

Cross-Canada Disease Report

Rapport des maladies diagnostiquées au Canada

Laboratory diagnosis of rabies in Canada for calendar year 2006

The Canadian Food Inspection Agency (CFIA), with laboratories in Ottawa, Ontario (Centre of Expertise for Rabies) and Lethbridge, Alberta, conducts rabies testing in Canada on all suspect rabid animals where there was human or domestic animal contact and for all human suspect cases (diagnostic submissions). In addition, individual provinces may contract with the CFIA to provide diagnostic support for intensified surveillance programs (survey samples). The majority of all submissions are tested by the fluorescent antibody test (FAT) (1), the method recommended by the World Health Organization for the routine diagnosis of rabies (2). In addition, diagnostic submissions where there was documented human contact and a negative FAT are subject to a second, confirmatory test, the rabies tissue culture inoculation test (RTCIT). Although not preferred as a method for routine rabies diagnosis, formalin-fixed samples can be tested by using an avidin-biotin complex (ABC) immunohistochemistry test (3).

In 2006, 7201 diagnostic submissions were received for testing. An additional 1872 survey samples were tested as part of surveillance programs carried out by the provinces of Ontario and Quebec (Table 1). A small proportion of the diagnostic submissions were unfit for testing by the FAT ($n = 86$) or ABC ($n = 1$). Of the submissions fit for testing, 229 were positive for rabies virus antigen by the FAT: 227 from the diagnostic submissions and 2 from the Quebec survey. While these data represent a decrease in the total number of annual rabies cases compared to each of the previous 5 y, the percent of positive submissions has not changed greatly over this time (2002 — 4.0%, 2003 — 3.2%, 2004 — 3.4%, 2005 — 3.6%, 2006 — 3.2%). Diagnostic submissions tested by ABC ($n = 6$) or RTCIT ($n = 5363$) in 2006 were all negative for rabies.

The majority of diagnostic submissions originated from the provinces of Ontario and Quebec (76.3%), followed by the Western provinces (19.3%), the Atlantic provinces (3.6%), and the Northern territories (0.7%). The largest numbers of positive cases originated from Ontario ($n = 82$), Manitoba ($n = 65$), and Saskatchewan ($n = 33$). Although Quebec submitted the 2nd largest number of submissions, only 0.6% were positive for rabies, in contrast with the results for Ontario (2.4%), Manitoba (12.7%), and Saskatchewan (11%). There were no rabies cases in New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland and Labrador, or the Yukon. However, submission numbers from these regions were low — fewer than 50 for 4 of the 5 regions. As such, it is probable that the true

Table 1. Rabies diagnosis in Canada for 2006

Province	Positive ^a	Negative ^b	Unfit	Total submitted	Percent positive
NT	8	9	0	17	47.1
YK	0	3	0	3	0.0
NU	10	21	0	31	32.3
BC	11	231	15	257	4.3
AB	5	318	1	324	1.5
SK	33	263	3	299	11.0
MB	65	444	3	512	12.7
ON	82	3322	45	3449	2.4
ON — survey ^c	0	505	0	505	0.0
QC	13	2018	19	2050	0.63
QC — survey ^c	2	1361	6	1369	0.15
NB	0	183	1	184	0.0
NS	0	48	0	48	0.0
PE	0	18	0	18	0.0
NL	0	9	0	9	0.0
Total diagnostic	227	6887	87	7201	3.2
Total survey ^b	2	1866	6	1874	0.1

NT — Northwest Territories; YK — Yukon; NU — Nunavut; BC — British Columbia; AB — Alberta; SK — Saskatchewan; MB — Manitoba; ON — Ontario; QC — Quebec; NB — New Brunswick; NS — Nova Scotia; PE — Prince Edward Island; NL — Newfoundland and Labrador

^a Positives by fluorescent antibody test (FAT); there were no avidin-biotin complex (ABC) immunohistochemistry test positive submissions in 2006

^b Includes both FAT and ABC negatives

^c Samples that were part of a provincial rabies surveillance program that did not meet the CFIA submission criteria. The CFIA laboratory was contracted by the provinces to provide testing for these samples

rabies burden in these regions is not reflected in these statistics. In particular, there were only 3 submissions from the Yukon. This article and Blanton et al (4) suggest that, given the prevalence of rabies in the Northwest Territories and Alaska in 2006, it is likely that there is rabies in the Yukon.

