



The Canadian Wildlife Health Cooperative Annual National Bat Health Report – 2023

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Abstract

Eight Canadian bat species are federally listed as endangered, threatened, are of special concern, or are proposed to be listed under these categories, stressing the importance of understanding and mitigating threats to these animals. This report summarizes bat health information collected through postmortem examination of samples collected and provided by provincial, territorial, federal, and other partners that were submitted to Regional Centres of the Canadian Wildlife Health Cooperative across Canada from April 2022 to March 2023. Trauma was the most diagnosed cause of death, primarily due to cat predation when the specific cause could be identified. Other commonly diagnosed causes of death were those of infectious or inflammatory nature, primarily bat rabies. While rabies is rare in healthy bats, rabies surveillance is important to protect the health of humans and domestic animals. White-nose syndrome was diagnosed in 4 specimens and remains a very important threat to monitor and mitigate as it spreads further west and north in Canada, due to its potential to cause dramatic population declines. These data illustrate the importance of our continued efforts to coordinate Canada's national bat health and white-nose syndrome program for wildlife management agencies with a responsibility for bat conservation and recovery so they can have an evidence-based approach to address threats and mitigate impacts to bat populations.

Introduction

Approximately 17 bat species have been identified in Canada (Adams 2003; Lausen et al. 2019; Naughton 2012). Three of these species, little brown myotis (*Myotis lucifugus*), northern myotis (*M. septentrionalis*), and tri-colored bat (*Perimyotis subflavus*), are federally listed as endangered under the [Species At Risk Act](#) (SARA) due to impact of the disease white-nose syndrome (WNS) caused by the fungus *Pseudogymnoascus destructans* (*Pd*) (Environment and Climate Change Canada 2018). Pallid bat (*Antrozous pallidus*) and spotted bat (*Euderma maculatum*) are federally listed as threatened and of special concern, respectively (Environment and Climate Change Canada 2017). The three migratory species, hoary bat (*Lasiurus cinereus*), eastern red bat (*L. borealis*), and silver-haired bat (*Lasionycteris noctivagans*) have been assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2023) as endangered. Additional species are [listed under various provincial and territorial](#) endangered species acts.



The objectives of this annual report are to summarize bat health data as collected by the Canadian Wildlife Health Cooperative (CWHC) across Canada, highlight notable bat health concerns, and report these findings to wildlife management agencies with a responsibility for bat conservation.

Methods

Targeted surveillance for WNS was conducted in a harmonized manner at all CWHC centres following a standardized [Canadian bat WNS necropsy protocol \(Canadian Wildlife Health Cooperative 2014\)](#), including internationally agreed upon diagnostic criteria for reporting cases of WNS at the individual specimen level. The Wildlife Health Intelligence Platform (WHIP), CWHC's national wildlife health database, was searched for any member of the Order Chiroptera (the taxonomical order of the bats) with earliest date (*i.e.*, date found, date received, date of death, or necropsy date) from April 1 2022 to March 31 2023. British Columbia data were provided by BC CWHC and include data from the 2022 calendar year. Yukon data were provided by the Yukon Fish and Wildlife Branch.

Necropsy reports were reviewed and the results were categorized by cause of death. Fields reviewed included: etiology, history, interpretation, category of diagnosis, rabies test status, and WNS test status. No specimens were submitted from Northwest Territories, Nunavut, and Newfoundland and Labrador (figure 1 and table 1). Regardless of etiology recorded in the database, all specimens that tested positive for rabies or WNS were designated as such for the cause of death (for example: a bat killed by a cat or human, testing positive for rabies, was classified with a final diagnosis of rabies as the cause of death even if the specimen initially had trauma as the cause of death).

