Speciation of The Warbling Vireo

Summer Research Program 2021

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Hello!

I’m Maygan Peck and I’m a 2021 Summer Research Program Student in the Biological Studies Lab.

I go to school at Onoway Junior Senior High and am looking forward to starting my senior year in the fall.

Abstract

For many years, birders have recognized that the Warbling Vireos found in Western North America sing quite a different song than those in Eastern North America. Recently, researchers from the University of Calgary, Lovell et al., (2021), have shown that these two subspecies, Eastern and Western, are genetically distinct enough to be considered separate species. Our research in the Bayne Lab this summer pinpoints the specific differences found in their songs in hopes of making field identification more reliable and consistent. Consistency in field identifications and a concrete understanding of how the songs are different would make it possible to identify the supposed contact zone in Alberta, Canada. Our data shows the specific, measurable differences in the songs of the two groups, therefore supporting speciation. We also challenge whether these differences are due to speciation or habitat structure. Our data shows that the subspecies prefer different habitat types however, their vocalizations have little disparity according to habitat. This inconsistency suggests further research, including a project in the Peace River region to look more closely at the habitat preferences and songs of genetically identified groups.

A Western Warbling Vireo, Photo: Samuelle Simard-Provençal

Autonomous Recording Unit

There are currently recording units across North America that listen in on nature including birds, animals, and anthropogenic noise. These Autonomous Recording Units (ARU's) have many advantages including allowing biologists to less invasively gather data and store it for future use. Researchers can listen to recordings several times, slow them down, and annotate them to ensure their data is correct and precise. Hedley (2021), also points out that this technology can be deployed by anyone, where traditional surveys require experienced biologists in the field.

ARU Deployed in the field
Photo: Bioacoustic Unit

Data

WildTrax is an online platform that allows biological data to be easily processed, stored, and shared. The site allows anyone to upload and access data. This could include images, ARU recordings, and avian point counts. The site has been an important tool in our project because it has allowed us to use data from across Alberta, without ever having to leave our homes. We also used data from Xeno Canto, a similar platform for our data across North America.

Video: https://www.wildtrax.ca/home.html

Reason for study:

Cryptic Speciation: when two or more species, that by definition cannot interbreed, are morphologically indistinguishable (they look exactly alike).

Merriam-Webster,. https://www.merriam-webster.com/dictionary/cryptic%20species.

The Amateur Entomologists' Society, https://www.amentsoc.org/insects/glossary/terms/cryptic-speciation/.

