XBAT Analysis of Prairie Warbler Field Recordings

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The Cornell Lab of Ornithology

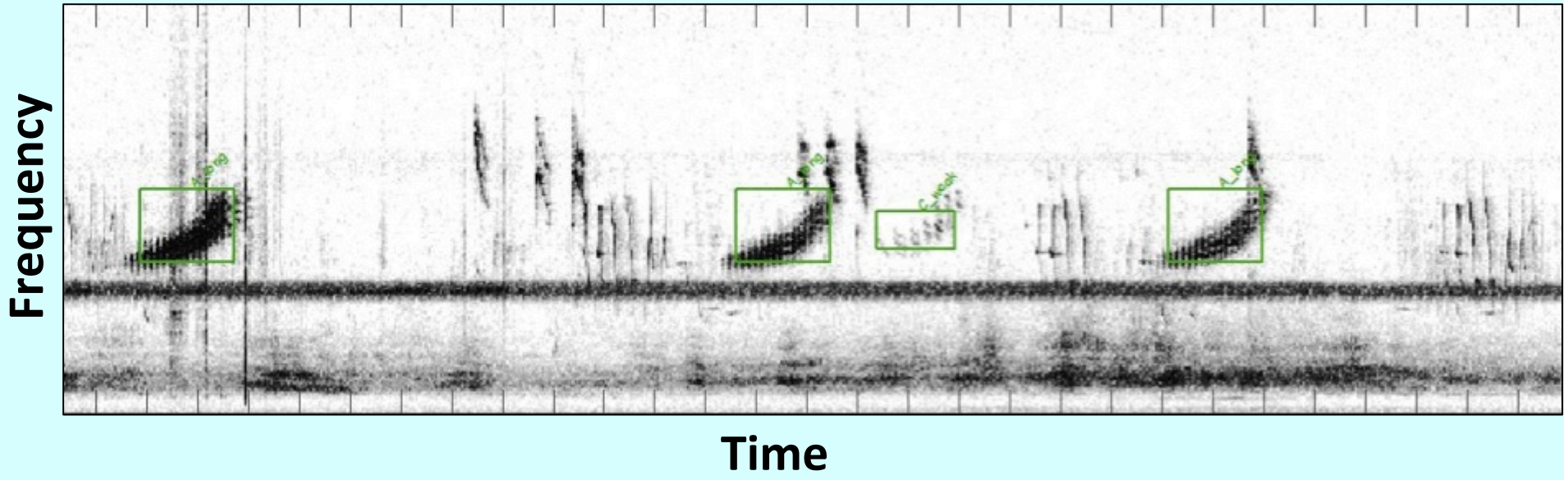
Automated Recording

- **Birds are frequent subjects**
  - **Vocally identifiable**
  - **70-94% of detections are auditory**

  (Scott et al. 1981, Dejong and Emlen 1985, Sauer et al. 1994)
- **Benefits**
  - **Removes field observer bias**
  - **Permanent record**
  - **Improves data collection abilities**
  - **May enhance detection rates**

  (Haselmayer and Quinn 2000, Acevedo and Villanueva-Rivera 2006, Tegeler et al. 2012)

Spectrogram



XBAT

Extensible Bioacoustic Tool

TheCornellLab

- **Open-source MATLAB platform**
- **Large-scale automated sound analysis**
- **<u>Interactive Automatic Detection</u>**

(Figueroa and Robbins 2008, Figueroa 2012)

