DoD Environmental Planning and Conservation Webinar Series

Acoustic Surveys for Bats: Detector Placement, Call Analysis, and Interpretation (Legacy Project 18-856)

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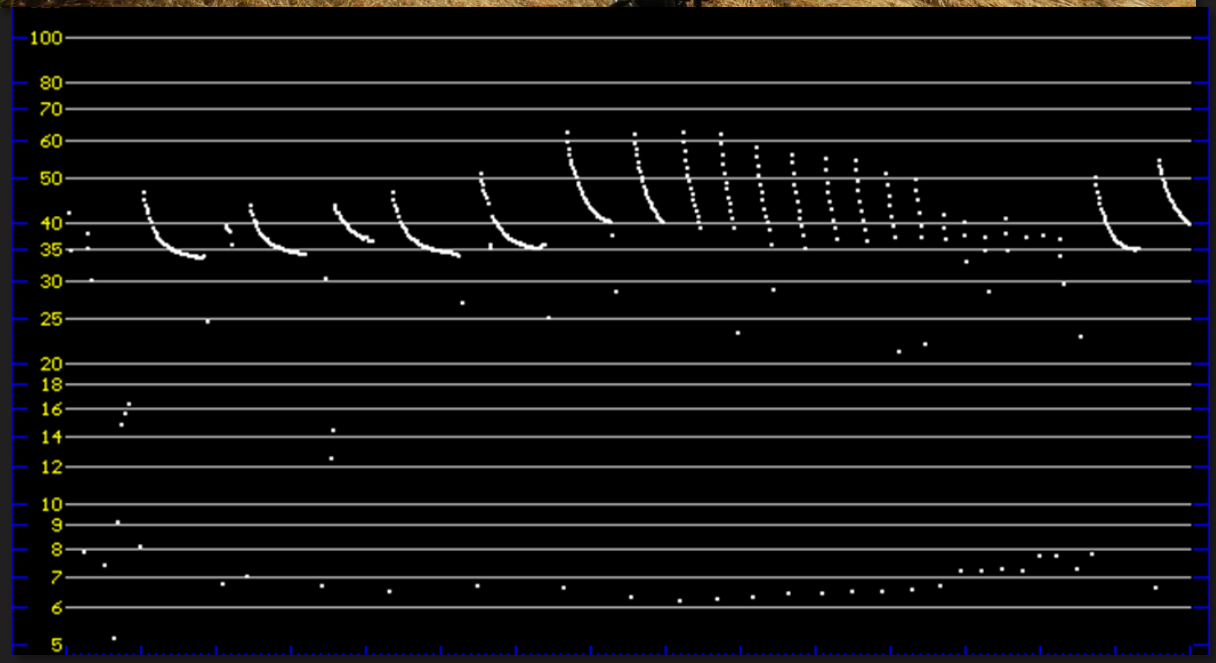
ACOUSTIC SURVEYS FOR BATS: DETECTOR PLACEMENT, CALL ANALYSIS, AND INTERPRETATION



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30 July 2024

U.S. ARMY

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DEPARTMENT OF DEFENSE LEGACY PROGRAM

GENERAL DETECTOR DEPLOYMENT GUIDANCE

SPECIFIC DETECTOR DEPLOYMENT GUIDANCE DEPENDS ON TARGET SPECIES AND MICROPHONE BEING USED

- Try to maximize time bat spends in the detection cone
- For linear landscape features (streams, roads, forest edges, etc.)
  - Directional microphones can be deployed parallel to linear features
  - Omnidirectional and hemispherical may need to be deployed in the middle of these linear features to maximize detection
- For non-linear landscape features (forest, openings, open fields, large lakes, etc.)
  - Detectors should be deployed to minimize introduction of clutter within area bats may be using
- Minimize possibility of reflection by avoiding sampling near hard flat surfaces
- Directional microphones can usually be deployed on the ground but, other microphones are generally deployed in an elevated manner to minimize wasted detection cone on the ground
- Net result is to maximize the call length and quality recorded, while minimizing negative impacts of detector placement on call quality

GENERAL TYPES OF ACOUSTIC SAMPLING

Active

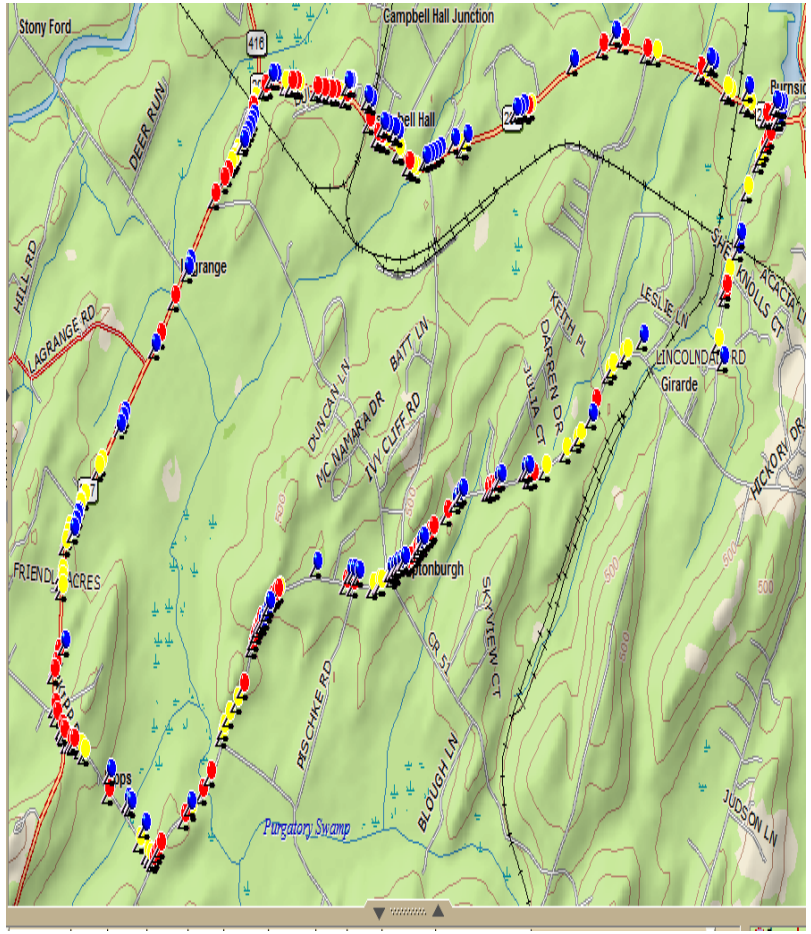
- ultrasonic detector is moved along a predetermined route
- used for bat population monitoring as part of NABAT
- can plot species presence along the route

