

# A Croak or a Chorus

Exploring Efficacy of the Marsh Monitoring Program (MMP) as a  
Tool for Single Season Habitat Inventories

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# The Marsh Monitoring Program



Est. 1995

- Long-term, trends over time
- Many Routes, many stations
- 3 survey periods
  - Early season (1-15 April)
  - Mid season (1-15 May)
  - Late season (1-15 June)
- 3 min passive listening / station
- Surveys >15 days apart

## Smooths effect of:

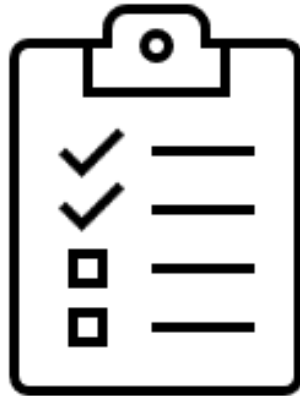
Variable survey conditions

Climatic variability

Short-term fluctuations in abundance

Small annual sample size,  
balanced by large aggregated  
dataset(s)

# Industry Application of the MMP

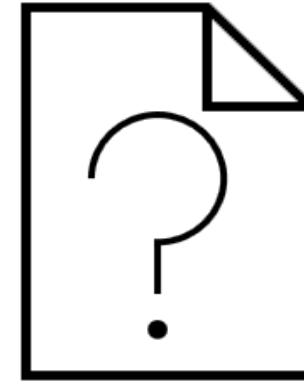


## How it's being used

Single season assessment

Inform habitat significance and sensitivity

Inform impact assessment, mitigation



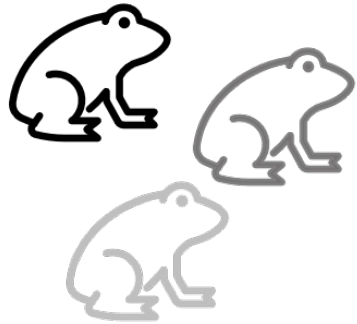
## Why it's being used

Widely established protocol

No study to indicate it's not effective in the way it's being used

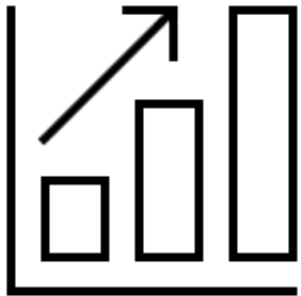
Lack of proven alternatives

# The 'Big' Question



Is the MMP an effective method to assess species richness and abundance in single season assessment practices?

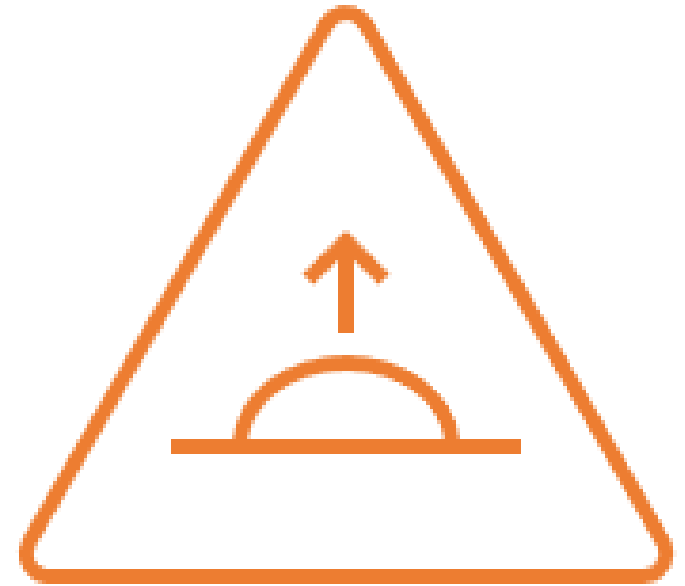
If no...



What alternative methods could increase assessment efficacy?