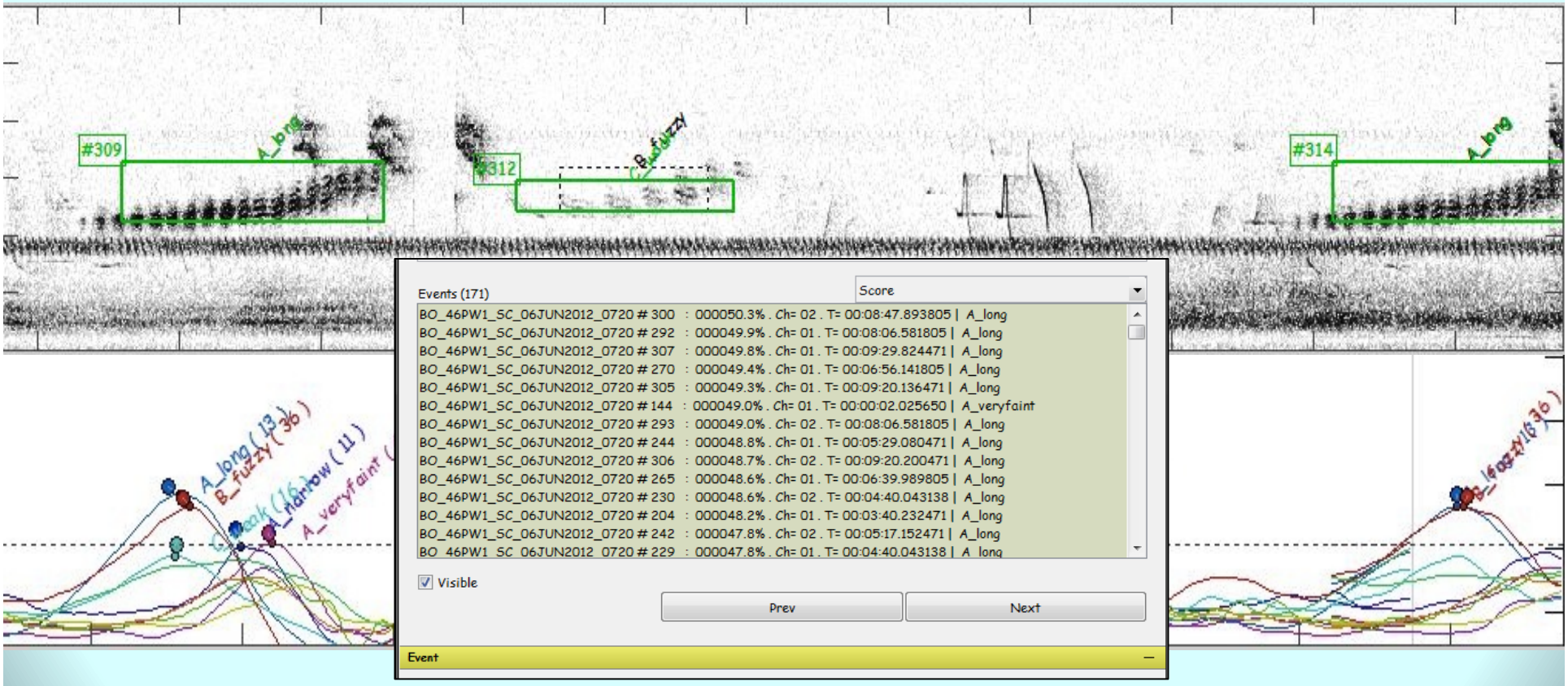
XBAT

EXTENSIBLE BIOACOUSTIC TOOL

XBAT

Interactive Automatic Detection

3.1. XBAT Sound Segmentation Tools



(Figueroa and Robbins 2008, Figueroa 2012)

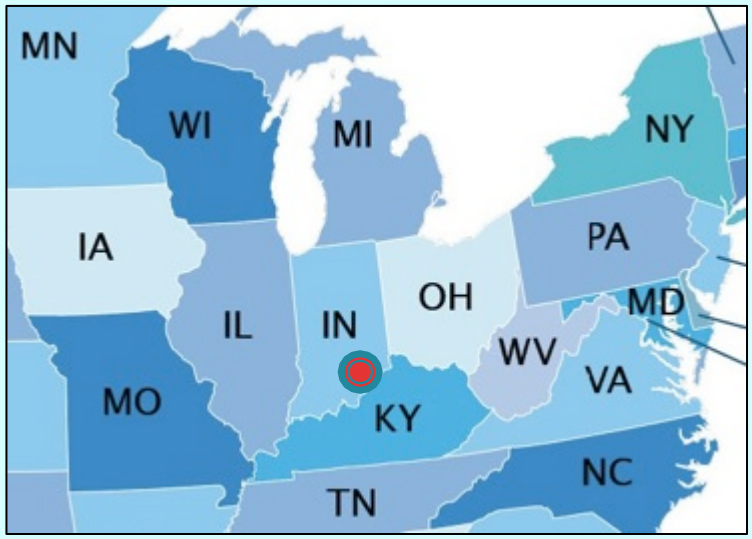
Objective

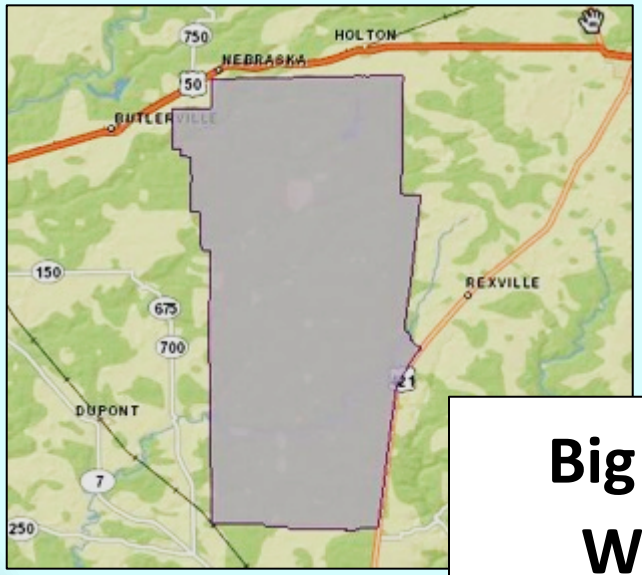
How well does XBAT detect Prairie Warbler songs in field audio recordings?

