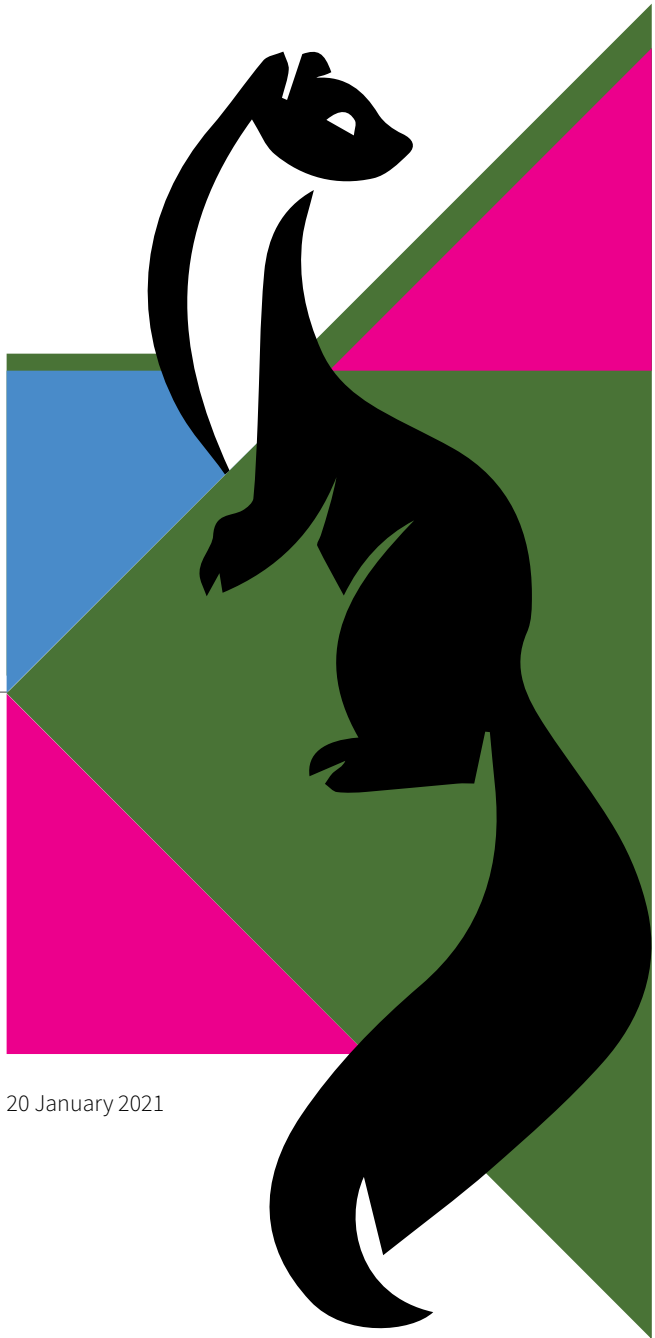
Food and Agriculture Organization of the United Nations

WORLD ORGANISATION FOR ANIMAL HEALTH

World Health Organization

SARS-CoV-2 in animals used for fur farming

GLEWS+ Risk assessment



20 January 2021

GLEWS+ TRIPARTITE RISK ASSESMENT FOR EMERGING THREATS AT THE ANIMAL, HUMAN, ECOSYSTEM INTERFACE

"GLEWS+" is the Joint FAO–OIE–WHO Global Early Warning System for health threats and emerging risks at the human–animal–ecosystems interface

SARS-CoV-2 in animals used for fur farming

GLEWS+
Risk assessment

Published by
the Food and Agriculture Organization of the United Nations
and
the World Organisation for Animal Health
and
the World Health Organization

20 January 2021

WHO reference number: WHO/2019-nCoV/fur_farming/risk_assessment/2021.1/
FAO job number: CB3368EN/1/02.21
OIE reference number: OIE/CoV-19/FF/EN/2021.1

Contents

Date of assessment: 20 January 2021

The aim of the GLEWS+ RA (the Joint FAO–OIE–WHO Global Early Warning System for health threats and emerging risks at the human–animal–ecosystems interface, risk assessment) mechanism is to help the Food and Agriculture Organization of the United Nations (FAO), the World Organisation for Animal Health (OIE) Members and the World Health Organization (WHO) State Parties to achieve more efficient control of acute disease outbreaks through a better understanding of the risk of emerging threats and the possible spread of pathogens so that infection prevention, control and response measures can be targeted.

This Tripartite assessment focuses on fur farms, considering that so far the only farms reporting the presence of SARS-CoV-2 are mink fur farms. The presence of this virus in the mink farms may have an important impact on livelihoods, public health and wildlife contributing to widespread socioeconomic disruption. In addition, the spread of SARS-CoV-2 in fur farms impacts animal welfare and poses a risk of spillover to native wildlife which may affect the biodiversity of species. This risk assessment is conducted at regional level to assess the overall risk of introduction and spread of SARS-CoV-2 within the fur farms, the spillover from fur farm to humans and the transmission of SARS-CoV-2 from fur farm animals to susceptible wildlife populations.

This risk assessment is based on information from 36 countries in Africa, Asia, Europe, South and North America, where animals of the families *Mustelidae*, *Leporidae* and *Canidae* are commercially farmed for fur or which have documented export of fur. These families include the known susceptible fur species (e.g.: minks, rabbits and raccoon dogs).

The countries and information considered in this assessment have been identified from data and reports shared with the FAO, OIE Members and WHO State Parties and from open sources. The countries included in this assessment comprise: Argentina, Belarus, Belgium, Bulgaria, Cambodia, Canada, China (People's Rep. of), Denmark, Estonia, Finland, France, Greece, Hungary, Iceland, India, Ireland, Italy, Kazakhstan, Latvia, Lithuania, Malaysia, Netherlands, Norway, Poland, Romania, Russian Federation, Slovakia, South Africa, Spain, Sweden, Thailand, Turkey, Ukraine, United States of America, Uruguay, and Vietnam.

The risk assessment is based on the information available as of 20 January 2021.

FAO, OIE, and WHO will update the assessment as and when new information becomes available.

List of contributors

FAO Fairouz Larfaoui, Ihab El Masry, Xavier Roche, Sophie von Dobschuetz, Cristina Rojo Gimeno, Jieun Kim, Elisa Palamara, Claudia Pittiglio, Giuseppina Cinardi, Julio Pinto, Orr Rozov, Junxia Song, Madhur Dhingra, Keith Sumption

OIE Paula Caceres, Roberta Morales, Paolo Tizzani, Matteo Morini, Itlala Gizo, Jenny Hutchison, Keith Hamilton, Matthew Stone

WHO Dubravka Selenic Minet, Stephane De La Rocque De Severac, Peter Sousa Hoejskov, Silviu Ciobanu, Marco Marklewitz, Sophie Allain Ioos , Brett Archer, Boris Pavlin

Acknowledgment

This Risk Assessment (RA) was written on behalf of the Food and Agriculture Organization, the World Organisation for Animal Health and the World Health Organization. The RA team members wish to acknowledge a number of colleagues who have provided inputs and data, including colleagues from decentralized offices who helped in data collection on fur farming and wild mustelids.

Dr Shyama Pagad, and Piero Genovesi who provided data from the Global Register of Introduced and Invasive Species (GRIIS) database,

Dr Oliver Morgan, WHO director the Health Emergency Information and Risk Assessment Department for his inputs and review of this document.

Dr Philip Gregory Smith, WHO technical adviser, chief of Health Emergency Information and Risk Assessment (HIM), manager of the Public Health Intelligence, Risk Assessment and Dissemination team (PHI) for his insights, advice and review of this document.

Ms Yurie Izawa and Ms Aura Rocio Escobar Corado Waeber, WHO technical officers, Information Systems and Analytics from the MAP team to produce WHO map.

Mrs Marta Gacic-Dobo, WHO manager, Immunization Strategic Information and Mr Hiiti Baran Sillo, WHO scientist, Regulatory Systems Strengthening MHP, for their advice regarding COVID-19 vaccines.

Dr Maria D Van Kerkhove, WHO Head Emerging Diseases and Zoonoses Unit and COVID-19 Health Ops and Technical Lead, for her inputs and review of this document.

Summary

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) was identified as an emerging coronavirus in humans in December 2019. The first human cases of COVID-19, the disease caused by the novel coronavirus SARS-CoV-2, were first reported by officials in Wuhan City, China (People's Rep. of), in December 2019; the disease has since affected almost 100 million people, causing over 2 million deaths worldwide. Human-to-animal transmission and subsequent circulation in animals and transmission back to humans has been documented in particular within farmed minks in several countries and, in a few cases, mink-to-human transmission has also occurred. To date, SARS-CoV-2 in animals has been identified in farmed minks populations in 10 countries (Canada, Denmark, France, Greece, Italy, Lithuania, the Netherlands, Spain, Sweden, and the United States of America), with the first two mink outbreaks reported in the Netherlands as early as April 2020. While on some affected mink farms, clinical signs in animals could be observed, including respiratory or gastro-intestinal signs (rarely), in most instances the only indication of virus circulation has been animal mortality levels slightly above baseline.

