Understanding the Status of Montana's Bat Species Using Acoustic Data

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MONTANA STATE LIBRARY
NATURAL HERITAGE PROGRAM

USFS Meeting
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Bats of Montana

Pallid Bat
(Antrozous pallidus)

Roost Loss

Townsend's Big-eared Bat
(Corynorhinus townsendii)

WNS

Big Brown Bat
(Eptesicus fuscus)

Spotted Bat
(Euderma maculatum)

Wind

Silver-haired Bat
(Lasionycteris noctivagans)

Wind

Eastern Red Bat
(Lasiurus borealis)

Wind

Hoary Bat
(Lasiurus cinereus)

WNS

California Myotis
(Myotis californicus)

WNS

Western Small-footed Myotis
(Myotis ciliolabrum)

WNS

Long-eared Myotis
(Myotis evotis)

WNS

Little Brown Myotis
(Myotis lucifugus)

WNS

Northern Myotis
(Myotis septentrionalis)

WNS

Fringed Myotis
(Myotis thysanodes)

WNS

Long-legged Myotis
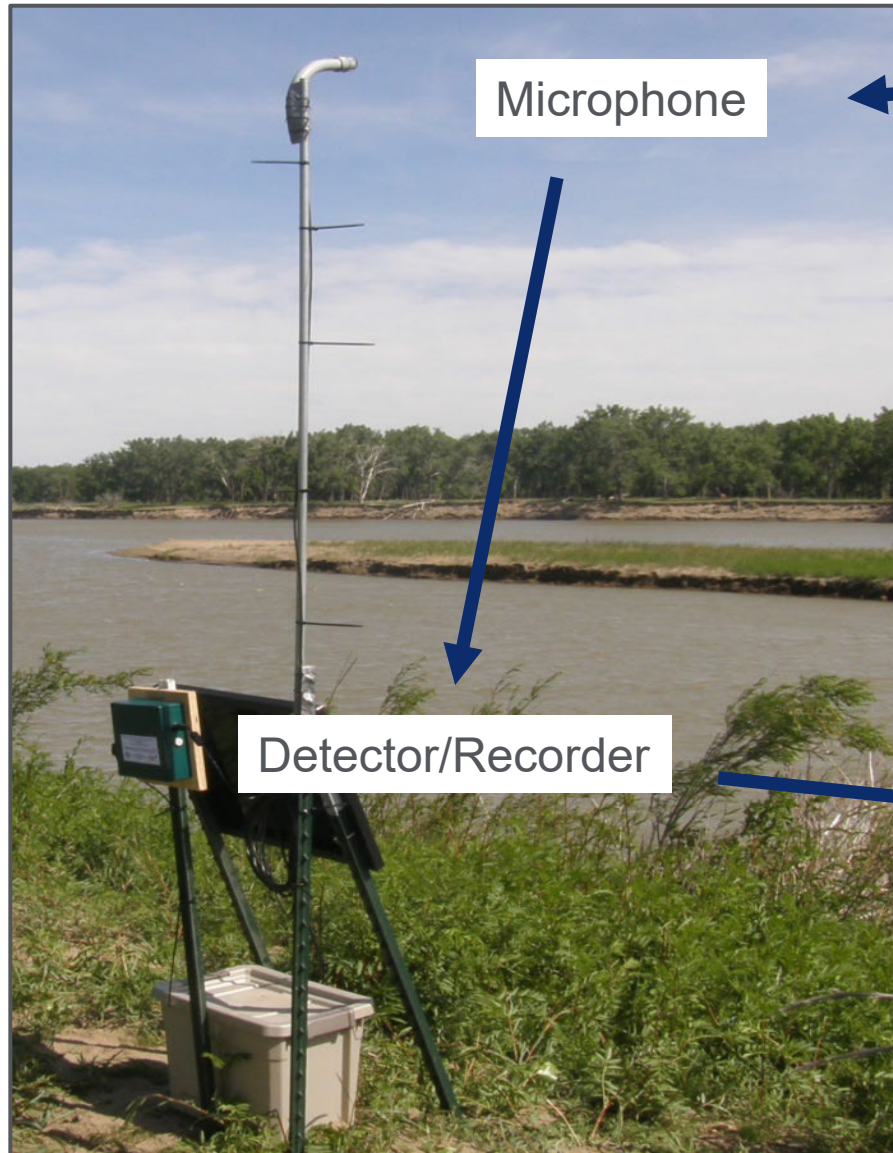*(Myotis volans)*

WNS

Yuma Myotis
(Myotis yumanensis)

