Utility of passive acoustic monitoring (PAM) to assess long-term patterns of songbird community composition within northeastern forests

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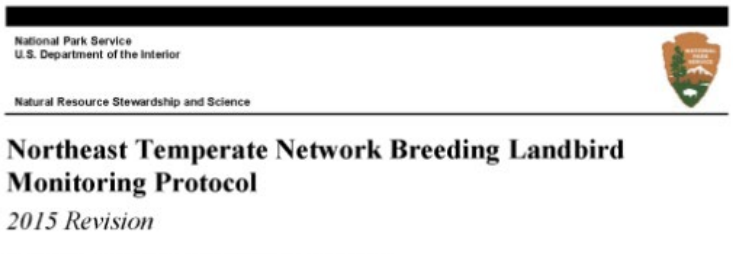
Landbird monitoring program

Objectives:

- Estimate trends in abundance of species breeding in park forests and grasslands
- Evaluate habitat condition based on community assemblage

Sampling Design:

- Annual point count monitoring since 2006
- ~240 permanent point count sites ME - NJ
- Number of sites per park is proportional to habitat area with sites separated by 250m
- Volunteer-based data collection


National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science

Northeast Temperate Network Breeding Landbird Monitoring Protocol

2015 Revision

Natural Resource Report NPS/NETN/NRR—2015/942

Faccio et al. 2015

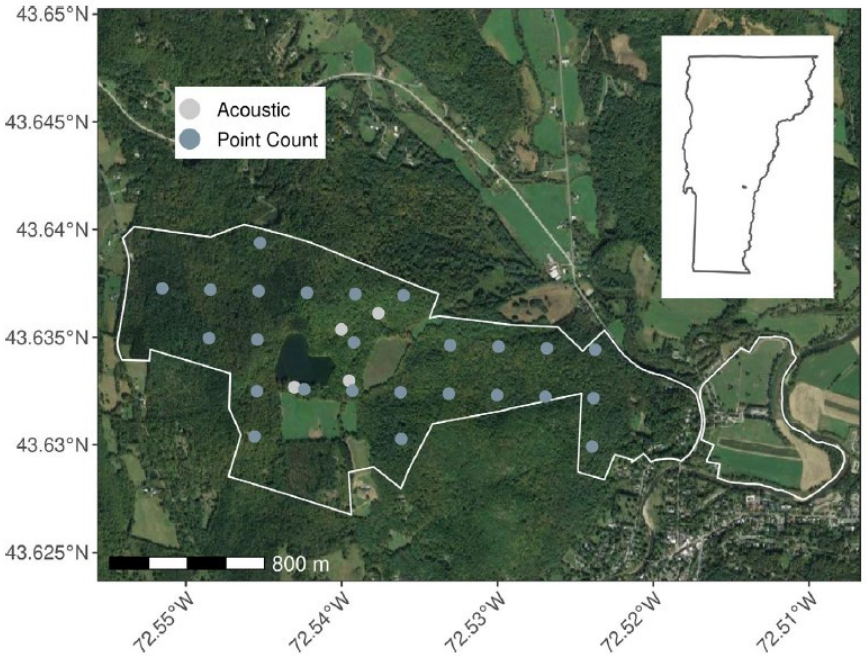
VERMONT CENTER FOR ECOSTUDIES
Uniting People and Science for Conservation

Sampling design in Woodstock, VT

Landbird monitoring program

- Our point count stations typically only get visited once annually for 10 minutes during peak breeding (limited sample)
- Point counts are conducted by many trained volunteers with variable experience (>100 since program started)
- Community level protocol - there is a wide range in relative abundances among species making occupancy and trend analyses tricky for less common species
- Park forest health is declining and bird communities are changing
- Sampling birds by acoustics could improve population estimates

Doser et al. 2020 Methods in Ecology and Evolution



Locations of acoustic recorders (white) and point counts (gray) in Marsh-Billings- Rockefeller (MABI) National Historical Park

Research Objectives

- Compare the Sampling Performance of Acoustic Recorders versus traditional Point Count Survey techniques.

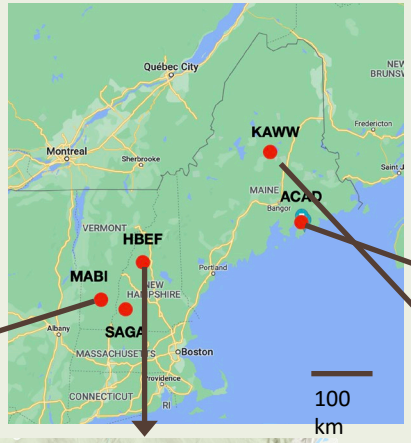
  Equal Sampling Effort: Assessing performance when total survey time is equal.

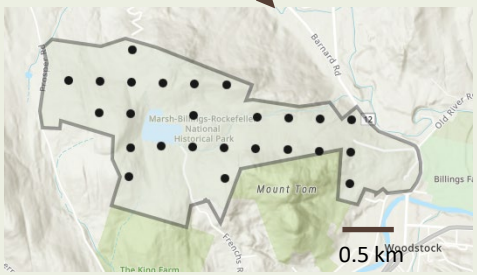
  Extended Effort: Performance gains achieved by longer duration acoustic recordings

- How do Automated Species Detection algorithms perform on sample avian communities?