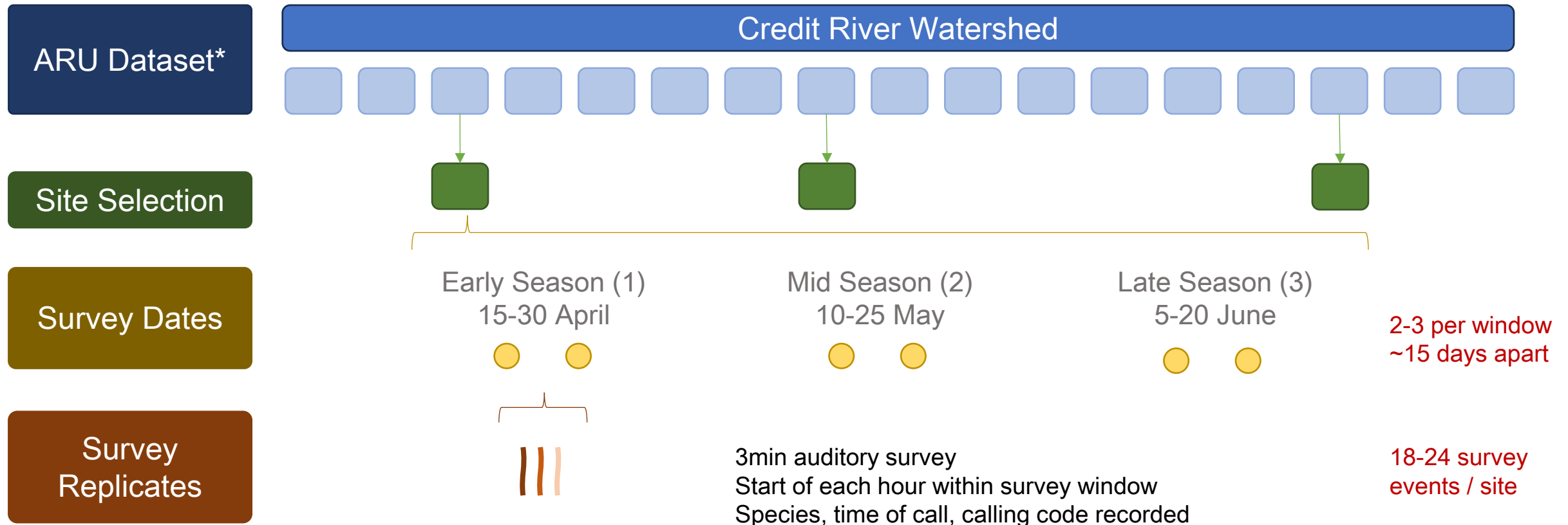
# Project In Progress



# Evaluating Efficacy

MMP as a Single-Season Assessment Tool

# Methods – Dataset Establishment

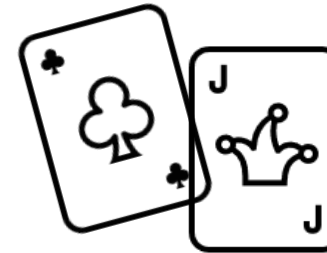


\*ARU data kindly provided by CVC to support this project.

# Methods – Species Richness

Survey Window	
#1 – Early Season April	←
#2 – Mid Season May	←
#3 – Late Season June	←