More recently, genetic analysis of SARS-CoV-2 viruses circulating among workers of these farms and in surrounding communities confirmed the transmission from minks to humans. Furthermore, mutations have been observed on several occasions in virus variants circulating in mink populations, some of those variants then being also transmitted to humans, with the associated risk of possible modification of transmissibility and pathogenicity or reduction of efficiency of currently developed vaccines as well as candidate vaccines.

So far genetic changes have not given rise to any change in clinical picture or epidemiology of COVID-19 infected mink farm workers and cases appear to be similar to those in people infected with non-mink related variants.

Using qualitative evidence and based on the likelihood and consequence assessed at the regional level with information available from 36 fur-animal producing countries, the overall risks at regional level of (1) Introduction and spread of SARS-CoV-2 within the fur farms, (2) Spillover from fur farms to humans and (3) Transmission of SARS-CoV-2 from fur farm animals to susceptible wildlife populations are minor in Africa due to the low volume of fur production and low human infection rate; Moderate in the Americas and Asia considering the high volume of fur production in these two regions and the increase in human cases; and high in Europe due to highest number of fur farms compared to other regions concentrated in the same geographical areas, the high variety of susceptible animal species, and highest number of confirmed spillback events from the infected farms into the local community in some European farms.

The level of confidence in the risk estimates for the first two aspects is considered moderate due to the lack of data in many countries regarding the density of fur animals in farms, the number of fur farms, information regarding biosecurity measures, and SARS-CoV-2 in animal surveillance results in the fur farming sector for both animals and humans; and the relatively low number of samples taken from fur farm workers.

The level of confidence in the risk estimates for the third aspect is considered low due to the lack of data related to diversity, density and distribution of susceptible wildlife species at country, sub-national and regional level.

Risk assessment questions

The likelihood and consequence at regional level are qualitatively estimated based on the country-level assessment in addition to other considerations mentioned under each risk question.

1. WHAT IS THE RISK OF INTRODUCTION AND SPREAD OF SARS-COV-2 WITHIN FUR FARMS?

Geographic level	Likelihood	Consequence	Risk	Confidence
Africa	Very unlikely	Moderate	Minor	Moderate
Americas	Likely	Moderate	Moderate	Moderate
Asia	Likely	Moderate	Moderate	Moderate
Europe	Very likely	Severe	High	Moderate

Rationale

The risk of introduction and spread of SARS-CoV-2 within fur farms at regional level considered five risk factors in the 36 targeted countries, namely: (i) density of farmed minks, (ii) biosecurity level in fur farming systems, (iii) confirmed cases of SARS-CoV-2 in mink or other mustelid farms, (iv) human cases of COVID-19 detected among workers on mink farms and communities around infected farms, (v) number of COVID-19 human cases in relation to the human population per million.

The risk of introduction and spread of SARS-CoV-2 (and emergence of new variants) within fur farms is considered:

- **Minor in Africa**, given the low volume of fur production, conducted by only one country (South Africa) as well as the few human cases of COVID-19 detected relative to the human population in Africa.
- **Moderate in the Americas and Asia**, considering the high volume of fur production in these regions, and the high variety of susceptible animal species used in fur farming, balanced against a lack of COVID-19 infection reported among fur farms workers in Asia and very few infections reported among fur farm workers in the Americas and Asia.
- **High in Europe**, taking into account the highest number of fur farms compared to other regions, the high variety of susceptible animal species used in fur farming, the high numbers of human cases of COVID-19 reported relative to the human population in a number of countries in Europe, confirmed infection events in farmed fur animals in many countries, as well as reported infection among fur farm workers.

The level of confidence in the risk estimates for question 1 is considered moderate due to the lack of data in many countries regarding the density of fur animals in farms, the number of fur farms, information regarding biosecurity level, and SARS-CoV-2 surveillance results in the fur farming sector for both animals and humans.

For more details on national likelihood assessments, please see Map 1 and Annex 1.

Spread of SARS-CoV-2 between fur farms may occur in various ways: by direct contact with infected animals, by indirect contact with fomites (e.g. contaminated materials, feed, or manure), or by farm workers and visitors shedding virus or carrying the virus on their clothes, equipment, or vehicles. SARS-CoV-2 in animals may also be transmitted through infected feral or stray animal species such as wild minks and cats, known to be susceptible hosts for the virus, though this has not been demonstrated thus far. Likelihood of spread following introduction is highly dependent on: the density of mink farms, and connectivity between farms through movements of animals, people, vehicles and other fomites;

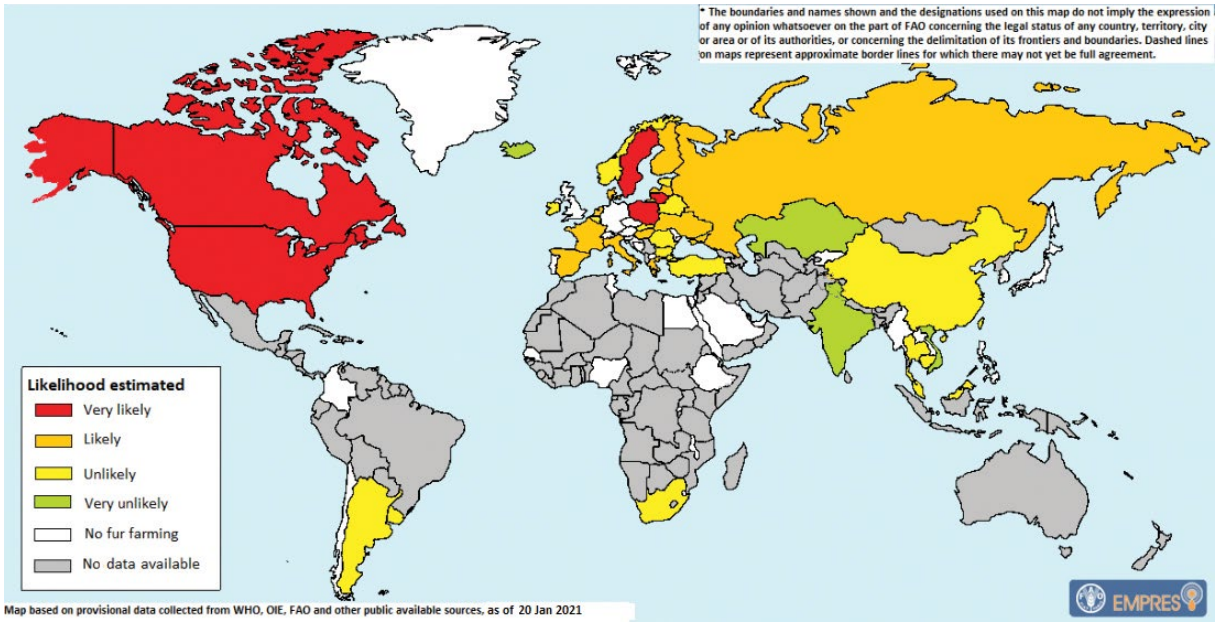
efficiency and efficacy of national early warning surveillance systems; and efficiency and efficacy of rapid response mechanisms within countries. However, as this risk assessment focuses on regional spread, these factors are not considered in this risk assessment.

The risk of transboundary spread of SARS-CoV-2 among fur farming countries at regional level is more attributed to the movement of COVID-19 infected humans than to the movement of infected minks or other susceptible animals.

Currently, all countries with fur farms are working to improve biosecurity and biocontainment and strengthening application of good hygiene management practices. However, it remains to be understood how well these practices are being implemented. Available data support that 18 out of the 36 countries assessed have moderate to high biosecurity measures. While access of visitors and workers to fur farms has become stricter and the use of personal protective equipment (PPE) for workers and visitors is recommended, active surveillance in farmed fur and other animals at the farm remains a challenge and requires consistent multisectoral collaboration and coordination. Active surveillance has been implemented in 15 countries and indeed has resulted in detecting outbreaks, however it was noted (based on the experience on the Netherlands and Denmark) that by the time minks start showing symptoms, the disease may have already spread unnoticed.

Several countries (Canada, Denmark, France, Greece, Italy, Lithuania, the Netherlands, Spain, Sweden, and the United States of America) have officially reported the emergence of SARS-CoV-2 in mink to the OIE.

MAP 1. LIKELIHOOD OF THE RISK OF INTRODUCTION AND SPREAD OF SARS-COV-2 WITHIN FUR FARMS AT NATIONAL LEVEL



2. WHAT IS THE PUBLIC HEALTH RISK FROM SARS-COV-2 SPILLOVER FROM FUR FARMING TO HUMANS?

Geographic level	Likelihood	Consequence	Risk	Confidence
Africa	Very unlikely	Moderate	Minor	Moderate
Americas	Likely	Moderate	Moderate	Moderate
Asia	Likely	Moderate	Moderate	Moderate
Europe	Very likely	Severe	High	Moderate

Rationale

SARS-CoV-2 spillover from fur farm animals to humans poses a serious public health and socio-economic threat and requires a One Health approach to manage.