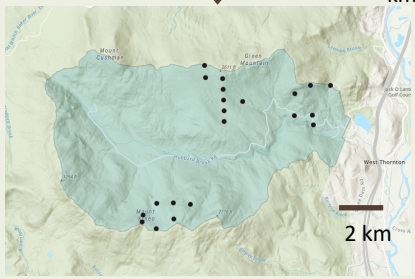
Effective Long-term Monitoring programs.

Study Sites

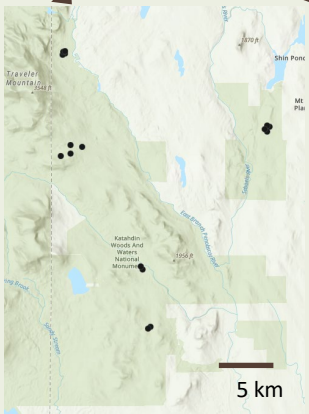




Marsh-Billing-Rockefeller NHP (MABI)



Hubbard Brook Experimental Forest (HBEF)

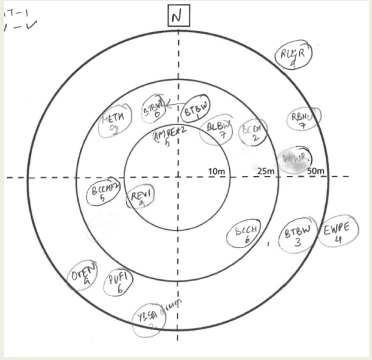


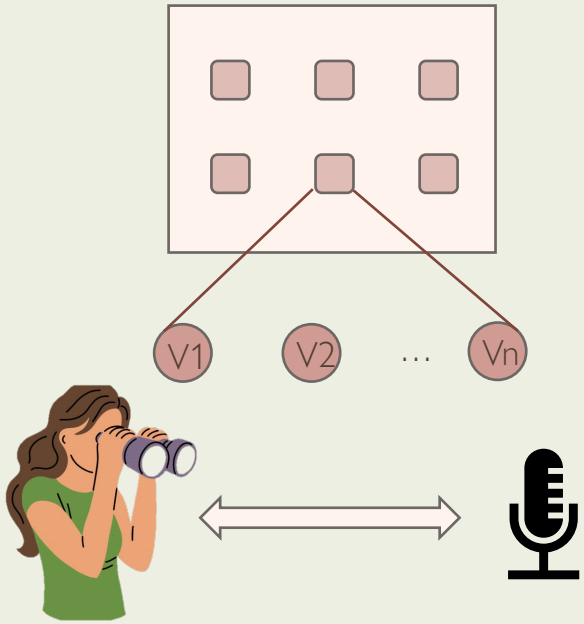
Katahdin Woods and Waters NM (KAWW)

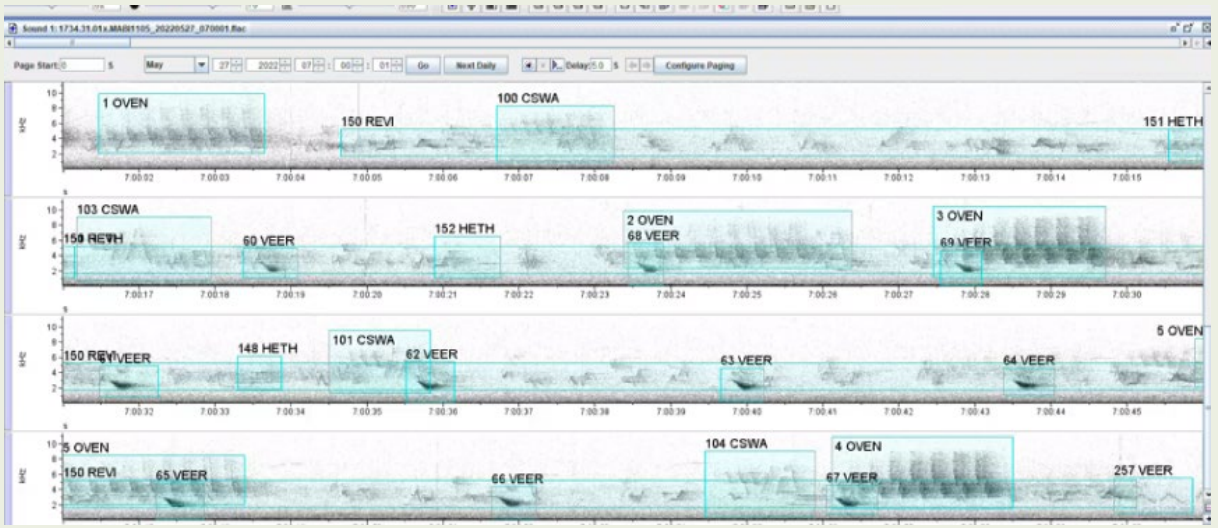
Acadia NP (ACAD)

