Executive Summary

Comparing Amphibian Soundscapes in the Hudson Valley

Rachel Hughes

Final report for Professional Science Master's (PSM) Degree
Environmental Sciences, Oregon State University

Increasing pressures from human development, environmental perturbation, and climate change are impacting amphibian habitats around the world. Monitoring amphibian population size and behaviors at amphibian breeding locations provides a method for studying changes due to these stressors. Passive acoustic monitoring (PAM) is a useful method for studying amphibians that communicate through sound because most males produce species-specific advertisement calls while searching for a mate. To implement a PAM program, recording devices are placed in habitats of interest to record sound patterns over time. The acoustic data are then analyzed to determine species composition at each location.

For this internship, PAM was used to study amphibian species richness at wetland habitats at the United States Military Academy (USMA) at West Point, in the Hudson Valley of New York. The internship was conducted with the Passive Acoustic Research Group from the Department of Geography and Environmental Engineering, under guidance from Principal Investigator Dr. Patrick Baker. Songmeter SM4 recorders (Wildlife Acoustics, Maynard, MA) were set up at 3 amphibian breeding sites and recorded from an hour after sunset to 0100 ET from February 2020 to September 2020. The first site, Constitution Island, is near sea level with a commuter rail line skirting the permanent pond. Morgan Farm, at 350 feet above sea level, is a vernal pond on the meadow/forest boundary adjacent to equestrian facilities. Bear Swamp, at 1180 feet above sea level, is a vernal pond in hemlock/hardwood forest and is the most removed from anthropogenic influence.

Two approaches were used for analyzing the data. Acoustic recordings were first analyzed using a short time frame of a few seconds, then using a long time frame of weeks to months. Short time frame spectrograms of the acoustic data were analyzed using Raven Pro version 1.6 Sound Analysis Software (Ithaca, NY) to identify anuran species by advertisement calls, as well as anthropogenic and other biological sounds. Using this short term analysis method, the range of dates for calling were identified for species at each location (Figure 1).

