Ultrasonic Bat Monitoring in Eastern Cape Breton

Project Report 2013-2014

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Glossary of Keywords

Adit: An entrance to an underground mine which is horizontal or nearly horizontal.

Echolocation: Transmission of sound waves and interpretation of returning echoes to determine the location of objects in the environment.

Hibernaculum (pl. hibernacula): A location where bats and other hibernating animals hibernate through the winter; for bats, this can include caves and abandoned mines.

Ultrasonic: Refers to sound waves with a frequency above the limit of human hearing.

Shaft: Vertical passages used in mines and tunnels to move fresh air underground and to remove stale air.

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Many thanks to Dr. Hugh Broders, Lynne Burns, and Jordi Segers of St. Mary's University for their help throughout this project. Their advice about deployment techniques and assistance with call identification is greatly appreciated.

Many thanks to Dr. Michael Orr and the local cave explorers who assisted us with the deployment of our bat detector at the cave in Victoria County. This is a little known cave that is highly valued by the caving community, and we are very grateful for their support of bat monitoring in this location.

The bat walks were very successful, fun events that we are excited to do again in the future. Thank you very much to the Baille Ard Trail Association and the Main-á-Dieu Coastal Discovery Centre for their help in making these events possible.

We'd also like to sincerely thank Andrew Hebda of the Nova Scotia Museum of Natural History, and the staff of the Nova Scotia Department of Natural Resources for all of their help with this project.

Introduction

White-nose syndrome (WNS), a fungal disease that causes bats to wake early from hibernation, has been wreaking havoc on bat populations in eastern North America. WNS typically leads to death from starvation, and is estimated to have killed over 5 million bats since it first appeared in North America in 2007.

Bats are unique and ecologically important mammals. They are the only mammals capable of true flight and they possess the rare ability of using sound waves for precise navigation called echolocation. Perhaps the most significant role bats play in our ecosystem is that of insect control. Some bat species can eat 50 - 100% of their body weight in insects in a single night. The absence of this insect control service could lead to an explosion in insect populations which has serious implications for crops, farmland, and public health.

White-nose syndrome is prevalent in the northeastern United States, New Brunswick, and wasfirst documented in southern Nova Scotia as of 2011. Given the speed at which the disease has spread, it seems reasonable to expect that Cape Breton bats are in danger; however, the disease had not been documented in Cape Breton as of 2013. This left an opportunity to gather contextual ecological data on Cape Breton populations before disease arrival, raise awareness about WNS to potentially help prevent or slow its spread, and monitor bats for signs of infection.

To accomplish this, four main objectives were developed:

Objective 1: Monitor bat activity in several summer habitats using ultrasonic bat detectors.

Objective 2: Relocate ultrasonic detectors to winter hibernacula to monitor for signs of activity indicative of white-nose syndrome.

Objective 3: Creation and distribution of an educational booklet on bats in Cape Breton.

Objective 4: Public education through information sessions and guided night-time bat walks.

Ultrasonic detectors

The bat detectors used in this project work by detecting the ultrasonic calls produced by bats as they fly. These calls cannot be heard by humans without the aid of such technology. In the case of the stationary Wildlife Acoustics SM2BAT+ units, the calls are recorded, stamped with time, date, and other information, and then saved to a memory card stored within the detector. These memory cards can later be removed so that the data can be analyzed using Wildlife Acoustics Kaleidoscope software. The data cannot be accessed in the field, but detailed information can be extracted from it. The detector can run on either D batteries or 12V deep-cycle batteries.

The handheld bat detector also detects ultrasonic calls, but transforms the sound so that it is audible to humans and immediately transmits it through a speaker. Although the calls can be recorded, only limited analysis is possible on this data. This detector is excellent for public engagement events and certain kinds of active monitoring.

Project implementation

Objective 1 – Monitor bat activity in summer habitats

The goal of monitoring activity in summer habitats was to gather contextual data about bats in Cape Breton, including presence/absence of species, seasonal trends in activity, and the time when summer activity ceased. To capture this data, four Song Meter SM2BAT+ ultrasonic bat detectors (manufactured by Wildlife Acoustics) were deployed in Eastern Cape Breton. The detectors were tied to a tree at eye level with the microphone attached higher up and facing open spaces where bats were likely to fly while feeding. As a power source, the detectors used 12V deep-cycle batteries which were kept on the ground in a protective case.