The two groups are extremely difficult to differentiate by physical features

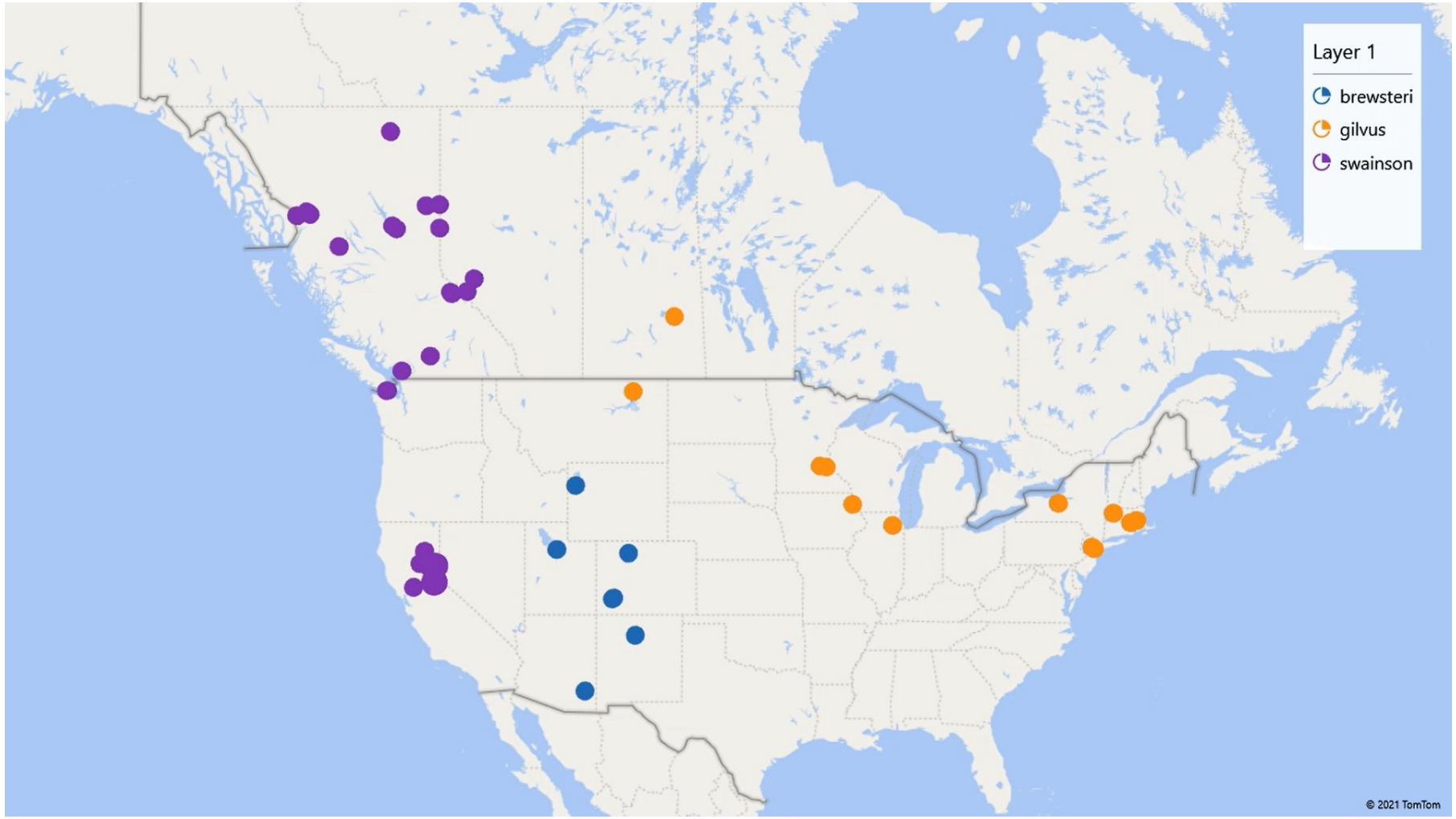
Eastern Warbling Vireo (Gilvus) Photo: Schain, Ryan. May 10, 2012
https://www.allaboutbirds.org/guide/Warbling_Vireo/photo-gallery/302322781

Western Warbling Vireo (Swainsoni) Photo: Hudson, Rachel. September 14, 2019
https://www.allaboutbirds.org/guide/Warbling_Vireo/photo-gallery/302322781

First Research Question:

Do Eastern and Western Birds Sound Different?

