time.

Sent from my iPhone

> On Jul 16, 2021, at 2:26 PM, Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca> wrote:
>
> I am not going to have had the conversations I need to by 9 am on Monday. Could we please move this to later in the day. I can be free after 1:30.
>
> *Dr Bonnie Henry*
> *Provincial Health Officer*
> *Office of the PHO*
> *Ministry of Health*
> s.15; s.19

Mailing address: PO Box 9648, STN PROV GOVT
Victoria, BC
V8W 9P4
Bonnie.henry@gov.bc.ca

Phone: s.17; s.19

I gratefully acknowledge that I live and work on the traditional unceded territory of the Lekwungen Peoples, specifically the Songhees and Esquimalt First Nations. Hay'sxw'qu Si'em

Warning: This email is intended only for the use of the individual or organization to whom it is addressed. It may contain information that is privileged or confidential. Any distribution, disclosure, copying, or other use by anyone else is strictly prohibited. If you have received this in error, please telephone or e-mail the sender immediately and delete the message.

-----Original Appointment-----
From: Ethier, Tom AFF:EX <Tom.Ethier@gov.bc.ca>
Sent: July 16, 2021 11:25 AM
To: Ethier, Tom AFF:EX; Dix, Adrian HLTH:EX; Henry, Bonnie HLTH:EX; Kristianson, Eric PREM:EX; MINCAL, AFF AFF:EX; McGuire, Jennifer AFF:EX
Cc: Godfrey, Sam AFF:EX; Sundhu, Ellora AFF:EX
Subject: Joint Minister's Briefing - MLP/Minister Dix Re: Mink - MLP/MAD/Dr. Henry/Erik/Tom/Jennifer/Sam/Ellora
When: July 19, 2021 9:00 AM-9:30 AM (UTC-08:00) Pacific Time (US & Canada).
Where: Microsoft Teams Meeting - Link Enclosed

Microsoft Teams meeting

Join on your computer or mobile app
Click here to join the meeting
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s.13 ; s.14 ; s.17

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s.14 ; s.17

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Withheld pursuant to/removed as

s.13 ; s.14 ; s.17

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Withheld pursuant to/removed as

s.14 ; s.17

RE: Mink Farm Related Orders

From: Burkett, Christy [FH] <Christy.Burkett@fraserhealth.ca>
To: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Cc: XT:HLTH Brodkin, Elizabeth <elizabeth.brodkin@fraserhealth.ca>, XT:Tyler, Ingrid FRHA:IN <ingrid.tyler@fraserhealth.ca>
Sent: July 19, 2021 12:16:22 PM PDT
Attachments: Mink Farm Order - Vaccinations.pdf, Mink Farm Order - Dec 14 2020.pdf

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Hi Brian,

The attached are the 2 orders that were given according to EH manager Blair Choquette who was working with Emily on the Mink farms.

Thanks,

Christy Burkett
Christy.burkett@fraserhealth.ca
Phone: *604-930-5405 ext 765638*

From: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Sent: Monday, July 19, 2021 12:00 PM
To: Burkett, Christy [FH] <Christy.Burkett@fraserhealth.ca>
Cc: Brodkin, Elizabeth Dr. [FH] <Elizabeth.Brodkin@fraserhealth.ca>; Tyler, Ingrid [FH] <ingrid.tyler@fraserhealth.ca>
Subject: RE: Mink Farm Related Orders

EXTERNAL SENDER. If you suspect this message is malicious, please forward to spam@phsa.ca and **do not** open attachments or click on links.

Hi Christy. I sent the request below to Emily but she is away and her email says to contact you.

Would you have copies of the mink farm related orders that are in force that you could send me?

Thanks.

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

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From: Emerson, Brian P HLTH:EX
Sent: July 19, 2021 11:45 AM
To: Emily Newhouse <Emily.newhouse@fraserhealth.ca>; Elizabeth Brodkin (elizabeth.brodkin@fraserhealth.ca) <elizabeth.brodkin@fraserhealth.ca>; Tyler, Ingrid <ingrid.tyler@fraserhealth.ca>
Subject: Mink Farm Related Orders

Good morning.

As you are likely aware Bonnie and the Chief Vet are considering whether additional measures are needed to deal with the mink farms and COVID-19.

Please send me the orders that you have in place for the farms, as these will be helpful in determining a potential role for the PHO and Chief Vet, versus a role for Fraser Health.

Thanks.

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

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Excerpts of the PUBLIC HEALTH ACT and Regulations

Definitions

1 In this Act:

"health hazard" means

(a) a condition, a thing or an activity that

(i) endangers, or is likely to endanger, public health, or

(ii) interferes, or is likely to interfere, with the suppression of infectious agents or hazardous agents, or

(b) a prescribed condition, thing or activity, including a prescribed condition, thing or activity that

(i) is associated with injury or illness, or

(ii) fails to meet a prescribed standard in relation to health, injury or illness;

Division 3 — Orders Respecting Infectious Agents and Hazardous Agents

When orders respecting infectious agents and hazardous agents may be made

27 (1) A medical health officer may issue an order under this Division only if the medical health officer reasonably believes that

(a) a person

(i) is an infected person, or

(ii) has custody or control of an infected person or an infected thing, and

(b) the order is necessary to protect public health.

(2) An order may be issued based on clinical findings or a person's or thing's circumstances or medical history, even if the person or thing has been examined and the examination did not reveal the presence of an infectious agent or a hazardous agent.

(3) For greater certainty, this section applies even if the person subject to the order is complying with all terms and conditions of a licence, a permit, an approval or another authorization issued under this or any other enactment.

General powers respecting infectious agents and hazardous agents

28 (1) If the circumstances described in section 27 *[when orders respecting infectious agents and hazardous agents may be made]* apply, a medical health officer may order a person to do anything that the medical health officer reasonably believes is necessary for either or both of the following purposes:

(a) to determine whether an infectious agent or a hazardous agent exists, or likely exists;

(b) to prevent the transmission of an infectious agent or a hazardous agent.

(2) A medical health officer may, in respect of an infected thing,

(a) make any order, with any necessary modifications, that can be made under this Division as if the infected thing were an infected person, and

(b) direct the order to any person having custody or control of the infected thing.

Specific powers respecting infectious agents and hazardous agents

29 (1) An order may be made under this section only

(a) if the circumstances described in section 27 *[when orders respecting infectious agents and hazardous agents may be made]* apply, and

(b) for the purposes set out in section 28 (1) *[general powers respecting infectious agents and hazardous agents]*.

(2) Without limiting section 28, a medical health officer may order a person to do one or more of the following:

(a) remain in a specified place, or not enter a place;

(b) avoid physical contact with, or being near, a person or thing;

(c) be under the supervision or care of a specified person;

(d) provide to the medical health officer or a specified person information, records, samples or other matters relevant to the person's possible infection with an infectious agent or contamination with a hazardous agent, including information respecting persons who may have been exposed to an infectious agent or a hazardous agent by the person;

(e) be examined by a specified person, including

(i) going to a specified facility for examination, and

(ii) being examined before a particular date or according to a schedule;

(f) submit to diagnostic examination, including going to a specified facility or providing the results to a specified person;

(g) take preventive measures, including

(i) going to a specified facility for preventive measures,

(ii) complying with preventive measures set out in the order, specified by a medical practitioner or nurse practitioner, or both, and

(iii) beginning preventive measures before a particular date, and continuing until a particular date or event;

(h) provide evidence of complying with the order, including

(i) getting a certificate of compliance from a medical practitioner, nurse practitioner or specified person, and

(ii) providing to a medical health officer any relevant record;

(i) take a prescribed action.

Division 4 — Orders Respecting Health Hazards and Contraventions

When orders respecting health hazards and contraventions may be made

30 (1) A health officer may issue an order under this Division only if the health officer reasonably believes that

(a) a health hazard exists,

(b) a condition, a thing or an activity presents a significant risk of causing a health hazard,

(c) a person has contravened a provision of the Act or a regulation made under it, or

(d) a person has contravened a term or condition of a licence or permit held by the person under this Act.

(2) For greater certainty, subsection (1) (a) to (c) applies even if the person subject to the order is complying with all terms and conditions of a licence, a permit, an approval or another authorization issued under this or any other enactment.

General powers respecting health hazards and contraventions

31 (1) If the circumstances described in section 30 *[when orders respecting health hazards and contraventions may be made]* apply, a health officer may order a person to do anything that the health officer reasonably believes is necessary for any of the following purposes:

(a) to determine whether a health hazard exists;

(b) to prevent or stop a health hazard, or mitigate the harm or prevent further harm from a health hazard;

(c) to bring the person into compliance with the Act or a regulation made under it;

(d) to bring the person into compliance with a term or condition of a licence or permit held by that person under this Act.

(2) A health officer may issue an order under subsection (1) to any of the following persons:

(a) a person whose action or omission

(i) is causing or has caused a health hazard, or

(ii) is not in compliance with the Act or a regulation made under it, or a term or condition of the person's licence or permit;

(b) a person who has custody or control of a thing, or control of a condition, that

(i) is a health hazard or is causing or has caused a health hazard, or

(ii) is not in compliance with the Act or a regulation made under it, or a term or condition of the person's licence or permit;

(c) the owner or occupier of a place where

(i) a health hazard is located, or

(ii) an activity is occurring that is not in compliance with the Act or a regulation made under it, or a term or condition of the licence or permit of the person doing the activity.

Specific powers respecting health hazards and contraventions

32 (1) An order may be made under this section only

(a) if the circumstances described in section 30 *[when orders respecting health hazards and contraventions may be made]* apply, and

(b) for the purposes set out in section 31 (1) *[general powers respecting health hazards and contraventions]*.

(2) Without limiting section 31, a health officer may order a person to do one or more of the following:

(a) have a thing examined, disinfected, decontaminated, altered or destroyed, including

(i) by a specified person, or under the supervision or instructions of a specified person,

(ii) moving the thing to a specified place, and

(iii) taking samples of the thing, or permitting samples of the thing to be taken;

(b) in respect of a place,

(i) leave the place,

(ii) not enter the place,

(iii) do specific work, including removing or altering things found in the place, and altering or locking the place to restrict or prevent entry to the place,

(iv) neither deal with a thing in or on the place nor dispose of a thing from the place, or deal with or dispose of the thing only in accordance with a specified procedure, and

(v) if the person has control of the place, assist in evacuating the place or examining persons found in the place, or taking preventive measures in respect of the place or persons found in the place;

(c) stop operating, or not operate, a thing;

(d) keep a thing in a specified place or in accordance with a specified procedure;

(e) prevent persons from accessing a thing;

(f) not dispose of, alter or destroy a thing, or dispose of, alter or destroy a thing only in accordance with a specified procedure;

(g) provide to the health officer or a specified person information, records, samples or other matters relevant to a thing's possible infection with an infectious agent or contamination with a hazardous agent, including information respecting persons who may have been exposed to an infectious agent or hazardous agent by the thing;

(h) wear a type of clothing or personal protective equipment, or change, remove or alter clothing or personal protective equipment, to protect the health and safety of persons;

(i) use a type of equipment or implement a process, or remove equipment or alter equipment or processes, to protect the health and safety of persons;

(j) provide evidence of complying with the order, including

(i) getting a certificate of compliance from a medical practitioner, nurse practitioner or specified person, and

(ii) providing to a health officer any relevant record;

(k) take a prescribed action.

(3) If a health officer orders a thing to be destroyed, the health officer must give the person having custody or control of the thing reasonable time to request reconsideration and review of the order under sections 43 and 44 unless

(a) the person consents in writing to the destruction of the thing, or

(b) Part 5 *[Emergency Powers]* applies.

Contents of orders

39 (3) An order may be made in respect of a class of persons.

Duty to comply with orders

42 (1) A person named or described in an order made under this Part must comply with the order.

Part 5 — Emergency Powers

Division 1 — Application of this Part

Definitions for this Part

51 In this Part:

"emergency" means a localized event or regional event that meets the conditions set out in section 52 (1) or (2) *[conditions to be met before this Part applies]*, respectively;

"localized event" means an immediate and significant risk to public health in a localized area;

"regional event" means an immediate and significant risk to public health throughout a region or the province.

Conditions to be met before this Part applies

52 (1) A person must not exercise powers under this Part in respect of a localized event unless the person reasonably believes that

(a) the action is immediately necessary to protect public health from significant harm, and

(b) compliance with this Act, other than this Part, or a regulation made under this Act would hinder that person from acting in a manner that would avoid or mitigate an immediate and significant risk to public health.

(2) Subject to subsection (3), a person must not exercise powers under this Part in respect of a regional event unless the provincial health officer provides notice that the provincial health officer reasonably believes that at least 2 of the following criteria exist:

(a) the regional event could have a serious impact on public health;

(b) the regional event is unusual or unexpected;

(c) there is a significant risk of the spread of an infectious agent or a hazardous agent;

(d) there is a significant risk of travel or trade restrictions as a result of the regional event.

(3) If the provincial health officer is not immediately available to give notice under subsection (2), a person may exercise powers under this Part until the provincial health officer becomes available.

Part applies despite other enactments

53 During an emergency, this Part applies despite any provision of this or any other enactment, including

(a) in respect of the collection, use or disclosure of personal information, the *Freedom of Information and Protection of Privacy Act* and the *Personal Information Protection Act*, and

(b) a provision that would impose a specific duty, limit or procedural requirement in respect of a specific person or thing,

to the extent there is any inconsistency or conflict with the provision or other enactment.

Division 2 — Emergency Powers

General emergency powers

54 (1) A health officer may, in an emergency, do one or more of the following:

(a) act in a shorter or longer time period than is otherwise required;

(b) not provide a notice that is otherwise required;

(c) do orally what must otherwise be done in writing;

(d) in respect of a licence or permit over which the health officer has authority under section 55 *[acting outside designated terms during emergencies]* or the regulations, suspend or vary the licence or permit without providing an opportunity to dispute the action;

(e) specify in an order a facility, place, person or procedure other than as required under section 63 *[power to establish directives and standards]*, unless an order under that section specifies that the order applies in an emergency;

(f) omit from an order things that are otherwise required;

(g) serve an order in any manner;

(h) not reconsider an order under section 43 *[reconsideration of orders]*, not review an order under section 44 *[review of orders]* or not reassess an order under section 45 *[mandatory reassessment of orders]*;

(i) exempt an examiner from providing examination results to an examined person;

(j) conduct an inspection at any time, with or without a warrant, including of a private dwelling;

(k) collect, use or disclose information, including personal information,

(i) that could not otherwise be collected, used or disclosed, or

(ii) in a form or manner other than the form or manner required.

(2) An order that may be made under this Part may be made in respect of a class of persons or things, and may make different requirements for different persons or things or classes of persons or things or for different geographic areas.

Offences

99 (1) A person who contravenes any of the following provisions commits an offence:

(k) section 42 *[failure to comply with an order of a health officer]*, except in respect of an order made under section 29 (2) (e) to (g) *[orders respecting examinations, diagnostic examinations or preventive measures]*;

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Excerpts of the PUBLIC HEALTH ACT and Regulations

Definitions

1 In this Act:

"health hazard" means

(a) a condition, a thing or an activity that

(i) endangers, or is likely to endanger, public health, or

(ii) interferes, or is likely to interfere, with the suppression of infectious agents or hazardous agents, or

(b) a prescribed condition, thing or activity, including a prescribed condition, thing or activity that

(i) is associated with injury or illness, or

(ii) fails to meet a prescribed standard in relation to health, injury or illness;

Division 3 — Orders Respecting Infectious Agents and Hazardous Agents

When orders respecting infectious agents and hazardous agents may be made

27 (1) A medical health officer may issue an order under this Division only if the medical health officer reasonably believes that

(a) a person

(i) is an infected person, or

(ii) has custody or control of an infected person or an infected thing, and

(b) the order is necessary to protect public health.

(2) An order may be issued based on clinical findings or a person's or thing's circumstances or medical history, even if the person or thing has been examined and the examination did not reveal the presence of an infectious agent or a hazardous agent.

(3) For greater certainty, this section applies even if the person subject to the order is complying with all terms and conditions of a licence, a permit, an approval or another authorization issued under this or any other enactment.

General powers respecting infectious agents and hazardous agents

28 (1) If the circumstances described in section 27 *[when orders respecting infectious agents and hazardous agents may be made]* apply, a medical health officer may order a person to do anything that the medical health officer reasonably believes is necessary for either or both of the following purposes:

(a) to determine whether an infectious agent or a hazardous agent exists, or likely exists;

(b) to prevent the transmission of an infectious agent or a hazardous agent.

(2) A medical health officer may, in respect of an infected thing,

(a) make any order, with any necessary modifications, that can be made under this Division as if the infected thing were an infected person, and

(b) direct the order to any person having custody or control of the infected thing.

Specific powers respecting infectious agents and hazardous agents

29 (1) An order may be made under this section only

(a) if the circumstances described in section 27 *[when orders respecting infectious agents and hazardous agents may be made]* apply, and

(b) for the purposes set out in section 28 (1) *[general powers respecting infectious agents and hazardous agents]*.

(2) Without limiting section 28, a medical health officer may order a person to do one or more of the following:

(a) remain in a specified place, or not enter a place;

(b) avoid physical contact with, or being near, a person or thing;

(c) be under the supervision or care of a specified person;

(d) provide to the medical health officer or a specified person information, records, samples or other matters relevant to the person's possible infection with an infectious agent or contamination with a hazardous agent, including information respecting persons who may have been exposed to an infectious agent or a hazardous agent by the person;

(e) be examined by a specified person, including

(i) going to a specified facility for examination, and

(ii) being examined before a particular date or according to a schedule;

(f) submit to diagnostic examination, including going to a specified facility or providing the results to a specified person;

(g) take preventive measures, including

(i) going to a specified facility for preventive measures,

(ii) complying with preventive measures set out in the order, specified by a medical practitioner or nurse practitioner, or both, and

(iii) beginning preventive measures before a particular date, and continuing until a particular date or event;

(h) provide evidence of complying with the order, including

(i) getting a certificate of compliance from a medical practitioner, nurse practitioner or specified person, and

(ii) providing to a medical health officer any relevant record;

(i) take a prescribed action.

Division 4 — Orders Respecting Health Hazards and Contraventions

When orders respecting health hazards and contraventions may be made

30 (1) A health officer may issue an order under this Division only if the health officer reasonably believes that

(a) a health hazard exists,

(b) a condition, a thing or an activity presents a significant risk of causing a health hazard,

(c) a person has contravened a provision of the Act or a regulation made under it, or

(d) a person has contravened a term or condition of a licence or permit held by the person under this Act.

(2) For greater certainty, subsection (1) (a) to (c) applies even if the person subject to the order is complying with all terms and conditions of a licence, a permit, an approval or another authorization issued under this or any other enactment.

General powers respecting health hazards and contraventions

31 (1) If the circumstances described in section 30 *[when orders respecting health hazards and contraventions may be made]* apply, a health officer may order a person to do anything that the health officer reasonably believes is necessary for any of the following purposes:

(a) to determine whether a health hazard exists;

(b) to prevent or stop a health hazard, or mitigate the harm or prevent further harm from a health hazard;

(c) to bring the person into compliance with the Act or a regulation made under it;

(d) to bring the person into compliance with a term or condition of a licence or permit held by that person under this Act.

(2) A health officer may issue an order under subsection (1) to any of the following persons:

(a) a person whose action or omission

(i) is causing or has caused a health hazard, or

(ii) is not in compliance with the Act or a regulation made under it, or a term or condition of the person's licence or permit;

(b) a person who has custody or control of a thing, or control of a condition, that

(i) is a health hazard or is causing or has caused a health hazard, or

(ii) is not in compliance with the Act or a regulation made under it, or a term or condition of the person's licence or permit;

(c) the owner or occupier of a place where

(i) a health hazard is located, or

(ii) an activity is occurring that is not in compliance with the Act or a regulation made under it, or a term or condition of the licence or permit of the person doing the activity.