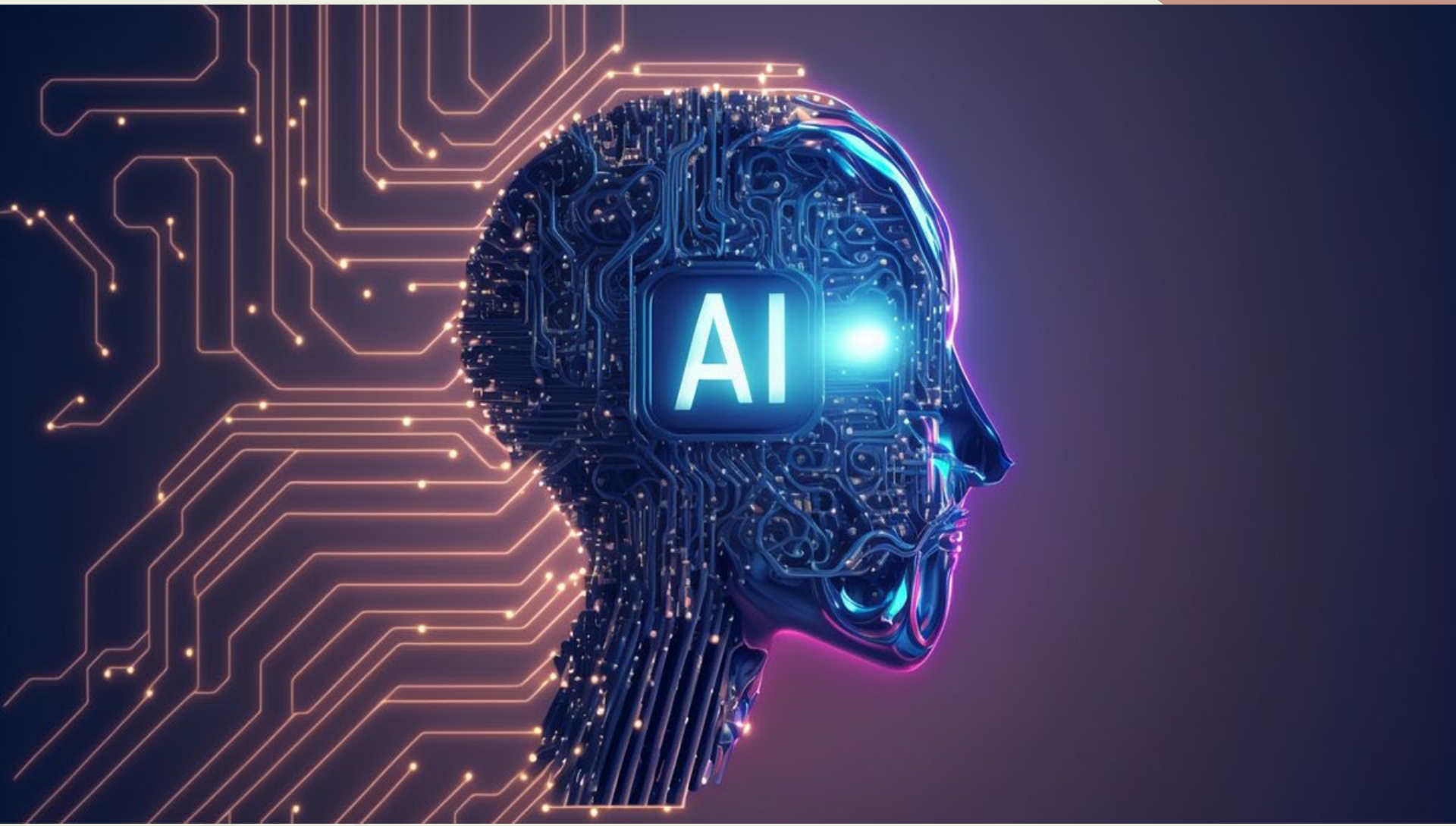
Data Collection

Data Collection

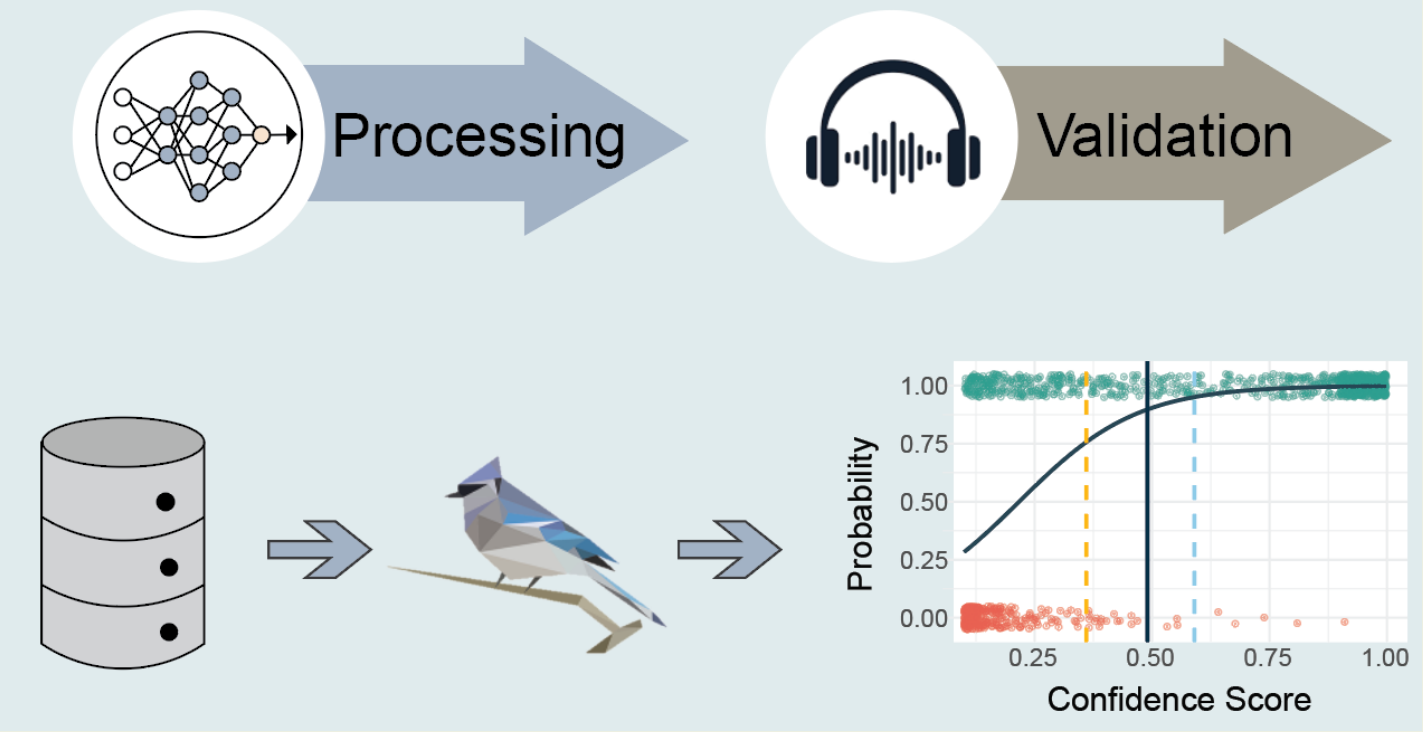




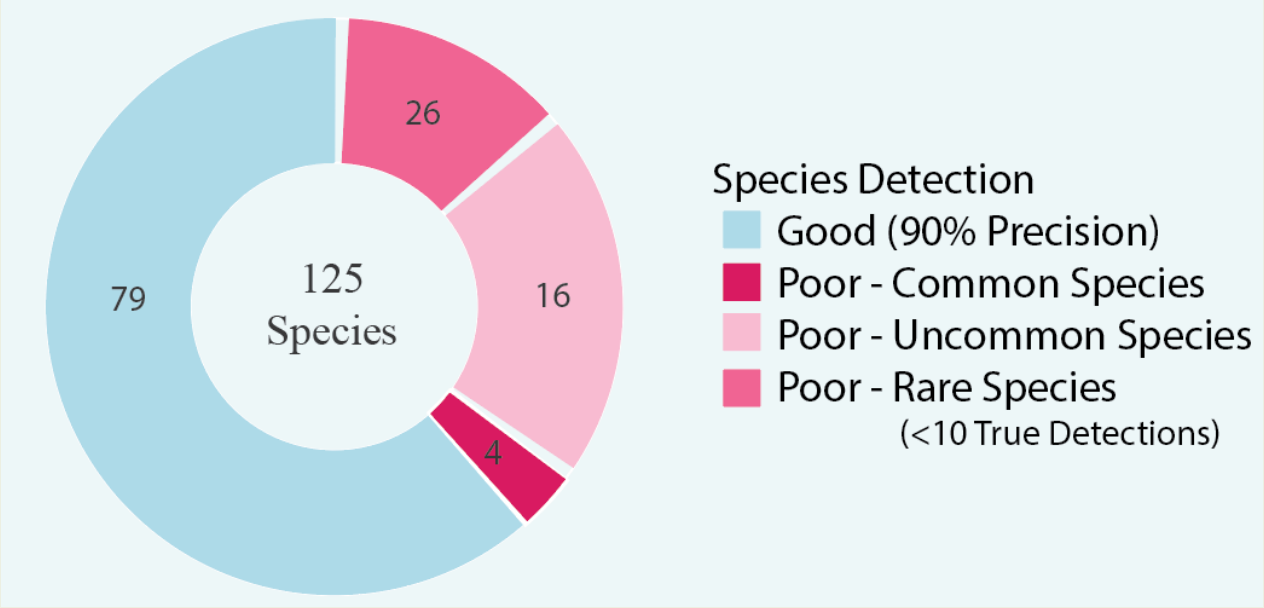



AI