The SM2BAT+ units were configured to record during the night when bats were feeding, starting 30 minutes before sunset and ending 30 minutes after sunrise. During this time, the detectors recorded the number of bat "passes," or instances of a bat flying past the microphone. The detectors cannot distinguish individual bats from each other; therefore, it is not possible using these detectors to count how many bats are present, but it does provide a measure of activity level.

Roughly every two weeks, batteries were checked for charge and memory cards were switched so that data could be retrieved and analyzed. The data collected over the summer was processed using Kaleidoscope software by Wildlife Acoustics. Using this software, each call detected over the course of the summer can be linked to a species of bat. Each call is also tagged with a time and date stamp, allowing seasonal and nightly trends to be identified.

This software analyzes sounds recorded by the detector and identifies them as either a bat or a "noise" file, which can include ultrasonic components of sounds produced by wind, rain, machinery, and other animals. For the purposes of this study we relied on the classification system of the software to determine the number of bat detections.

Detectors were deployed in a total of six locations in Ben Eoin (three locations), Howie Centre (two locations), and Margaree (one location), Nova Scotia.

Bat detectors 1 and 3 – Ben Eoin, NS

Bat detector 1 (BD1) and bat detector 3 (BD3) were deployed in the Ben Eoin Provincial Park on 11 July 2013 (Figure 1) and recorded a full season of activity in this location until they were retrieved on 22 October 2013. Both recorded in Full Spectrum mode.

The park is on the southeast side of the Nova Scotia Route 4 highway in a mixed forest. An area near the bat detector locations is cleared to accommodate a dirt road and central picnic area. Both detectors were deployed at the interface of grassland and mixed forest (Figure 2).

BD3 was deployed near the entrance to the park (about 100m from the highway) at the boundary of mixed forest and a small patch of grassland (45.96135^{o} -60.46033^{o}). The patch contains logs and other forest debris, and is covered in tall grasses, goldenrod, and other wildflowers. A small brook was also located approximately 50m behind the detector in the forest. The detector was placed about 0.5m above ground, and the microphone about 2m up, pointing toward the grassland.

BD1 was deployed at the far end of the large cleared area, about 275m from the highway and 150m away from the dirt road (45.96196° -60.45714°). They were also placed at the boundary of the forest and the adjacent grassland. The grassland is covered in large woody debris and tall grasses. It tends to become soft and marshy in times of heavy or frequent rainfall, but is otherwise dry. The detector was placed between 1.5 and 2m from the ground, and the microphone was placed about 3m from the ground, facing the clearing.

Figure 1. Locations of bat detectors 1 and 3 in Ben Eoin Provincial Park from 11 July to 22 October 2013.

Bat detector 2 (BD2) was deployed in the same location as BD1 from 11 July to 13 August. BD2 was configured in Zero Crossing, a different detection mode than the other two detectors in this location. BD2 and BD1 were deployed together to test the two modes and determine the difference between the results they produced. This deployment reinforced the notion of using full spectrum recording instead of zero crossing.