Across breeding season and several locations

- **# Detections ≈ # Songs**
- **Maximize correct detections**
- **Minimize incorrect detections**

Methods



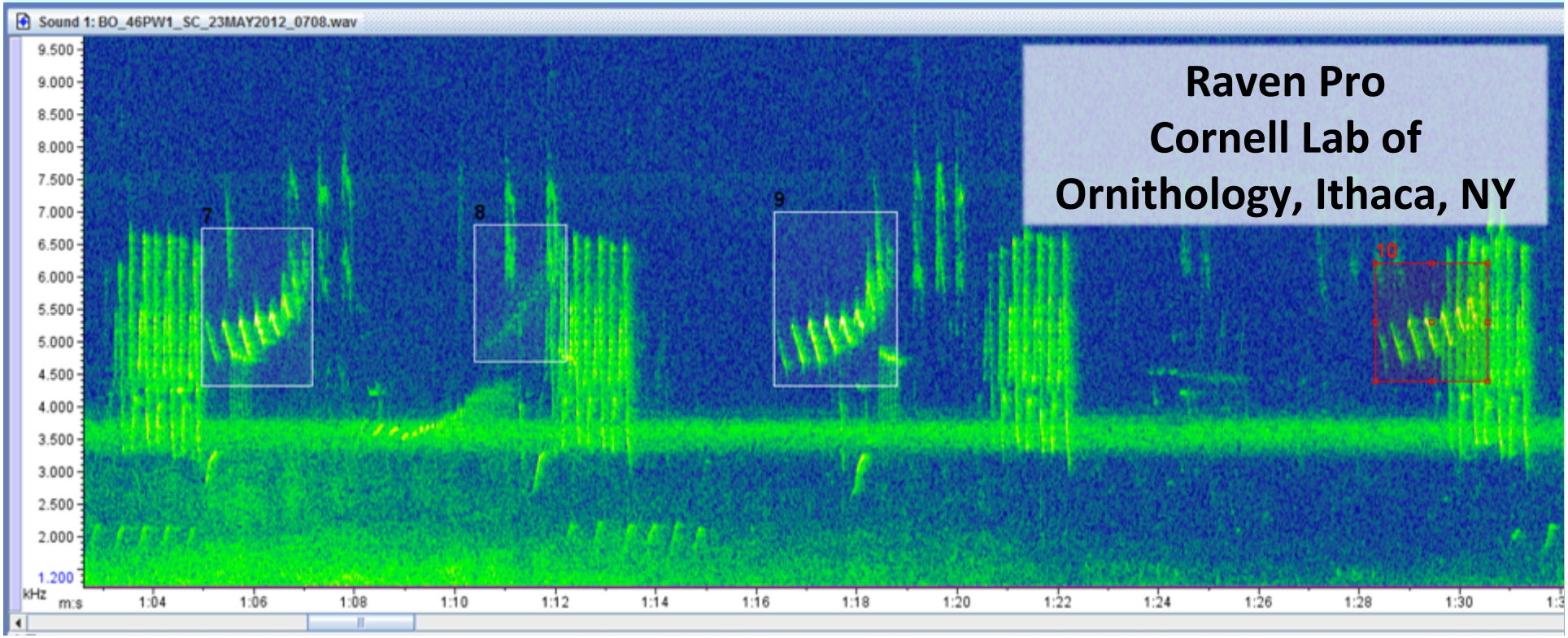


Wildlife Acoustics, Concord, MA

Big Oaks National Wildlife Refuge

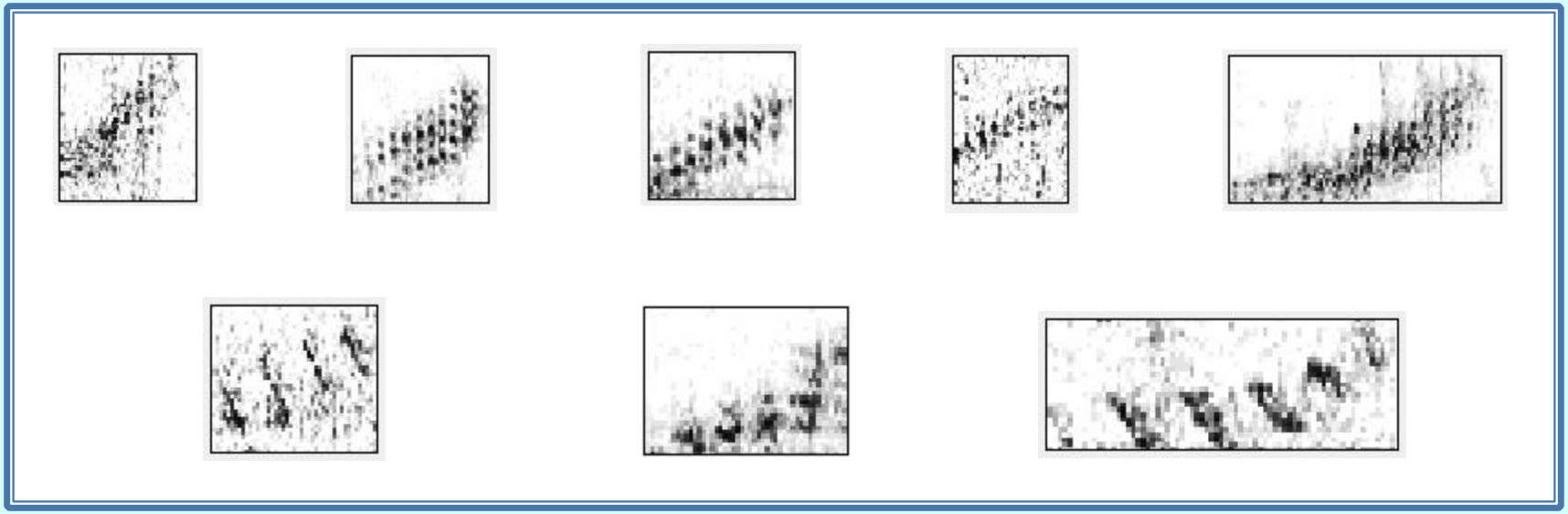
Methods

- 33 audio files (10-min each)
- 15 May – 20 July 2012
- 10-min before sunrise to 4 hrs after