18-24 survey events / site, across all windows



## Monte-Carlo Simulation

1 replicate from each survey window = MMP Permutation

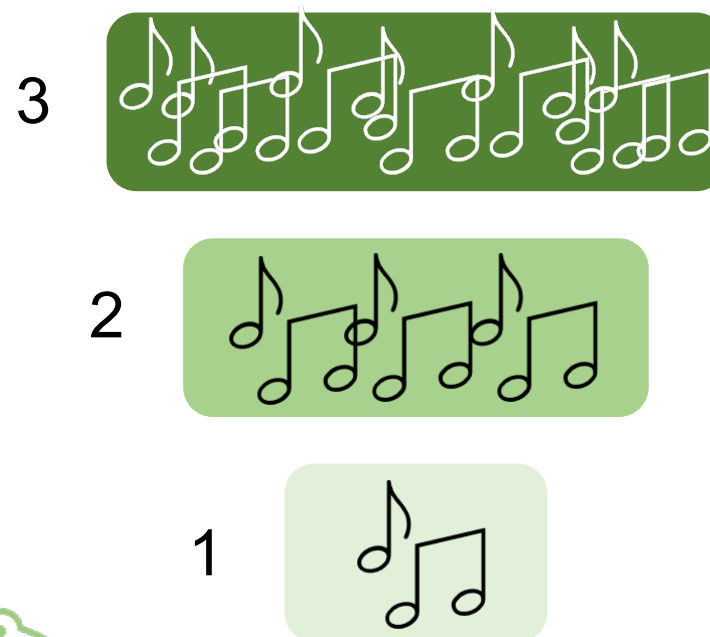
Every possible MMP permutation run for each site

# Methods – Abundance

## Basic Assessment

Total instances of each Call Code by species within a site.

% of instances at each call code to generally assess variability across call codes and as an estimate of the likelihood of capturing maximum call code.



# Results - Richness - Overview

## Species Richness

Total number of species captured across all survey replicates.

Periods observed.

## Simulation Results

Mean captured richness through iterations of MMP survey protocol application.

Likelihood of **full species richness** being captured through a single season MMP protocol.

Likelihood of **each species** being captured through a single season MMP protocol (graph).