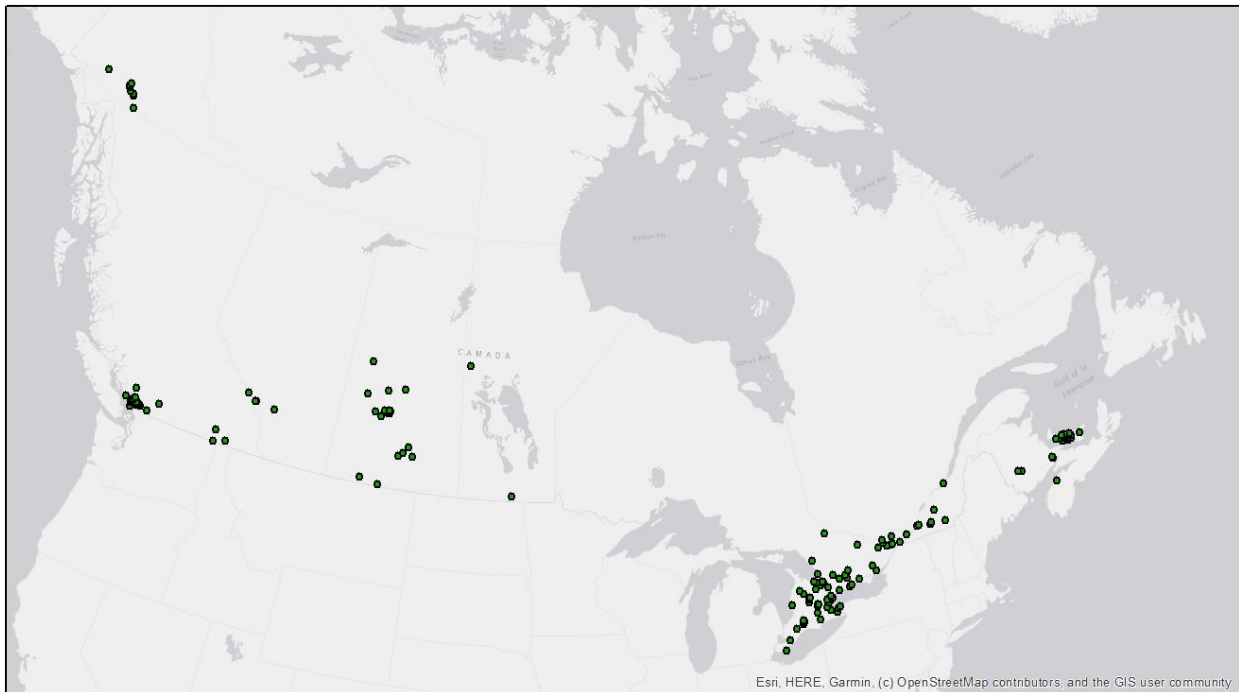


Figure 1: Map of Canada illustrating known locations of bat mortality events with specimens submitted to CWHC centres



Table 1: Number of specimens across Canada

| Province or Territory | Number of specimens |
|---------------------------|---------------------|
| Alberta | 5 |
| British Columbia | 57 |
| Manitoba | 4 |
| New Brunswick | 6 |
| Newfoundland and Labrador | 0 |
| Northwest Territories | 0 |
| Nova Scotia | 1 |
| Nunavut | 0 |
| Ontario | 76 |
| Prince Edward Island | 16 |
| Québec | 10 |
| Saskatchewan | 100 |
| Yukon | 12 |
| Total | 287 |

Results and Discussion

Necropsy reports were available for 287 bats (*i.e.*, members of the order Chiroptera), of which 150 had a final diagnosis. A diagnostic category of “undetermined” was also included for those cases where the cause of death was not determined. The 137 remaining cases were pending a final diagnosis at the time this report was completed.

Bat species were grouped as presented in Table 2. Sixteen (16) specimens were only identified in the necropsy reports as “bat” and are listed as “Chiroptera”. Similarly, 8 specimens were only identified to the genus level, “*Myotis*”. These categories might have been used for specimens with significant postmortem decomposition that precluded accurate species identification.

