Sky-Blue Princess: An Analysis of Cerulean Warblers and Whole Songbird Communities through Passive Acoustic Monitoring at Fern Valley Field Station

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Deforestation and Reforestation

Deforestation can occur when forested lands are cleared for agriculture or development.

Reforestation is the act of a previously deforested habitat growing back.

Land can be left alone, and trees can return

Humans can actively reforest the land

Birds as Bioindicators

- Bioindicators: taxa whose numbers or well-being can give an idea as to how the ecosystem is doing
    - They can be affected by food availability, habitat degradation, and predator populations
    - Can be used to direct conservation efforts

Fern Valley Field Station

- Located in Holmes County, near Big Prairie, OH
- 56 Acres
- Mature Forest- land was once farmed
  - Riparian zones (Wilkin Run)
- Regenerating Forest- abandoned cow pasture
  - Active regeneration efforts are underway
  - Monitoring reptiles via coverboards
  - Tree tubes, active planting and monitoring of native trees

Figure 1: Aerial view of Fern Valley Field Station. Mature deployment locations are denoted with red squares. Regenerating sites are denoted with red circles.

Passive Acoustic Monitoring

- Recording devices are deployed in the field and left for a long period of time

- Data collected are audio recordings

- Recorders are programmed either to continuously run or run for a set period of time each day

Benefits:
- Data collection does not depend on continued availability for fieldwork
- Large amounts of data can be collected autonomously
- Birds that are hard to spot (e.g. Cerulean Warblers) can be detected by call

Figure 2: Tree where a bioacoustic recorder was placed. The recorder was secured using a locking cable tie, and flagging tape was tied to the tree for visibility purposes.

Methods

- Six Wildlife Acoustics bioacoustics recorders were placed at Fern Valley
  - Three in the Mature forest, three in the regenerating forest
  - Deployed May 29th, 2025; collected July 2nd, 2025
  - Three recordings per day: one at sunrise, and two more recordings one and two hours after sunrise (30 minutes of footage per day

Figure 2: Tree where a bioacoustic recorder was placed. The recorder was secured using a locking cable tie, and flagging tape was tied to the tree for visibility purposes.

Methods

- All recordings were analyzed using Kaleidoscope Pro
- Recordings were broken down into individual calls, and calls were sorted into clusters
- Clusters were identified by ear, with assistance from BirdNet

Results

Table 1: Table denoting the total number of observations for each species observed in the study, along with the percentage of the data each species comprises.

Species Frequency

Species	Scientific Name	Total Observations	% of Data
Acadian Flycatcher	Empidonax virescens	14351	14.9
American Crow	Corvus brachyrhynchos	3674	3.8
American Robin	Turdus migratorus	6179	6.4
Carolina Chickadee	Poecile carolinensis	200	0.2
Carolina Wren	Thyrothorus ludovicianus	236	0.2
Cedar Waxwing	Bombycilla cedrorum	95	0.1
Cerulean Warbler	Setophaga cerulea	2959	3.1
Cerulean Warbler or Northern Parula	Setophaga cerulea or americana	503	0.5
Common Yellowthroat	Geothlypis trichas	961	1
Dark-eyed Junco	Junco hyemalis	496	0.5
Downy Woodpecker	Picoides pubescens	504	0.5
Eastern Towhee	Pipilo erythropthalmus	5903	6.1
Eastern Wood-Pewee	Contopus virens	7228	7.5
Field Sparrow	Spizella pusilla	10988	11.4
Gray Catbird	Dumetella carolinensis	506	0.5
Hooded Warbler	Setophaga citrina	216	0.2
Indigo Bunting	Passerina cyanea	271	0.3
Northern Cardinal	Cardinalis cardinalis	11845	12.3
Pine Warbler	Setophaga pinus	394	0.4
Red-Bellied Woodpecker	Melanerpes carolinus	259	0.3
Red-eyed Vireo	Vireo olivaceus	275	0.3
Rose-Breasted Grosbeak	Pheucticus ludovicianus	6023	6.2
Song Sparrow	Melospiza melodia	209	0.2
Tufted Titmouse	Baeolophus bicolor	11318	11.7
White-Eyed Vireo	Vireo griseus	2477	2.6
Wild Turkey	Meleagris gallopavo	127	0.1
Willow Flycatcher	Empidonax traillii	360	0.4
Wood Thrush	Hylocichla mustelina	4214	4.4
Worm-Eating Warbler	Helmitheros vermivorum	371	0.4
Yellow Warbler	Setophaga petechia	2156	2.2
Yellow-Breasted Chat	Ictera virens	1177	1.2