Despite biosecurity measures in place in mink farms at the time of writing this Tripartite risk assessment, spillover from animals to humans and vice versa has been reported in ten countries (Canada, Denmark, France, Greece, Italy, Lithuania, the Netherlands, Spain, Sweden and the United States of America).

As per recent COVID-19 surveillance results, Canada, Denmark, France, Greece, Italy, Lithuania, the Netherlands, Spain, Sweden and the United States of America have reported SARS-CoV-2 infections in mink farms affecting animals and humans and some of these countries detected cases of new SARS-CoV-2 variants associated with farmed mink.

The spread of these variants has reinforced the need to strengthen mechanisms to identify and prioritize potentially relevant mutations globally; and the need to reduce overall transmission rates through established control methods, to reduce the likelihood and negative impact of mutations.

Based on the small sample size taken from mink farm workers infected with SARS-CoV-2 variant, it is difficult to accurately assess the transmissibility, pathogenicity and phenotypic changes potentially impacting the efficiency of candidate vaccines. So far genetic changes have not given rise to any change in clinical picture or epidemiology of COVID-19 infected farm workers.

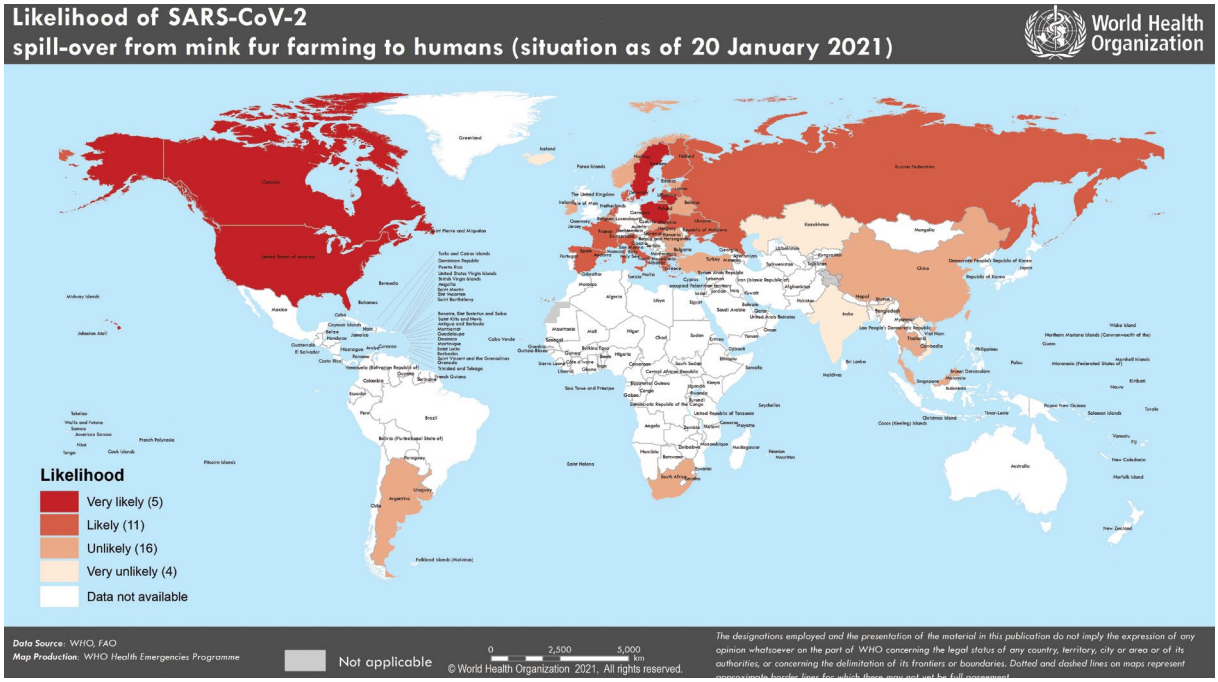
Despite public awareness, the use of PPE at fur farms to protect an individual from inhalation, dermal or physical exposures with infected and potentially infected animals is still not practiced routinely.

Based on current information and research conducted in countries where infections were reported in mink farms, the risk of COVID-19 spread to nearby communities should be considered, and farm workers and any visitors, including veterinarians, feed suppliers, and others who may be in direct contact with infected minks or the environment at the farm (e.g., feed, equipment, manure…) are at a high occupational health risk.

The public health risk from SARS-CoV-2 spillover from fur farming to humans is considered:

- **Minor in Africa**, given the low volume of fur production farms. However, potential risk of spillover of SARS-CoV-2 from infected farm workers to farmed fur animals and farmed fur animals to humans should not be neglected.
- **Moderate in the Americas and Asia**, for individuals having direct or indirect contact with farmed fur animals, considering the high volume of fur production in these regions; although scattered in various regions and therefore reducing the risk of transmission between farms and amplification. However, about half the furs produced in North America come from small, family-run farms, and biosecurity measures vary among farms. In Asia, a lower biosecurity level increases the risk pathways for spillover.
- **High in Europe**, considering the highest number of fur farms concentrated in the same geographical areas, and confirmed spillback from the infected farms into the local community in some European countries. As viruses move between human and animal populations, genetic modifications in the virus can occur and new variants are more likely to arise.

MAP 2. LIKELIHOOD OF SARS-CoV-2 SPILLOVER FROM MINK FUR FARMING TO HUMANS AT NATIONAL LEVEL



3. WHAT IS THE RISK OF TRANSMISSION OF SARS-COV-2 FROM FUR FARMING SYSTEMS TO SUSCEPTIBLE WILDLIFE POPULATIONS?

Geographic level	Likelihood	Consequence	Risk	Confidence
Africa	Likely	Minor	Minor	Low
Americas	Very likely	Minor	Moderate	Low
Asia	Very likely	Minor	Moderate	Low
Europe	Very likely	Moderate	High	Low

Emerging infectious diseases often constitute a threat for wildlife conservation and biodiversity. Fur animals escaping farms may act as maintenance hosts and cause spillover of SARS-CoV-2 into sympatric wildlife species, provided the presence of susceptible hosts. However, there is not enough information currently available to assess the likelihood of a reservoir of SARS-CoV-2 being established in susceptible wildlife. Mink escapes from captivity have also historically been a problem in every country where mink farming exists or has existed. The escape of minks is believed to increase during the mass culling process. In one region of Denmark, it has been found that most free-ranging mink (79%, n = 213) were born in a farm and subsequently escaped, indicating that farms can act as a true source for the wild populations, maintaining high levels of mink abundance. Similar conclusions have been reported in other countries. Escaped minks do not stay in isolation from wild ones; hybridization between escaped and wild minks in the wild has been documented. SARS-CoV-2 in animals has been confirmed in a free-ranging wild mink captured in the surrounding area of an affected mink farm in Utah, United States of America. This is the first free-ranging, native wild animal confirmed globally with SARS-CoV-2. This suggests that a wild mink was infected due to indirect or direct contact with infected farmed minks. However, there is no evidence that SARS-CoV-2 is circulating in wild mink populations surrounding the affected mink farms.

At national level, transmission of SARS-CoV-2 from fur farmed animals to wildlife is possible through direct contact between wildlife and infected farmed animals, as well as through indirect contact with contaminated carcasses, waste, and other fomites. Direct and indirect contact between fur farmed animals or fomites and stray animals (i.e stray cats) is known to occur. Such stray animals could act

as a bridge species by then transmitting the virus to wild susceptible species. Exposure of stray cats to SARS-CoV-2 in the vicinities of infected mink farms has been described, even in countries with known moderate to high biosecurity. For more details on national likelihood assessments, please see Map 3 and Annex 2.

At regional level, transboundary spread is mainly expected within fur farms located at country border areas given that long distance dispersal of escaped minks from home range is not expected as long as the minks have easy access to food in their immediate vicinity. Some factors under consideration are described in Annex 2. This question will be updated as additional information on wildlife population distribution and density become available.