Table 2: Number of bats submitted per species

| Common name | Scientific name | Number of specimens |
|--------------------------|-----------------------------------|---------------------|
| Big brown bat | <i>Eptesicus fuscus</i> | 170 |
| Little brown myotis | <i>Myotis lucifugus</i> | 57 |
| California myotis | <i>Myotis californicus</i> | 1 |
| Yuma myotis | <i>Myotis yumanensis</i> | 6 |
| Unidentified myotis | <i>Myotis</i> sp. | 8 |
| Townsend’s big-eared bat | <i>Corynorhinus townsendii</i> | 2 |
| Eastern red bat | <i>Lasiurus borealis</i> | 1 |
| Hoary bat | <i>Lasiurus cinereus</i> | 4 |
| Silver-haired bat | <i>Lasionycteris novctivagans</i> | 22 |
| Unidentified bats | Chiroptera | 16 |
| Total | | 287 |



Big brown bat (*Eptesicus fuscus*) was the most commonly submitted species (n = 170), followed by little brown myotis (n = 57), the latter being listed as “Endangered” under Canada’s Species at Risk Act (Environment and Climate Change Canada 2018). Predominance of these species was expected as both species roost in anthropogenic structures increasing their detectability when sick, injured, or dead. There were no submissions of northern myotis or tri-colored bats; both species being listed as “Endangered” under Canada’s Species at Risk Act (Environment and Climate Change Canada 2018). Balzer et al. (2021) reported that, based on capture records, northern myotis populations in the Maritime provinces of Canada have experienced a serious decline, and this trend may be true for northern myotis populations in other regions of Canada. Tri-colored bat has a very restricted range in Canada (Naughton 2012) and combined with the impacts of WNS (Cheng et al. 2021) may explain why no cases were submitted to the CWHC.

Causes of death per species or group are presented in Table 3. Further data summaries regarding causes of death consider only the 150 specimens with a final diagnosis unless otherwise indicated.

Trauma was the most commonly diagnosed cause of death, with all trauma categories combined representing 35.3% of all incidents of mortality (53/150) (Table 3). A frequent cause of traumatic mortality, when the specific cause could be identified, was predation by cats (18/53, Table 4).

Infectious disease / inflammation was identified as the cause of death in 33/150 specimens (Table 5). Significant infectious diseases of bats are bat rabies and white-nose syndrome. Rabies was diagnosed in 18/150 bats (12.0%), comparable to previous years’ results in CWHC reports, including 10.9% and 5.5% as reported in Segers et al. 2021 and Segers et al. 2022 respectively, and those reported in other studies (Beattie et al. 2022; Davis et al. 2012).

It is important to note that rabies is relatively uncommon in healthy populations of bats, often reported in <1% of the population (Davis et al. 2012; Klug et al. 2011; Trimarchi and Debbie 1977). A higher proportion of rabies-positive individuals reported here reflects that bats submitted for health surveillance reasons are sick, injured, or dead and thus are more likely to have rabies than healthy individuals in the population. While our data are not representative of healthy populations, they do provide essential diagnostic information to inform decision making on best practices after contact between a sick bat and a human or domestic animal, illustrating the importance of rabies surveillance in bats for medical and veterinary health professionals. For example, there were three cases of likely contact between a rabid bat and a domestic animal between April 1 2022 and March 31 2023. The rapid response and sharing of these rabies diagnoses in bats with the appropriate health authorities facilitates medical treatment and highlights how bat health surveillance can contribute in a meaningful manner to the One Health approach of federal, provincial, and territorial governments in Canada.

White-nose syndrome was diagnosed in 4/150 bats (2.7%), all of which were little brown myotis in Manitoba and Saskatchewan, the latter being situated outside the previously known range of WNS.



White-nose syndrome and *Pd*, continue to spread across Canada, but the ability to detect this disease has decreased drastically when compared to when it first emerged in Canada. Prior to the emergence of WNS in Canada, many bat hibernacula were already known in eastern and central Canada, allowing for targeted surveillance in these locations and relatively quick detection of WNS. However, few bat hibernacula are known in western and northern Canada, making rapid detection of *Pd* and diagnosis of WNS particularly challenging in these geographical regions which limits our ability to document the spread and severity of disease in western and northern bat populations. Therefore, the public reporting of bats during the WNS surveillance season of November 1 of a given year until May 31 of the following year should be strongly encouraged through media outreach as a strategy to increase surveillance efforts for WNS in western and northern Canada.