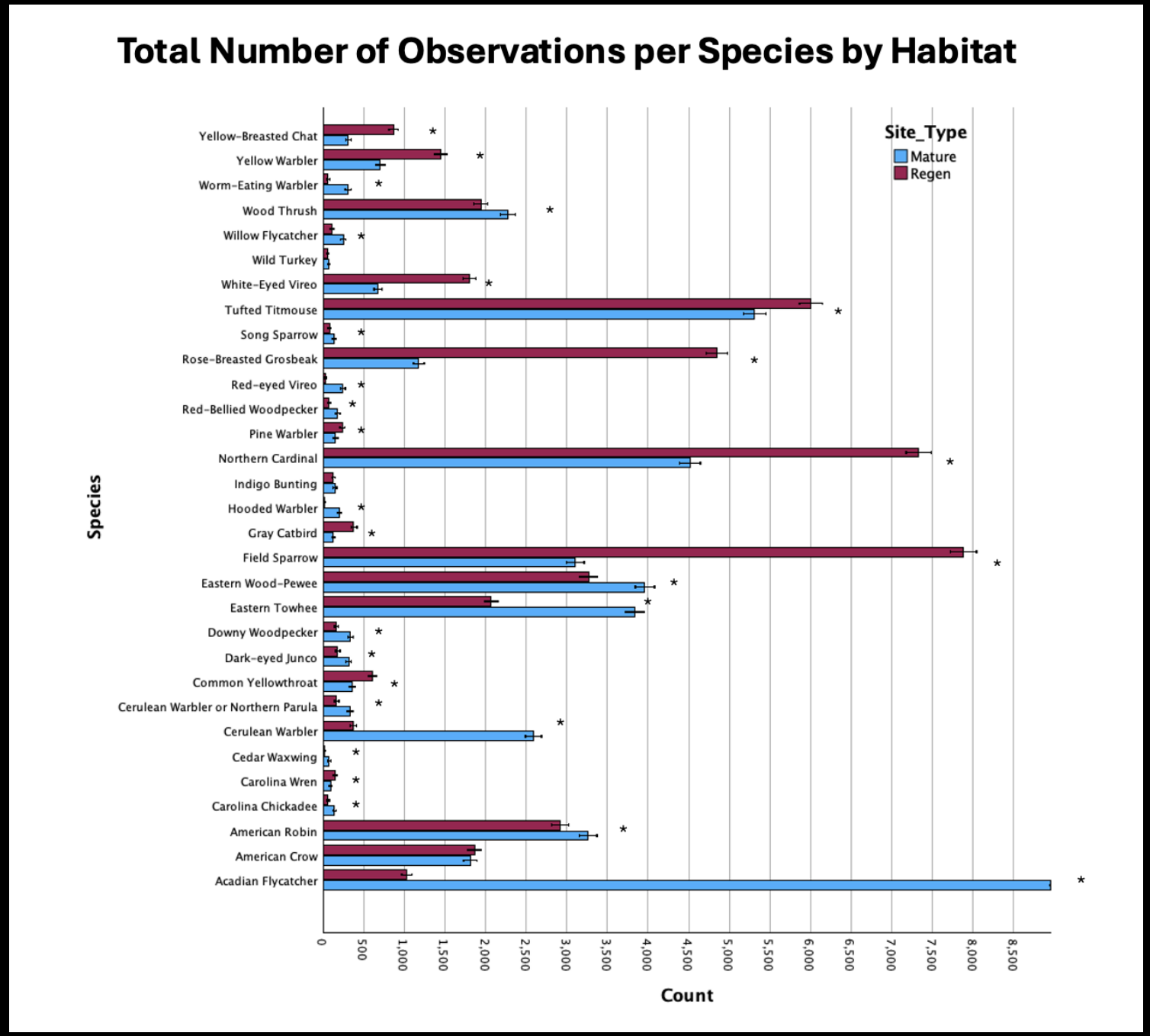

Figure 3: Bar chart displaying the numbers of each species observed by habitat type. Asterisks signify a significant difference (<0.001) in bird counts between the mature (blue) and regenerating (red) forests. All significant findings resulted in a P value of <0.001. Error bars signify a 95% Confidence Interval. The mature forest Acadian Flycatcher count has been cut off for clarity of other less-observed species. The total number of Acadian Flycatchers observed in the mature forest was 13320.