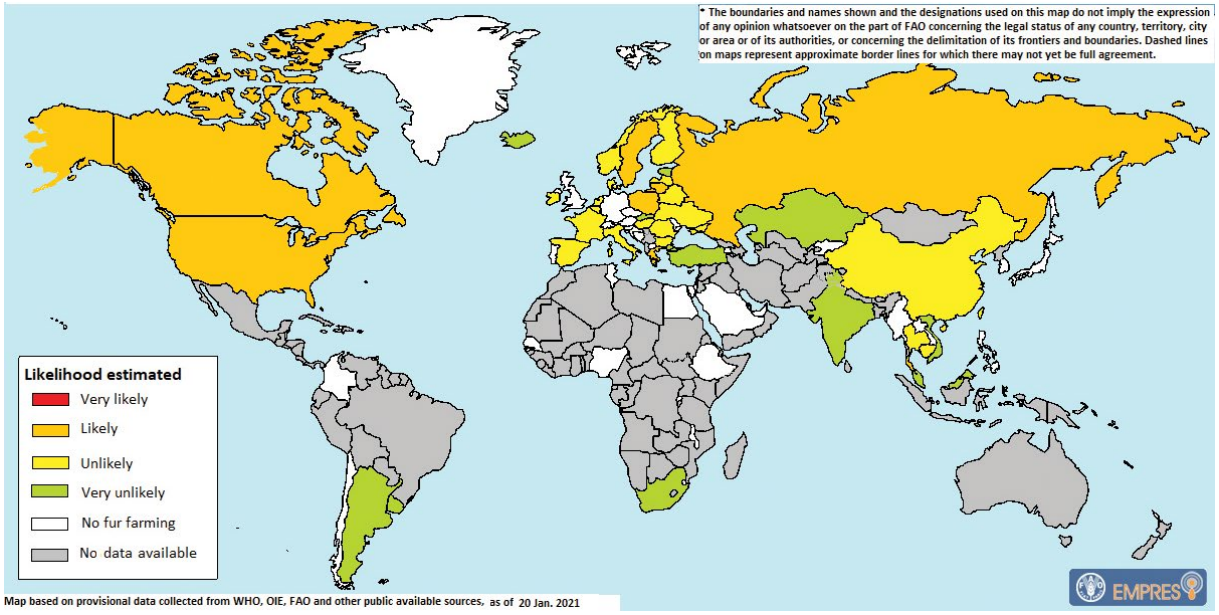
Rationale

The risk of SARS-CoV-2 spread from fur farming systems to susceptible wildlife populations in the mentioned regions has considered four factors, namely: (i) density of farmed minks, (ii) biosecurity level in fur farming systems, (iii) confirmed cases of SARS-CoV-2 infection in minks in fur farms, and (iv) presence of wild mustelids and canids in the country. In December 2020, the first free-ranging, native wild mink confirmed with SARS-CoV-2 was detected in Utah, United States of Americas, and phylogenetic analysis of the virus isolate confirmed a close genetic match with the virus found on the mink farm.

The risk of transmission of SARS-CoV-2 from fur farms to susceptible wildlife populations is considered:

- **High in Europe**, given the transmission of SARS-CoV-2 to susceptible wildlife is either likely or very likely to occur in five countries, the high number of fur farms compared to other regions, the diversity of susceptible animal species bred in fur farms, and the presence of wild susceptible species of the families *Mustelidae* and *Canidae.*
- **Moderate in Asia and the Americas**, given the volume of fur production in those areas, the high diversity of susceptible animal species bred in fur farming systems, and the presence of wild susceptible species of the families *Mustelidae* and *Canidae.*
- **Minor in Africa**, given the quite low volume of fur production, and the low number of farms present in one country (South Africa).

MAP 3. LIKELIHOOD OF SARS-COV-2 FROM FUR FARMING SYSTEM TO SUSCEPTIBLE WILDLIFE POPULATIONS AT NATIONAL LEVEL



Supporting information

HAZARD/PATHOGEN/DISEASE INFORMATION

Coronaviruses (CoV) are known to cause disease in humans and animals. Human coronaviruses were first identified in the mid-1960s. Four out of the seven known human CoVs cause symptoms of common cold with only moderate clinical impact. The other three, MERS-CoV, SARS-CoV, and SARS-CoV-2, are zoonotic viruses transmissible from vertebrate animals to humans, and through mutations and recombination that occur, they are capable of adapting to human hosts.

SARS-CoV-2 has been classified as a novel member of the genus *Betacoronavirus* first identified in humans in December 2019 and has since then affected more than 95 million people causing over 2 million deaths worldwide. The virus is believed to be ancestrally linked to viruses of bats, but the exact origin of SARS-CoV-2 and intermediate host(s) have not yet been identified. The virus appears to be primarily transmitted by human-to-human transmission through respiratory droplets and close contact, although there is evidence of transmission at the human-animal interface. SARS-CoV-2 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) or after experimental infection (mice, dogs, cats, ferrets, hamsters, primates, tree shrew). Animal-to-human and animal-to-animal transmission has been documented within farmed minks in several countries, and 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.

Emerging infectious diseases can often pose a threat to native wildlife species. Escaped fur farmed animals that can act as maintenance hosts and cause spillover to sympatric wildlife are a particular threat. Any wildlife species that becomes a reservoir for SARS-CoV-2 could pose a continued public health risk of zoonosis, a risk for the transmission of SARS-CoV-2 to other animal species, and the risk of negative perceptions of those species resulting in human threats to the species and their populations.

SARS-CoV-2 has been identified and reported in farmed mink population in 10 countries (Canada, Denmark, France, Greece, Italy, Lithuania, the Netherlands, Spain, Sweden, and the United States of America) with the first two mink outbreaks reported in the Netherlands in April 2020. Most of the affected farms reported SARS-CoV-2 infection among workers and it is hypothesized that the mink farms were infected through human-mink transmission, proving SARS-CoV-2 capable of reverse zoonosis. Subsequent mink-human transmission was confirmed in farms in Denmark, Lithuania, the Netherlands, Spain, Italy, the United State of America, Sweden and Greece.

SARS-CoV-2 VARIANT

The appearance of mutations is a natural and expected event within the evolution of the SARS-CoV-2, which has been monitored and observed since the start of the pandemic. In most instances, mutations have no or little direct impact; however, over the last few months, several SARS-CoV-2 variants have been identified that are of concern.

These variants include among others: infection among farmed mink, SARS-CoV-2 VOC 202012/01 (Variant of Concern, year 2020, month 12, variant 01) in the B.1.1.7 lineage, SARS-CoV-2 501Y.V2 variant in the B.1.351 lineage, and several variants in lineage B.1.1.28.

Additional variants of potential interest or concern are emerging rapidly as sequencing activities

strengthen globally. Preliminary data suggest that at least two variants, VOC 202012/01 and 501Y.V2, are more transmissible than the wild type. Emerging evidence suggests the 501Y.V2 variant is able to escape antibody neutralization, with neutralizing activity lost in half the people tested and reduced levels in the other half, which suggests potential susceptibility to re-infection.

There is currently little available information to assess if there are changes in severity as a result of these new variants; however, the observed increase in transmissibility with similar levels of infection-severity has led to an increase in the sheer number of COVID-19 hospitalizations and deaths, and strained health systems in countries affected. Established and proven preventive and public health and social measures appear to remain effective, with demonstrated declines in human case incidence observed in countries applying measures.

The implications of these identified mutations that were reported in humans and in animals in several countries are yet unknown. Studies are ongoing to determine if they could impact diagnostic tests, therapeutics and/or effectiveness of future vaccines and increase susceptibility to further infections. Further studies are needed to assess the zoonotic potential of SARS-CoV-2 variants and any potential change in transmissibility or virulence and any implications for reinfection. Further spread of mink-associated variant virus could potentially cause serious public health impacts due to reduced antibody neutralization activity . Further research is needed to understand the pathogenicity of SARS-CoV-2, especially in farmed fur animals, modes of transmission, incubation period, pathogenicity and transmission to susceptible wildlife animals.

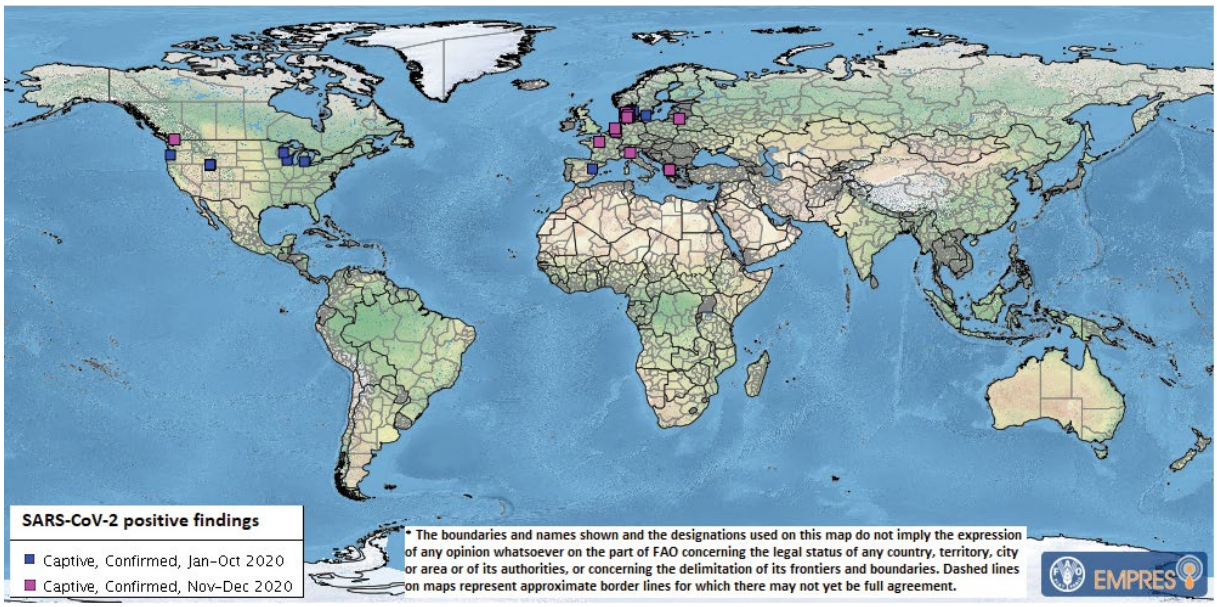
EVENT BACKGROUND

The first mink SARS-CoV-2 infection was identified on two mink farms in the Netherlands on 26 April 2020, and in May two more mink farms in the Netherlands were infected. During environmental and animal testing at the mink farm, SARS-CoV-2 was detected in three cats living at a mink farm, as well as in dust particles in the mink barns. After ten days, a farm worker was reported to have contracted COVID-19 and according to the official investigation report, it is likely mink infected with SARS-CoV-2 transmitted the virus to the worker. However, it is still unknown how minks were infected.

