BC Bat Action Team

2024 -2028 BC Bat Action Plan

Contents

Cover photo: Little Brown Myotis. Peace region, BC Credit: J. Hobbs

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Preface

BC Bat Action Team (BCBAT)

The British Columbia Bat Action Team (BCBAT, see Appendix I for a listing of all abbreviations) is a group of professional biologists, academic researchers, veterinarians, environmental educators, students, naturalists, wildlife rehabilitators, and other people that are interested in bat conservation in British Columbia (BC).

What does BCBAT do?

BCBAT promotes the conservation of bats in BC. The BC Ministries of Water, Land and Resource Stewardship (WLRS), Environment and Climate Change Strategy (ENV) and Forests (FOR) are responsible for the management and conservation of bats and bat habitat in the province. BCBAT provides valuable input into development of provincial bat survey standards, best management practices for various sectors that have impacts on bats and bat habitat, conservation and recovery of bat species at risk, education and outreach, and identification of bat research and conservation priorities.

Development of BC Bat Action Plan

In September 2016, following the discovery of white-nose syndrome (WNS) in Washington, and motivated by the urgency of impending high mortality rates for BC bats and the limited capacity and funding invested in this issue by the provincial government, members of BCBAT came together to develop an Action Plan in response to the threat of WNS. The group that met in Chase, BC in September was diverse, bringing expertise from conservation and stewardship groups, academia, and biologists that work closely with industry.

In this facilitated meeting, the group developed a list of goals and then described actions that would be needed to achieve each goal. The actions were then prioritized based on the expert opinion of the members of the group. Each attendee was given a limited number of “points” (as a proxy for limited resources) to distribute to the actions under each goal. Actions that the group thought were the most important and urgent received the most points.

Prioritization of actions under each goal was determined based on the number of individual points they received, and 3 categories of points were delineated to establish Level I, II, and III priorities. Receiving a large number of points meant that an action was the most important (Level I). In a final consolidation, the initial list of goals was grouped into six main action categories. The raw data (goals, action, points) that underpinned this prioritization exercise have been archived by BCBAT and can be accessed upon request.

In September 2019, a subsection of the BC Bat Action Team convened at Blue Lake Lodge in the East Kootenay of BC to re-evaluate the Plan and update it based on information to date, including the fact that WNS was not yet detected in the province. One of the other main goals and accomplishments of this meeting was development of a WNS Communication Plan. An updated 2016-2020 Action Plan was issued in Fall 2019 which included some changes to priorities, and a change in the way that Levels I, II and III were referred to, as Essential (urgent and important, needs to start immediately), Necessary (important but not urgent, action can start in 2-5 years) and Beneficial (action is beneficial and could start at any time that was feasible). The 'Essential' rank was modified in 2024 to reflect the urgency of continuing key projects already underway (urgent and important, critical to continue or to start immediately).

Townsend's Big-eared Bat Photo: C. Lausen

In December 2020, due to COVID-19 limitations an in-person meeting of the BC Bat Action Team could not take place. Instead, a small group of BC Bat Action Team members volunteered to once again review priorities and make updates, issuing an interim Plan until a quorum of the BC Bat Action Team could reconvene in person to develop another 5-year plan.

The current version of the plan, which focussed on a reorganization of Goals and Actions according to IUCN / Conservation Standards, was outlined at the BC Bat Action Team in-person meeting in Victoria in April 2023, and the Action Table was re-organized according to these Standards. In January 2024, current priorities were assigned through an online meeting of 25 participants plus submission of written comments. The results are intended to guide bat conservation in BC for the next five years. The 2024 version of the plan is available for download on the BCBAT.ca website at https://bcbat.ca/action-team/ .

Executive Summary

The BC Bat Action Plan was developed in 2016 to inform and prioritize the activities of multiple groups working for bat conservation in BC. The impetus for the action plan was largely in response to the emerging threat of White Nose Syndrome (WNS) in western North America but has since expanded to encompass additional threats. The Plan and priorities were revisited in 2019 and 2020. In 2022, the status of most BC bat species was reassessed, and the Action Table was reorganized to standardize threat classification, approach and terminology according to International Union for the Conservation of nature (IUCN) and Conservation Measures Partnership (CMP) standards (CMP 2020).

In January 2024, the Bat Action Team met online to prioritize conservation Strategies with rankings of Essential (urgent and important, critical to continue or to start immediately), Necessary (important but not urgent, action can start in 2-5 years), and Beneficial (action is beneficial and could start at any time that was feasible).

Strategies ranked as Essential for bat conservation in BC as of January 2024 are:
Goal 1 – Prevent and mitigate threats

- Focus on researching and implementing mitigation for the priority threats of white-nose syndrome, forest practices, wind energy development, and climate change including fires,
- Assess effectiveness of, and enhance, Best Management Practices and existing habitat protection tools,
- Use existing legislation and improve legal protections to safeguard hibernacula, swarming sites, and maternity habitats, and
- Continue to monitor health and disease status of BC bats, particularly for WNS/Pd.

Goal 2 - Address knowledge gaps constraining bat conservation and management

- clarify bats seasonal ranges and habitat requirements,
- continue and improve population monitoring, including through NABAT program and BC Annual Bat Count,
- develop a coordinated long-term monitoring strategy including analysis of various data types, and
- promote submission of data and identification of important features and areas for bats in order to inform land use decisions and conservation actions.

Goal 3 - Increase community participation and government and non-government capacity in bat conservation

- expand and stabilise financial support for bat conservation initiatives,
- maintain the cooperative approach, encourage communication and participation, and maintain and develop new partnerships include with First Nations partners to facilitate/deliver projects,
- support ongoing outreach programs including the BC Community Bat Program and BatCaver, and
- empower the bat community and partners through workshops, training, and providing resources.

The BC Bat Action Plan and Action Table are available on the BCBAT.ca website at https://bcbat.ca/action-team/.

Introduction to bats of BC

Species and status

British Columbia is the most bat-diverse province in Canada. Fifteen (15) of the 19 Canadian bat species occur in BC (BC Conservation Data Centre 2024), and there are currently two additional species detected with only acoustics records (Table 1). Seven of BC's species are found nowhere else in Canada. Over half of the bat species in BC are of conservation concern.

Ecological and economic importance of bats

As the primary consumers of night-time insects, bats play important roles in many ecosystems and provide significant economic value through ecosystem services including pest control. It has been suggested that bats can be bioindicators in changing ecosystems (Russo and Jones 2015). If WNS causes significant declines in bat populations in BC, as has occurred in eastern North America, there are likely to be far-reaching and long-lasting impacts on other wildlife such as birds and fish, arising from a trophic cascade of changing insect diversity and relative abundances. Loss of functional biodiversity is a concern for BC given the large number of bat species in the province (nearly 20% of small mammal diversity), each with different ecologies and fulfilling unique niches. Bats can be considered a "valued component" in the provincial environmental assessment framework (Environmental Assessment Office 2013), depending on the project, which highlights their ecological importance.

By providing natural pest control services, bats are valuable to forestry, agriculture, organic farming, gardening and mosquito-control, but this value is challenging to quantify. Boyles et al. (2011) estimated that bats provide US$3.7–$53 billion per year in pest control for agricultural crops in the United States (calculated as the cost of pesticide materials and application services). In BC, moths are an important dietary component of many bat species, and at least some bat species may contribute to pest control of forest insects during outbreaks. For example, the Long-eared Myotis (*M. evotis*) eats spruce budworm caterpillars and moths, a significant forest pest (Wilson and Barclay 2006). Bats are also major consumers of biting and pest insects in urban environments.

Spotted bat in Okanagan. Photo: M. Proctor.

Table 1. List of BC bat species and their provincial and federal status as of 2024. Two species have only been confirmed acoustically and are currently considered accidental.