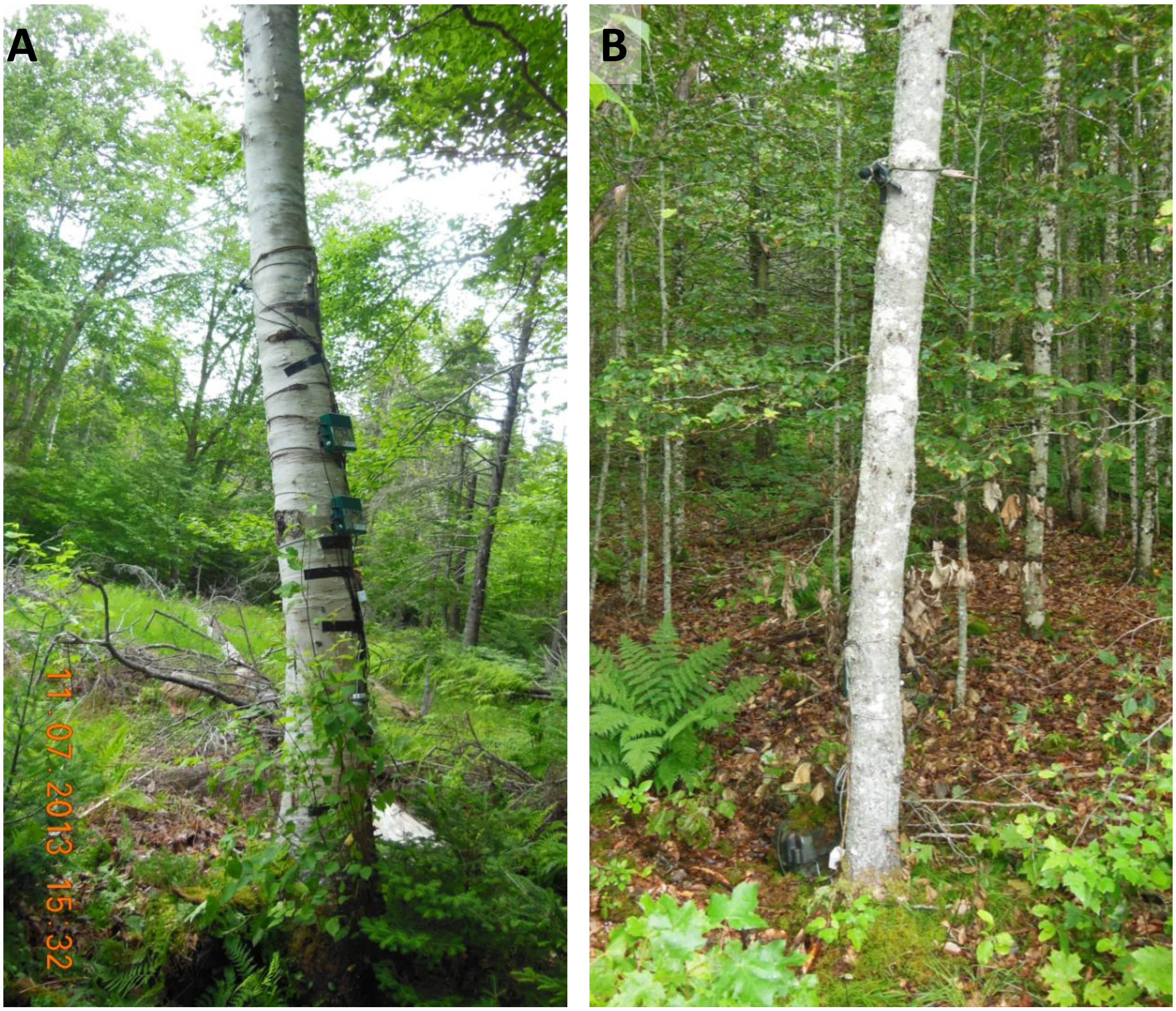

Figure 2. Bat detector 1 (A) and bat detector 3 (B) deployed at the Ben Eoin Provincial Park during the summer of 2013. Both detectors were located on the interface of mixed forest and open grassy areas of the park.

Bat detector 2 – Howie Centre, NS

Bat detector 2 (BD2) was deployed in Howie Centre on 16 August 2013 and recorded until 3 November 2013 (Figure 3). This detector was attached to a hardwood tree located on the periphery of a brook fed pond (46.07155° -60.24659°); the pond is bounded by rushes and alders and is home to several beavers. The surrounding land use within 100m of the detector includes grassland historically used for farming, mixed forest, and wetlands.

