

AZA SMALL CARNIVORE TAXON ADVISORY GROUP
SARS-COV-2 CONSIDERATIONS AND PRECAUTIONS

6 April 2020
Updated 27 April 2020
19 April 2021 updates in green

Colleagues,

Recently, SARS-CoV-2 the virus that causes COVID-19, was confirmed in a Malayan tiger with respiratory signs at the Wildlife Conservation Society/Bronx Zoo in New York, NY, USA (<https://newsroom.wcs.org/News-Releases/articleType/ArticleView/articleId/14010/A-Tiger-at-Bronx-Zoo-Tests-Positive-for-COVID-19-The-Tiger-and-the-Zoos-Other-Cats-Are-Doing-Well-at-This-Time.aspx>). As a result, the AZA Felid TAG veterinary advisors (Drs. Terio, Bronson, and McAloose) sent an update on this case to the TAG and the American Association of Zoo Veterinarians (AAZV) along with recommendations for precautionary measures to be taken when working around exotic felids during the current coronavirus pandemic. While there is much we do not know at this time about SARS-CoV-2 and **this tiger is currently the only zoo case confirmed by an approved testing laboratory (see update below)**, the Small Carnivore TAG veterinary advisors want to be proactive with considerations and precautions with small carnivore species in zoological institutions.

Since the beginning of the pandemic in addition to the above mentioned tiger, other species have tested positive ([CDC data](#)): lions, pumas, cougars, snow leopards, gorillas, Asian small clawed otters. “It is suspected that these animals became sick after being exposed to an animal caretaker with COVID-19. In many situations, this happened despite the staff wearing personal protective equipment and following COVID-19 precautions.”

Farmed mink worldwide remain the most commonly affected small carnivore, where most cases have been traced back to care staff ([OIE](#)).

Based on abundant information gained during the SARS outbreak of 2002-2004, various species of civets, the raccoon dog, and the Chinese ferret badgers have been identified as being infected with SARS-like coronaviruses (May et al. 2004). Masked palm civets were also shown to become experimentally infected with two isolates of human SARS-CoV, showing clinical signs of lethargy and fever, with pneumonia and leukopenia present on postmortem exam (Wu et al. 2005). Experimentally, domestic cats and ferrets were also infected with SARS-CoV from a human patient, and ferrets developed clinical signs and were also able to transmit the virus to uninfected ferrets (Martina et al. 2003). Information in veterinary patients related to the more recent pandemic of SARS-CoV-2 is still evolving; however, a recent unpublished study showed experimental infection and rapid transmission of SARS-CoV-2 in domestic ferrets, shedding virus in respiratory secretions, saliva, feces, and urine, and airborne transmission to naïve ferrets with indirect contact (Kim et al 2020). Another recent unpublished study also found that SARS-CoV-2 infected and replicated efficiently in domestic cats and domestic ferrets (Shi et al. 2020). Mink are also suspected to be a possible source of SARS-CoV-2 in China (Guo et al 2020).

Findings in small carnivores from experimental studies and cases reported to have been infected with COVID-19:

Species	Organism	Method of infection	Shedding/sample	Clinical signs	Reference
Masked palm civet	two isolates of human SARS-CoV	Experimental	Not reported	lethargy and fever, with pneumonia and leukopenia present on postmortem exam	(Wu et al. 2005)
Domestic ferret	SARS-CoV	Experimental	Yes	Lethargy, conjunctivitis	(Martina et al. 2003)

Domestic ferret	SARS-CoV-2	Experimental	Yes	Lethargy, fever, occasional cough	(Kim et al. 2020, unpublished)
Domestic ferret	SARS-CoV-2	Experimental	Not reported	Not reported	(Chen et al. 2020, unpublished)
Mink at a farm (3 + animals at a farm of 13,000)	SARS-CoV-2	Natural from infected staff	Not reported, also not reported how many were tested	Respiratory problems, GI and increased death	Letter from the Minister of Ag, nature and food quality
Mink (wild Utah)	SARS-CoV-2	Found during survey around mink farms	Real time RT-PCR & seq. (NVSL)	Animal was asymptomatic	OIE
Domestic ferret (Slovenia)	SARS-CoV-2	Source: Contact with COVID-19 positive people	Real time PCR	No clinical signs	OIE
Asian small-clawed otters	SARS-CoV-2	Natural, suspect asymptomatic staff source	Not reported in press release	Mild respiratory symptoms such as sneezing, runny noses, mild lethargy, and some began coughing	Press release from the Georgia Aquarium

Echoing the insights of the Felid TAG veterinary advisors, there are many unknowns about the current SARS-CoV-2; however, the aforementioned unpublished studies show concerning results in domestic ferrets, and previous SARS-CoV infections have been documented in species within the families *Viverridae* and *Mustelidae*. As a result, we suspect the possibility that SARS-CoV-2 may become a concern with these small carnivore species and their relatives in zoological institutions. We do not know the full zoonotic or anthrozoonotic potential of SARS-CoV-2, but we do know that humans can carry SARS-CoV-2 asymptotically, and the tiger infected at the Bronx Zoo is suspected to have been infected from exposure to an asymptomatic keeper. Given the history of small carnivore species with SARS-CoV infections and the current SARS-CoV-2 pandemic, the Small Carnivore TAG veterinary advisors are proactively recommending similar risk assessment measures to those recommended by the Felid TAG, which include the following:

- PPE management and disinfection protocols (including fomites such as toys, furniture, and food/water bowls)
 - PPE supplies and use should be critically evaluated due to need by the human medical community for the current SARS-CoV-2 pandemic
- Limitation of staff contact with animals and holding/habitat areas
- Assessment of proximity of small carnivore species to other suspected at-risk species (other small carnivore and felid species)
- Ensure only essential workers have routine access to small carnivore species and that those workers are closely monitored for illness or history of exposure to ill people.
 - It is also important to evaluate staffing needs and coverage should any staff become sick, to ensure availability of adequately trained staff.
- [NAROs and ASCOs holding facilities should refer to PPE recommendations distributed by Dr. Myers for these species.](#)

If a small carnivore species presents with clinical signs such as fever, lethargy, or respiratory signs, samples can be submitted out of an abundance of caution, especially in light of each institution's risk assessment and finances. Clinical evaluation and sample submission should take into consideration the following:

- Consider isolating the animal(s) and/or managing that animal's environment/holding area as a quarantine space that is serviced at the end of the shift.
- Per regulatory authorities, **zoos must first contact their State Animal Health Official to obtain permission to send samples**, and these officials may suggest a certain lab.
 - Oral/nasal swabs, tracheal wash, other respiratory samples, or feces can be sent to approved veterinary diagnostic laboratories.
 - SARS-CoV-2 is an OIE reportable disease and reporting is mandatory.
 - Any positive sample will be automatically sent to National Veterinary Services Laboratory (NVSL), and if positive, reported to federal and state officials.
 - The decision to test should be made with understanding of the above implications.
- If animals die with clinical signs consistent with SARS-CoV-2, consider performing necropsies under a hood, or if hood is unavailable, use appropriate PPE and ventilation.
- For black-footed ferrets specifically, refer to the SSP and USFWS guidelines.

If your institution develops a suspect or confirmed SARS-CoV-2 case in a small carnivore species and the case information can be shared, please let us know so we can serve as a central repository of information for small carnivores in zoos as the current pandemic evolves.

Vaccines:

- Black-footed ferrets were vaccinated early on with a vaccine provided by NWHC, no adverse effects were noted but efficacy remains undetermined. [AHAA news](#).
- Zoetis vaccine has been tested in mink with good titers, but duration of titers has not been evaluated.
- Domestic cats have developed long titers.

The FELID TAG has been working with vaccine manufacturers and has put out an announcement. It reads in part:

“Both Zoetis and Medgene Labs have developed vaccines using recombinant technology and are seeking approval for use in mink.” “Medgene Labs and Zoetis plan to begin producing their new vaccines soon, and they have offered to make vaccine available to the zoo community. Zoos will likely be able to receive doses in the coming months to vaccinate their felids and other at-risk animals in their collections. The companies have reached out directly to some zoos already, and individual institutions that are interested in trialing these vaccine in their animals can reach out directly to Zoetis (John Hardham; john.m.hardham@zoetis.com) or Medgene Labs (Ashley Petersen; ashley@medgenelabs.com, 605-692-1268) to discuss their interests and needs. For both of these vaccines, it will be a two-dose regimen given three weeks apart”.

If you plan to vaccinate your small carnivores (e.g. mustelids). We would like to ask institutions to voluntarily keep us posted on any news that we can share with the TAG.

We wish everyone well and please do not hesitate to contact us with any questions. Stay safe!

Anneke Moresco, DVM, PhD
Co-Veterinary Advisor, Small Carnivore TAG
anneke_moresco@hotmail.com

Jimmy Johnson, DVM, MS, CertAqV, DACZM
Co-Veterinary Advisor, Small Carnivore TAG
Veterinary Advisor, Binturong SSP
jjohnson@stlzoo.org

Sushan Han, DVM, PhD, DACVP
Pathology Advisor, Small Carnivore TAG
sushan.han@colostate.edu

Selected literature review

- Chen, H et al. Susceptibility of ferrets, cats, dogs, and different domestic animals to SARS-coronavirus-2. bioRxiv 2020.03.30.015347; 2020. (unpublished pre-print)
- Guo, Q, et al. Host and infectivity prediction of Wuhan 2019 novel coronavirus using deep learning algorithm. bioRxiv 2020.01.21.914044; 2020. (unpublished pre-print)

- Kim, Y, et al. Infection and rapid transmission of SARS-CoV-2 in ferrets. Cell host and microbe (pre-print: https://www.cell.com/pb-assets/journals/research/cell-host-microbe/PDFs/chom_2285_preproof.pdf); 2020.
- May, RM, et al. Animal origins of SARS coronavirus: possible links with the international trade in small carnivores. Phil. Trans. R. Soc. Lond. B359: 1107–1114; 2004.
- Martina, BEE, et al. SARS virus infection of cats and ferrets. Nature 25(6961): 915; 2003.
- Song, H, et al. Cross-host evolution of severe acute respiratory syndrome coronavirus in palm civet and human. PNAS 02 (7) 2430-2435; 2005.
- Wu, D, et al. Civets Are Equally Susceptible to Experimental Infection by Two Different Severe Acute Respiratory Syndrome Coronavirus Isolates Journal of Virology, 79 (4) 2620-2625; 2005.
- <https://www.rijksoverheid.nl/actueel/nieuws/2020/04/26/covid-19-geconstateerd-op-twee-nertsenbedrijven>