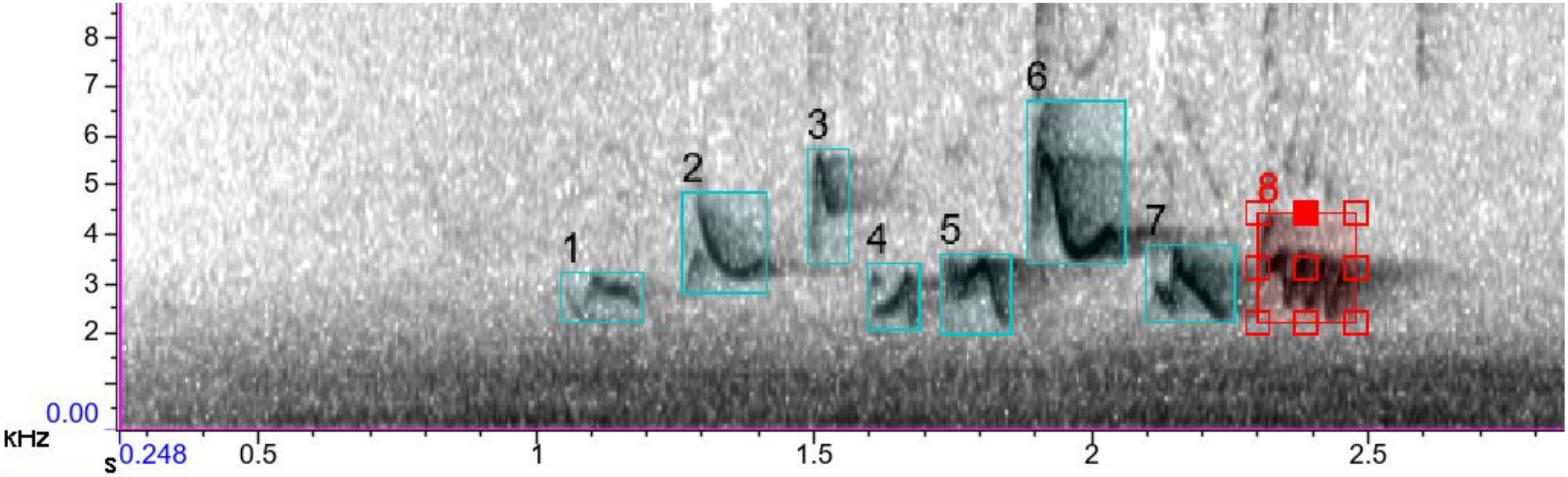
Riesen-Sivard (2021) answers this question in further detail.



The first data set was used to differentiate the song features of the subspecies. Data from Alberta was not used as it is considered the contact zone (Lovell et al., 2021).

Annotation Process

Our team used Raven lite to annotate the recordings of the Warbling Vireo. We annotated sound files that were passively and actively recorded across North America, carefully avoiding any from the contact zone. Raven measured the frequency and time of each note and created a data table that we could then analyze.



Measurements

To gather tangible evidence we measured each individual note in the Warbling Vireo song. Some of the specific measurements of the notes are displayed in this graphic, including each note length, the bandwidth (overall change in frequency of each note), and the mean frequency of each note. Some of the other measurements we took included the length of the entire song, the percentage of the song that was gaps, and the average change in frequency of all of the notes in the songs. The numbers gained from our measurements allowed us to visualise the differences in the songs of each subspecies.