Stamping out measures were taken in all affected mink farms in the Netherlands. Strict biosecurity and biocontainment measures, including mandatory screening, a ban on mink movement, the restriction of visitors and mandatory use of PPE for all staff and visitors were recommended.

From 26 April through 20 January, a total of 10 countries have officially reported SARS-CoV-2 identified on mink farms, eight EU Member States: Denmark (207 farms), France (1 farm), Greece (17 farms), Italy (1 farm), Lithuania (2 farms), Netherlands (69 farms), Spain (1 farm), Sweden (13 farms) and in North America in the United States of America (17 farms) and Canada (2 farms).

MAP 4. GLOBAL OVERVIEW OF POSITIVE SARS-COV-2 IN MINK FARMS, AS OF 20 JANUARY 2021



CONTEXT DESCRIPTION

Fur farming is the practice of breeding or raising certain types of animals for their fur. For the purpose of this document information was made available by 36 countries in the world reporting farming of *Mustelidae*, which includes: minks, sables, martens, otters, stoats, badgers, weasels, and ferrets; and other fur animals as chinchillas, rabbits, hares, raccoon dogs, foxes, Arctic foxes, bobcats, lynx and nutrias.

Most of the world's farmed fur is produced in Europe. There are around 5 000 fur farms in the EU, located across 23 countries. In 2018 the biggest fur animal producers in the EU were Denmark (17.6 m), Poland (5 m), Netherlands (4.5 m), Finland (1.85 m), Greece and Lithuania (both 1.2 m). These countries collectively accounted for 50% of the global production of farmed fur and Denmark was the leading mink production country in Europe. Figures for the same period show that mink were farmed for their fur in China (People's Rep. of) (20.7 m), the United States of America (3.1 m) and Canada (1.7 m), bringing the total to approximately 60.5 million mink.

Several countries have banned fur farming altogether due to ethical or public health reasons and there are restrictions for import and export of furs in several parts of the world.

Countries' capacity

The level of capacity to manage the risk of SARS-CoV-2 introduction and spread in fur farming systems and transmission to susceptible wildlife varies greatly across countries.

Countries apply different biosecurity and public health measures and surveillance systems vary from ad-hoc testing of fur farmed animals and farm workers to well-established integrated surveillance systems using the One Health approach. In some countries, whole genome sequencing is performed on all positive animal and/or human cases, while in others there is no capacity for whole genome sequencing and samples are sent to laboratories in other countries for sequencing.

In term of vaccination, there are currently more than 50 COVID-19 vaccine candidates in trials. As of 20 January 2021, 12 COVID-19 vaccines (developed by AZ/Oxford, Bharat Biotech international Limited, China National Biotec Group (CNBG)/ Sinopharm, Fiocruz, Fosun Biotech, Gamaleya Research Institute, Moderna, Pfizer/ BioNTech, Serum Institute of India, Sinovac, Tianjin CanSino and Vektor State Research Center of Virology and Biotechnology) have been permitted for use in humans by selected

national authorities; So far WHO has granted emergency use listing (EUL) to the Pfizer/ BioNTech vaccine on 31 December 2020. However, national regulatory authorities do have the mandate and the jurisdiction to take the appropriate regulatory decisions and issue authorizations for the use of vaccines within their own countries.

Countries' vulnerability

Some countries are more vulnerable to disease threats. The level of biosecurity and biosafety on fur farms is not standardized. Many fur animals are kept together in a small area, and virus transmission in such large numbers of a homogenous population can drive virus evolution. Despite public awareness, use of full PPE is still inconsistently used at farms and the close contact during mink husbandry practices and pelting and processing is a continued risk for spillover of the virus to humans and/or animals. Also, availability of PPE is limited in some countries.

COVID-19 vaccines for use in human are not administered in all countries due to vaccine shortages. COVID-19 vaccine for animals is still at an experimental stage of development. Low-income countries may also be more vulnerable to transmission between fur farmed animals and humans due to limited capacity for early detection and to perform whole genome sequencing and compare data across the animal human interface.

Recommendations

RECOMMENDED MITIGATION MEASURES REDUCING LIKELIHOOD OF SARS-COV-2 PUBLIC HEALTH RISK AS WELL AS INTRODUCTION AND SPREAD WITHIN FUR FARMS

- Apply and enforce strict sanitary biosecurity measures against SARS-CoV-2 on fur farms holding[1] species of the families *Mustelidae*, *Leporidae* and *Canidae* (including raccoon dogs, fox, sable, mink, ferret and rabbits) and consider rapid containment measures at local, national, and regional levels.
- Provide and ensure the use of appropriate personal protective equipment (PPE) by farm workers and visitors. Human infection can be prevented by wearing PPE and washing or sanitizing hands thoroughly after working with animals. Farm workers when cleaning and disinfecting will require increased protection and use of respirators, chemical-resistant clothing, chemical-resistant gloves and goggles.
- Based on current evidence, testing of animals for SARS-CoV-2 should be risk-based and only be considered in the broader response to COVID-19 within a One Health approach, incorporating an early warning and surveillance system based on case definitions in farm workers and animals as appropriate.
- Sampling and testing among susceptible wild species and other free-roaming animals in the vicinities of SARS-CoV-2 infected fur farms should be considered based on the geographical proximity and in conjunction with veterinary and wildlife authorities.
- Farm workers with symptoms compatible with COVID-19 and/or who live with someone with symptoms compatible with COVID-19 should not be permitted to enter fur farm premises.
- In SARS-CoV-2 outbreaks involving fur farms, sequencing of viruses from human cases and minks, including phylogenetic analysis and comparison of genetic sequences, is recommended to understand the direction of infection (animal-animal, animal-human, human- animal or human-human) and to identify and assess any mutations occurring.
- All countries are advised to strengthen biosafety and biosecurity measures in farms and around known wild animal reservoirs in order to limit the risk of spillover. This includes infection prevention and control measures for farm workers, farm visitors and those who may be involved in animal husbandry or culling.
- All countries are advised to enhance surveillance for COVID-19 at the animal-human interface where susceptible animal reservoirs are identified, including fur farms.
- The research community is encouraged to assess the susceptibility to SARS-CoV-2 of other farmed fur species
- Further research is needed to understand the pathogenicity of SARS-CoV-2 variants, especially in farmed fur animals, modes of transmission, incubation and infectious period; and pathogenicity and transmission risk to susceptible wildlife animals.

WHEN ENTERING THE FARM, THE FOLLOWING MEASURES SHOULD BE FOLLOWED:

- Non-essential visitors should not be allowed on the premises.
- Workers and visitors must park their vehicles in designated areas away from animal housing.
- Keep a record of all people who enter the farm including the date, contact information, hour of entry and exit, and the nature of their visit, including visits to other farms in past two weeks (e.g. for food suppliers, veterinarians); no person should be allowed on site if they have signs and symptoms compatible with COVID-19.
- Anyone infected with SARS-CoV-2, or people in quarantine due to contact with COVID-19 patients, should not be allowed to enter the farm until cleared by medical providers.
- Stagger arrival of workers to the farm so they do not congregate in the common spaces.
- Use an all-in all-out strategy where feasible, with cleaning and disinfection before restocking, using recommended disinfectants and following the instruction on the product label.

