Question: Does air temperature predict spring peeper and wood frog calling around West Point, and how does calling differ between elevations at similar sites?

Hypothesis: Increasing temperatures are associated with an increased likelihood of the first call date occurring and calling will occur later at higher elevations due to lower temperatures.

BACKGROUND

This study focuses on the calling phenology of springtime amphibians, particularly wood frogs (Rana sylvatica) and spring peepers (Pseudacris crucifer), in the West Point area.

Intense frog calling is energetically expensive for the organisms and indicates breeding activity (Smyers et al. 2021).

Studies are documenting acoustic habitats and analyzing their ecological aspects using passive acoustic monitoring (PAM), a technique that digitally records the acoustic space of ecosystems with minimal disturbance of the habitat (Merchant et al. 2015).

was used over the course of 3 years at 3 locations to determine calling phenology across different weather conditions and elevations.

For wood frogs in the White Mountains of New Hampshire, calling phenology varied based on elevation, with calling beginning later at higher elevations, and weather, particularly temperature (Smyers et al. 2021).

Previous research has suggested that a thermal sum with a base of 3 degrees Celsius, an attribute called TS3, is a better predictor of the date of first calling for spring peepers than other weather variables (Lovett 2013).

Studies of vernal pools and amphibians at and around West Point have taken place since 1898 (Meaurs 1898; Barbour 1997; Hughes 2021).

FIELD WORK AND DATA COLLECTION

Figure 5. Spectrograms of spring peeper (top) and wood frog (calling). Recordings were analyzed using Mothra developed by Cornell Lab of Ornithology to visualize and listen to each recorded calling behavior. A certain day was ranked from 0-3, with 0 indicating no calling activity, 1 indicating an individual calling, 2 indicating multiple individuals, and 3 indicating a full chorus.

Figure 6. Average daily temperature for each year at each site. Weather data from local weather stations (Black Rock Forest Ridgetop at 1400 ft, USMA RAWR at 922 ft, and Black Rock Forest Lowland at 270 ft) was matched with each study site (Bear Swamp at 1180 ft, Morgan Farms at 350 ft, and Constitution Island at 0 ft) based on elevation. However, 2022 data is not yet available for the Ridgetop station, so data from a temperature logger was used for Bear Swamp in 2020.

RESULTS

Figure 2. Google Earth snapshot of Constitution Island (CI), Morgan Farms (MF), and Bear Swamp (BS) to show the 3 study sites, their elevation, and their proximity to West Point (Hughes 2021).

Figure 3. Cumulative Growing Degree Days above 3 degrees C (TS3) for spring peepers (top) and wood frogs (bottom) at the 3 study sites, with each line indicating the year. The plotted points indicate the start of calling, and the dashed line indicates the 3-year average TS3 at that site.

Figure 4. CDT Williams placing the SMA Acoustic Recorder at Constitution Island in June 2021 (left) and February 2022 (right). The SMA was programmed to record for 5 minutes at 1 hour after sunset for the course of the study period to identify when amphibians were calling, and the dashed line indicates the 3-year average TS3 at that site.

Figure 5. The two amphibian species studied were spring peepers (left) and wood frogs (right).

CONCLUSIONS, DISCUSSION, AND FUTURE RESEARCH

• Temperatures tend to decrease with elevation around the same location.

• Spring peepers call first at Constitution Island on average a Julian Day of 66, second at Morgan Farms on average Julian Day of 70, and latest at Bear Swamp on average Julian Day of 80. Wood frogs called first at Morgan Farms around Julian Day 72 and later at Bear Swamp around Julian Day 79. These trends correspond with amphibians calling later at higher elevations.

• As elevation increased, the TS3 of first call increased. The cause of this needs to be explored further and may be due to the weather station temperature not matching up with the actual temperature at each site. Further research on different temporal and spatial scales is required to increase understanding of the influence of weather and elevation on amphibian behaviors and population dynamics.

• Amphibian populations are declining, which is concerning due to their role as bioindicators for the health of ecosystems and the environment.

• The Department of Defense manages 8.8 million acres of land in the United States. To be good stewards of this resource, it is important to monitor and understand the ecosystems and organisms that we share space with (Vincent et al. 2020).

• Scientists should continue to use PAM to determine changes in calling phenology and species diversity over time, especially as the global climate continues to warm, to determine if there are changes in spring breeding amphibians calling phenology.

ACKNOWLEDGMENTS

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