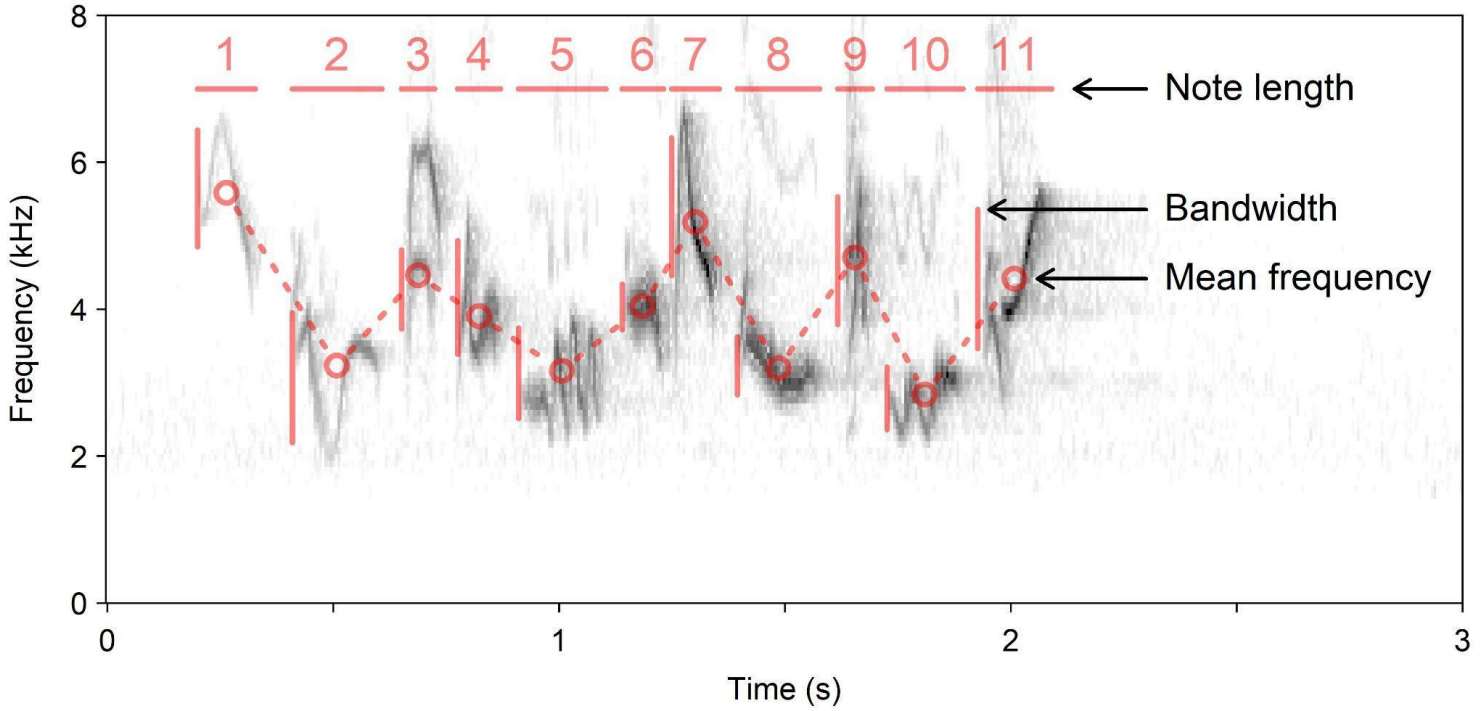