Monitoring Challenges in Montana

Acoustic Bat Detection
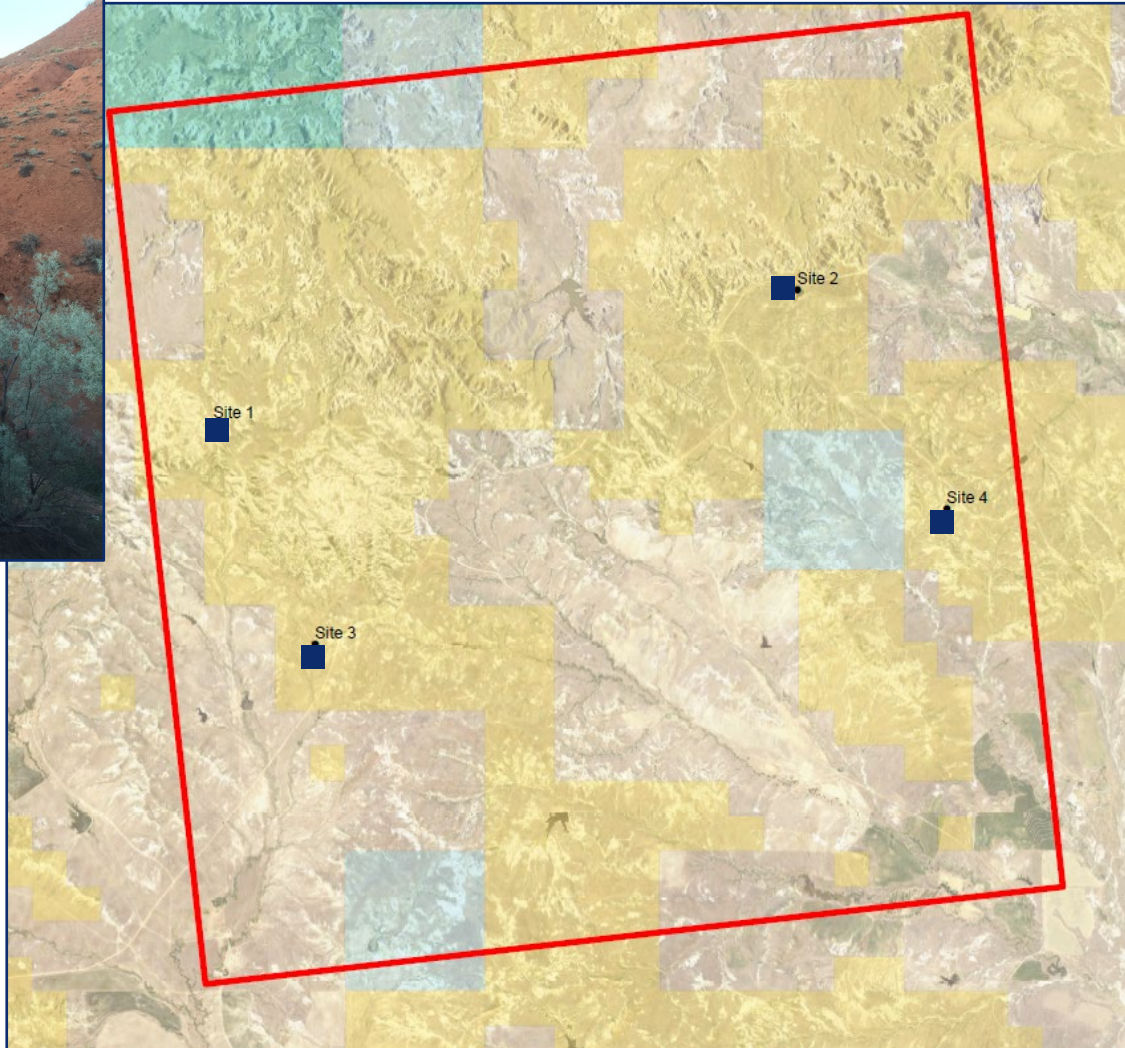
Microphone

Detector/Recorder
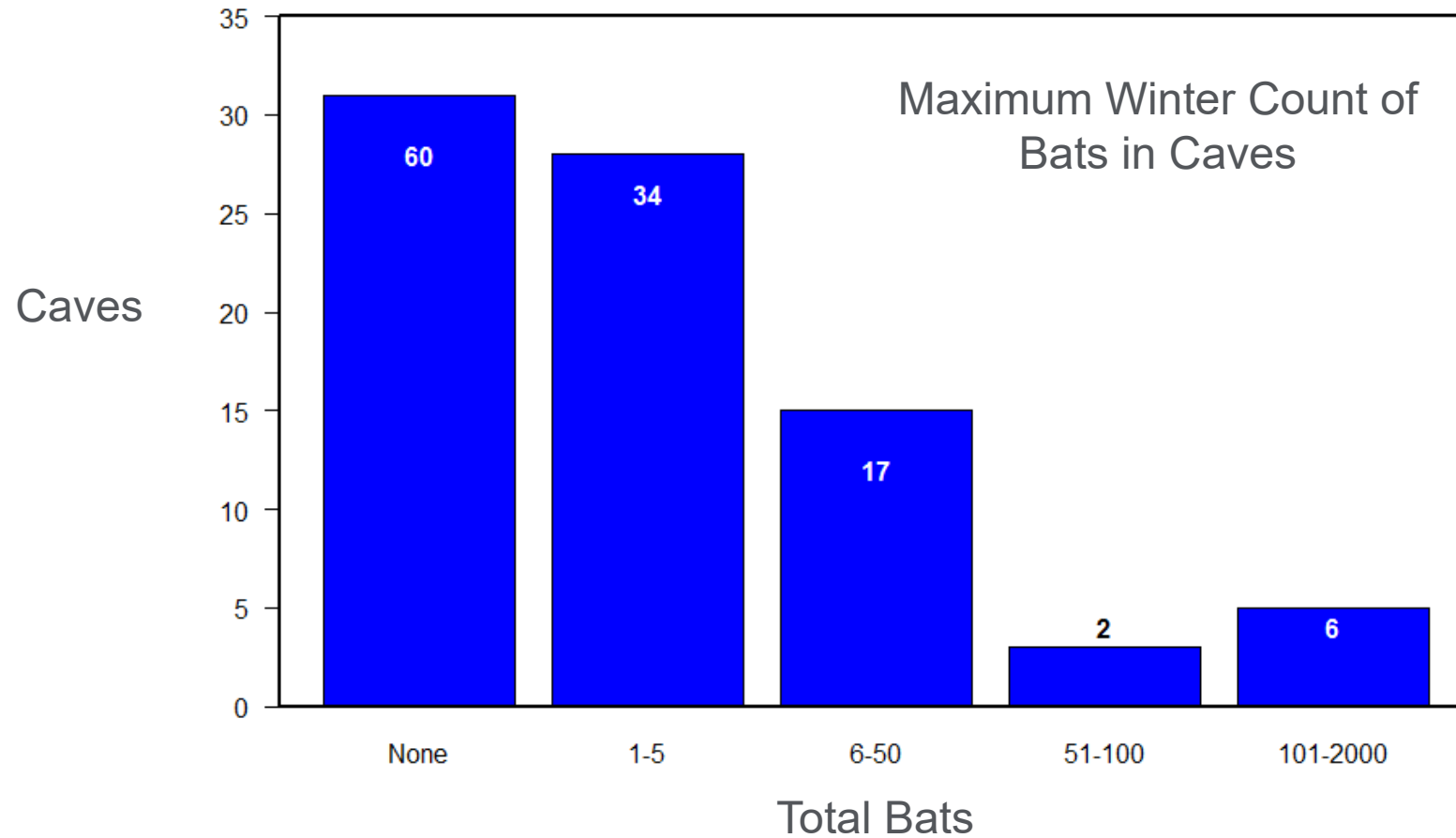
Echolocation
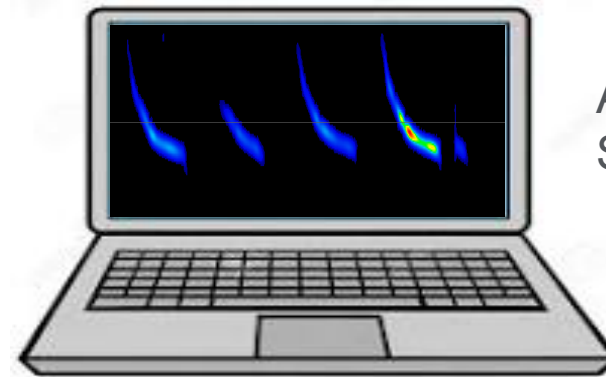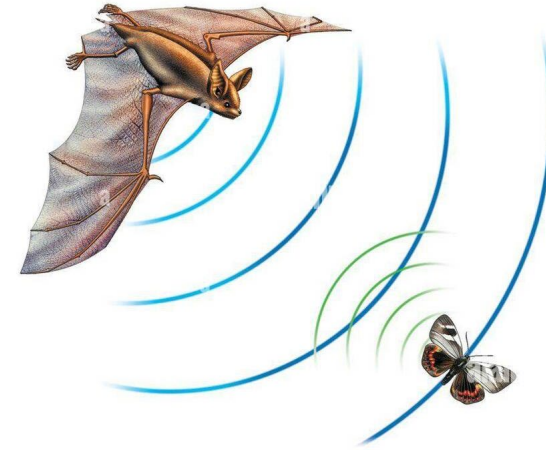
Analysis and
Species Identification