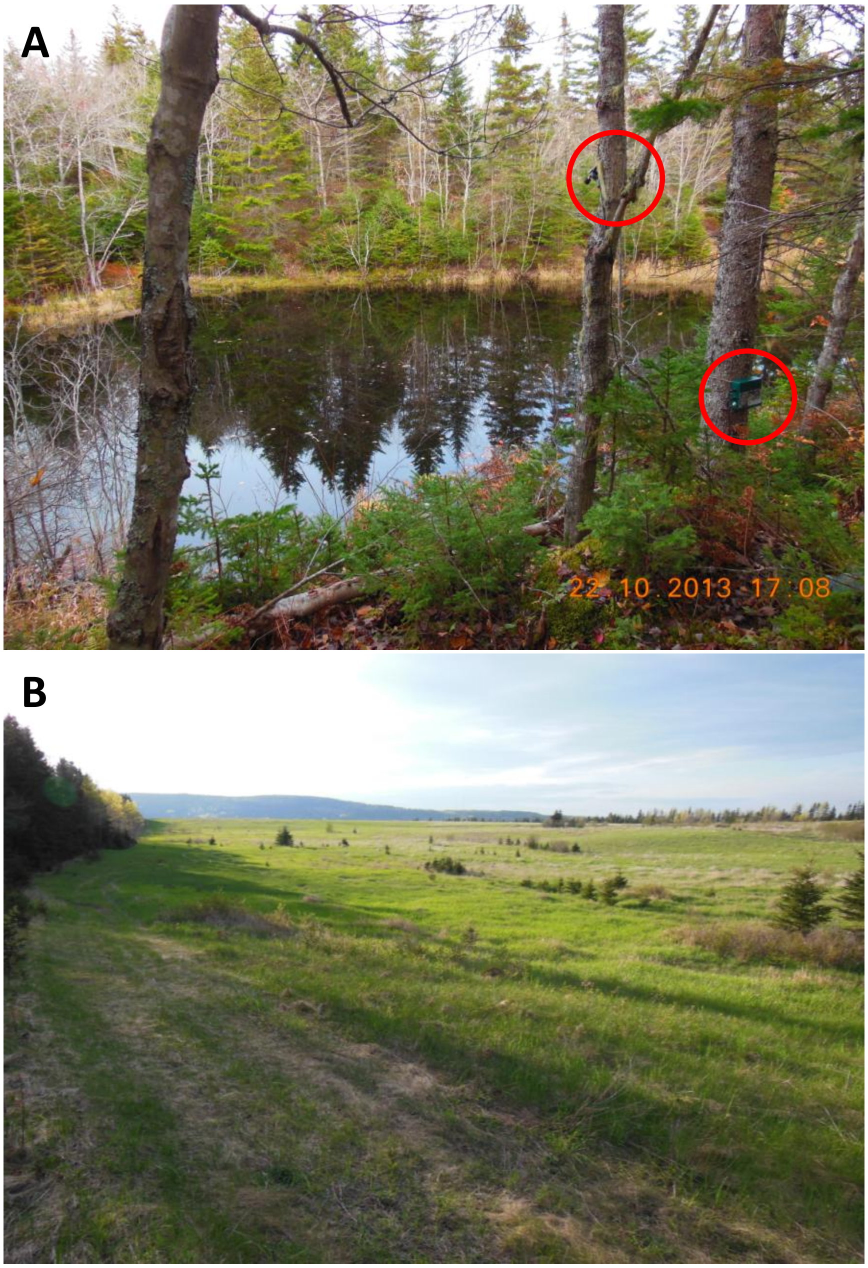

Figure 3. Photo A depicts bat detector 2 deployed next to a pond in Howie Centre; the microphone and main body of the detector are highlighted with red circles. Photo B is an example of grassland habitat located 75 meters away from bat detector 2.

Bat detector 4 – Mobile detector

Rather than being deployed in one location for the duration of the summer, bat detector 4 (BD4) was used primarily for testing and demonstration purposes. It was deployed for small periods of time in Ben Eoin, Howie Centre, and Margaree on the following dates:

- Ben Eoin – 28 June to 17 July (45.96325° -60.46356°)
- Howie Centre – 28 August to 29 August (46.08060° -60.25930°)
- Margaree – 31 August to 2 September (46.34470° -60.95411°)

The Ben Eoin location was similar to the others, but was surrounded by forested area and not adjacent to any clearing; only a narrow road nearby could be used as a corridor for bats. In 19 days, 125 calls were detected in this location. Both the Howie Centre and Margaree locations were near residential areas. A total of 48 bat passes were detected during the two days the detector was deployed in Howie Centre, and 44 passes in Margaree.

It was also used for demonstration during children's day camps and the guided night-time bat walks.

Species detected

Only two species of bats were routinely identified with high levels of confidence by the software: the little brown bat (*Myotis lucifugus*) and the northern long-eared bat (*Myotis septentrionalis*). Due to the similarity of their calls, it is possible that some bats were identified by the software as the incorrect species of *Myotis.* Cape Breton is within the normal range of both of these species, and they have been recorded elsewhere in Nova Scotia. Therefore, it is likely that both of these species are present in Cape Breton.