Common Name	Scientific Name	BC status	COSEWIC Status	Canadian range entirely in BC
Pallid Bat	*Antrozous pallidus*	Red	Threatened	Yes
Townsend's Big-eared Bat	*Corynorhinus townsendii*	Blue		Yes
Big Brown Bat	*Eptesicus fuscus*	Yellow		
Spotted Bat	*Euderma maculatum*	Blue	Special Concern	Yes
Eastern Red Bat	*Lasiurus borealis*	Not assessed	Endangered	
Hoary Bat	*Lasiurus cinereus*	Blue	Endangered	
Silver-haired Bat	*Lasionycteris noctivagans*	Yellow	Endangered	
Californian Myotis	*Myotis californicus*	Yellow		Yes
Western Small-footed Myotis	*Myotis ciliolabrum*	Blue		
Long-eared Myotis	*Myotis evotis*	Yellow		
Little Brown Myotis	*Myotis lucifugus*	Blue	Endangered	
Northern Myotis	*Myotis septentrionalis*	Blue	Endangered	
Fringed Myotis	*Myotis thysanodes*	Blue	Data Deficient	Yes
Long-legged Myotis	*Myotis volans*	Yellow		
Yuma Myotis	*Myotis yumanensis*	Blue		Yes
Canyon Bat*	*Parastrellus hesperus*	Accidental		Yes
Brazilian Free-tailed Bat*[1]	*Tadarida brasiliensis*	Accidental		Yes
Big Free-tailed Bat[2]	*Nyctinomops macrotus*	Accidental		Yes

*Acoustic records only.

[1] *Tadarida brasiliensis* is commonly known as both Brazilian and/or Mexican Free-tailed Bat (BC CDC 2024).

[2] *Nyctinomops* is known only from one specimen in 1938 (BC CDC 2024).

Threats assessment of BC bats

The threats facing bats were classified through expert-solicitation led by the BC Conservation Data Centre (BC CDC) and WLRS in 2022, following the IUCN-CMP (International Union for the Conservation of Nature – Conservation Measures Partnership) unified threats classification system (see Salafsky et al. 2008 for definitions and Master et al. 2012 for guidelines). The threat assessment process consists of assessing impacts for each of 11 main categories of threats and their subcategories, based on the scope (proportion of population exposed to the threat over the next 10-year period), severity (predicted population decline within the scope during the next 10 years or 3 generations, whichever is longer up to ~100 years), and timing of each threat. Threat impact reflects a reduction of a species population, and

each combination of scope and severity corresponds to the following classes of threat impact: very high (75% declines), high (40%), medium (15%), and low (3%) (BC WLRS 2023).

Table 1. Using scope and severity to derive the impact of a threat (from BC WLRS 2023).

		Scope					
		Pervasive	**Large**	**Restricted**	**Small**	**Negligible**	**Unknown**
Severity	**Extreme**	Very high	High	Medium	Low	Negligible	Unknown
	Serious	High	High	Medium	Low	Negligible	Unknown
	Moderate	Medium	Medium	Low	Low	Negligible	Unknown
	Slight	Low	Low	Low	Low	Negligible	Unknown
	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Unknown
	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown
	Neutral or Potential Benefit	Not a threat	Not a threat	Not a threat	Not a threat	Not a threat	Unknown

Impact: Very high; High; Medium; Low; Negligible/Unknown/Not a threat

Detailed threat assessments were conducted for each species of bat and then summarized by assessed impact for each Level 1 threat category (Appendix II). Each threat category is discussed individually below, but it is important to emphasize that these threats act cumulatively, and the overall impact can be substantial even when the individual impact of each threat might be negligible or low. Threat assessments are intended to be re-visited every five years by the BC CDC.

1. Residential and commercial development: This category of threat includes expansion or intensification of human settlements or other nonagricultural land uses (e.g., malls, golf courses) in the next 10 years that would destroy or degrade bat habitat. The three species that would be most affected by this threat in this short term are Yuma Myotis, Townsend's Big Eared Bat and Pallid Bat. The overall impact on these three species is estimated to be "low" as future development will probably be expansion around existing development, especially given the 10-year timeframe of assessment. The impact on the remaining BC bat species was assessed as "negligible" at the provincial scale, even if localized impacts in some areas can be very significant and visible.

Urban expansion and rural redevelopment are expected to impact occurrences through loss of natural habitats (trees, rocky outcrops) and anthropogenic roost structures (destruction of old houses and barns, renovations leading to exclusion from roosts in buildings). Yuma Myotis and Townsend's Big-eared Bat are expected to be impacted as development is usually focused on low-elevation, valley-bottom habitats, used by these two species for roosting especially by large colonies of reproductive females. The small range of Pallid Bats in BC is concentrated around the south Okanagan, which is undergoing tremendous residential development making this species also more sensitive to this threat. Loss of habitat and displacement of large maternity colonies could result in lowered reproductive success or mortality from displacement from valley-bottom habitats.

2. Agriculture and aquaculture: This category includes threats arising from the expansion or intensification or change in agricultural practises that could impact bat habitat over the next 10 years. This threat is expected to have a "low" impact on the following species Pallid Bat, Spotted Bat,

Townsends Big-eared bat, Yuma Myotis, Big Brown Bat, Little Brown Myotis, and a “negligible” impact on the other species. Much of the habitat loss to agricultural expansion has been in the past decades, and only modest expansion and intensification is predicted for the next 10 years, mostly in the Thompson Okanagan region and Creston and Fraser Valley. Agricultural intensification can be in the form of increasing farm sizes or conversion of orchards and old fields to greenhouses, vineyards, berries, or canola, and can result in loss of roosting and foraging habitat or a decrease in habitat quality due to lack of insect diversity. Grazing affects large areas of bat habitat and may change vegetation structure and type and therefore potentially change insect abundance. The presence of watering areas for cattle may provide beneficial drinking habitats for bats especially in arid areas of the province. Barbed wire fences could result in direct mortality, but the impact of this threat remains unknown. The impact of agricultural pesticides is discussed under the separate heading of pollution below.

3. Energy production and mining: This category includes threats arising from the exploring, development and production of non-biological resources and energy, including renewable energy such as wind energy. This threat was assessed to be “high” for Eastern Red Bat and Hoary Bat, “high to low” for Silver-haired Bat, “medium” for Northern Myotis, “Medium-low” for Townsends Big-eared bat; “low” for Long-legged Myotis, Long-eared Myotis and Little Brown Myotis and “negligible” for the remaining species.

Within BC, there are currently 10 operational wind farms (primarily in northeastern BC but also Okanagan, Lower Mainland, and northern Vancouver Island). For the seven with summarized mortality data, there were 500+ bat mortalities per year as of 2019 (ENV unpublished data 2019). Outside of BC, Silver-haired populations are predicted to be declining at 7 - 58 % per year depending on the data source (E Baerwald pers comm 2022). Declines of Hoary Bats in the Pacific Northwest were estimated in 2019 at 1-2 % yearly based on acoustic monitoring (Rodhouse et al. 2019).

Although the distribution of windfarms in BC is currently quite restricted, this mortality information and national threat assessments for migratory bats (COSEWIC 2023) lead to threat scoring as “high” for Eastern Red Bats and Hoary Bats due to expected long-distance migration through a myriad of wind farms in the western USA, and “high to low” for Silver-haired Bats due to uncertainties in migration strategies and the presence of an overwintering population in southern BC.

This threat is assessed at “medium” for Northern Myotis because six of the 10 currently operational wind energy projects are within the range of this species and about 5% (25 per year) of the mortalities recorded at these facilities are confirmed to be Northern Myotis (ENV unpublished data 2019).