# Results – Site 1

## Species Richness

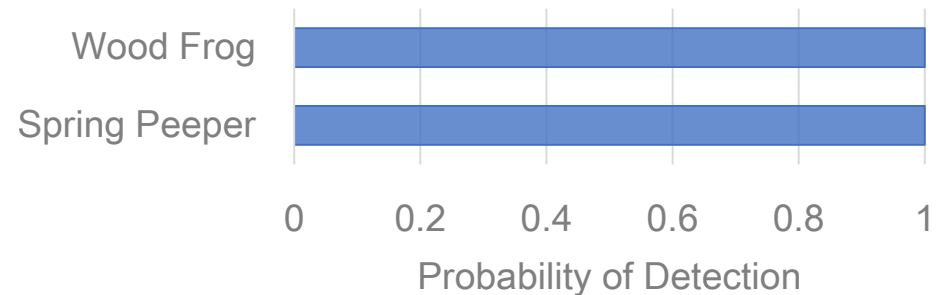
Species captured: 2

Species	Apr	May	Jun
Wood Frog	X		
Spring Peeper	X	X	

## Simulation Results

Mean Captured Richness: 2

100% chance of capturing the full species diversity with MMP



# Results – Site 2

## Species Richness

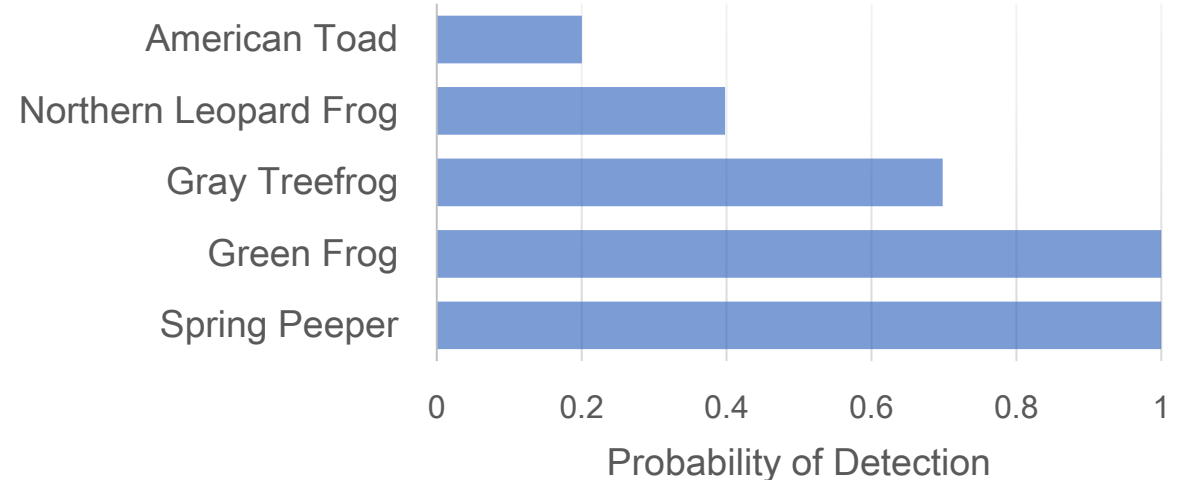
Species captured: 5

Species	Apr	May	Jun
Spring Peeper	X	X	
Northern Leopard Frog		X	
Gray Treefrog		X	X
American Toad		X	
Green Frog		X	X

## Simulation Results

Mean Captured Richness: 3.3

10% chance of capturing the full species diversity with MMP



# Results – Site 3

## Species Richness

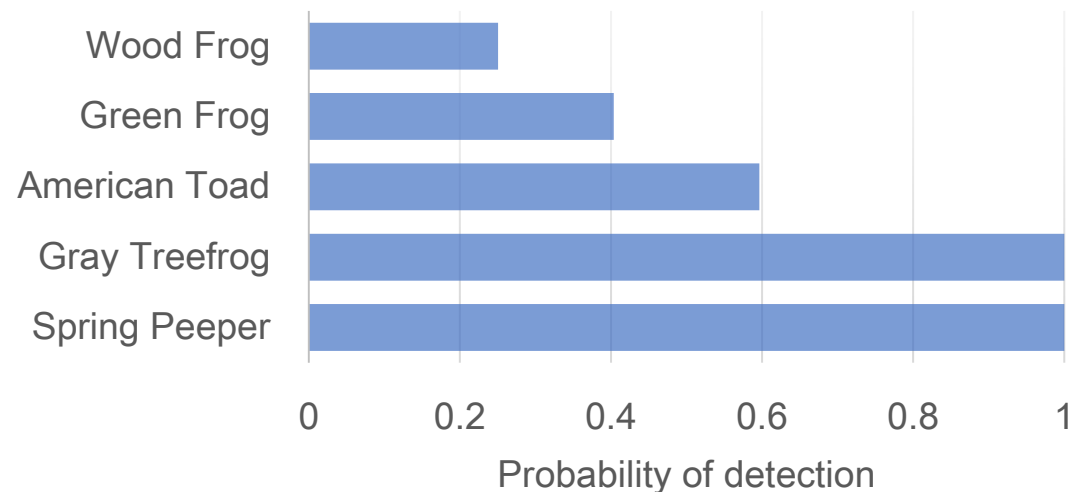
Species captured: 5

Species	Apr	May	Jun
Wood Frog	X		
Spring Peeper	X	X	
Gray Treefrog		X	X
American Toad		X	
Green Frog		X	