Other species that were identified by the software included: *Lasiurus borealis, Perimyotis subflavus, Eptesicus fuscus, Lasiurus cinereus, Myotis grisescens, Myotis leibeii, Myotis sodalis,* and *Nycticeius humeralis*. Many of these are almost certainly misidentifications. The only species that were identified with high confidence were *L. borealis* (2 nights), *M. leibeii*(2 nights) and *N. humeralis* (2 nights). Cape Breton is out of range of the latter two, somewhat for *M. leibeii* and considerably so for *N. humeralis*. *Lasiurus borealis* has been recorded on mainland Nova Scotia and it was expected that it might be present in Cape Breton; however, we cannot say for certain that it is present based on this data.

Activity level

Bats are highly active during the summer months when they are feeding, and as expected, calls were recorded on the first night after deployment of BD4 on 28 June 2013. The final bat call was recorded on 22 October 2013 by BD1 in Ben Eoin.

As mentioned above, in this study "activity level" refers to the number of bat passes recorded by the detectors, not the number of individual bats present. The total number of bat passes detected at long term monitoring sites (detectors 1-3) is summarized in Table 1.

Table 1. Total number of bat detections at long-term monitoring sites from July to October 2013.

Detector No.	1	2	3	Total
Location	Ben Eoin	Howie Centre	Ben Eoin	
Deployment dates	11 July - 22 October	16 August - 03 November	11 July - 22 October	
Days Deployed	103	79	103	
July	355	-	564	919
August	2477	3631	648	6756
September	2675	870	328	3873
October	247	20	96	363
Total	5754	4521	1636	11911

The highest number of detections was recorded in Ben Eoin by BD1. BD3, deployed nearby, did not detect nearly as much activity; about 3.5 times as many bat passes were recorded by BD1. Overall, the habitat conditions in the two locations are similar; however, BD1 was deployed further from the road and has a somewhat larger open feeding area. The difference in activity between these two locations demonstrates the importance of fine scale site selection in bat detector deployment.

Although it was deployed for 40 days fewer than detectors 1 and 3, BD2 recorded almost as many calls as BD1. Roughly 80% of all calls recorded by BD2 occurred in August. The majority of calls at BD1 were recorded in August and September, with a similar number of calls recorded each month. Curiously, calls were distributed fairly evenly across the monitoring period at BD3.

The pattern of bat activity from dusk to dawn is shown in Figure 4 as the proportion of calls recorded each month that occurred during each hour. In July, there are obvious spikes in activity around dusk and dawn, with a consistent low activity level in between. This trend is not as pronounced for any other month, although there seem to be spikes in activity at dusk during October and September, and higher activity around dawn in August. Earlier emergence and later retirement are also evident in later months, corresponding with the longer nights in September and October.

The number of bat passes recorded each day is shown in Figure 5. The number of calls recorded can vary considerably from day to day; wind, rain, and other weather conditions can interfere with the hunting techniques of bats and reduce their activity level. Long-term monitoring is therefore necessary to capture an accurate record of bat activity in a given area.