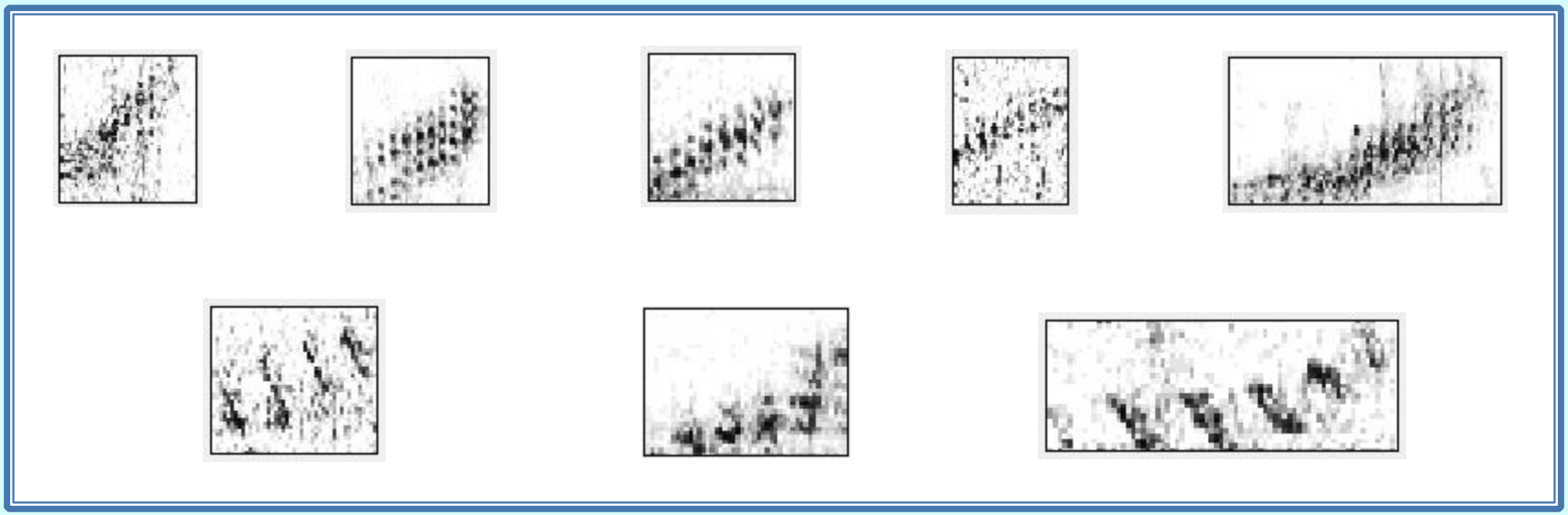
Methods

Used 33% of the files to create and train a set of robust detectors