This threat is assessed at “medium-low” for Townsend’s Big-eared bat because quarrying of rock and talus slopes for riprap for construction targets the natural habitats of female bats in maternity colonies (Reid et al 2010) and hibernacula (C Lausen, M Sarell pers comm), and has potential to affect a large proportion of the population if activities occur where bats are aggregated in groups in talus (C Lausen, M Sarell pers comm).

This threat is scored as “low” for Long-legged Myotis, Long-eared Myotis and Little Brown Myotis. The threat arises primarily from loss of habitat from seismic exploration and mining and quarrying. However, direct mortality at wind energy projects also a factor, with Long-legged Myotis making up 1% and Little Brown Myotis 26 % of the identifiable mortalities in NE BC (ENV unpublished data 2019). In spite of this large component of mortality being Little Brown Myotis, the overall threat rating is “low” because wind

projects are found only in a very small portion of the range of Little Brown Myotis in BC and the species is not a long-distance migrant.

4. Transportation and service corridors: This category includes threats arising from long, narrow transport corridors, including mortality that arises from vehicles using them. This threat was assessed to have a "low" impact on Little Brown Myotis and Yuma Myotis. The impact on the remaining species was assessed to be "negligible".

Both Little Brown Myotis and Yuma Myotis are impacted by this threat not only due to habitat loss from ongoing development of the road networks and utility corridors but also direct mortality (Ramalho and Aguiar 2020, Lausen et al. 2022) and disruption of activity patterns (Jarem and Mathews 2021) especially in areas with high human population density. There is currently no data on fatality numbers, but these data will be difficult to gather as bats are too small to be detected in road mortality counts. Mortality may be high at dusk when bats are emerging from a cliff beside a road (C Lausen pers comm). Maintenance and cleaning of bridges/overpasses/other structures have potential for unintentional direct mortality or disturbance/displacement and impacts on reproductive success. Following timing guidelines outlined in the provincial Best Management Practices for Bats and Bridges (BC ECCS 2022) can reduce impacts of this threat.

5. Biological resource use: This category includes threats from consumptive use of "wild" biological resources such as harvesting of timber, but this category also includes persecution or control of species that are considered undesirable. The species that are most impacted by this threat are species that are foliage or tree crevice roosting bats, and/or those that roost in anthropogenic structures and are impacted by eviction of bat colonies. This threat is assessed to have a "high" impact on Northern Myotis, "medium" impact on Eastern Red Bat, Hoary Bat, Silver-haired bat, Long-legged Myotis, Long-eared Myotis, and Little Brown Myotis, and "low" impact on Townsend's Big-eared Bat, Big Brown Bat, California Myotis, Fringed Myotis, and Yuma Myotis.

Forest harvesting is a significant threat to species that have maternity colonies in tree crevices (Barclay and Brigham 1996, Betts 1998, Vonhof and Gwilliam 2000) or foliage, and poses even more of a threat to species such as Silver-haired Bats and Little Brown Myotis that may hibernate in tree crevices or adjacent to roots in winter and early spring in southern or coastal BC (Nagorsen et al. 1993, Blejwas et al 2021, de Freitas 2022, de Freitas and Lausen 2022). Forestry leads to loss of maternity roosting habitat as crevice- and cavity-roosting species require mature stands /older age classes of forest with an open canopy to provide maternity roost structures in large dead or dying trees (Barclay and Brigham 1996, Psyllakis and Brigham 2006, Olson and Barclay 2013). Forestry practices with an 80–120-year stand rotation are unlikely to provide roost structures for bats. Harvesting affects forest structure leading to changes in bat activity and foraging patterns (Barclay and Brigham 1996, Lauzon 2019). Harvesting may also result in direct mortality, particularly if torpid bats are in trees in winter or early spring. This threat occurs across BC and not only targets coniferous forests but also deciduous forests in some regions (e.g., for wood pellet production in the Peace).

Intentional mortality through trapping and killing bats in buildings for control or persecution is an ongoing issue for species such as Yuma Myotis, Little Brown Myotis, Big Brown Bat, Townsend's Big-eared Bat, California Myotis and Long-legged Myotis. These species use anthropogenic roost structures for maternity colonies where reproductive females who may form large colonies (100+ or even 1000+;

BC Community Bat Program 2023) in buildings. The outreach and education work of the BC Community Bat Program is likely reducing the scope of this threat, but this remains an ongoing threat at this time.

6. Human intrusions and disturbance: This category includes threats arising from non-consumptive use of biological resources such as recreation, or instances of human gatherings in natural areas such as protests or work-related activities such as wilderness training. The impact of this threat across all BC bat species was assessed as “negligible”.

There is potential for disturbance to maternity colonies and hibernating populations in rock crevices, caves, and mine adits by cavers, vandals, climbers, or recreating general public. Development of new climbing routes may cause disturbance or direct mortality. Bat research can lead to mortality or decrease in reproductive success; alternatively, research may benefit populations though improved conservation actions.

7. Natural system modifications: This category includes threats arising from actions to modify or improve natural systems for the benefit of human welfare, often with negative consequences for some wildlife. The impact of this threat was assessed as “low” for Townsend’s Big-eared Bat, Silver-haired Bat, Big Brown Bat, and all the Myotis species (Little Brown, Yuma, Long-legged, Long-eared, Fringed, Northern, Small-footed).

The primary natural system modification across the province affecting many of the species is the changes in fire frequency and intensity. Fire has immediate impacts through loss of roost trees and structures, depending on fire severity (Pritchard et al. 2021) and through immediate mortality. Smoke may affect foraging success and bat health and often occur during the lactation period, so may impact pups. There is anecdotal evidence that bats are displaced from maternity roosts by fire/smoke (M Kellner pers comm 2022). Scope depends on fire occurrence over the next 10 years; however, increasing fire frequency and severity is expected in next 10 years (Hagmann et al. 2021). The range of severity reflects uncertainty about fire severity and impacts on individuals and habitats, including the potential to lose roost structures in high severity fires or have legacy roosts when lower intensity fires (Loeb and Blakey 2021). Fuel management in rural areas will reduce availability of roost trees in those regions. In the next 10 years fire frequency and intensity may increase to more catastrophic events.

Natural systems can also be modified when rivers are dammed, re-routed or wetlands drained. Many of these changes have happened in the past decades. Site C is the major dam construction that is currently underway and has caused the loss of roosting and foraging habitat in forest and riparian areas lost to flooding and clearing for dam construction. This large-scale change in the landscape could have potential impacts on migrating bats using the Peace River as a migratory corridor (Baerwald pers comm 2022).

The impacts of herbicides and pesticides to control agricultural and forest pests may change insect diversity and abundance (Brühl et al. 2020), with declines in insect availability potentially affecting fitness of bats (Davy et al. 2022). Direct impacts of pesticides on bats are considered under the sub-heading of pollution.

8. Invasive and other problematic species and genes: This category includes threats arising from non-native plants and animals, and pathogens and could also include native species that have increased in abundance due to human actions and could harm the target species.

The primary threat in this category is white-nose syndrome (WNS) caused by the fungus *Pseudogymnoascus destructans* (Pd). The disease has killed millions of bats across North America and is one of the major wildlife crises of our time. WNS affects bats in the winter because the fungal agent causing the disease thrives at cooler temperatures and high humidity often found in hibernacula. As a result, extensive mortality in some hibernating bat species in eastern North America has occurred (WNS Response Team 2024). In affected colonies, mortality rates can exceed 90% (WNS Response Team 2024). At least thirteen species are thought to hibernate in winter in BC and are potentially at risk of WNS mortality. The threat to three species of bats - Little Brown, Northern, and Yuma Myotis - is assessed as "very high to high" based on documented mortality in Eastern Canada and known mortality of Yuma Myotis in the western US.