Passive

- ultrasonic detector is placed in a single location and sampling occurs only at that site
- Used in
  - NABAT sampling
  - FWS Regulatory Clearance
  - Long-term monitoring

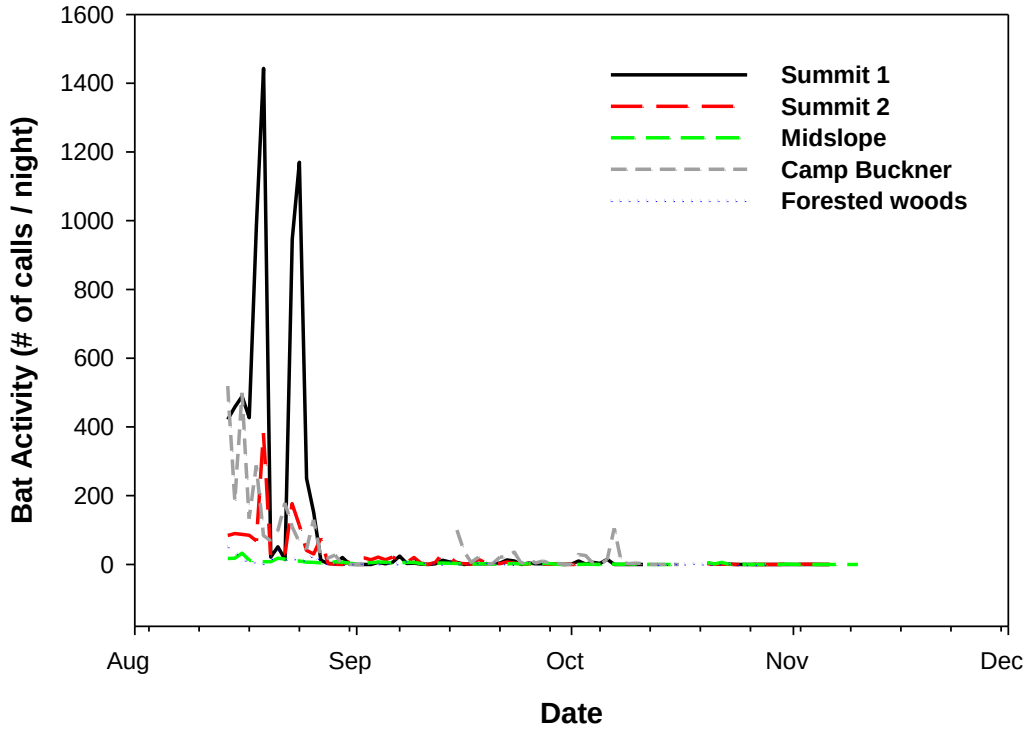
TRANSECT SAMPLING

- Provides snapshot of the activity and species presence across a broad area
- Used to assess population level impacts of threats to bats
- Provides very sensitive population trend analyses



FIXED POINT ACOUSTIC SAMPLING

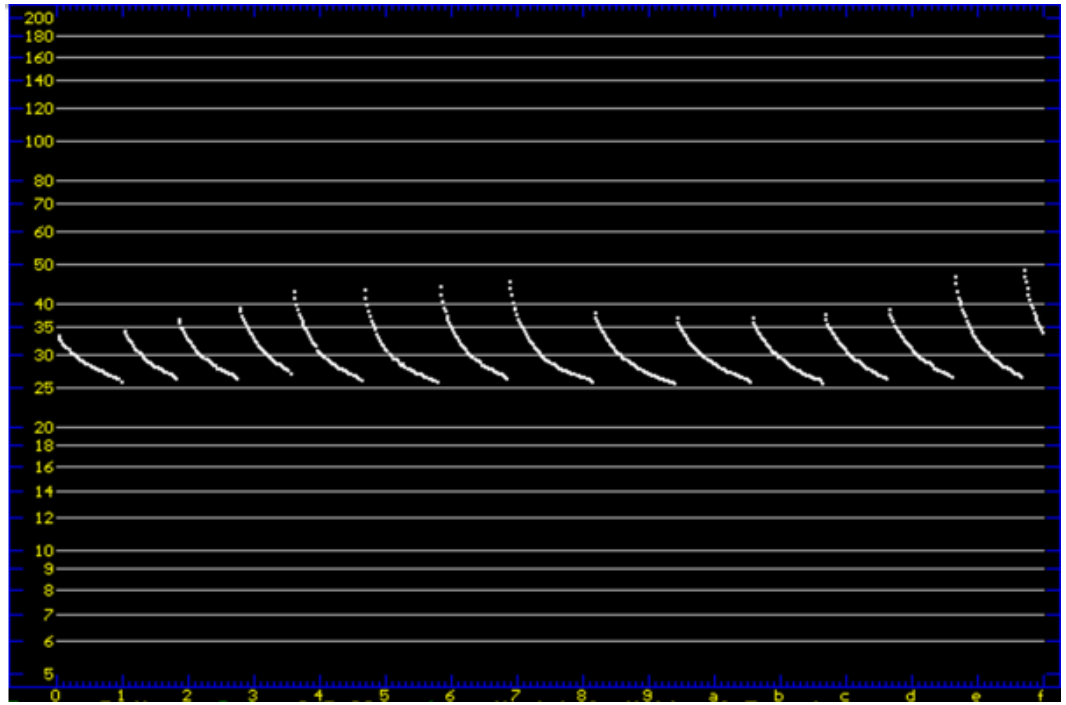
- Allows extensive sampling with little human input (i.e., regulatory clearance and long-term monitoring)
- Overcomes the impacts of temporal variation on the results
- Can sample areas that cannot be sampled using other techniques



