CANADIAN WILDLIFE HEALTH COOPERATIVE

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The Canadian Wildlife Health Cooperative Annual National Bat Health Report – 2024

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Abstract

Eight Canadian bat species are federally listed as endangered, threatened, 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 post mortem examination of specimens 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 2023 to March 2024. Trauma was the most common cause of death diagnosed, primarily due to cat predation when the specific etiology of the trauma could be identified, but we also acknowledge how other traumatic causes of mortality, such as those caused by glue traps, are likely vastly under reported. 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 one specimen but 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. We report on two incidents of bats discovered outside of their native range, highlighting the risks that come with accidental species translocation, emphasizing the importance of minimizing the chance of occurrence of such events. These findings illustrate the importance of our continued efforts to coordinate Canada's national bat health program on behalf of Canadian wildlife management agencies with the 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

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(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 the responsibility for bat conservation and recovery.

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 2023 to March 31 2024. Yukon data were provided by the Yukon Fish and Wildlife Branch and Northwest Territories data were provided by Northwest Territories Wildlife Management Division.

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 Manitoba, 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 assigned those diagnoses as 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).

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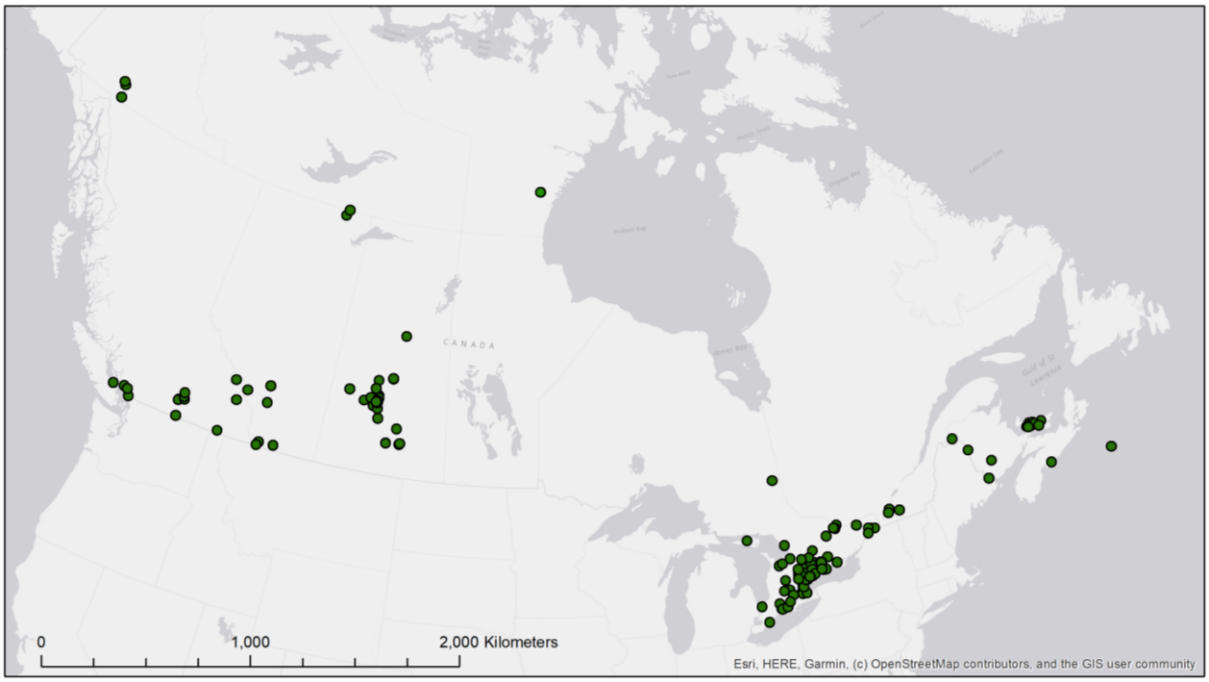

Figure 1: Map of Canada illustrating known locations of bat mortality events with specimens submitted to CWHC centres or data provided by regional jurisdictions

Table 1: Number of specimens across Canada

Province or Territory	Number of specimens
Alberta	17
British Columbia	46
Manitoba	0
New Brunswick	4
Newfoundland and Labrador	0
Northwest Territories	2
Nova Scotia	2
Nunavut	0
Ontario	81
Prince Edward Island	9
Québec	4
Saskatchewan	87
Yukon	4
Total	256

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Results and Discussion

Necropsy reports were available for 256 bats, of which 233 had a final diagnosis. A diagnostic category of "undetermined" was also included for those cases where the cause of death was not determined. The 23 remaining cases were pending a final diagnosis at the time this report was completed.