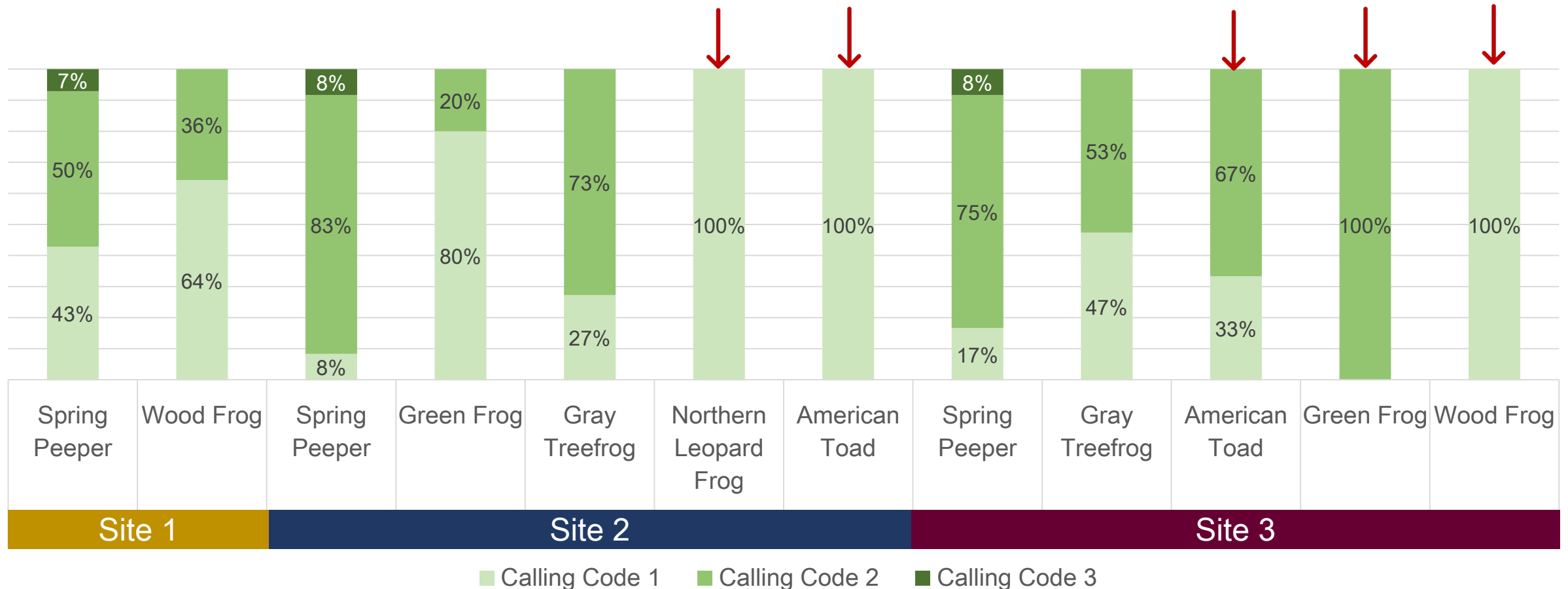
## Simulation Results

Mean Captured Richness: 3.3

0% chance of capturing the full species diversity with MMP



# Results – Abundance – Code Distribution



<10 species occurrences

# Key Outcomes

As a single-season assessment tool, the MMP...

Is not effective for assessing species richness / diversity.

Has a high risk of under-representing species abundance.

# Implications

Impact Assessments often rely on a single-season field program.



Survey output is used to inform feature sensitivity and significance – Significant Wildlife Habitat.



Informs policy-based protections / management.

Protocol underrepresenting species richness & diversity



Risk that features are mis-assessed / mis-classified.



Not applying correct protections / management measures.

# Exploring New Methods

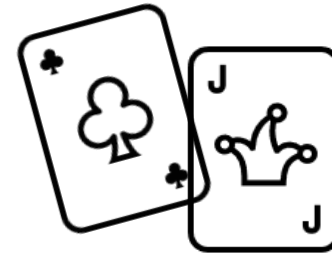
Alternatives for Single-Season Assessment

Some Early Trials

# Trial 1: The Simple Approach

Works within a familiar framework.

How does doubling the survey effort affect likelihood of capturing species richness?