BirdNET Workflow



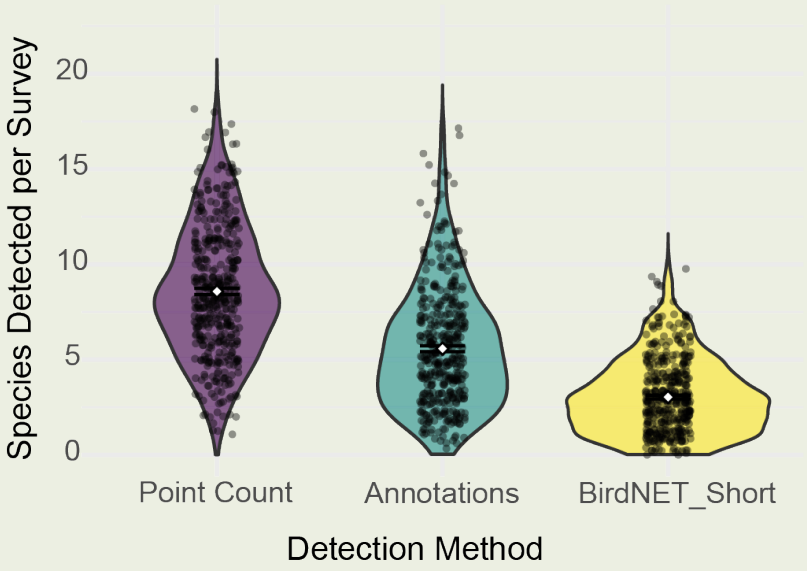
Overall Performance of BirdNET



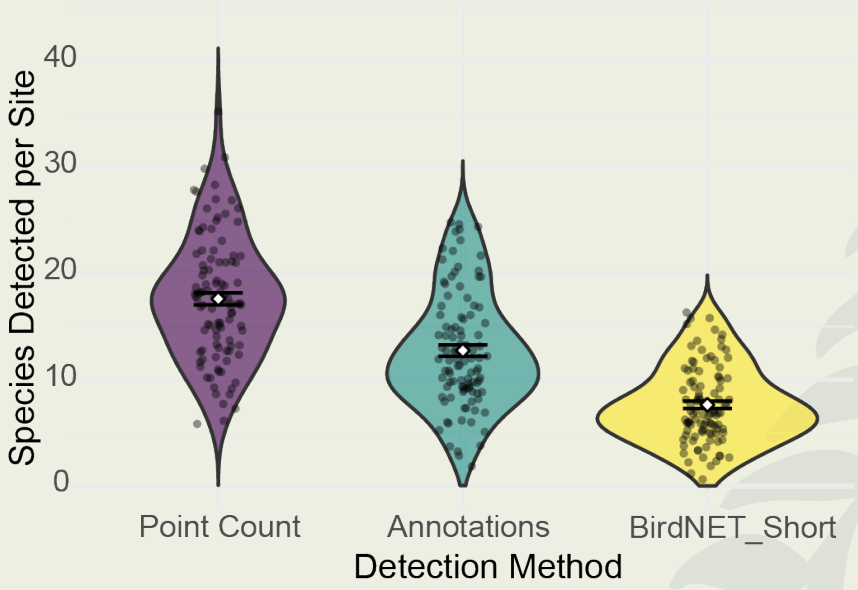
Where it does not work

Differences across Sampling Methods