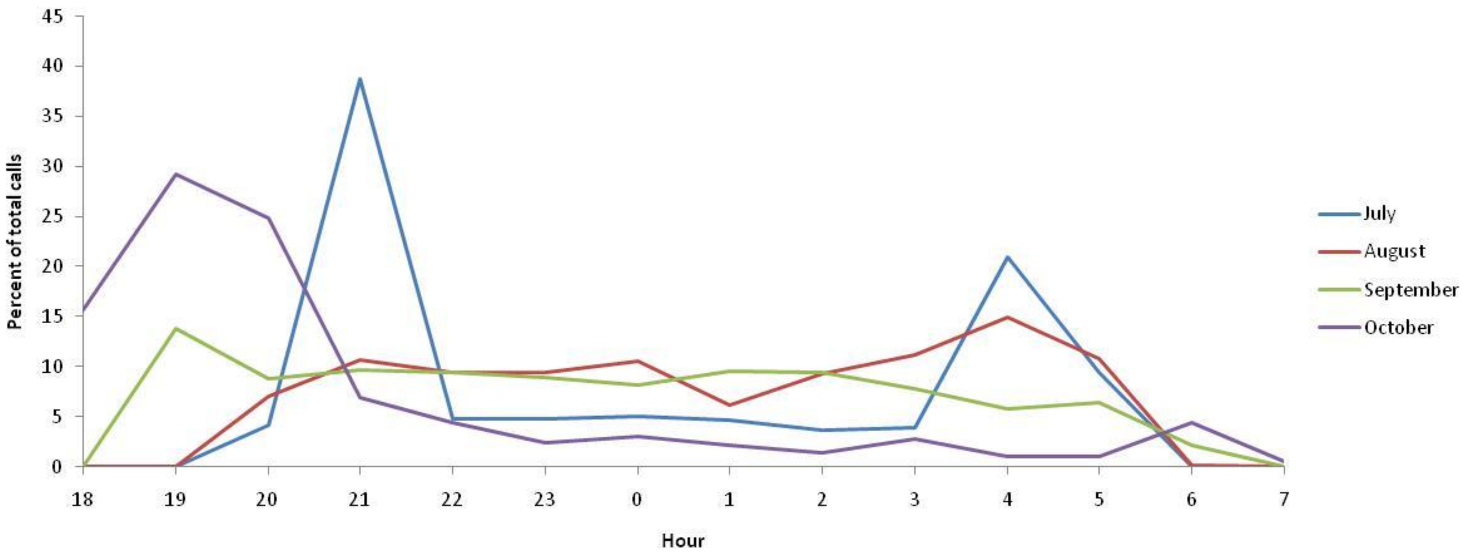

Figure 4. Percentage of total monthly bat passes occurring during each hour from July to October.

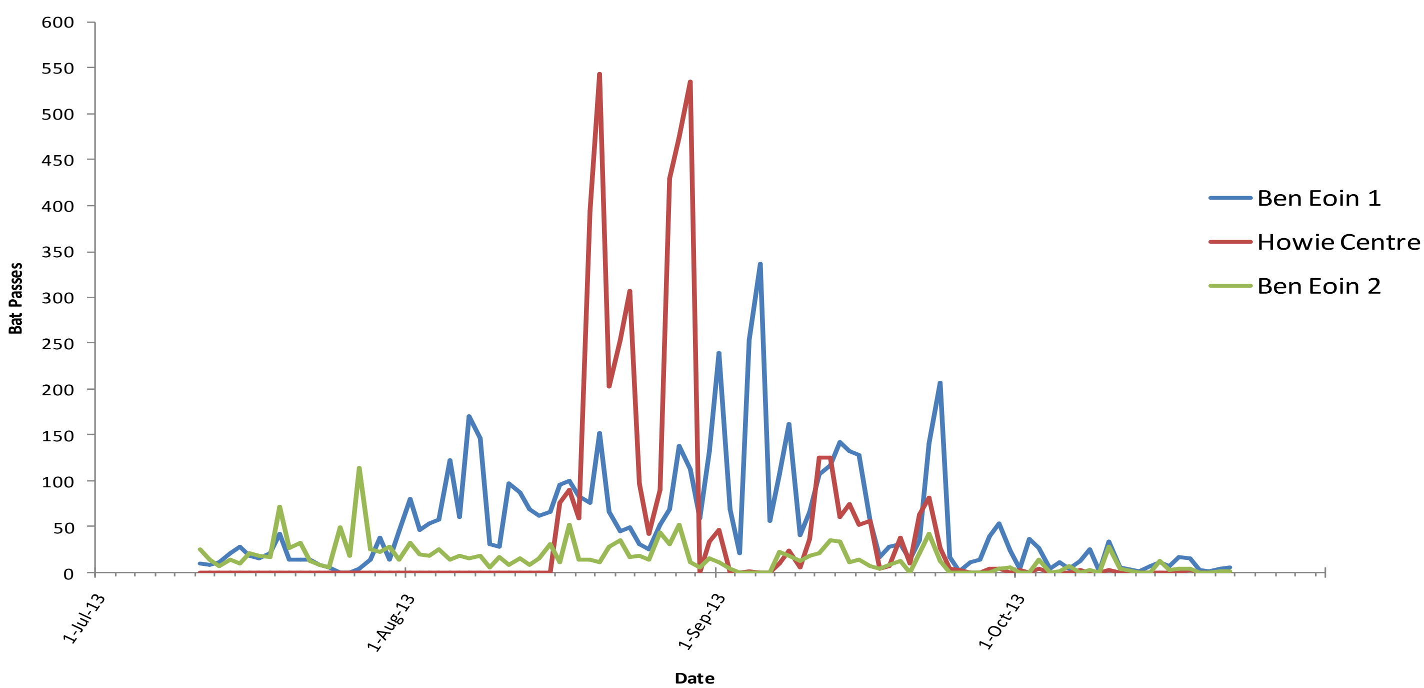

Figure 5. Number of bat passes recorded each day at monitoring sites from July to October 2013.