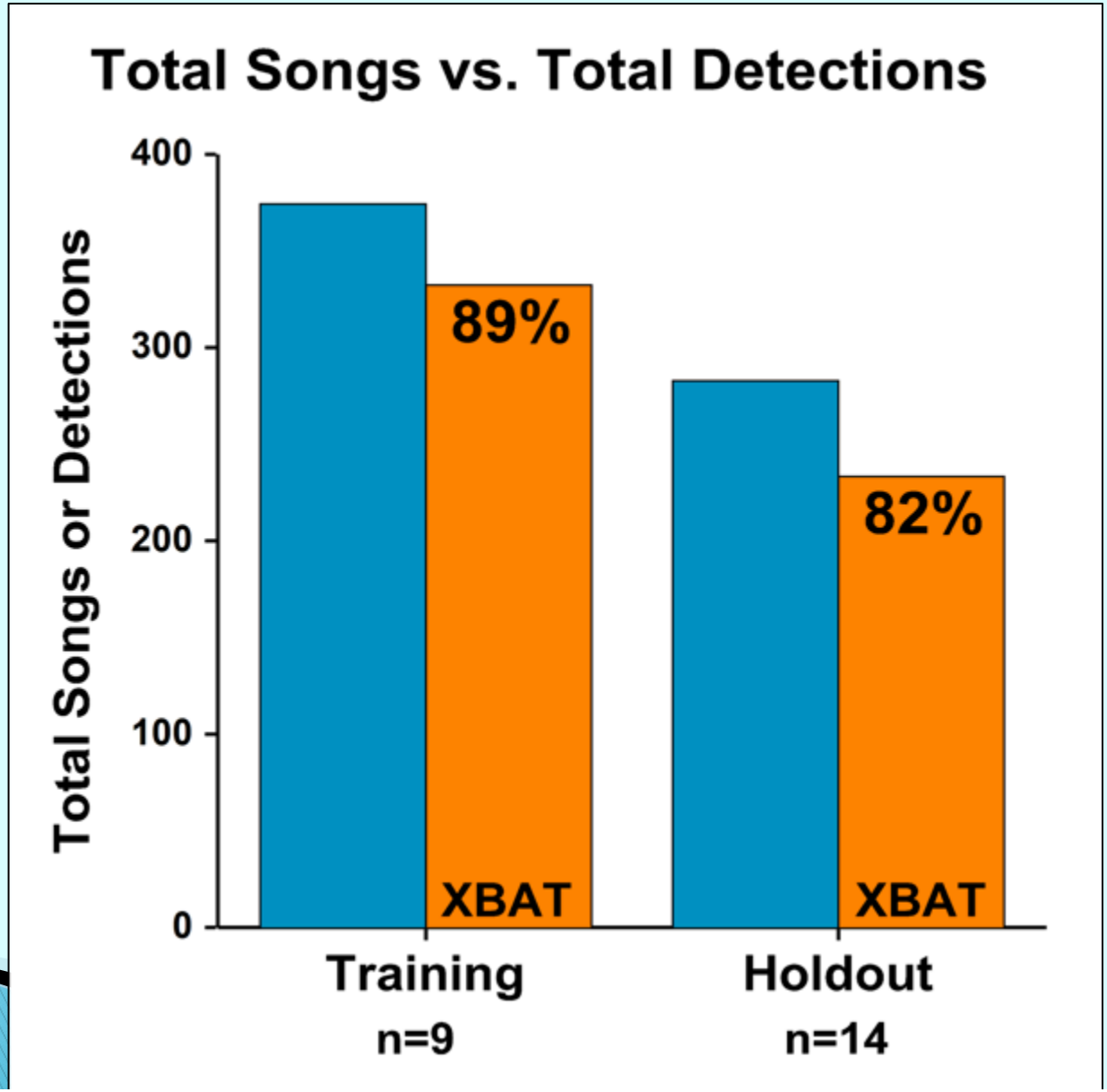


Methods

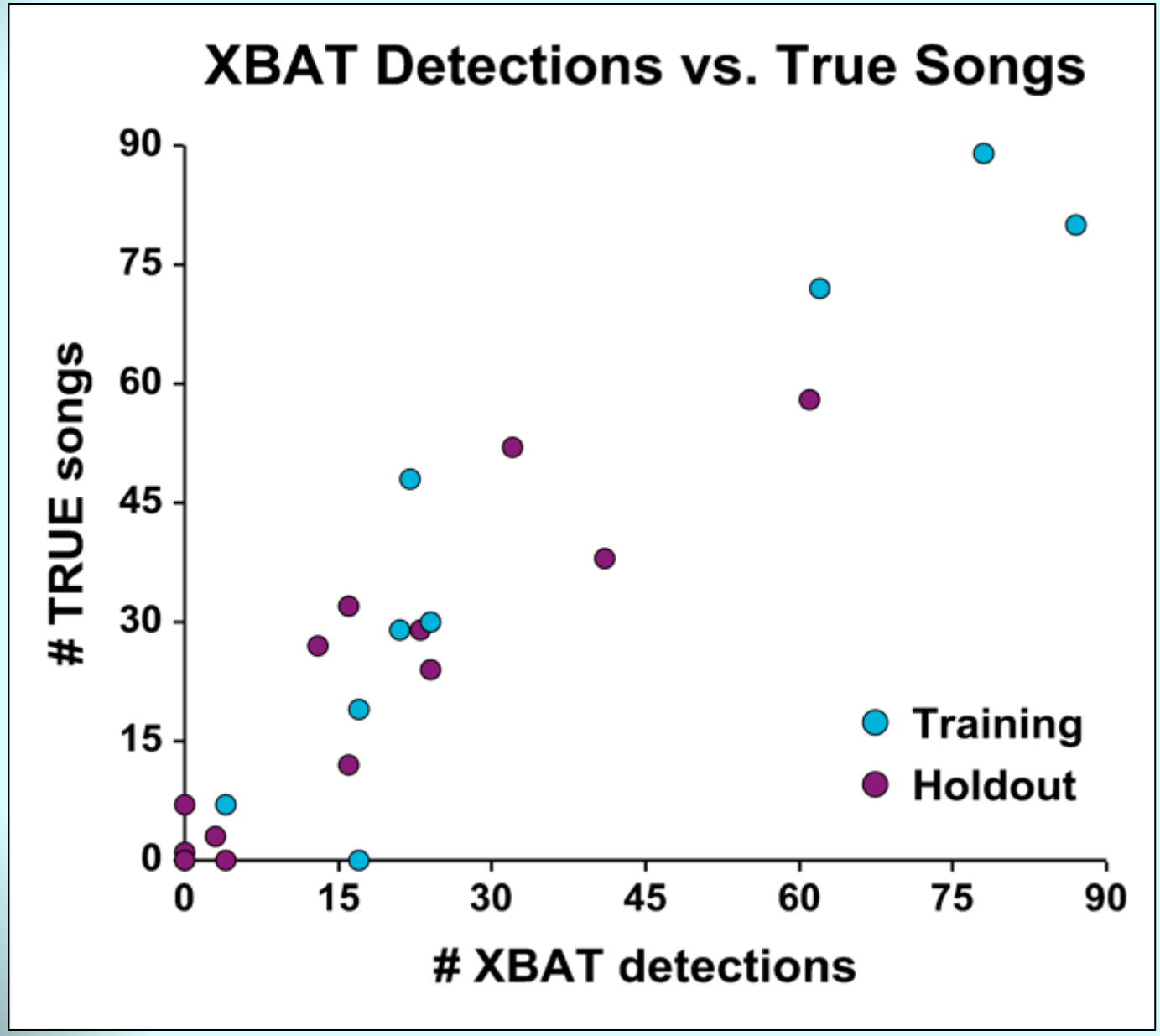
Run the detectors on the holdout sample (67%)



