

Acoustic Identification Basics

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24 April 2017



**US Army Corps
of Engineers®**



General pulse structure types

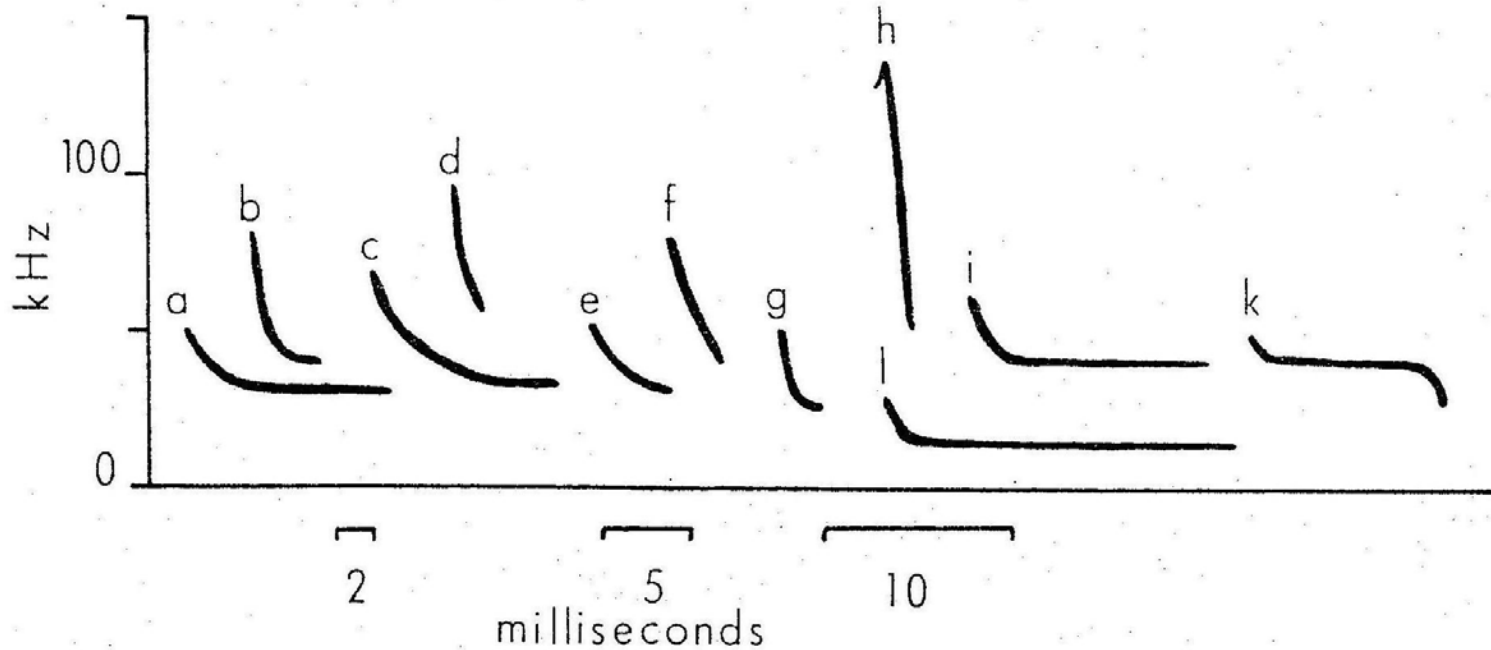


