North American Bat Monitoring Program in British Columbia

Pemberton 2019 Data Collection Summary

Acknowledgements

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Introduction

White-nose Syndrome (WNS) is a deadly fungal disease that kills bats while they hibernate. This fungal disease has devastated bat populations in the eastern states and provinces of the USA and Canada since it was discovered in New York State in 2006 (USFWS 2016). WNS has spread at a steady pace westward across North America until March 2016, when it made a major leap and was discovered in the Pacific Northwest, in the state of Washington.

Since its jump to the west was discovered in 2016, it has spread slowly, still contained, as far as we know, to Washington state (USFWS 2019). The arrival of WNS in the province of British Columbia (BC) is likely imminent and the lower mainland and southern reaches of Vancouver Island are likely to see the arrival of this disease first assuming no long distance translocations of this disease into the province occur.

For years, biologists across North America have stressed the importance of collecting baseline data on bat populations and habitat, especially in advance of a virulent disease like WNS, which has resulted in mortality rates in excess of 95% in eastern Canada's bat hibernacula (USFWS 2019). In response to the discovery of WNS in Washington, a group of well-respected local biologists (the BC Bat Action Team), assembled to create a BC Action Plan. The plan has identified baseline monitoring as one of the highest priority actions needed to address critical threats to bat populations, with WNS identified as one of the most devastating threats (BCBAT 2017).

The North American Bat Monitoring (NABat; Loeb et al. 2015) program is a multi-agency initiative that was designed by US and Canadian biologists and statisticians, and is being coordinated and administered by the US Geological Survey (USGS). In Canada, the Canadian Wildlife Health Cooperative plays a lead role in coordinating efforts nation-wide. Wildlife Conservation Society Canada has implemented the

program in British Columbia, with the assistance of bat biologists and naturalists across the province. The goal is to increase baseline monitoring, facilitating diversity and relative abundance trend analyses at national and continental scales. In areas where WNS has not yet been found, NABat will help to prepare provinces and states for the arrival of the disease, support effective conservation decision making, and better secure our knowledge of diversity and relative abundance of local bat populations in advance of infection. NABat consists of 2 main components: acoustic monitoring and counting bats in colonies.

NABat's objectives are to:

- Establish baseline bat diversity and abundance prior to the arrival of White-Nose Syndrome (WNS);
- Provide the architecture for coordinated bat monitoring to support local, regional and range-wide inferences about trends in bat populations and abundances in response to WNS, climate, wind energy, and habitat loss;
- Quantify the impact of WNS on bat populations of different species, detect early warning signs of population declines, and estimate extirpation risk;
- Facilitate mitigation and recovery actions; and
- Enable effective evaluation of management and conservation efforts with information on bat population trends.

As the NABat program expands, monitoring of additional grid cells throughout BC will improve the detail and accuracy of our estimates and trend analysis, which will also provide greater confidence that we can appropriately detect overall and species-specific impacts of WNS if it spreads into BC. We are developing a monitoring framework with baseline data robust to yearly variation, which will be required for disease surveillance and detecting changes in bat communities over time. These are necessary starting points for the mitigation of WNS impacts and eventual recovery of affected bat populations.

NABat monitoring in BC should enable rapid disease detection, track disease spread, and quantify the impact of the disease on bat populations. While WCS Canada's current NABat efforts are important for the continentally-scaled monitoring effort, more intensive sampling will be needed to detect small-scale trends for provincial scale assessment. Future power analyses are needed to determine what level of increased sampling and other design considerations will be optimal for detecting change at desired geographic scales. As NABat is a long-term monitoring program, consistent data collection over an extended time period is critically important. The continental monitoring protocol suggests that sites should be monitored each year for at least 5 years in order to provide adequate data for trend analyses, and especially for detection of WNS, as the disease-causing fungus, *Pseudogymnoascus destructans (Pd)* spreads across North America. Additional benefits of gathering these data include development of fine-scale habitat associations to inform land conservation and management actions, support for Conservation Data Centre status assessments, clarification of species range maps and baseline location data to support improved environmental assessments and best practices for management.

Acoustic Monitoring Methods

While NABat monitoring entails multiple avenues of data collection, acoustic data is the main focus of this report. Annual collection of acoustic recordings using both passive and mobile bat detectors is used to estimate both species diversity and relative species abundance (Lausen and Craig 2017). The sounds recorded on these detectors are used to identify the species of bat residing in an area (Lausen et al. 2017).