Bat species were grouped as presented in Table 2. Eleven (11) specimens were only identified in the necropsy reports as "bat" and are listed as "Chiroptera". Similarly, 4 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	Species code	Number of specimens
Big brown bat	*Eptesicus fuscus*	EPFU	153
Little brown myotis	*Myotis lucifugus*	MYLU	58
Northern myotis	*Myotis septentrionalis*	MYSE	4
Long-eared myotis	*Myotis evotis*	MYEV	2
California myotis	*Myotis californicus*	MYCA	1
Yuma myotis	*Myotis yumanensis*	MYYU	5
Long-legged myotis	*Myotis volans*	MYVO	2
Unidentified myotis	*Myotis* sp.	UNMY	4
Townsend's big-eared bat	*Corynorhinus townsendii*	COTO	1
Tri-colored bat	*Perimyotis subflavus*	PESU	2
Eastern red bat	*Lasiurus borealis*	LABO	1
Hoary bat	*Lasiurus cinereus*	LACI	5
Silver-haired bat	*Lasionycteris novctivagans*	LANO	6
Nathusius' pipistrelle	*Pipistrellus nathusii*	PINA	1
Unidentified bats	Chiroptera	CHIR	11
Total			256

Big brown bat (*Eptesicus fuscus)* was the most commonly submitted species (n = 153), followed by little brown myotis (n = 58), the latter being listed as "Endangered" under Canada's Species at Risk Act (SARA) (Environment and Climate Change Canada 2018). The predominance of these species was expected as both species roost in anthropogenic structures increasing their detectability when sick, injured, or dead. Northern myotis and tri-colored bat, both listed as "Endangered" under SARA (Environment and Climate Change Canada 2018), represented 4 cases and 2 cases respectively, and these species were absent from the data set in last year's report (CWHC Annual National Bat Health Report 2023). 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 few cases were submitted to the CWHC.

Two notable submissions involved species non-native to Canada and included a Nathusius' pipistrelle (*Pipistrellus nathusii*) and one currently unidentified bat that is likely not a species native to Canada. The Nathusius' pipistrelle was found on board a cargo ship during unloading, likely hitching a ride from its origin port in Germany or the United Kingdom. The bat yet to have its identity confirmed was found dead in a building in Sable Island National Park Reserve, 290 km southeast of Halifax, Nova Scotia. Tentatively it has been identified as a species not known to occur in Canada, but it may be a species common in the eastern United States which will require further genetic testing to confirm. Published records exist of wildlife, including bats, being accidentally translocated as stowaways by aircrafts and ships (Constantine 2003, but also see various referenced material in Constantine 2003). Additionally, due to climate change, ranges for various southern species are shifting northward and high wind events are documented to have carried flying animals, including bats, a long way from their typical habitats to new locations (Martay et al. 2023). However, even when a translocation event is detected, it is likely that many such incidents remain unreported in published literature, and it is quite possible that many such incidents go unnoticed altogether, allowing exotic species to be introduced into new ranges without any immediate human knowledge. Although the chance of survival or establishment of a new bat species outside its natural range is unlikely, there remains the risk of such a translocated animal introducing foreign pathogens into the new ecosystem in which they reside, with unforeseen consequences to native life (Constantine 2003). Therefore, we need to limit the anthropogenic translocation of wildlife in situations when we have the ability to do so. This is best accomplished with increased and continued vigilance for stowaway wildlife, especially bats as their size and agility let them easily hide on board long-distance transportation vehicles (e.g., trucks, trains, ships, airplanes, recreational vehicles), and standard operating protocols to report such events and best management practices to prevent their occurrence should be promoted among industry and the public. The CWHC, in collaboration with many partners, developed educational material with instructions on how to minimize the risk of translocating bats over large distances, primarily in the context of limiting the spread of *Pd*, and subsequently WNS, across North America (see "Translocating bats brochure").

Causes of death per species or group are presented in Table 3. Further data summaries regarding causes of death consider only the 233 specimens with a final diagnosis unless otherwise indicated.

Trauma was the most commonly diagnosed cause of death, with all trauma categories combined representing 37.3% of all incidents of mortality (87/233) (Table 3). A frequent cause of traumatic mortality, when the specific cause could be identified, was predation by cats (31/87, Table 4).