Survey-level

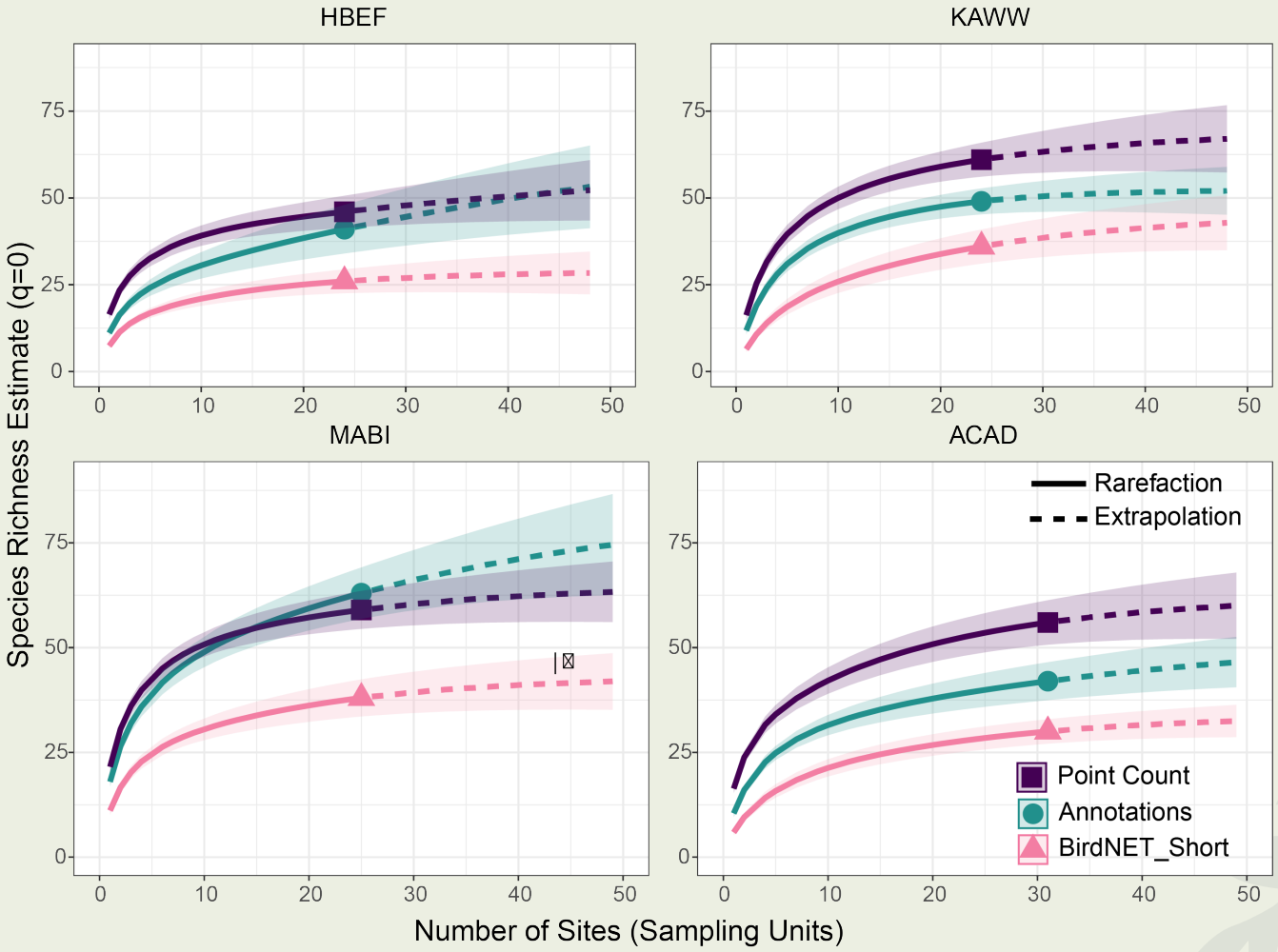


Site-level



Higher number of species detected in Point Count surveys compared to Acoustic sampling. BirdNET