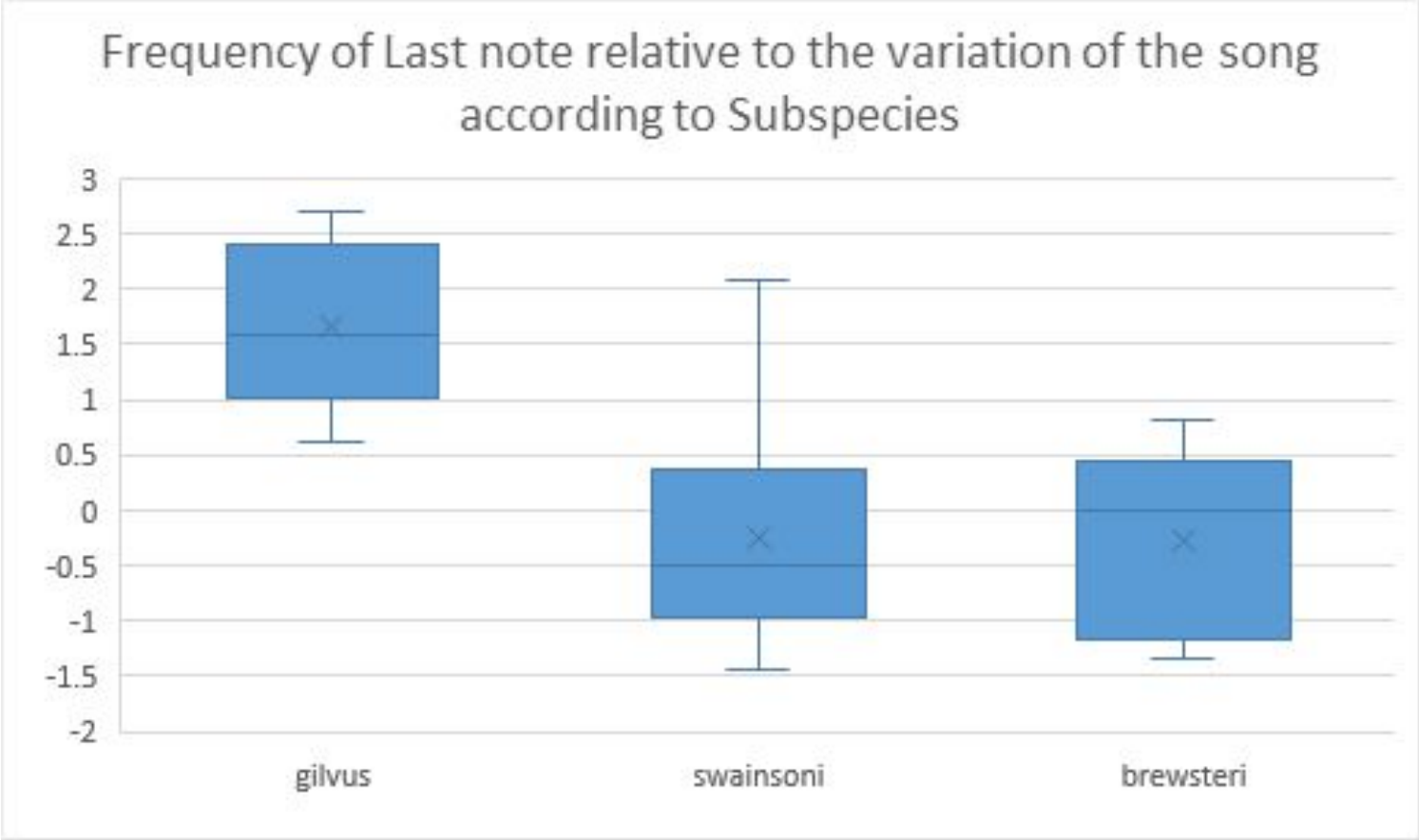


