Hawk Mountain Kiosk Allows Visitors to *Survey for Rare Bats*

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Bats belong to the mammalian taxonomic Order of Chiroptera and make up one in five of all documented mammal species. The long evolutionary history of bats has resulted in a range of adaptations that allow them to exploit nocturnal niches worldwide. The ecological and economic benefits provided by bats are numerous, and include seed dispersal, pollination, insect suppression, nutrient distribution and indicators of environmental health. For example, bat activity has been correlated to areas of higher water quality that benefit human societies. In Pennsylvania, insectivorous bats, such as the little brown bat, are capable of consuming up to 100% of their body weight a night in insect prey, serving as an important pest control mechanism for agriculture. To replace this naturally occurring ecosystem service of pest control would cost $22.9 billion annually in pesticide application in North America alone.

Hoary bat by Adrian Braidotti

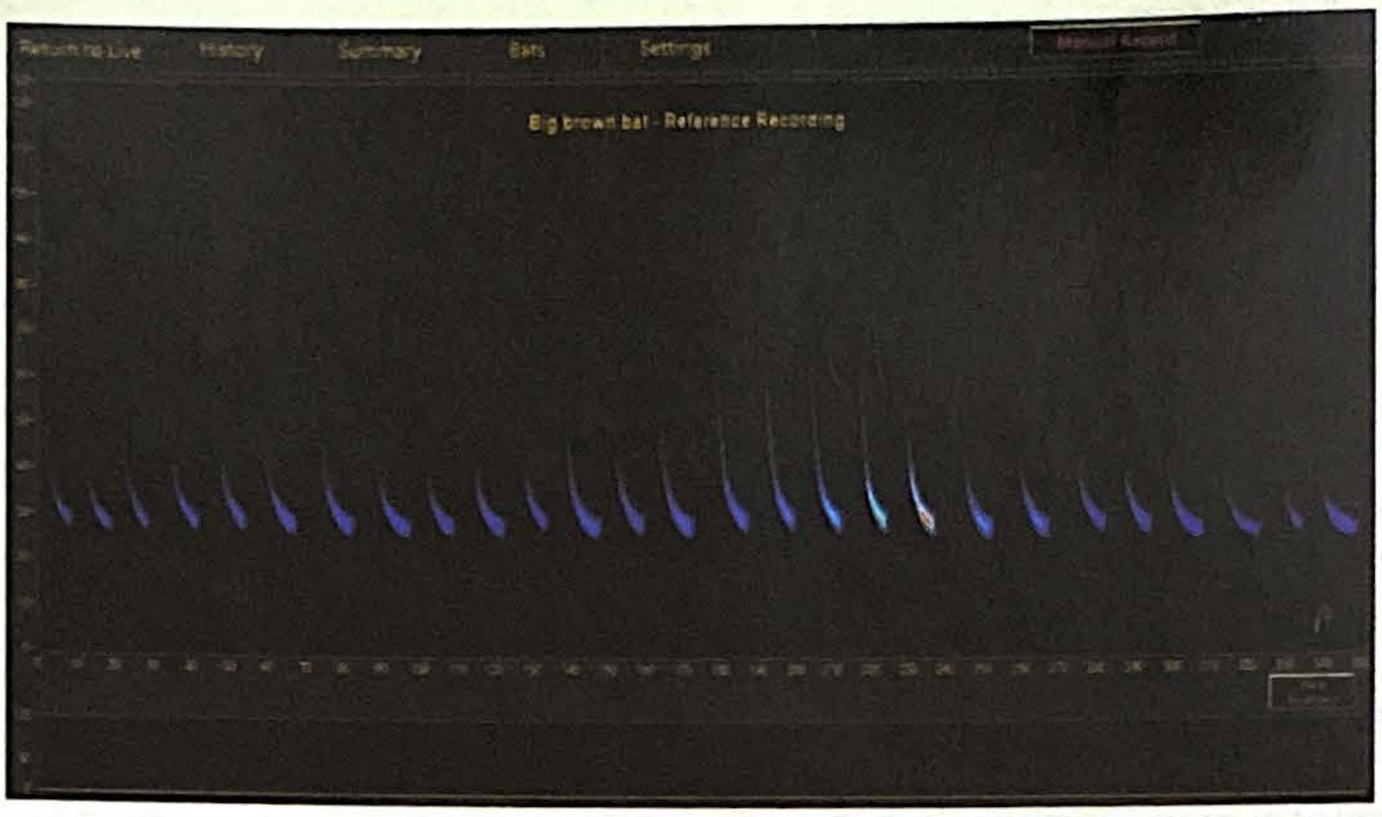
*Little brown bat*by Stacie Wolny

Despite the integral role that bats play in their ecosystems, they face many compounding threats that have led to contractions in their population sizes. Examples of threats include disease, destruction of old growth forests, hibernacula modifications, climate change, and environmental pollutants. Ten years ago, the little brown bat, tri-colored bat, and northern long-eared bat were common and widespread in Pennsylvania, and the federally endangered Indiana bat was found throughout the Commonwealth. However, in the