A chance to work with Dr. Kunz's data

Dr. Kunz has provided live video footage of Brazilian free-tailed bat emergences from caves in south-central Texas. In Dr. Kunz's research, he places thermal infrared cameras near the entrance of the cave to count how many bats leave the cave each evening to feed on flying insects, such as moths and beetles. Because all adult bats leave the cave in the evening, he uses these counts to determine how many bats roost in the cave and disperse to feed on insects on a given night.

Video File 1: Kunz_EmergenceReturn_v1.mov.
(Credit Nickolay I Hirstov* and Thomas H. Kunz, Boston University)

These bats often begin to emerge from caves well before sunset, especially in dry years. In wet years, they usually begin to emerge after sunset. The reason for these differences in emergence times is that there are fewer insects in dry years, and the bats need more time to feed to sustain themselves and to feed their babies. From these videos, students can get some idea of the challenges associated with counting these bats, given the large numbers and the fact that they are difficult to count after it gets dark. That is why he uses thermal infrared cameras to view the bats and then uses computer vision algorithms to "detect" (Video File 2) and to "track" (Video File 3),

This movie shows how Brazilian free-tailed bats are detected with a thermal infrared as they emerge nightly from a cave in south-central Texas: **Video File 2. Kunz_Tadarida_Detect_Large.mov**
(Credit: Thomas H. Kunz and Margrit Betke, Boston University)**

This movie show long tracks of detected Brazilian free-tailed bats (based on video file 2) as they emerge nightly from a cave in south-central Texas: **Video File 3. Kunz_Tadarida_Track_Long.mov**
(Credit, Thomas H. Kunz and Margrit Betke, Boston University)**

Students should be able to watch these videos in a way that they can pause it and count the number of bats exiting the cave during a certain period. We recommend pausing and counting bats on the screen and using this as a one-second count for bats. Once they have this number they can do the same calculations that Dr. Kunz does in his own research.

Calculations:

1. Based on Dr. Kunz's video records, it takes this colony of Brazilian free-tailed bats 60 minutes to emerge from this cave. The video shown here lasts for 3 minutes, and students took a count for one second. With this information, and assuming that the emergence flow of bats is constant over the entire 60-minute period, you should be able to estimate the number of adult bats present in this colony.

2. Based on Dr. Kunz's research, the average body weight of each Brazilian free-tailed bat in this colony is 12 grams. Bats of this size are capable of eating on average half of their body weight each night outside of the cave. If these bats spend 8 hours outside of their cave, what is the total weight of insects that bats in this colony will eat in one night? Can you convert this weight of insects into the equivalent amount of quarter pounders that you would need to eat if you ate half of your body weight each night?

3. During the 6-week period when mother bats are nursing their babies during the summer [each mother gives birth to one baby (pup) during the month of June], each mother can eat up to three-fourths of her body weight each night. Using this information, how many pounds of insects would be eaten by the number of mother bats in this cave when they are nursing babies (assume mother bats are 90% of the total bat population)?

4. The decline of bat populations due to white-nose syndrome will directly affect the insect populations living in the same regions as the affected bat colonies. Can you describe possible consequences that the decline in bat populations might have on the surrounding ecosystem?

5. A related article for further information on how bats affect agriculture and the consequences of declining bat populations: http://www.sciencemag.org/content/332/6025/41.full.pdf?sid=fcd7e774-5f87-4e6c-a4b0-8ff8cb3f4206

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** Margrit Betke is Dr. Kunz's colleague in the Department of Computer Science at Boston University who developed the computer algorithms to detect and track the bats that were captured using thermal infrared cameras.