Photo: Richard Hedley

The relative frequency of the Last Note

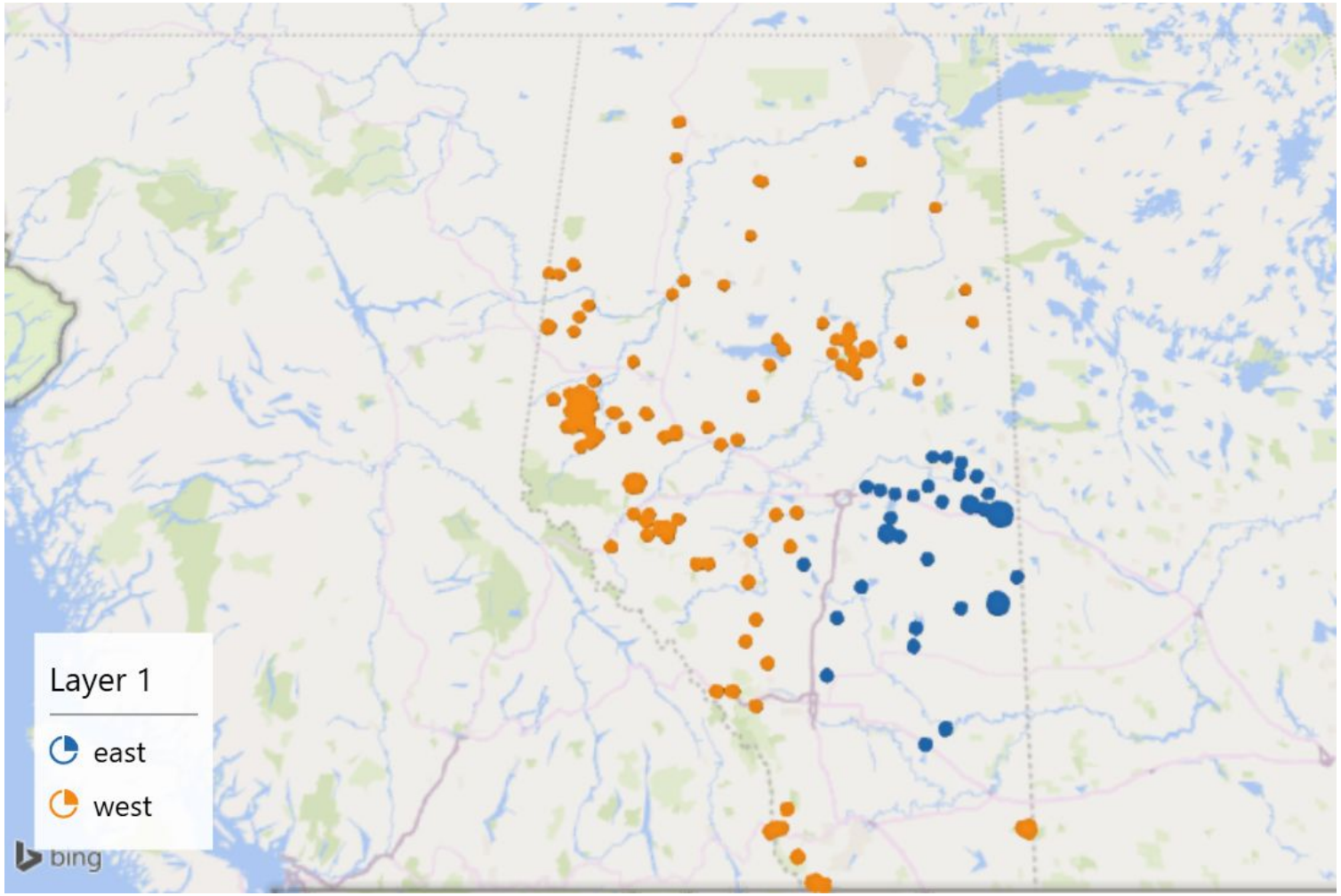
According to Spencer (2012), the gilvus (Eastern) subspecies generally starts with lower frequency notes and raises the pitch of the last few notes. This compares to the swainsoni (Western) in that they usually have a more even song overall. Our data in this graph proves Spencer's (2012) statement and pinpoints a main difference in the songs of the two subspecies.