However, for most western species, we do not know how populations will be affected by WNS. As of 2024, WNS has been documented in western bat species including Fringed Myotis, Long-legged Myotis, and Long-eared Myotis (WNS Response Team 2024). The impact of WNS on these three species is assessed at "high to low" to capture the uncertainty of the disease impacts in these novel invasions.

The Big Brown Bat is unusual in that it listed as susceptible to WNS (WNS Response Team 2024), however research in eastern North America has found that Big Brown Bats do not show population declines and appear to be resistant to the fungus. Because of this, the threat is ranked as "negligible" for Big Brown Bat. Several species have been confirmed with Pd but not with the disease WNS – Eastern Red Bat, Silver-haired Bat, Townsend's Big-eared Bat, and Western Small-footed Myotis. Impact of the threat of WNS is considered "unknown" for these species. The impacts of WNS on the remaining BC species are assessed as "unknown" – these species are Hoary Bat, California Myotis, Spotted Bat, and Pallid Bat. Not assessed in BC are the Brazilian Free-tailed Bat, which does get infected with Pd but does not develop the disease, and the Canyon Bat for which the susceptibility and impact of Pd and WNS are unknown.

Additional diseases in this category include interstitial pneumonia (likely viral but unconfirmed) which was reported as cause of death for two mass mortalities of Myotis bats (G. McGregor pers comm 2021) in mixed Yuma and Little Brown Myotis colonies; the majority of the bats in the colonies are Yuma Myotis and thus mortalities were most likely Yuma Myotis. One episode was of 62 bats collected from 6 bat boxes in Sun Oka and Okanagan Lake South Provincial Parks in June and July 2016 (not all bats were collected, and number was likely higher given scavengers likely picked up bats). The second was 70+ bats at Colony Farms, Coquitlam. The range and prevalence of this disease is unknown, but no mass mortalities with similar diagnoses have been reported since 2018. There are speculative linkages between the 2018 mortalities and hot temperatures and/or high humidity. Rabies is found across BC, but with low incidence of occurrence. Less than 0.5 % of wild bat populations are thought to carry the virus (Pybus 1986), and this disease is not scored as a threat because of its apparent 'static' state in wild populations.

Predation of bats by feral or domestic cats also falls in this category and may be a large source of mortality (Beattie et al 2022) but has small scope as it is limited to areas with human development. Invasive plant species such as Burdock also pose a threat to bats as they get tangled in the seed pods of this plant and die as they are unable to free themselves.


Left: Cat and bat. Photo: BC Community Bat Program. Right: Long-eared Myotis in Burdock. Photo: M. Anions.

9. Pollution: This category includes threats arising from harmful materials such as toxic chemicals, sedimentation, or harmful effects from excess energy such as light, sound or ground vibrations. This threat was assessed as "negligible" for all bats in BC when considered at the provincial scale, even if they could cause acute harmful effects on a local scale.

A number of BC bats forage over water including over wastewater and tailings ponds. Direct health impacts from consumption and/or bioaccumulation of hormones of pesticides/ herbicides/ pharmaceuticals are largely unknown. Reviews highlight the lack of information about potential direct and indirect impacts to bats (e.g., Bayat et al. 2014). The impacts of light and noise pollution on are largely unquantified, but noise is known to impact some species (e.g., Pallid Bat foraging, Bunkley and Barber 2015, Allen et al 2021). Noise from trains is loud and has large ultrasonic component that likely impacts foraging (e.g., Jerem and Mathews 2021). Overall, the impact of this threat category on BC bats requires more research to understand impacts and quantify severity of threats.

10. Geological events: This category includes threats arising from catastrophic geological events such as earthquakes, volcanoes, and mudslides. This threat was assessed as "negligible" but may be most significant for species that roost in cliffs and talus, including Townsend's Big-eared Bat, Big Brown Bat, Spotted Bat, Western Small-footed Bat, and Fringed Myotis. These species may be vulnerable to landslides or avalanches destroying roosts, and the frequency of these events could increase due to other anthropogenic factors such as unsafe resource road building, deforestation, and climate change. This is a challenging category to score for threats as the frequency of these threats is unpredictable.

11. Climate change and severe weather: This category of threat includes habitat shifts, drought, high temperatures and storms and flooding. Climate change impacts manifest over decades and are not easily assignable as a cause for mortality. However, climate change has been implicated in recent extreme weather events and ecosystem and habitat shifts. Climate change was assessed as a "low" threat to all BC bat species.

Climate change could cause potential changes in forest structure and available foraging habitat. Bats in areas without large lakes may require the presence of small/ ephemeral ponds that can be affected by drought through evaporation and increasing vegetation growth. These changes can potentially change

prey base and water availability, particularly for lactating females. Severe weather and extreme weather fluctuations may impact bats at all seasons through affecting thermoregulation and insect availability. The heat dome in July 2021 caused temporary abandonment of traditional maternity colonies of some bat species in anthropogenic structures, with unknown impacts to populations (Kellner pers. comm. 2021). Extreme heat and humidity are known to affect behaviour of bats in roosts, as observed at bat boxes on hot days, and may be associated with mortality at some artificial roost sites. Impacts of extreme heat on reproductive success are unknown and may be variable depending on the timing of heat. In 2021, excessively high temperatures were observed around the pupping period and likely impacted reproductive success; this was not observed in 2022. Loss of roosts including bridges, cliffs, trees from blowdown, destruction of anthropogenic roosts, saturation of crevices with mud and death of individuals may arise during storms or flood events.

Summary of threats

The most significant threat facing bats in BC is the emergence of white-nose syndrome. The first detection of Pd in the province was from guano samples collected in 2022, and it is unknown when a bat exhibiting symptoms of the disease will be detected and how long before population declines are observed. There is no proven prevention or treatment for WNS, and hence the focus of the Bat Action Plan currently is to reduce the impact of other threats and build resilience in bat populations.

Energy production and mining, including mortality at wind energy installations, mining and quarrying, and oil and gas drilling, and biological resource use including forestry are the two other threat categories stand out in their level of impact on multiple species.

Climate change is acknowledged as an imminent and pervasive threat that could have both slow long-term impacts and unpredictable impacts during catastrophic climate events. The scope of actions to mitigate climate change are generally outside the scope of the BC Bat Action Plan but actions that build resilience in bat populations by maintaining habitat diversity and connectivity may serve to protect bat populations from rapid declines.

It is important to clarify that while actions that address threats that impact multiple species will be cost effective, individual threats that impact specific species and/or specific populations cannot be ignored. Local action is as important for the conservation of healthy bat populations as more strategic larger scale efforts at the provincial scale.

BC Bat Action Plan

Vision

The aim of this BC Bat Action Plan is to present unified focal areas of research and action that would enable attainting the vision of ***Abundant, healthy, and resilient bat species and populations in British Columbia.***

Goals and Focus Areas

To realize this vision, there are three Goals, each with nested Focus Areas (Table 2), Strategies, and Actions.

Table 2. BC Bat Action Plan Goals and nested Focal Areas. Prioritized Strategies and associated Actions can be found in the partner Bat Action Table.

Goal 1 – Prevent and mitigate threats to bats
1. Research and implement mitigation of high impact/priority threats based on the IUCN Threat Categorization 2. Develop the use of policy and regulatory tools under current and new legislation to prevent threat impacts. 3. Monitor threats and research cumulative effects of multiple threats. 4. Conduct effectiveness monitoring of mitigation tools.
Goal 2 - Address knowledge gaps constraining bat conservation and management
1. Clarify range and seasonal distribution of all BC bats. 2. Population monitoring for species of interest/concern. 3. Research to understand ecology and habitat use of BC bats to facilitate threat mitigation and restoration efforts.
Goal 3 – Sustain and increase community participation and government and non-government capacity in bat conservation
1. Sustain and increase regional, provincial, and external collaborations including collaborations with First Nations. 2. Continue outreach to raise awareness of bats, conservation issues, and threat reduction BMPs and guidance. 3. Provide training for bat monitors, researchers, stewards, and others involved in bat conservation and management, and increase bat conservation capacity in the province.