Specific powers respecting health hazards and contraventions

32 (1) An order may be made under this section only

(a) if the circumstances described in section 30 *[when orders respecting health hazards and contraventions may be made]* apply, and

(b) for the purposes set out in section 31 (1) *[general powers respecting health hazards and contraventions]*.

(2) Without limiting section 31, a health officer may order a person to do one or more of the following:

(a) have a thing examined, disinfected, decontaminated, altered or destroyed, including

(i) by a specified person, or under the supervision or instructions of a specified person,

(ii) moving the thing to a specified place, and

(iii) taking samples of the thing, or permitting samples of the thing to be taken;

(b) in respect of a place,

(i) leave the place,

(ii) not enter the place,

(iii) do specific work, including removing or altering things found in the place, and altering or locking the place to restrict or prevent entry to the place,

(iv) neither deal with a thing in or on the place nor dispose of a thing from the place, or deal with or dispose of the thing only in accordance with a specified procedure, and

(v) if the person has control of the place, assist in evacuating the place or examining persons found in the place, or taking preventive measures in respect of the place or persons found in the place;

(c) stop operating, or not operate, a thing;

(d) keep a thing in a specified place or in accordance with a specified procedure;

(e) prevent persons from accessing a thing;

(f) not dispose of, alter or destroy a thing, or dispose of, alter or destroy a thing only in accordance with a specified procedure;

(g) provide to the health officer or a specified person information, records, samples or other matters relevant to a thing's possible infection with an infectious agent or contamination with a hazardous agent, including information respecting persons who may have been exposed to an infectious agent or hazardous agent by the thing;

(h) wear a type of clothing or personal protective equipment, or change, remove or alter clothing or personal protective equipment, to protect the health and safety of persons;

(i) use a type of equipment or implement a process, or remove equipment or alter equipment or processes, to protect the health and safety of persons;

(j) provide evidence of complying with the order, including

(i) getting a certificate of compliance from a medical practitioner, nurse practitioner or specified person, and

(ii) providing to a health officer any relevant record;

(k) take a prescribed action.

(3) If a health officer orders a thing to be destroyed, the health officer must give the person having custody or control of the thing reasonable time to request reconsideration and review of the order under sections 43 and 44 unless

(a) the person consents in writing to the destruction of the thing, or

(b) Part 5 *[Emergency Powers]* applies.

Contents of orders

39 (3) An order may be made in respect of a class of persons.

Duty to comply with orders

42 (1) A person named or described in an order made under this Part must comply with the order.

Part 5 — Emergency Powers

Division 1 — Application of this Part

Definitions for this Part

51 In this Part:

"emergency" means a localized event or regional event that meets the conditions set out in section 52 (1) or (2) *[conditions to be met before this Part applies]*, respectively;

"localized event" means an immediate and significant risk to public health in a localized area;

"regional event" means an immediate and significant risk to public health throughout a region or the province.

Conditions to be met before this Part applies

52 (1) A person must not exercise powers under this Part in respect of a localized event unless the person reasonably believes that

(a) the action is immediately necessary to protect public health from significant harm, and

(b) compliance with this Act, other than this Part, or a regulation made under this Act would hinder that person from acting in a manner that would avoid or mitigate an immediate and significant risk to public health.

(2) Subject to subsection (3), a person must not exercise powers under this Part in respect of a regional event unless the provincial health officer provides notice that the provincial health officer reasonably believes that at least 2 of the following criteria exist:

(a) the regional event could have a serious impact on public health;

(b) the regional event is unusual or unexpected;

(c) there is a significant risk of the spread of an infectious agent or a hazardous agent;

(d) there is a significant risk of travel or trade restrictions as a result of the regional event.

(3) If the provincial health officer is not immediately available to give notice under subsection (2), a person may exercise powers under this Part until the provincial health officer becomes available.

Part applies despite other enactments

53 During an emergency, this Part applies despite any provision of this or any other enactment, including

(a) in respect of the collection, use or disclosure of personal information, the *Freedom of Information and Protection of Privacy Act* and the *Personal Information Protection Act*, and

(b) a provision that would impose a specific duty, limit or procedural requirement in respect of a specific person or thing,

to the extent there is any inconsistency or conflict with the provision or other enactment.

Division 2 — Emergency Powers

General emergency powers

54 (1) A health officer may, in an emergency, do one or more of the following:

(a) act in a shorter or longer time period than is otherwise required;

(b) not provide a notice that is otherwise required;

(c) do orally what must otherwise be done in writing;

(d) in respect of a licence or permit over which the health officer has authority under section 55 *[acting outside designated terms during emergencies]* or the regulations, suspend or vary the licence or permit without providing an opportunity to dispute the action;

(e) specify in an order a facility, place, person or procedure other than as required under section 63 *[power to establish directives and standards]*, unless an order under that section specifies that the order applies in an emergency;

(f) omit from an order things that are otherwise required;

(g) serve an order in any manner;

(h) not reconsider an order under section 43 *[reconsideration of orders]*, not review an order under section 44 *[review of orders]* or not reassess an order under section 45 *[mandatory reassessment of orders]*;

(i) exempt an examiner from providing examination results to an examined person;

(j) conduct an inspection at any time, with or without a warrant, including of a private dwelling;

(k) collect, use or disclose information, including personal information,

(i) that could not otherwise be collected, used or disclosed, or

(ii) in a form or manner other than the form or manner required.

(2) An order that may be made under this Part may be made in respect of a class of persons or things, and may make different requirements for different persons or things or classes of persons or things or for different geographic areas.

Offences

99 (1) A person who contravenes any of the following provisions commits an offence:

(k) section 42 *[failure to comply with an order of a health officer]*, except in respect of an order made under section 29 (2) (e) to (g) *[orders respecting examinations, diagnostic examinations or preventive measures]*;

Page 502 of 656

Withheld pursuant to/removed as

s.14 ; s.15 ; s.17 ; s.19

Page 503 of 656 to/à Page 507 of 656

Withheld pursuant to/removed as

s.14 ; s.17

NCFAD has confirmed the two mink samples as positive

From: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
To: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Cc: Ethier, Tom AFF:EX <Tom.Ethier@gov.bc.ca>
Sent: July 20, 2021 11:54:11 AM PDT
Attachments: 2021DCS-0000037681-4.PDF, image001.jpg, image002.jpg, 2021DCS-0000037684-4.PDF

Dr. Henry, we have received confirmation from the NCFAD that the two mink samples have tested positive. See attached for detailed information.

BRITISH COLUMBIA
Ministry of Agriculture, Food and Fisheries

Ursula Viney, CPA, CGA
Executive Director, Plant and Animal Health Branch
Ministry of Agriculture, Food and Fisheries
Office: (778) 666-0546 Mobile: (604) 302-9001
Mailing Address: 1767 Angus Campbell Road | Abbotsford BC V3G 2M3

From: Joseph, Tomy AFF:EX <Tomy.Joseph@gov.bc.ca>
Sent: July 20, 2021 11:25 AM
To: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>; Himsworth, Chelsea AFF:EX <Chelsea.Himsworth@gov.bc.ca>
Subject: FW: results for ref# 21-4612 and 21-4614 mink samples
Importance: High

FYI. The NCFAD confirmed our positive results for nasal swabs from both cases (21-4612 and 21-4614).

From: Kathleen Hooper-McGrevy <kathleen.hooper-mcgrevy@inspection.gc.ca>
Sent: July 20, 2021 11:17 AM
To: Joseph, Tomy AFF:EX <Tomy.Joseph@gov.bc.ca>
Cc: Gunvaldsen, Rayna AFF:EX <Rayna.Gunvaldsen@gov.bc.ca>; Alex McIsaac <alex.mcisaac@inspection.gc.ca>; John Pasick <John.Pasick@inspection.gc.ca>; Bradley Pickering <bradley.pickering@inspection.gc.ca>; Julie Paré <julie.pare@inspection.gc.ca>
Subject: results for ref# 21-4612 and 21-4614 mink samples

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Afternoon Tomy,

You timed your query perfect. Brad had just authorized out this morning. Please find below the results for the last mink samples (ref#21-4612 and #21-4614) submitted to NCFAD. I have also attached the ROAs for your use.

WIN-AH-2021-OTH-0058
System ID#: 2021DCS-0000037681-4 (BC AHC #21-4612)
Reason for submission: lab referral for confirmatory testing
Location: Chilliwack, BC
Submitted by: Michelle Li
District Office: (864) Animal Health Abbotsford Multi Programs
Species: mink
Samples: 1 Nasal and 1 rectal swab a mink
Tests performed: SARS-CoV-2 Real Time RT-PCR
History: Mink submitted as part of wildlife COVID Surveillance. Suspected farm raised.

NCFAD Results:

- Sample #1 (nasal swab) tested **positive** for SARS-CoV-2. Tested positive for E gene and tested positive for RdRp gene.

- Sample #2 (rectal swab) tested **negative** for SARS-CoV-2. Tested negative for E gene and tested negative for RdRp gene.

WIN-AH-2021-OTH-0059
System ID#: 2021DCS-0000037684-4 (BC AHC #21-4614)
Reason for submission: lab referral for confirmatory testing
Location: Chilliwack, BC
Submitted by: Michelle Li
District Office: (864) Animal Health Abbotsford Multi Programs
Species: mink
Samples: 1 Nasal and 1 rectal swab a mink
Tests performed: SARS-CoV-2 Real Time RT-PCR
History: Mink submitted as part of wildlife COVID Surveillance. Suspected farm raised.

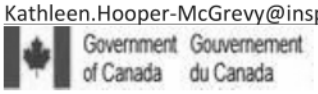
NCFAD Results:
- Sample #1 (nasal swab) tested **positive** for SARS-CoV-2. Tested positive for E gene and tested positive for RdRp gene.
- Sample #2 (rectal swab) tested **negative** for SARS-CoV-2. Tested suspicious for E gene and tested negative for RdRp gene.

Note: OIE recommended guidelines are two positive gene targets or 1 positive target with sequence data. RT-PCR result based on: Positive <36 Ct, suspicious 36-39 Ct, >39 Ct negative. Real time RT-PCR results are derived from a non-routine test currently under in-house validation.

If you have any questions, please don't hesitate to email me. I'm sure Julie would like to know if you figure out if these are in fact escapees from the closely located mink farm (for reporting to OIE).

Cheers
Kathleen

Dr. Kathleen Hooper-McGrevy
A/Director
NCFAD Research Manager and Diagnostic Coordinator, Science Branch
Canadian Food Inspection Agency / Government of Canada
Kathleen.Hooper-McGrevy@inspection.gc.ca / Tel: 204-789-5048

Directrice intérimaire
Gestionnaire de Recherche du CNMAE et Coordonnatrice Diagnostique, Branche Scientifique
Agence canadienne d'inspection des aliments / Gouvernement du Canada
Kathleen.Hooper-McGrevy@inspection.gc.ca / Tél. : 204-789-5048


Note the recent update in my email address. Please change it in your contact list.

Canadian Food Inspection Agency | Agence canadienne d'inspection des aliments

CANADIAN FOOD INSPECTION AGENCY

REPORT OF ANALYSIS

Animal Health Disease Control (DC) Specimen Submission
Version 7.0.2
Serial: 000010027403

System ID: 2021DCS-0000037681-4 **Receptions by all Labs:** 1 **Number of Jobs Authorized:** 1

Laboratory No.: WIN-AH-2021-OTH-0058 **Date Received:** 2021-07-16 **Job Status:** Authorized

Laboratory: (1111) NATIONAL CENTER FOR ANIMAL DISEASES
1015 ARLINGTON ST
WINNIPEG, MB R3E 3M4

Telephone: (204) 789-2001
Fax: (204) 789-2038

This report shall not be reproduced, except in full, without the written approval of the laboratory.

Sampling Location:
DR. CAELEY THACKER - FLNRORD

BC

Location Category: Other
Establishment No.:
Location Information:

CFIA Office:
(864) ANIMAL HEALTH ABBOTSFORD MULTI PROGRAMS
30585B PROGRESSIVE WAY
FLOOR 1, ROOM 102
ABBOTSFORD, BC V2T 6W3
Telephone: (604) 557-4500
Fax: (604) 557-4502

Submitted By: CFIA Inspector
MICHELLE LI
(4080) ANIMAL HEALTH - ABBOTSFORD ANIMAL HEALTH
30585B PROGRESSIVE WAY
ABBOTSFORD, BC V2T 6W3

Telephone: (604) 557-4500
Fax: (604) 557-4502
Cell:
Email: MICHELLE.LI@INSPECTION.GC.CA

Program: ANIMAL HEALTH **Reason for Test:** Laboratory Referral **Disease Category:** Other
CFIA Case No.: **Original Laboratory No.:** 21-4612
Survey No.:

Date Shipped: 2021-07-15 **Number of Samples:** 2 **Submission Priority:** Normal
Submission Comments/History: BC AHC Case #21-4612

Test:	COVID-PCR	Coronavirus-Polymerase chain reaction	Authorized

The following vial/submitter sample number has a negative result and result comment:

Vial/Submitter Sample #:	0002	**Sample Type:**	Swab
Official Animal ID:		**Health of Animal Tag No.:**	
Tattoo Number:		**Eartag:**	
Animal Name:		**Other Animal ID / Desc.:**	#2 RECTAL
Date Sampled:		**Sex:**	
Species:	MINK	**Status:**	Unknown
Carcass Held:	No	**Age:**	Not Provided (Estimate)
Preservative:	Frozen		
Result:	Negative///Négatif		
Comments:	RT-PCR confirmation is by two positive gene targets. Positive <36 Ct, suspicious 36-39 Ct, >39 Ct negative. Results are derived from a non-routine test currently under in-house validation		

The following vial/submitter sample number has a non-negative result:

Vial/Submitter Sample #:	0001	**Sample Type:**	Swab
Official Animal ID:		**Health of Animal Tag No.:**	
Tattoo Number:		**Eartag:**	
Animal Name:		**Other Animal ID / Desc.:**	#1 NASAL
Date Sampled:		**Sex:**	
Species:	MINK	**Status:**	Unknown
Carcass Held:	No	**Age:**	Not Provided (Estimate)
Preservative:	Frozen		
Result:	Positive///Positif		
Comments:	RT-PCR confirmation is by two positive gene targets. Positive <36 Ct, suspicious 36-39 Ct, >39 Ct negative. Results are derived from a non-routine test currently under in-house validation		

Date Test Authorized: 2021-07-20 **Authorized by:** pickeringb

Execution Time: 2021-07-20 10:36:22 AM

Canada

System ID: **2021DCS-0000037681-4** **Receptions by all Labs: 1** **Number of Jobs Authorized: 1**

These results relate only to the sample as received and tested by this laboratory.

Job Reference No.: 2021DCSS-0000050741-4

***** END OF REPORT *****

Execution Time: 2021-07-20 10:36:22 AM

Canada

BRITISH COLUMBIA
Ministry of Agriculture, Food and Fisheries

Ursula Viney, CPA, CGA
Executive Director, Plant and Animal Health Branch
Ministry of Agriculture, Food and Fisheries
Office: (778) 666-0546 Mobile: (604) 302-9001
Mailing Address: 1767 Angus Campbell Road | Abbotsford BC V3G 2M3

Canadian Food Inspection Agency | Agence canadienne d'inspection des aliments

CANADIAN FOOD INSPECTION AGENCY

REPORT OF ANALYSIS

Animal Health Disease Control (DC) Specimen Submission
Version 7.0.2
Serial: 000010027409

System ID: 2021DCS-0000037684-4 **Receptions by all Labs:** 1 **Number of Jobs Authorized:** 1

Laboratory No.: WIN-AH-2021-OTH-0059 **Date Received:** 2021-07-16 **Job Status:** Authorized

Laboratory: (1111) NATIONAL CENTER FOR ANIMAL DISEASES
1015 ARLINGTON ST
WINNIPEG, MB R3E 3M4

Telephone: (204) 789-2001
Fax: (204) 789-2038

This report shall not be reproduced, except in full, without the written approval of the laboratory.

Sampling Location:
DR. CAELEY THACKER - FLNRORD

BC

Location Category: Other
Establishment No.:
Location Information:

CFIA Office:
(864) ANIMAL HEALTH ABBOTSFORD MULTI PROGRAMS
30585B PROGRESSIVE WAY
FLOOR 1, ROOM 102
ABBOTSFORD, BC V2T 6W3
Telephone: (604) 557-4500
Fax: (604) 557-4502

Submitted By: CFIA Inspector
MICHELLE LI
(4080) ANIMAL HEALTH - ABBOTSFORD ANIMAL HEALTH
30585B PROGRESSIVE WAY
ABBOTSFORD, BC V2T 6W3

Telephone: (604) 557-4500
Fax: (604) 557-4502
Cell:
Email: MICHELLE.LI@INSPECTION.GC.CA

Program: ANIMAL HEALTH **Reason for Test:** Laboratory Referral **Disease Category:** Other
CFIA Case No.: **Original Laboratory No.:** 21-4614
Survey No.:

Date Shipped: 2021-07-15 **Number of Samples:** 2 **Submission Priority:** Normal
Submission Comments/History: BC AHC Case #21-4614

Test:	COVID-PCR	Coronavirus-Polymerase chain reaction	Authorized

The following vial/submitter sample number has a negative result and result comment:

Vial/Submitter Sample #:	0002	**Sample Type:**	Swab
Official Animal ID:		**Health of Animal Tag No.:**	
Tattoo Number:		**Eartag:**	
Animal Name:		**Other Animal ID / Desc.:**	#2 RECTAL
Date Sampled:		**Sex:**	
Species:	MINK	**Status:**	Unknown
Carcass Held:	No	**Age:**	Not Provided (Estimate)
Preservative:	Frozen		
Result:	Negative///Négatif		
Comments:	RT-PCR confirmation is by two positive gene targets. Positive <36 Ct, suspicious 36-39 Ct, >39 Ct negative. Results are derived from a non-routine test currently under in-house validation		

The following vial/submitter sample number has a non-negative result:

Vial/Submitter Sample #:	0001	**Sample Type:**	Swab
Official Animal ID:		**Health of Animal Tag No.:**	
Tattoo Number:		**Eartag:**	
Animal Name:		**Other Animal ID / Desc.:**	#1 NASAL
Date Sampled:		**Sex:**	
Species:	MINK	**Status:**	Unknown
Carcass Held:	No	**Age:**	Not Provided (Estimate)
Preservative:	Frozen		
Result:	Positive///Positif		
Comments:	RT-PCR confirmation is by two positive gene targets. Positive <36 Ct, suspicious 36-39 Ct, >39 Ct negative. Results are derived from a non-routine test currently under in-house validation		

Date Test Authorized: 2021-07-20 **Authorized by:** pickeringb

Execution Time: 2021-07-20 10:36:41 AM

Canada

System ID: **2021DCS-0000037684-4** **Receptions by all Labs: 1** **Number of Jobs Authorized: 1**

These results relate only to the sample as received and tested by this laboratory.

Job Reference No.: 2021DCSS-0000050744-4

***** END OF REPORT *****

Execution Time: 2021-07-20 10:36:41 AM

Canada

BRITISH COLUMBIA
Ministry of Agriculture, Food and Fisheries

Ursula Viney, CPA, CGA
Executive Director, Plant and Animal Health Branch
Ministry of Agriculture, Food and Fisheries
Office: (778) 666-0546 Mobile: (604) 302-9001
Mailing Address: 1767 Angus Campbell Road | Abbotsford BC V3G 2M3

Re: Mink Farm Related PHO Orders

From: Tyler, Ingrid [FH] <ingrid.tyler@fraserhealth.ca>
To: XT:HLTH Brodkin, Elizabeth <elizabeth.brodkin@fraserhealth.ca>, Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>, Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>
Cc: Kerwin, Oona [FH] <Oona.Kerwin@fraserhealth.ca>
Sent: July 20, 2021 9:43:43 PM PDT

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Hi Brian - I can confirm that the surveillance of local wildlife that you describe lies with MinAg, not FH. Thanks, Ingrid

Sent from my iPhone.