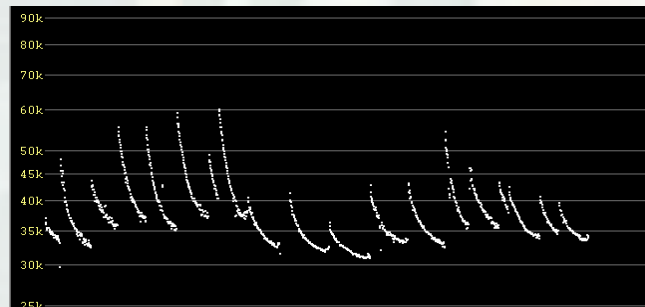
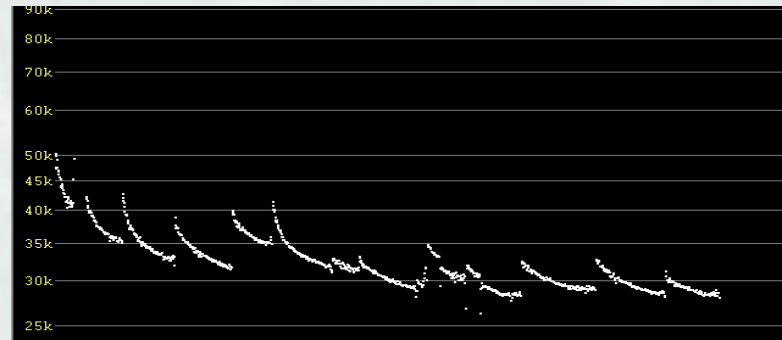
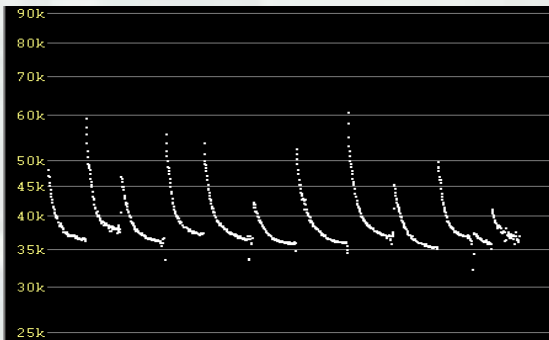
FIG. 6. DIAGNOSTIC ECHOLOCATION CALLS PRODUCED BY DIFFERENT SPECIES OF INSECTIVOROUS BATS