In preparation for the program, we used the BC portion of the North America 10x10 km grid system, which was derived from a random-tessellation stratified (GRTS) survey design algorithm (Loeb et al. 2015). BC contains a total of 10,146 grid cells. We instructed all new participants to select the grid cell with the lowest ID in their area that contains sufficiently accessible bat habitat to deploy two to four passive detectors for 4 - 7 nights. We also encouraged participants (Grid Leaders) to choose a grid cell that contains a road with a relatively straight 30 - 45 km section suitable for mobile transects.

Passive bat detectors are recording devices equipped with ultrasound microphones that grid cell leaders deployed in strategically-selected bat habitat within 2 to 4 quadrants of each 10 x 10 km grid cell. In 2017, detectors were deployed between late May to early July and collected data for at least seven nights. This period was after migratory species had returned to the area and before the young began to fly on their own. A temperature and relative humidity logging device was also deployed in each grid cell to collect data on ambient conditions that can be related to nightly activity. If no temperature probe could be deployed, or the device failed, hourly temperature and humidity records were collected from a nearby weather station.

Two driving transects were also conducted while the passive bat detectors were deployed. Approximately 30 minutes after sunset, vehicles with a bat detector's ultrasound microphone mounted on the roof were driven along a relatively linear path at 30 km per hour (slightly faster than many bat species would fly). With the assumption that each bat recording on the transect represents a different individual, a rough approximation of relative species abundance can be calculated from these files.

Both passive and transect dataset were processed through auto identification (auto ID) software (Kaleidoscope Pro and Sonobat) using settings outlined in the NABat procedure (Lausen et al. 2017). This software provides a good first-pass identification and helps eliminate most of the recordings that just contain noise from rain, insects, or other animals. Pre-set species lists were used to identify likely candidate species for auto ID based on the geographic location of each grid cell. Expert analysts then examined each high quality bat file to correct or confirm all IDs.

Summary of 2019 NABat Data

The data summarized in this report represent the fourth year of NABat activities in BC, summer 2019. With the continuing efforts of our NABat volunteers and grid cell leaders, we surveyed 51 grid cells in 8 different ecoprovinces across British Columbia in 2019 (Figure 1; Table 1). New grid cells were located in strategically selected locations where sampling efforts have previously been low. We continue to explore avenues to establish new NABat grid cells in northern BC to address the remaining sampling gap.

Within the 51 monitored grid cells, we collected and completed auto-ID and expert manual analysis of over 200,000 recordings of bats. Monitoring at each grid cell was scheduled to occur at a time of year where environmental conditions were similar to previous years. Most detectors that were deployed in previous years recorded similar numbers of raw files per night, though minor variations due to weather and stochasticity were evident, as expected. A simple metric like number of recordings can not estimate abundance of species at each site, but the consistency in number of recordings is suggestive that no major disturbances occurred at this site since previous years.

In Pemberton, we detected evidence of 9 different species of bats. Namely, Townsend's big-eared bat, big brown bat, hoary bat, silver-haired bat, Californian myotis, long-eared bat, little brown bat, long-legged bat, and Yuma myotis (Table 1, Figure 2). This site provides remarkable species diversity, capturing activity from over half of the species known to reside in western Canada. Diversity between detectors was relatively low, and each detector collected at least one recording from almost all 9 species. Two transects and one year of observation is not generally sufficient to accurately estimate relative abundances of species, but little brown myotis and silver-haired bats were the most frequently detected species along the transect routes in Pemberton (Figure 3).

In this year's 2019 monitoring season, we are continuing to increase our provincial sample size to fill in gaps in historical records of BC and opportunistically as interested volunteers are available. For 2020, we will opportunistically deploy detectors in new grid cells in selected areas, with additional support from our ever expanding network of landowners, volunteers, and trained grid leaders. As we establish baseline abundance and distribution through continued monitoring of new and existing grid cells, we are building a record of yearly variation and will be well-poised to detect the spread of WNS in bats across the province and quantify its impact. How each bat species in BC will be differentially affected by WNS is currently unknown. However, as WNS appears in BC, NABat monitoring may be our best method for widespread assessment of what species are being most affected. The baseline monitoring data collected here will also provide context for evaluating mitigation and recovery strategies. By identifying when, where, and what species are most affected by WNS' spread, we can then act to protect critical habitat for the most impacted species to help facilitate species recovery in the long-term.