From: Brodkin, Elizabeth Dr. [FH] <Elizabeth.Brodkin@fraserhealth.ca>
Sent: Tuesday, July 20, 2021 7:17:40 PM
To: Emerson, Brian [EXT] <Brian.Emerson@gov.bc.ca>; Tyler, Ingrid [FH] <ingrid.tyler@fraserhealth.ca>; Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>
Cc: Kerwin, Oona [FH] <Oona.Kerwin@fraserhealth.ca>
Subject: RE: Mink Farm Related PHO Orders

Hi Brian,

I don't believe we are doing any trapping and testing – that would be with Ministry of Ag, but I am copying Oona to confirm.

EB

Dr. Elizabeth Brodkin, MD, FCFP, MHSc, FRCPC
Vice President Population Health and Chief Medical Health Officer
Fraser Health
Phone: (604) 307-4928

Executive Assistant
Courtney.Morimoto@fraserhealth.ca

We recognize Fraser Health provides care on the unceded and traditional homelands of the Coast Salish and Nlaka'pamux Nations

---

From: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Sent: Tuesday, July 20, 2021 6:27 PM
To: Brodkin, Elizabeth Dr. [FH] <Elizabeth.Brodkin@fraserhealth.ca>; Tyler, Ingrid [FH] <ingrid.tyler@fraserhealth.ca>; Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>
Subject: Mink Farm Related PHO Orders

EXTERNAL SENDER. If you suspect this message is malicious, please forward to spam@phsa.ca and **do not** open attachments or click on links.

Hi Elizabeth and Ingrid (and copying Emily, but knowing that s.22

Just letting you know that Bonnie has decided to issue a PHO order to put a moratorium on new mink farms, and to limit the current mink farms to their current capacity.

We would of course want to see the current FH orders stay in place.

As part of the development of the order it would be helpful to know whether the FH monitoring includes trapping and testing of live wildlife and/or escaped farmed mink.

Will keep you in the loop, happy to chat if you have any questions or concerns, and if there is someone else to include in FH as this evolves please let me know

Thanks.

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C[s.17] F. 250.952. 1713 brian.emerson@gov.bc.ca

Re: More positive mink

From: Ethier, Tom AFF:EX <Tom.Ethier@gov.bc.ca>
To: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Cc: Brown, Stephen R HLTH:EX <Stephen.Brown@gov.bc.ca>, McGuire, Jennifer AFF:EX <Jennifer.Mcguire@gov.bc.ca>
Sent: July 20, 2021 10:22:58 PM PDT
Attachments: image001.jpg

Thanks Dr Henry. Will do.

Sent from my iPhone

> On Jul 20, 2021, at 8:52 PM, Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca> wrote:
>
> Thank you Tom. We should have it finalized tomorrow. Please send us your IB to review before releasing.
> Thanks,
> Bonnie
>
> Dr Bonnie Henry
> Provincial Health Officer
> Ministry of Health
> Bonnie.henry@gov.bc.ca
> s.17; s.19
>
> > On Jul 20, 2021, at 8:31 PM, Ethier, Tom AFF:EX <Tom.Ethier@gov.bc.ca> wrote:
> >
> > Evening Dr Henry and Stephen, more infected mink from that farm of last week including another escapee.
> >
> > We are drafting an info bulletin that will describe the steps we will be taking to prevent this ongoing risk.
> >
> > Our plan is to release that bulletin once your order goes into effect. Do you have an ETA of when that is likely to happen?
> >
> > Many thanks, Tom.
> >
> > Sent from my iPhone
> >
> > Begin forwarded message:
> >
> > **From:** "Viney, Ursula E AFF:EX" <Ursula.Viney@gov.bc.ca>
> > **Date:** July 20, 2021 at 5:41:13 PM PDT
> > **To:** "Ethier, Tom AFF:EX" <Tom.Ethier@gov.bc.ca>

Subject: More positive mink

Hi Tom, in addition to the two confirmed positive mink (earlier email), another captured (escaped) mink tested positive and 4 “regular” mink from the already infected farm tested positive at our lab today. Will send the 5 samples to Winnipeg (NCFAD) for confirmatory testing.

<image001.jpg>

FW: More positive mink

From: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
To: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Sent: July 21, 2021 8:44:03 AM PDT
Attachments: image003.jpg
fyi

Dr Bonnie Henry
Provincial Health Officer
Office of the PHO
Ministry of Health
s.15; s.19
Mailing address: PO Box 9648, STN PROV GOVT
Victoria, BC
V8W 9P4
Bonnie.henry@gov.bc.ca

Phone: s.17; s.19

I gratefully acknowledge that I live and work on the traditional unceded territory of the Lekwungen Peoples, specifically the Songhees and Esquimalt First Nations. Hay'sxw'qu Si'em

Warning: This email is intended only for the use of the individual or organization to whom it is addressed. It may contain information that is privileged or confidential. Any distribution, disclosure, copying, or other use by anyone else is strictly prohibited. If you have received this in error, please telephone or e-mail the sender immediately and delete the message.

From: Ethier, Tom AFF:EX <Tom.Ethier@gov.bc.ca>
Sent: July 20, 2021 8:31 PM
To: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>; Brown, Stephen R HLTH:EX <Stephen.Brown@gov.bc.ca>
Cc: McGuire, Jennifer AFF:EX <Jennifer.Mcguire@gov.bc.ca>
Subject: Fwd: More positive mink

Evening Dr Henry and Stephen, more infected mink from that farm of last week including another escapee.

We are drafting an info bulletin that will describe the steps we will be taking to prevent this ongoing risk.

Our plan is to release that bulletin once your order goes into effect. Do you have an ETA of when that is likely to happen?

Many thanks, Tom.

Sent from my iPhone

Begin forwarded message:

> **From:** "Viney, Ursula E AFF:EX" <Ursula.Viney@gov.bc.ca>
> **Date:** July 20, 2021 at 5:41:13 PM PDT
> **To:** "Ethier, Tom AFF:EX" <Tom.Ethier@gov.bc.ca>
> **Subject: More positive mink**
>
> Hi Tom, in addition to the two confirmed positive mink (earlier email), another captured (escaped) mink tested positive and 4 "regular" mink from the already infected farm tested positive at our lab today. Will send the 5 samples to Winnipeg (NCFAD) for confirmatory testing.

BRITISH COLUMBIA
Ministry of Agriculture, Food and Fisheries

Ursula Viney, CPA, CGA
Executive Director, Plant and Animal Health Branch
Ministry of Agriculture, Food and Fisheries
Office: (778) 666-0546 Mobile: (604) 302-9001
Mailing Address: 1767 Angus Campbell Road | Abbotsford BC V3G 2M3

BRITISH COLUMBIA
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Page 533 of 656

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Page 555 of 656

Withheld pursuant to/removed as

s.13 ; s.14 ; s.17

Page 556 of 656

Withheld pursuant to/removed as

s.14

FW: Updated Email Address List

From: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
To: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Sent: July 22, 2021 9:52:23 AM PDT
Attachments: image003.jpg

Hi Brian, please see below for emails and contact information for all mink farms with current licences. As many of the farms are family owned and operated you will notice there are several email addresses associated with each farm. These are the emails we used when meeting with the producers in January 2021. Will your staff be setting up the meeting for Friday afternoon? Thanks,

Ursula

From: Hughes, Marie Julie AFF:EX <MarieJulie.Hughes@gov.bc.ca>
Sent: July 22, 2021 9:38 AM
To: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
Subject: Updated Email Address List

Hi Ursula,

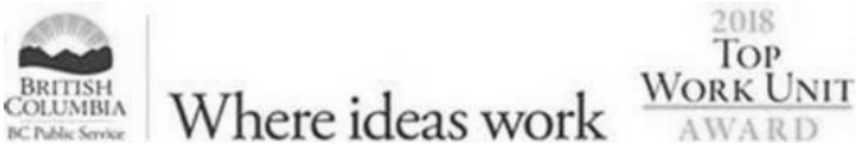
As discussed, I have provided contact names, I also went through the list of invitees for the SARS-Cov-2 meeting in January and added everyone that attended that meeting as well. You will notice that a few of the email addresses are for "farm office", I don't have a name associated to all of these.

Farms with Live Animals

s.3

Julie

(Marie) Julie Hughes
Compliance, Operations and Data Officer
British Columbia Ministry of Agriculture, Food and Fisheries
1767 Angus Campbell Road, Abbotsford, BC V3G 2M3
Tel: 778-666-0560
Mariejulie.hughes@gov.bc.ca
www.gov.bc.ca/animalhealthcentre



Re: Mink Farm Related PHO Orders - meeting tomorrow at 3 pm

From: Kerwin, Oona [FH] <Oona.Kerwin@fraserhealth.ca>
To: XT:HLTH Brodkin, Elizabeth <elizabeth.brodkin@fraserhealth.ca>
Cc: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>, XT:Tyler, Ingrid FRHA:IN <ingrid.tyler@fraserhealth.ca>, Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>, Choquette, Blair [FH] <Blair.Choquette@fraserhealth.ca>
Sent: July 22, 2021 2:15:44 PM PDT

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Hi Elizabeth, I'm copying Blair on this to request him to attend.

Thanks,
Oona

Sent from my iPhone

> On Jul 22, 2021, at 1:26 PM, Brodkin, Elizabeth Dr. [FH] <Elizabeth.Brodkin@fraserhealth.ca> wrote:
>
> Oona who is available to attend, given that s.22
>
> Dr. Elizabeth Brodkin, MD, FCFP, MHSc, FRCPC
> Vice President Population Health and Chief Medical Health Officer
> Fraser Health
> Phone: (604) 307-4928
>
> Executive Assistant
> Courtney.Morimoto@fraserhealth.ca
>
> *We recognize Fraser Health provides care on the unceded and traditional homelands of the Coast Salish and Nlaka'pamux Nations*
>
> **From:** Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
> **Sent:** Thursday, July 22, 2021 1:26 PM
> **To:** Kerwin, Oona [FH] <Oona.Kerwin@fraserhealth.ca>; Brodkin, Elizabeth Dr. [FH] <Elizabeth.Brodkin@fraserhealth.ca>; Tyler, Ingrid [FH] <ingrid.tyler@fraserhealth.ca>; Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>
> **Subject:** RE: Mink Farm Related PHO Orders - meeting tomorrow at 3 pm
>
> **EXTERNAL SENDER.** If you suspect this message is malicious, please forward to spam@phsa.ca and **do not** open attachments or click on links.
>
> Thanks for the information.
>
> I will be organizing a call with the farm license holders to give them a head's up on the order to come tomorrow at 3 pm. If someone from Fraser Health that has been involved

with mink farms issue could attend that might be helpful, but not absolutely necessary given the short notice. Let me know.

Thanks.

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C[s.17] F. 250.952. 1713 brian.emerson@gov.bc.ca

---

From: Kerwin, Oona [FH] <Oona.Kerwin@fraserhealth.ca>
Sent: July 21, 2021 9:39 AM
To: XT:HLTH Brodkin, Elizabeth <elizabeth.brodkin@fraserhealth.ca>; Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>; XT:Tyler, Ingrid FRHA:IN <ingrid.tyler@fraserhealth.ca>; Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>
Subject: RE: Mink Farm Related PHO Orders

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Hi Elizabeth,

Confirming that Agriculture is the lead for trapping and testing. Our role has been only to pick up mortalities.

oona

Oona Kerwin
Regional Director
Population and Public Health
Central City Tower
#400 - 13450 102 Avenue
Surrey, BC V3T 5X3
phone: 604-930-5405
fax: 604-930-5415
oona.kerwin@fraserhealth.ca

From: Brodkin, Elizabeth Dr. [FH] <Elizabeth.Brodkin@fraserhealth.ca>
Sent: Tuesday, July 20, 2021 7:18 PM
To: Emerson, Brian [EXT] <Brian.Emerson@gov.bc.ca>; Tyler, Ingrid [FH] <ingrid.tyler@fraserhealth.ca>; Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>
Cc: Kerwin, Oona [FH] <Oona.Kerwin@fraserhealth.ca>
Subject: RE: Mink Farm Related PHO Orders

Hi Brian,

I don't believe we are doing any trapping and testing – that would be with Ministry of Ag, but I am copying Oona to confirm.

EB

Dr. Elizabeth Brodkin, MD, FCFP, MHSc, FRCPC
Vice President Population Health and Chief Medical Health Officer
Fraser Health
Phone: (604) 307-4928

Executive Assistant
Courtney.Morimoto@fraserhealth.ca

We recognize Fraser Health provides care on the unceded and traditional homelands of the Coast Salish and Nlaka'pamux Nations

---

From: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Sent: Tuesday, July 20, 2021 6:27 PM
To: Brodkin, Elizabeth Dr. [FH] <Elizabeth.Brodkin@fraserhealth.ca>; Tyler, Ingrid [FH] <ingrid.tyler@fraserhealth.ca>; Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>
Subject: Mink Farm Related PHO Orders

EXTERNAL SENDER. If you suspect this message is malicious, please forward to spam@phsa.ca and **do not** open attachments or click on links.

Hi Elizabeth and Ingrid (and copying Emily, but knowing that[s.22]

Just letting you know that Bonnie has decided to issue a PHO order to put a moratorium on new mink farms, and to limit the current mink farms to their current capacity.

We would of course want to see the current FH orders stay in place.

As part of the development of the order it would be helpful to know whether the FH monitoring includes trapping and testing of live wildlife and/or escaped farmed mink.

Will keep you in the loop, happy to chat if you have any questions or concerns, and if there is someone else to include in FH as this evolves please let me know

Thanks.

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C[s.17] F. 250.952. 1713 brian.emerson@gov.bc.ca

RE: Teleconference

From: Emerson, Brian P HLTH:EX
To: s.3
Sent: July 22, 2021 3:23:05 PM PDT

Hi Joseph and yes, this is an urgent matter due to ongoing, recently detected mink infections.

Thanks.

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 (s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

-----Original Message-----
From s.3
Sent: July 22, 2021 3:14 PM
To: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Subject: Teleconference

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Hi Brian.

We've received your email.

Sorry, I have to ask. Is this an emergency? It seems like very short notice to get everyone together for a last minute Friday afternoon conference. Can this be done next week?

Thank you

s.3

RE: Teleconference re Mink Farms Today

From: Emerson, Brian P HLTH:EX
To: s.3
Cc: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>, Choquette, Blair <Blair.Choquette@fraserhealth.ca>
Sent: July 23, 2021 10:41:37 AM PDT

Yes, that is fine Joe and feel free to forward the calendar invitation to them.

I am copying Ursula from Min Agriculture as she will on the call for them, and Blair from Fraser Health who will also be on the call, for their awareness.

Thanks.

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

-----Original Message-----
From s.3
Sent: July 23, 2021 10:14 AM
To: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Subject: Teleconference

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Hi Brian.

FYI - We have invited our industry Veterinarian (Dr. Dan McDermid) and Canadian Mink Breeders Association President (Matt Moses/Nova Scotia) and Vice-President (Rob Bollert/Ontario) on the call this afternoon. And I have reached out to the licensed mink farmers.

Hope this is ok.

s.3

RE: For PHO Review/Input: Mink IB for review

From: Emerson, Brian P HLTH:EX
To: Youngs, Kirsten R GCPE:EX <Kirsten.Youngs@gov.bc.ca>, (Marielle.Tounsi@gov.bc.ca) <Marielle.Tounsi@gov.bc.ca>
Cc: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>, Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
Sent: July 23, 2021 10:56:18 AM PDT
Attachments: MINK ORDER V.7 July 22 AFF BE.docx

Hi Kirsten and Marielle.

Just letting you know that me and Ursula will be meeting with the mink farmers this afternoon (3 pm) to give them a head's up on the PHO order to come. An environmental health officer from Fraser Health will also be attending.

They have invited their industry Veterinarian (Dr. Dan McDermid) and Canadian Mink Breeders Association President (Matt Moses/Nova Scotia) and Vice-President (Rob Bollert/Ontario) to be on the call.

Attached is the near final version of the order, which I will be sending to them early afternoon, prior to the call.

Ursula – my understanding of the latest status is that two mink at a quarantined farm recently tested positive for SARS-CoV-2 (would be good to know when) and that five additional mink samples from the same farm have also tested non-negative at the B.C. Animal Health Lab with final results pending from the national lab in Winnipeg. What is not clear to me is whether reports of mink capture in the wild that also tested positive are include in these numbers, how many were captured in the wild, and whether we know they were from a farm or are wild mink. For the call today can you provide a summary of this information? The farmers want to know why the urgency for the call so I think these new findings are important to convey at the start of the call.

Thanks.

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

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From: Emerson, Brian P HLTH:EX
Sent: July 21, 2021 4:00 PM
To: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>; Youngs, Kirsten R GCPE:EX <Kirsten.Youngs@gov.bc.ca>
Subject: RE: For PHO Review/Input: Mink IB for review

A few comment from me on added to Bonnie's, and you will see I have sent the draft order around for review.

Thanks.

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1

T 250.952.1701 C s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

From: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Sent: July 21, 2021 3:40 PM
To: Youngs, Kirsten R GCPE:EX <Kirsten.Youngs@gov.bc.ca>; Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Subject: RE: For PHO Review/Input: Mink IB for review

A few comments, I haven't seen a final order yet.
b

Dr Bonnie Henry
Provincial Health Officer
Office of the PHO
Ministry of Health
s.15; s.19

Mailing address: PO Box 9648, STN PROV GOVT
Victoria, BC
V8W 9P4
Bonnie.henry@gov.bc.ca

Phone: s.17; s.19

I gratefully acknowledge that I live and work on the traditional unceded territory of the Lekwungen Peoples, specifically the Songhees and Esquimalt First Nations. Hay'sxw'qu Si'em

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From: Youngs, Kirsten R GCPE:EX <Kirsten.Youngs@gov.bc.ca>
Sent: July 21, 2021 2:01 PM
To: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>; Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Subject: For PHO Review/Input: Mink IB for review

Hello both,
An info bulletin attached for your review ahead of or in tandem with the order re mink – if there is a draft order I'm happy to build out the PHO paragraph as highlighted, just let me know what that's ready to see.

Cheers,
K

From: Cotton, Brian GCPE:EX <Brian.Cotton@gov.bc.ca>
Sent: July 21, 2021 1:58 PM
To: Youngs, Kirsten R GCPE:EX <Kirsten.Youngs@gov.bc.ca>
Subject: Mink IB for review

Here's what you've been waiting for IB attached with a placeholder to include some info on the PHO order as well as the link to the order. From an e-chain my DM fwd me, it appears the order should be finalized today and DBH wanted to review the IB. I'm told international notification won't be happening today so IB would go tomorrow at earliest.