Strategies and Actions

In the companion Action Table, nested within each Focal Area are the prioritized Strategies, each with a set of actions underway or proposed for implementation. All actions identified from 2016 through 2023 have been grouped under Strategies according to the IUCN-CMP Action Classification (https://conservationstandards.org/library-item/threats-and-actions-taxonomies/). This framework allows biologists, researchers, and funders to consider how well proposed actions (projects) address the Goals, Focus Areas, and prioritized Strategies. Development of SMART actions is encouraged – specific, measurable, achievable, and ambitious, relevant and results-based, and time-bound (Leech et al. 2004).

Current projects and achievements / completed actions

A listing of current/ongoing projects was developed from survey responses sent to the BC Bat Action Team coordinator. These have been compiled according to Goals in a tab of the Action Table spreadsheet. An online data collection form will be used to streamline this process in future, to facilitate interested users in regular reviewing projects and identifying gaps in Actions.

Any actions that are considered Completed will be archived in the Achievements section of the Action Table. Measurable outcomes can be also included in this table to highlight achievements for ongoing projects (e.g., Five BC Communities achieve bat-friendly community status by 2023).

Updates

This Action Plan will remain a living document. This document and the associated spreadshseet of action items will be posted on the BCBAT page of the provincial bat website: https://bcbat.ca/action-team/. This Action Plan and the progress made on this plan, including updates on current projects, will be reviewed in 2028 when a new plan may need to be written.

Acknowledgements

The BC Bat Action Plan exists because of the members of the BC Bat Action Team and their efforts in Chase in 2016, Blue Lake in 2019, and in online meetings and discussion in 2020 and 2024 (Appendix IV). Thank-you to all team members and supporters.

Literature Cited

Allen, L.C., Hristov, N.I., Rubin, J.J., Lightsey, J.T. and Barber, J.R., 2021. Noise distracts foraging bats. *Proceedings of the Royal Society B*, *288*(1944), p.20202689.

Bayat, S., Geiser, F., Kristiansen, P. and Wilson, S.C., 2014. Organic contaminants in bats: trends and new issues. Environment international, 63, pp.40-52.

BC Community Bat Program. 2023. British Columbia Community Bat Program - Annual Bat Count (2012-2023). Available: https://bcbats.ca/attachments/Annual-Bat-Count-Summary-2023_24.pdf

Barclay, R.M. and Brigham, R.M., 1996. Bats and Forests Symposium, Victoria, British Columbia, Canada. Res. Br., BC Min. For., Victoria, BC Work. Pap.

B.C. Conservation Data Centre (CDC). 2024. BC Species and Ecosystems Explorer. B.C. Ministry of Environment, Victoria B.C. Available: http://a100.gov.bc.ca/pub/eswp/.

B.C. Ministry of Environment and Climate Change Strategy (ECCS). 2022. Best Management Practices for Bats in British Columbia, Chapter 9: Bridges. B.C. Ministry of Environment and Climate Change

Strategy, Victoria, BC. 52 pp. https://a100.gov.bc.ca/pub/eirs/viewDocumentDetail.do?fromStatic=true&repository=BDP&documentId=12460

B.C. Ministry of Water, Land and Resource Stewardship (WLRS). 2023. British Columbia Guide to Recovery Planning for Species at Risk. Appendix 5. Guidance for Threat Assessments. Version 3.0. 25 pp. Available at : https://www2.gov.bc.ca/assets/gov/environment/plants-animals-and-ecosystems/appendix_5_guidance_for_threat_assessments_v30_jan_2023.pdf

Beattie, I., Schofer, D., McGregor, G., Lee, M.J., Lee, L.K., Himsworth, C.G. and Byers, K.A., 2022. An investigation of bat mortality in British Columbia, Canada. *Canadian Journal of Zoology*, *100*(7), pp.464-473.

Betts, B.J., 1998. Roosts used by maternity colonies of silver-haired bats in northeastern Oregon. Journal of Mammalogy, 79(2), pp.643-650.

Blejwas, K.M., Pendleton, G.W., Kohan, M.L. and Beard, L.O., 2021. The Milieu Souterrain Superficiel as hibernation habitat for bats: implications for white-nose syndrome. Journal of Mammalogy, 102(4), pp.1110-1127.

Boyles, J.G., Cryan, P.M., McCracken, G.F., Kunz, T.H. 2011. Economic importance of bats in agriculture. Science 332, 41–42.

Brühl, C.A., L. Despres, O. Frör, C.D. Patil, B. Poulin, G. Tetreau and S. Allgeier. 2020. Environmental and socioeconomic effects of mosquito control in Europe using the biocide *Bacillus thuringiensis* subsp*. israelensis* (Bti). Science of the Total Environment 724:137800.

Bunkley, J.P. and Barber, J.R., 2015. Noise reduces foraging efficiency in pallid bats (Antrozous pallidus). Ethology, 121(11), pp.1116-1121.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2014. Assessment and status report on the little brown myotis, *Myotis lucifugus,* northern myotis, *Myotis septentrionalis,* tri-colored bat, *Perimyotis subflavus,* in Canada. Species at Risk Public Registry. Available at: http://www.sararegistry.gc.ca/document/default_e.cfm?documentID=1323.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 2023. COSEWIC assessment and status report on the Hoary Bat Lasiurus cinereus, Eastern Red Bat Lasiurus borealis and Silver-haired Bat, Lasionycteris noctivagans, in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xxi + 100 pp. (https://www.canada.ca/en/environment-climate-change/services/species-risk-public-registry.html).

Conservation Measures Partnership. 2020. Open standards for the practice of conservation. https://conservationstandards.org/wp-content/uploads/sites/3/2023/09/CMP-Open-Standards-for-the-Practice-of-Conservation-v4.0-English.pdf

Davy, C.M., von Zuben, V., Kukka, P.M., Gerber, B.D., Slough, B.G. and Jung, T.S., 2022. Rapidly declining body size in an insectivorous bat is associated with increased precipitation and decreased survival. Ecological Applications, 32(7), p.e2639.

de Freitas, E. 2022. Spring roost selection and thermoregulation of silver-haired bats in the Smallwood creek area. WCSC report for BC Ministry of Environment and Climate Change Strategy. 14 pp. http://a100.gov.bc.ca/pub/siwe/sensDataReq.do?projectId=6010&docId=44450&fromPage=details

de Freitas, E. and C. Lausen. 2022. Year-round roost selection and thermoregulation of Silver-haired Bats in Smallwood-Garrity Area, Kootenay Lake. WCSC report for BC Ministry of Environment and Climate Change Strategy. 9 pp. http://a100.gov.bc.ca/pub/siwe/sensDataReq.do?projectId=6010&docId=44447&fromPage=details

Environmental Assessment Office. 2013. Guideline for the selection of valued components and assessment of potential effects. http://www.eao.gov.bc.ca/pdf/EAO_Valued_Components_Guideline_2013_09_09.pdf

Gignoux-Wolfsohn, S.A., Pinsky, M., Kerwin, K., Herzog, C., Hall, M., Bennett, A., Fefferman, N. and Maslo, B., 2019. Genomic signatures of evolutionary rescue in bats surviving white-nose syndrome. bioRxiv, p.470294.