Natural Variation in Calls

Bats produce an enormous amount of calls

1 bat produces 10 calls / sec = 36,000 calls per hour / bat

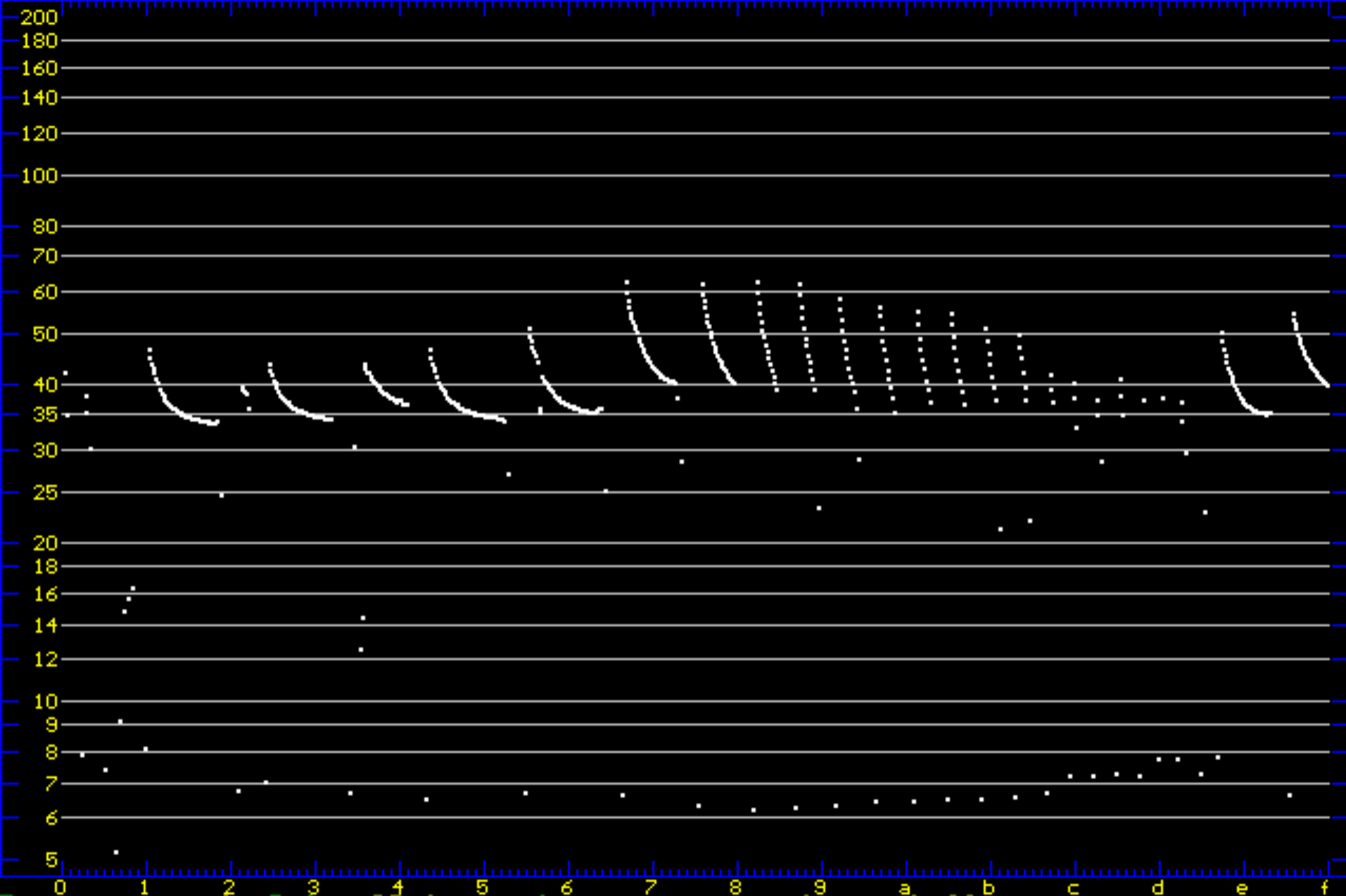
Leads to both within and between individual variation



Sources of variation

- Equipment deployment
- Within an individual
- Within a species
- Response to clutter
 - ▶ Vegetation, other bats, high prey availability
- Doppler effect
- Among species

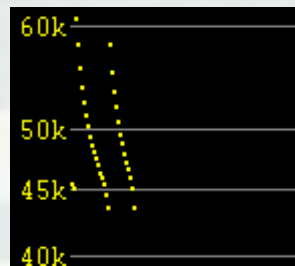
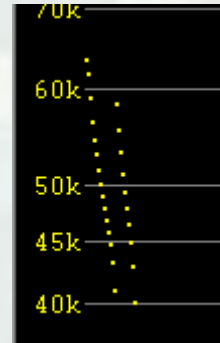