NABat Program Implementation in Montana

Survey goals:
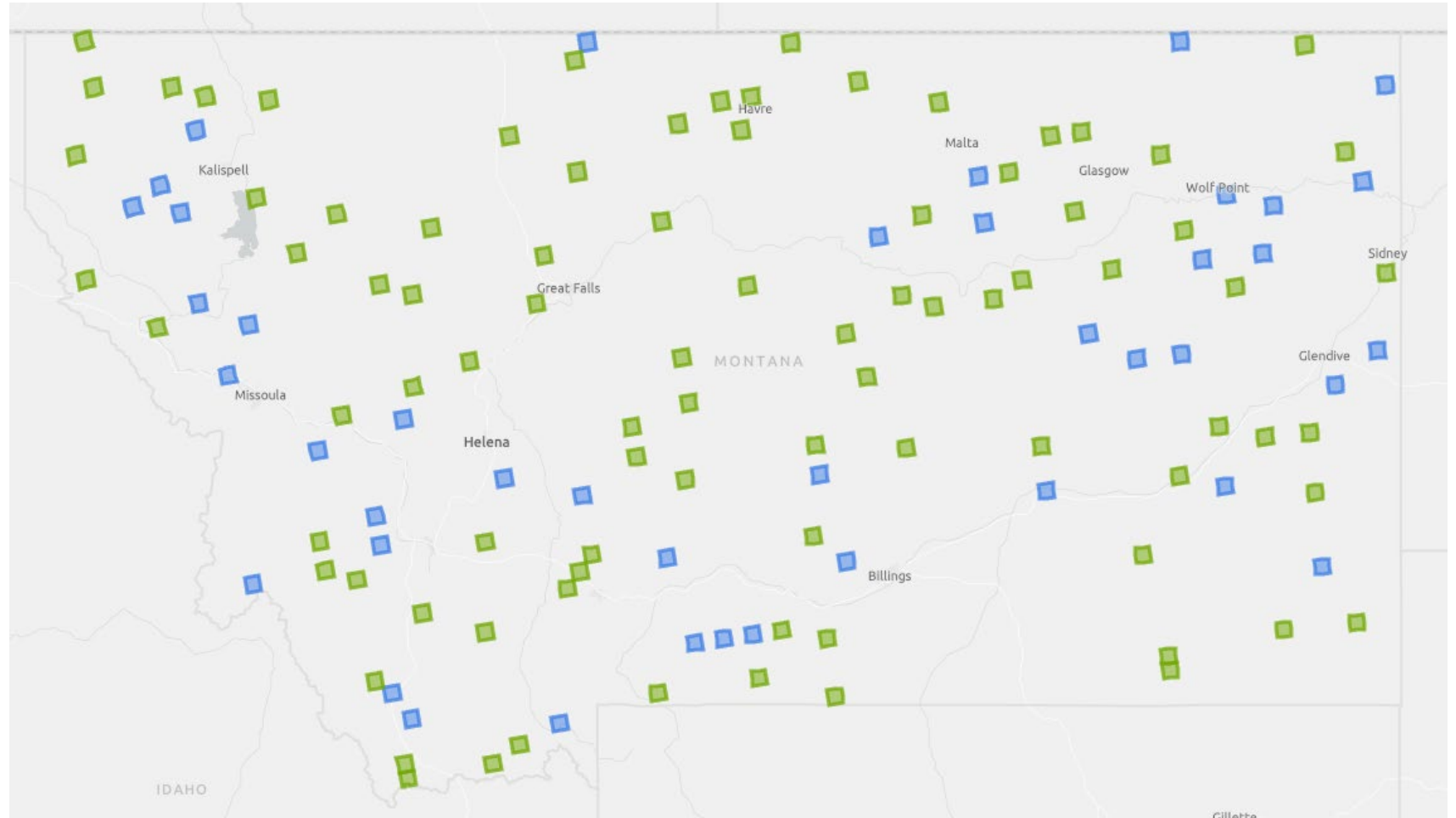- Assess species present within grid cell