Thank you,
Brian Cotton
Communications Director

Ministry of Agriculture, Food and Fisheries
Phone: (250) 387-9618
Cell: (250) 818-4233

DRAFT ORDER OF THE PROVINCIAL HEALTH OFFICER

(Pursuant to Sections 30, 31, 32, 39, and 54(1) of the *Public Health Act*, S.B.C. 2008)

MINK FARMS – July XX, 2021

The *Public Health Act* is at:
http://www.bclaws.ca/civix/content/complete/statreg/08028/?xsl=/templates/browse.xsl
(excerpts enclosed)

TO: ANY PERSON WHO MAY PROPOSE TO OPERATE A MINK FARM IN BRITISH COLUMBIA UNDER THE *ANIMAL HEALTH ACT* AND WHO IS NOT AUTHORIZED AS OF THE DATE OF THIS ORDER TO OPERATE A MINK FARM; AND

TO: PERSONS LICENSED TO OPERATE FUR FARMS FOR THE PURPOSE OF FARMING MINK, PURSUANT TO THE *ANIMAL HEALTH ACT*

WHEREAS:

A. A communicable disease known as COVID-19 has emerged in British Columbia;

B. SARS-CoV-2, an infectious agent, can cause outbreaks of serious illness known as COVID-19 among the public;

C. A person infected with SARS-CoV-2 can infect other people with whom the infected person is in contact;

D. On March 17, 2020, I provided notice under section 52 (2) of the *Public Health Act* that the transmission of the infectious agent SARS-CoV-2, which has caused cases and outbreaks of a serious communicable disease known as COVID-19 among the population of the Province of British Columbia, constitutes a regional event as defined in section 51 of the *Public Health Act*;

E. Around the world, mink at mink farms have proven to be susceptible to COVID-19 infection and there is a demonstrated risk of mutation of SARS-CoV-2 virus in the mink population;

F. COVID-19 outbreaks have occurred at mink farms within the Fraser Health region;

G. Mutated strains of SARS-CoV-2 may re-infect humans and such mutated strains may pose a risk of development of variants of concern;

Ministry of Health
Office of the
Provincial Health Officer
4th Floor, 1515 Blanshard Street
PO Box 9648 STN PROV GOVT
Victoria BC V8W 9P4
Fax: (250) 952-1570
http://www.health.gov.bc.ca/pho/

H. The emergence of variants of concern is likely to interfere with the suppression of SARS-CoV-2 in British Columbia;

I. The medical health officer for the Fraser Health Authority has issued orders requiring a range of mitigation measures which must be followed by owners and operators of mink farms and farm workers in the Fraser Health Region. Additionally, the Chief Veterinarian of British Columbia has issued Quarantine Zone Orders from time to time to mink farms due to concerns about transmission of SARS-CoV2 on existing mink farms in BC (the "Mitigation Measures");

J. Despite the Mitigation Measures, there have been recent instances of SARS-CoV-2 in farmed mink in the province;

K. I have reason to believe and do believe that:

(i) mink farming is a health hazard as it is an activity which endangers or is likely to endanger public health

(ii) there is a risk mink infected with SARS-CoV-2 could result in infection of workers at mink farms, which could lead to further transmission in human populations;

(iii) there is a risk the mink could escape into the wild and pose a risk of transmission of SARS-CoV-2 to wild animals, also posing a risk of potential transmission from wild animals to human populations;

(iv) the susceptibility of mink to infection with SARS-CoV-2 creates a risk of development of variants of concern which pose a threat to public health and could undermine the efficacy of the COVID-19 vaccination program in British Columbia; and

(v) any increase in the number of mink farms or the number of farmed mink in British Columbia would increase the threat to public health arising from mink farming.

THEREFORE, I reasonably believe it is necessary for me to exercise the powers in sections, 30, 31, 32, 39, and 54(1) of the Public Health Act to **ORDER AS FOLLOWS**:

DEFINITIONS:

In this Order:

"breeding mink" means mink possessed by a licensed fur farm operator for the purpose of breeding;

"non-breeding mink" means mink possessed by a licensed fur farm operator for the purpose of slaughter and harvesting of pelts

A. ANY PERSON WHO MAY PROPOSE TO OPERATE A MINK FARM IN BRITISH COLUMBIA AND WHO IS NOT AUTHORIZED AS OF THE DATE OF THIS ORDER UNDER THE *ANIMAL HEALTH ACT* TO OPERATE A MINK FARM:

You must not operate a mink farm.

B. PERSONS LICENSED TO OPERATE FUR FARMS FOR THE PURPOSE OF FARMING MINK, PURSUANT TO THE *ANIMAL HEALTH ACT*:

1. For each farm which you operate you must immediately report to me and to the medical health officer for the health region in which the mink farm is located:

    a. the number of breeding mink;

    b. the number of non-breeding mink; and

    c. the total number of mink on the farm.

2. For each mink farm you operate, you must not any allow:

    a. the number of breeding mink to exceed the number of breeding mink present on each farm as of the date of this order;

    b. the number of non breeding mink to exceed the number of non-breeding mink present on each farm as of the date of this order; and

    c. the breeding of mink.

3. You must not acquire, by any means, any live mink in addition to the mink which were present on the farm as of the date of this Order;

C. RELATED MEDICAL HEALTH OFFICERS ORDERS

Recognizing that the risk differs in different regions of the province and that medical health officers are in the best position to assess local circumstances and to determine whether additional or more restrictive steps need to be taken to reduce the risk of the transmission of COVID-19 due to mink farming, **FOR CERTAINTY**:

1. A medical health officer may issue an order further to their powers in the *Public Health Act,* which may add further prohibitions, or impose more restrictive limitations or conditions respecting farming of mink in the whole or part of the geographic area of the province for which the medical health officer is designated and,

2. This Order does not impact any orders made by a medical health officer respecting the activities described in this Order made prior to the making of this Order.

This Order is effective immediately.

This Order expires January 31, 2022.

All persons to whom this order is directed are required under section 42 of the *Public Health Act* to comply with this Order.

Failure to comply with this Variance is an offence under section 99 (1) (k) of the *Public Health Act*.

Pursuant to section 43 of the *Public Health Act*, you may request me to reconsider this Order if you:

(a) have additional relevant information that was not reasonably available to the health officer when the order was issued or varied,

(b) have a proposal that was not presented to the health officer when the order was issued or varied but, if implemented, would

(i) meet the objective of the order, and

(ii) be suitable as the basis of a written agreement under section 38 *[may make written agreements]*, or

(c)require more time to comply with the order.

If you fail to comply with this Order, I have the authority to take enforcement action against you under Part 4, Division 6 of the *Public Health Act.*

You may contact me at:

Dr. Bonnie Henry, Provincial Health Officer
s.15; s.19
PO Box 9648 STN PROV GOVT, Victoria BC V8W 9P4
Fax: (250) 952-1570
Email: ProvHlthOffice@gov.bc.ca

DATED THIS: XX day of July 2021

DRAFT

SIGNED: _____
Bonnie Henry
MD, MPH, FRCPC
Provincial Health Officer

DELIVERY BY: Posting to the BC Government and the BC Centre for Disease Control websites and by email and to:

Licensed operators of fur farms for mink
Ministry of Agriculture, Food and Fisheries:
Dr. Rayna Gunvaldsen, Chief Veterinarian
Tom Ethier, Deputy Minster
Jennifer McGuire, Assistant Deputy Minister, Science, Policy and Inspections Division
Vancouver Coastal Health Authority:
Dr. Patricia Daly, Chief Medical Health Officer
Fraser Health Authority:
Dr. Elizabeth Brodkin, Chief Medical Health Officer
Vancouver Island Health Authority:
Dr. Richard Stanwick, Chief Medical Health Officer
Interior Health Authority:
Dr. Sue Pollock. Chief Medical Health Officer
Northern Health Authority:
Dr. Jong Kim, Chief Medical Health Officer

Enclosure: Excerpts of the *Public Health Act*.

ENCLOSURE

Excerpts of the *Public Health Act* [SBC 2008] c. 28

Definitions

1 In this Act:

"*health hazard*" means

(a) a condition, a thing or an activity that

(i) endangers, or is likely to endanger, public health, or

(ii) interferes, or is likely to interfere, with the suppression of infectious agents or hazardous agents, or

(b) a prescribed condition, thing or activity, including a prescribed condition, thing or activity that

(i) is associated with injury or illness, or

(ii) fails to meet a prescribed standard in relation to health, injury or illness;

When orders respecting health hazards and contraventions may be made

30 (1) A health officer may issue an order under this Division only if the health officer reasonably believes that

(a) a health hazard exists,

(b) a condition, a thing or an activity presents a significant risk of causing a health hazard,

(c) a person has contravened a provision of the Act or a regulation made under it, or

(d) a person has contravened a term or condition of a licence or permit held by the person under this Act.

(2) For greater certainty, subsection (1) (a) to (c) applies even if the person subject to the order is complying with all terms and conditions of a licence, a permit, an approval or another authorization issued under this or any other enactment.

General powers respecting health hazards and contraventions

31 (1) If the circumstances described in section 30 *[when orders respecting health hazards and contraventions may be made]* apply, a health officer may order a person to do anything that the health officer reasonably believes is necessary for any of the following purposes:

(a) to determine whether a health hazard exists;

(b) to prevent or stop a health hazard, or mitigate the harm or prevent further harm from a health hazard;

(c) to bring the person into compliance with the Act or a regulation made under it;

(d) to bring the person into compliance with a term or condition of a licence or permit held by that person under this Act.

(2) A health officer may issue an order under subsection (1) to any of the following persons:

(a) a person whose action or omission

(i) is causing or has caused a health hazard, or

(ii) is not in compliance with the Act or a regulation made under it, or a term or condition of the person's licence or permit;

(b) a person who has custody or control of a thing, or control of a condition, that

(i) is a health hazard or is causing or has caused a health hazard, or

(ii) is not in compliance with the Act or a regulation made under it, or a term or condition of the person's licence or permit;

(c) the owner or occupier of a place where

(i) a health hazard is located, or

(ii) an activity is occurring that is not in compliance with the Act or a regulation made under it, or a term or condition of the licence or permit of the person doing the activity.

Specific powers respecting health hazards and contraventions

32 (1) An order may be made under this section only

(a) if the circumstances described in section 30 *[when orders respecting health hazards and contraventions may be made]* apply, and

(b) for the purposes set out in section 31 (1) *[general powers respecting health hazards and contraventions]*.

(2) Without limiting section 31, a health officer may order a person to do one or more of the following:

(a) have a thing examined, disinfected, decontaminated, altered or destroyed, including

(i) by a specified person, or under the supervision or instructions of a specified person,

(ii) moving the thing to a specified place, and

(iii) taking samples of the thing, or permitting samples of the thing to be taken;

(b) in respect of a place,

(i) leave the place,

(ii) not enter the place,

(iii) do specific work, including removing or altering things found in the place, and altering or locking the place to restrict or prevent entry to the place,

(iv) neither deal with a thing in or on the place nor dispose of a thing from the place, or deal with or dispose of the thing only in accordance with a specified procedure, and

(v) if the person has control of the place, assist in evacuating the place or examining persons found in the place, or taking preventive measures in respect of the place or persons found in the place;

(c) stop operating, or not operate, a thing;

(d) keep a thing in a specified place or in accordance with a specified procedure;

(e) prevent persons from accessing a thing;

(f) not dispose of, alter or destroy a thing, or dispose of, alter or destroy a thing only in accordance with a specified procedure;

(g) provide to the health officer or a specified person information, records, samples or other matters relevant to a thing's possible infection with an infectious agent or contamination with a hazardous agent, including information respecting persons who may have been exposed to an infectious agent or hazardous agent by the thing;

(h) wear a type of clothing or personal protective equipment, or change, remove or alter clothing or personal protective equipment, to protect the health and safety of persons;

(i) use a type of equipment or implement a process, or remove equipment or alter equipment or processes, to protect the health and safety of persons;

(j) provide evidence of complying with the order, including

(i) getting a certificate of compliance from a medical practitioner, nurse practitioner or specified person, and

(ii) providing to a health officer any relevant record;

(k) take a prescribed action.

(3) If a health officer orders a thing to be destroyed, the health officer must give the person having custody or control of the thing reasonable time to request reconsideration and review of the order under sections 43 and 44 unless

(a) the person consents in writing to the destruction of the thing, or

(b) Part 5 *[Emergency Powers]* applies.

Contents of orders

39 (3) An order may be made in respect of a class of persons.

(6)A health officer who makes an order may vary the order

(a)at any time on the health officer's own initiative, or

(b)on the request of a person affected by the order, following a reconsideration under section 43 *[reconsideration of orders]*.

Duty to comply with orders

42 (1) A person named or described in an order made under this Part must comply with the order.

(2) Subsection (1) applies regardless of whether the person leaves the geographic area for which the health officer who made the order is designated.

Reconsideration of orders

43 (1) A person affected by an order, or the variance of an order, may request the health officer who issued the order or made the variance to reconsider the order or variance if the person

(a) has additional relevant information that was not reasonably available to the health officer when the order was issued or varied,

(b) has a proposal that was not presented to the health officer when the order was issued or varied but, if implemented, would

(i) meet the objective of the order, and

(ii) be suitable as the basis of a written agreement under section 38 *[may make written agreements]*, or

(c) requires more time to comply with the order.

(2) A request for reconsideration must be made in the form required by the health officer.

(3) After considering a request for reconsideration, a health officer may do one or more of the following:

(a) reject the request on the basis that the information submitted in support of the request

(i) is not relevant, or

(ii) was reasonably available at the time the order was issued;

(b) delay the date the order is to take effect or suspend the order, if satisfied that doing so would not be detrimental to public health;

(c) confirm, rescind or vary the order.

(4) A health officer must provide written reasons for a decision to reject the request under subsection (3) (a) or to confirm or vary the order under subsection (3) (c).

(5) Following a decision made under subsection (3) (a) or (c), no further request for reconsideration may be made.

(6) An order is not suspended during the period of reconsideration unless the health officer agrees, in writing, to suspend it.

(7) For the purposes of this section,

(a) if an order is made that affects a class of persons, a request for reconsideration may be made by one person on behalf of the class, and

(b) if multiple orders are made that affect a class of persons, or address related matters or issues, a health officer may reconsider the orders separately or together.

(8) If a health officer is unable or unavailable to reconsider an order he or she made, a similarly designated health officer may act under this section in respect of the order as if the similarly designated health officer were reconsidering an order that he or she made.

Offences

99 (1) A person who contravenes any of the following provisions commits an offence:

…

(k) section 42 *[failure to comply with an order of a health officer]*, except in respect of an order made under section 29 (2) (e) to (g) *[orders respecting examinations, diagnostic examinations or preventive measures]*;

RE: For PHO Review/Input: Mink IB for review

From: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
To: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Sent: July 23, 2021 11:57:37 AM PDT

Hi Brian, yes, I can report out about the recent results.

Ursula

From: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Sent: July 23, 2021 11:52 AM
To: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
Subject: RE: For PHO Review/Input: Mink IB for review

Thanks Ursuala.

Are you fine with reporting about the recent problems and results at the start of the call today?

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

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From: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
Sent: July 23, 2021 11:14 AM
To: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Cc: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Subject: RE: For PHO Review/Input: Mink IB for review

Hi Brian,

Quarantined farm update - To date, five escaped mink have been trapped of which three have tested non-negative at our lab. Two of these samples have been confirmed positive by NCFAD. Additionally, 4 mortalities were submitted from the farm this week – all of which have tested non-negative at our lab. All non-negative samples have been sent to the NCFAD with confirmatory results expected today or Monday.

Ursula

From: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Sent: July 23, 2021 10:56 AM
To: Youngs, Kirsten R GCPE:EX <Kirsten.Youngs@gov.bc.ca>; Tounsi, Marielle GCPE:EX <Marielle.Tounsi@gov.bc.ca>
Cc: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>; Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
Subject: RE: For PHO Review/Input: Mink IB for review

Hi Kirsten and Marielle.

Just letting you know that me and Ursula will be meeting with the mink farmers this afternoon (3 pm) to give them a head's up on the PHO order to come. An environmental health officer from Fraser Health will also be attending.

They have invited their industry Veterinarian (Dr. Dan McDermid) and Canadian Mink Breeders Association President (Matt Moses/Nova Scotia) and Vice-President (Rob Bollert/Ontario) to be on the call.

Attached is the near final version of the order, which I will be sending to them early afternoon, prior to the call.

Ursula – my understanding of the latest status is that two mink at a quarantined farm recently tested positive for SARS-CoV-2 (would be good to know when) and that five additional mink samples from the same farm have also tested non-negative at the B.C. Animal Health Lab with final results pending from the national lab in Winnipeg. What is not clear to me is whether reports of mink capture in the wild that also tested positive are include in these numbers, how many were captured in the wild, and whether we know they were from a farm or are wild mink. For the call today can you provide a summary of this information? The farmers want to know why the urgency for the call so I think these new findings are important to convey at the start of the call.

Thanks.

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

---

From: Emerson, Brian P HLTH:EX
Sent: July 21, 2021 4:00 PM
To: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>; Youngs, Kirsten R GCPE:EX <Kirsten.Youngs@gov.bc.ca>
Subject: RE: For PHO Review/Input: Mink IB for review

A few comment from me on added to Bonnie's, and you will see I have sent the draft order around for review.

Thanks.

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

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From: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Sent: July 21, 2021 3:40 PM
To: Youngs, Kirsten R GCPE:EX <Kirsten.Youngs@gov.bc.ca>; Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Subject: RE: For PHO Review/Input: Mink IB for review

A few comments, I haven't seen a final order yet.
b

Dr Bonnie Henry
Provincial Health Officer
Office of the PHO
Ministry of Health
s.15; s.19
Mailing address: PO Box 9648, STN PROV GOVT
Victoria, BC
V8W 9P4
Bonnie.henry@gov.bc.ca

Phone[s.17; s.19]

I gratefully acknowledge that I live and work on the traditional unceded territory of the Lekwungen Peoples, specifically the Songhees and Esquimalt First Nations. Hay'sxw'qu Si'em

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From: Youngs, Kirsten R GCPE:EX <Kirsten.Youngs@gov.bc.ca>
Sent: July 21, 2021 2:01 PM
To: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>; Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Subject: For PHO Review/Input: Mink IB for review

Hello both,
An info bulletin attached for your review ahead of or in tandem with the order re mink – if there is a draft order I'm happy to build out the PHO paragraph as highlighted, just let me know what that's ready to see.

Cheers,
K

From: Cotton, Brian GCPE:EX <Brian.Cotton@gov.bc.ca>
Sent: July 21, 2021 1:58 PM
To: Youngs, Kirsten R GCPE:EX <Kirsten.Youngs@gov.bc.ca>
Subject: Mink IB for review

Here's what you've been waiting for IB attached with a placeholder to include some info on the PHO order as well as the link to the order. From an e-chain my DM fwd me, it appears the order should be finalized today and DBH wanted to review the IB. I'm told international notification won't be happening today so IB would go tomorrow at earliest.

Thank you,
Brian Cotton
Communications Director

Ministry of Agriculture, Food and Fisheries
Phone: (250) 387-9618
Cell: (250) 818-4233

RE: Teleconference today (Friday, July 23), 3:00 pm to discuss SARS-CoV-2 virus infections in mink, and proposed Provincial Health Officer actions

From: Emerson, Brian P HLTH:EX
To: s.3

<Blair.Choquette@fraserhealth.ca>, Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
Sent: July 23, 2021 12:39:24 PM PDT
Attachments: MINK ORDER draft July 23.docx

Good afternoon.

Further to my email from yesterday this is to give you some more detail about the call this afternoon.

Firstly, Ursula Viney, Executive Director with the Ministry of Agriculture, Food and Fisheries, will provide an update on the ongoing problems with infections and escape of mink with SARS-CoV-2.

Secondly, I will describe proposed actions by the Provincial Health Officer (PHO), answer questions, and discuss the implications. To this point attached is a draft order that the PHO is planning to issue next week. Due to the health hazard that mink farms pose, the order will put in place a moratorium on new mink farms, and cap capacity of the current farms to their current numbers.

Please feel free to forward this along to others who are going to attend the call that are not on this list.

Thank you for your availability on short notice to help address this urgent issue.

Brian Emerson

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

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From: Emerson, Brian P HLTH:EX
Sent: Julv 22. 2021 1:53 PM
s.3

Cc: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
Subject: Teleconference tomorrow (Friday, July 23), 3:00 pm to discuss SARS-CoV-2 virus infections in mink, and proposed Provincial Health Officer actions
Importance: High

Dear licensed fur farmers of mink farms,

This email is to let you know that I am organizing a teleconference for tomorrow afternoon at 3 pm to discuss some proposed actions by the Provincial Health Officer with respect to mink farms, consequent to the occurrence of SARS-CoV-2 virus infections, which causes COVID-19 in humans.