Various other causes of death were reported. Nine (9) big brown bats, 1 little brown myotis, and 1 silver-haired bat had various infections and inflammatory lesions other than WNS and rabies that caused their death, including fungal dermatitis, pneumonia, and other systemic bacterial infections. A consistent etiology was not identified linking these particular cases suggesting they simply represent background individual mortality and are not a significant threat to bat health at the population level. Further, the cause of death was undetermined in 58/150 (38.7%) of specimens; this often occurs when marked postmortem decomposition precludes a complete and accurate necropsy. Two big brown bats were diagnosed to have died from bycatch in glue traps, but it is likely that the true mortality due to glue traps is a much more common and persistent problem to bat health than could be identified in WHIP because most bats killed under such circumstances would simply be discarded and not submitted for postmortem examination. Glue traps are nonspecific and known to be prone for entrapment of non-target species, are considered inhumane as the trapped individuals die of starvation or dehydration (Branco et al. 2017) and should be considered a last line of defence for dealing with pest species such as rodents (Burnham 2015).



Table 3: Identified causes of death by bat species or grouping

| Cause of death | Unidentified <i>Myotis</i> species | Big Brown Bat | Hoary Bat | Little Brown Bat | Silver-Haired Bat | Yuma Bat | Total |
|-------------------------------------|---------------------------------------|------------------|--------------|---------------------|----------------------|-------------|-------|
| Trauma* | 0 | 37 | 0 | 11 | 4 | 1 | 53 |
| Infectious disease / Inflammation** | 0 | 26 | 1 | 5 | 1 | 0 | 33 |
| Emaciation | 0 | 4 | 0 | 1 | 0 | 0 | 5 |
| No diagnosis | 2 | 50 | 0 | 5 | 1 | 0 | 58 |
| Other | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| Total | 2 | 117 | 1 | 23 | 6 | 1 | 150 |

*See breakdown of Trauma types in table 4

** See breakdown of Infectious disease / Inflammation types in table 5

Table 4: Identified causes of trauma by bat species

| Trauma type | Big Brown Bat | Little Brown Bat | Silver-Haired Bat | Yuma myotis | Total |
|-----------------------|------------------|---------------------|----------------------|----------------|-------|
| Cat predation | 12 | 5 | 1 | 0 | 18 |
| Predation* | 4 | 1 | 1 | 1 | 7 |
| Collision | 2 | 0 | 0 | 0 | 2 |
| Electrocution | 1 | 0 | 0 | 0 | 1 |
| Glue trap | 2 | 0 | 0 | 0 | 2 |
| Trauma (undetermined) | 15 | 5 | 2 | 0 | 22 |
| Other trapping | 1 | 0 | 0 | 0 | 1 |
| Total | 37 | 11 | 4 | 1 | 53 |

*Species of animal that predated the bat was not identified



Table 5: Identified infectious disease and inflammatory causes of death by bat species

| Infectious disease / inflammatory category | Big Brown Bat | Hoary Bat | Little Brown Bat | Silver-Haired Bat | Total |
|--|---------------|-----------|------------------|-------------------|-------|
| Rabies | 17 | 1 | 0 | 0 | 18 |
| White-nose syndrome | 0 | 0 | 4 | 0 | 4 |
| Other or undetermined | 9 | 0 | 1 | 1 | 11 |
| Total | 26 | 1 | 5 | 1 | 33 |



Conclusion

Only a few cases of WNS were confirmed in the last surveillance season, however, it remains important to be vigilant for WNS, especially as the disease was recently diagnosed in Saskatchewan and the etiological agent, *Pd*, has now been detected throughout southern Alberta and in a single location in British Columbia (Canadian Wildlife Health Cooperative 2023). The continuation of the CWHC's targeted WNS surveillance program is important as this disease continues to move west and north in Canada, threatening additional species of bats that have not yet been exposed to the disease in our country.