CALL ANALYSIS AND INTERPRETATION

STEPS IN THE ACOUSTIC ANALYSIS OF BAT ECHOLOCATION CALL DATA

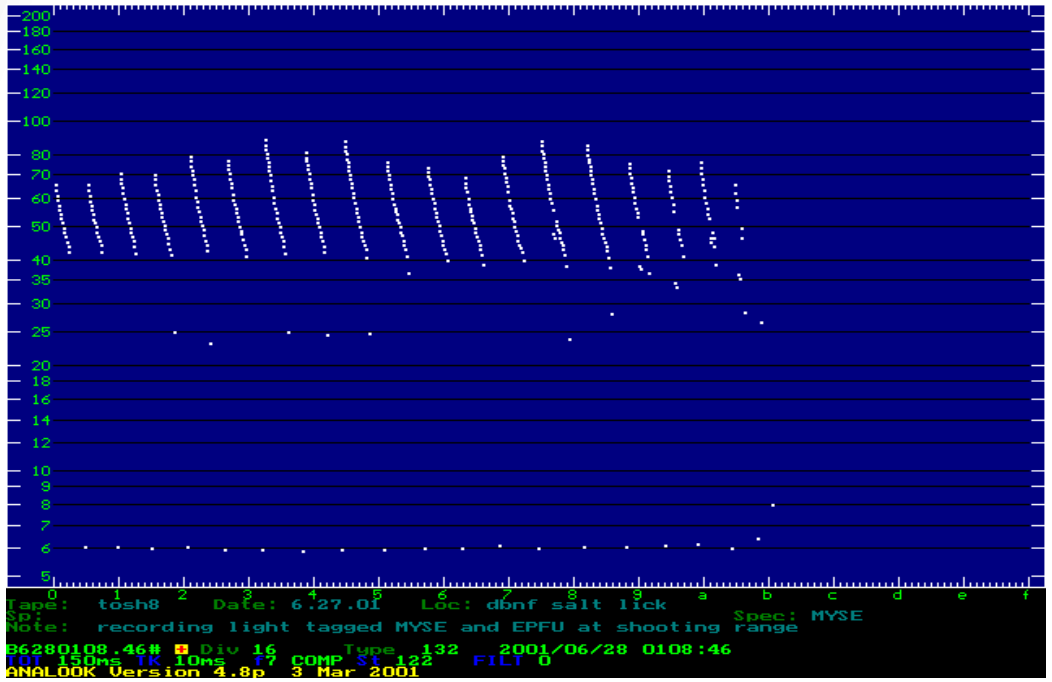
- Obtaining known call library
  - Required for all species trying to identify
- Filtering
  - This removes the non-bat signals that were recorded (e.g., extraneous noise, call fragments, etc.)
- Comparison with known call library