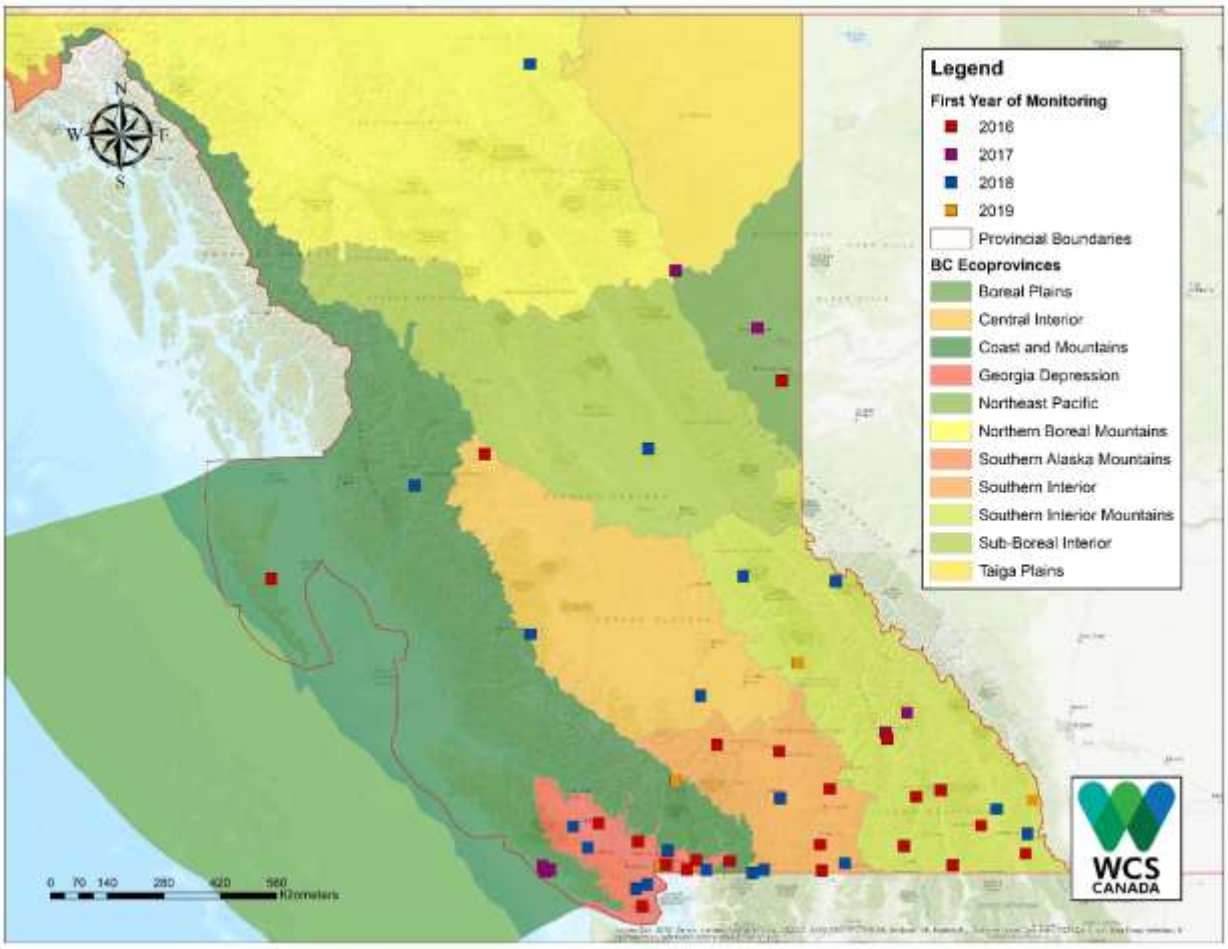

Figure 1. 1:5,800,000 scale map of British Columbia ecoprovinces demonstrating locations of NABat 2016 - 2019 surveying efforts. Each red square contains 2 to 4 passive detectors and up to 2 driving transect replicates.

Table 1. Species presence at each site as identified in acoustic recordings collected from the stationary bat detectors in grid cell 143274 in summer 2019, excluding all low quality files.