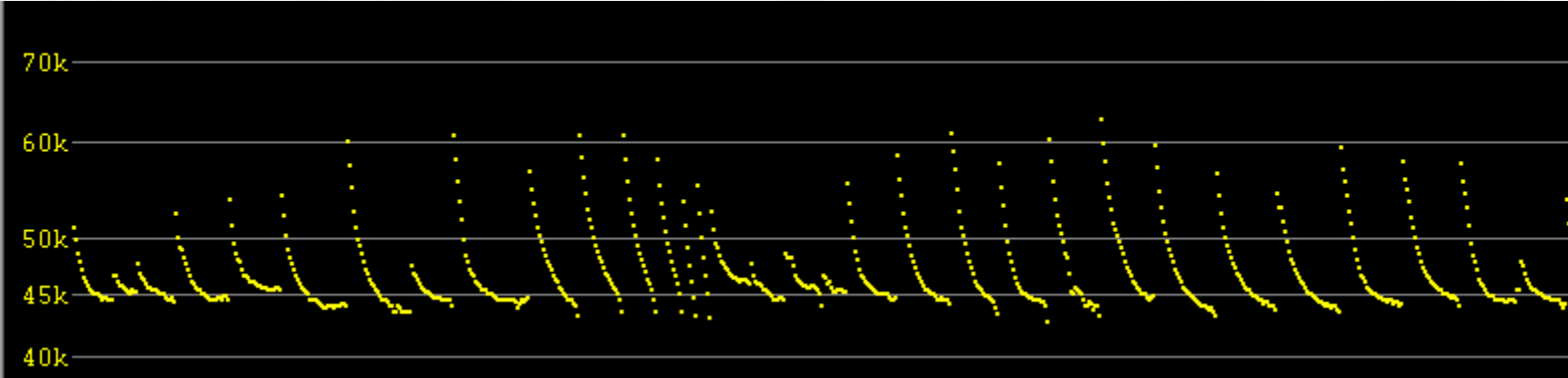
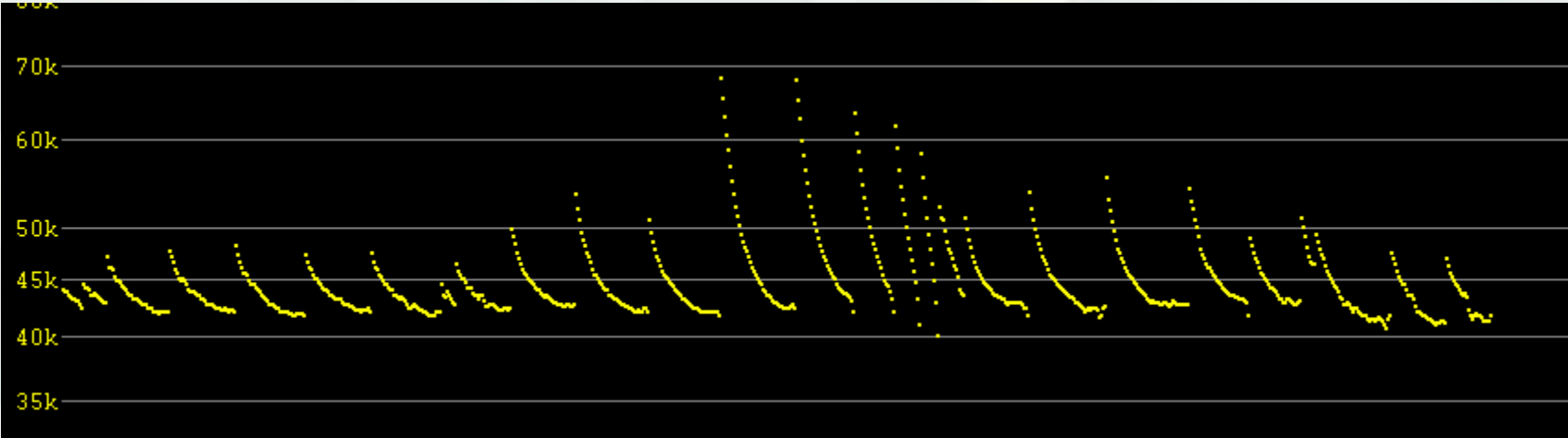
Type: compaq1 Date: 30 jun Loc: area around cave hollow cave
 Sp: Spec: active
 Note: driving roads around cave

96302051.07# Div 16 Type 129 1999/06/30 2051:07
 TOT 150ms TK 10ms f7 COMP St 2 FILT 0
 ANALOOK Version 4.8n 3 Oct 2000