A calendar invitation will be coming to you shortly.

If you cannot attend please have someone from your farm attend as a delegate.

The call-in number, which will also be in the calendar invitation, is s.15; s.17 Conference ID s.15; s.17

Thank you.

Brian Emerson

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

Page 580 of 656 to/à Page 585 of 656

Withheld pursuant to/removed as

s.14 ; s.17

Draft Order Mink Farms

From: s.3
To: Brian.Emerson@gov.bc.ca, Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Sent: July 23, 2021 4:28:38 PM PDT

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Hello Dr. Brian

On behalf of s.3 thank you for meeting with us today.

We would like to put on record that we object to including **Section B 2c** to the Order. The inclusion of "the breeding of mink" is unnecessarily redundant and will result catastrophic detrimental effects to our industry.

Furthermore, our industry will need notice very quickly if the intention is to no longer allow mink to breed as that decision will bring very real financial difficulties and compensation expectations. For example, there was a discussion about the Covid mink vaccine; please note that to facilitate this possibility, we need to be assured that breeding will be permitted next year as there is a substantial wait time before ordering which includes outlaying of costs in advance.

Regards,

s.3

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www.avast.com

Draft Order Mink Farms

From: s.3
To: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Sent: July 23, 2021 4:28:38 PM PDT

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Hello Dr. Brian

On behalf o[s.3] thank you for meeting with us today.

We would like to put on record that we object to including **Section B 2c** to the Order. The inclusion of "the breeding of mink" is unnecessarily redundant and will result catastrophic detrimental effects to our industry.

Furthermore, our industry will need notice very quickly if the intention is to no longer allow mink to breed as that decision will bring very real financial difficulties and compensation expectations. For example, there was a discussion about the Covid mink vaccine; please note that to facilitate this possibility, we need to be assured that breeding will be permitted next year as there is a substantial wait time before ordering which includes outlaying of costs in advance.

Regards,

s.3

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www.avast.com

RE: Teleconference today (Friday, July 23), 3:00 pm to discuss SARS-CoV-2 virus infections in mink, and proposed Provincial Health Officer actions

From: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
To: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Sent: July 23, 2021 4:38:37 PM PDT

Thanks Brian. The Chief Vet did not explicitly "give" permission for breeding to happen. She simply did no prohibit breeding.[s.14]

s.14

Ursula

From: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Sent: July 23, 2021 4:29 PM
To: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
Subject: RE: Teleconference today (Friday, July 23), 3:00 pm to discuss SARS-CoV-2 virus infections in mink, and proposed Provincial Health Officer actions

Hi Ursula and yes, I think it went ok, given the circumstances.

Thanks for confirming that breeding would not happen until Feb/Mar.

s.13; s.17

Thanks.

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C[s.17] F. 250.952. 1713 brian.emerson@gov.bc.ca

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From: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
Sent: July 23, 2021 4:16 PM
To: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Subject: RE: Teleconference today (Friday, July 23), 3:00 pm to discuss SARS-CoV-2 virus infections in mink, and proposed Provincial Health Officer actions

Hi Brian, overall a good call. It is true that various groups have called for either the banning of fur farming or at the very least a ban on breeding mink. It is also correct that mink will not go into heat until Feb/Mar. [s.13; s.17]

s.13; s.17

s.13; s.17

s.13; s.17 Thanks,

Ursula

From: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Sent: July 23, 2021 4:11 PM
To: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
Subject: RE: Teleconference today (Friday, July 23), 3:00 pm to discuss SARS-CoV-2 virus infections in mink, and proposed Provincial Health Officer actions

Thanks Ursula for helping with the call and managing this situation.

s.13; s.17

Thanks.

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C[s.17] F. 250.952. 1713 brian.emerson@gov.bc.ca

---

From: Emerson, Brian P HLTH:EX
Sent: July 23, 2021 12:39 PM
To:s.3
s.3

s.3 Choquette, Blair <Blair.Choquette@fraserhealth.ca>; Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
Subject: RE: Teleconference today (Friday, July 23), 3:00 pm to discuss SARS-CoV-2 virus infections in mink, and proposed Provincial Health Officer actions
Importance: High

Good afternoon.

Further to my email from yesterday this is to give you some more detail about the call this afternoon.

Firstly, Ursula Viney, Executive Director with the Ministry of Agriculture, Food and Fisheries, will provide an update on the ongoing problems with infections and escape of mink with SARS-CoV-2.

Secondly, I will describe proposed actions by the Provincial Health Officer (PHO), answer questions, and discuss the implications. To this point attached is a draft order that the PHO is planning to issue next week. Due to the health hazard that mink farms pose, the order will put in place a moratorium on new mink farms, and cap capacity of the current farms to their current numbers.

Please feel free to forward this along to others who are going to attend the call that are not on this list.

Thank you for your availability on short notice to help address this urgent issue.

Brian Emerson

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

From: Emerson, Brian P HLTH:EX
Sent: July 22, 2021 1:53 PM
To: s.3
s.3

Cc: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
Subject: Teleconference tomorrow (Friday, July 23), 3:00 pm to discuss SARS-CoV-2 virus infections in mink, and proposed Provincial Health Officer actions
Importance: High

Dear licensed fur farmers of mink farms,

This email is to let you know that I am organizing a teleconference for tomorrow afternoon at 3 pm to discuss some proposed actions by the Provincial Health Officer with respect to mink farms, consequent to the occurrence of SARS-CoV-2 virus infections, which causes COVID-19 in humans.

A calendar invitation will be coming to you shortly.

If you cannot attend please have someone from your farm attend as a delegate.

The call-in number, which will also be in the calendar invitation, is s.15; s.17 Conference ID s.15; s.17

Thank you.

Brian Emerson

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

Mink Farm Teleconference and Order for approval

From:	Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
To:	Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Cc:	Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>, Choquette, Blair <Blair.Choquette@fraserhealth.ca>, Youngs, Kirsten R GCPE:EX <Kirsten.Youngs@gov.bc.ca>
Sent:	July 26, 2021 7:23:17 AM PDT
Attachments:	Draft Order Mink Farms, MINK ORDER draft July 26.docx

Hi Bonnie.

Further to the call I had with the mink farmers on Friday, and our email exchange last evening, attached are the notes of the meeting.

As I mentioned yesterday, the most contentious issue was the prohibition on breeding in the Order, given that the mink will not breed until February or March. The President of the Canadian Mink Farmers Association stated that including a prohibition on breeding was unnecessary and that including such a prohibition would do "irreparable harm" not only to the BC industry but also the Canadian industry, as the "activists" would use this as support for shutting down the industry. This was reiterated by the farmers. I received a follow-up email to this effect from one of the farmers (attached) who states that keeping this clause in "will result catastrophic detrimental effects to our industry".

s.13; s.17

Thanks.

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

~~*DRAFT*~~ ORDER OF THE PROVINCIAL HEALTH OFFICER

(Pursuant to Sections 30, 31, 32, 39, and 54(1) of the *Public Health Act*, S.B.C. 2008)

MINK FARMS – July ~~XX~~26, 2021

The *Public Health Act* is at:
http://www.bclaws.ca/civix/content/complete/statreg/08028/?xsl=/templates/browse.xsl
(excerpts enclosed)

TO: ANY PERSON WHO MAY PROPOSE TO OPERATE A MINK FARM IN BRITISH COLUMBIA UNDER THE *ANIMAL HEALTH ACT* AND WHO IS NOT AUTHORIZED AS OF THE DATE OF THIS ORDER TO OPERATE A MINK FARM; AND

TO: PERSONS LICENSED TO OPERATE FUR FARMS FOR THE PURPOSE OF FARMING MINK, PURSUANT TO THE *ANIMAL HEALTH ACT*

WHEREAS:

A. A communicable disease known as COVID-19 has emerged in British Columbia;

B. SARS-CoV-2, an infectious agent, can cause outbreaks of serious illness known as COVID-19 among the public;

C. A person infected with SARS-CoV-2 can infect other people with whom the infected person is in contact;

D. On March 17, 2020, I provided notice under section 52 (2) of the *Public Health Act* that the transmission of the infectious agent SARS-CoV-2, which has caused cases and outbreaks of a serious communicable disease known as COVID-19 among the population of the Province of British Columbia, constitutes a regional event as defined in section 51 of the *Public Health Act*;

E. Around the world, mink at mink farms have proven to be susceptible to COVID-19 infection and there is a demonstrated risk of mutation of SARS-CoV-2 virus in the mink population;

F. COVID-19 outbreaks have occurred at mink farms within the Fraser Health region;

G. Mutated strains of SARS-CoV-2 may re-infect humans and such mutated strains may pose a risk of development of variants of concern;

Ministry of Health
Office of the
Provincial Health Officer
4th Floor, 1515 Blanshard Street
PO Box 9648 STN PROV GOVT
Victoria BC V8W 9P4
Fax: (250) 952-1570
http://www.health.gov.bc.ca/pho/

H. The emergence of variants of concern is likely to interfere with the suppression of SARS-CoV-2 in British Columbia;

I. The medical health officer for the Fraser Health Authority has issued orders requiring a range of mitigation measures which must be followed by owners and operators of mink farms and farm workers in the Fraser Health Region. Additionally, the Chief Veterinarian of British Columbia has issued Quarantine Zone Orders from time to time to mink farms due to concerns about transmission of SARS-CoV2 on existing mink farms in BC (the "Mitigation Measures");

J. Despite the Mitigation Measures, there have been recent instances of SARS-CoV-2 in farmed mink in the province;

K. I have reason to believe and do believe that:

(i) mink farming is a health hazard as it is an activity which endangers or is likely to endanger public health

(ii) there is a risk mink infected with SARS-CoV-2 could result in infection of workers at mink farms, which could lead to further transmission in human populations;

(iii) there is a risk the mink could escape into the wild and pose a risk of transmission of SARS-CoV-2 to wild animals, also posing a risk of potential transmission from wild animals to human populations;

(iv) the susceptibility of mink to infection with SARS-CoV-2 creates a risk of development of variants of concern which pose a threat to public health and could undermine the efficacy of the COVID-19 vaccination program in British Columbia; and

(v) any increase in the number of mink farms or the number of farmed mink in British Columbia would increase the threat to public health arising from mink farming.

THEREFORE, I reasonably believe it is necessary for me to exercise the powers in sections, 30, 31, 32, 39, and 54(1) of the Public Health Act to **ORDER AS FOLLOWS**:

DEFINITIONS:

In this Order:

"breeding mink stock" means mink possessed by a licensed fur farm operator for the purpose of breeding;

"non-breeding mink" means mink possessed by a licensed fur farm operator for the purpose of slaughter and harvesting of pelts

A. ANY PERSON WHO MAY PROPOSE TO OPERATE A MINK FARM IN BRITISH COLUMBIA AND WHO IS NOT AUTHORIZED AS OF THE DATE OF THIS ORDER UNDER THE *ANIMAL HEALTH ACT* TO OPERATE A MINK FARM:

You must not operate a mink farm.

B. PERSONS LICENSED TO OPERATE FUR FARMS FOR THE PURPOSE OF FARMING MINK, PURSUANT TO THE *ANIMAL HEALTH ACT*:

1. For each farm which you operate you must immediately report to me and to the medical health officer for the health region in which the mink farm is located:

    a. the number of breeding mink stock;

    b. the number of non-breeding mink; and

    c. the total number of mink on the farm.

2. For each mink farm you operate, you must not any allow:

    a. the number of breeding mink stock to exceed the number of breeding mink stock present on each farm as of the date of this order;

    b. the number of non-breeding mink to exceed the number of non-breeding mink present on each farm as of the date of this order; and

    s.13

3. You must not acquire, by any means, any live mink in addition to the mink which were present on the farm as of the date of this Order;

C. RELATED MEDICAL HEALTH OFFICERS ORDERS

Recognizing that the risk differs in different regions of the province and that medical health officers are in the best position to assess local circumstances and to determine whether additional or more restrictive steps need to be taken to reduce the risk of the transmission of COVID-19 due to mink farming, **FOR CERTAINTY**:

1. A medical health officer may issue an order further to their powers in the *Public Health Act,* which may add further prohibitions, or impose more restrictive limitations or conditions respecting farming of mink in the whole or part of the geographic area of the province for which the medical health officer is designated and,

2. This Order does not impact any orders made by a medical health officer respecting the activities described in this Order made prior to the making of this Order.

This Order is effective immediately.

This Order expires January 31, 2022.

All persons to whom this order is directed are required under section 42 of the *Public Health Act* to comply with this Order.

Failure to comply with this Variance is an offence under section 99 (1) (k) of the *Public Health Act*.

Pursuant to section 43 of the *Public Health Act*, you may request me to reconsider this Order if you:

(a) have additional relevant information that was not reasonably available to the health officer when the order was issued or varied,

(b) have a proposal that was not presented to the health officer when the order was issued or varied but, if implemented, would

(i) meet the objective of the order, and

(ii) be suitable as the basis of a written agreement under section 38 *[may make written agreements]*, or

(c)require more time to comply with the order.

If you fail to comply with this Order, I have the authority to take enforcement action against you under Part 4, Division 6 of the *Public Health Act.*

You may contact me at:

Dr. Bonnie Henry, Provincial Health Officer
s.15; s.19
PO Box 9648 STN PROV GOVT, Victoria BC V8W 9P4
Fax: (250) 952-1570
Email: ProvHlthOffice@gov.bc.ca

DATED THIS: ~~XX~~ 26th day of July 2021

DRAFT

SIGNED: _____
Bonnie Henry
MD, MPH, FRCPC
Provincial Health Officer

DELIVERY BY: Posting to the BC Government and the BC Centre for Disease Control websites and by email and to:

Licensed operators of fur farms for mink
Ministry of Agriculture, Food and Fisheries:
Dr. Rayna Gunvaldsen, Chief Veterinarian
Tom Ethier, Deputy Minster
Jennifer McGuire, Assistant Deputy Minister, Science, Policy and Inspections Division
Vancouver Coastal Health Authority:
Dr. Patricia Daly, Chief Medical Health Officer
Fraser Health Authority:
Dr. Elizabeth Brodkin, Chief Medical Health Officer
Vancouver Island Health Authority:
Dr. Richard Stanwick, Chief Medical Health Officer
Interior Health Authority:
Dr. Sue Pollock. Chief Medical Health Officer
Northern Health Authority:
Dr. Jong Kim, Chief Medical Health Officer

Enclosure: Excerpts of the *Public Health Act*.

ENCLOSURE

Excerpts of the *Public Health Act* [SBC 2008] c. 28

Definitions

1 In this Act:

"*health hazard*" means

(a) a condition, a thing or an activity that

(i) endangers, or is likely to endanger, public health, or

(ii) interferes, or is likely to interfere, with the suppression of infectious agents or hazardous agents, or

(b) a prescribed condition, thing or activity, including a prescribed condition, thing or activity that

(i) is associated with injury or illness, or

(ii) fails to meet a prescribed standard in relation to health, injury or illness;

When orders respecting health hazards and contraventions may be made

30 (1) A health officer may issue an order under this Division only if the health officer reasonably believes that

(a) a health hazard exists,

(b) a condition, a thing or an activity presents a significant risk of causing a health hazard,

(c) a person has contravened a provision of the Act or a regulation made under it, or

(d) a person has contravened a term or condition of a licence or permit held by the person under this Act.

(2) For greater certainty, subsection (1) (a) to (c) applies even if the person subject to the order is complying with all terms and conditions of a licence, a permit, an approval or another authorization issued under this or any other enactment.

General powers respecting health hazards and contraventions

31 (1) If the circumstances described in section 30 *[when orders respecting health hazards and contraventions may be made]* apply, a health officer may order a person to do anything that the health officer reasonably believes is necessary for any of the following purposes:

(a) to determine whether a health hazard exists;

(b) to prevent or stop a health hazard, or mitigate the harm or prevent further harm from a health hazard;

(c) to bring the person into compliance with the Act or a regulation made under it;

(d) to bring the person into compliance with a term or condition of a licence or permit held by that person under this Act.

(2) A health officer may issue an order under subsection (1) to any of the following persons:

(a) a person whose action or omission

(i) is causing or has caused a health hazard, or

(ii) is not in compliance with the Act or a regulation made under it, or a term or condition of the person's licence or permit;

(b) a person who has custody or control of a thing, or control of a condition, that

(i) is a health hazard or is causing or has caused a health hazard, or

(ii) is not in compliance with the Act or a regulation made under it, or a term or condition of the person's licence or permit;

(c) the owner or occupier of a place where

(i) a health hazard is located, or

(ii) an activity is occurring that is not in compliance with the Act or a regulation made under it, or a term or condition of the licence or permit of the person doing the activity.

Specific powers respecting health hazards and contraventions

32 (1) An order may be made under this section only

(a) if the circumstances described in section 30 *[when orders respecting health hazards and contraventions may be made]* apply, and

(b) for the purposes set out in section 31 (1) *[general powers respecting health hazards and contraventions]*.

(2) Without limiting section 31, a health officer may order a person to do one or more of the following:

(a) have a thing examined, disinfected, decontaminated, altered or destroyed, including

(i) by a specified person, or under the supervision or instructions of a specified person,

(ii) moving the thing to a specified place, and

(iii) taking samples of the thing, or permitting samples of the thing to be taken;

(b) in respect of a place,

(i) leave the place,

(ii) not enter the place,

(iii) do specific work, including removing or altering things found in the place, and altering or locking the place to restrict or prevent entry to the place,

(iv) neither deal with a thing in or on the place nor dispose of a thing from the place, or deal with or dispose of the thing only in accordance with a specified procedure, and

(v) if the person has control of the place, assist in evacuating the place or examining persons found in the place, or taking preventive measures in respect of the place or persons found in the place;

(c) stop operating, or not operate, a thing;

(d) keep a thing in a specified place or in accordance with a specified procedure;

(e) prevent persons from accessing a thing;

(f) not dispose of, alter or destroy a thing, or dispose of, alter or destroy a thing only in accordance with a specified procedure;

(g) provide to the health officer or a specified person information, records, samples or other matters relevant to a thing's possible infection with an infectious agent or contamination with a hazardous agent, including information respecting persons who may have been exposed to an infectious agent or hazardous agent by the thing;

(h) wear a type of clothing or personal protective equipment, or change, remove or alter clothing or personal protective equipment, to protect the health and safety of persons;

(i) use a type of equipment or implement a process, or remove equipment or alter equipment or processes, to protect the health and safety of persons;

(j) provide evidence of complying with the order, including

(i) getting a certificate of compliance from a medical practitioner, nurse practitioner or specified person, and

(ii) providing to a health officer any relevant record;

(k) take a prescribed action.

(3) If a health officer orders a thing to be destroyed, the health officer must give the person having custody or control of the thing reasonable time to request reconsideration and review of the order under sections 43 and 44 unless

(a) the person consents in writing to the destruction of the thing, or

(b) Part 5 *[Emergency Powers]* applies.

Contents of orders

39 (3) An order may be made in respect of a class of persons.

(6)A health officer who makes an order may vary the order

(a)at any time on the health officer's own initiative, or

(b)on the request of a person affected by the order, following a reconsideration under section 43 *[reconsideration of orders]*.

Duty to comply with orders

42 (1) A person named or described in an order made under this Part must comply with the order.

(2) Subsection (1) applies regardless of whether the person leaves the geographic area for which the health officer who made the order is designated.

Reconsideration of orders

43 (1) A person affected by an order, or the variance of an order, may request the health officer who issued the order or made the variance to reconsider the order or variance if the person

(a) has additional relevant information that was not reasonably available to the health officer when the order was issued or varied,

(b) has a proposal that was not presented to the health officer when the order was issued or varied but, if implemented, would

(i) meet the objective of the order, and

(ii) be suitable as the basis of a written agreement under section 38 *[may make written agreements]*, or

(c) requires more time to comply with the order.

