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BIOL 345 WLE S23

**One Way or Another: Utilizing Acoustic Activity and Richness Measurements to Investigate Potential Preferences in Pond Characteristics of Bats in Appleton, Wisconsin**

**Introduction:** Bats provide a plethora of valuable ecosystem services, including arthropod suppression, seed dispersal, and pollination, which increase human well-being (Kunz et al. 2011). Therefore, they are economically and environmentally important, which makes maintaining healthy and diverse populations invaluable (e.g. Boyles et al. 2011; Kasso and Balakrishnan 2013). However, bats rely heavily on aquatic habitats, predominantly as drinking and foraging sources, which have suffered drastic declines due to human-led intensification of both housing and agriculture development in the United States (Bohn and Kershner 2001). As a result, many studies have started quantifying the preferential characteristics of aquatic habitats used by bats for use when developing artificial aquatic habitats in human settings (e.g. Razgour et al. 2011; Straka et al. 2016).

Of the potential aquatic habitats to study in relation to bats, perhaps the most valuable is the pond. Foundationally, ponds are shallow bodies of standing water in which light can penetrate to the bottom sediments. It has been estimated that 90% of all standing waterbodies on earth are ponds, and their artificial prevalence has been increasing rapidly (Downing et al. 2006). Additionally, implementation of artificial ponds has been shown to support bats in both urban and agricultural settings (e.g. Stahlschmidt et al. 2012; Ancilloto et al. 2019). However, much of the literature on pond characteristic preferences of bats has been developed outside of the United States, which necessitates research on the topic internally.

Here, passive acoustic monitoring was used to collect data on bat activity and richness at ponds found throughout two wildlife sites in Appleton, Wisconsin. We recorded pond characteristics, namely canopy cover, surrounding vegetation density, surface water scale, pond size, insect abundance, and water quality, with the aim of identifying ideal characteristics of a pond for local bat species. However, the quantification of ideal characteristics is complicated by the fact that bats vary immensely in echolocation behavior and flight morphology (Norberg and Rayner 1987). For example, of the six species of bats, all within the family *Vespertilionidae*, found in Appleton, foraging behaviors vary from slow flight with maneuverability in clutter to fast flight open-aired hawking because of adaptive variability quantified through wing-loading and aspect ratio measurements (Figure 1).

Therefore, quantifying habitat preferences throughout

**Sources**

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Because of this considerable species variation, formulating one single hypothesis to capture pond preferability was not plausible. Therefore, we developed four hypotheses aimed to capture species specific preferability. The first two hypotheses attempt to capture expected richness differences between sites, while the second two attempt to explain differences in activity levels overall. Firstly, we hypothesize that ponds with low canopy cover, surrounding vegetation density, and surface water scale measurements and high pond size and insect densities would be rich in bat species with high aspect ratios (i.e. *L. cinereus*, *L. borealis, L. noctivigans, & E. fuscus)* because they primarily forage on insects in through open-aired flight. Secondly,