**Public Engagement Accelerator Fund – Final report**

**Funded project: Producing a handbook for conducting bat echolocation research**

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**Abstract**

Bats are a diverse group who provide important ecosystem services around the world. Many bat species are at risk and require informed management. Researchers may study bats using acoustic methods; that is, deploying “bat detectors” to record the echolocation calls of flying bats. Recordings may be analyzed and even identified to species. Conducting acoustic studies requires significant expertise: it can be really challenging for novices in the field to gain the necessary skillset to conduct high quality research. We partnered with Bat Conservation International (BCI), a US-based non-governmental organization, to produce an edited online book (“Bat echolocation research: A handbook for planning and conducting acoustic studies”) summarizing best practices for each step of the process required to research bats using acoustic methods. We aimed to (i) create an internationally relevant and comprehensive resource that would (ii) contribute to increasing the quality of acoustic research of bat populations; and (ii) empower people in decision-making positions to critically assess such research. Production of the book was a collaborative effort, involving input from members of the bat research community at every stage, including crafting the outline, generating the text and figures, and reviewing the final product. The final document is the product of greater than 50 written, acoustically recorded, and photographic contributions from expert bat biologists around the world and is now freely available through Bat Conservation International ([www.batcon.org/Handbook](http://www.batcon.org/Handbook)). We anticipate that this resource will be heavily used, particularly by scientists and students who are new to bat acoustic research techniques. It is particularly timely, as the COVID-19 crisis has necessitated the suspension of all but the most critical bat research involving live bat capture. As a result, many bat researchers are turning to less invasive acoustic monitoring methods to continue their work. The project resulted in mutual benefit to both MUN and BCI and contributed to several MUN Public Engagement Fund objectives, including mobilizing knowledge and expertise in support of the public (environmental) good; connecting university expertise to non-degree learning opportunities; and contributing to building greater capacity for researchers around the world (including external partners and collaborators).

**Background**

Bats are an important group of mammals that provide several key ecosystem services, such as plant pollination and management of agricultural insect pests. Bats are estimated to contribute $3.7B+ to the North American agricultural industry. Globally, many bat species are at risk, particularly in North America where multiple populations have declined dramatically. In response to these declines, there has been an increase in government-mandated bat population monitoring. These studies provide crucial information about bat populations and inform conservation and management decisions. Frequently, bat monitoring is conducted by government or industry biologists who are not bat specialists.

Researchers often survey bats using passive acoustic monitoring devices (“bat detectors”) that detect and record echolocation calls of local bats. The resulting recordings are analyzed and identified to species in order to quantify bat activity and species presence. The problem is that acoustic monitoring is not straightforward. Novices to the field must select among a dizzying array of hardware and software choices to collect and analyze data. Ultimately, tremendous quantities of data are collected and are in a form (high frequency audio recordings) that most biologists have never seen. There is a very real potential for the uninitiated to collect and process data poorly, resulting in false conclusions that can have significant negative conservation consequences. While some resources exist on acoustic bat research techniques, many of these are out of date, as the field progresses very quickly. A number of excellent bat survey field courses exists, but all are at significant cost and are not universally accessible.

The aim of the present project was to mobilize the large body of academic research on best practices for acoustic monitoring of bats in a free and easily accessible format. In doing so, we hoped to meet three objectives:

(i) to create a comprehensive online resource for use by government, industry, and academic biologists when planning and conducting acoustic monitoring of bats around the world.

(ii) To increase the quality of data collected and analyzed in bat acoustic monitoring studies so that conservation and management decisions can be made with the highest level of confidence possible; and

(iii) To provide sufficient background information for government managers to be able to assess bat acoustic monitoring studies.

We aimed to meet these objectives by producing a brief but comprehensive, freely available online book (“Bat echolocation research: A handbook for planning and conducting acoustic studies”, hereafter the “Handbook”) that would summarize key information on planning and conducting bat echolocation research.