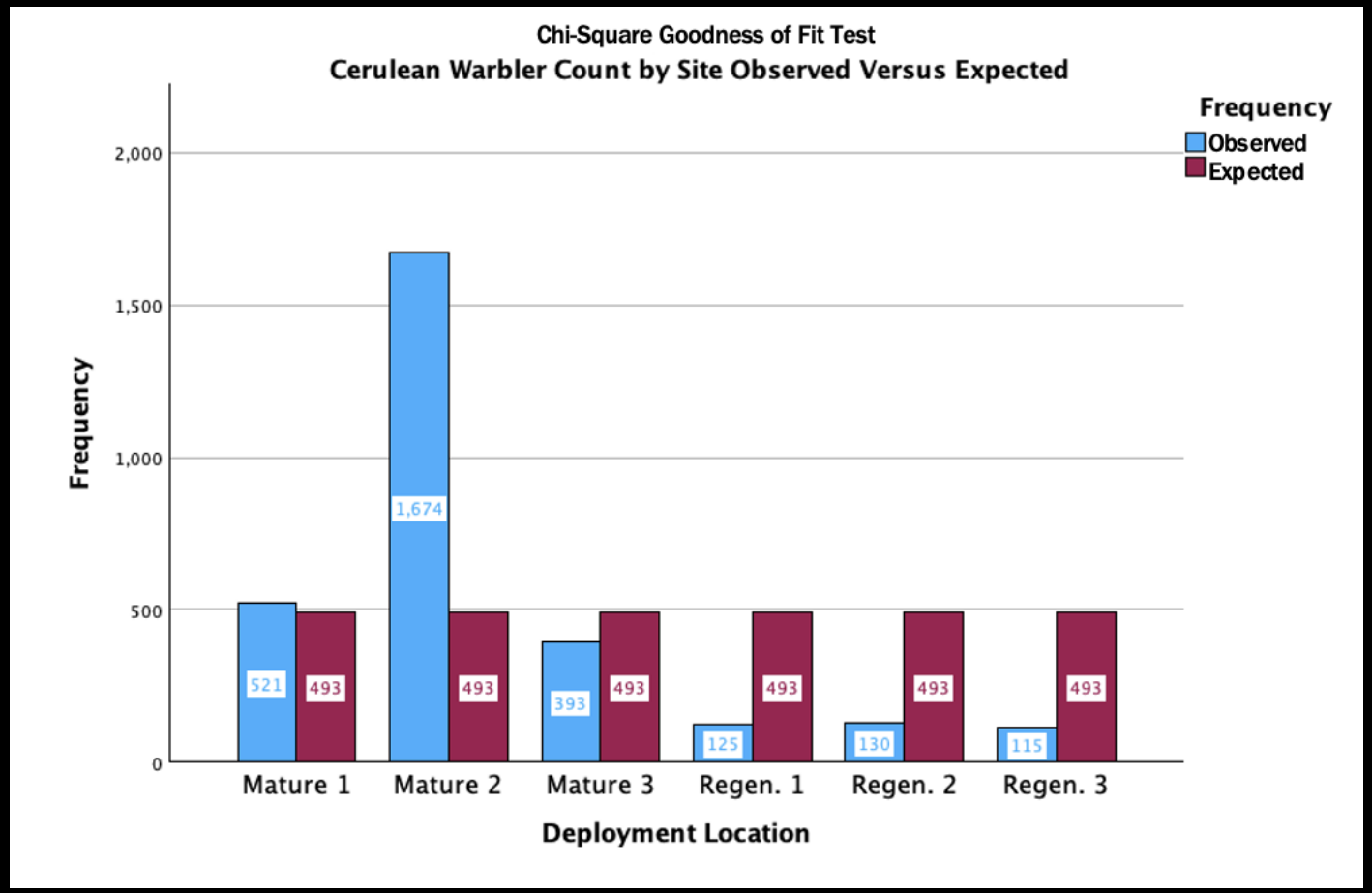

Figure 4: Number of Cerulean Warbler calls by deployment location. "Regen." is an abbreviation for "Regenerating", shortened for clarity. Observed values are depicted in blue, and expected values are denoted in red. These observed and expected values were calculated into the Chi-Square test for Cerulean Warblers by deployment location.