Objective 2 – Monitor hibernacula for signs of white-nose syndrome

Bats should be almost entirely inactive during the winter months; they wake for brief periods every couple of weeks to drink or defecate, and then re-enter hibernation. White-nose syndrome disrupts this pattern by waking bats from hibernation more often, causing them to deplete the fat they rely on to survive the winter. As a result, the bats often leave the hibernaculum in search of food and subsequently starve or freeze to death. Therefore, detection of high levels of activity or signs of feeding behaviour during the winter months are highly indicative of white-nose syndrome.

Part of the difficulty of monitoring bats in this area during winter months is that the locations of their hibernation sites are not known. Monitoring potential hibernation sites allows us to positively identify sites as hibernacula (if bats are detected at all), determine which sites do not seem to be hibernacula (if no signs of bat activity are detected), and whether white-nose syndrome is present (if excessive activity is detected).

Three detectors were deployed for winter monitoring. Two detectors were deployed at different openings at an abandoned mine site in Grand Mira and a third detector was deployed at a cave in Victoria County. The status of these two locations as hibernation sites was uncertain. Bats had been observed in the cave during the summer months by local cavers, and their descriptions of the cave environment indicated that it might be suitable habitat for hibernation. The mine site was chosen for monitoring because of its conditions. It is located in a cleared area surrounded by forest, which are good feeding conditions for bats, and the mine has not been used by humans for more than 30 years.

Abandoned mine – Grand Mira, NS

The monitoring site in Grand Mira is a former lead mine that was decommissioned in 1981. There are three entrances to the mine, an adit, a vent shaft, and a fan shaft. The two entrances monitored are located in a cleared valley surrounded by extensive forest.

One bat detector was deployed at the adit entrance on 21 January 2014 (setup shown in Figure 6). The bat detector and batteries were both deployed in protective cases at ground level. The microphone was hung inside the metal tube through a hole roughly 1m above the ground. A number of other small holes are present in the structure which could be used by bats to enter or exit the mine.

A second bat detector was deployed at a shaft entrance on 13 February 2014. In this case, the microphone was hung down into the shaft through a hole at ground level so that the microphone was positioned underground.

Figure 6. Setup of stationary detector at abandoned mine in Grand Mira, NS.

Dissolution Cave – Victoria County, NS

The monitoring site is a dissolution cave located in an extensive gypsum deposit in Victoria County. A stream runs along a large gypsum outcropping and into the main entrance to the cave. Apart from this entrance, there are also several "skylights," or holes which lead to the main tunnel located on top of the gypsum outcropping. It is surrounded by karst terrain, and is very difficult to access.

One detector was deployed at a small skylight on 23 February 2014. The microphone was hung just above the hole in order to capture both the calls of any bats exiting through the skylight as well as any activity taking place within the cave but near the exit.

Objective 3 – Creation of educational "Bat Booklet"

The bat booklet, "An Introduction to Bats in Cape Breton" was completed in September 2013. The booklet contains basic information about bat biology, echolocation, white-nose syndrome, local species, and ACAP's bat monitoring project. It also offers readers tips about what they can do to help prevent the spread of white-nose syndrome and how they can help their local research and conservation effort. The booklet was distributed to bat walk participants, information session attendees, and participants at other ACAP events. Several booklets have also been placed at winter deployment sites to explain the bat detectors to any who stumble upon them.

A copy of the bat booklet accompanies this report and is available for download on ACAP's website: www.acapcb.ns.ca.

Objective 4 – Public outreach

Guided Bat Walks

Two guided night-time bat walks were held in September 2013. Both walks began at 7:30 and lasted until approximately 9:00pm. Before beginning the walk, a brief presentation was given to ensure all participants had a basic understanding of bat biology and ecology, white-nose syndrome, and ACAP's bat project.

The first walk was held 5 September 2013 at the Baille Ard Nature Trail in Sydney and was attended by 60 people (Figure 7). Bats were detected within the first few minutes of the walk at the trail entrance in an open area surrounded by trees, and bats were easily seen flying overhead. Bats were detected in several other locations throughout the entire duration of the walk. Small groups also visited the demonstration set-up of the stationary bat detector.