INSIDE THE FARM, THE FOLLOWING MEASURES SHOULD BE ADOPTED:

- Wear new or cleaned and disinfected personal protective equipment such as a disposable mask, apron, nitrile gloves and boots when moving between different sheds/barns.
- Use a footbath with clean disinfectant (changed daily) to disinfect boots when entering the farm.
- Change/disinfect PPE daily, i.e. every time before you enter and after you leave the farm.
- Clean and disinfect all spaces, using recommended disinfectants and following the instruction on the product label.
- Routinely clean and disinfect common areas e.g. resting areas, kitchen, coffee room, changing rooms, bathrooms, sleeping quarters.
- Keep premises clean by proper storage of feed and bedding materials, and ensure removal of debris, feed waste, and feces daily. Follow proper disposal of waste, feces or other materials to avoid attracting pests. The manure and bedding waste must be disinfected before it is removed from the farm. All sawdust that was used during pelting will contain fat and must therefore in accordance to regulations be properly destroyed.
- Use closed feeding and watering systems that are cleaned whenever possible, but at least monthly.
- Close holes, cracks, fix doors, fix enclosures to prevent animals from escaping and moving around the farm, and discourage the presence of dogs, cats, wild animals and pests.
- Do not rotate workers between farms, to decrease the possibility of further virus spread.
- Ensure personal distance between people is observed at all times (at least 1 meter distance) and stagger mealtimes and breaks to avoid large gatherings in the break rooms.
- Prepare for a possible shortage of the workforce and prepare a contingency plan to ensure continuity of work.
- When using tools, make sure to always disinfect them after use and before use in any other part of the farm.
- Practice basic personal hygiene measures, in particular regular handwashing before and after handling animals.
- Raise awareness among farm workers about how SARS-CoV-2 in animals spreads and how to prevent getting infected and routinely remind them about biosafety and biosecurity measures against SARS-CoV-2 on the farm in the language of the farm workers.

DATA SHARING

- As SARS-CoV-2 is considered an emerging disease, countries are urged to submit an immediate notification through OIE-WAHIS, as per Article 1.1.4. of the *Terrestrial Animal Health Code*, to report any occurrence of animal cases of infection with SARS-CoV-2 that comply with the *case definition* provided in the OIE guidelines. Members are encouraged to report any other relevant information to the OIE as per Article 1.1.6. of the *Terrestrial Animal Health Code*, such as experimental studies or prevalence surveys, to help advance our understanding of SARS-CoV-2. Immediate notification is an important One Health surveillance activity that supports the efforts of the public health sector to control COVID-19 globally.
- Rapid communication of applied research or field studies addressing animal infection, particularly fur species, and sharing results immediately with the national Veterinary Services, is encouraged to enhance preparedness and response.
- Outbreaks on mink farms highlight the important role that farmed fur populations can play in the on-going transmission of SARS-CoV-2 and the critical importance of strong surveillance, sampling, and sequencing of these viruses, especially around areas where such animal reservoirs are identified using the One Health approach. All countries are encouraged to increase the sequencing of SARS-CoV-2 where possible, through building capacity at national level or establishing mechanisms for referring samples to regional labs with sequencing capacity and sharing of sequence data internationally to monitor the evolution of the virus. All countries should continue to apply appropriate prevention and control activities, assess local transmission levels and adapt public health and social measures accordingly and as per WHO guidance.

Annexes

Annex 1: Risk factors and likelihood of introduction and spread of SARS-CoV-2 within fur farmS

Countries where fur farming is known	Categories of mink density	Biosecurity	Confirmed cases of SARS-CoV-2 in farmed mustelids	Human cases of COVID-19 detected among workers in mink farms	Likelihood
Argentina	<500,000	No data	No	No	**Unlikely**
Belarus	500,000 - <1,000,000	No data	No	No	**Unlikely**
Belgium	<500,000	High	No	No	**Unlikely**
Bulgaria	<500,000	Low	No	No	**Unlikely**
Cambodia	≥1,000,000	No data	No	No	**Unlikely**
Canada	≥1,000,000	Moderate	Yes	Yes	**Very likely**
China (People's Rep. of)	≥1,000,000	Moderate	No	No	**Unlikely**
Denmark	<500,000	High	Yes	Yes	**Likely**
Estonia	<500,000	No data	No	No	**Unlikely**
Finland	≥1,000,000	Moderate	No	Yes	**Likely**
France	<500,000	High	Yes	No	**Likely**
Greece	≥1,000,000	High	Yes	Yes	**Likely**
Hungary	<500,000	Low	No	No	**Likely**
Iceland	<500,000	No data	No	No	**Very unlikely**
India	<500,000	No data	No	No	**Very unlikely**
Ireland	<500,000	High	No	No	**Unlikely**
Italy	<500,000	High	Yes	No	**Likely**
Kazakhstan	<500,000	No data	No	No	**Very unlikely**
Latvia	500,000 - <1,000,000	Moderate	No	No	**Likely**
Lithuania	≥1,000,000	High	Yes	Yes	**Very likely**
Malaysia	<500,000	No data	No	No	**Unlikely**
Netherlands	<500,000	High	Yes	Yes	**Likely**
Norway	500,000 - <1,000,000	High	No	No	**Unlikely**
Poland	≥1,000,000	Low	No	No	**Very likely**
Romania	<500,000	Moderate	No	No	**Unlikely**
Russian Federation	500,000 - <1,000,000	Low	No	No	**Likely**
Slovakia	<500,000	No data	No	No	**Unlikely**
South Africa	<500,000	No data	No	No	**Unlikely**
Spain	500,000 - <1,000,000	High	Yes	Yes	**Likely**
Sweden	≥1,000,000	High	Yes	Yes	**Very likely**
Thailand	≥1,000,000	No data	No	No	**Unlikely**
Turkey	<500,000	No data	No	No	**Unlikely**
Ukraine	500,000 - <1,000,000	High	No	Yes	**Likely**
Uruguay	<500,000	No data	No	No	**Unlikely**
United States of America	≥1,000,000	Moderate	No	Yes	**Very likely**
Viet Nam	<500,000	No data	No	No	**Very unlikely**

No data: where there is no data on biosecurity likelihood estimates have higher uncertainty compared to others

Annex 2: Risk factors and likelihood of transmission of SARS-CoV-2 from fur farming systems to susceptible wildlife populations

Countries where fur farming is known	Mink number	Confirmed cases of SARS-CoV-2 infection in farmed mustelids	Biosecurity	Presence of wild mustelids	Likelihood
Argentina	<500,000	No	No data	Yes	**Very unlikely**
Belarus	500,000 - <1,000,000	No	No data	Yes	**Unlikely**
Belgium	<500,000	No	High	Yes	**Unlikely**
Bulgaria	<500,000	No	Low	Yes	**Unlikely**
Cambodia	≥1,000,000	No	No data	Yes	**Unlikely**
Canada	≥1,000,000	Yes	Moderate	Yes	**Likely**
China (People's Rep. of)	≥1,000,000	No	Moderate	Yes	**Unlikely**
Denmark	<500,000	Yes	High	Yes	**Unlikely**
Estonia	<500,000	No	No data	Yes	**Very unlikely**
Finland	≥1,000,000	No	Moderate	Yes	**Unlikely**
France	<500,000	Yes	High	Yes	**Unlikely**
Greece	≥1,000,000	Yes	High	Yes	**Likely**
Hungary	<500,000	No	Low	Yes	**Unlikely**
Iceland	<500,000	No	No data	Yes	**Very unlikely**
India	<500,000	No	No data	Yes	**Very unlikely**
Ireland	<500,000	No	High	Yes	**Unlikely**
Italy	<500,000	Yes	High	Yes	**Unlikely**
Kazakhstan	<500,000	No	No data	Yes	**Very unlikely**
Latvia	500,000 - <1,000,000	No	Moderate	Yes	**Unlikely**
Lithuania	≥1,000,000	Yes	High	Yes	**Likely**
Malaysia	<500,000	No	No data	Yes	**Very unlikely**
Netherlands	<500,000	Yes	High	Yes	**Unlikely**
Norway	500,000 - <1,000,000	No	High	Yes	**Unlikely**
Poland	≥1,000,000	No	Low	Yes	**Likely**
Romania	<500,000	No	Moderate	Yes	**Unlikely**
Russian Federation	500,000 - <1,000,000	No	Low	Yes	**Likely**
Slovakia	<500,000	No	No data	Yes	**Very unlikely**
South Africa	<500,000	No	No data	Yes	**Very unlikely**
Spain	500,000 - <1,000,000	Yes	High	Yes	**Unlikely**
Sweden	≥1,000,000	Yes	High	Yes	**Likely**
Thailand	≥1,000,000	No	No data	Yes	**Unlikely**
Turkey	<500,000	No	No data	Yes	**Very unlikely**
Ukraine	500,000 - <1,000,000	No	High	Yes	**Unlikely**
Uruguay	<500,000	No	No data	Yes	**Very unlikely**
United States of America	≥1,000,000	Yes	Moderate	Yes	**Likely**
Viet Nam	< 500,000	No	No data	Yes	**Very unlikely**

No data: where there is no data on biosecurity likelihood estimates have higher uncertainty compared to others

