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High-Tech Bat Counts
Tapping the promise of thermal imaging
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When thousands – or millions – of bats gather in a cave or mine, figuring out how many are in there can be a daunting challenge. But accurate counts are critical in determining the status of bat populations, especially endangered species such as the Mexican long-nosed bat. Now, however, improving technology for thermal imaging and computer visualization holds the promise of more accurate surveys, with less disturbance of roosting bats. Biologists Thomas H. Kunz (a member of BCI's Scientific Advisory Board) and Nickolay Hristov of Boston University and I documented the value of using infrared thermal imaging to count Mexican long-nosed bats (Leptonycteris nivalis) emerging after sunset from Emory Cave in Big Bend National Park in West Texas. The project was funded in part by BCI's North American Bat Conservation Fund and the National Science Foundation and undertaken with the cooperation of the national park and Resource Manager Raymond Skiles.

In the traditional bat-counting method, in use for decades, you enter the roost and count the bats in a manageable space (a square foot or a square meter, usually), then measure or estimate the total area where bats are roosting. A rough total is obtained by multiplying square feet of roosting space by the number of bats per square foot. The accuracy of this method depends heavily on the experience of the counter and on a relatively discrete roosting area. Such estimates can sometimes vary widely.
Mexican long-nosed bats are listed as endangered in Mexico and also in their narrow range in the Southwestern United States. A colony of nectar-eating bats, which migrates north from Mexico in the spring, spends summers at Emory Cave in the Chisos Mountains. Their numbers fluctuate throughout their residence, apparently in response to the flowering of agaves, their primary source of nectar.

These bats are critical pollinators of agaves and many cacti in the arid region, but they are reportedly in decline. Reliable population data throughout their range are not available, however.
Traditional roost counts have been conducted at Emory Cave once a year for most years since 1988. Estimates range from zero in 1994 and 2002 to 6,630 in 1988. Researchers recently discovered that the cave's Mexican long-nosed bats can disappear from their main roosting area, retreating into inaccessible chambers where they cannot be seen and counted.

Trying to count bats as they emerge at dusk proved unreliable because of low light, heavy vegetation and the tendency of many bats to circle in the entrance or move in and out of the cave. The counts are further complicated because fringed myotis (Myotis thysanodes) and Townsend's big-eared bats (Corynorhinus townsendii) also use the cave in low numbers.

Accurate counts are, nonetheless, critical for the conservation of Mexican long-nosed bats. So we turned to thermal imaging. These cameras detect heat from the bats' bodies, so ambient light is not needed. Kunz and his team are also using thermal-imaging technology to census Mexican free-tailed bats (Tadarida brasiliensis) emerging from caves in south-central Texas and New Mexico.

In summer 2005, we recorded the emergence of bats at Emory Cave for 1 to 1 1⁄2 hours on each of six nights (June 4 and 5, July 4 and 5, and August 4 and 5) with an infrared thermal camera. Primary participants included Tom Kunz, Nick Hristov, Molly McDonough and me. The tripod-mounted, FLIR S-60 infrared thermal camera was placed just inside the opening to record bats passing from right to left to exit the cave. The video was saved on the hard drive of a laptop computer.

The recordings were played back on a computer and the bats were manually – and laboriously – counted with the assistance of biologist Michael Dixon of Angelo State University in San Angelo, Texas. We counted the number of bats leaving the cave each second, as well as the number entering it. The emergence rate is the number of bats leaving per minute, while the net number of bats per minute was obtained by subtracting the number entering from the number leaving. Our "net number" was 372 and 434 bats in June; 3,517 and 3,385 in July; and 853 and 642 in August.

Surface-area counts on July 6 and August 6, on the morning after a filmed emergence, used two bat-density estimates to cover a range of published densities: 62 bats per square foot and 152 bats per square foot. The July count estimated 930 bats with the low-density estimate and 2,250 with the larger number. Both are significantly lower than the video count.
On August 6, although we could hear hundreds of bats returning around sunrise, we found none in the main roost. We could, however, hear chattering noises beneath us, so we assume they moved into deeper passageways. The surface count that day was zero.

We discovered that the thermal recordings allowed us to -distinguish Mexican long-nosed bats, with a diamond- or T-shaped image, from other species in the cave. We determined that Mexican long-nosed bats accounted for at least 210 of 853 bats emerging August 4. If the number of fringed myotis and Townsend's big-eared bats was approximately the same in July, when long-nosed bats were at their peak, there were at least 2,472 to 2,874 Mexican long-nosed bats in Emory Cave.
Our work in West Texas strongly suggests that infrared thermal imaging offers a more accurate and reliable means of estimating colony size than had been available previously. It provides a high-resolution, permanent record of the emergence, does not disturb the bats and is less susceptible to human error. It is, however, more expensive and time-consuming than -traditional methods, and the results cannot now be directly compared to previous census data. Nonetheless, this is a technology worth exploring, especially as work continues on the recovery of the Mexican long-nosed bat.

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