## Monte-Carlo Simulation

2 replicates from each survey window = MMP Permutation

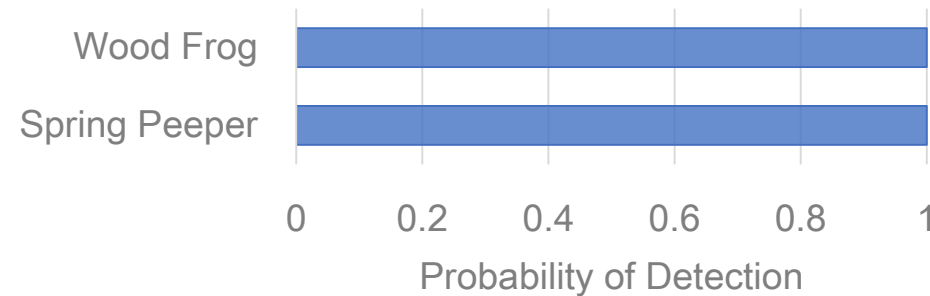
Every possible MMP permutation run for each site

# Results – Site 1 – ↑ Effort

## Simulation Results – 1 & 2

Mean Captured Richness: 2

100% chance of capturing the full species diversity with MMP

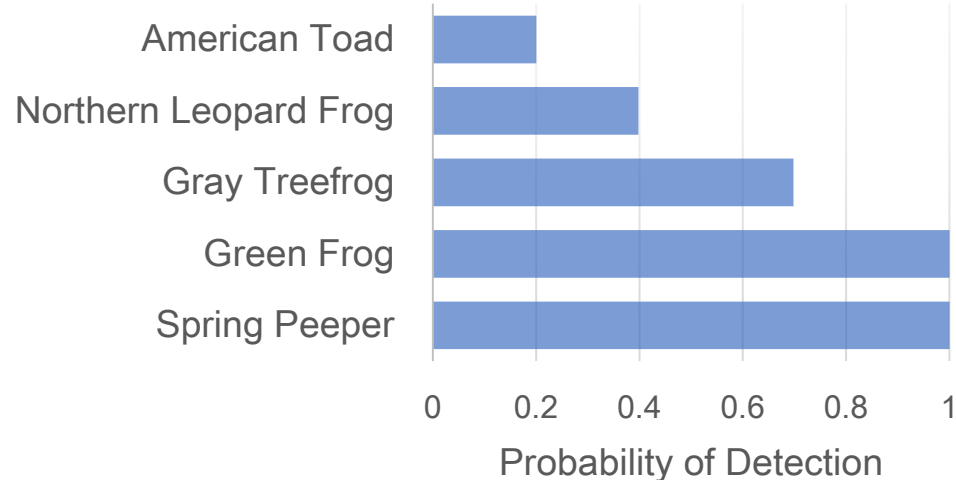


# Results – Site 2 – ↑ Effort

## Simulation Results – 1

Mean Captured Richness: 3.3

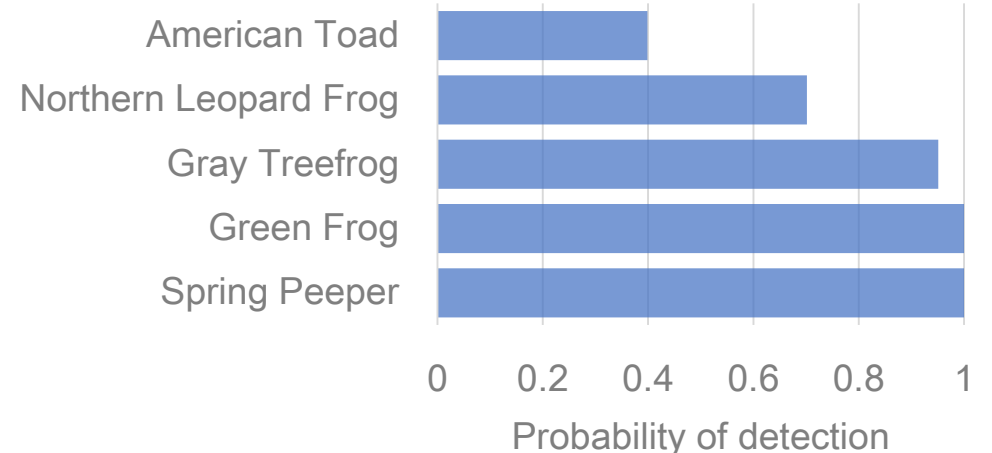
10% chance of capturing the full species diversity with MMP



