An Ounce of Prevention: Using Infra-Red Technology to Proactively Manage a Bat Roost

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Introduction
Monitoring patterns of roost use by bats can be difficult and time consuming, especially when a high level of accuracy is necessary. Advances in technology allow improved management of species which historically have been challenging to study, and allows researchers and managers more insight into behavior and risk assessment.

We installed an infra-red beam-break system on a Mexican free-tailed bat (Tadarida brasiliensis) seasonal cavernicolous roost in central Nevada to monitor roost activity. The system runs continuously and passively, and provides an index of activity on a daily basis to managers via cellular connection, thus requiring minimal field maintenance.

We were eager to determine if this beam-break system and the data it provides would be instrumental to a nearby commercial wind energy facility, but use of this technology may have broader implications. Insight into changes in activity patterns across different scales, from hourly to spanning multiple years, may be examined; and variables, such as weather, which can affect activity patterns, may be investigated.

Materials and methods
The beam break system spans the dimensions of the cave portal and consists of eight pairs of horizontal beams spaced vertically 38 cm apart (Fig. 1). Dual beams placed side-by-side per horizon allow the system to differentiate between ingress and egress flight (Fig 2).

A solar panel maintains a 12V deep discharge battery. Both beam-break and system status data is transmitted real-time to a SQL database via a cellular connection. The system automatically stores data if the cellular connection is lost, and uploads it once a connection is restored.

When a bat flies in or out of the cave, one beam in a horizontal pair is interrupted by the passage of the bat slightly before the other. The blocking of the IR signal is recorded by the system, producing not only a date stamp, but also the direction of the bat (ingress or egress), based on the order of the horizontal beams broken.

Results
The cave is active late-May through October annually. Early-June through early July is consistently active. A lull in activity mid- to late-July is typical each year. Mid-August through September receive the highest levels of activity annually. Extensive variation exists both annually and within the season.

Nightly activity levels consistently vary greatly across nights. Rarely do activity levels remain fairly consistent for more than a few days (e.g. mid-July 2013 and 2014).

Conclusions
During May-October 2014-2018 when T. brasiliensis is active at the cave, the beam break system was operational 94.3% of the time (n = 694 nights). Since the system stores its data if the cellular connection is lost, loss of data has been exceptionally limited. The system requires little maintenance, only being calibrated a few times in the past 6 years. The surface of the sensors need cleaned annually because of the sheer number of bats using the roost.

Data on ingress and egress activity at the cave portal has been quite informative. Activity levels at the site can vary several fold over the span of just a few days. The ability to assess activity levels and patterns from previous nights of data from the office allows researchers the ability to target specific nights for fieldwork at the site, thus minimizing wasted field time.

This system has been invaluable to the commercial wind energy facility located approximately 4 miles southwest of the cave. The data is used in real-time to assist the wind facility in identifying potential high periods of localized activity for operation management actions (e.g. increasing turbine cut-in speeds) to reduce bat impacts. This system has proven to be substantially more informative to the wind facility operators than two ground-based radar systems initially deployed at the facility to track bat activity, and at a mere fraction of the cost.

An unanticipated data point the system provides is its ability to identify human activity at the cave portal. This becomes obvious when the data identifies several vertical feet of IR beams broken simultaneously, corresponding to human ingress/egress at the cave portal. The portal is situated on a steep cliff and inaccessible to other animal species capable of being mistaken for human activity.

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