Pemberton Grid Cell 2019	*NE*	*NW*	*SE*	*SW*
Townsend's Big Eared Bat	✓		✓	✓
Big Brown Bat	✓		✓	✓
Hoary Bat	✓	✓	✓	✓
Silver-Haired Bat	✓	✓	✓	✓
Californian Myotis	✓	✓	✓	✓
Long-Eared Myotis	✓	✓	✓	✓
Little Brown Myotis	✓	✓	✓	✓
Long-Legged Myotis	✓	✓	✓	✓
Yuma Myotis		✓	✓	✓
Grand Total	374	207	347	384

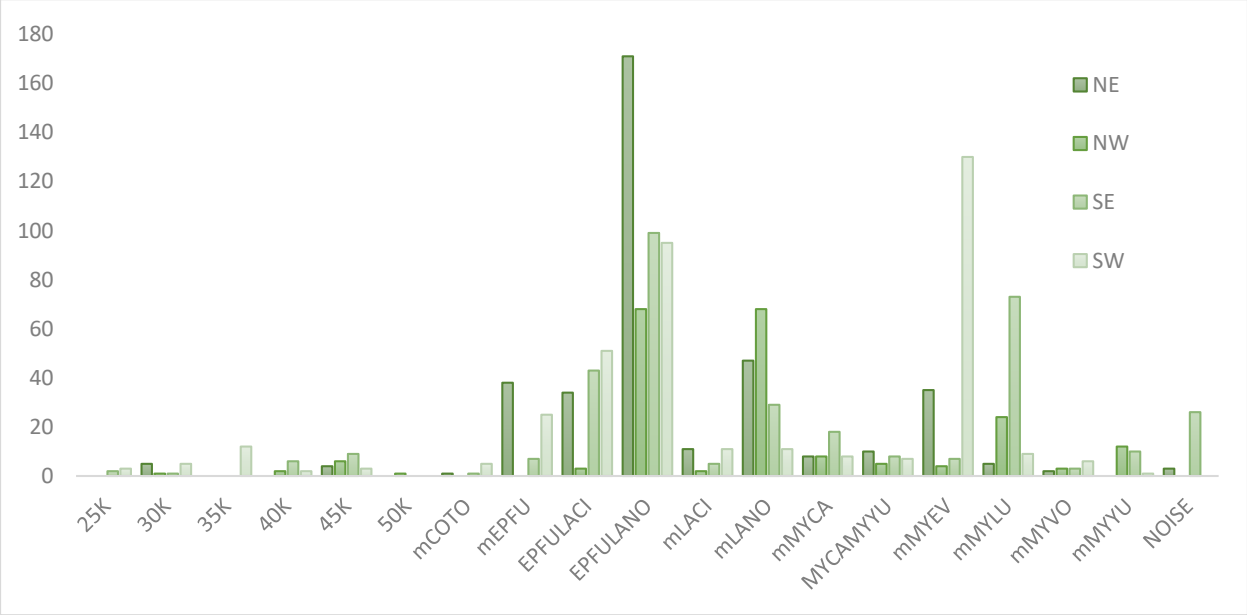

Figure 2. Sum of acoustic recordings collected from each passive detector in grid cell 143274 in summer 2019, excluding all low quality files. Note, the total number of files of each species or detector does not directly indicate species relative abundance.