Infectious disease / inflammation was identified as the cause of death in 51/233 specimens (Table 5). Significant infectious diseases of bats are bat rabies and white-nose syndrome. Rabies was diagnosed in 35/233 bats (15.0%), comparable to previous years' results in CWHC reports, including 10.9%, 5.5%, and

12.0% as reported in Segers et al. 2021, Segers et al. 2022, and Segers et al. 2023 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). The higher prevalence of rabies-positive individuals reported here reflects that bats submitted for health surveillance reasons are a biased subsample within their population in that they are often sick, injured, or dead and thus are more likely to have rabies than healthy individuals in that same population. While our data are not representative of healthy populations, they do provide essential diagnostic information to guide 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, in this dataset there were six cases of possible or likely contact between a rabid bat and a human and/or domestic animal, and an additional nine cases of bats handled in wildlife rehabilitation facilities that later tested positive for rabies. This critical diagnostic information would have been used to inform public health agencies to plan appropriate post exposure prophylaxis for any potentially exposed individuals or animals. There were two cases of rabid bats where it was reported that there was no contact with humans or domestic animals. Additionally, 18 incidents of rabies in a bat had no history provided on whether or not possible contact with humans or domestic animals occurred, highlighting the importance of collecting such information when possible. 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 1/233 (0.4%) bats, in a little brown myotis in Ontario within the known range of the disease. White-nose syndrome and *Pd*, continue to spread across Canada, but submissions from WNS endemic areas have decreased drastically compared to when WNS first emerged in Canada. Overwintering sites are not well known in Western Canada at the leading edge of WNS emergence so targeted surveillance is difficult. Prior to the emergence of WNS in Canada, many bat hibernacula were already known in eastern and central Canada, allowing for routine targeted surveillance in these locations and relatively quick detection of WNS. However, in many regions where WNS is established, hibernacula surveys are conducted at longer intervals to detect any population changes but ensure the remaining bat populations are minimally disturbed. Dead bats found on the landscape in late winter and early spring are now the primary data source for detection of WNS in many jurisdictions in eastern and central Canada. As mentioned earlier, few bat hibernacula are known in western and northern Canada which makes rapid detection of *Pd* and diagnosis of WNS particularly challenging in these geographical regions on the leading edge of the known range of Pd and spread of WNS, limiting our ability to document the spread and severity of disease in western and northern bat populations. This region has several hibernating bat species that have not yet been exposed to WNS in Canada, and there is uncertainty as to how their populations will be affected by WNS. The Wildlife Conservation Society Canada, partnering with western provinces and northern territories, is conducting thorough *Pd* and WNS surveys, collecting wing swabs and skin biopsies to aid in the detection of WNS.

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Additionally, 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. Eleven (11) big brown bats, 1 little brown myotis, 1 northern myotis, and 2 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 incidents suggesting they simply represent background individual mortality and are not a significant threat to bat health at the population level. Two (2) bats, including a big brown bat and the Nathusius' pipistrelle, were euthanized but appeared healthy. Euthanasia of seemingly healthy bats can be done for various reasons. In the case of the big brown bat, there were concerns of possible human contact and euthanasia for rabies testing is often required for the protection of public health. In the case of the Nathusius' pipistrelle, euthanasia was done because this species is not native to North America and release into the wild or captive management were not acceptable options. Three (3) bats, 1 little brown myotis and 2 northern myotis, were submitted because they died during field research activities, but a specific cause for the mortalities could not be determined. Handling of wildlife is a stressful event to the handled animal and wildlife biologists take great care to minimize welfare concerns related to their fieldwork. CWHC, in partnership with Parks Canada and in collaboration with many bat, wildlife health, and animal welfare experts across Canada, published "Welfare and Handling Recommendations for Bat Censuses in Canada" (Patriquin et al. 2023) to provide extensive guidance on how to protect the welfare of bats during field studies that involve capture and handling. The cause of death for 7 bats, 6 big brown bats and 1 long-eared myotis, was unnecessary human-induced trauma in that bats that were found by people and subsequently killed for no reason. A bat encounter is not by definition a human-wildlife conflict if there is no contact between the bat and humans or domestic animals. In such cases, and if public health does not require euthanasia of the bat, bats can be left alone outdoors or carefully captured and set free if found indoors (see Bats in Buildings documents). These unwarranted incidents of anthropogenic bat mortality demonstrate that continued education of the public is necessary to prevent such harm done to bats, especially endangered species such as little brown myotis which frequently roost in anthropogenic structures. Further, the cause of death was undetermined in 72/233 (32.2%) of specimens which most often occurs when marked postmortem decomposition precludes a complete and accurate necropsy. Once bats die, their small carcasses tend to decompose rapidly, particularly during periods of the year with higher environmental temperatures. Four (4) big brown bats died due to their bycatch in glue traps. We believe it is highly likely that the true mortality due to glue traps is under-represented in the WHIP and a much more significant problem to bat health 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 by-catch of non-target species, are considered inhumane as the trapped individuals die of stress, 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).