Protocols:
- 4 sites within the cell
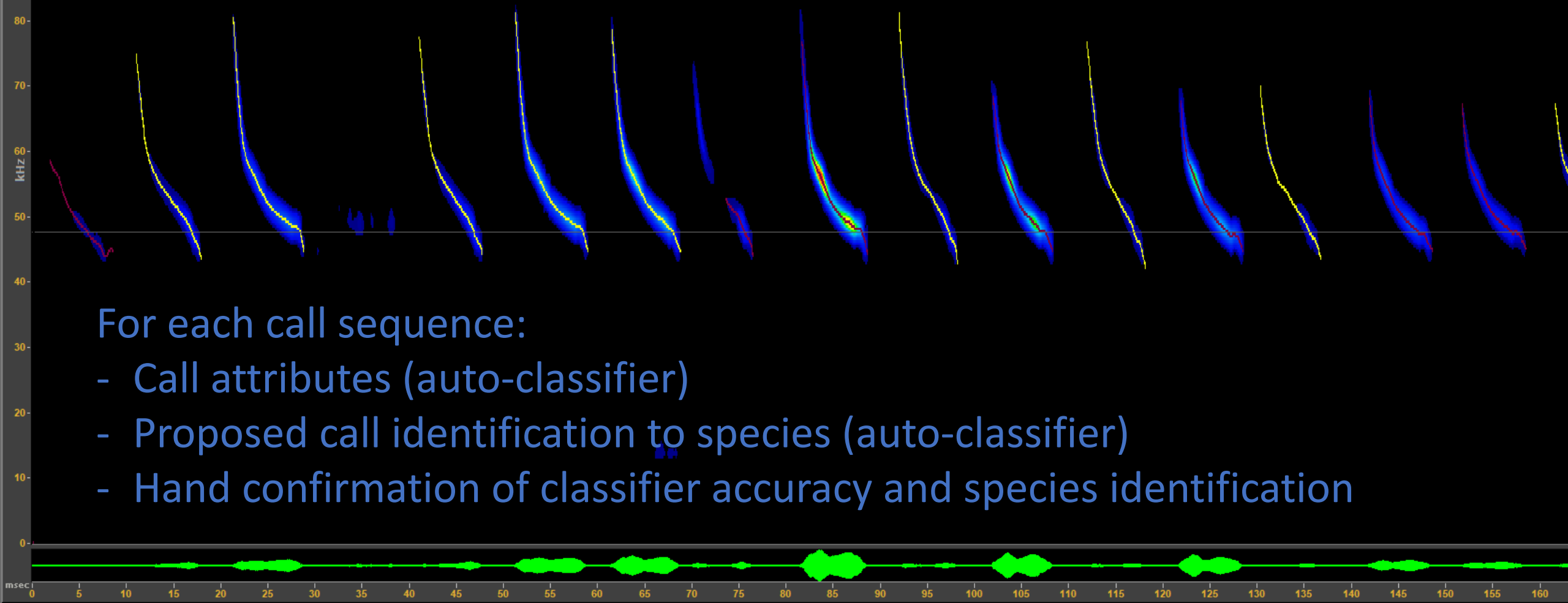- 4 nights of survey per site

Deployed at:
- Water sources
- Roosts
- Foraging areas

NABat Program Implementation in Montana

- 122 Cells surveyed
- 1476 sites assessed
- 4 seasons of data collected (2020-2023)
- 3 Million + call sequences recorded
- 13 species confirmed*

Data Processing

For each call sequence:
- Call attributes (auto-classifier)
- Proposed call identification to species (auto-classifier)
- Hand confirmation of classifier accuracy and species identification