The most frequent cause of death categories reported in the report period of April 2022 to March 2023 were trauma and infectious disease / inflammation, the latter being primarily rabies. Opportunistic and targeted surveillance for rabies in bats remains important to protect the health of humans and domestic animals as well as to better understand the epidemiology of this disease as it relates to the health of Canadian bat populations.

Additionally, the CWHC is concerned about the impact of two threats on endangered bats we believe are most certainly underreported and underrepresented in our own data: cat predation and glue traps. Cat predation was frequently identified as a cause of trauma. Bat species that dwell in human structures or near human populations, especially reproductive females, are most at risk (Ancillotto et al. 2013). This includes the federally endangered little brown myotis. Domestic cats are reported in the literature as an under-appreciated threat to bats (Oedin et al. 2021). Public outreach to mitigate this impact is important and can be accomplished by: 1) encouraging cat owners to keep cats indoor or bring them indoors around dusk and dawn when bats emerge from and return to anthropogenic roosts, and 2) ensuring they are employing strategies to prevent bats from entering living spaces in human occupied buildings reducing the possibility for cats in indoor environments to predate on them (McBurney 2020). The non-target by-catch of bats by glue traps is not well reported in the scientific literature, but these inhumane and indiscriminate traps have been banned in certain countries (e.g., United Kingdom, following the recommendations of the Humane Society International 2022), and a report for the Canadian Association of Humane Trapping concluded that *"the available evidence overwhelmingly demonstrates that the use of glue traps for rodent pest control does not meet established standards for either humane restraint or humane killing"* (Fenwick 2013). The CWHC has identified this as an issue for bats (McBurney 2020) and this is supported by the diagnosis of entrapment by glue trap as the cause of death in two big brown bats during the survey period covered in this report as well as for other bat species, including the endangered little brown myotis, in our bat health data from previous years (Segers et al. 2021, Segers et al. 2022). Therefore, we are very concerned that the impact of this threat on endangered bat species is poorly understood. Furthermore, the CWHC believes the use of glue traps for pest control management is inappropriate in the majority of situations, and similar to other countries, Canada should consider banning the use of glue traps for nuisance wildlife control. In the meantime, glue traps should only be used as a method of last resort and only with best practice guides for their use emphasizing the need for trained users, frequent checking on deployed traps, and humane procedures for euthanizing trapped animals (Fay 2022).



The CWHC has coordinated Canada's national WNS response program since 2012 and will continue to monitor this disease's progression as it continues to spread in the remainder of the country. While regions where WNS is endemic concentrate on response efforts and recovery of affected bat species, monitoring for the emergence of *Pd* and WNS and assessing bat populations pre-emergence of WNS remains important at the leading edge of WNS emergence in Canada. The CWHC targeted WNS surveillance program prioritizes incidents in new geographic regions and in new species. Although the impact of WNS can be mitigated to a certain extent, once it emerges, its negative impact on bat health through markedly increased individual mortality and significant population declines cannot currently be avoided. Therefore, understanding other health issues affecting bat populations is critical so these threats do not compound the effects of WNS and so appropriate strategies can be developed to mitigate and prevent them for the overall protection of bat health in Canada. Recently, COSEWIC (2023) assessed hoary bat, eastern red bat, and silver-haired bat as endangered with a recommendation for federal listing under the Species at Risk Act. Both the COSEWIC assessment and the CWHC annual bat health reports illustrate the importance of the CWHC's Bat Health Program to migratory bats as well as hibernating bats. The CWHC will continue to work with our federal, provincial, and territorial partners to achieve their goals for mitigation, recovery, and protection and ensure our bat health program provides evidence-based knowledge on which to base timely response and management initiatives for the protection and recovery of bat populations across our country.

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