## Simulation Results - 2

Mean Captured Richness: 4.1

37% chance of capturing the full species diversity with MMP

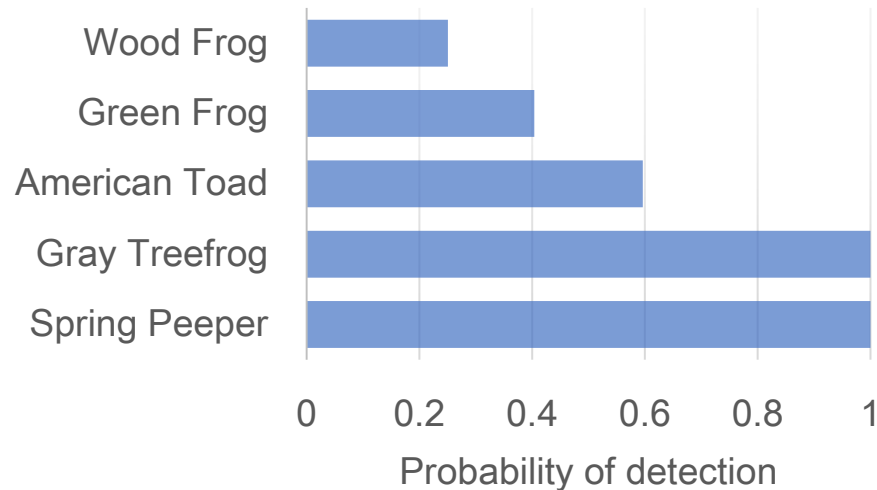


# Results – Site 3 – ↑ Effort

## Simulation Results - 1

Mean Captured Richness: 3.3

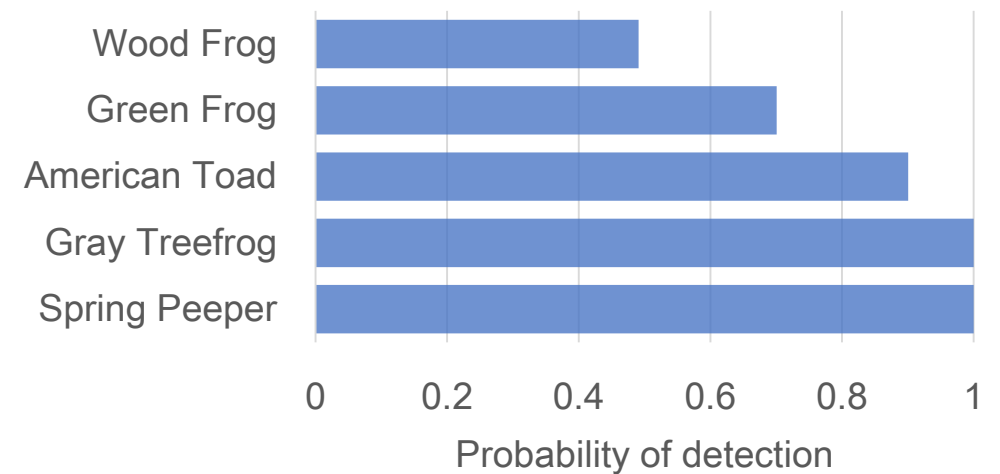
0% chance of capturing the full species diversity with MMP



## Simulation Results - 2

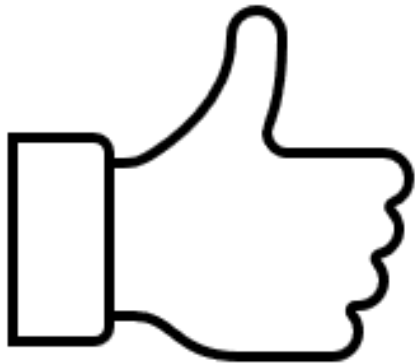
Mean Captured Richness: 4.1

30% chance of capturing the full species diversity with MMP

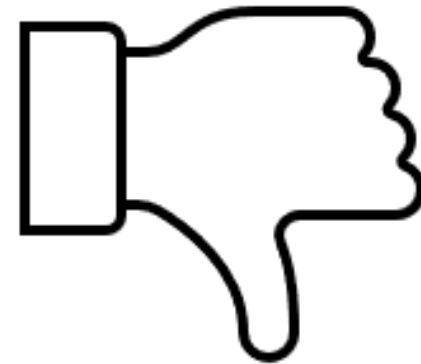


# Key Outcomes

Substantial improvement.