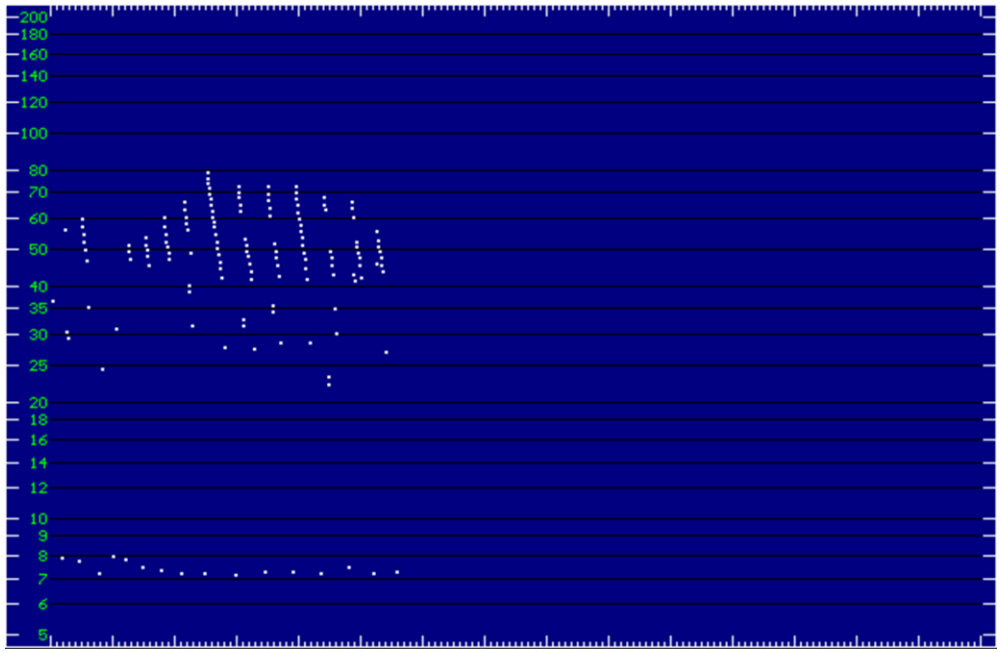
COLLECTION OF A KNOWN CALL LIBRARY

- Light tagging
- Recording outside known roost site
- Recording at site where id can be determined
- Zip line

