

An Outbreak of Rabbit Hemorrhagic Disease in British Columbia, Canada

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ABSTRACT: From 2018 to 2019, an outbreak of rabbit hemorrhagic disease virus 2 occurred in British Columbia, Canada, in feral and domestic European rabbits (*Oryctolagus cuniculus*). Anthropogenic translocation of infected animals is suspected to have played a role in the introduction and spread of the virus.

Rabbit hemorrhagic disease (RHD) is a viral disease that can affect a variety of wild and domestic lagomorph species, particularly European rabbits (*Oryctolagus cuniculus*) (Mutze et al. 1988; McIntosh et al. 2007). It is caused by rabbit hemorrhagic disease virus (RHDV), family *Caliciviridae*, species *Lagovirus europaeus* (Abrantes et al. 2012; Dalton et al. 2012; Le Pendu et al. 2017). There are two main pathogenic RHDV genotypes: GI.1/RHDV and GI.2/RHDV (RHDV2; Le Pendu et al. 2017). The latter emerged in 2010 and has become the dominant genotype circulating globally (Le Gall-Recule et al. 2013; OIE 2019; Rouco et al. 2019). Compared to GI.1/RHDV, RHDV2 has an increased host range, increased pathogenicity for younger leporids, and a more variable mortality rate (OIE 2019).

Clinical signs of RHD follow an incubation period of 1–5 d and can include sudden death, depression, neurologic abnormalities (e.g., ataxia, convulsions), respiratory distress, and bloody nasal or oral discharge (OIE 2019). The virus is highly contagious and pathogenic, often leading to high mortality in affected populations (Capucci et al. 2017). It is

transmitted through contact with infected animals, mechanical vectors (e.g., insects), and fomites (Abrantes et al. 2012). Long-distance transport of RHDV is thought to be due to anthropogenic translocation of infected rabbits (Rouco et al. 2019).

In February 2018, a mortality event occurred in a feral European rabbit colony on Vancouver Island, British Columbia, Canada. Rabbits were submitted to the Animal Health Centre, British Columbia Ministry of Agriculture, Food, and Fisheries, for postmortem examination. Gross and microscopic lesions were consistent with RHD, and PCR for RHDV (Bascañana et al. 1997) was positive (Ambagala et al. 2021). Whole genome sequencing (WGS) performed at the National Centre for Foreign Animal Disease, Winnipeg, Manitoba, Canada, identified an RHDV2 strain (GenBank accession no. MT900570) novel to North America (Ambagala et al. 2021). Rabbit hemorrhagic disease had not previously been identified in British Columbia. This strain showed only 92.7% identity with the first reported case of RHDV2 in North America, which occurred on a hobby farm in Quebec, Canada, in 2016 (Ambagala et al. 2021). However, it was closely related to subsequent outbreaks in European rabbits in the US (USDA 2020b). An enhanced passive surveillance program was immediately initiated through which any lagomorph from British Columbia suffering from morbidity or mortality of unknown cause could be submitted to