Potential Hybridization Event

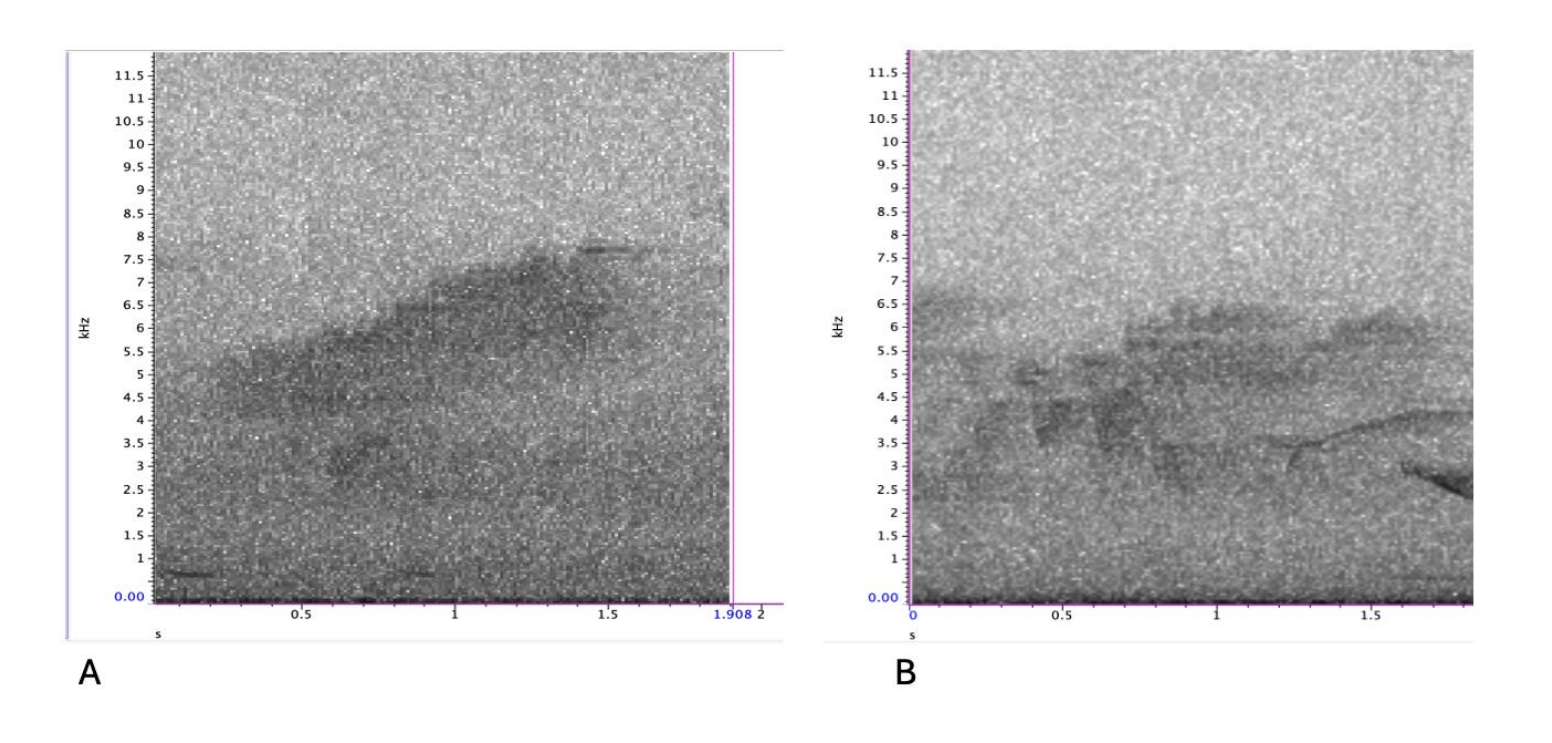

Figure 5: Actual potential hybrid call from the data (A), and an actual Cerulean Warbler call from the data (B). There is some background noise in the Kaleidoscope files (A and B). kHZ is on the Y-axis, and time (seconds) is on the X-axis for all spectrograms. These spectrograms were created using Raven Lite (The Cornell Lab of Ornithology, 2026)