Results


Total Songs vs. Total Detections
Total Songs or Detections
400
300
200
100
0
89%
82%
XBAT
XBAT
Training
n=9
Holdout
n=14

Results



Paired Wilcoxon
z-value = 1.83
p = 0.07

Results

2. Examine each detection for accuracy and identify misses

Results

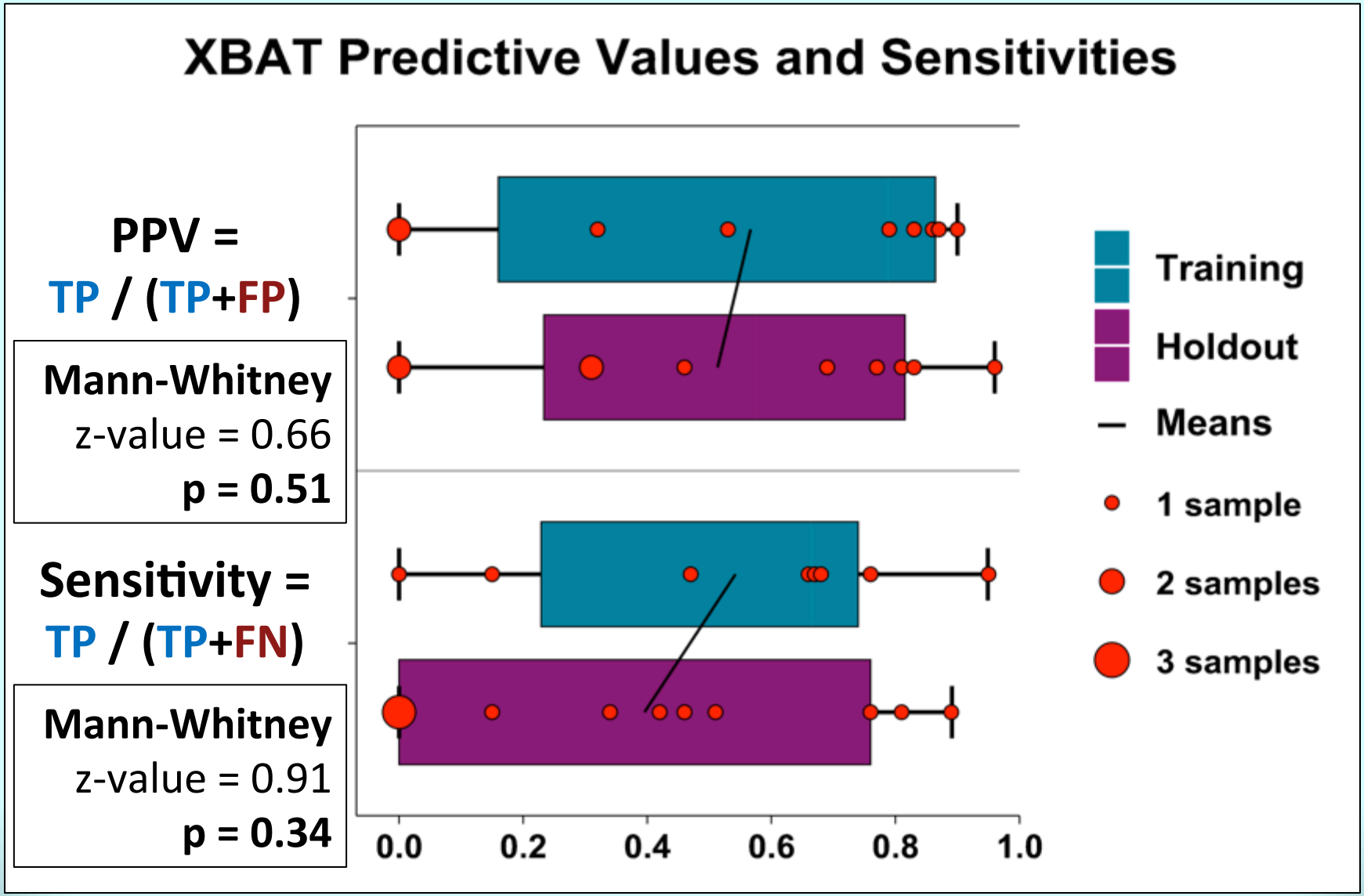
2. Examine each detection for accuracy and identify misses