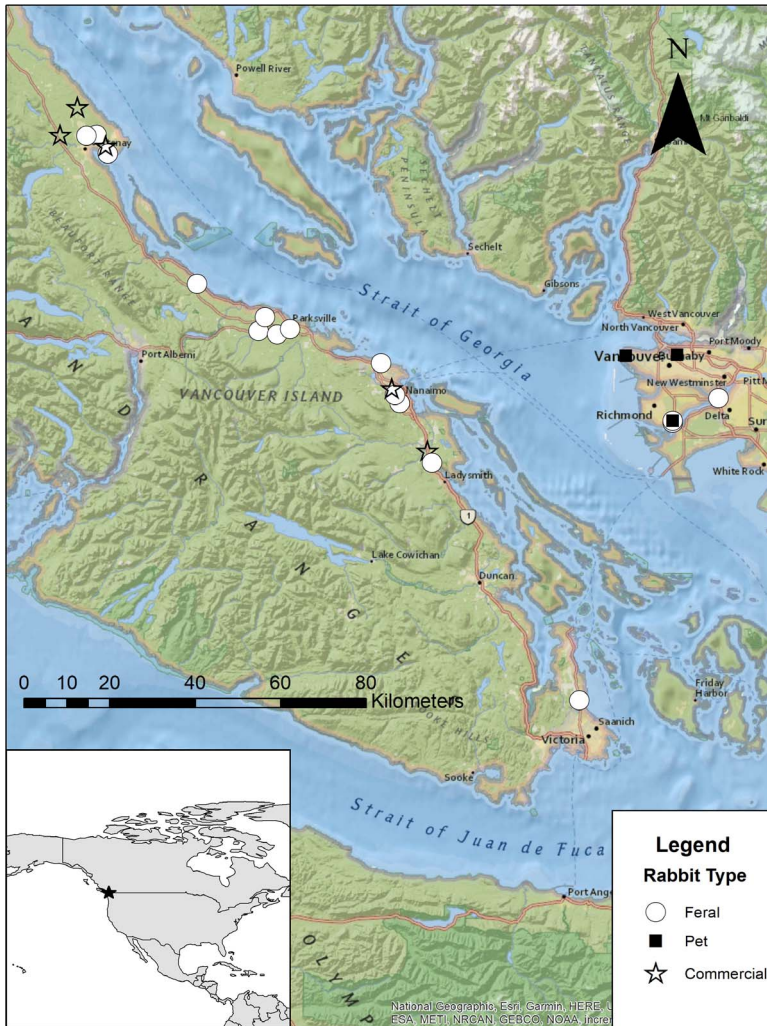


FIGURE 1. Distribution of rabbit hemorrhagic disease (RHD) cases in feral and domestic European rabbits (*Oryctolagus cuniculus*) during a RHD outbreak in British Columbia, Canada, 2018–19. The location of the outbreak area is shown (geographic area within North America is shown on the inset map). White circles represent cases in feral rabbits, black squares represent cases in pet rabbits, and hollow stars represent cases in commercial rabbits.

the Animal Health Centre for RHDV PCR testing free of charge. Once the disease was confirmed at a particular location, no further animals from the affected group were tested.

In total, 94 European rabbits were tested from February 2018 to February 2021, which detected 24 cases of RHD (a case was defined as one or more RHDV PCR-positive rabbit[s] from one location). Among the 24 cases, 17 (70.8%) occurred from February to May 2018, and seven (29.2%) occurred from April to September 2019. All affected animals were

European rabbits, with 16 cases involving feral rabbits, five cases in commercial rabbitries, and three cases in pet rabbits (one of these involved pet rabbits in a rescue shelter). Cases were clustered along the southeast coast of Vancouver Island and the adjacent southwest coast of the British Columbia mainland (Fig. 1). A case of particular note was a case involving pet rabbits residing in an apartment building in downtown Vancouver, which had no clear epidemiologic connection to the main outbreak. This case was suffi-

ciently unusual to warrant WGS by the National Centre for Foreign Animal Disease (GenBank no. MT900574), which found only 97.4% identity to the index case at the nucleotide level (Ambagala et al. 2021), possibly indicating an independent incursion (note 98.8% identity with a 2019 German strain, GenBank no. LR899144).

The origin of the outbreak and the mechanisms for local transmission remain unclear. However, as previously suggested (Rouco et al. 2019), it is likely that anthropogenic translocation of infected animals played a significant role in the introduction and spread of RHDV2 in British Columbia. Release of infected domestic rabbits was probably the source of the virus for feral populations. Subsequently, infected feral rabbits may have served as a reservoir for the virus and a source of infection for captive and free-ranging populations. As has been observed in past RHD outbreaks, seasonal peaks in cases in March and April coincided with the known period of increased activity and breeding in feral rabbits (Abrantes et al. 2012).

There have been no RHD cases since September 2019. For feral rabbits, the end of the outbreak may have resulted from mass mortality or acquired immunity (Abrantes et al. 2012). The provincial wildlife veterinarian noted that feral rabbit populations in affected areas had declined dramatically. For domestic rabbits, cessation of cases may have been due to loss of the wildlife reservoir or to vaccination. Since 2018, the British Columbia Chief Veterinary Officer has imported RHD vaccines (Filavac VHD K C+V, Filavie, Sèvremoine, France) and made those vaccines available to veterinarians for use in domestic rabbits. From 2018 to 2020, a total of 16,860 RHD vaccine doses were distributed to 73 veterinary practices in the southern half of British Columbia.

There were no cases in eastern cottontails (*Sylvilagus floridanus*), the only wild lagomorph species in the outbreak area (Klinkenberg 2020). A 2020 RHD outbreak in the southwest US affected cottontails (*Sylvilagus* spp.) but was caused by an RHDV2 thought to be distinct from that in British Columbia

(USDA 2020a, 2020b). It is unknown whether the British Columbia strain is pathogenic for eastern cottontails or other native leporids in British Columbia such as the snowshoe hare (*Lepus americanus*), white-tailed jackrabbit (*Lepus townsendii*), and Nuttall's cottontail (*Sylvilagus nuttallii*).

Although the British Columbia RHD surveillance system probably provided an accurate approximation of the general location and timing of cases, it almost certainly underestimated the true incidence of RHD, particularly for feral rabbits. In the future, a wider public awareness campaign, including support for transporting animals to the laboratory, and additional WGS, may help to better capture the epidemiology of RHD outbreaks.

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