detected least number of species in similar sampling effort.

Species Accumulations



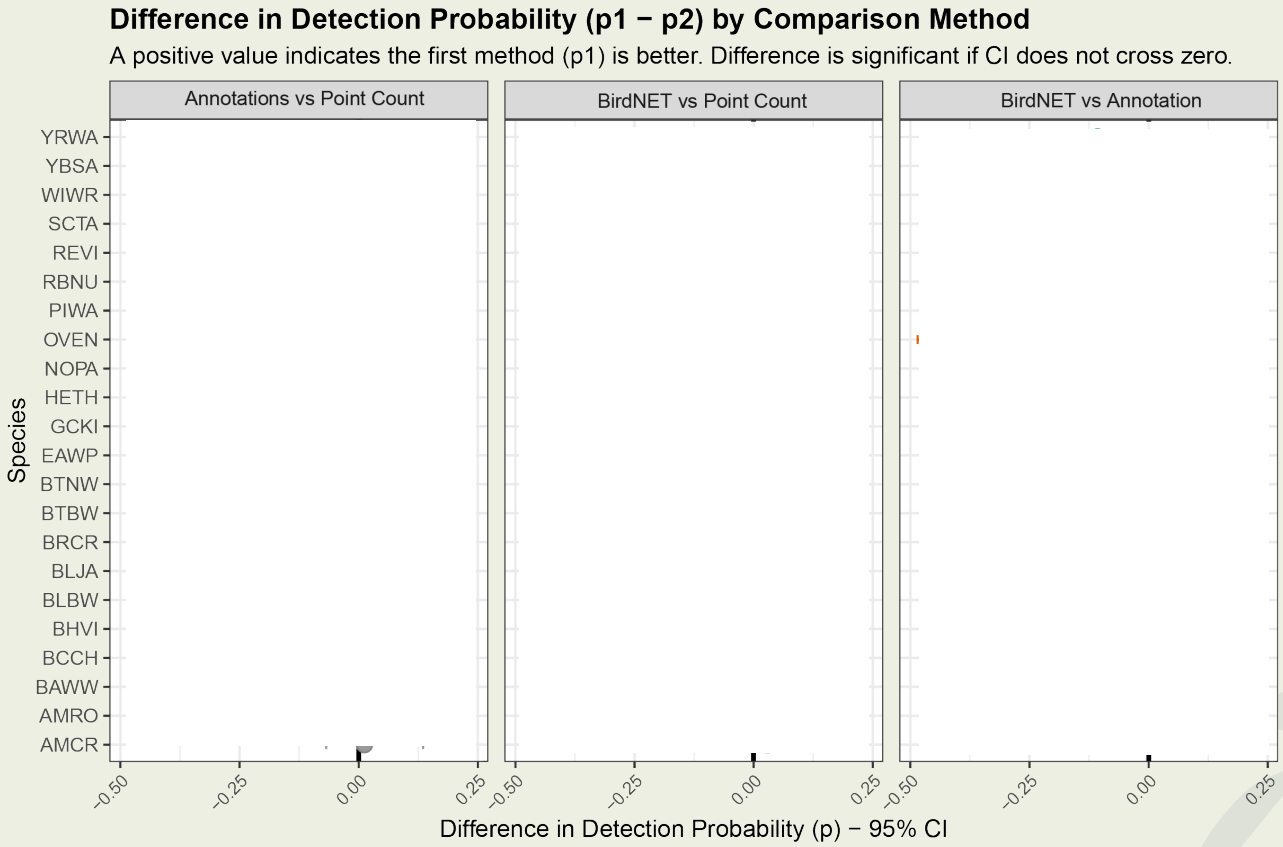
Detection Probability across Multiple Methods