References

1. World Organisation for Animal Health (OIE), (2021). Questions and Answers on COVID-19. Available at: https://www.oie.int/scientific-expertise/specific-information-and-recommendations/questions-and-answers-on-2019novel-coronavirus/. (accessed on 20 January 2021)
2. World Organisation for Animal Health (OIE), (2021). OIE Technical Factsheet: Infection with SARS-CoV-2 in animals. Available at: https://rr-asia.oie.int/wp-content/uploads/2020/06/200608_a_factsheet_sars-cov-2.pdf (accessed on 20 January 2021)
3. World Organisation for Animal Health (OIE), (2021). OIE statement on COVID-19 and mink. Available at: https://www.oie.int/en/for-the-media/press-releases/detail/article/oie-statement-on-covid-19-and-mink/. (accessed on 20 January 2021)
4. World Organisation for Animal Health (OIE), (2021). OIE COVID-19 Portal: Events in animals. Available at: https://www.oie.int/en/scientific-expertise/specific-information-and-recommendations/questions-and-answers-on-2019novel-coronavirus/events-in-animals/. (accessed on 20 January 2021)
5. World Organisation for Animal Health (OIE), (2021). OIE Guidance on working with farmed animals of species susceptible to infection with SARS-CoV-2. Available at: https://rr-middleeast.oie.int/wp-content/uploads/2020/11/draft-oie-guidance-farmed-animals_cleanms05-11.pdf (accessed on 20 January 2021)
6. World Organisation for Animal Health (OIE), (2020). Considerations for sampling, testing, and reporting of SARS-CoV-2 in animals. Available at: https://www.oie.int/fileadmin/Home/MM/A_Sampling_Testing_and_Reporting_of_SARS-CoV-2_in_animals_3_July_2020.pdf (accessed on 20 January 2021)
7. FAO, 2021. COVID-19 and animals. Information of risk mitigation measures for livestock and agricultural professionals. Available at: http://www.fao.org/documents/card/en/c/cb2549en. (accessed on 20 January 2021)
8. FAO, Exposure of humans or animals to SARS-CoV-2 from wild, livestock, companion and aquatic animals. Available at: http://www.fao.org/3/ca9959en/CA9959EN.pdf. (accessed on 20 January 2021)
9. WHO, Origins of the SARS-CoV-2 virus. Available at: https://www.who.int/health-topics/coronavirus/who-recommendations-to-reduce-risk-of-transmission-of-emerging-pathogens-from-animals-to-humans-in-live-animal-markets. (accessed on 20 January 2021)
10. WHO, Coronavirus disease (COVID-19): Health and safety in the workplace. Available at: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/question-and-answers-hub/q-a-detail/coronavirus-disease-covid-19-health-and-safety-in-the-workplace. (accessed on 20 January 2021)
11. WHO COVID-19 Case definitions. Available at: https://www.who.int/publications/i/item/WHO-2019-nCoV-Surveillance_Case_Definition-2020.2. (accessed on 20 January 2021)
12. WHO Public health surveillance for COVID-19: interim guidance. Available at: https://www.who.int/publications/i/item/who-2019-nCoV-surveillanceguidance-2020.8. (accessed on 20 January 2021)
13. WHO Coronavirus Disease (COVID-19) Dashboard. Available at: https://covid19.who.int/table (accessed on 20 January 2021)
14. WHO, Disease Outbreak News,SARS-CoV-2 mink-associated variant strain – Denmark. Available at: https://www.who.int/csr/don/03-december-2020-mink-associated-sars-cov2-denmark/en/ (accessed on 20 January 2021)

15. WHO, COVID-19 Vaccines. Available at: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/covid-19-vaccines (accessed on 20 January 2021)
16. Taxonomic information. Available at: https://talk.ictvonline.org/taxonomy (accessed on 20 January 2021)
17. Kidd, A.G., Bowman, J., Lesbarrères, D. & Schulte-Hostedde, A.I. (2009). - Hybridization between escaped domestic and wild American mink *(Neovison vison). Molec. Ecol.*, 18 (6), 1175-1186. Available at: https://onlinelibrary.wiley.com/doi/full/10.1111/j.1365-294X.2009.04100.x (accessed on 20 January 2021)
18. Harrington, L., Bocedi, G., Travis, J.M.J., Palmer, S., Fraser, E., Lambin, X., MacDonald, D. & Macdonald, D. (2015). - Range expansion of an invasive species through a heterogeneous landscape - the case of American mink in Scotland. *Diver. Distrib.*, 1-13. Available at: https://www.academia.edu/33411922/Range_expansion_of_an_invasive_species_through_a_heterogeneous_landscape_the_case_of_American_mink_in_Scotland (accessed on 20 January 2021)
19. Richard M., Kok A., de Meulder D. (2020). SARS-CoV-2 is transmitted via contact and via the air between ferrets. *Nat Commun.* 2020; 113496. Available at: https://www.biorxiv.org/content/biorxiv/early/2020/04/17/2020.04.16.044503.full.pdf (accessed on 20 January 2021)
20. Fur Farming Wikipedia. Available at: https://en.wikipedia.org/wiki/Fur_farming (accessed on 20 January 2021)
21. Born Free USA (2009). Cruelty uncaged: A review of fur farming in North America. Available at: http://7a1eb59c2270eb1d8b3d-a9354ca433cea7ae96304b2a57fdc8a0.r60.cf1.rackcdn.com/FurFarmReport.pdf (accessed on 20 January 2021)
22. Rinne, T. (2020). Fur farm animals and fur farming is in a decline – according to a statistical report published by FiFur. Available at: https://animaliamedia.fi/en/fur_farm-animals-and-fur_farming-is-in-a-decline-according-to-a-statistical-report-published-by-fifur/#:~:text=In%202019%20the%20fur%20farming%20industry%20employed%20only%201207%20workers.&text=3.1%20million%20animals%20were%20bred,(158%20000%20in%202018) (accessed on 20 January 2021)
23. Humane Society International. (2021). The Fur Trade. Available at: https://www.hsi.org/news-media/fur-trade/ (accessed on 20 January 2021)
24. Fur Free Alliance (2020). Leading animal protection organisations call for the permanent closure of fur farms in Europe. Available at: https://www.furfreealliance.com/leading-animal-protection-organisations-call-for-the-permanent-closure-of-fur farms-in-europe/ (accessed on 20 January 2021)
25. Mahdy, M.A.A., Younis, W. & Ewaida, Z. (2020). An Overview of SARS-CoV-2 and Animal Infection. *Front. Vet. Sci.*, **7**, 1084. Available at: https://www.frontiersin.org/articles/10.3389/fvets.2020.596391/full (accessed on 20 January 2021)
26. Hobbs, E.C. & Reid, T.J. (2020). Animals and SARS-CoV-2: Species susceptibility and viral transmission in experimental and natural conditions, and the potential implications for community transmission. *Trans. Emerg. Dis*, Online ahead of print. Available at: https://onlinelibrary.wiley.com/doi/10.1111/tbed.13885 (accessed on 20 January 2021)
27. Kim, Y.-I, Kim, S.-G., Kim E.-H., Park S.-J., Yu K.-M., Chang J.H. *et al.* (2020). Infection and Rapid Transmission of SARS-CoV-2 in Ferrets. *Cell Host Microbe,* **27** (5), 704-709. Available at: https://www.sciencedirect.com/science/article/pii/S1931312820301876 (accessed on 20 January 2021)
28. European Centre for Disease Prevention and Control (ECDPC) (2020). Detection of new SARS-CoV-2 variants related to mink. Available at: https://www.ecdc.europa.eu/sites/default/files/documents/RRA-SARS-CoV-2-in-mink-12-nov-2020.pdf (accessed on 20 January 2021)
29. Hanse, H.O. (2017). European mink industry – socio-economic impact assessment. Available at: https://www.altinget.dk/misc/Fur-Invasive-19-09.pdf (accessed on 20 January 2021)
30. ACTAsia, (2019) and its position in the global fur industry. China's fur trade. Available at: https://www.actasia.org/wp-content/uploads/2019/10/China-Fur-Report-7.4-DIGITAL-2.pdf (accessed on 20 January 2021)
31. Hammershøj, M., Pertoldi, C., Asferg, T., Møller, T. B., Kristensen, N. B. (2005). Danish free-ranging mink populations consist mainly of farm animals: evidence from microsatellite and stable isotope analyses. *J. Nature Conservation* **13** (4), 267-274. Available at: https://www.sciencedirect.com/science/article/abs/pii/S1617138105000178 (accessed on 12 February 2021).
32. Ecology Asia. Carnivorans of Southeast Asia. Available at: https://www.ecologyasia.com/verts/carnivorans.htm (accessed on 20 January 2021)