Species specific Occupancy Models

- National NABat Analyses for Species Status Assessments
- State Specific for ESA listed/proposed species
  - Species:
    - Northern Long-eared Bat (a.k.a Northern Myotis, *M. septentrionalis*)
      - Species poorly suited to acoustic analysis
    - Little Brown Myotis
    - Hoary Bat
  - Models:
    - Species detection/ non-detection data at 2 of 4 nights per detector site
    - 8 detection periods within each cell
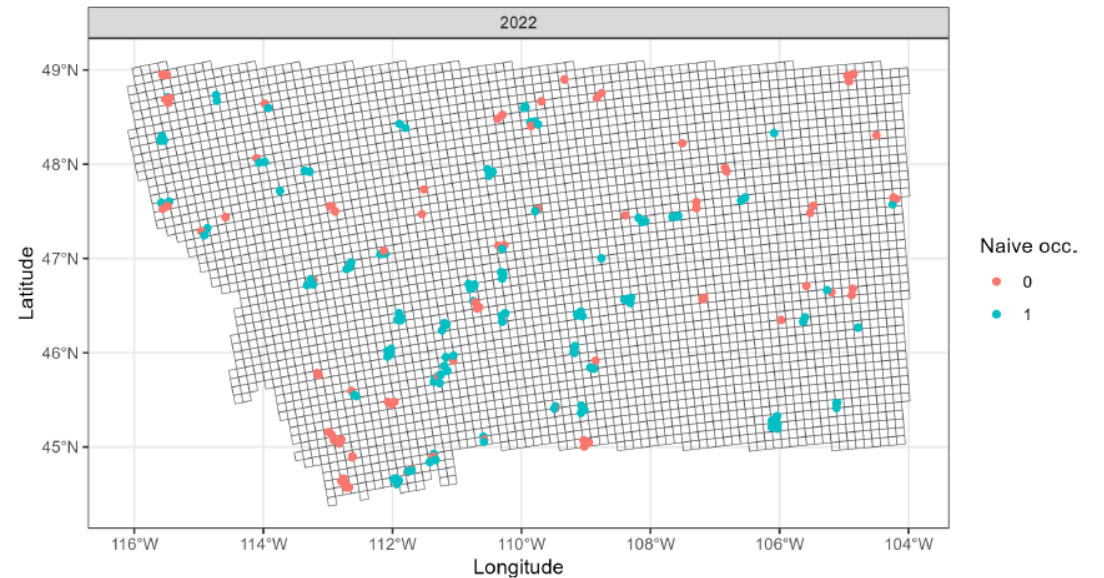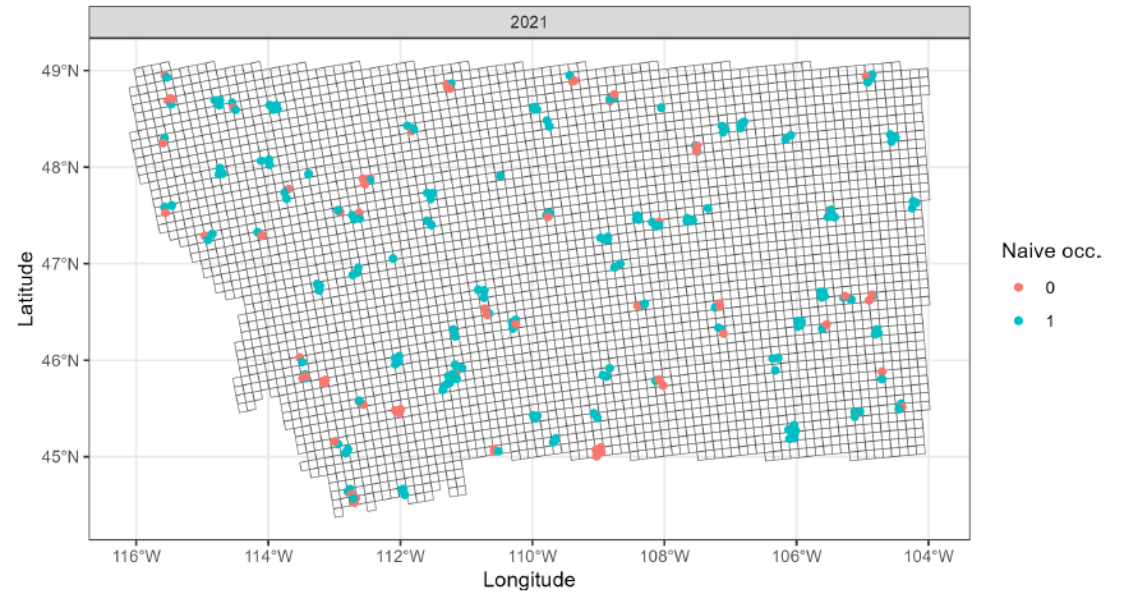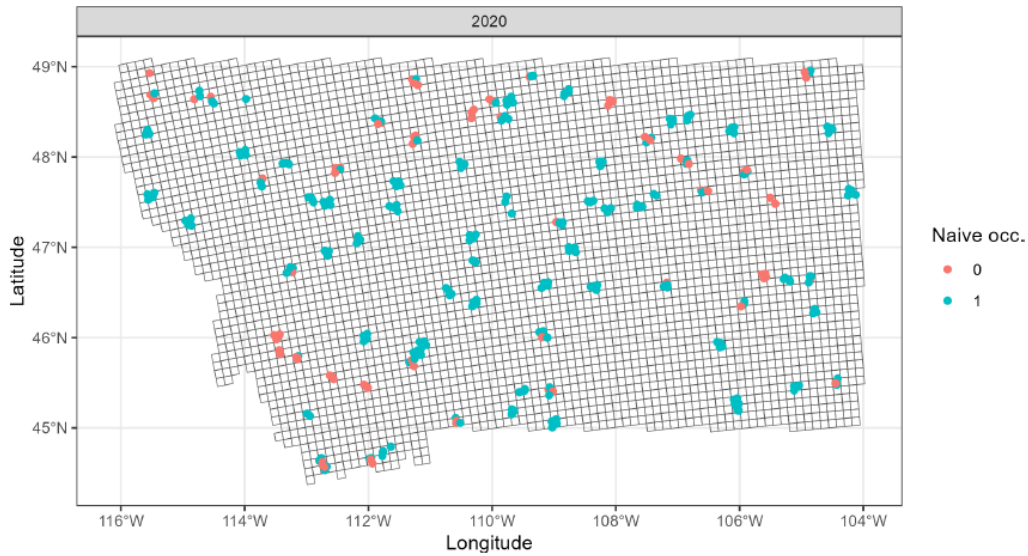   - Occupancy at cell level by year