Hagmann, R.K., Hessburg, P.F., Prichard, S.J., Povak, N.A., Brown, P.M., Fulé, P.Z., Keane, R.E., Knapp, E.E., Lydersen, J.M., Metlen, K.L. and Reilly, M.J., 2021. Evidence for widespread changes in the structure, composition, and fire regimes of western North American forests. Ecological Applications, 31(8), p.e02431.

IUCN-CMP Action Classification (https://conservationstandards.org/library-item/threats-and-actions-taxonomies/)

Jerem, P. and Mathews, F., 2021. Trends and knowledge gaps in field research investigating effects of anthropogenic noise. Conservation Biology, 35(1), pp.115-129.

Lausen, C., Nagorsen, D.W., Brigham, R.M. and Hobbs, J., 2022. Bats of British Columbia. Victoria: Royal BC Museum.

Lauzon, A., 2019. Long-term effects of forest harvesting on habitat use by insectivorous bats (Doctoral dissertation, Faculty of Graduate Studies and Research, University of Regina).

Leech, Susan M., Karyn A. Sutherland, and Carla Wainwright. 2004. Recovery Planning to Achieve Desired Results: Using Principles of Extension to Create Meaningful Behavioural Changes Linked to Overall Recovery Goals, Proceedings of the Species at Risk 2004 Pathways to Recovery Conference. March 2-6, 2004, Victoria, B.C. Species at Risk 2004 Pathways to Recovery Conference Organizing Committee, Victoria, B.C.

Loeb, S.C. and Blakey, R.V., 2021. Bats and fire: a global review. Fire Ecology, 17, pp.1-18.

Master, L.L., Faber-Langendoen, D., Bittman, R., Hammerson, G.A., Heidel, B., Ramsay, L., Snow, K., Teucher, A. and Tomaino, A. 2012. NatureServe conservation status assessments: factors for evaluating species and ecosystem risk. NatureServe, Arlington, VA, p.76.

Nagorsen, D.W. and Brigham, R.M. 1993. Bats of British Columbia. Royal BC Museum Handbook. Victoria, BC.

Olson, C.R. and Barclay, R.M., 2013. Concurrent changes in group size and roost use by reproductive female little brown bats (Myotis lucifugus). Canadian Journal of Zoology, 91(3), pp.149-155.

Psyllakis, J.M. and Brigham, R.M., 2006. Characteristics of diurnal roosts used by female Myotis bats in sub-boreal forests. Forest Ecology and Management, 223(1-3), pp.93-102.

Prichard, S.J., Hessburg, P.F., Hagmann, R.K., Povak, N.A., Dobrowski, S.Z., Hurteau, M.D., Kane, V.R., Keane, R.E., Kobziar, L.N., Kolden, C.A. and North, M., 2021. Adapting western North American forests to climate change and wildfires: 10 common questions. Ecological applications, 31(8), p.e02433.

Pybus, M.J., 1986. Rabies in insectivorous bats of western Canada, 1979 to 1983. Journal of Wildlife Diseases, 22(3), pp.307-313.

Rodhouse, T.J., Rodriguez, R.M., Banner, K.M., Ormsbee, P.C., Barnett, J. and Irvine, K.M., 2019. Evidence of region-wide bat population decline from long-term monitoring and Bayesian occupancy models with empirically informed priors. Ecology and evolution, 9(19), pp.11078-11088.

Ramalho, D.F. and Aguiar, L., 2020. Bats on the Road—A Review of the Impacts of Roads and Highways on Bats. Acta Chiropterologica, 22(2), pp.417-433.

Russo, D. and G. Jones. 2015. Bats as bioindicators: an introduction. Mammalian Biology 80:157-158.

Salafsky, N., Salzer, D., Stattersfield, A.J., Hilton-Taylor, C.R.A.I.G., Neugarten, R., Butchart, S.H., Collen, B.E.N., Cox, N., Master, L.L., O'CONNOR, S.H.E.I.L.A. and Wilkie, D., 2008. A standard lexicon for biodiversity conservation: unified classifications of threats and actions. *Conservation Biology*, *22*(4), pp.897-911.

Vonhof, M.J. and Gwilliam, J.C., 2000. A summary of bat research in the Pend d'Oreille Valley in southern British Columbia. Columbia Basin Fish and Wildlife Compensation Program.

WNS Response Team. 2024. White-nose Syndrome occurrence map - by year (2024). White-noseSyndrome.org, a coordinated response to the devastating bat disease. Available: www.whitenosesyndrome.org

Wilson, J.M., Barclay, R.M.R. 2006. Consumption of Caterpillars by Bats During an Outbreak of Western Spruce Budworm. The American Midland Naturalist 155(1):244-249.

Appendix I. Abbreviations.

ABAT	Alberta Bat Action Team
ABCBP	Alberta Community Bat Program
ABCF	Association of BC Forest Professionals
BCBAT	British Columbia Bat Action Team
BCCBP	British Columbia Community Bat Program
BCCF	British Columbia Conservation Foundation
BCIA	British Columbia institute of Agrologists
BMP	Best Management Practices
Bt	*Bacillus thuringiensis* (biocide for insect control)
CAB	College of Applied Biology (registered professional biologists)
CI-WHF	Commission-Identified Wildlife Habitat Feature (Oil and Gas Commission)
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CWHC	Canadian Wildlife Health Cooperative
EA	Environmental Assessment
ECCC	Environment and Climate Change Canada
ENV	BC Ministry of Environment and Climate Change Strategy
FORREX	Forum for Research and Extension in Natural Resources (*under revision*)
FOR	BC Ministry of Forests
FRPA	Forest and Range Practices Act
FSC	Forest Stewardship Council
EMPR	Ministry of Energy, Mines and Petroleum Resources
MLA	Member of Legislative Assembly
TRAN	Ministry of Transportation and Infrastructure
MP	Member of Parliament
NABat	North American Bat Monitoring Program (Loeb et al. 2015)
NSERC	Natural Sciences and Engineering Research Council
OGAA	Oil and Gas Activities Act
P.I.T.	passive integrated transponder
PARF	Protected Areas Research Forum
Pd	*Pseudogymnoascus destructans* [the fungus that causes WNS]
QA/QC	Quality Assurance/Quality Control
QEP	Qualified Environmental Professional
RBCM	Royal British Columbia Museum
RISC	Resources Information Standards Committee
SARA	Species at Risk Act

