



*A Wood Frog floats serenely in a vernal pool.*

# Automated Audio Analysis

**Frogs in a pond, a canary in the coal mine?**

BY KEVIN TOLAN



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Calling Wood Frogs are an annual harbinger of winter's end throughout the northeast. As snowmelt and early spring rains begin seeping into the ground, these cold-hardy frogs thaw from their frozen torpor and start migrating to their breeding ponds. There are few New Englanders who have not heard the frenetic quacking of this ubiquitous amphibian from vernal pools still partially covered in ice.

This explosion of activity provides an excellent opportunity to track annual phenology (the timing of biological events). By comparing the start date of Wood Frog chorusing and the period over which they call each year, we can monitor how the frogs are responding

to a changing climate. These data not only allow us to examine short-term trends, such as year-to-year changes in phenology, they also help us establish a baseline against which to track future changes.

Over the past three springs, VCE's stalwart vernal pool monitors have trudged across the sodden, slippery landscape to deploy autonomous recording units (ARUs) for our Vermont Vernal Pool Monitoring Project. These specialized audio recorders are set to record four, 10-minute periods per day: one in the afternoon and three around dusk, when Wood Frogs are most likely to be chorusing.

After three seasons of monitoring,

we have amassed more than 3,250 hours of audio data from over 60 sites—far too much for humans to analyze effectively, so we have automated the process! Using R, an open-source analysis software, we have developed templates to “match” against our audio data, such that we can score similarities between the two recording types. Any recordings with a high proportion of similarities to the template are considered matches, i.e., positive Wood Frog identifications. Using this method, we can now run an entire site’s audio data with the mere click of a button.

Since this project began in 2019, Wood Frogs have generally started calling earlier at our study sites (see graph). Of course, three years of data are not nearly enough to establish a long-term trend, and we will not know the real implications of our findings for several

years. Does earlier chorusing indicate a short-term, cyclical trend, or a more worrisome sign of what is to come?

Looking ahead, we plan to create additional templates to detect other species at vernal pools, such as Barred Owls, common predators at vernal pools. This work may also greatly expand opportunities for ARU deployment in other VCE research programs, like our Eastern Whip-Poor-Will Monitoring Project.

In an ever-changing environment, it is vital to track the responses of wildlife to phenological and ecological factors. Whether monitoring phenology or species presence and absence, developing low-cost, battery-efficient ARUs can potentially expand and enhance field surveys for wildlife. At VCE, we are always eager to explore new avenues and create innovative tools to track our native fauna! **FN**



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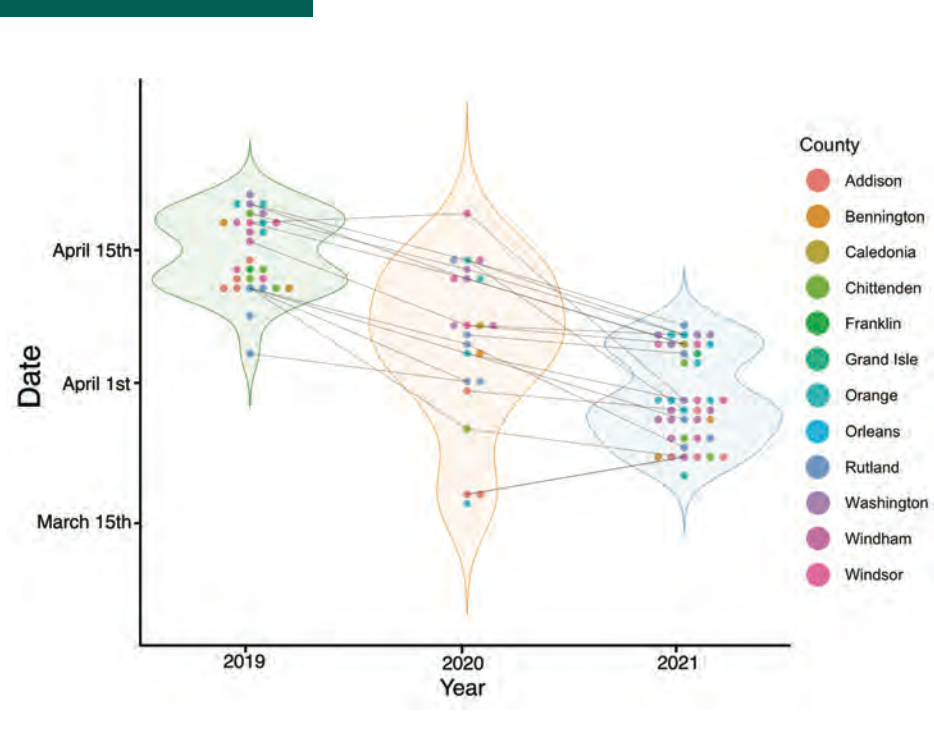
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## Wood Frog Calling



Since 2019, Wood Frogs have started calling earlier at most study sites. This graph shows the annual date that Wood Frog calling was first detected at monitored vernal pools. Each line connects a given pool’s dates. This figure excludes sites with no detections.

(\*The year 2019 did not have a daytime recording period, which may have influenced when first detections occurred.) Code credit: van Langen, J. (2020). <<https://github.com/jorvan/open-visualizations>>

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