Little Brown Myotis

- Cell Occupancy change 2020-2022
- Naïve Occupancy similar through all years

Naive occ.	Year	Count
0	2020.00	79
1	2020.00	250
0	2021.00	48
1	2021.00	280
0	2022.00	82
1	2022.00	245
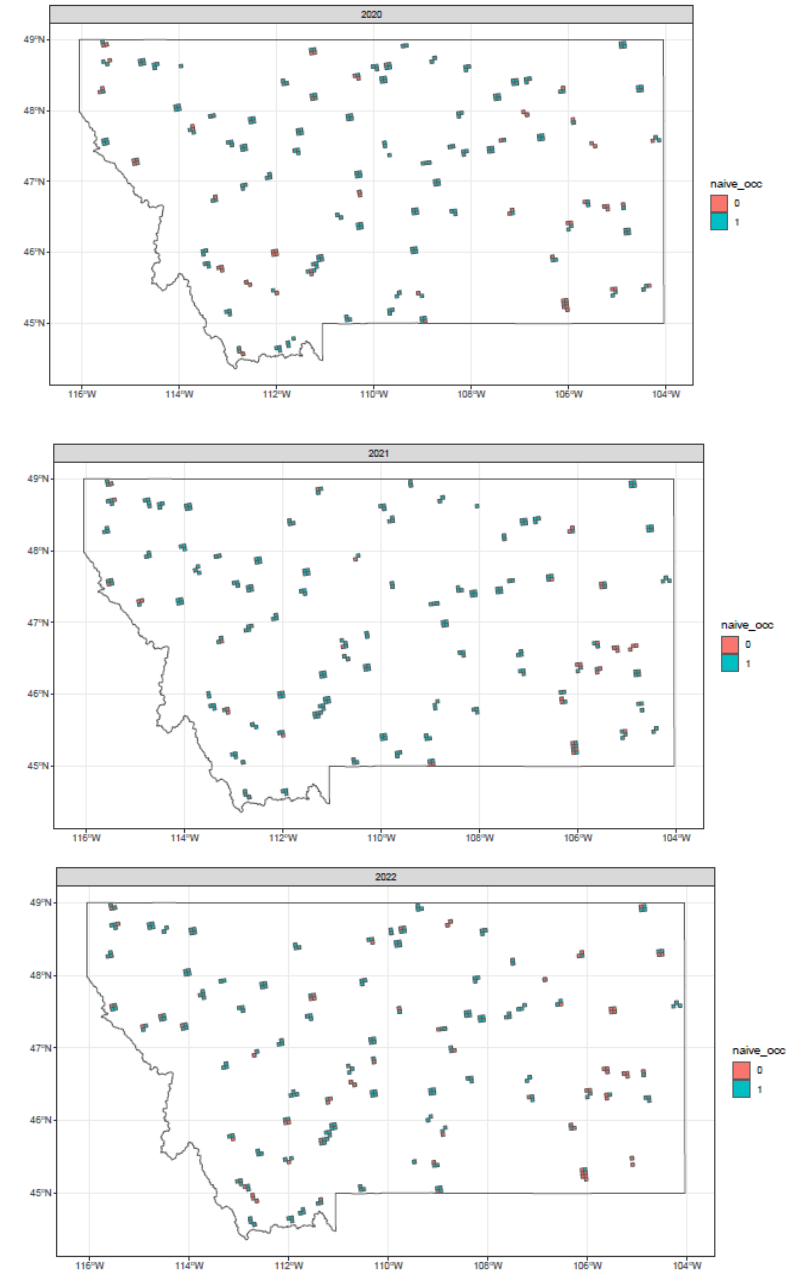
Hoary Bat

Hoary Bat

- USGS analysis
- Occupancy from NABat monitoring from 2020-2022
- Decline in occupancy observed in 2022
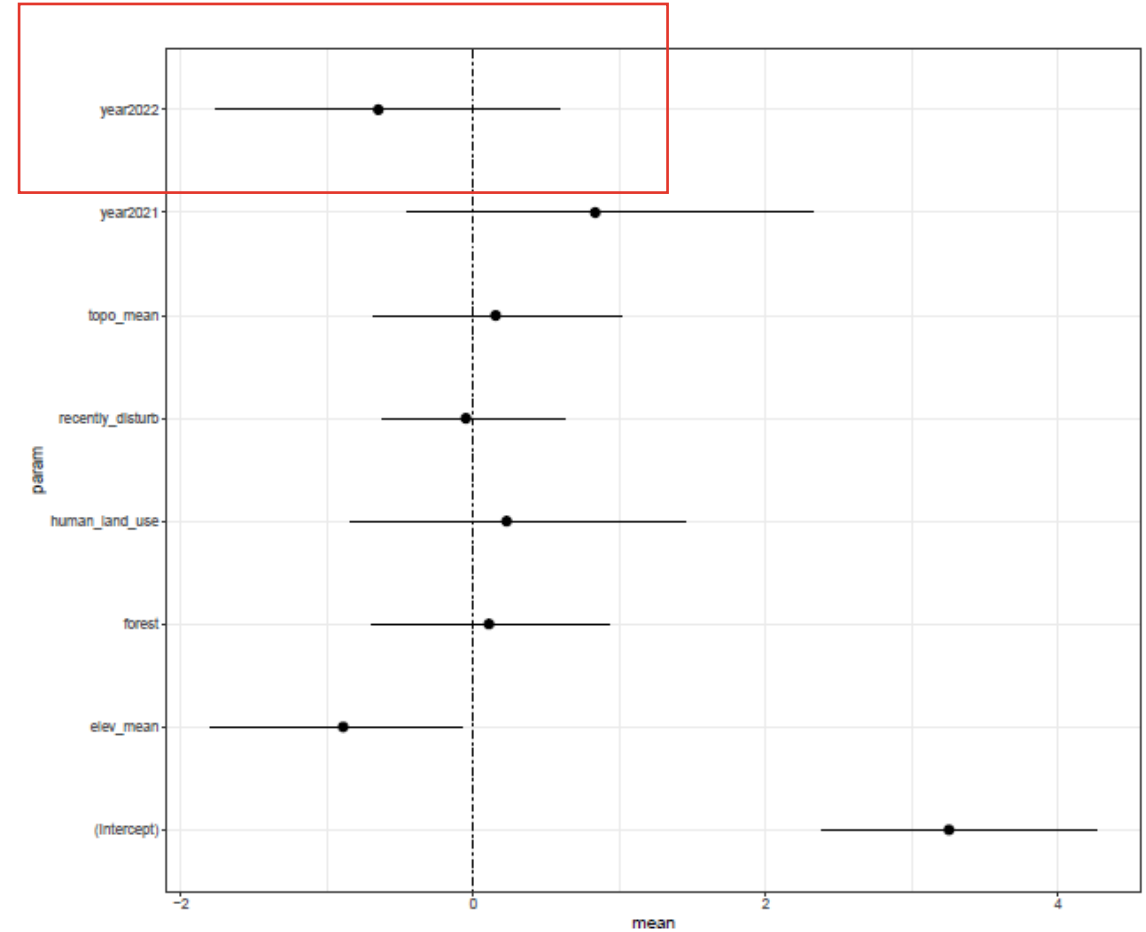- Plan to rerun with 2023 and 2024 data

Figure 20: Ninety-five percent credibility intervals for the coefficients in the occupancy portion of the model on the logit scale.