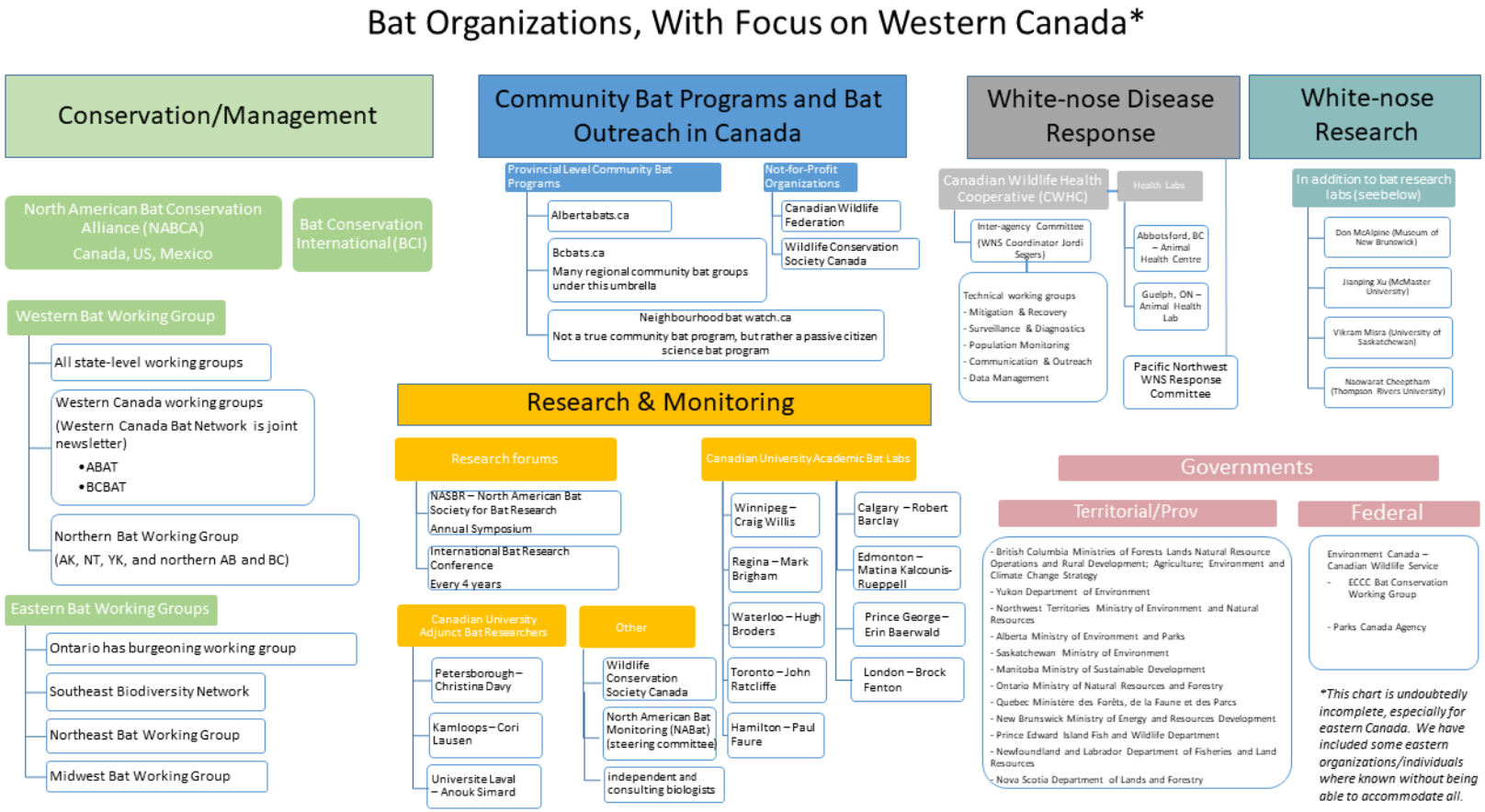
SOP	Standard Operating Practices
UBCM	Union of BC Municipalities
UNBC	University of Northern BC
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WBWG	Western Bat Working Group
WCSC	Wildlife Conservation Society Canada
WHA	Wildlife Habitat Area
WHF	Wildlife Habitat Feature
WLRS	BC Ministry of Water, Land and Resource Stewardship
WNS	white-nose syndrome

Appendix II. Level 1 Threat Assessments for BC Bat Species

Scientific Name	BC / COSEWIC Status	Residential & commercial development	Agriculture & aquaculture	Energy production & mining	Transportation & service corridors	Biological resource use	Human intrusions & disturbance	Natural system modifications	Invasive & other problematic species & genes	Pollution	Geological events	Climate change & severe weather
Antrozous pallidus	Red /T	Low	Low	Negligible	Negligible	Negligible	Negligible	Negligible	Unknown	Negligible	Negligible	Low
Corynorhinus townsendii	Blue	Low	Low	Medium - Low	Negligible	Low	Negligible	Low	Unknown	Negligible	Negligible	Low
Eptesicus fuscus	Yellow	Negligible	Low	Negligible	Negligible	Low	Negligible	Low	Negligible	Negligible	Negligible	Low
Euderma maculatum	Blue / SC	Negligible	Low	Negligible	Negligible	Negligible	Negligible	Negligible	Unknown	Negligible	Negligible	Low
Lasiurus borealis	Unknown / E	Negligible	Not a threat	High	Negligible	Medium	Negligible	Negligible	Unknown	Negligible	Negligible	Low
Lasiurus cinereus	Blue / E	Negligible	Not a threat	High	Negligible	Medium	Negligible	Negligible	Unknown	Negligible	Negligible	Low
Lasionycteris noctivagans	Yellow / E	Negligible	Negligible	High - Low	Negligible	Medium	Negligible	Low	Unknown	Negligible	Negligible	Low
Myotis californicus	Yellow	Negligible	Negligible	Negligible	Negligible	Low	Negligible	Low	Unknown	Negligible	Negligible	Low
Myotis ciliolabrum	Blue	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Low	Unknown	Negligible	Negligible	Low
Myotis evotis	Yellow	Negligible	Negligible	Low	Negligible	Medium	Negligible	Low	High - Low	Negligible	Negligible	Low
Myotis lucifugus	Blue /E	Negligible	Low	Low	Low	Medium	Negligible	Low	Very High - High	Negligible	Negligible	Low
Myotis septentrionalis	Blue /E	Negligible	Negligible	Medium	Negligible	High	Negligible	Low	Very High - High	Negligible	Negligible	Low
Myotis thysanodes	Blue / DD	Negligible	Negligible	Negligible	Negligible	Low	Negligible	Low	High - Low	Negligible	Negligible	Low
Myotis volans	Yellow	Negligible	Negligible	Low	Negligible	Medium	Negligible	Low	High - Low	Negligible	Negligible	Low
Myotis yumanensis	Blue	Low	Low	Negligible	Low	Low	Negligible	Low	Very High - High	Negligible	Negligible	Low
Summary with top three threats indicated in orange		3 low, 12 negligible	6 low, 7 negligible, 2 not threat	2 high, 1 High-low, 1 medium, 1 medium-low, 3 low, 6 negligible	2 low, 13 negligible	1 high, 6 medium, 5 low, 3 negligible	15 negligible	11 low, 4 negligible	3 very high-high, 3 high-low, 8 unknown, 1 negligible	15 negligible	15 negligible	15 low

The full excel version of the table can be obtained from WLRS/Bat Conservation Coordinator (mandy.kellner@gov.bc.ca).

APPENDIX III. Organizations applicable to bat research, conservation, outreach



APPENDIX IV. Meeting attendees and acknowledgements.

A. Inaugural 2016 meeting in Chase where the Action Plan was initially developed.

Group Photo: Members of BCBAT present at the Action Planning meeting in Chase, BC on 16-17 Sept. 2016.
Back row left to right: Jared Hobbs, Purnima Govindarajulu, Mandy Kellner, Doug Burles, Karen Hodges, Jason Rae, Christian Engelstoft, Tanya Luszcz, Fawn Ross, Michelle Evelyn, Chris Currie, Lorraine Andrusiak. Front row left to right: Felix Martinez, Cori Lausen, Aimee Mitchell, Juliet Craig, Susan Holroyd, Susan Dulc, Patrick Burke. Laying at front: Leigh Anne Isaac.

B. BCBAT/ABAT Joint Meeting, Blue Lake, where this document was reviewed and revised, Sept. 2019.

Group Photo: Members of BCBAT present at the Action Plan Review meeting in Blue Lake, BC on 13-15 Sept. 2019.

From Left to right: Elodie Kuhnert, Erin Baerwald, Shari Willmott, Mandy Kellner, Cory Olson, Susan Holroyd, Juliet Craig, Leah Andresen, Trudy Chatwin, Purnima Govindarajulu, Orville Dyer, Jordi Segers, Leigh Anne Isaac, Mike Kelly, Dana Blouin, Nicole Besler, Aimee Mitchell, Lisa Wilkinson, Cody Fouts, Barb

Johnston, Chris Currie, Jason Headley, Glenna McGregor, Heather Gates, Susan Dulc, Jared Hobbs, Jeff Shatford, Jason Rae, Erin Lowe, Cori Lausen.