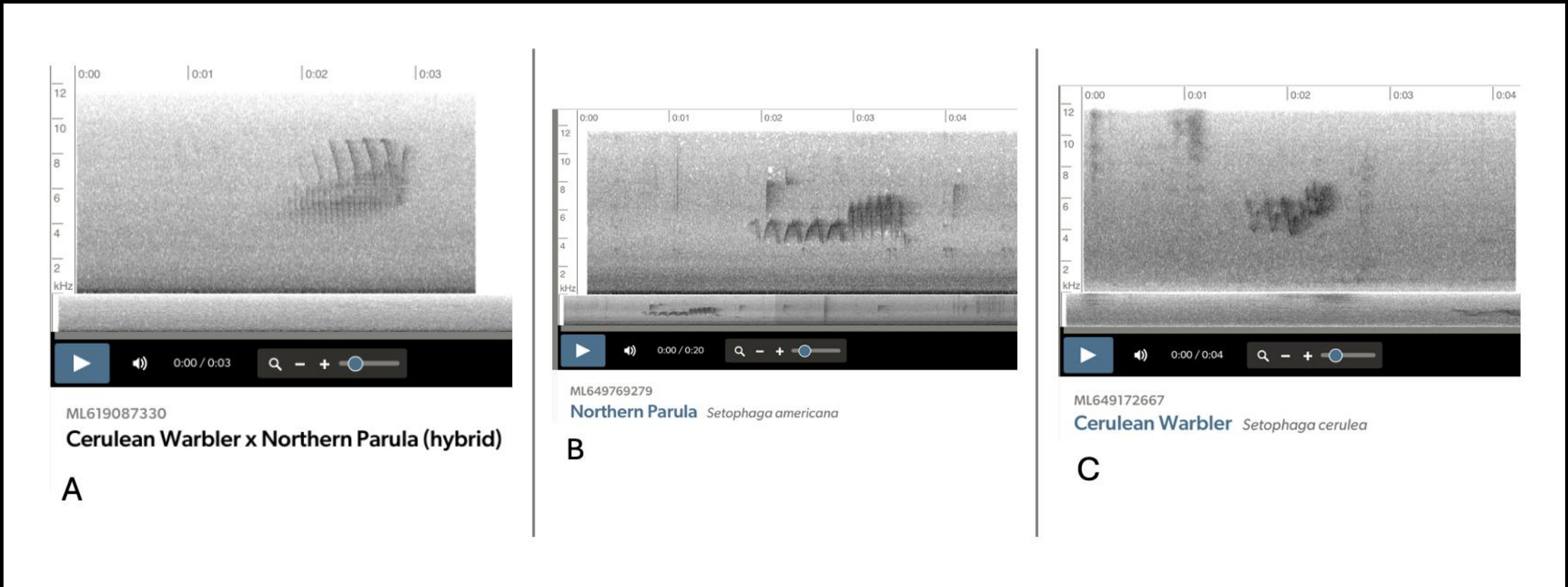

Figure 6: Confirmed Cerulean Warbler x Northern Parula hybrid call from the Macaulay Library (accession number ML619087330) (A), A Northern Parula call from the Macaulay Library (accession number ML649769279) (B), and a Cerulean Warbler call from the Macaulay Library (accession number ML649172667) (C). There is little background noise, making these files clearer than those in Figure 5. kHZ is on the Y-axis, and seconds are on the X-axis for all spectrograms.

Discussion

- Whole-bird communities differ among mature and regenerating forests.
- As for Cerulean Warblers, they were detected more frequently in the mature forest.
- Both habitats contained a mix of generalists and specialists.
- There were still some unusual findings.

Discussion

- Tufted Titmice in the regenerating forest
- Worm-eating Warblers
- Dark-eyed Juncos during the breeding season?

Photo Credit: Cornell Lab of Ornithology

Implications

- Tracking forest recovery after damage, whether human-caused or natural

- Raising awareness for the protection of old-growth forests in the Midwest
  - The Midwest, in fact, holds interesting biodiversity and should be brought into focus.

- Fern Valley has some unusual breeding season residents.
  - Changes in habitat preference? Changes in breeding season and ranges?

Thank You!

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