

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

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Recently, SARS-CoV-2 the virus that causes COVID-19, was confirmed in several large felids 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 **these large felids at WCS are currently the only zoo cases confirmed by an approved testing laboratory**, the Small Carnivore TAG veterinary advisors want to be proactive with considerations and precautions with small carnivore species in zoological institutions.

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in veterinary patients related to the more recent pandemic of SARS-CoV-2 is still evolving; however, a recent unpublished study showed experimental infection and rapid transmission of SARS-CoV-2 in domestic ferrets, shedding virus in respiratory secretions, saliva, feces, and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 recently published 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). Farmed mink in the Netherlands were found to be positive and displaying clinical signs of upper respiratory tract disease and suspected of transmitting the disease from humans. Findings from experimental studies and reports are summarized below:

| 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   | (Shi et al. 2020)                                       |
| 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 |

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 anthrozoönotic 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.

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 the understanding the above implications.
- If animals die with clinical signs consistent with SARS-CoV, 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.

We want to reiterate, there are no current cases of SARS-CoV-2 confirmed in small carnivore species in AZA institutions, and this information consists of proactive measures out of an abundance of caution due to the history SARS-CoV in small carnivore species. 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.

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

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## Selected literature review

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