C. Zoom screenshot of the small group that volunteered in Dec. 2020 to review and update the BC Bat Team's Action Plan, issuing a one-year 2021 Plan. Starting from top-left by row: Leigh Anne Isaac (ENV), Cori Lausen (WCSC), Jason Rae (WCSC), Tanya Luszcz (CWS), Mandy Kellner (ENV), Susan Holroyd (ABAT), Brian Paterson (Zonal Ecosystems). Missing from photo: Lorraine Andrusiak (SNC Lavalin), Kim Dohms (CWS).

D. Individuals who developed the initial 2016 Action Plan, attended the 2019 BCBAT/ABAT joint meeting, and the 2020 and 2024 virtual meetings.

Name	Meeting attended or comments submitted - 2016, 2019, 2020, 2024	Affiliation
Leah Andresen	2019	Keefer Ecological Services
Lorraine Andrusiak	2016, 2020, 2024	SNC-Lavalin (2016- 2020) / Ausenco (2024)
Erin Baerwald	2019	University of Regina
Robert Barclay	2024	University of Calgary, professor emeritus
Jennifer Barden	2024	Fraser Valley Conservancy
Carita Bergmann	2016	Parks Canada, Gwaii Haanas
Nicole Besler	2019	VAST Resource Solutions, KCBP
Dana Blouin	2019	Wildlife Conservation Society
Patrick Burke	2016	South Coast Bat Conservation Society
Doug Burles	2016	Coordinator Thompson Region Community Bat Program, independent researcher
Trudy Chatwin	2019	Emeritus BC Ministry of Environment
Juliet Craig	2016, 2019	Silverwing Ecological Consulting, BC Community Bat Program and Kootenay Community Bat Project
Chris Currie	2016, 2019	South Coast Bat Conservation Society
Emily de Freitas	2024	VAST Environmental
Lindsay Dewart	2024	BC Parks
Susan Dulc	2016, 2019	Aurora Consulting
Orville Dyer	2019	Ministry of Environment and Climate Change Strategy
Christian Engelstoft	2016	Habitat Acquisition Trust
Michelle Evelyn	2016, 2024	Sunshine Coast Wildlife Project
Cody Fouts	2019	VAST Resource Solutions, KCBP
Heather Gates	2019, 2024	Wildlife Conservation Society Canada
Samantha Gidora	2024	TRU MSc Candidate
Purnima Govindarajulu	2016, 2019, 2020, 2024	BC Min. of Environment / WLRS
Ingebjorg Jean Hansen	2016, 2024	Independent Biologist / WLRS
Jason Headley	2019	Alberta Community Bat Program
Jared Hobbs	2016, 2019	Independent Biologist
Karen Hodges	2016	University of British Columbia - Okanagan
Dacyn Holinda	2024	Stanley Park Ecological Society
Susan Holroyd	2016, 2019, 2020, 2024	Alberta Community Bat Program, Calgary, AB
Leigh Anne Isaac	2016, 2019, 2020, 2024	VAST Resource Solutions & Kootenay Community Bat Project (2016, 2019); BC ENW/WLRS (2020, 2024
Barb Johnston	2019	Parks Canada
Autumn Kirk	2024	Independent Biologist
Mike Kelly	2019	Alberta Community Bat Program
Mandy Kellner	2016, 2019, 2020, 2024	BC Community Bat Program (2016, 2019, 2020); BC ENV (2020), BC WLRS 2024

Elodie Kuhnert	2019, 2019, 2024	Kootenay Community Bat Program (KCBP)
Cori Lausen	2016, 2019, 2020, 2024	Wildlife Conservation Society Canada
Erin Low	2019, 2024	Alberta Community Bat Program / WCSC
Tanya Luszcz	2016, 2020	Partners in Flight, CWS
Felix Martinez	2016	South Coast Bat Conservation Society
Laura Matthias	2016	Salt Spring Island Conservancy
Glenna McGregor	2019	BC Ministry of Agriculture
Aimee Mitchell	2016, 2019	Athene Consulting
Matthew Mitchell	2024	UBC Research Associate
Aiva Noringseth	2024	Independent Biologist
Cory Olson	2019	Alberta Community Bat Program
Peter Ommundsen	2016, 2024	Salt Spring Island Conservancy (2016), independent biologist 2024
Liliana Ortega	2024	Thompson Community Bat Program
Brian Paterson	2016, 2020, 2024	Independent Biologist
Linda Pfeiffer	2019	Bat Ambassador
Jason Rae	2016, 2019, 2020, 2024	Wildlife Conservation Society Canada
Paula Rodriguez de la Vega	2024	BC Community Bat Program
Fawn Ross	2016	Associated Environmental Consultants Inc.
Mike Sarell	2016	Ophiuchus Consulting
Jordi Segers	2019	Canadian Wildlife Health Cooperative
Jeffrey Shatford	2019	Species at Risk Recovery Branch, Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD)
Caeley Thacker	2024	BC WLRS
Elizabeth Thunstrom	2016	Wildlife Rescue Association BC (emeritus)
Wendy Tyrell	2024	Salt Spring Conservancy
Emily Upham-Mills	2024	BC WLRS
Jan Veroti	2019	Kootenay and BC Community Bat Program
Lisa Wilkinson	2019	Alberta Environment and Parks
Shari Willmott	2019, 2024	FLNRORD / FOR / WLRS - Wildlife Health Program

E. 2016 Sponsors and Special Acknowledgements

The BC Bat Action Team would like to acknowledge the organizations and individuals who made the 2016 Chase meeting possible: Fish and Wildlife Compensation Program who provided funding for meeting space and food; Blair Acton owner of Squilax Shuswap Hostel who provided free accommodation for participants and catered the event at cost; the Adams Lake Indian Band who provided a discounted rate on the meeting facility rental; Dr. Cori Lausen with Wildlife Conservation Society of Canada who initiated the meeting and finalized the action plan; Fawn Ross who coordinated the meeting details; Juliet Craig who facilitated the meeting; Sarah Bennett of Origin Brand for graphic design of the final document; and the following members who worked to re-bin the plan categories in the final consolidation – Lorraine Andrusiak, Dr. Karen Hodges, Carita Bergmann, Mike Sarell, and Dr. Leigh Anne Isaac. We are particularly grateful to all the meeting participants who provided their time in-kind to attend this meeting and develop the action plan, and to all of the individuals who provided review and edits during its final stages. More than 360 hours of volunteer time was donated to the creation of this Action Plan.

F. 2019 Sponsors and Special Acknowledgements

BCBAT would like to acknowledge the following organizations for financially contributing to the success of the 2019 inter-provincial meeting. Our invaluable meeting sponsors included the following: Fish and Wildlife Compensation Program – Columbia, Coastal and Peace regions, BC Ministry of Environment and Climate Change Strategy, VAST Resource Solutions, and Cranbrook Pest Control. Thank you also to Blue Lake Camp for hosting us and to Over Time Beer Works for providing some delicious beverages.

The joint meeting would not have been made possible without the time, effort, and energy of our organizing team, which included Leigh Anne Isaac, Elodie Kuhnert, Orville Dyer, Cori Lausen, Nicole Besler, Cody Fouts, Susan Holroyd, and Lisa Wilkinson. The concurrent sessions were led by a team of individuals that included Orville Dyer, Lisa Wilkinson, Jordi Segers, Cori Lausen, Mandy Kellner, Cory Olson, Susan Holroyd, Glenna MacGregor, Jason Rae, Jared Hobbs (and Charlie Palmer for sending contribution), Leigh Anne Isaac, and Erin Baerwald. Thank you also to Juliet Craig for facilitating our WNS response session.