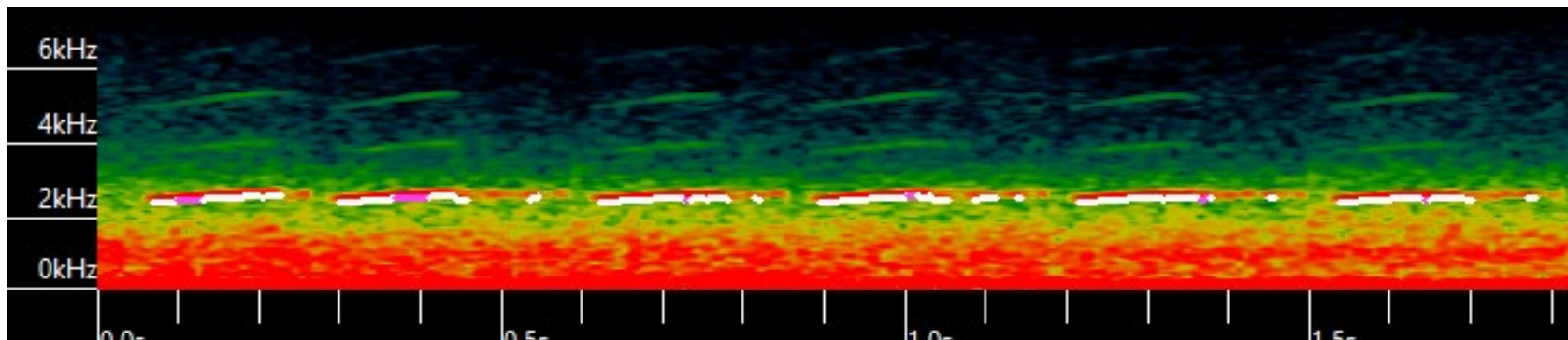


Still under-represents richness.



# Trial 2– Auto Classification

Automatically classify all the anuran calls in a dataset to see the number, timing, and distribution of each frog species.



# Trial 2– Auto Classification

## Some Challenges

Noisy datasets (e.g., traffic)

Calls from other species with similar spectral characteristics to anurans

Noise levels and overlap of each anuran calls (e.g., Spring Peeper relative to a Wood Frog)

# Trial 2– Auto Classification

Complex shape

Sound range overlap

Harmonics

Overlapping Calls

Features	Hidden Markov Model (HMM)	Convolutional Neural Networks (CNN)
Model Type	Probabilistic, sequential	Deep Neural
Data Needed	Small dataset	Large dataset
Robustness to noise	Low	High
Dimensionality	1-Dimensional (sequence modelling)	2-Dimensional (e.g., uses the full 2D spectrogram)
Contextual Description	Learns the <i>sequence of sound units</i> in a call (e.g., rise → steady tone → fall).	Learns the <i>shape</i> of the call in the spectrogram directly.

# And the work continues...

More sites + Site Variability.

Run models to improve assessment of abundance.

More trials for solutions within existing survey framework.

Automated Identification - Deep neural networks.

# Thank You!

## Acknowledgements

**Credit Valley Conservation** – kindly provided the ARU data

**Patrick Strazlkoswki** – put the wheels in motion

**Kristen Capobianco** – did all the ARU listening (whew)

**Benjamin Meinen** – technical wizard & stats guru who made things possible

**Kristen Harrison** – project director & ecological contributions