State Model:

$Z_{i,j} \sim \text{Bernoulli}\ (\psi_{i,j})$ $\quad\quad$ $\text{logit}(\psi_{i,j}) = \alpha_{\psi,j}$

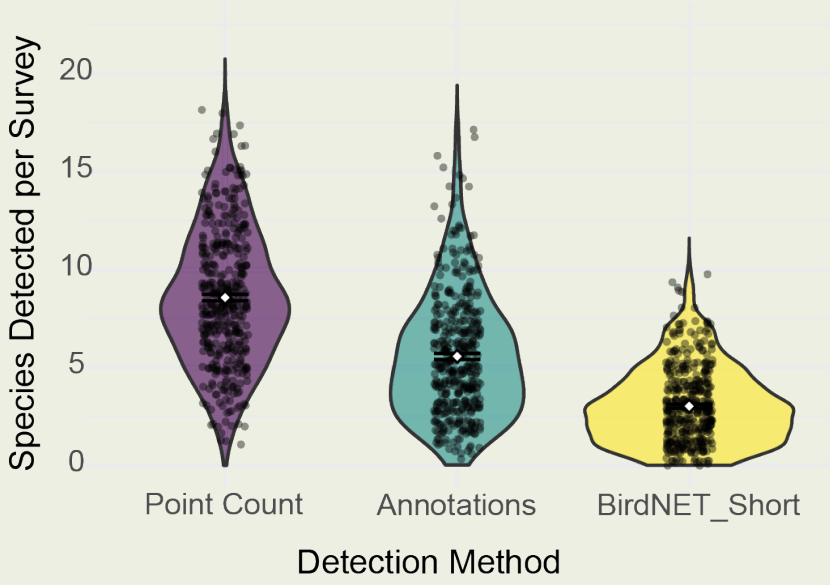
Observation Model:

$Y_{i,j,k} \sim \text{Bernoulli}\ (Z_{i,j} \cdot p_{i,j,k})$ $\quad\quad$ $\text{logit}(p_{i,j,k}) = \alpha_{p,j} + \alpha_{\text{Method},j,m} + \beta_{doy} \cdot doy_{i,k} + \beta_{time} \cdot time_{i,k}$

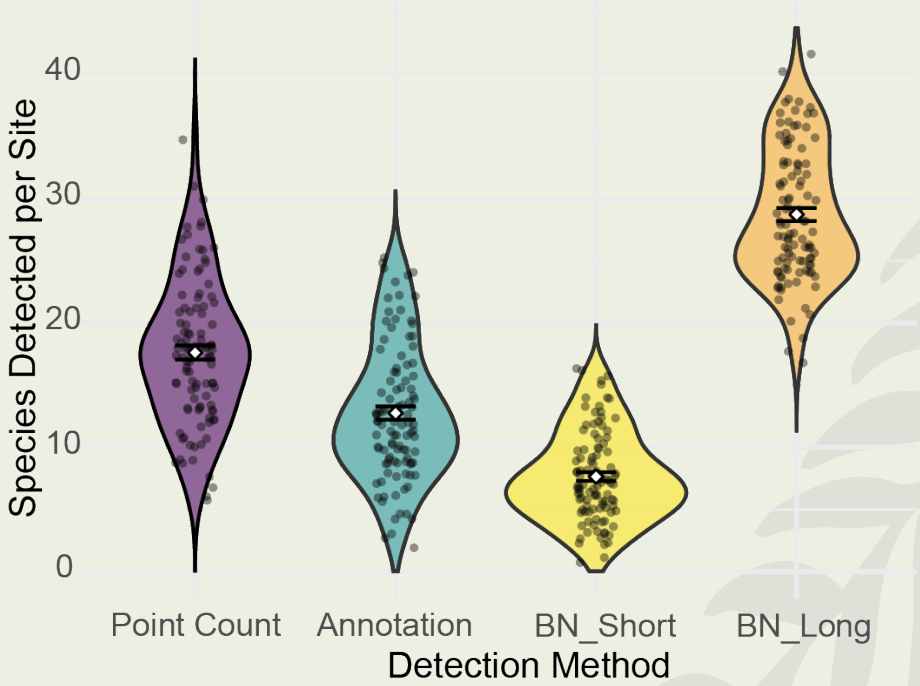


Differences across Sampling Methods

Survey-level



Site-level



Across longer Sampling period, BirdNET outperformed traditional sampling method

In Conclusion

- For equal sampling effort, traditional Point Count surveys performed better than Acoustic Sampling.
- However, with increased sampling effort, Acoustic Sampling with automated species detection (with BirdNET) outperformed Point Counts.
- BirdNET was able to detect 79 species with 90% precision, but a few common species were not reliably detected.