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

Cause of death	CHIR	COTO	EPFU	LABO	LACI	LANO	MYCA	MYEV	MYLU	MYSE	MYVO	MYYU	PESU	PINA	UNMY	Total
Dehydration												1				1
Emaciation		1	7						5		1					14
Euthanized			1											1		2
Infectious disease / Inflammation[1]			39		2	2			7	1						51
Open/no diagnosis	6		43		1	1			19			2	2		1	75
Research									1	2						3
Trauma[2]	2		58	1	2	3	1	2	13	1	1	2			1	87
Total	8	1	148	1	5	6	1	2	41	4	2	5	2	1	2	233

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

2 See breakdown of Trauma types in table 4

Table 4: Identified causes of trauma by bat species

Trauma type	CHIR	EPFU	LABO	LACI	LANO	MYCA	MYEV	MYLU	MYSE	MYVO	MYYU	UNMY	Total
Drowning					1								1
Electrocution		1											1
Human inflicted		6					1						7
Predation[1]		1						2					3
Predation by bird		3											3
Predation by cat	2	16			1		1	8			2	1	31
Predation by dog		4											4
Glue trap		4											4
Trauma (undetermined)[2]		23	1	2	1	1		3	1	1			33
Total	2	58	1	2	3	1	2	13	1	1	2	1	87

1 Species of animal that predated the bat was not identified

2 Specific cause of trauma was not identified

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

Infectious disease / inflammatory category	EPFU	LACI	LANO	MYLU	MYSE	Total
Rabies	28	2		5		35
White-nose syndrome				1		1
Other or undetermined	11		2	1	1	15
Total	39	2	2	7	1	51

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Conclusion

Only a single case of WNS was confirmed in the last surveillance season, however, targeted surveillance for WNS remains important. This is especially true since the etiological agent, *Pd*, is present throughout southern Alberta and in a single location in British Columbia and the current Canadian experience has demonstrated that once this pathogen is identified in a region, the emergence of WNS in susceptible bat species follows (Canadian Wildlife Health Cooperative 2023). Therefore, the CWHC will continue its important targeted WNS surveillance program and will continue to collaborate with our partners as this disease continues to move west and north in Canada, to document its impact on endangered species as well as any additional species of bats that have yet to be exposed to the disease in our country.

The most frequent cause of death categories diagnosed in the report period of April 2023 to March 2024 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 several other threats on endangered bats we believe are most certainly underreported and thus underrepresented in our own data: cat predation, glue traps, and other unnecessary human induced causes of mortality. 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 their 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 the living spaces in human occupied buildings, reducing the possibility for cats in indoor environments to injure or 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). This is supported by incidents of entrapment by glue trap as the cause of death in four 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 and documented. Furthermore, the CWHC believes the use of glue traps for pest control management is inappropriate in most situations, and similar to other countries, Canada should consider banning the use of glue traps for nuisance wildlife control. In the

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meantime, glue traps should only be used as a method of last resort and only while working under best practice guidelines for their use emphasizing the need for trained users, frequent checking on deployed traps, and humane procedures for euthanizing trapped animals (Fay 2022). Poor understanding of bats, the important roles they play in the ecosystem, and the population status of endangered bat species, may lead to the unnecessary killing of bats when encountered by members of the public. Educating the public about these topics and how to avoid direct interactions with bats, and how to safely move a bat found indoors to the outside can improve how people interact with bats they encounter. Additionally, such education may help limit avoidable contact with bats and decrease the number of times bats are euthanized as required by public health for rabies testing.

Our findings of two non-native bat species in Eastern Canada, one from Europe and another from an unknown origin, raises potential concerns around the introduction of foreign pathogens. Vigilance for non-native wildlife at coastal regions, particularly at international ports, is important to detect stowaway wildlife before they get the chance to escape into our Canadian ecosystem.

The CWHC has coordinated Canada's national WNS response program since 2012 and will continue to monitor this disease's progression and advise wildlife management agencies on recovery actions as it continues to emerge 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 those incidents in new geographic regions and with species not previously diagnosed with WNS in Canada. 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 appropriate strategies can be developed to mitigate and prevent these additional health problems 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. The CWHC is working closely with Federal, Provincial, and Territorial partners to better protect migratory bats from the threats these species are facing. Both the COSEWIC assessment and the annual CWHC bat health reports illustrate the importance of the CWHC's Bat Health Program in identifying and addressing health issues significant for 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 of threats and recovery and protection of bat populations. We will accomplish this by ensuring 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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