(2) A request for reconsideration must be made in the form required by the health officer.

(3) After considering a request for reconsideration, a health officer may do one or more of the following:

(a) reject the request on the basis that the information submitted in support of the request

(i) is not relevant, or

(ii) was reasonably available at the time the order was issued;

(b) delay the date the order is to take effect or suspend the order, if satisfied that doing so would not be detrimental to public health;

(c) confirm, rescind or vary the order.

(4) A health officer must provide written reasons for a decision to reject the request under subsection (3) (a) or to confirm or vary the order under subsection (3) (c).

(5) Following a decision made under subsection (3) (a) or (c), no further request for reconsideration may be made.

(6) An order is not suspended during the period of reconsideration unless the health officer agrees, in writing, to suspend it.

(7) For the purposes of this section,

(a) if an order is made that affects a class of persons, a request for reconsideration may be made by one person on behalf of the class, and

(b) if multiple orders are made that affect a class of persons, or address related matters or issues, a health officer may reconsider the orders separately or together.

(8) If a health officer is unable or unavailable to reconsider an order he or she made, a similarly designated health officer may act under this section in respect of the order as if the similarly designated health officer were reconsidering an order that he or she made.

Offences

99 (1) A person who contravenes any of the following provisions commits an offence:

…

(k) section 42 *[failure to comply with an order of a health officer]*, except in respect of an order made under section 29 (2) (e) to (g) *[orders respecting examinations, diagnostic examinations or preventive measures]*;

Mink Farm Teleconference and Order for approval

From:	Emerson, Brian P HLTH:EX
To:	Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Cc:	Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>, Choquette, Blair <Blair.Choquette@fraserhealth.ca>, Youngs, Kirsten R <Kirsten.Youngs@gov.bc.ca>
Sent:	July 26, 2021 7:23:17 AM PDT
Attachments:	Draft Order Mink Farms, MINK ORDER draft July 26.docx

Hi Bonnie.

Further to the call I had with the mink farmers on Friday, and our email exchange last evening, attached are the notes of the meeting.

As I mentioned yesterday, the most contentious issue was the prohibition on breeding in the Order, given that the mink will not breed until February or March. The President of the Canadian Mink Farmers Association stated that including a prohibition on breeding was unnecessary and that including such a prohibition would do "irreparable harm" not only to the BC industry but also the Canadian industry, as the "activists" would use this as support for shutting down the industry. This was reiterated by the farmers. I received a follow-up email to this effect from one of the farmers (attached) who states that keeping this clause in "will result catastrophic detrimental effects to our industry".

s.13; s.17

Thanks.

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

RE: Mink Farm Teleconference and Order for approval and Information Bulletin

From: Emerson, Brian P HLTH:EX
To: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Cc: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>, Choquette, Blair <Blair.Choquette@fraserhealth.ca>, Youngs, Kirsten R GCPE:EX <Kirsten.Youngs@gov.bc.ca>
Sent: July 26, 2021 8:02:45 AM PDT
Attachments: IB_Captured COVID Mink July 20_21 DRAFT 3bh BE.docx

Thanks, Bonnie, on to it, and will send the Order soon to the farmers and arrange for posting to the website.

I did say a number of times that MAFF would be having further discussions with the farmers in the near future about the long term plans of the industry, which was reinforced by Ursula.

Blair – can I direct the farmers on Fraser Health to report their numbers to you, as well as to us? Or is there someone else you would like them to report to?

Ursula – I understand all the farms are in the Fraser Health region s.13; s.17 s.13; s.17 so I can direct that farmer to report the numbers of live mink, if any, to the MHO in Interior Health.

Kirsten – See attached for edits to the IB, added to Bonnie's.

Thanks.

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

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From: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Sent: July 26, 2021 7:30 AM
To: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Cc: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>; Choquette, Blair <Blair.Choquette@fraserhealth.ca>; Youngs, Kirsten R GCPE:EX <Kirsten.Youngs@gov.bc.ca>
Subject: RE: Mink Farm Teleconference and Order for approval

Thanks Brian,
I am good with the revised order s.17
Let's post as soon as we can and get the IB out.
Thanks,
Bonnie

Dr Bonnie Henry
Provincial Health Officer
Office of the PHO
Ministry of Health
s.15; s.19
Mailing address: PO Box 9648, STN PROV GOVT
Victoria, BC
V8W 9P4
Bonnie.henry@gov.bc.ca

Phone: s.17; s.19

I gratefully acknowledge that I live and work on the traditional unceded territory of the Lekwungen Peoples, specifically the Songhees and Esquimalt First Nations. Hay'sxw'qu Si'em

Warning: This email is intended only for the use of the individual or organization to whom it is addressed. It may contain information that is privileged or confidential. Any distribution, disclosure, copying, or other use by anyone else is strictly prohibited. If you have received this in error, please telephone or e-mail the sender immediately and delete the message.

From: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Sent: July 26, 2021 7:23 AM
To: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>
Cc: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>; Choquette, Blair <Blair.Choquette@fraserhealth.ca>; Youngs, Kirsten R GCPE:EX <Kirsten.Youngs@gov.bc.ca>
Subject: Mink Farm Teleconference and Order for approval
Importance: High

Hi Bonnie.

Further to the call I had with the mink farmers on Friday, and our email exchange last evening, attached are the notes of the meeting.

As I mentioned yesterday, the most contentious issue was the prohibition on breeding in the Order, given that the mink will not breed until February or March. The President of the Canadian Mink Farmers Association stated that including a prohibition on breeding was unnecessary and that including such a prohibition would do "irreparable harm" not only to the BC industry but also the Canadian industry, as the "activists" would use this as support for shutting down the industry. This was reiterated by the farmers. I received a follow-up email to this effect from one of the farmers (attached) who states that keeping this clause in "will result catastrophic detrimental effects to our industry".

s.13; s.17

Thanks.

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

BRITISH COLUMBIA

INFORMATION BULLETIN

Ministry of Agriculture, Food and Fisheries

[release number]
[Date]

Mink test positive for SARS-CoV-2

FRASER VALLEY – Two mink have tested positive for SARS-CoV-2, the virus that causes COVID-19 in humans, on a farm currently under quarantine after it had mink test positive in May.

Five additional mink samples from the same farm have preliminary tested positive at the B.C. Animal Health Lab with final results pending from the national lab in Winnipeg.

The two positive mink were identified through a coordinated wildlife surveillance project led by the Ministry of Forests, Lands, Natural Resource Operations and Rural Development in cooperation with the One Health Working Group. One of the main objectives is to assess the potential for virus transmission to free-ranging animals from an infected premise. In this instance, four mink had escaped their cages and were captured on-farm.

As a result of the latest infections, as.13 ~~health~~Provincial Health Officer order has also been issued to all mink farm operators in the province, placing a moratorium on any new mink farms in BC and.13 ~~capping~~.13 existing mink farms.13 at their current numbers.13 .13 The order is effective immediately and each farm is required to report the total number of mink, both breeding stock and non-breeding mink to thes.13 Provincial Health Officer and the medical health officer in~~t~~ their health authority.

The Province is also conducting a review of its policies and regulations with respect to fur farms while ensuring the recommended mitigation measures are in place and enforced to protect both public and animal health.

Three B.C. mink farms have had mink test positive for .13 SARS-CoV-2 since December 2020 and all three remain under quarantine with no mink being moved to or from the properties. Fraser Health, WorkSafeBC and the Province continue to ensure biosecurity measures are in place to protect workers and families on mink farms as well as making sure each farm is taking all necessary precautions to reduce the risk of spreadings.13 ~~COVID-19~~ through human to animal or animal to human transmission.

s.13

The nine B.C. mink farms, all located in the Fraser Valley, employ approximately 150 workers. The exact locations of mink farms are not being released as per Section 16.1 of the Animal Health Act, which prohibits the disclosure of information that would identify a specific place where an animal is located.

Learn more:

Ministry of Healts.13 **Provincial Health Officer Order on mink farms – link needed**

Ministry of Agriculture, Food and Fisheries Information Bulletin (May 2021) with details on third B.C. mink farm to test positive for COVID-19: https://news.gov.bc.ca/releases/2021AFF0035-000953

Genome BC News Release (March 2021) with details on the project One Health Genomics: COVID-19 Adaptation investigation in mink: https://www.genomebc.ca/blog/one-health-investing-in-human-animal-and-environmental-health

Contact:

Dave Townsend
Media Relations
Ministry of Agriculture, Food and Fisheries
250 356-7098
250 889-5945 (mobile)

Provincial Health Officer Order re SARS-CoV-2 virus infections in mink farms

From: Emerson, Brian P HLTH:EX
To: s.3

s.3 Choquette, Blair <Blair.Choquette@fraserhealth.ca>
Cc: Henry, Bonnie HLTH:EX <Bonnie.Henry@gov.bc.ca>, Gunvaldsen, Rayna (Rayna.Gunvaldsen@gov.bc.ca) <Rayna.Gunvaldsen@gov.bc.ca>, Ethier, Tom AFF:EX <Tom.Ethier@gov.bc.ca>, McGuire, Jennifer <Jennifer.Mcguire@gov.bc.ca>, Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>, Elizabeth Brodkin (elizabeth.brodkin@fraserhealth.ca) <elizabeth.brodkin@fraserhealth.ca>, Tyler, Ingrid <ingrid.tyler@fraserhealth.ca>, Emily Newhouse <Emily.newhouse@fraserhealth.ca>, Choquette, Blair <Blair.Choquette@fraserhealth.ca>, Kerwin, Oona <Oona.Kerwin@fraserhealth.ca>, XT:HLTH Pollock, Sue <sue.pollock@interiorhealth.ca>, Zimmerman, Courtney <Courtney.Zimmerman@interiorhealth.ca>, Jong Kim (Jong.Kim@northernhealth.ca) <Jong.Kim@northernhealth.ca>, richard.stanwick@viha.ca, Daly, Patty [VCH] <Patricia.Daly@vch.ca>, Youngs, Kirsten R <Kirsten.Youngs@gov.bc.ca>, Nelson, Tiffany GCPE:EX <Tiffany.Nelson@gov.bc.ca>
Sent: July 26, 2021 9:39:57 AM PDT
Attachments: PHO Order re MInk Farms July 26 - final.pdf

Dear licensed fur farmers of mink farms in BC,

Thank you for the discussion about this urgent issue on Friday.

Further to the draft Order sent to you on July 23, 2021, attached is the revised Order, hereby served upon you by me on behalf of Dr. Bonnie Henry, Provincial Health Officer.

This order will be posted to the PHO website later today at https://www2.gov.bc.ca/gov/content/health/about-bc-s-health-care-system/office-of-the-provincial-health-officer/current-health-topics/covid-19-novel-coronavirus).

Please note that this Order:

- Prohibits operation of new mink farms.
- Requires that you report the number of breeding mink stock; the number of non-breeding mink; and the total number of mink on the farm to the PHO. For farms in the Fraser Health region please report the numbers to me (brian.emerson@gov.bc.ca) on behalf of Dr. Henry, and to Blair Choquette (Blair.Choquette@fraserhealth.ca) on behalf of the Fraser Health MHO. For the farm in Interior Health s.3 please report the numbers to me and to Dr. Sue Pollock, Chief Medical Health Officer (sue.pollock@interiorhealth.ca)
- Requires that you not allow the number of breeding mink stock to exceed the number of breeding mink stock present on each farm as of today; the number of non-breeding mink to exceed the number of non-breeding mink present on each farm as of today; and you must not acquire any live mink in addition to the mink which are present on the farm as of today.
- Note that, as per our discussion, the prohibition on breeding of mink has been removed from the order, on the understanding that breeding will happen until next spring due to the annual cycle. As discussed, the Ministry of Agriculture, Food and Fisheries will soon be discussing this and other related issues with the farmers.

Pursuant to section 3 of the Public Health Inspections and Orders Regulation (see excerpt below) please confirm receipt of this Order within 96 hours me; both verbally (phone 250.952.1701 and leave a message) and by electronic mail (brian.emerson@gov.bc.ca), or by fax (250.952. 1713), or in writing.

Please feel free to provide this to Matt Moses and Rob Bollert, Canadian Mink Farm Association, and Dr. Dan McDermid, as I do not have their email addresses.

If you have any questions about this Order, please contact me.

Yours truly,

Brian Emerson

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

Public Health Inspections and Orders Regulation Excerpt
Service of orders
3 (1) Orders and notices of variations of orders may be served on a person who is affected by the order or notice as follows:
…
(c) by electronic mail sent to the person's last known electronic mail address;
…
(3) Subject to subsection (4), if an order or notice is sent by electronic mail, the order or notice is not effectively served unless all of the following conditions are met:
(a) the person who is subject to the order or notice confirms that the order or notice was received;
(b) the confirmation is made
(i) both verbally and by electronic mail,
(ii) by fax, including the person's signature, or
(iii) in writing, including the person's signature;
(c) the confirmation is received by the person who served the order or notice, or a person acting on his or her behalf, no later than 96 hours after the electronic message was sent.
(4) Subsection (3) (c) does not apply if the person who is the subject of the order confirms, in writing, after the expiry of the 96 hour period that the order
(a) was received by the person, and
(b) is effectively served.

From: Emerson, Brian P HLTH:EX
Sent: July 23, 2021 12:39 PM
To: s.3
s.3

s.3 Choquette, Blair <Blair.Choquette@fraserhealth.ca>; Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
Subject: RE: Teleconference today (Friday, July 23), 3:00 pm to discuss SARS-CoV-2 virus infections in mink, and proposed Provincial Health Officer actions
Importance: High

Good afternoon.

Further to my email from yesterday this is to give you some more detail about the call this afternoon.

Firstly, Ursula Viney, Executive Director with the Ministry of Agriculture, Food and Fisheries, will provide an update on the ongoing problems with infections and escape of mink with SARS-CoV-2.

Secondly, I will describe proposed actions by the Provincial Health Officer (PHO), answer questions, and discuss the implications. To this point attached is a draft order that the PHO is planning to issue next week. Due to the health hazard that mink farms pose, the order will put in place a moratorium on new mink farms, and cap capacity of the current farms to their current numbers.

Please feel free to forward this along to others who are going to attend the call that are not on this list.

Thank you for your availability on short notice to help address this urgent issue.

Brian Emerson

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

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From: Emerson, Brian P HLTH:EX
Sent: July 22, 2021 1:53 PM
To: s.3
s.3

Cc: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
Subject: Teleconference tomorrow (Friday, July 23), 3:00 pm to discuss SARS-CoV-2 virus infections in mink, and proposed Provincial Health Officer actions
Importance: High

Dear licensed fur farmers of mink farms,

This email is to let you know that I am organizing a teleconference for tomorrow afternoon at 3 pm to discuss some proposed actions by the Provincial Health Officer with respect to mink farms, consequent to the occurrence of SARS-CoV-2 virus infections, which causes COVID-19 in humans.

A calendar invitation will be coming to you shortly.

If you cannot attend please have someone from your farm attend as a delegate.

The call-in number, which will also be in the calendar invitation, is 1 s.15; s.17 Conference ID s.15; s.17

Thank you.

Brian Emerson

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

ORDER OF THE PROVINCIAL HEALTH OFFICER

(Pursuant to Sections 30, 31, 32, 39, and 54(1) of the *Public Health Act*, S.B.C. 2008)

MINK FARMS – July 26, 2021

The *Public Health Act* is at:
http://www.bclaws.ca/civix/content/complete/statreg/08028/?xsl=/templates/browse.xsl
(excerpts enclosed)

TO: ANY PERSON WHO MAY PROPOSE TO OPERATE A MINK FARM IN BRITISH COLUMBIA UNDER THE *ANIMAL HEALTH ACT* AND WHO IS NOT AUTHORIZED AS OF THE DATE OF THIS ORDER TO OPERATE A MINK FARM; AND

TO: PERSONS LICENSED TO OPERATE FUR FARMS FOR THE PURPOSE OF FARMING MINK, PURSUANT TO THE *ANIMAL HEALTH ACT*

WHEREAS:

A. A communicable disease known as COVID-19 has emerged in British Columbia;

B. SARS-CoV-2, an infectious agent, can cause outbreaks of serious illness known as COVID-19 among the public;

C. A person infected with SARS-CoV-2 can infect other people with whom the infected person is in contact;

D. On March 17, 2020, I provided notice under section 52 (2) of the *Public Health Act* that the transmission of the infectious agent SARS-CoV-2, which has caused cases and outbreaks of a serious communicable disease known as COVID-19 among the population of the Province of British Columbia, constitutes a regional event as defined in section 51 of the *Public Health Act*;

E. Around the world, mink at mink farms have proven to be susceptible to COVID-19 infection and there is a demonstrated risk of mutation of SARS-CoV-2 virus in the mink population;

F. COVID-19 outbreaks have occurred at mink farms within the Fraser Health region;

G. Mutated strains of SARS-CoV-2 may re-infect humans and such mutated strains may pose a risk of development of variants of concern;

Ministry of Health

Office of the
Provincial Health Officer

4th Floor, 1515 Blanshard Street
PO Box 9648 STN PROV GOVT
Victoria BC V8W 9P4
Fax: (250) 952-1570
http://www.health.gov.bc.ca/pho/

H. The emergence of variants of concern is likely to interfere with the suppression of SARS-CoV-2 in British Columbia;

I. The medical health officer for the Fraser Health Authority has issued orders requiring a range of mitigation measures which must be followed by owners and operators of mink farms and farm workers in the Fraser Health Region. Additionally, the Chief Veterinarian of British Columbia has issued Quarantine Zone Orders from time to time to mink farms due to concerns about transmission of SARS-CoV2 on existing mink farms in BC (the "Mitigation Measures");

J. Despite the Mitigation Measures, there have been recent instances of SARS-CoV-2 in farmed mink in the province;

K. I have reason to believe and do believe that:

(i) mink farming is a health hazard as it is an activity which endangers or is likely to endanger public health

(ii) there is a risk mink infected with SARS-CoV-2 could result in infection of workers at mink farms, which could lead to further transmission in human populations;

(iii) there is a risk the mink could escape into the wild and pose a risk of transmission of SARS-CoV-2 to wild animals, also posing a risk of potential transmission from wild animals to human populations;

(iv) the susceptibility of mink to infection with SARS-CoV-2 creates a risk of development of variants of concern which pose a threat to public health and could undermine the efficacy of the COVID-19 vaccination program in British Columbia; and

(v) any increase in the number of mink farms or the number of farmed mink in British Columbia would increase the threat to public health arising from mink farming.

THEREFORE, I reasonably believe it is necessary for me to exercise the powers in sections, 30, 31, 32, 39, and 54(1) of the *Public Health Act* to **ORDER AS FOLLOWS**:

DEFINITIONS:

In this Order:

"breeding mink stock" means mink possessed by a licensed fur farm operator for the purpose of breeding;

"non-breeding mink" means mink possessed by a licensed fur farm operator for the purpose of slaughter and harvesting of pelts

A. ANY PERSON WHO MAY PROPOSE TO OPERATE A MINK FARM IN BRITISH COLUMBIA AND WHO IS NOT AUTHORIZED AS OF THE DATE OF THIS ORDER UNDER THE *ANIMAL HEALTH ACT* TO OPERATE A MINK FARM:

You must not operate a mink farm.

B. PERSONS LICENSED TO OPERATE FUR FARMS FOR THE PURPOSE OF FARMING MINK, PURSUANT TO THE *ANIMAL HEALTH ACT*:

1. For each farm which you operate you must immediately report to me and to the medical health officer for the health region in which the mink farm is located:

    a. the number of breeding mink stock;

    b. the number of non-breeding mink; and

    c. the total number of mink on the farm.

2. For each mink farm you operate, you must not allow:

    a. the number of breeding mink stock to exceed the number of breeding mink stock present on each farm as of the date of this order;

    b. the number of non-breeding mink to exceed the number of non-breeding mink present on each farm as of the date of this order.