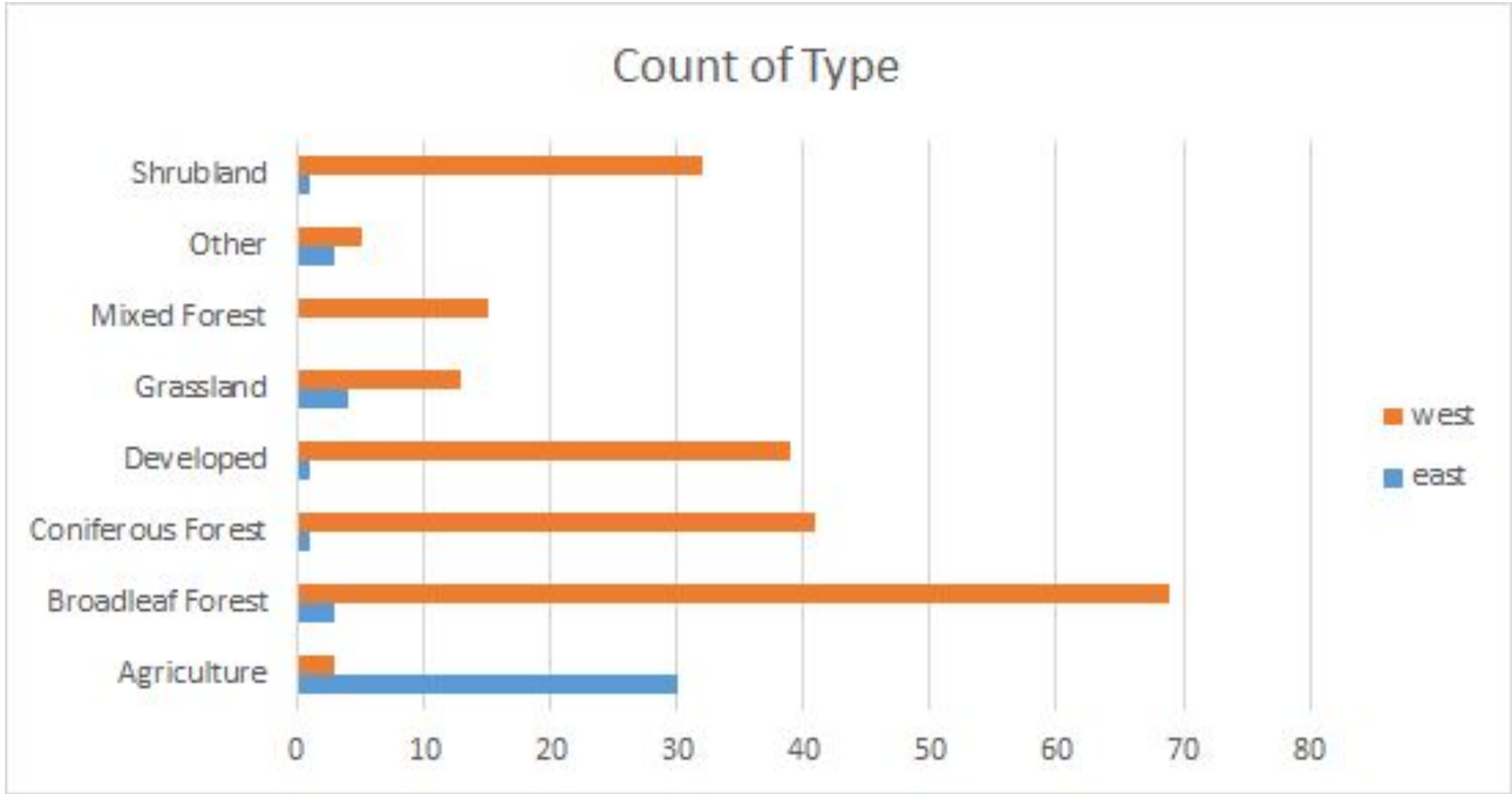
Error bars illustrate the uncertainty of the data while the solid boxes describe the concentrated data points. This more accurately describes the data set and the overlap between subspecies. Brewsteri is a third, southern subspecies of the Warbling Vireo, our research had little focus on this group.