The species that tested positive for each province and territory are listed in Table 2. Of these, 45.4% were wild carnivora (striped skunks [*Mephitis mephitis*] were most abundant), 31.4% were bats (big brown bats [*Eptesicus fuscus*] were most abundant), and 23.1% were domestic animals (cattle [*Bos taurus*] were most abundant). As observed in previous years, there was a regional distribution with respect to the species of the positive cases. Not unexpectedly, the Northwest Territories and Nunavut did not have any bat rabies, but did record cases in arctic foxes (*Alopex lagopus*) and red foxes (*Vulpes vulpes*), as well as in dogs (*Canis domesticus*). Positive bats were found in all provinces with rabies cases. Species affected included big brown, little brown (*Myotis lucifugus*), silver-haired (*Lasionycteris noctivagans*), hoary (*Lasiurus cinereus*), California (*M. californicus*), and long-eared (*M. evotis*) bats. All rabies cases from British Columbia

Table 2. Rabies testing by species and province/territory in Canada for 2006 – diagnostic submissions

Species	NT		YK		NU		BC		AB		SK		MB		ON		QC		NB		NS		PE		NL		Total	
	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P	S	P
Bovine	0	0	0	0	0	0	2	0	16	0	45	3	76	12	110	11	18	0	1	0	1	0	1	0	0	0	270	26
Equine	0	0	0	0	0	0	3	0	7	0	7	3	13	4	40	0	3	0	5	0	1	0	1	0	0	0	80	7
Ovine	0	0	0	0	0	0	0	0	1	0	0	0	3	0	13	1	2	0	0	0	0	0	0	0	0	0	19	1
Cat	0	0	1	0	1	0	33	0	62	1	71	1	141	2	686	2	514	0	14	0	7	0	2	0	1	0	1533	6
Dog	5	2	1	0	20	4	19	0	76	0	76	1	139	4	403	0	641	2	24	0	2	0	1	0	2	0	1409	13
O. Dom.	0	0	0	0	0	0	1	0	1	0	2	0	7	0	26	0	14	0	5	0	0	0	0	0	0	0	56	0
Human	0	0	0	0	0	0	2	0	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	5	0
Bat	0	0	0	0	0	0	181	11	26	4	26	4	4	3	1329	42	519	8	26	0	25	0	13	0	0	0	2150	72
Raccoon	0	0	0	0	0	0	3	0	1	0	2	0	18	0	401	1	219	2 ^a	97	0	12	0	0	0	0	0	755	3 ^a
Red fox	7	3	0	0	3	1	0	0	2	0	2	0	3	0	117	2	26	0	2	0	0	0	0	0	5	0	167	6
Arctic fox	4	3	0	0	6	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	8
Skunk	0	0	0	0	0	0	6	0	107	0	50	21	83	39	145	23	37	1	5	0	0	0	0	0	0	0	433	84
O. WI.	1	0	1	0	1	0	7	0	25	0	18	0	25	1	177	0	56	0	5	0	0	0	0	0	1	0	315	1

NT — Northwest Territories; YK — Yukon; NU — Nunavut; BC — British Columbia; AB — Alberta; SK — Saskatchewan; MB — Manitoba; ON — Ontario; QC — Quebec; NB — New Brunswick; NS — Nova Scotia; PE — Prince Edward Island; NL — Newfoundland and Labrador; S — submitted; P — positive; O. Dom — Other domestic animal (including: alpaca, bison, domestic rabbit, domestic rat, donkey, ferret, gerbil, goat, guinea pig, hamster, llama, mule, pig, white mouse); O. WI — Other wildlife (including: beaver, black bear, chipmunk, coyote, deer, deer mouse, elk, ermine, grizzly bear, groundhog, fisher, mole, hoary marmot, lynx, weasel, marten, muskrat, mountain goat, opossum, otter, polar bear, porcupine, rabbit, shrew, squirrel, vole, wild rat, wolf)

^a There were 2 additional positive raccoons from the Quebec survey

and Alberta were in bats, with the exception of 1 rabid cat (*Felis domesticus*) found in Alberta. Saskatchewan, Manitoba, Ontario, and Quebec all had cases in wildlife other than bats, as well as in domestic animals, including cats, dogs, cattle, horses (*Equus caballus*), and 1 sheep (*Ovis aries*). In addition to the animal submissions, 5 suspect human rabies cases were tested by FAT, reverse transcriptase polymerase chain reaction, or both; all tests were negative for rabies.