Modeling of Call Counts

- Motivation: Occupancy may not change despite significant declines in population at sites
- Solution: Use activity data as a indices of abundance within cells
  - Activity: Number of calls recorded by a species or species group within a given night

Challenges Using Acoustic Data for Monitoring

- Proposed species ID is often incorrect at the species level
- Hand confirmation of species not possible for every call
- Number of calls ≠ Number of bats

However

- Call sequence attributes are assigned to calls and almost always correct

		Suggested ID					
		LACI	LANO	EPFU	No ID	Proportion Correct	Total Calls
Species Recorded	LACI	11		1	6	0.92	18
	LANO	4	12	7	12	0.52	35
	EPFU	4	1	30	16	0.86	51

Threshold Approach to Identify WNS Species

California Myotis

Yuma Myotis

Western Small-footed Myotis

Long-legged Myotis

Little Brown Myotis

Northern Myotis

Eastern Red Bat

Long-eared Myotis

Fringed Myotis

Not WNS susceptible
WNS Susceptible

Townsends Big-eared Bat

Big Brown Bat

Silver-haired Bat

Pallid Bat

Hoary Bat

Spotted Bat

8 kHz

34 kHz

50kHz

Average Characteristic Frequency

Status quo modeling

- **Step 1**
  - Model *Pd* data
  - Obtain summary of *Pd* occurrence at sampled acoustic locations
    - ex. "plug-in" and "prior" methods (Cameletti et al. 2019)
- **Step 2**
  - Model bat relative activity data and assess the impact of *Pd* on activity via regression analysis

Towards a new model

- **Shortcomings**
  - Failure to acknowledge/propagate the uncertainty in *Pd* occurrence through to the activity model, potentially resulting in overprecise estimates of the effect of Pd on activity
  - Failure to leverage the joint information contained in the activity and *Pd* data, resulting in a loss of precision on the *Pd* occurrence estimates
- **Solution**
  - Jointly model the count and *Pd* data in one coherent modeling framework, allowing for propagation of the uncertainty in the disease process through to the activity process

Covariates

## Relative activity model

- Site type
  - Flyway
  - Lentic water
  - Lotic water
  - Roosting structure
  - Other

- Maximum daily temperature

- Count of previous night's detections

- Interaction between site type and previous night's detections

- Probability of *Pd* presence

Pd spread model

- Third degree spatial polynomial
  - $\sim lat + lon + lat^2 + lon^2 + lat * lon^2 + lon * lat^2 + lat^3 + lon^3$
  - Spatial random effect
    - Drawn from a Gaussian process with a double exponential covariance structure

Negative Impact on Count   Positive Impact on Count
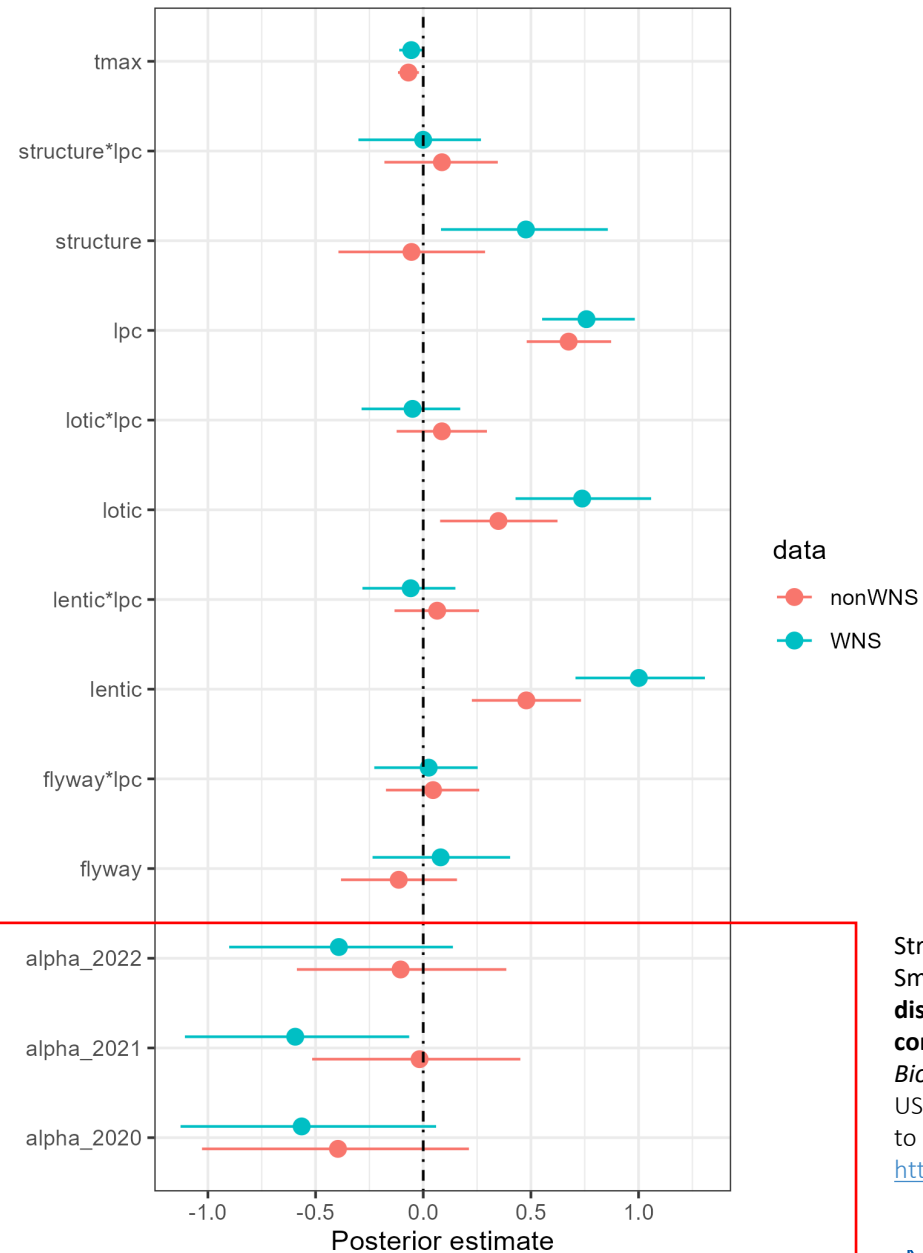
Pd Presence