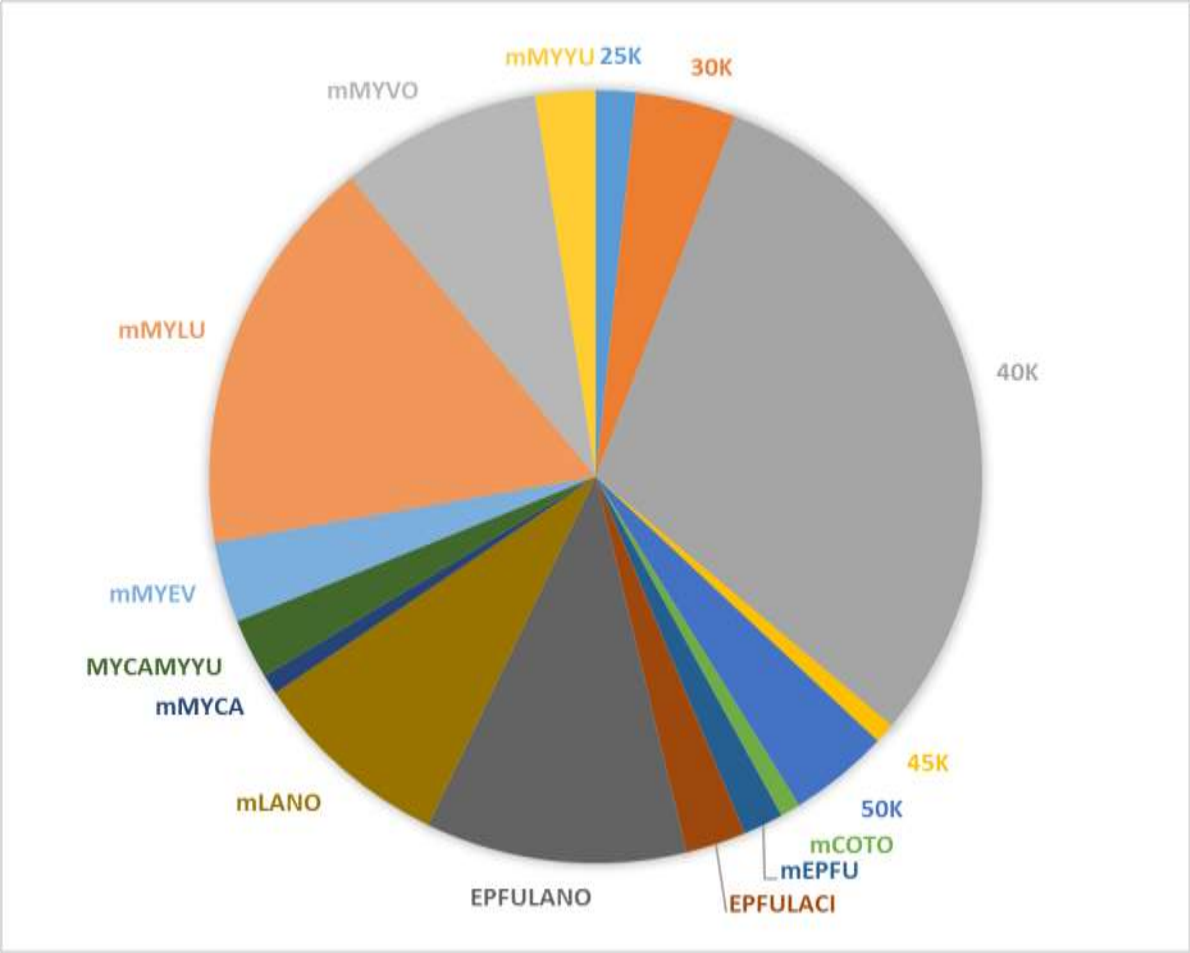

Figure 3. Sum of acoustic recordings collected from two ~45km car transects driven in grid cell 143274 in summer 2019.

Appendix S1. Glossary of information describing common group labels of species.

Label	*Species*	*Description*
50K	MYCA or MYYU	**Frequency groupings**. Possible species ID includes the set of species shown, where appropriate. Differentiating to species-level not possible. "K" stands for kHz. The number refers to the lowest frequency commonly produced.
40-45K	MYCA, MYCI, MYVO, MYLU, MYSE, or MYYU	
30-35K	EPFU (if high vegetation area) or MYEV	
25K	EPFU, LANO, LACI, or TABR	
20K	LACI or TABR	
LowF	ANPA, COTO, EPFU, LACI, LANO, MYTH, or TABR	Poor quality recording. Possible species ID includes the set of species shown, where appropriate. Differentiating to species-level not possible usually due to too few pulses. LowF refers to species that put most of their echolocation energy into frequencies below 30kHz. HighF bats produce calls that are above 30kHz.
HighF	MYCA, MYCI, MYLU, MYSE, MYVO, MYYU, LABO	
EPFULANO	Possible EPFU or LANO	**Couplets**. Possible recording of either species. These pairs of species are acoustically very similar, and some recordings contain no characteristics to differentiate between the two.
EPFUTABR	Possible EPFU or TABR	
TABRLANO	Possible TABR or LANO	
COTOMYTH	Possible COTO or MYTH	
ANPALACI	Possible ANPA or LACI	
ANPAEPFU	Possible ANPA or EPFU	
MYLULABO	Possible MYLU or LABO	

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