	XBAT detection	No detection
Song present		
Song absent		

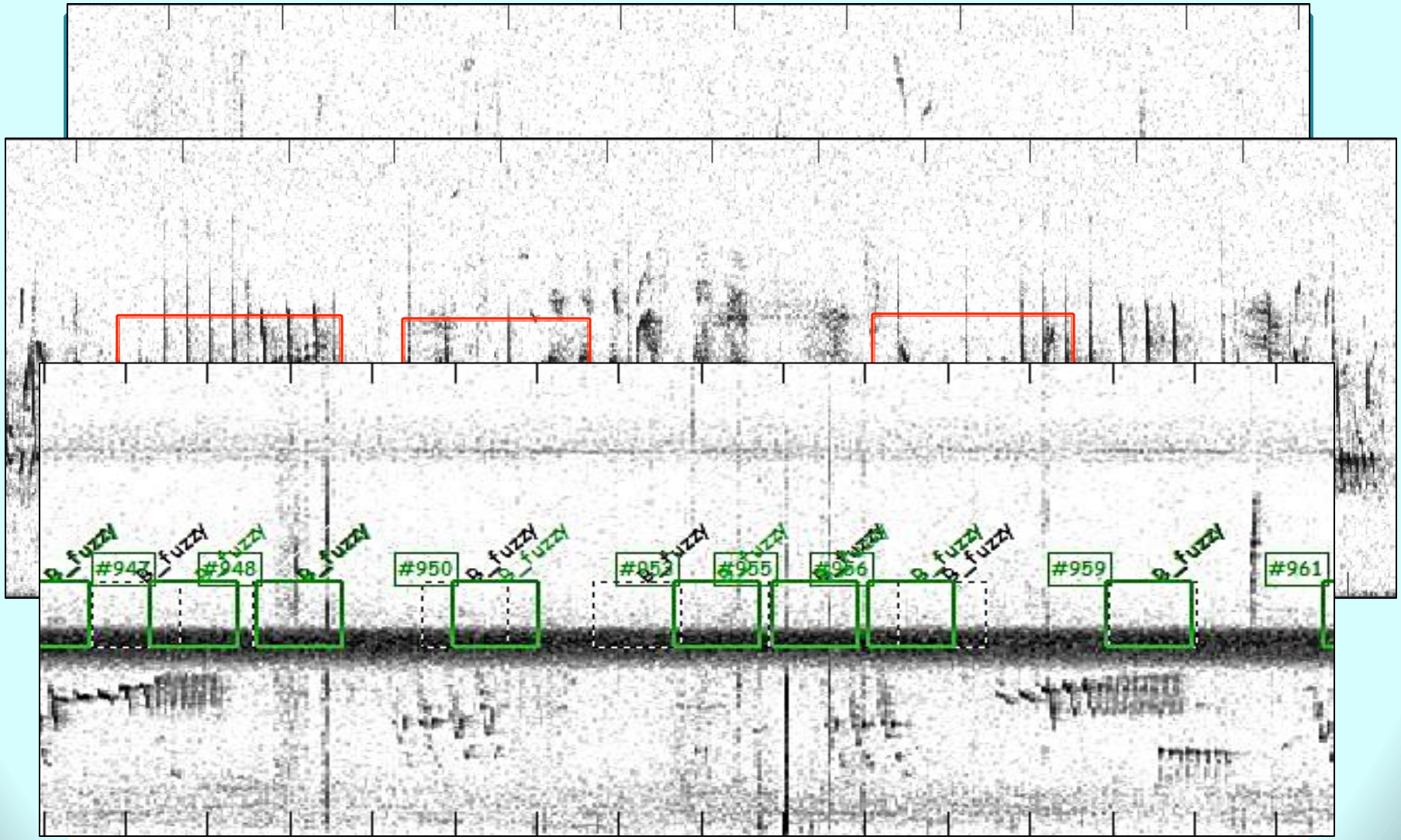
Positive Predictive Value (PPV) = TP / (TP+FP)

Sensitivity = TP / (TP+FN)

Results


XBAT Predictive Values and Sensitivities
PPV =
TP / (TP+FP)
Mann-Whitney
z-value = 0.66
p = 0.51
Sensitivity =
TP / (TP+FN)
Mann-Whitney
z-value = 0.91
p = 0.34
0.0
0.2
0.4
0.6
0.8
1.0
Training
Holdout
Means
1 sample
2 samples
3 samples

