



Update on SARS-CoV-2 Surveillance in Canadian Wildlife, January 2020 - October 2022

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1. Background – why is surveillance important?

Under a One Health framework, Canadian federal agencies, along with provincial and territorial governments, academic institutions, and other partners, have been proactively engaged in research and surveillance activities to better understand SARS-CoV-2 at the interface between wildlife, domestic animals, and humans in Canada.

By spring 2020, numerous animal species were known to be susceptible to SARS-CoV-2, either through natural or experimental infections, however there were many unknowns regarding how SARS-CoV-2 would behave if virus spill over were to occur from humans to wildlife populations. There were concerns about the impacts on susceptible wildlife species, as well as the potential for wild animal populations to establish reservoirs of the virus and viral evolution, which were later heightened by the [first detection of SARS-CoV-2 in white-tailed deer in the United States in August 2021*](#). Given these concerns, surveillance for SARS-CoV-2 in Canada's wildlife was considered necessary. Surveillance is a critical tool that can be used to inform our understanding of the health status of wildlife populations in Canada. For a novel pathogen like SARS-CoV-2, surveillance in wildlife populations can help to generate critical epidemiological information that is needed for conservation and management action.

Due diligence and public assurance are also needed to demonstrate that potential avenues for the spread of SARS-CoV-2 in wild animal populations are being investigated, particularly given the heightened public concern of risk. Surveillance activities are particularly important for helping provide assurance and building confidence in the safety and sustainability of cultural practices and traditional food systems, and meeting constitutional obligations to ensure Indigenous populations have access to safe wild foods.

2. How was surveillance conducted in Canada?

Since the first detections of SARS-CoV-2 in susceptible companion animals internationally in the spring of 2020, many agencies and organizations have worked in partnership, including Environment and Climate Change Canada (ECCC), the Canadian Food Inspection Agency (CFIA), the Public Health Agency of Canada (PHAC), and Parks Canada, the provinces and territories, academic institutions, and the Canadian Wildlife Health Cooperative (CWHC) to undertake surveillance activities for SARS-CoV-2 in Canadian wildlife. A full list of partners is available below.



The national SARS-CoV-2 wildlife surveillance program leveraged existing capacity, inter-agency networks, and wildlife disease surveillance and research programs across Canada. It also required the development of novel methods and protocols including standardized sampling guidance and building new genomics, and technical capacity to identify and characterize SARS-CoV-2 in a range of species and sample types.

Surveillance efforts were focused on target species of wildlife that were known or suspected to be suitable hosts for SARS-CoV-2, species that were expected to interact with humans, particularly in areas with high transmission rates in the human population, and species commonly harvested and/or of importance to Indigenous communities. Across Canada, samples were collected through ongoing research, monitoring, and animal management programs (e.g., routine necropsy submissions to the CWHC, chronic wasting disease testing programs, enhanced rabies surveillance) and from hunter/harvester submissions and were submitted to partnering laboratories to test for SARS-CoV-2 infection and exposure.

Samples underwent molecular testing (PCR) to test for evidence for the presence of SARS-CoV-2, at partner laboratories beginning in the fall of 2021 (but including samples collected as early as 2020) and continued into 2022. All positive or suspect positive samples were sent to CFIA's National Centre for Foreign Animal Disease (CFIA-NCFAD) for confirmation and sequencing. The first confirmed positives were reported to the World Organization for Animal Health and all results were communicated directly to submitting partners following which public-facing communications were developed and circulated. The [SARS-CoV-2 in Animals Dashboard](#) was developed as a public interface to display CFIA-NCFAD confirmed positive cases and is available on the Canadian Animal Health Surveillance System website.

3. Objectives of surveillance

The overall objectives of SARS-CoV-2 surveillance in wildlife in the first year were to:

- 1) identify Canadian wildlife species susceptible to SARS-CoV-2 and assess the potential impacts of the virus on these species;
- 2) identify potential wildlife reservoirs for the virus;
- 3) investigate origins and evolution of viruses found in wildlife populations, using genomics techniques;
- 4) understand potential pathways of spread from humans to wildlife (and back), and within and between wildlife species;
- 5) assess the potential risk posed to the public, including hunters and trappers, who may come into close contact with potentially infected wildlife species.



4. Results

As of October 1, 2022, 2768 cervids across Canada were tested for the presence of SARS-CoV-2 viral RNA through RT-PCR. Of 1727 free-ranging, wild white-tailed deer (WTD) sampled in Canada from June 2020 to October 2022, SARS-CoV-2 was confirmed in 49 WTD from British Columbia, Saskatchewan, Manitoba, Ontario, Quebec, New Brunswick, and Alberta (**Table 1**). Of 300 mule deer sampled in western Canada (numbers of deer sampled in BC, AB, SK, MB, and YT were 17, 117, 109, 24, and 33, respectively), 3 were positive from AB. Furthermore, all caribou (461), moose (149), elk (113), and black-tailed deer (4) sampled across Canada tested negative for SARS-CoV-2 on RT-PCR. All deer that tested positive were apparently healthy and showed no clinical signs of disease.

An additional 2508 samples from other free-ranging wild species from 9 orders and 18 different families have also been tested, all of which were negative for SARS-CoV-2 on RT-PCR (**Table 2**).

Table 1. Number of free-ranging white-tailed deer tested* for SARS-CoV-2 by RT-PCR (collected from June 2020 to October 2022).