Sequence Length



Sequence Length Matters

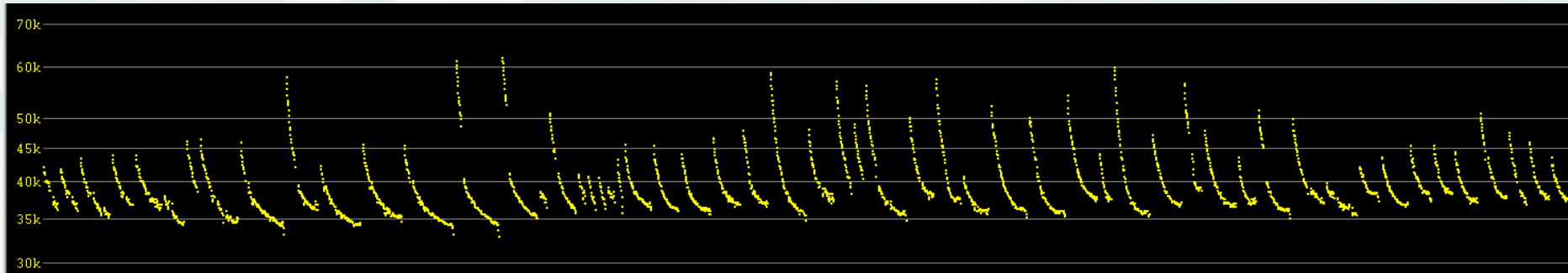
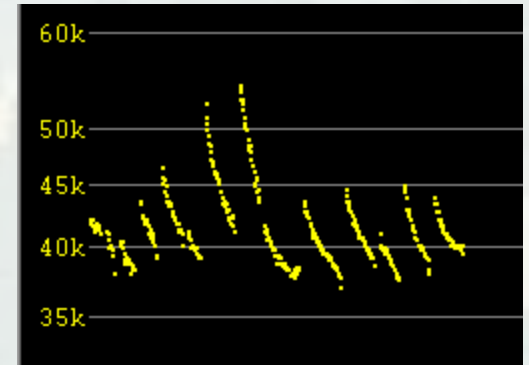
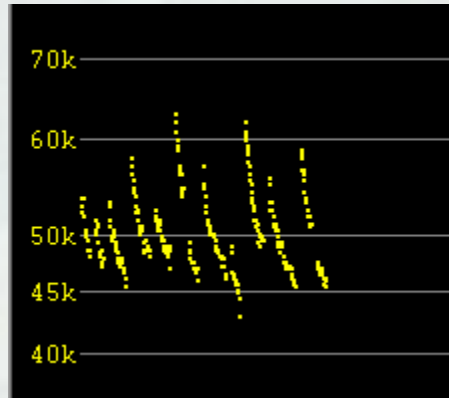
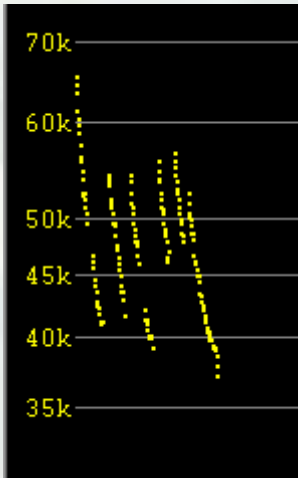


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Broken and Fragmentary Pulses