EXAMPLE OF THE IMPACT OF RECORDING ENVIRONMENT



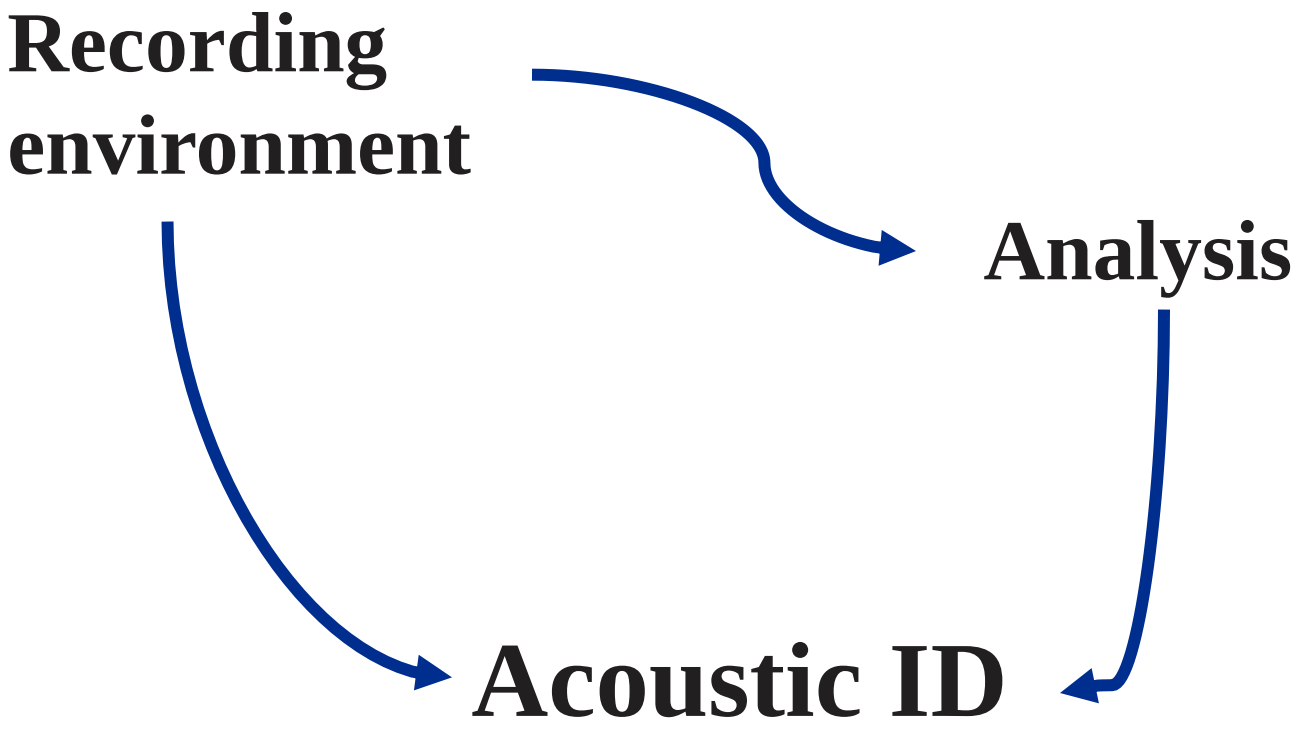
Light tagged bat



Passively recorded bat

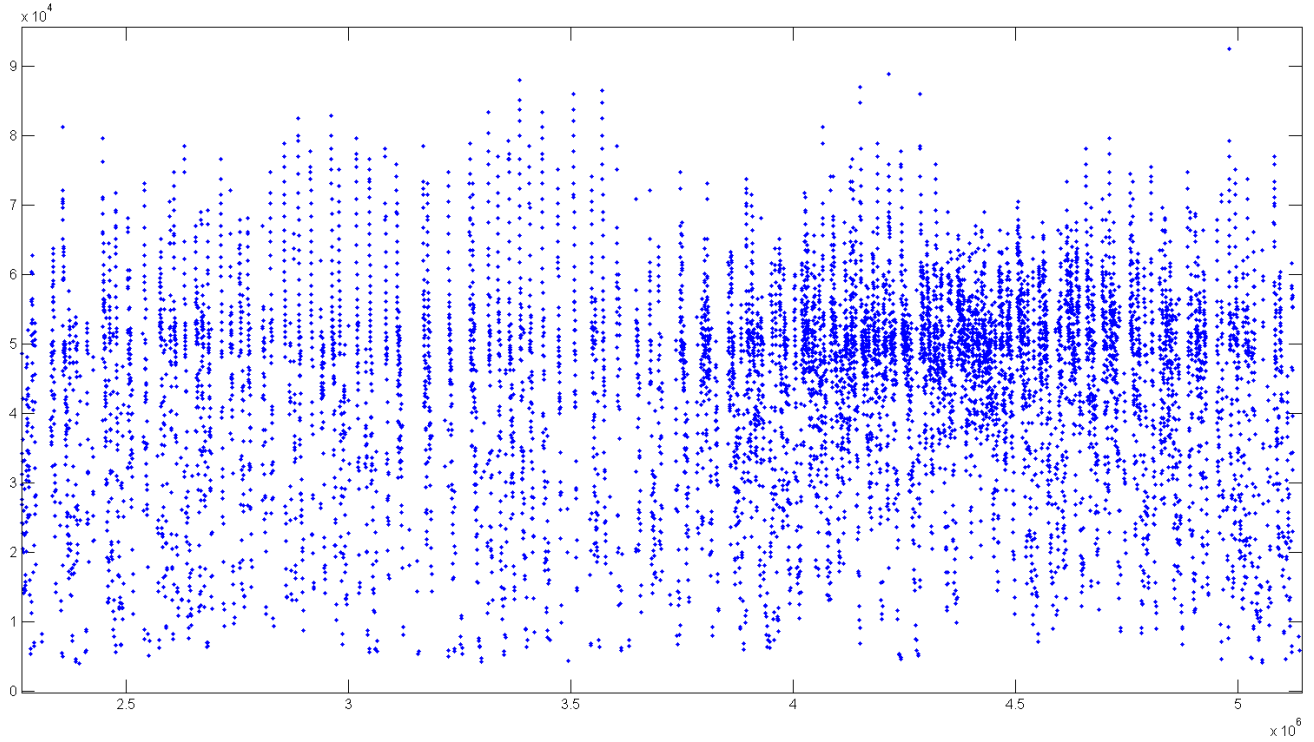
ANY CALL ID IS ONLY AS GOOD AS THE LIBRARY IN WHICH IT IS BASED!