Second Research Question:

Where In Alberta Are the Subspecies Found?



These data points were derived by a trained ornithologist who classified recordings by subspecies from over 260 locations based on their song characteristics. This data was used in our habitat analysis and illustrates how discrete the subspecies are in location. (E. Bayne, R. Hedley, personal communication, August 10, 2021)



West and East subspecies found across different habitat types.

Our data suggests that Eastern Warbling Vireos prefer an agricultural habitat, while Western Warbling Vireos prefer forested, developed, and shrubland habitats.

Third Research Question:

Do Their Songs Differ According to Habitat?

How Bird Songs Generally Change According to Habitat

Sound, such as a bird song, is more likely to be absorbed, echoed, or attenuate in habitats with more structures for the sound waves to hit. A forested area compared to a grassland would have more absorption and echoing, especially regarding high frequencies (Brumm & Marc, 2009). This is why birds are more likely to use lower frequencies and less notes in closed habitats. However, an open habitat also negatively impacts sound quality as it will generally have stronger wind. Birds adapt their songs, especially their trills by increasing the frequency and speed to combat the wind.

We classified all the habitat types into two categories; open and closed

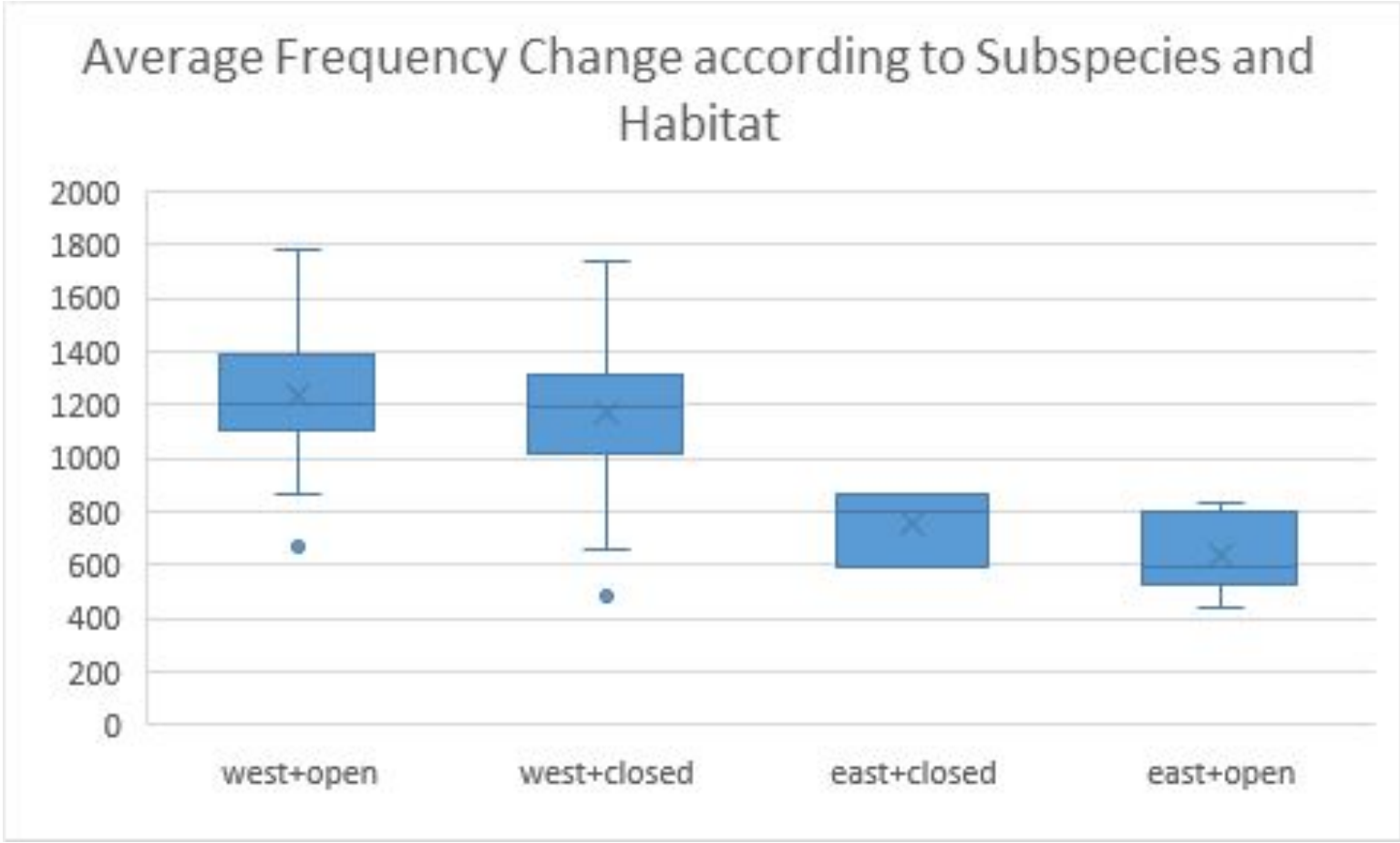
Open

Closed

Photo: Samuelle Simard-Provençal

Average Frequency Change according to Subspecies and Habitat

All of the song features we looked at showed very little variation according to habitat type. This shows that the Warbling Vireo does not adapt their vocalizations in different habitats. The difference according to subspecies is much greater than the difference according to habitat, which suggests that speciation is the reason for the changes seen in the songs. However, the conflicting trend that the groups have different habitat preference signify a need for further research.



The change according to subspecies is much greater than the change according to habitat type, this supports the theory of speciation.

Our data suggests that, although the subspecies prefer different habitats, habitat does not appear to strongly shape song characteristics. Therefore, suggesting that the differentiation in song is not habitat adaptation alone. This combined with genetic research from Lovell et al., (2021), would recommend further research. Specifically, research in the Peace River region of Northern Alberta may show whether agriculture impacts where Eastern Warbling Vireos are likely to live. Identifying genetically Eastern populations in Peace River would suggest that the subspecies has adapted to live in agricultural habitats thus, reinforcing speciation. (E. Bayne, personal communication, August 10, 2021)

Why is Research on Speciation Important?

When conducting conservation surveys, it's important to understand the speciation of different organisms because in the case of cryptic species, one could be thriving, while another is in need of conservation efforts. Evolutionary and territorial researchers could use our project in the study of how vocalizations change with evolution, or according to area.

Photo: Samuelle Simard-Provençal

I hope you had an im-peck-able time viewing my presentation!

Thank You to Everyone that Made this Possible!

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Chloe Riesen-Savard
The WISEST staff

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