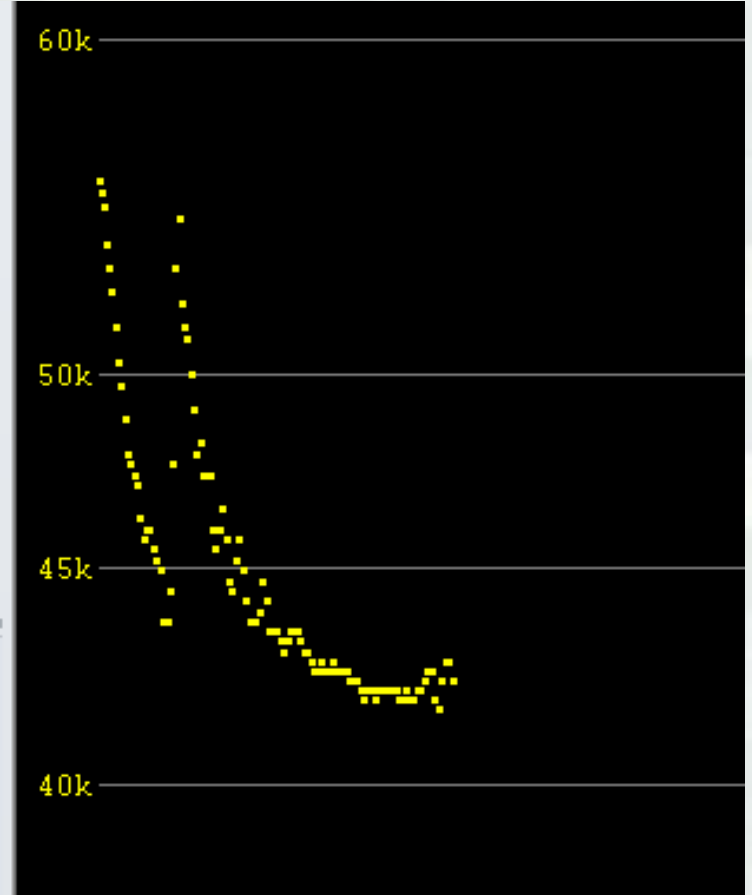
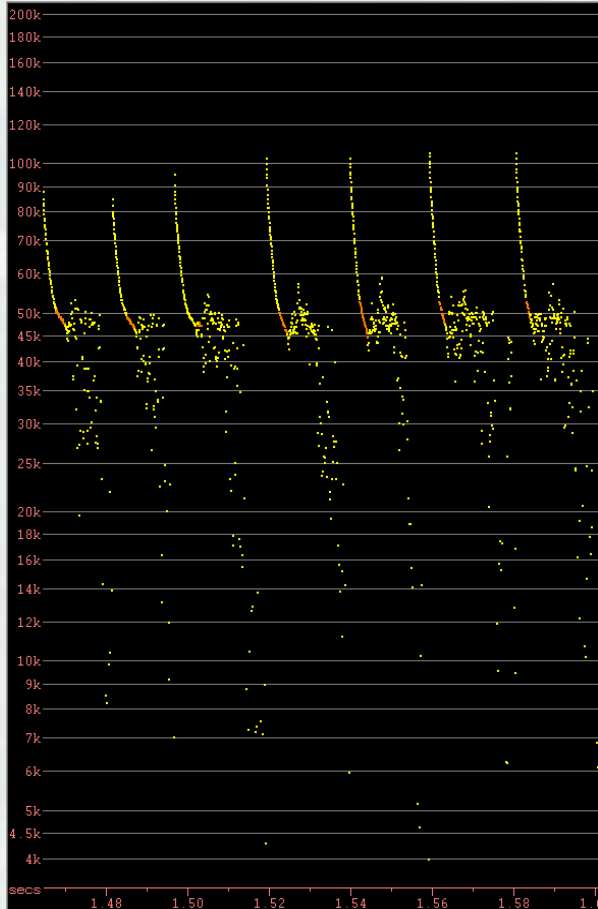