Next Steps:

- Optimizing acoustic sampling effort
- Improving birdNET performance with high quality training data.

Acknowledgements

Matt Ayres
Hannah ter Hofstede
Doug Bolger
David Lutz
Laurel Symes
(K. Lisa Yang Center for Conservation Bioacoustics, Cornell Lab of Ornithology)
Aaron Weed
(NPS Northeast Temperate Network)

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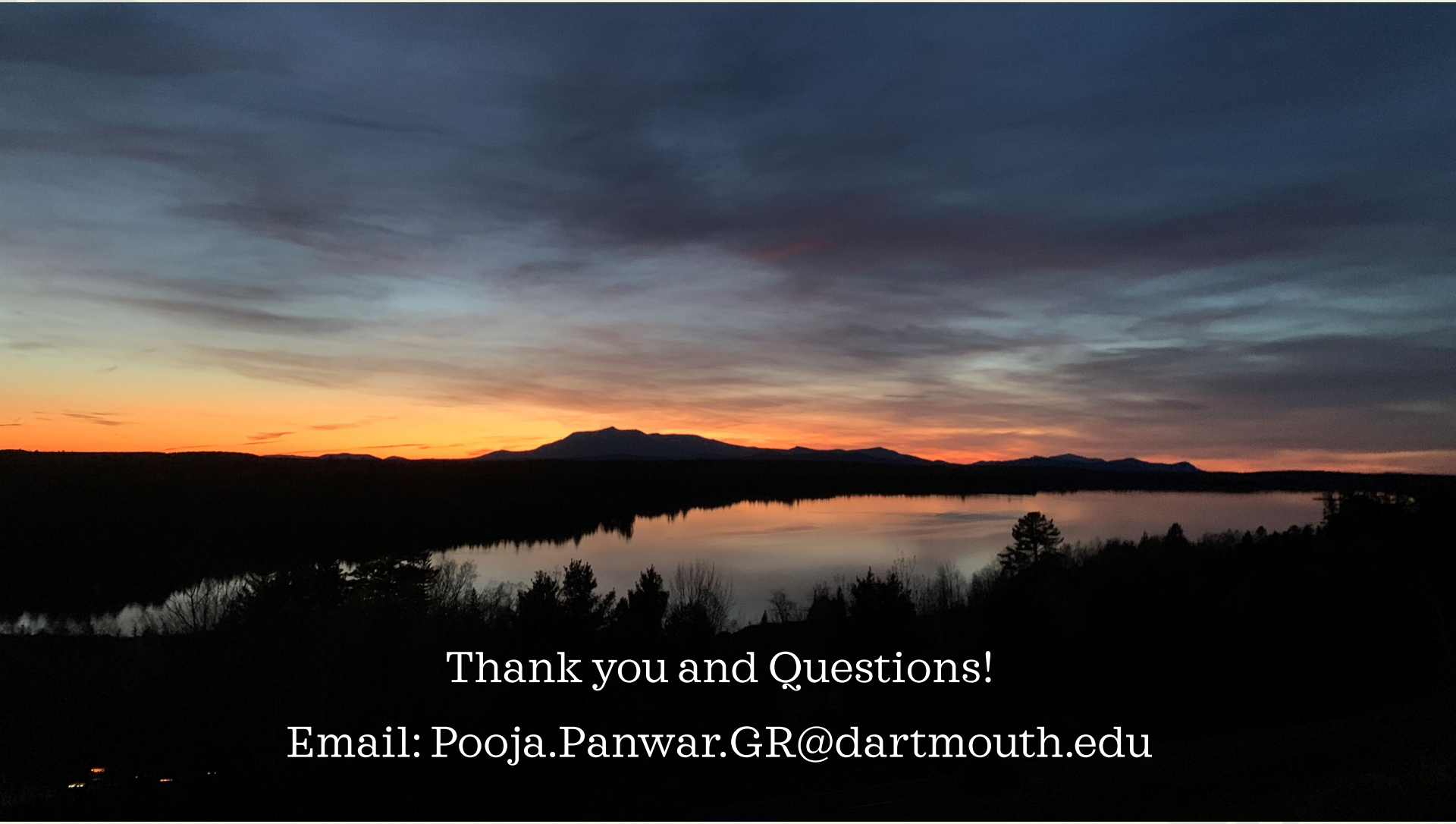
Field Technicians: Wyatt Cummings, Jack Roney, Jason Jiao, Evalynn Bogusz, Kristopher Moreno, Ada Marotzke, Derek Walsh.
Lab Tech: Jack Bushong, Wyatt Cummings, Brooke Goodman, Gillian Audier, Kyle Burton.







Thank you and Questions!
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