last 10 years, populations of these bat species have declined dramatically with the onset and spread of the fungus Pseudogymnoascus destructans that causes the disease White-nose Syndrome. Currently, there are seven bat species in Pennsylvania listed as species of conservation concern as identified in the Pennsylvania Wildlife Action Plan: big brown bat, tri-colored bat, northern long-eared bat, eastern small-footed bat, Indiana bat, little brown bat, and silver-haired bat.

A lesser seen threat to bat species is the imposed negative stigma put upon them, be it through popular culture or their relatively cryptic life history that makes them less familiar to people. A lack of knowledge of bat biology and their services is a hindrance to their conservation, particularly in terms of funding and public support. A lack of understanding encourages persecution of their colonies found in man-made structures, lack of funding for their protection, and a disregard for the consideration of important bat habitat in development decisions.

Tricolored bat by Kory Roberts

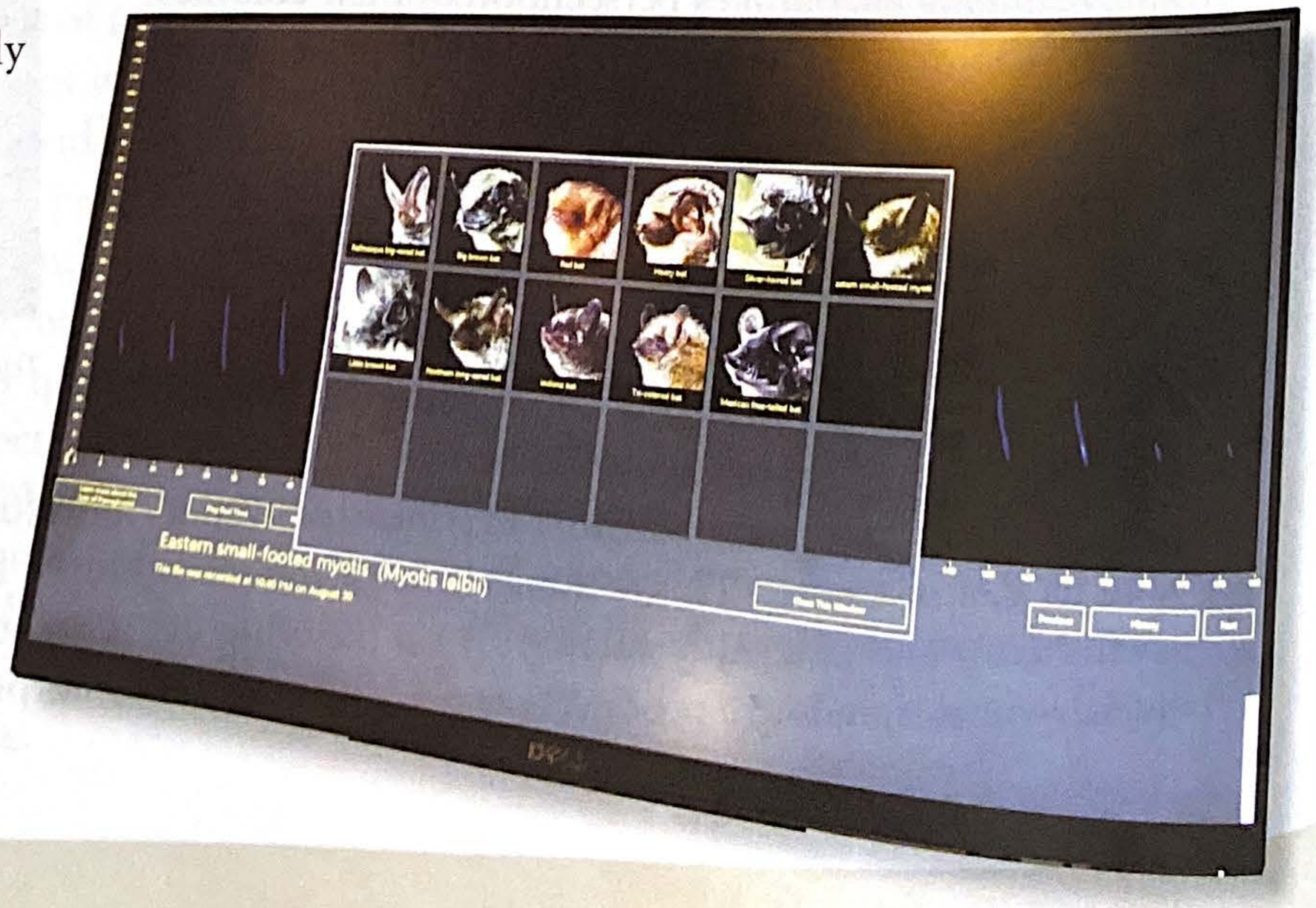
The first step in combatting these stigmas is through environmental education. Environmental education and public outreach are integral to bat conservation and can result in behavioral changes that benefit bat populations. Hawk Mountain Sanctuary has now become involved in monitoring bat activity around its Visitor Center. This is done through the recording of bat vocalizations. Bats effectively and efficiently catch prey on the wing via echolocation. High frequency vocal signals are produced and are reflected for interpretation when an