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Echoes

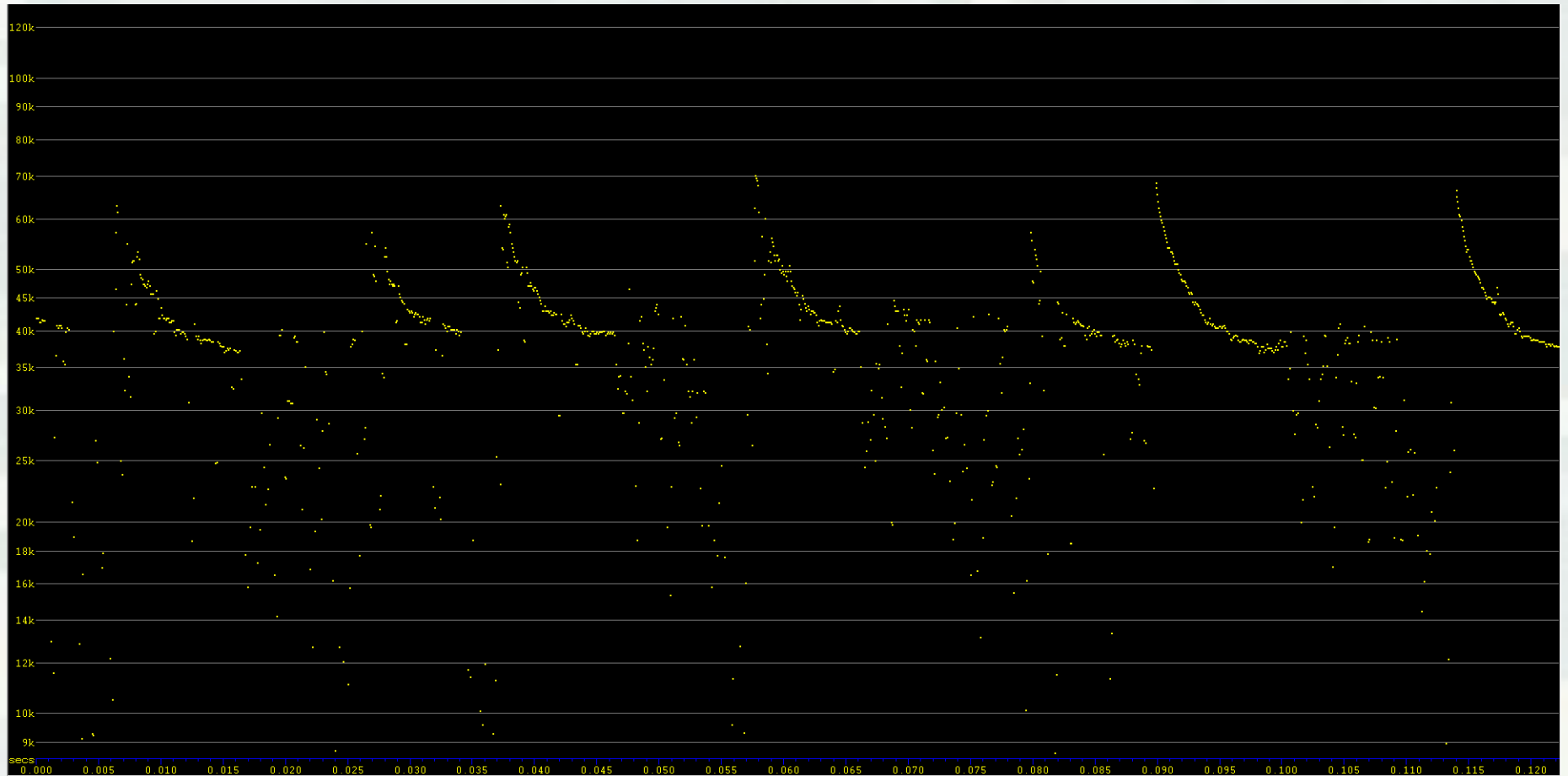


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Noise

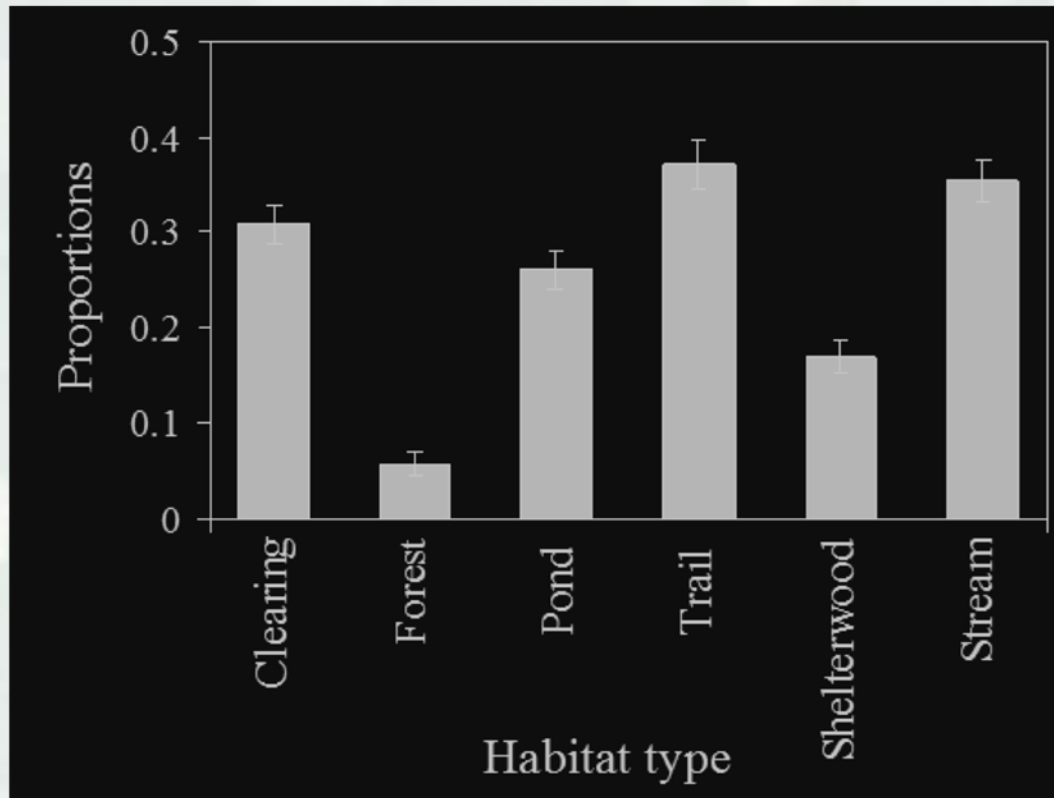


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Proportion of ID'able Sequences



Classification rates (%) of mixture DFA

	MYAU	MYGR	MYLE	MYLU	MYSE	MYSO
MYAU	80			3		
MYGR		94		1		
MYLE			93		4	3
MYLU	20	3		89		6
MYSE			2		93	
MYSO			5	6	2	91
Other		3		1		



Notes on the acoustic ID of bats in the eastern US

- With **good quality** calls, identifications of all *Myotis* spp. are relatively easy
- There are no distinct species groups that separate out (i.e., there is no *Myotis* group)



However, since acoustic IDs are not 100% accurate we need help in interpreting presence based on number of files



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Maximum Likelihood Estimate

- Incorporates classification matrix from acoustic ID testing to determine potential errors
- Null hypothesis: all of the files that were identified as a species were actually misclassified other species
 - ▶ So $p\text{-value} < 0.05$ represents rejection of the null hypothesis and determination of species presence



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



Interpreting Results

- 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



Another Example

- Species A was identified at 90% accuracy and were misclassified as species B at 10%
 - ▶ 9 files identified as species A
 - ▶ 5 file identified as species B
- Interpretation: Both species are present



Focus on Presence / Absence

- Pulse level ID
 - ▶ Almost any species can have portion of call that looks like any other
- Sequence ID
 - ▶ Depending on species present, many sequences can be misidentified when species due to known error rates
- Must rely on Maximum Likelihood
 - ▶ MLE accounts for natural error and overlap of call ID



Keys for Successful Species ID

- Record high quality calls
- Avoid clutter
- Use weatherproofing only when absolutely necessary
- Check data as being recorded (nightly or site)