Results Summary



Discussion

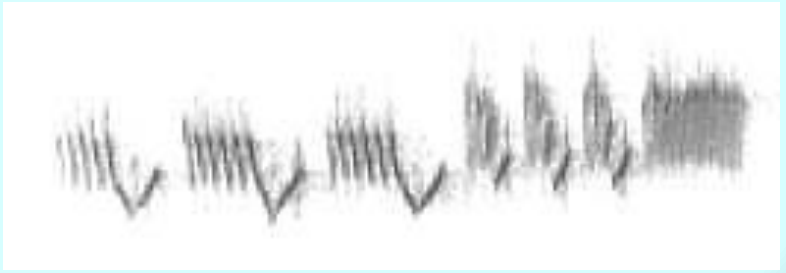
Cerulean Warbler XBAT detection (Charif and Pitzrick 2008)

PPV = 66% (range: 39 to 97%)

72% (range: 0 to 96%)

Est. Sensitivity = 22% (range: 0 to 51%)

62% (range: 0 to 95%)

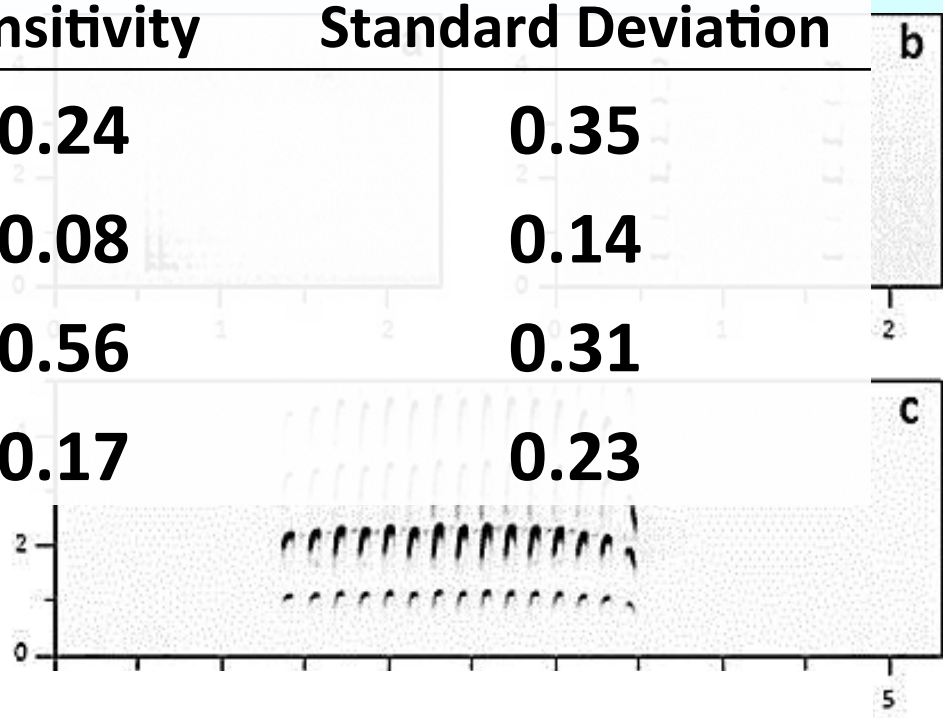


Discussion

Woodpecker XBAT detection

(Swiston and Mennill 2009)

Sound	Sensitivity	Standard Deviation
Pale-billed double knock	0.24	0.35
Ivory-billed double knock	0.08	0.14
Ivory-billed “kent” call	0.56	0.31
Pileated cackle call	0.17	0.23
Prairie Warbler	0.62	0.33



Discussion

American Robin and Kingfisher detection (Potamitis et al. 2014)

Feature Extraction and Pattern Recognition

Hidden Markov Models

PPV = 85%
Sensitivity = 77%

Prairie Warbler
PPV = 72%
Sensitivity = 62%

PPV = 85%
Sensitivity = 85%

Implications

- **There are limitations to automated detection!**
- **Background Noise and Interspecific Songs**
  - **Some files incompatible with automated detection**
- **Other detection methods show more promise (Potamitis et al. 2014)**

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Photo Credits

- Bryan Pfeiffer http://bryanpfeiffer.com/2014/04/29/chasing-spring-2014-warblers-and-woodpeckers/
- http://fontsinuse.com/uses/7431/the-cornell-lab-of-ornithology
- http://www.mappery.com/map-of/USA-States-Map
- http://www.fws.gov/refuge/Big_Oaks/visit/plan_your_visit.html
- http://www.hiltonpond.org/ThisWeek050422.html
- Todd Arcos http://nc.audubon.org/cerulean-warbler-0
- Nikolay Staykov http://birdsphotographer.com/?p=1698&lang=en
- http://ibc.lynxeds.com/photo/american-robin-turdus-migratorius/bird-was-singing-branch
- https://www.pinterest.com/pin/261560690831447564/

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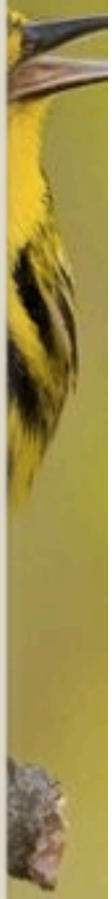

Questions?

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