33. Risk Assessment Group Covid Animals (RAGCA), (2020). Risque zoonotique associé à l'infection de visons par le SARS-CoV-2. Available at: http://www.afsca.be/professionnels/publications/communications/covid19/_documents/RAGCA-mink-DK-SARS-CoV-2_FR.pdf (accessed on 20 January 2021)
34. Risk Assessment Group Covid Animals (RAGCA), (2020). Scientific opinion for the risk assessment by analysis of information related to the farming of an American mink for fur in the territory of Bulgaria. Available at: https://corhv.government.bg/files/%d0%a1%d1%82%d0%b0%d0%bd%d0%be%d0%b2%d0%b8%d1%89%d0%b0%20%d0%b8%20%d0%be%d1%86%d0%b5%d0%bd%d0%ba%d0%b0%20%d0%bd%d0%b0%20%d1%80%d0%b8%d1%81%d0%ba%d0%b0/02_%d0%97%d0%b4%d1%80%d0%b0%d0%b2%d0%b5%20%d0%bd%d0%b0%20%d0%b6%d0%b8%d0%b2%d0%be%d1%82%d0%bd%d0%b8%d1%82%d0%b5%20%d0%b8%20%d1%85%d1%83%d0%bc%d0%b0%d0%bd%d0%bd%d0%be%20%d0%be%d1%82%d0%bd%d0%be%d1%88%d0%b5%d0%bd%d0%b8%d0%b5%20%d0%ba%d1%8a%d0%bc%20%d1%82%d1%8f%d1%85/2017_09_29_Conclusions_SCIENTIFIC__OPINION__MINK_Farm_Georgiev_all.pdf (accessed on 20 January 2021)
35. Institut Pasteur du Cambodge. General presentation of the main activities. Available at: https://www.pasteur-kh.org/virology-unit/ (accessed on 20 January 2021)
36. Canadian Food Inspection Agency (2021). Animal Biosecurity: Pocket Guide for the National Farm–Level Mink Biosecurity Standard. Available at: http://www.canadamink.ca/wp-content/uploads/2018/06/National-Farm-Level-Mink-Biosecurity-Pocket-Guide.pdf (accessed on 20 January 2021)
37. Statistics Canada. Supply and disposition of mink and fox on fur farms. Available at: https://www150.statcan.gc.ca/t1/tbl1/en/tv.action?pid=3210011601 (accessed on 20 January 2021)
38. International Fur Animal Scientific Association (IFASA) (2011). *SCIENTIFUR*, **35** (3). Available at: http://ifasanet.org/PDF/vol35/Scientifur_35_3.pdf (accessed on 20 January 2021)
39. Fur Europe annual report 2014. Available at: https://www.fureurope.eu/wp-content/uploads/2015/09/Fur_Europe_Annual_Report_September_2015_smallsize.pdf (accessed on 20 January 2021)
40. Humane Society (2020). Leading animal protection organisations call for the permanent closure of fur farms in Europe. Available at: https://www.hsi.org/news-media/leading-animal-protection-organisations-call-for-the-permanent-closure-of-fur-farms-in-europe/ (accessed on 20 January 2021)
41. Coalition Clean Baltic (CCB) (2017). Data for the EU countries. Available at: https://www.ccb.se/Evidence2017/IAF_nonconv/Fur%20farming/Fur%20farming%20data%20in%20the%20BSR.pdf (accessed on 20 January 2021)
42. Nordgren, H., Vapalahti, K., Vapalahti, O., Sukura, A. & Virtala, A.M. (2017). Questionnaire survey of detrimental fur animal epidemic necrotic pyoderma in Finland. Available at: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5543541/ (accessed on 20 January 2021)
43. Eurogroup for Animals (2019). Germany shuts down its last fur farm. Available at: https://www.eurogroupforanimals.org/news/germany-shuts-down-its-last-fur farm (accessed on 20 January 2021)
44. United Nations COMTRADE database. Available at: https://comtrade.un.org/data/ (accessed on 20 January 2021)
45. ProMed (2020). Coronavirus disease 2019 update (527): animal, Greece (western Macedonia) mink, spread, genome analysis. Available at: https://eksegersi.gr/wp-content/uploads/2020/12/ProMED.pdf (accessed on 20 January 2021)
46. Latvian Biomedical Research and Study Centre (2020). SARS-CoV-2 virus genome data are used for epidemiological surveillance and control of Covid-19 in Latvia. Available at: http://biomed.lu.lv/en/startpage/news/sars-cov-2-virus-genome-data-are-used-for-epidemiological-surveillance-and-control-of-covid-19-in-latvia/ (accessed on 20 January 2021)
47. Latvian State Food and Veterinary Office (2020). COVID-19 situacija audinių ūkiuose Lietuvoje: naujų protrūkių nenustatyta. Available at: https://vmvt.lt/naujienos/covid-19-situacija-audiniu-ukiuose-lietuvoje-nauju-protrukiu-nenustatyta (accessed on 20 January 2021)
48. Sustainable Fur (2020). New COVID-19 research results from Dutch mink farms. Available at: https://

www.sustainablefur.com/news_item/new-covid-19-research-results-from-dutch-mink-farms/ (accessed on 20 January 2021)
49. Norwegian Fur Animal Society (2020). Godt smittevern i norske pelsdyrgårder. Available at: https://norpels.no/godt-smittevern-i-norske-pelsdyrgarder/ (accessed on 20 January 2021)
50. Wiltowska, B. (2020). Investigation on a mink farm in Poland, probably the biggest mink farm in the world. Available at: https://animainternational.org/blog/goreczki-investigation (accessed on 20 January 2021)
51. PETA. A Guide to the Fur-Free Revolution: These Places Have Banned Fur. Available at: https://www.peta.org/features/fur-bans-fur-free-future/ (accessed on 20 January 2021)
52. ProMED (2020). PRO/AH/EDR> COVID-19 update (319): Spain (AR) animal, farmed mink, 1st rep. Available at: https://promedmail.org/promed-post/?id=20200717.7584560 (accessed on 20 January 2021)
53. Fur Free Alliance. Fur Farming Legislation Around The World. Available at: https://web.archive.org/web/20090116015047/http://www.infurmation.com/furfarmlegislation.php (accessed on 20 January 2021)
54. Government of the United Kingdom and Northern Ireland (2002). The Fur Farming (Prohibition) (Northern Ireland) Order 2002. Available at: https://www.legislation.gov.uk/nisi/2002/3151/contents (accessed on 20 January 2021)
55. United States Department of Agriculture (USDA) (2020). Response & Containment Guidelines Interim Guidance for Animal Health and Public Health Officials Managing Farmed Mink and other Farmed Mustelids with SARS-CoV-2. Available at: https://www.aphis.usda.gov/publications/animal_health/sars-cov-2-mink-guidance.pdf (accessed on 20 January 2021)
56. United States Department of Agriculture (USDA) (2020). Mink (July 2020), USDA, National Agricultural Statistics Service. Available at: https://furcommission.com/wp-content/uploads/2020/07/USDAmink2020.pdf (accessed on 20 January 2021)
57. Guardian (2020). Covid-19 mink variants discovered in humans in seven countries. Available at: https://www.theguardian.com/environment/2020/nov/18/covid-19-mink-variants-discovered-in-humans-in-seven-countries (accessed on 20 January 2021)
58. United States Department of Agriculture (USDA). Interim SARS-CoV-2 Guidance and Recommendations for Farmed Mink and Other Mustelids. Available at: https://www.aphis.usda.gov/animal_health/one_health/downloads/sars-cov-2-guidance-for-farmed-mink.pdf (accessed on 20 January 2021)
59. Centers for Disease Control and Prevention (2020). Steps to Prevent COVID-19 on Mink Farms. Available at: http://furcommission.com/wp-content/uploads/2020/11/Mink-Training-Presentation_4Nov2020.pdf (accessed on 20 January 2021)
60. Oreshkova, N., Molenaar, R. J., *et al.* (2020). SARS-CoV-2 infection in farmed minks, the Netherlands, April 2020. BioRxiv doi: https://doi.org/10.1101/2020.05.18.101493.
61. Oreshkova, N., Molenaar, R.J. *et al.* (2020). - SARA-CoV-2 infection in farmed minks, the Netherlands, April and May 2020. *Eurosurv.*, **25** (23), 2001005. https://doi.org/10.2807/1560-7917.ES.2020.25.23.2001005
62. Pagad, S., Genovesi, P., Carnevali, L. *et al.* (2018). Introducing the Global Register of Introduced and Invasive Species. *Sci Data* **5**, 170202. https://doi.org/10.1038/sdata.2017.202
63. Global Register of Introduced and Invasive Species. Available at: http://www.griis.org/about.php, as of 20 December 2020 (accessed on 20 January 2021)
64. Jones, D.L., Quintela Baluja, M. *et al.* (2020). - Shedding of SARS-CoV-2 in feces and urine and its potential role in person-to-person transmission and the environment-based spread of COVID-19. *Sci. Total Environ.*, **749**, 141364. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0048969720348932 (accessed on 20 January 2021)
65. Truth About Fur (2017). Fur Farming in North America. Available at: https://www.truthaboutfur.com/c/truthaboutfur/uploads/zva_bank_docs.file/FurFarming.pdf (accessed on 20 January 2021)
66. Association of Nordic Farms of Ukraine. Mink world production and mink production in Ukraine [in Russian]. Available at: https://uffa.org.ua/ru/mirovoe-proizvodstvo/ (accessed on 20 January 2021)
67. United Nations Children's Fund (UNICEF). COVID-19 Vaccine Market Dashboard. Available at: https://www.unicef.org/supply/covid-19-vaccine-market-dashboard (accessed on 20 January 2021)