Province/ Territory	N	# Positive (%)
YT	N/A	--
NT	1	0 (0%)
NU	N/A	--
BC	130	12 (9.2%)
AB	195	9 (4.6%)
SK	243	4 (1.6%)
MB	243	3 (1.2%)
ON	514	17 (3.3%)
QC	260	3 (1.2%)
NB	62	1 (1.6%)
NS	79	0 (0%)
PE	N/A	--
NL	N/A	--
Total	1727	49 (2.8%)

N/A indicates that white-tailed deer are outside of the typical range for the province/territory.

Table 2. Number of non-cervid free-ranging animals tested* by RT-PCR across Canada (collected from December 2019 to October 2022).

Order	Family / Species	N
Carnivora	Mustelids, felids, canids, skunks, raccoons, bears	1972
Artiodactyla	Wild boar, bison, muskoxen	56
Lagomorpha	Urban hares and rabbits	155
Rodentia & Eulipotyphla	Voles, mice, squirrels, beavers, muskrat, porcupine, shrews	254
Chiroptera	New World bats	52
Cetacea	Dolphin, porpoise	3
Didelphimorphia	Opossum	6
Galliformes	Wild turkeys	10
Total		2508

PCR testing was performed at the Prairie and Northern Wildlife Research Centre and Western College of Veterinary Medicine or at the National Centre for Foreign Animal Disease for samples collected from BC, AB, SK, MB, NB, NS, NL, YT, NT, and NU and caribou samples from ON and QC and a small number of samples from ON; PCR testing was performed at Sunnybrook Research Institute for the majority of white-tailed deer samples from ON and all white-tailed deer samples from QC; PCR testing was performed at the Animal Health Laboratory at the University of Guelph for a small number of white-tailed deer from ON. Table includes samples reported in Greenhorn et al, 2022*.



Sequencing results to date suggest multiple spill over events from humans to WTD, with subsequent transmission among WTD (Kotwa et al., 2022*; Pickering et al., 2022*). SARS-CoV-2 genome sequences recovered from WTD samples were found to either be similar to those circulating in human populations or very different from the most closely related sequences in public databases, which suggests sustained transmission and evolution of the virus within deer populations. Surveillance in Ontario WTD detected positive WTD samples containing a virus that was closely related to a virus detected in a SARS-CoV-2 positive human in the same region and time period, which suggests a possible occurrence of deer-to-human transmission (Pickering et al., 2022*).

5. Next Steps

Information about SARS-CoV-2 is continually evolving. Continued surveillance in wildlife species is needed to monitor the evolution of SARS-CoV-2 within cervid and other wildlife populations over time; to monitor for changes in impacts, prevalence, virulence or transmissibility, in cervids and other wildlife species; to further understand the potential role of deer as reservoirs for transmission to other susceptible wildlife and humans; and to investigate potential transmission pathways within and between species.

Collaborations are continuing among partners to carry out surveillance for SARS-CoV-2 in Canadian wildlife in 2023-2024.

List of Surveillance Partners

Federal and Provincial Agencies

Environment and Climate Change Canada (ECCC)

- Science & Technology Branch (STB)
- Canadian Wildlife Service (CWS)

Canadian Food Inspection Agency

- National Centre for Foreign Animal Diseases (NCFAD)
- Animal Health Science Division, Science Branch
- Office of the Chief Veterinary Officer of Canada

Public Health Agency of Canada (PHAC),

- Centre for Food-borne, Environmental and Zoonotic Infectious Diseases (CFEZID)
- National Microbiology Laboratory (NML)

Parks Canada Agency (PCA)

Polar Knowledge Canada – Canadian High Arctic Research Station

Government of British Columbia

- Ministry of Forests, Lands, Natural Resource Operations and Rural Development
- Ministry of Agriculture
- BC Centre for Disease Control

Government of Alberta

- Ministry of Environment and Parks



Government of Saskatchewan

- Ministry of Environment

Government of Manitoba

- Natural Resources and Northern Development

Government of Ontario

- Ministry of Natural Resources and Forestry (MNR)

Government of Québec

- Ministère de l'Environnement, de la Lutte contre les changements climatiques, de la Faune et des Parcs (MELCCFP)

Government of New Brunswick

- Department of Natural Resources and Energy Development
- Department of Agriculture, Aquaculture and Fisheries

Government of Nova Scotia

- Department of Natural Resources and Renewables

Government of Newfoundland and Labrador

- Department of Fisheries, Forestry and Agriculture

Government of Northwest Territories

- Department of Environment and Climate Change

Government of Yukon

- Department of Environment

Partners in Academia, Non-Government Institutions, and Communities

Canadian Wildlife Health Cooperative (CWHC)

Sunnybrook Research Institute (SRI)

University of Saskatchewan

University of Toronto

Dalhousie University

University of Guelph

Université de Montréal

University of Calgary

Makivik Corporation

Saskatchewan Trappers Association

Zoo de Granby

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List of Organizational Leads

Organizational-identified leads for federal, provincial, and territorial governments, CWHC, and SRI involved in field collection, sample analysis, data management, and coordination.

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Public Health Agency of Canada

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Parks Canada

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Government of Yukon

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Government of Northwest Territories

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* Documents only available in English

This document was developed with input from a working group consisting of Canadian wildlife and public health experts, with representation from federal, provincial, and territorial governments, the Canadian Wildlife Health Cooperative, Parks Canada, Environment and Climate Change Canada, Canadian Food Inspection Agency, Public Health Agency of Canada, and academia.

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