The second walk was held 6 September at the Sandy Beach Boardwalk in Main-á-Dieu. Twenty-five people attended. The weather conditions were not ideal for bat activity, however bats were still active and detected over the duration of the walk.

Figure 7. Bat walk participants at Baille Ard Trail in Sydney, NS on 5 September 2013.

Public information session

A public information session was held 28 January 2014 and was attended by 26 people. The audience included bat researchers from Cape Breton University and Saint Mary's University, local cavers and outdoor enthusiasts, and community members. The presentation included basic information about bat biology and local species, an explanation of white-nose syndrome signs and spread, an overview of ACAP's bat project, and the results of our summer monitoring. A question and answer period followed, and bat booklets were distributed.

Surveys were handed out before and after the public information session presentation to determine how much knowledge of bats improved among participants. The survey consisted of 4 sections:

- A self-assessment of knowledge level about bats
- True/False questions about basic bat biology and white-nose syndrome
- The mortality rate of WNS (multiple choice)
- A short description of one thing that can be done to aid bat conservation or research

Some improvement in knowledge of bats was observed on all but one survey, which was filled out correctly prior to the presentation. The results of the other questions are summarized in Table 2. "Correct prior" indicates that the participant answered correctly on the pre-survey. "No improvement" indicates an incorrect response (or no response) on both surveys, and "improvement" indicates that a correct response was received on the post-survey but not the pre-survey.

Four participants self-reported that they felt more knowledgeable after the presentation; all other participants reported that they felt they had the same level of knowledge. The only question that was answered incorrectly after the presentation was "White-nose syndrome can be spread by humans."

Table 2. Improvement in knowledge of bats and white-nose syndrome after public presentation as determined by pre- and post-surveys.

Question	Correct prior	No improvement	Improvement
Basic bat info	5	1	12
Mortality rate	12	0	6
Bat conservation	3	3	12

Summer and winter Day Camps

In addition to the above events, the bat project was included in three summer day camps (one each in Sydney, North Sydney, and Glace Bay, NS) and one March break day camp (Sydney, NS). One day out of each week-long camp focused on learning about bats, and included a brief interactive presentation by staff working on the bat project. The rest of the day was filled with games and activities designed to reinforce the information learned in the presentation; one of the bat crafts created is shown in Figure 8. A total of 57 children attended all four day camps.

Figure 8. Children at summer Day Camp in Glace Bay, NS displaying bat crafts.

Conclusions

Monitor bat activity in summer habitats

The use of stationary acoustic bat detectors is an effective method of monitoring bat activity levels in a single area over a long period of time. Given the variation observed in activity levels day-to-day, monitoring over long time periods is necessary to capture an accurate picture of typical levels of bat activity.

Bat detectors 1 and 3 were deployed close to each other in very similar habitats, but BD1 detected over 3 times more bat passes than BD3. The difference in activity between these two locations demonstrates the importance of fine scale site selection in bat detector deployment.

Monitor hibernacula for signs of white-nose syndrome

So far, no bat activity has been detected at winter monitoring locations, and no dead or day-flying bats were observed near the sites. Detectors are still deployed at both sites in case previously undetected bats emerge from the site in spring. White-nose syndrome has continued to spread across North America and other Canadian provinces, and so winter monitoring should be continued in anticipation of its eventual arrival on Cape Breton Island.

Creation of educational "Bat Booklet"

The bat booklet is an excellent tool for quickly introducing people to basic information about bats. Although it took significantly more time to produce than anticipated, it will be useful for bat education in future years of the bat monitoring project.

Public outreach

The bat walks provided an opportunity for interested people to see and hear bats in a way that isn't typically available to the general public. Bat walks are fun, family-friendly activities that provide unique and interesting public education opportunities. Additionally, they draw people into environments that are familiar in the day but unfamiliar at night, allowing them to experience their local ecosystem in a new way. Overall, the events were very successful and resulted in a great deal of positive feedback.

The public information session allowed for detailed information about bats to be transferred to interested members of the public in a way that the bat walks did not. Knowledge of bats and white-nose syndrome among participants improved as a result of attending the presentation, and participants also learned how they could contribute to the conservation effort. The only question that was answered incorrectly after the presentation was "White-nose syndrome can be spread by humans"; more clarity on this point will be necessary in future presentations.

Day camps are a great platform for educating children through engaging activities. The children that attended the day camps were very enthusiastic about bat conservation and seemed to enjoy the experience.