FACTORS AFFECTING SPECIES ID

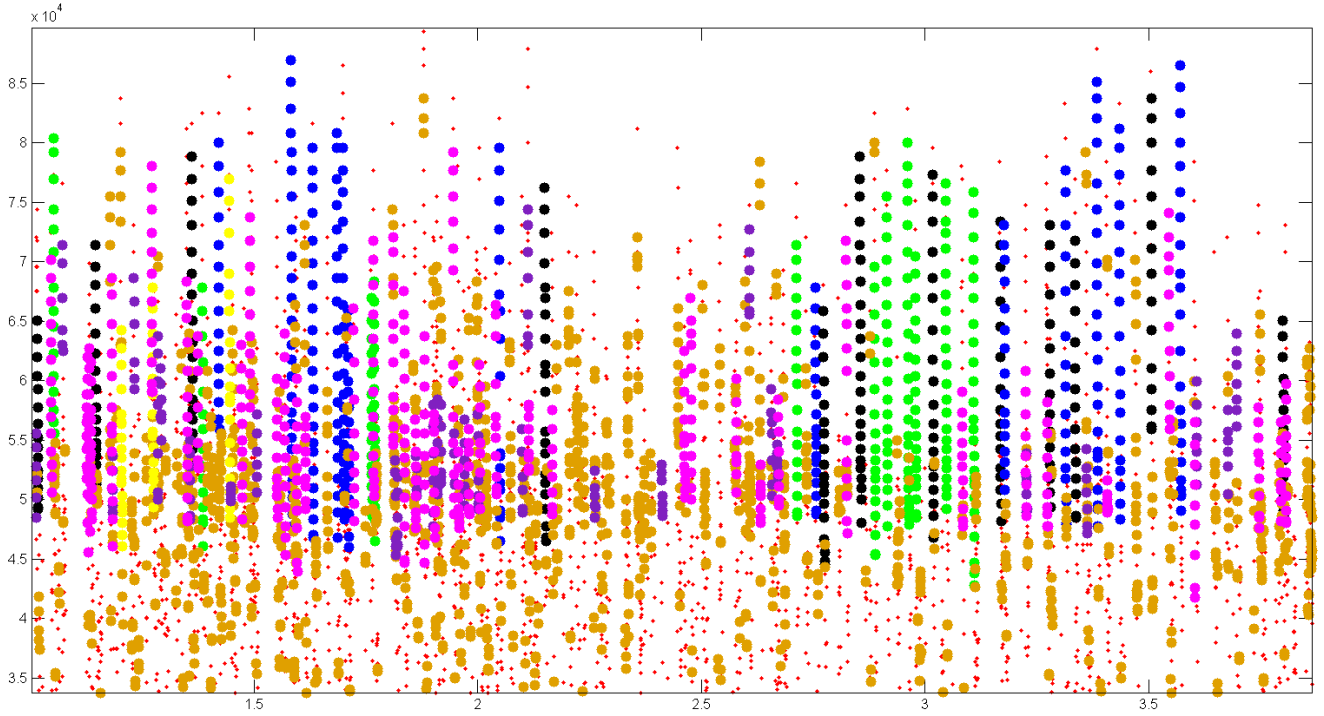


FILTERING

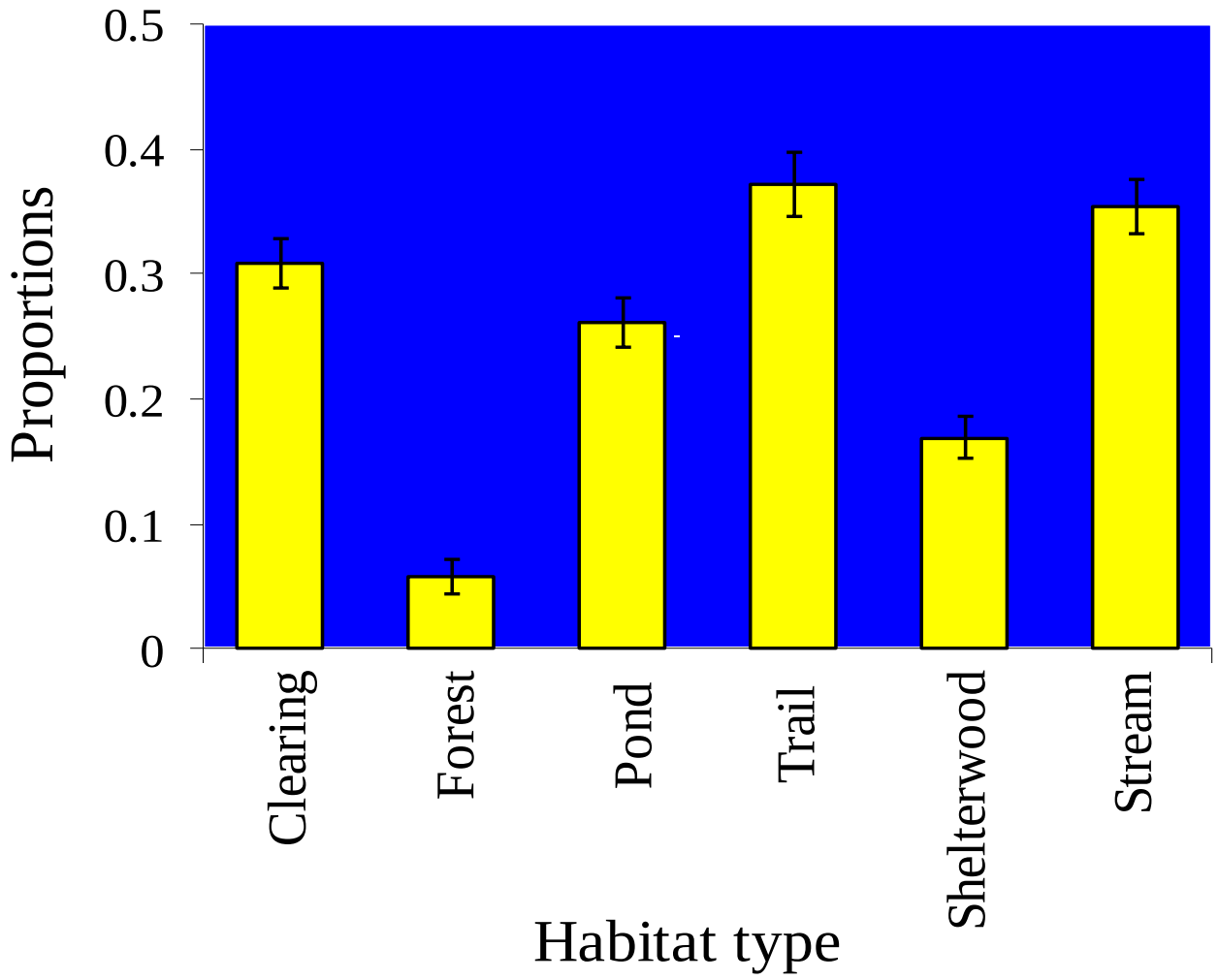
RAW FILE



FILTERED FILE

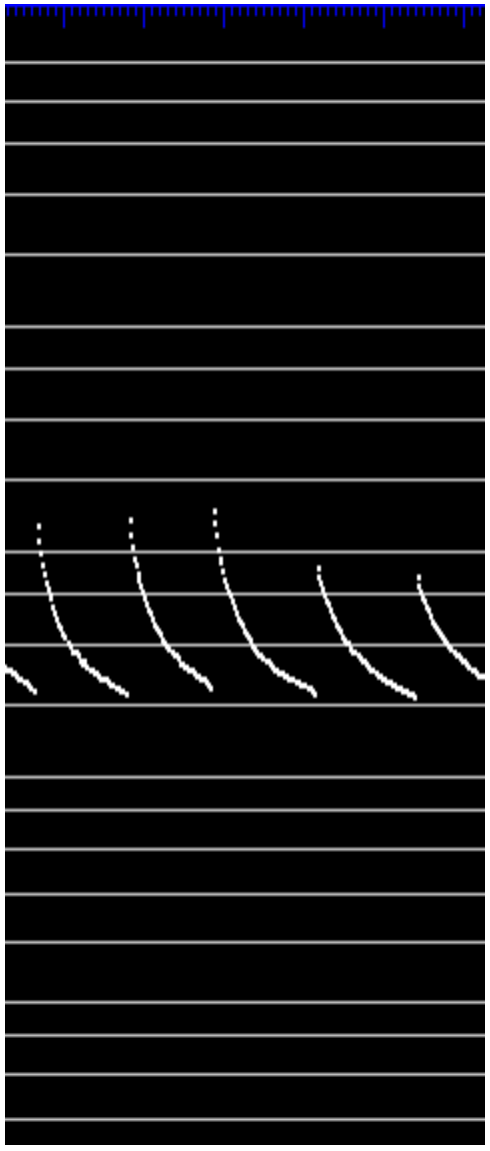


PROPORTION OF POTENTIALLY IDENTIFIABLE CALL SEQUENCES BY HABITAT

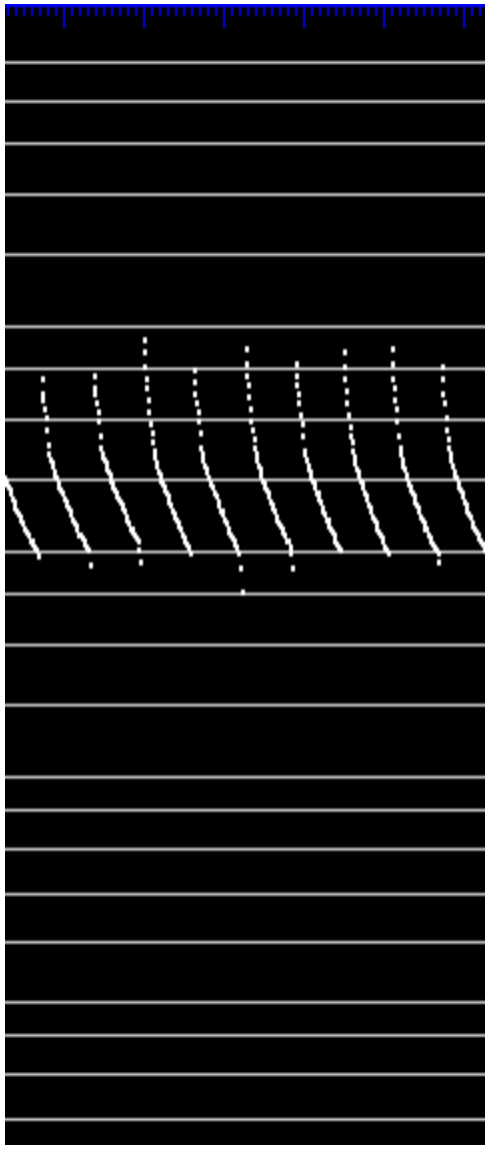


QUALITATIVE IDENTIFICATION

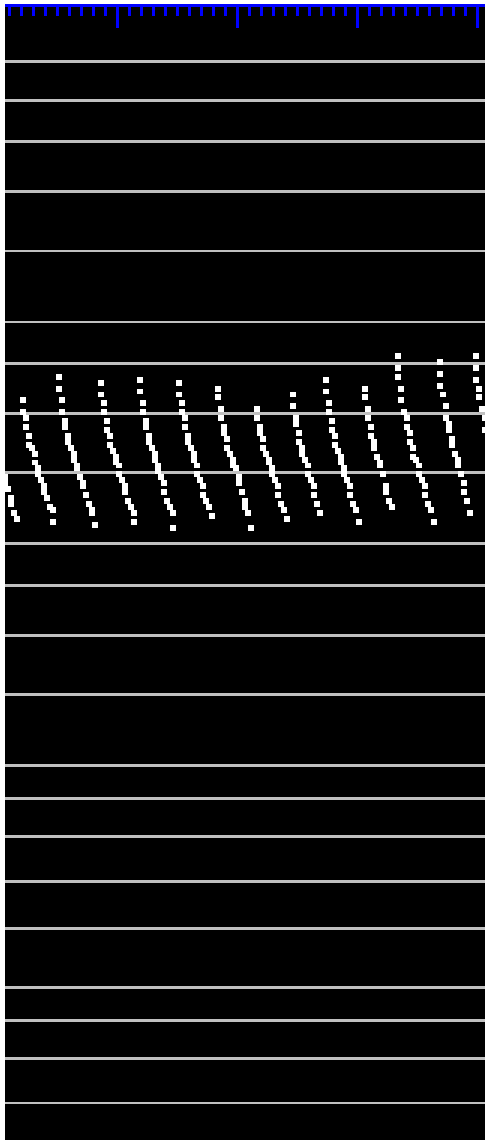
Big Brown Bat



Little Brown Bat



Indiana Bat



QUANTITATIVE IDENTIFICATION

WHY DO WE USE AUTOMATED ACOUSTIC ID?

- Accuracy
- Consistency
- Measurable bias
- Reproducibility
- Efficiency

CLASSIFICATION MATRIX

		Classified														
		EPFU	LABO	LACI	LANO	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO	Noise	NYHU	PESU	Unknown	**Producers accuracy**
Actual	EPFU	246	7	1	16									2	91	**0.90**
	LABO		92			2			2				15	4	79	**0.80**
	LACI			18										1	7	**0.95**
	LANO	6	1	1	57									4	23	**0.83**
	MYAU					4		2	2		13				21	**0.19**
	MYGR		4				149	3						3	43	**0.94**
	MYLE		6					26		20	27	8			142	**0.33**
	MYLU		7				2		101		49			3	57	**0.62**
	MYSE		9					12		34		19			110	**0.62**
	MYSO		11					19	19	5	157	1			61	**0.74**
	NYHU		6			1							32		29	**0.82**
	PESU		2				3							218	40	**0.98**
Users accuracy		**0.98**	**0.63**	**0.90**	**0.78**	**0.57**	**0.97**	**0.42**	**0.82**	**0.58**	**0.64**		**0.68**	**0.93**		

ACOUSTIC ID

- In some situations, *Myotis spp*. calls can be very easy to identify
  - Requires good quality search phase calls
  - Large source of problem with *Myotis spp*. identification is low call quality