Submissions that tested positive for rabies were identified by antigenic typing using panels of monoclonal antibodies that distinguish between the common variants known to circulate in Canada (5,6). In general, bats that tested positive for rabies carried the variants commonly associated with the given bat species. Two variants continue to circulate in skunks found in Canada. In Saskatchewan and Manitoba this is the Western skunk virus variant and in Ontario this is the Arctic variant normally associated with arctic and red foxes. While the Arctic variant has been controlled in red foxes in Ontario by using the ERA oral vaccine (7), the striped skunk, which remains refractory to immunization with ERA, has become a reservoir of this variant in the south-western area of the province, centered in Wellington and Grey counties (8). The impact of the epizootic of rabies in skunks in Ontario is clear: In 2006 all of the cases of rabies in domestic animals in this province ($n = 14$), as well as the cases in red fox and raccoon (*Procyon lotor*) ($n = 3$), were from this region, and were all due to the Arctic variant. Likewise, in Manitoba and Saskatchewan, the spillover of rabies into domestic animals was due to infection caused by the Western skunk variant. Two cases of spillover of rabies from bats were found in 2006; the first was a cat in Alberta that was infected with a variant associated with little brown bats, the second was a skunk from Quebec infected with a variant associated with big brown bats. Not surprisingly, the dogs and foxes that tested positive from the Northwest Territories and Nunavut and 2 dogs from northern Quebec had the Arctic variant.

In May 2006, a raccoon, found in southern Quebec near the Vermont border, tested positive for rabies virus that was

Table 3. Summary of Canadian rabies diagnostic data with respect to human exposure

	Human contact ^a		No human contact	
	Submitted	Positive (%)	Submitted	Positive (%)
Bats	1567	45 (2.9)	440	27 (6.1)
Other wildlife	675	24 (3.6)	928	80 (8.6)
Domestic animals	3120	42 (1.3)	150	11 (7.3)
Total	5362	111 (2.1)	1518	118 (7.8)

^a Includes bites, scratches, and mucous membrane contamination

typed as the mid-Atlantic raccoon variant. This represented a new incursion of this variant into Canada since the last reported case of raccoon-variant rabies was in eastern Ontario in September 2005. A subsequent surveillance program initiated by the Quebec government identified an additional 2 raccoons harbouring the mid-Atlantic raccoon variant in June. Another raccoon that tested positive for rabies (also mid-Atlantic raccoon variant) was reported in November. This epizootic has grown to more than 60 cases identified in 2007, including raccoons, skunks, and 1 red fox, infected with the raccoon-variant rabies virus.

The rate of positive submissions was consistently higher for cases involving no human contact versus those involving human contact as reported by the veterinary investigator (Table 3). This was true for all the species categories (bats, other wildlife, domestic animals). Of the 229 positive submissions in 2006, more than half ($n = 118$) originated from animals where there was no known human contact, despite the fact that 76% of the diagnostic submissions were animals reported to have had human contact. Thirty-eight percent of the positive results with no human contact (45/118) also did not have any reported domestic animal contact. In addition, the positive specimens with no human contact originated from 96 counties in Canada, while those with a history of human exposure represented only 70 counties. With respect to understanding rabies epidemiology in Canada, there is substantial benefit to be gained from testing animals that are exhibiting clinical symptoms consistent with

rabies, regardless of whether they pose a direct health risk to humans or domestic animals. A true picture of the rabies burden, obtained by comprehensive testing, is necessary for efficacious and cost-effective control measures to be implemented.

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Christine Fehlner-Gardiner, Frances Muldoon, Susan Nadin-Davis, Alexander Wandeler, Canadian Food Inspection Agency, Ottawa Laboratory Fallowfield, 3851 Fallowfield Road, P.O. Box 11300, Station "H", Ottawa, Ontario K2H 8P9; Josephine Kush, Lorne T. Jordan, Lethbridge Laboratory, Township Rd. 9-1, P.O. Box 640, Lethbridge, Alberta T1J 3Z4.

Address all correspondence to Dr. Christine Fehlner-Gardiner; e-mail: fehlnergardiner@inspection.gc.ca

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