**Process**

Creating the Handbook was a collaborative process that began at the International Echolocation Symposium, a conference that occurred in Tucson, Arizona in 2017. An objective of the Symposium was to bring together academic researchers of echolocation; practitioners of echolocation monitoring methods, such as government and industry biologists; and engineers and vendors who design and sell echolocation monitoring equipment. I worked with two colleagues (Dr. Mark Brigham, University of Regina, and Dr. Alex Silvis, West Virginia Division of Natural Resources) to form the editorial team for the Handbook. We held four open meetings over the course of the symposium, during which we facilitated guided discussions with all interested conference participants with the aim of developing a structure and outline for the Handbook. One important point that emerged from these discussions was the need to create a resource with international relevance. There is undoubtedly a North American and European bias in bat research, but bats live around the world and many populations outside of North America and Europe have received very little study. The editorial team identified internationalization of the book as a top priority in the project.

Following the conference, we circulated the draft outline to all conference participants and made some final changes in response to their feedback. We then solicited contributions (written, photo, and examples of recorded echolocation calls) from targeted experts to complete the Handbook. We made a concerted effort to seek out examples and case studies from around the world and structured the Handbook to include guidance on conducting research in areas with varying levels of pre-existing knowledge about local bats. Because the goal of the Handbook was to be an instructional document, we felt it necessary that it read as if written by one voice and we received permission from all authors to make small modifications to their contributions in order to achieve this flow. We partnered with Bat Conservation International (BCI), a US-based non-governmental organization, to successfully apply for a MUN Public Engagement Accelerator Fund, which allowed us to pay for editing and copy-editing services to create a clear, easy-to-read professional document. Following the completion of the Handbook, we requested that four expert bat biologists including people in academia, government, and industry, review the Handbook. We updated the document in response to their feedback.

The completed Handbook contains contributions from 52 expert bat biologists around the world and is now freely available using the links below. It contains content (photos, recordings, case studies) from all six continents of the world where bats are found. We are working with staff at BCI to make it possible to also navigate to the Handbook through their website and anticipate that this will be possible soon.

*Permalink:* <https://www.batcon.org/wp-content/uploads/2020/09/Bat_Echolocation_Research_2nd_Ed_20200918.pdf>

*Friendly link:* [www.batcon.org/Handbook](http://www.batcon.org/Handbook)

**Demonstration of mutual benefit and contributions to Memorial’s Public Engagement Framework**

1. *Production of the Handbook was an* *exciting opportunity for MUN to engage with an international community of biologists* by filling a major knowledge/resource gap. Engagement occurred between the university and the international organization, BCI, as well as with an international team of editors and contributors.
2. *The final Handbook* *directly contributes to the strategic goals of BCI*, which centre around conserving bat populations globally, including accelerating scientific research on bats. Inextricably linked to these goals is the ability, by partner organizations and members of the general public, to monitor and research bats using best practices. The Handbook provides a resource to improve the quality of bat research using acoustic methods.
3. *The Handbook mobilizes knowledge and expertise in support of the public good*. Much of the expertise on the best techniques and strategies for acoustic monitoring of bats is published in fee-for-access academic journals or simply in the heads of highly experienced bat biologists. The freely available Handbook, authored entirely by members of the bat acoustic research community, places some this academic knowledge in a form that is easily accessible to the members of the public who need it.
4. *The Handbook connects university expertise (from the editorial team and contributors, including Dr. Fraser at MUN) to non-degree learning opportunities* by acting as an important and timely training document. The Handbook is particularly targeted at trained biologists who nevertheless are novices to bat acoustic monitoring. We anticipate that most users will be professional scientists working for governmental agencies, non-governmental organizations, or environmental consulting firms, and who have already completed their formal biological training. It is our hope that the Handbook will support them in extending their skill set and so will be a valuable resource for professional development learning.
5. *The Handbook contributes to building greater capacity for researchers and managers around the world* by empowering them to more confidently plan, execute and assess mandated bat acoustic surveys, subsequently contributing to the overall body of knowledge about bat populations globally.

**Next steps**

We are planning a promotional campaign for the Handbook in the coming weeks. We will circulate a description of it to all bat advocacy groups and BCI has agreed to feature it in the next issue of their BATS Magazine. We have further requested that several mammal- and vertebrate-based journals review the resource through written book reviews.

**Contributions**

All parties involved in the project have met their commitments, as described in our funding proposal. The editorial team edited, produced, and authored parts of the Handbook. Bat Conservation International allowed us free use of their copyrighted photographs throughout the Handbook and are posting the final document to their website, where it will be available to the public for free download. Further, two members of the BCI staff authored components of the Handbook.