Spectrogram of a big brown bat (Eptesicus fuscus) from the reference library of SonoBat LIVE. The height of the call structure indicates the frequency and the colors indicate call volume.

object obstructs the bat's path, assisting in orientation and obstacle avoidance. These signals can be detected by ultrasonic microphones and stored on an external drive. Automated species identification software can then be used to discriminate bat ultrasonic echolocation vocalizations from background noise and use a multi-variate algorithm to compare recorded bat calls to libraries of known bat species and their calls. The ultrasonic frequency at which bats produce their calls is fairly distinct and not used by many other organisms. The use of acoustic techniques to record and identify bat species has been conducted in numerous research projects in the United States and around the world.

Visitors to the Hawk Mountain Sanctuary can now review bat vocalizations and observe species identification via a permanent Public Bat Kiosk. This kiosk is linked to an ultrasonic microphone that records ultrasound audio from bats that echolocate over the roof of the Visitor Center. Once bat calls are detected, the Bat Kiosk software records and identifies the bat calls. This user-friendly version of an audio identification program is called SonoBatLIVE, and it automatically separates files containing bat call features from noise files to select those that meet the quality threshold for bat call identification. Based on a library of known bat species calls, the kiosk compares structural and tonal features of the collected calls to the library and attributes species identification based on maximum likelihood models. For the Bat Kiosk user, identified calls are displayed visually in spectrogram form. These spectrograms are compiled into nightly reports that can be browsed by visitors to demonstrate which bat species were present in the area the night before. The display interface also contains pictures of the bats found



in Pennsylvania, as well as some biological and ecological information on their critical role in proper ecosystem functioning.

The bat kiosk system was established at Hawk Mountain during summer 2019 and will continue to collect bat call data through the fall of 2020. The bat kiosk provides the ability for Hawk Mountain to collect data year-round and allows for an inventory of bat species in the area. So far, bat species that have been identified include big brown bat, red bat, hoary bat, silver-haired bat, small-footed bat, tricolored bat, and either a little brown bat or Indiana bat. The calls of these latter two species are hard to differentiate using the software, and thus are usually lumped together as a Myotis bat species, since both belong to the Genus Myotis. The Hawk Mountain Bat Kiosk was established as a collaborative effort between the Applied Conservation Lab at Millersville University and Bat Conservation and Management.

All bat call data recorded and identified from the Hawk Mountain Bat Kiosk is archived. The goal will be to monitor and detect changes in bat activity at Hawk Mountain over longer temporal scales. In addition, data can be analyzed to determine seasonal trends in bat activity, including timing of migration and entrance into hibernacula. This data will be monitored and analyzed by undergraduate research students at Millersville University.

The interactive nature of the Bat Kiosk serves as public outreach on bat education and a way to get people interested in these important keystone species. The Kiosk will continue to be accessible by visitors so that more information on the importance of bats can be shared for educational purposes and data recorded for research purposes.

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If you wish to support the efforts for this project please contact Dr. Aaron Haines, Director of the Applied Conservation Lab at Millersville University. Support can offset updates to the Bat Kiosk system such as improved modeling and remote download capabilities, as well as support for undergraduate research students analyzing the data for presentations and publication.