3. You must not acquire, by any means, any live mink in addition to the mink which were present on the farm as of the date of this Order.

C. RELATED MEDICAL HEALTH OFFICERS ORDERS

Recognizing that the risk differs in different regions of the province and that medical health officers are in the best position to assess local circumstances and to determine whether additional or more restrictive steps need to be taken to reduce the risk of the transmission of COVID-19 due to mink farming, **FOR CERTAINTY**:

1. A medical health officer may issue an order further to their powers in the *Public Health Act,* which may add further prohibitions, or impose more restrictive limitations or conditions respecting farming of mink in the whole or part of the geographic area of the province for which the medical health officer is designated and,

2. This Order does not impact any orders made by a medical health officer respecting the activities described in this Order made prior to the making of this Order.

This Order is effective immediately.

This Order expires January 31, 2022.

All persons to whom this order is directed are required under section 42 of the *Public Health Act* to comply with this Order.

Failure to comply with this Variance is an offence under section 99 (1) (k) of the *Public Health Act*.

Pursuant to section 43 of the *Public Health Act*, you may request me to reconsider this Order if you:

(a) have additional relevant information that was not reasonably available to the health officer when the order was issued or varied,

(b) have a proposal that was not presented to the health officer when the order was issued or varied but, if implemented, would

(i) meet the objective of the order, and

(ii) be suitable as the basis of a written agreement under section 38 *[may make written agreements]*, or

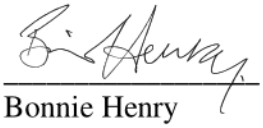
(c) require more time to comply with the order.

If you fail to comply with this Order, I have the authority to take enforcement action against you under Part 4, Division 6 of the *Public Health Act.*

You may contact me at:

Dr. Bonnie Henry, Provincial Health Officer
s.15; s.19
PO Box 9648 STN PROV GOVT, Victoria BC V8W 9P4
Fax: (250) 952-1570
Email: ProvHlthOffice@gov.bc.ca

DATED THIS: 26th day of July 2021

SIGNED: 

Bonnie Henry
MD, MPH, FRCPC
Provincial Health Officer

DELIVERY BY: Posting to the BC Government and the BC Centre for Disease Control websites and by email and to:

Licensed operators of fur farms for mink

Ministry of Agriculture, Food and Fisheries:
Dr. Rayna Gunvaldsen, Chief Veterinarian
Tom Ethier, Deputy Minster
Jennifer McGuire, Assistant Deputy Minister, Science, Policy and Inspections Division

Vancouver Coastal Health Authority:
Dr. Patricia Daly, Chief Medical Health Officer

Fraser Health Authority:
Dr. Elizabeth Brodkin, Chief Medical Health Officer

Vancouver Island Health Authority:
Dr. Richard Stanwick, Chief Medical Health Officer

Interior Health Authority:
Dr. Sue Pollock. Chief Medical Health Officer

Northern Health Authority:
Dr. Jong Kim, Chief Medical Health Officer

Enclosure: Excerpts of the *Public Health Act*.

ENCLOSURE

Excerpts of the *Public Health Act* [SBC 2008] c. 28

Definitions

1 In this Act:

"*health hazard*" means

(a) a condition, a thing or an activity that

(i) endangers, or is likely to endanger, public health, or

(ii) interferes, or is likely to interfere, with the suppression of infectious agents or hazardous agents, or

(b) a prescribed condition, thing or activity, including a prescribed condition, thing or activity that

(i) is associated with injury or illness, or

(ii) fails to meet a prescribed standard in relation to health, injury or illness;

When orders respecting health hazards and contraventions may be made

30 (1) A health officer may issue an order under this Division only if the health officer reasonably believes that

(a) a health hazard exists,

(b) a condition, a thing or an activity presents a significant risk of causing a health hazard,

(c) a person has contravened a provision of the Act or a regulation made under it, or

(d) a person has contravened a term or condition of a licence or permit held by the person under this Act.

(2) For greater certainty, subsection (1) (a) to (c) applies even if the person subject to the order is complying with all terms and conditions of a licence, a permit, an approval or another authorization issued under this or any other enactment.

General powers respecting health hazards and contraventions

31 (1) If the circumstances described in section 30 *[when orders respecting health hazards and contraventions may be made]* apply, a health officer may order a person to do anything that the health officer reasonably believes is necessary for any of the following purposes:

(a) to determine whether a health hazard exists;

(b) to prevent or stop a health hazard, or mitigate the harm or prevent further harm from a health hazard;

(c) to bring the person into compliance with the Act or a regulation made under it;

(d) to bring the person into compliance with a term or condition of a licence or permit held by that person under this Act.

(2) A health officer may issue an order under subsection (1) to any of the following persons:

(a) a person whose action or omission

(i) is causing or has caused a health hazard, or

(ii) is not in compliance with the Act or a regulation made under it, or a term or condition of the person's licence or permit;

(b) a person who has custody or control of a thing, or control of a condition, that

(i) is a health hazard or is causing or has caused a health hazard, or

(ii) is not in compliance with the Act or a regulation made under it, or a term or condition of the person's licence or permit;

(c) the owner or occupier of a place where

(i) a health hazard is located, or

(ii) an activity is occurring that is not in compliance with the Act or a regulation made under it, or a term or condition of the licence or permit of the person doing the activity.

Specific powers respecting health hazards and contraventions

32 (1) An order may be made under this section only

(a) if the circumstances described in section 30 *[when orders respecting health hazards and contraventions may be made]* apply, and

(b) for the purposes set out in section 31 (1) *[general powers respecting health hazards and contraventions]*.

(2) Without limiting section 31, a health officer may order a person to do one or more of the following:

(a) have a thing examined, disinfected, decontaminated, altered or destroyed, including

(i) by a specified person, or under the supervision or instructions of a specified person,

(ii) moving the thing to a specified place, and

(iii) taking samples of the thing, or permitting samples of the thing to be taken;

(b) in respect of a place,

(i) leave the place,

(ii) not enter the place,

(iii) do specific work, including removing or altering things found in the place, and altering or locking the place to restrict or prevent entry to the place,

(iv) neither deal with a thing in or on the place nor dispose of a thing from the place, or deal with or dispose of the thing only in accordance with a specified procedure, and

(v) if the person has control of the place, assist in evacuating the place or examining persons found in the place, or taking preventive measures in respect of the place or persons found in the place;

(c) stop operating, or not operate, a thing;

(d) keep a thing in a specified place or in accordance with a specified procedure;

(e) prevent persons from accessing a thing;

(f) not dispose of, alter or destroy a thing, or dispose of, alter or destroy a thing only in accordance with a specified procedure;

(g) provide to the health officer or a specified person information, records, samples or other matters relevant to a thing's possible infection with an infectious agent or contamination with a hazardous agent, including information respecting persons who may have been exposed to an infectious agent or hazardous agent by the thing;

(h) wear a type of clothing or personal protective equipment, or change, remove or alter clothing or personal protective equipment, to protect the health and safety of persons;

(i) use a type of equipment or implement a process, or remove equipment or alter equipment or processes, to protect the health and safety of persons;

(j) provide evidence of complying with the order, including

(i) getting a certificate of compliance from a medical practitioner, nurse practitioner or specified person, and

(ii) providing to a health officer any relevant record;

(k) take a prescribed action.

(3) If a health officer orders a thing to be destroyed, the health officer must give the person having custody or control of the thing reasonable time to request reconsideration and review of the order under sections 43 and 44 unless

(a) the person consents in writing to the destruction of the thing, or

(b) Part 5 *[Emergency Powers]* applies.

Contents of orders

39 (3) An order may be made in respect of a class of persons.

(6)A health officer who makes an order may vary the order

(a)at any time on the health officer's own initiative, or

(b)on the request of a person affected by the order, following a reconsideration under section 43 *[reconsideration of orders]*.

Duty to comply with orders

42 (1) A person named or described in an order made under this Part must comply with the order.

(2) Subsection (1) applies regardless of whether the person leaves the geographic area for which the health officer who made the order is designated.

Reconsideration of orders

43 (1) A person affected by an order, or the variance of an order, may request the health officer who issued the order or made the variance to reconsider the order or variance if the person

(a) has additional relevant information that was not reasonably available to the health officer when the order was issued or varied,

(b) has a proposal that was not presented to the health officer when the order was issued or varied but, if implemented, would

(i) meet the objective of the order, and

(ii) be suitable as the basis of a written agreement under section 38 *[may make written agreements]*, or

(c) requires more time to comply with the order.

(2) A request for reconsideration must be made in the form required by the health officer.

(3) After considering a request for reconsideration, a health officer may do one or more of the following:

(a) reject the request on the basis that the information submitted in support of the request

(i) is not relevant, or

(ii) was reasonably available at the time the order was issued;

(b) delay the date the order is to take effect or suspend the order, if satisfied that doing so would not be detrimental to public health;

(c) confirm, rescind or vary the order.

(4) A health officer must provide written reasons for a decision to reject the request under subsection (3) (a) or to confirm or vary the order under subsection (3) (c).

(5) Following a decision made under subsection (3) (a) or (c), no further request for reconsideration may be made.

(6) An order is not suspended during the period of reconsideration unless the health officer agrees, in writing, to suspend it.

(7) For the purposes of this section,

(a) if an order is made that affects a class of persons, a request for reconsideration may be made by one person on behalf of the class, and

(b) if multiple orders are made that affect a class of persons, or address related matters or issues, a health officer may reconsider the orders separately or together.

(8) If a health officer is unable or unavailable to reconsider an order he or she made, a similarly designated health officer may act under this section in respect of the order as if the similarly designated health officer were reconsidering an order that he or she made.

Offences

99 (1) A person who contravenes any of the following provisions commits an offence:

(k) section 42 *[failure to comply with an order of a health officer]*, except in respect of an order made under section 29 (2) (e) to (g) *[orders respecting examinations, diagnostic examinations or preventive measures]*;

Page 619 of 656 to/à Page 624 of 656

Withheld pursuant to/removed as

s.14 ; s.17

Role of Chief Vet in protection of public health

From: Emerson, Brian P HLTH:EX
To: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
Sent: July 26, 2021 10:38:12 AM PDT
Attachments: s.14; s.17

Hi Ursula and thanks for clarifying the issue about authority to allow breeding.

I too recall some uncertainty about the Chief Vets authority regarding protecting public health when it came to breeding. I am not sure if you received the joint legal opinion (attached) but for future reference it is clear from this opinion that the Chief Vet can take action under the *Animal Health Act* to protect not only animal health, but human health e.g.

When general orders may be made

39 (1) An inspector may make an order under this Division only if the inspector reasonably believes that

(a) an animal is or may be affected by, or is at risk of being exposed to an animal affected by, a notifiable or reportable disease,

(b) an animal product or byproduct is or may be affected by a notifiable or reportable disease,

(c) a condition, a thing or an activity presents a significant risk of causing a threat to

(i) animal health, or

(ii) public health in relation to diseases that are or may be transmissible from animals to humans,

Hopefully you and your team will have sorted out the breeding question well in advance of the next breeding season.

Thanks again for all your assistance with this file!

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

---

From: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
Sent: July 23, 2021 4:39 PM
To: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Subject: RE: Teleconference today (Friday, July 23), 3:00 pm to discuss SARS-CoV-2 virus infections in mink, and proposed Provincial Health Officer actions

Thanks Brian. The Chief Vet did not explicitly "give" permission for breeding to happen. She simply did not prohibit breeding. s.14
s.14

Ursula

From: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Sent: July 23, 2021 4:29 PM

To: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
Subject: RE: Teleconference today (Friday, July 23), 3:00 pm to discuss SARS-CoV-2 virus infections in mink, and proposed Provincial Health Officer actions

Hi Ursula and yes, I think it went ok, given the circumstances.

Thanks for confirming that breeding would not happen until Feb/Mar.

I think there are two options if time is running out and there is not a permanent solution was not in place.
s.13; s.17

Thanks.

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

---

From: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
Sent: July 23, 2021 4:16 PM
To: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Subject: RE: Teleconference today (Friday, July 23), 3:00 pm to discuss SARS-CoV-2 virus infections in mink, and proposed Provincial Health Officer actions

Hi Brian, overall a good call. It is true that various groups have called for either the banning of fur farming or at the very least a ban on breeding mink. It is also correct that mink will not go into heat until Feb/Mar. s.13; s.17
s.13; s.17

s.13; s.17
s.13; s.17 Thanks,

Ursula

From: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Sent: July 23, 2021 4:11 PM
To: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
Subject: RE: Teleconference today (Friday, July 23), 3:00 pm to discuss SARS-CoV-2 virus infections in mink, and proposed Provincial Health Officer actions

Thanks Ursula for helping with the call and managing this situation.

s.13; s.17

Thanks.

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

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From: Emerson, Brian P HLTH:EX
Sent: July 23, 2021 12:39 PM
To: s.3
s.3

s.3 Choquette, Blair <Blair.Choquette@fraserhealth.ca>; Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
Subject: RE: Teleconference today (Friday, July 23), 3:00 pm to discuss SARS-CoV-2 virus infections in mink, and proposed Provincial Health Officer actions
Importance: High

Good afternoon.

Further to my email from yesterday this is to give you some more detail about the call this afternoon.

Firstly, Ursula Viney, Executive Director with the Ministry of Agriculture, Food and Fisheries, will provide an update on the ongoing problems with infections and escape of mink with SARS-CoV-2.

Secondly, I will describe proposed actions by the Provincial Health Officer (PHO), answer questions, and discuss the implications. To this point attached is a draft order that the PHO is planning to issue next week. Due to the health hazard that mink farms pose, the order will put in place a moratorium on new mink farms, and cap capacity of the current farms to their current numbers.

Please feel free to forward this along to others who are going to attend the call that are not on this list.

Thank you for your availability on short notice to help address this urgent issue.

Brian Emerson

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

---

From: Emerson, Brian P HLTH:EX
Sent: July 22, 2021 1:53 PM
To: s.3
s.3

Cc: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>

Subject: Teleconference tomorrow (Friday, July 23), 3:00 pm to discuss SARS-CoV-2 virus infections in mink, and proposed Provincial Health Officer actions
Importance: High

Dear licensed fur farmers of mink farms,

This email is to let you know that I am organizing a teleconference for tomorrow afternoon at 3 pm to discuss some proposed actions by the Provincial Health Officer with respect to mink farms, consequent to the occurrence of SARS-CoV-2 virus infections, which causes COVID-19 in humans.

A calendar invitation will be coming to you shortly.

If you cannot attend please have someone from your farm attend as a delegate.

The call-in number, which will also be in the calendar invitation, is 1 s.15; s.17 Conference ID s.15; s.17

Thank you.

Brian Emerson

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

Page 629 of 656 to/à Page 637 of 656

Withheld pursuant to/removed as

s.14 ; s.17

B.C Mink Producers Association

From: s.3
To: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>, Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Sent: July 26, 2021 11:24:12 PM PDT

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

BCMPA would like to Thank everyone involved who worked on the statement put out by the Province today in regards to the mink caught outside the premises of the quarantined farm in question. We appreciate the change after taking some of our concerns into consideration.

As this report definitely comes with more pressure for all parties involved, our industry appreciates the language you used regarding this difficult situation we find ourselves in.

With that being said, our livelihoods are technically still very much in limbo and potentially only an amendment away from further restrictions. We are needing the Government to make it very clear as to what their agenda is for our future. This needs to be done sooner than later.

We also need clear information from you on what actions are needed in order to satisfy your office, so we can lift these orders. You have identified us as a Public Health risk and this brings more issues for our sector. We need to know what has to happen to remove the Health orders. We are under previous orders as well - with no discussion on what could remove them. The positive AND negative mink farms need direction as we work through some difficult requirements already in-acted upon us.

For the moment, we'd like to Thank you again for listening and taking another look before releasing your report.

s.3

FW: Health Order Mink Farms - July 26th 2021

From: s.3
To: Blair.Choquette@fraserhealth.ca, Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Sent: July 27, 2021 3:49:43 PM PDT
Attachments: Health Order - Mink Farms July 26th 2021.pdf, image001.jpg

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

See email below

s.3

From: s.3
Sent: July 27, 2021 3:34 PM
To: ProvHlthOffice@gov.bc.ca; elizabeth.brodkin@fraserhealth.ca
Cc: bbbernemann@yahoo.ca
Subject: Health Order Mink Farms - July 26th 2021

In reference to 'Order of the Provincial Health Officer' Mink Farms – July 26th 2021:

Please find attached the report of mink stock (breeding and non-breeding) for s.3

s.3

This email has been checked for viruses by Avast antivirus software.
www.avast.com

s.3

Attention to:

Dr. Bonnie Henry, Provincial health Officer

Dr. Elizabeth Brodkin, Chief Medical Health Officer, Fraser Health Authority

As per the ***Order of the Provincial Health Officer : Mink Farms – July 26th 2021***

Section B 1

A) Number of Breeding mink stock: effective July 26th 2021

13,800 Breeding Females

3,450 Breeding Males

B) Number of non-breeding mink: effective July 26th 2021

52,240 non-breeding mink (male and female)

C) Total Number of mink on the farm: effective July 26th 2021

69,490

**** Please note:

Section 2 b :

The number of non-breeding mink present after whelping in 2022 will be dependent on the whelp average per breeding female which fluctuates each year.

Submitted by;

s.3 - July 27th 2021

Director s.3

mink numbers on farm

From: s.3

To: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>

Cc: Blair.Choquette@fraserhealth.ca

Sent: July 28, 2021 9:09:45 PM PDT

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Good Evening,

At s.3 we have a total of 30,540 mink on the premises. 5,750 of which are Breeders for our farm. We also have 885 breeders ordered by s.3 for delivery before next breeding season.

s.3

On behalf of Bonnie Henry

From: s.3
To: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Sent: July 29, 2021 12:19:31 PM PDT

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

I currently have no mink only pelts to sell.I couldn't buy breeding stock last year due to COVID and now it looks like I can't continue next year either. I am patiently waiting to hear when and what needs to be done so I can continue a lively hood.

s.3

Sent from my iPhone

RE: Mink Farm Reporting Numbers

From: Choquette, Blair [FH] <Blair.Choquette@fraserhealth.ca>
To: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Cc: Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>
Sent: July 29, 2021 6:52:07 PM PDT

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Hi Brian

Below is the information submitted to date. A couple of notes:

- Both s.3 each have 2 locations. It would appear that they have rolled up their numbers. I can follow-up with the operators for a break down based on location?
- s.3 has not reported out. It is our understanding that the operator only keeps about 20 mink (possible for farm tax purposes). The owner is s.3 is also the general manager for s.3 s.3
- s.3 - only two numbers provided. Number of Breeders (not broken down into male/female) and Total Number.

Producer	Breeding Females Mink	Breeding Males Mink	Non-Breeding Mink	Total
s.3	13,800	3450	52,240	69,490
	19,750	4950	76,570	101,270
	3800	950	22,150	26,900
	4200	1050	24,150	29,400
	1,800	450	10,500	12,800
	5750* number not broken down into Female/Male		24,790* number not provided by producer. Only total and number of breeders. FH to confirm	30,540

s.3

Not provided			Not provided
0	0	0	0
0	0	0	885 breeders ordered from s.3 s.3 to be delivered before next breeding season

Blair

-----Original Message-----
From: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Sent: Thursday, July 29, 2021 2:52 PM
To: Choquette, Blair [FH] <Blair.Choquette@fraserhealth.ca>
Cc: Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>
Subject: Re: s.3

EXTERNAL SENDER. If you suspect this message is malicious, please forward to spam@phsa.ca and do not open attachments or click on links.

Thanks Blair.

Having you got a tracking summary of what has come in? I think I will need to send some reminders tomorrow.

Thanks again.