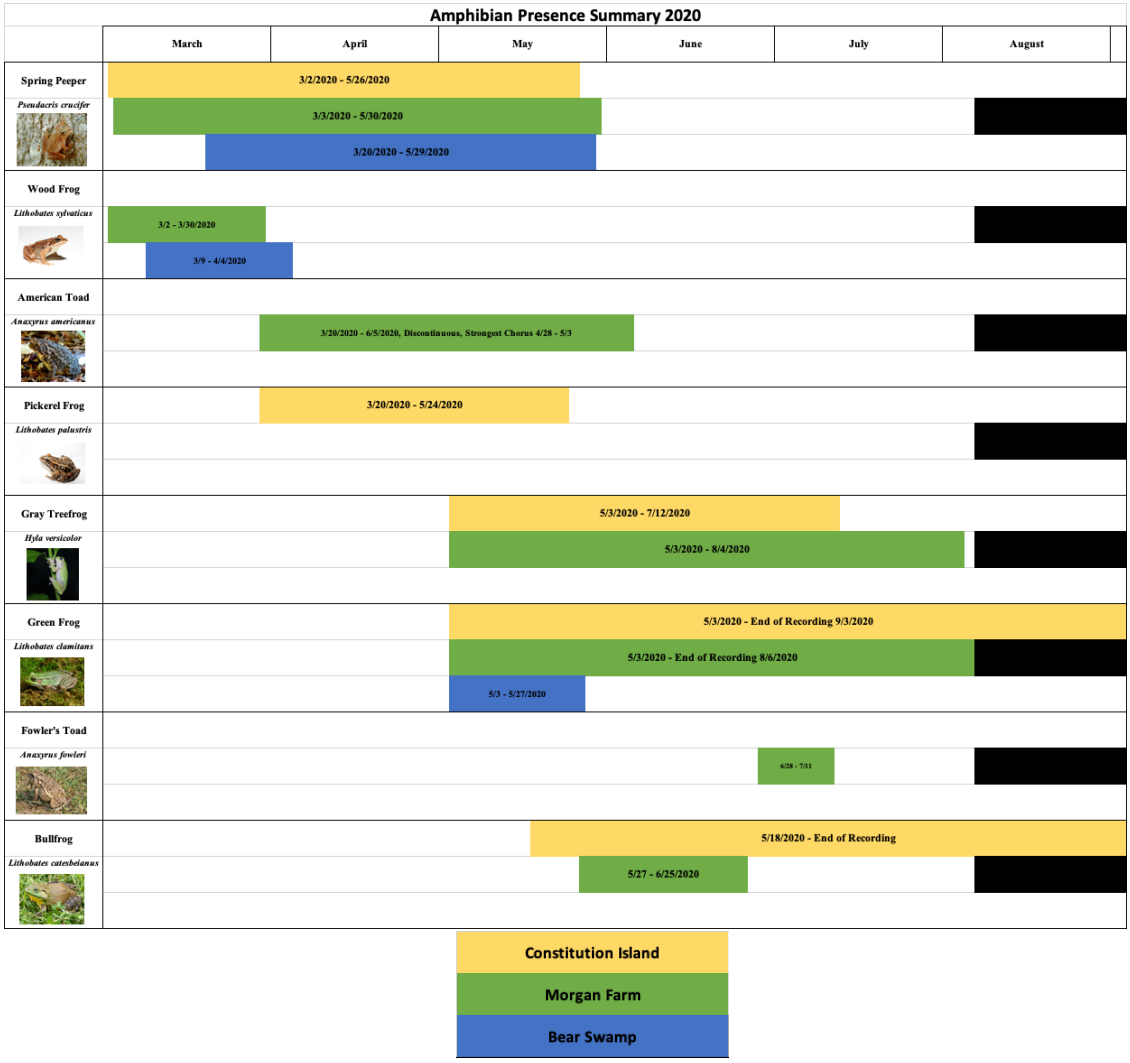

Figure 1: Amphibian presence and calling period by location and species in 2020. The black bars in August at Morgan Farm indicate that the recorder was removed August 5, 2020, while recording continued at the other sites through September 3, 2020.

For the long time frame approach, partial long term spectrograms were produced using the Seewave package in R. These partial long term spectrograms are concatenated from the 5 to 7 hours of data recorded each night. Chorusing amphibians and insects that have vocalizations in an intense chorus in a narrow frequency band are identifiable on the long term spectrograms. Comparing the long term spectrograms illustrates the delayed calling onset for the highest elevation site at Bear Swamp, as well as the diversity of calls at the meadow/forest vernal pond at Morgan Farm. Only 3 of the 8 species identified in the short time frame analysis are apparent in the long term spectrograms (Figure 2).

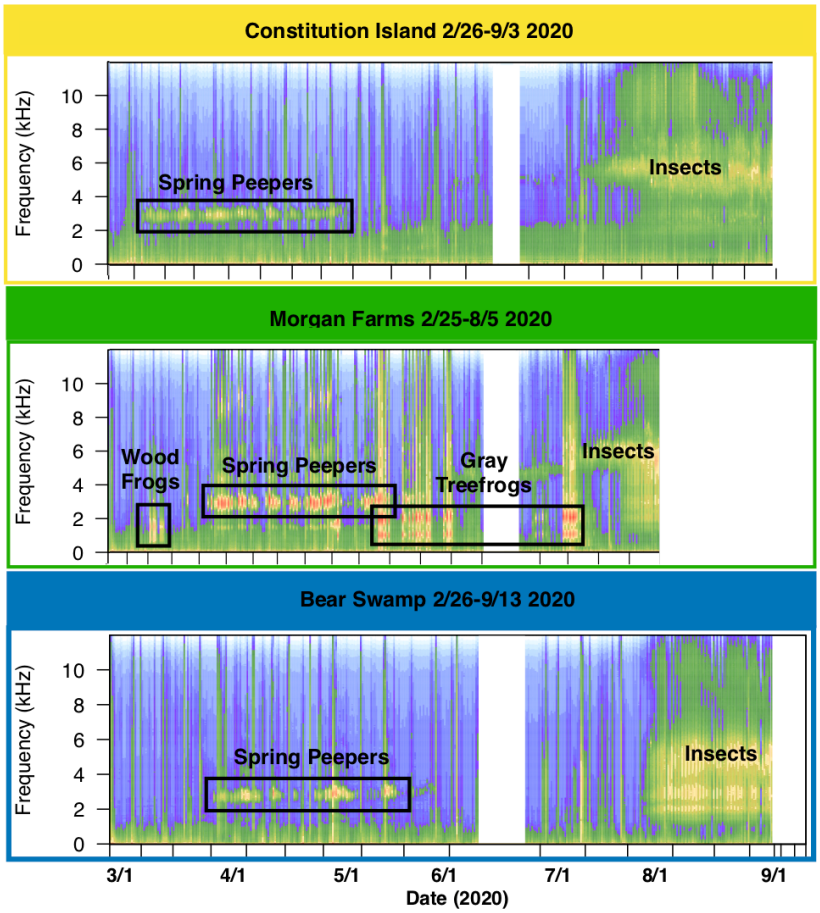

Figure 2: Partial long term spectrograms at each location, with amphibian calls identified. The white areas indicate evenings of missing data due to battery failures.

This internship focused on analysis for the amphibian PAM program at USMA. By completing analyses for the acoustic data from the 2020 field season, the internship provided value to USMA in cost savings for analysis. Additional value was provided by establishing a baseline of amphibian species at the studied locations, initiating study of amphibian breeding phenology on USMA property, and by creating a record of processes in order to streamline training for future analysts. Additional work building on this baseline of species composition will incorporate suggested improvements such as co-located temperature sensors that add intrinsic value for studying amphibian behaviors using PAM on USMA.

PAM offers a repeatable, reliable method for monitoring species that communicate acoustically as well as other biological and anthropogenic sound sources. Variations in sound patterns and call strength in a soundscape can be used to evaluate the health of an ecosystem over time, while avoiding field visits that can be invasive and are time and personnel intensive. The analysis completed during this internship provides a baseline for future study of amphibian habitats as human development encroaches on amphibian habitats around USMA and the Hudson Valley.