Report on the use of passive acoustic monitoring in Prince Edward Island National Park

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To run this report locally:

- Open RStudio or your preferred IDE
- Create a new project and set up for version control using the GitHub repository
- Pull from remote main
- Load the `pei.RData` file in the first chunk
- Render the document and review the results

Abstract

Passive acoustic monitoring has proven to be a valuable tool for monitoring vocalizing species. Environmental sensors are becoming increasingly easy to program and can autonomously generating extensive data sets of the soundscape, an invaluable resource for ecological integrity monitoring. Prince Edward Island National deployed autonomous recording units (ARUs) across 30 locations during a comprehensive five-year survey. The analysis revealed that species richness and diversity remained relatively stable, while single-species species occupancy exhibited diverse patterns. Common and generalist species showed consistent occupancy, but there was a notable reduction in conifer-nesting species in 2023, likely attributed to forest structural loss. Ongoing monitoring and dynamic models can yield more detailed and predictive results to ensure the continued maintenance of ecological integrity in the Park.

Land Acknowledgement

In the spirit of Reconciliation, we acknowledge that the land upon which this data was gathered is unceeded Mi'kmaq territory. Epekwitk (Prince Edward Island), Mi'kma'ki, is covered by the historic Treaties of Peace and Friendship. We pay our respects to the Indigenous Mi'kmaq People who have occupied this Island for over 12,000 years; past, present and future.

Introduction

Human activities have been identified as key pressures and contributors to the global decline in forest wildlife (Allan et al. (2017)). The repercussions of habitat fragmentation (Fahrig (2003)) and loss (Hanski (2011)), climate change (Mantyka-pringle, Martin, and Rhodes (2012), Sattar et al. (2021),

Allan, James R, Oscar Venter, Sean Maxwell, Bastian Bertzky, Kendall Jones, Yichuan Shi, and James EM Watson. 2017. "Recent Increases in Human Pressure and Forest Loss Threaten Many Natural World Heritage Sites." *Biological Conservation* 206: 47–55.

Fahrig, Lenore. 2003. "Effects of Habitat Fragmentation on Biodiversity." *Annual Review of Ecology, Evolution, and Systematics* 34 (1): 487–515.

Hanski, Ilkka. 2011. "Habitat Loss, the Dynamics of Biodiversity, and a

Abrahms et al. (2023)), and increased access to sensitive areas exert direct and indirect pressures on forest biodiversity, particularly in managed regions in Canada (Lemieux et al. (2011)).

In 2019, Prince Edward Island National Park initiated a program incorporating autonomous recording units (ARUs) for passive acoustic monitoring (PAM) of the Park's wildlife. ARUs are compact environmental sensors that are designed to passively record the environment (Shonfield and Bayne (2017)), capturing vocalizing species like birds and amphibians, which is growing in use across the globe (Sugai et al. (2018)). This technology enables resource managers to conduct prolonged surveys with minimal human interference. The subsequent data collected by these units contribute valuable information to ecological integrity metrics such as species richness, diversity, occupancy, and trends over time. This data aids decision-making and management within the Park. Given the rapid and ease of accumulating data from these units, maintaining a high standard of data integrity is paramount to ensure future data interoperability and sharing. WildTrax is an online platform developed by the Alberta Biodiversity Monitoring Institute (**ABMI**) for users of environmental sensors to help addresses these big data challenges by providing solutions to standardize, harmonize, and share data.

The objectives of this report are to:

- Describe the data management and processing procedures for the acoustic data collected from 2019 to 2023;
- Utilize traditional human tagging, visual scanning and automated recognition techniques to detect and count species and individuals heard on recordings;
- Define straightforward methods for evaluating species presence, species richness, and species occupancy over time at various locations;
- Offer recommendations for ongoing monitoring approaches to contribute to the assessment of ecological integrity in forest ecosystems;
- Facilitate data publication to the public, resource managers, academic institutions, and any other relevant agencies

Lemieux, Christopher J, Thomas J Beechey, Daniel J Scott, and Paul A Gray. 2011. "The State of Climate Change Adaptation in Canada's Protected Areas Sector." *The Canadian Geographer/Le Géographe Canadien* 55 (3): 301–17.

Shonfield, Julia, and Erin M Bayne. 2017. "Autonomous Recording Units in Avian Ecological Research: Current Use and Future Applications." *Avian Conservation & Ecology* 12 (1).

Sugai, Larissa Sayuri Moreira, Thiago Sanna Freire Silva, Jr Ribeiro José Wagner, and Diego Llusia. 2018. "Terrestrial Passive Acoustic Monitoring: Review and Perspectives." *BioScience* 69 (1): 15–25. https://doi.org/10.1093/biosci/biy147.

Abrahms, Briana, Neil H Carter, TJ Clark-Wolf, Kaitlyn M Gaynor, Erik Johansson, Alex McInturff, Anna C Nisi, Kasim Rafiq, and Leigh West. 2023. "Climate Change as a Global Amplifier of Human–Wildlife Conflict." *Nature Climate Change* 13 (3): 224–34.