Brian
Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting) BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria<x-apple-data-detectors://17/0>, BC V8W 9P1
T 250.952.1701<tel:250.952.1701> C s.17 F. 250.952. 1713<tel:250.952.%201713>
brian.emerson@gov.bc.ca<mailto:brian.emerson@gov.bc.ca>

On Jul 29, 2021, at 2:11 PM, Choquette, Blair [FH] <Blair.Choquette@fraserhealth.ca> wrote:

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

FYI

Blair

Blair Choquette
Health Protection Manager
Environmental Health Services
Fraser Health
400 2777 Gladwin Rd,

Abbotsford, BC V2T 4V1
Tel: (604) 870-7921 Fax: (604) 852-1558

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-----Original Message-----
From: s.3
Sent: Thursday, July 29, 2021 12:25 PM
To: Choquette, Blair [FH] <Blair.Choquette@fraserhealth.ca>
Subject: On behalf of the MHO

EXTERNAL SENDER. If you suspect this message is malicious, please forward to spam@phsa.ca and do not open attachments or click on links.

I currently have no live animals on my farm, I have still pelts to sell from previous years . Iwas told last year I couldn't repopulate my farm due to COVID restrictions and now these rules prevent me from continuing a livelihood this year as well. I , as well as the rest of the industry await some answers on our future sooner than later hopefully s.3
s.3

Sent from my iPhone

RE: Mink Farm Reporting Numbers

From: Emerson, Brian P HLTH:EX
To: Choquette, Blair [FH] <Blair.Choquette@fraserhealth.ca>
Cc: Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>
Sent: July 30, 2021 7:44:00 AM PDT
Attachments: RE: Updated Email Address List

Thanks Blair.

In the order we did specify that we wanted to know numbers for "each farm" so please do follow up with s.3 for a break down by location.

The list of farms I received from Min Ag (see attached) did not include s.3 It must not be a licensed fur farm. I will follow up with them to see if they have a record.

We did not ask for breakdown by sex so I am OK with combined numbers from s.3

I am scheduled to be off next week but will continue to pursue this as will be at home for my vacation, and am available for follow up if needed.

Thanks again!

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health. PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C s.17 . 250.952. 1713 brian.emerson@gov.bc.ca

---

From: Choquette, Blair [FH] <Blair.Choquette@fraserhealth.ca>
Sent: July 29, 2021 6:52 PM
To: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Cc: Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>
Subject: RE: Mink Farm Reporting Numbers

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

Hi Brian

Below is the information submitted to date. A couple of notes:

- Both s.3 farms each have 2 locations. It would appear that they have rolled up their numbers. I can follow-up with the operators for a break down based on location?

s.3 has not reported out. It is our understanding that the operator only keeps about 20 mink (possible for farm tax purposes). The owner s.3 is also the general manager for s.3

s.3 - only two numbers provided. Number of Breeders (not broken down into male/female) and Total Number.

Producer	Breeding Females Mink	Breeding Males Mink	Non-Breeding Mink	Total

s.3

13,800	3450	52,240	69,490
19,750	4950	76,570	101,270
3800	950	22,150	26,900
4200	1050	24,150	29,400
1,800	450	10,500	12,800
5750* number not broken down into Female/Male		24,790* number not provided by producer. Only total and number of breeders. FH to confirm	30,540
Not provided			Not provided
0	0	0	0
0	0	0	885 breeders ordered from s.3 s.3 to be delivered before next breeding season

Blair

-----Original Message-----
From: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Sent: Thursday, July 29, 2021 2:52 PM
To: Choquette, Blair [FH] <Blair.Choquette@fraserhealth.ca>
Cc: Newhouse, Emily [FH] <Emily.Newhouse@fraserhealth.ca>
Subject: Res.3

EXTERNAL SENDER. If you suspect this message is malicious, please forward to spam@phsa.ca and do not open attachments or click on links.

Thanks Blair.

Having you got a tracking summary of what has come in? I think I will need to send some reminders tomorrow.

Thanks again.

Brian
Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting) BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria<x-apple-data-detectors://17/0>, BC V8W 9P1
T 250.952.1701<tel:250.952.1701> C s.17 F. 250.952. 1713<tel:250.952.%201713>
brian.emerson@gov.bc.ca<mailto:brian.emerson@gov.bc.ca>

On Jul 29, 2021, at 2:11 PM, Choquette, Blair [FH] <Blair.Choquette@fraserhealth.ca> wrote:

[EXTERNAL] This email came from an external source. Only open attachments or links that you are expecting from a known sender.

FYI

Blair

Blair Choquette
Health Protection Manager
Environmental Health Services
Fraser Health
400 2777 Gladwin Rd,
Abbotsford, BC V2T 4V1
Tel: (604) 870-7921 Fax: (604) 852-1558

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-----Original Message-----
From s.17
Sent: Thursday, July 29, 2021 12:25 PM
To: Choquette, Blair [FH] <Blair.Choquette@fraserhealth.ca>
Subject: On behalf of the MHO

EXTERNAL SENDER. If you suspect this message is malicious, please forward to spam@phsa.ca and do not open attachments or click on links.

I currently have no live animals on my farm, I have still pelts to sell from previous years . Iwas told last year I couldn't repopulate my farm due to COVID restrictions and now these rules prevent me from continuing a livelihood this vear as well. I , as well as the rest of the industry await some answers on our future sooner than later hopefully s.17
s.17

Sent from my iPhone

RE: Updated Email Address List

From: Hughes, Marie Julie AFF:EX <MarieJulie.Hughes@gov.bc.ca>
To: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>, Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Sent: July 22, 2021 11:24:20 AM PDT
Attachments: image001.jpg, image002.jpg

Good morning,

These are the license holders as reported in the Ministry of Agriculture Licensing System (MALS).

Farms with Live Animals

s.3

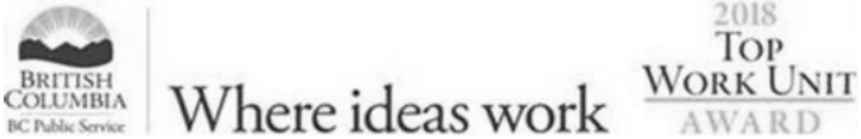
Farms with Pelts Only

s.3

Please let me know if I can be of further assistance,

Julie

(Marie) Julie Hughes
Compliance, Operations and Data Officer
British Columbia Ministry of Agriculture, Food and Fisheries
1767 Angus Campbell Road, Abbotsford, BC V3G 2M3
Tel: 778-666-0560
Mariejulie.hughes@gov.bc.ca
www.gov.bc.ca/animalhealthcentre



From: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
Sent: July 22, 2021 11:01 AM
To: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>; Hughes, Marie Julie AFF:EX <MarieJulie.Hughes@gov.bc.ca>
Subject: RE: Updated Email Address List

Thanks Brian. Julie will be sending you're the shortened list soon.

3:00 pm works for me. Thanks,

Ursula

From: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Sent: July 22, 2021 10:51 AM
To: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>; Hughes, Marie Julie AFF:EX <MarieJulie.Hughes@gov.bc.ca>
Subject: RE: Updated Email Address List

Thanks Ursula and Julie

I will need to know who is the "licensed fur farmer" for each farm, so that the order can be served on the most responsible person. Please identify who is the holder of licence for each farm.

I can also use that short list to set up the meeting. I am thinking of aiming for 3 pm. Would that work for you?

Thanks.

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

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From: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
Sent: July 22, 2021 9:52 AM
To: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Subject: FW: Updated Email Address List

Hi Brian, please see below for emails and contact information for all mink farms with current licences. As many of the farms are family owned and operated you will notice there are several email addresses associated with each farm. These are the emails we used when meeting with the producers in January 2021. Will your staff be setting up the meeting for Friday afternoon? Thanks,

Ursula

From: Hughes, Marie Julie AFF:EX <MarieJulie.Hughes@gov.bc.ca>
Sent: July 22, 2021 9:38 AM
To: Viney, Ursula E AFF:EX <Ursula.Viney@gov.bc.ca>
Subject: Updated Email Address List

Hi Ursula,

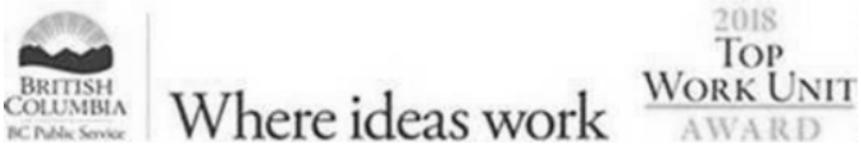
As discussed, I have provided contact names, I also went through the list of invitees for the SARS-Cov-2 meeting in January and added everyone that attended that meeting as well. You will notice that a few of the email addresses are for "farm office", I don't have a name associated to all of these.

Farms with Live Animals

s.3

Julie

(Marie) Julie Hughes
Compliance, Operations and Data Officer
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Tel: 778-666-0560
Mariejulie.hughes@gov.bc.ca
www.gov.bc.ca/animalhealthcentre



RE: Mink Farm order CLIFF 1205446

From: Emerson, Brian P HLTH:EX
To: Lu, Michael Q HLTH:EX <Michael.Lu@gov.bc.ca>
Cc: Havens, Jessica HLTH:EX <Jessica.Havens@gov.bc.ca>, Halicki, Ashley HLTH:EX <Ashley.Halicki@gov.bc.ca>
Sent: August 16, 2021 11:38:35 AM PDT

Hi Michael.

The answer is that we are aware of the breeding cycle of mink, we are engaged in consultation with the Ministry of Agriculture on the mink farms issues, and we will be reviewing the expiry of this order in light of the evolution of the pandemic over the fall and winter.

Thanks.

Brian

Dr. Brian P. Emerson, Deputy Provincial Health Officer (acting)
BC Ministry of Health, PO Box 9648 Stn Prov Govt, Victoria, BC V8W 9P1
T 250.952.1701 C s.17 F. 250.952. 1713 brian.emerson@gov.bc.ca

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From: Halicki, Ashley HLTH:EX <Ashley.Halicki@gov.bc.ca>
Sent: August 13, 2021 12:38 PM
To: Emerson, Brian P HLTH:EX <Brian.Emerson@gov.bc.ca>
Cc: Lu, Michael Q HLTH:EX <Michael.Lu@gov.bc.ca>; Havens, Jessica HLTH:EX <Jessica.Havens@gov.bc.ca>
Subject: FW: Mink Farm order CLIFF 1205446

Hi Brian,

So sorry to bother you. I know how busy you are during your "time off." Are you able to advise on the below?

Thank you,

Ashley Halicki | Executive Administrative Assistant
Office of the Provincial Health Officer, Ministry of Health

Offering acknowledgement in respect of the Lekwungen-speaking peoples, traditional keepers of this land, and the Songhees, Esquimalt, and WSÁNEĆ peoples whose historical relationships with this land continue today.

This message, including any attachments to it, is not to be disclosed outside of the Provincial Government without prior written approval from the Ministry of Health. If you have received this communication in error, please destroy the email message and any attachments immediately and notify me by telephone or by email.

From: Lu, Michael Q HLTH:EX <Michael.Lu@gov.bc.ca>
Sent: August 13, 2021 12:23 PM
To: Halicki, Ashley HLTH:EX <Ashley.Halicki@gov.bc.ca>
Cc: Havens, Jessica HLTH:EX <Jessica.Havens@gov.bc.ca>
Subject: Mink Farm order CLIFF 1205446

Hi Ashley,

I was wondering if I can get an answer for this client's question from Dr. Emerson. Client works for s.22 and is wondering the reason why the Mink Farm order is set to expire on January 31, 2022. Client claims that the date seemed odd to her because that happens to coincide with the rough starting date of mink breeding season each year. Client is just wondering if that date is the result of some consultation between the Ministry of Health and another relevant Ministry.

No rush on this, and thank you for any answer you can provide!

Michael Lu
Patient and Client Relations Officer
Patient and Client Relations, Corporate Issues and Client Relations Branch
Ministry of Health
1515 Blanshard St | PO BOX 9652 STN PROV GOVT | Victoria BC | V8W 9P4
Telephone: 236-478-1863 | michael.lu@gov.bc.ca

Province[1]	Has the mink industry within your province been engaged on this issue? Briefly describe.	Have enhanced biosecurity measures (e.g. screening employees, routine mask wearing, movement restrictions, etc.) been recommended for mink producers in your jurisdiction? Briefly describe.	Is any surveillance of farmed mink being conducted in your jurisdiction (specify active and/or passive)? Briefly describe.	Are public health investigators collecting information on contact or occupation with animals/mink for suspected and confirmed COVID-19 cases? Briefly describe.	Is there engagement between the multiple relevant sectors (e.g. provincial agriculture, public health, and wildlife/environment)? Briefly describe.	Does your jurisdiction have the lab capacity to test mink for SARS-CoV-2 (by PCR)?[2] Briefly describe.	Additonal information[3]
BC	Yes - discussions between Worksafe and Ministry of Agriculture, in consultation with public health, have taken place with industry, public health as yet to engage directly.	Yes - an advisory has been distributed to producers in the province recommending some enhanced measures (e.g. restrict access to mink housing and feed to essential staff); farmers are using a variety of types of masks from non-medical disposable masks, to medical masks to N95. Public health advising medical mask on premises, and N95 for AGMP including pelting (yet to be implemented fully by industry). Operators are doing daily symptoms check on workers before allowing access to premises.	Yes - Passive only (i.e. mink producers have been advised to monitor for clinical signs in mink and contact their veterinarian and the Ministry of Agriculture). There are discussions happening on a voluntary program on testing of mink. A program to test mink farm workers (both by PCR [NP swab and gargle] and possibly serology) might be in place in the near future.	Relevant regional health authority is aware of risk, engaged with provincial PH, and dicsussing directly with other OneHealth stakeholders. System for flagging covid test from farm workers being discussed. If cases in mink or worker are detected, a full outbreak investigation will occur including collecting information on occupation and contact with mink.	Yes - discussions between these sectors are taking place regularly.	Yes, the Animal Health Centre, BC Ministry of Agriculture, has the capacity to conduct PCR testing on animals/mink.	Most workers are local. Eight farms, relatively small size, in one health region, mandatory licensing. 2020 breeder females: 50,000
MB	s.16						
ON							
QC							
PE							

NB	s.16												
NS													
NL													

[1] *Only provinces/territorities with currently active mink farms are included.*
[2] *The Council of CVO's issued a position statement (April 2020) on how and when animal testing should proceed. For Atlantic Provinces requiring diagnostic support, the Ontario and Quebec Canadian Animal Health Surveillance Network labs would be willing to do the testing. Prairie Diagnostic Services (PDS) in Saskatchewan is also providing these services. Positives will be forwarded to the National Center for Foreign Animal Diseases for confirmatory testing (as per the guidance document for laboratories conducting animal tests for SARs-CoV-2.*
[3] *Number of farms & animals updated as per information received from the Canadian Mink Breeders Association via CFIA on December 6, 2020.*

	Country										
	Netherlands	Denmark	Spain	USA	Sweden	Greece	France	Poland	Lithuania	Italy	Ireland
# of positive farms	70	290	1	16	13	12	1	1	1	9 (in Lombardy)	3
Estimated total # of mink farms	127 (2.32M mink)	1200	38	245 (3.1M pelts) (2018)	40 (600 000)	92	4	354 (6M mink)	86 (1.6M mink)	27	reported
Date first positive farm reported	26-Apr-2020	17-Jun-2020	16-Jul-2020	15-Aug-2020	23-Oct-2020	13-Nov-2020	20-Nov-2020	20-Nov-2020	26-Nov-2020		
Culling infected farms?	Yes (all farms)	Yes (all farms) but only a hold on the industry not a decision to stop in the long term	Yes	No	No	No (first farm only)	Yes	Limited info available, opposition to culling by industry reported in media	No (only infected animals)		
Compensation provided?	Yes (details of compensation package still being finalized, bridging income to be provided until 2024)	Yes (awaiting final adoption of bill, political negotiations on compensation)	Yes	Yes in Utah for monitoring/research purposes	n/a	n/a	Unknown	Unknown	Unknown		
Reason for culling/not culling	Public health risk due to reservoir and previous 2024 ban	Public health risk due to reservoir and mutations	High percentage samples PCR positive (87%)	State jurisdiction, to date, not aware of any culling	Small mink population, pelting decreased number susceptible animals significantly (80%)	Other control measures put in place	Unknown		Monitoring other animals?		
Initial detection	Respiratory symptoms and increased mortality in mink – retrospective identification of infected people	Testing following a positive human case	Testing following a positive human case	Respiratory symptoms and increased mortality in mink	Deadstock surveillance 1/3 +	Respiratory symptoms and increased mortality in mink	Active surveillance to look for the virus			Testing following a positive human case	Active surveillance to look for the virus
Surveillance design	Passive surveillance: • SARS-CoV-2 notifiable upon suspicion (i.e. respiratory signs +/- increased mortality) (8 farms identified) Active surveillance: • Early Warning System (EWS) – 3-5 carcasses sent for post-mortem and PCR testing/week (21 farms identified) Serological screening of all farms	Active surveillance: • Initially, were sampling 30 animals per visit • 5 dead mink per week pooled into one tube	Unknown if surveillance activities taking place	Working to develop tiered active surveillance for unaffected, suspected, and confirmed farms (currently only doing ongoing testing on infected farms)	Active surveillance Testing of dead mink- swabbing oral cavity and pharynx - PCR					20 mink submitted for testing – 1 weekly + Only week positives? (contamination suspected)	
other notes	May 20th 2020 onwards, mink farmers, veterinarians and laboratories were obliged to report symptoms in mink to NFCPSA and an extensive surveillance system was set up After the initial detection of SARS-CoV-2, farms were screened weekly.	Sample kits are sent out to farmers The samples are sent to the Statens Serum Institut or DTU, which analyzes the samples and sends answers directly to the owner of the mink farm via e-mail. The Danish Veterinary and Food Administration also notified The Danish Veterinary and Food Administration pays for sample material and analysis. The mink breeder must pay postage himself.	No disease was noted in the mink at time of detection - Serum samples and oropharyngeal and rectal swabs in 30 live animals/oropharyngeal and rectal swabs from 7- one positive and 7 inconclusive, 15 days later, 86% positive by PCR		swabs from the oral cavity and pharynx were positive, organs negative; only slight increase in mortality noted						
References	https://www.oie.int/fileadmin/Home/MM/letter_6_October_2020_to_OIE_update_situation_SARS_CoV_2_infections_in_mink_in_The_Netherlands.pdf	https://www.foedevarestyrelsen.dk/Dyr/Dyr-og-Covid-19/Mink-og-COVID-19/Aflivning-for-alle-minkavlere/Sider/default.aspx	https://www.oie.int/fileadmin/Home/MM/Informe_visones_OIE_16.07.20__.pdf	https://www.oie.int/wahis_2/public/wahid.php/Reviewreport/Review?page_refer=MapFullEventReport&reportid=36731	https://www.oie.int/fileadmin/Home/MM/Sweden_1.12.2020.pdf	https://www.oie.int/fileadmin/Home/MM/Greece_04.12.2020.pdf	https://www.oie.int/wahis_2/public/wahid.php/Reviewreport/Review?page_refer=MapFullEventReport&reportid=36748	https://www.reuters.com/article/us-health-coronavirus-poland-mink-idUSKBN2801A2	https://www.oie.int/wahis_2/public/wahid.php/Reviewreport/Review?page_refer=MapFullEventReport&reportid=36816		
	https://www.dutchnews.nl/news/2020/12/dutch-mink-farming-industry-closes-down-just-four-fur-farms-to-go-minister-tells-mps/	https://www.oie.int/fileadmin/Home/MM/Update_5_Letter_to_OIE_on_Sars-CoV-2_in_Denmark.pdf	https://www.bbc.com/news/world-europe-53439263				https://www.theglobeandmail.com/world/article-france-finds-covid-19-in-mink-at-eure-et-loire-region-farm-1000-to/				