Conclusions

- *Pd* presence is impacting susceptible bat species in our region
- Declines are from eastern MT with few caves and mines so non-cave/mine hibernacula may be impacted by WNS
- Further exploration of models that can account for error in auto-classifed species identifications will help explore population trajectories for impacted species

Future Work

- Plan to run the NABat grid through at least summer 2026
- Collect additional data to inform species specific activity models
  - Record flight calls to inform dynamic confusion matrix between Myotis species.
  - Move toward species-specific activity models
- Goals:
  - Capture Pd/ WNS impacts through the period of peak impact
  - Explore **changes** to **occupancy** and **activity** through impact period
  - Update trend used in Conservation Status Ranks (S Ranks) and maintain accurate Species of Concern designations for all bat species
  - Provide data for National NABat analyses, USFWS Species Status Assessments (SSAs)
  - Provide data for implementation of conservation efforts (habitat-based, vaccines etc.)

Additional Data that may be of interest

- **Historic Acoustic Data**
  - Push to NABat portal
  - Summaries Available:
    https://mtnhp.org/Reports/ZOO_Bat_Acoustic_Directory_Bachen2020.pdf

- **Analyze SE Montana/ NW SD for Tri-colored Bat presence**
  - Sioux District and Dakota Prairie Grassland

- **Push Capture Data to NABat portal**
  - 1989-2019 submitted
  - 2021-2024 winter 2024
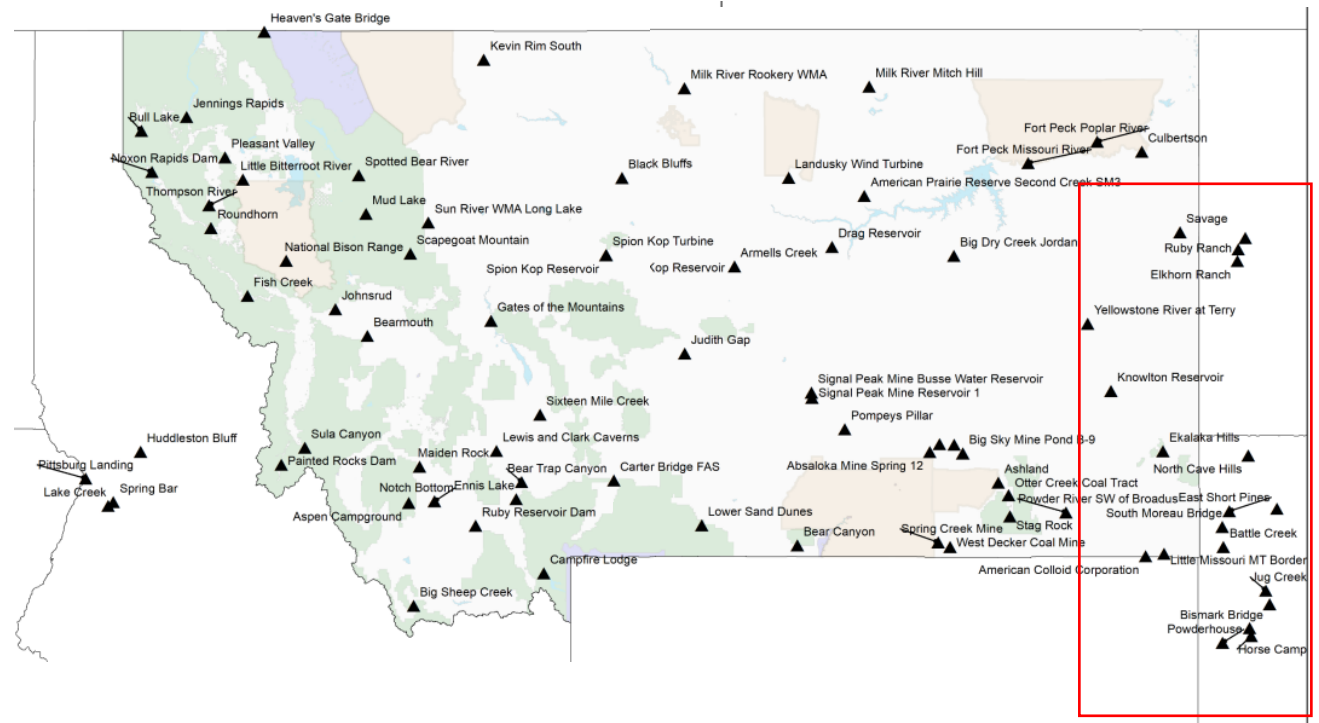
Thanks to Partners and Volunteers!