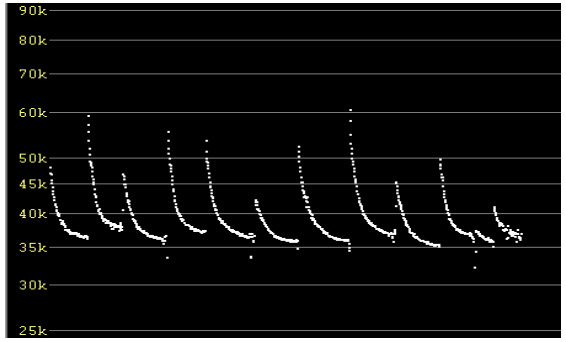
- There are very few distinct species groups that separate out (i.e., there is no *Myotis* group)

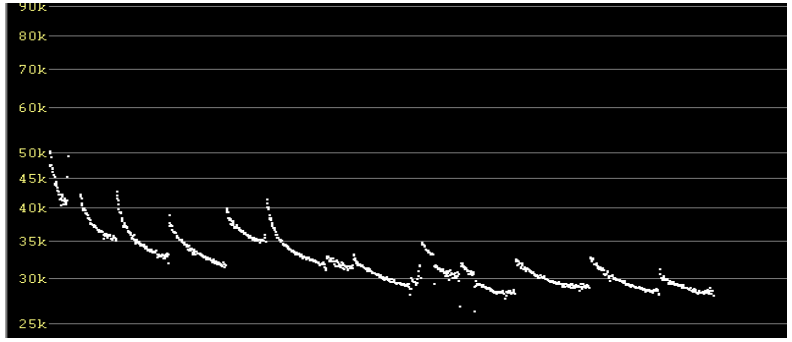
- With large call libraries, eastern red bats become a much bigger problem as they can overlap with multiple *Myotis* species calls

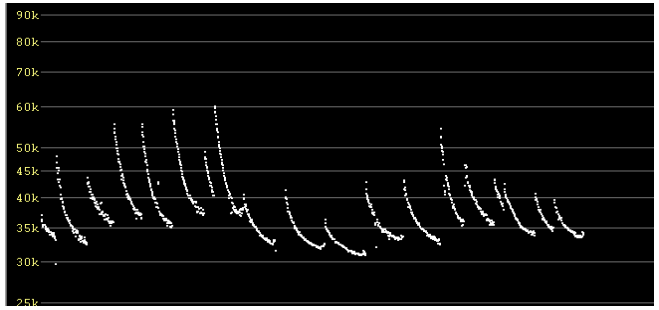
HOWEVER, SINCE ACOUSTIC IDS ARE NOT 100% ACCURATE WE NEED HELP IN INTERPRETING PRESENCE BASED ON NUMBER OF FILES

NATURAL VARIATION IN CALLS

Bats produce an enormous amount of calls
1 bat produces 10 calls / sec = 36,000 calls per hour







INTERPRETING ACOUSTIC ID RESULTS

If species ID were 100% then it would be easy

- 9 files identified as species A
- 1 file identified as species B

Interpretation: Both species would be present

MAXIMUM LIKELIHOOD ESTIMATE

- Incorporates classification matrix from acoustic ID testing to determine potential errors
- Null hypothesis: all files that were identified as a species were misclassified as other species
- So, p-value < 0.05 represents rejection of the null hypothesis and determination of species presence
- Example:
  - Species A was identified at 90% accuracy and were misclassified as species B at 10%
    - 9 files identified as species A
    - 1 file identified as species B

- Interpretation: Species A was present, species B was not

MLE OUTPUT EXAMPLE

		EPTFUS	LASBOR	LASCIN	LASNOC	MYOGRI	MYOLEI	MYOSEP	MYOSOD	NYCHUM	PERSUB
Site 1	6/20/2023	0	1	0.12064	1	1	1	1	1	1	1
	6/21/2023	0.002117	1	1	1	1	1	1	1	0.634978	1
	6/22/2023	0	1	0.781487	1	1	1	1	1	0.634978	1
	6/23/2023	4E-07	1	0.04268	1	1	1	1	1	0.006757	1

AUTOMATED ANALYSIS OUTPUT

- MLE output
  - Provides MLE results documenting species presence for each site/night
- Night level summary
  - Provides # of files and Species ID for each site/night combination
- File level analysis
  - Provides summary for each individual file analyzed

ANALYSIS APPROACHES

Quantitative

- Pros
  - Consistent
  - Measurable bias
  - Efficient
- Cons
  - Systematic errors

Qualitative

- Pros
  - Can see “big picture”
- Cons
  - Inconsistent
  - Unmeasured bias
  - Inefficient

INTERPRETATION OF ACOUSTIC ANALYSES

- Methodology to be used
  - Qualitative IDs only
  - Quantitative IDs only
  - Qualitative ID to check quantitative IDs
- Quality is a spectrum; accept limitations of data
- Remember that trying to ID bad calls is the #1 source for misidentifications
- Need to evaluate risk of both false positive and negative IDs

INTERPRETATION OF ACOUSTIC ANALYSES CONT'D

- Challenges to software results should always be justified
- Make decisions based on weight of evidence
- Watch out for red bats
- Consider effects of habitat

"I can't disagree with the automated species ID. Kind of like a challenge in football. Can't always confirm. Sometimes you just have to go with the call on the field."

- Eric Britzke

WITHIN DoD IT IS DIFFICULT TO HAVE A COMPUTER TO BE ABLE TO CONFIGURE HARDWARE, RUN, SOFTWARE, AND STORE DATA FOR ANY OF THESE SYSTEMS.

SOLUTIONS?

ACKNOWLEDGEMENT

This project is funded by the Department of Defense Legacy Resource Management Program

QUESTIONS?