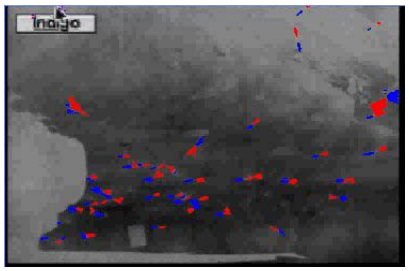
US Army Corps of Engineers®
Engineer Research and Development Center

Censusing Gray Bats Using Digital Image Processing Techniques

Technology

Digital image processing techniques have been shown to be effective at detecting and estimating bat counts in emergences. Imaging bats as they exit maternity caves offers a potential technique for making objective and precise counts that can be performed by field biologists. A night vision camera system is required since emergences occur under low light conditions and illumination in the visible band alters the bats' behavior. If cameras are positioned correctly and have the right field of view, all exiting bats will be recorded in the imagery. For small caves (those with no more than a few thousand bats) it is possible for an observer to manually count the exiting bats by replaying the imagery. Above this number it becomes extremely difficult for a human observer to get reliable counts, and other counting methods are required. ERDC's Environmental Laboratory (ERDC-EL) is developing image processing techniques that actually count all bats emerging from a cave. This is based on using a change detection procedure to detect and track bats flying through the camera's field of view and then evaluating the tracked pattern to count bats exiting and returning to the cave. The procedure can be used on imagery collected with thermal infrared cameras, which take "heat pictures" without any illumination. ERDC-EL is also testing the use of illuminated near-infrared cameras, which illuminate the field of view in the near-infrared waveband outside of the spectral sensitivity of the bats' vision.

Problem



The gray bat (*Myotis grisescens*) has been listed as endangered under the Endangered Species Act for 30 years. Decline of the species was related to destruction of hibernacula and maternity caves. Since listing, significant steps have been taken to protect and restore these critical habitats and as a result there is anecdotal evidence that the population has rebounded. To date it has not been possible to document this apparent rebound with any statistical certainty due to the disparity of census techniques used. The current techniques include hibernacula counts (based on cave surface area occupied by bats), estimates based on guano deposits, and visual counts of emergences from maternity caves. Each technique has certain inherent biases and is subjective, resulting in different counts among individuals performing the technique. In order to evaluate gray bat population trends, and possibly delist the species, ERDC-EL is developing an objective and precise technique that can easily be performed by field biologists.

.

Expected Cost To Implement

Equipment requirements include a night vision camera, portable recording equipment, a PC, and archival digital storage medium. The preferred night vision camera is a thermal infrared imager; the current low-end cost of a suitable thermal camera is approximately $7K. A secondary option would be a near-infrared camera with illuminators. This can be obtained for about $1K, although the performance will not match that of a thermal camera. A suitable laptop PC currently costs about $2K. Digital video recording equipment and archival storage can be acquired for about $500 each. Details on equipment specification can be obtained from the ERDC POC. Custom processing software has been developed by ERDC and is available at no cost. ERDC assistance to configure and test equipment and on-site training are available on a reimbursable basis.

ERDC-EL staff is available on a reimbursable basis to conduct imaging censuses or help users apply digital imaging in conducting bat censuses. Costs for this technical assistance will vary depending upon the level of involvement of the EL staff. For a cost estimate, please contact the ERDC POC, Bruce.M.Sabol@usace.army.mil.

.

Benefits/Savings

The benefit of this technique is that it will generate reliable and accurate census data that requires no subjective judgment and will not vary between operators. If used on a regular basis the equipment should pay for itself in a single field season based on savings in labor costs.

Status

Techniques for detection, tracking, and counting have been developed and verified for thermal infrared imagery. Slightly modified techniques are required and are being developed for illuminated near infrared imagery. Beta testing of the thermal software is under way and training is being provided to excursion teams from the U.S. Fish and Wildlife Service that will begin using the technique to evaluate gray bat population trends.

ERDC POC

Bruce Sabol, 601-634-2297, Bruce.M.Sabol@usace.army.mil

Distribution Sources

Analysis software and instruction manuals may be obtained at no cost by contacting the ERDC POC. Specific training for new users is highly recommended and can be scheduled at ERDC or the user's test site.

Available Documentation

Sabol, B.M., and M. K. Hudson. 1995. Technique using thermal infrared-imaging for estimating populations of gray bats. *J. of Mammalogy* 76(4):1242-1248.

Melton, R.E., B.M. Sabol, and A. Sherman. 2005. Poor man's missile tracking technology: thermal IR detection and tracking of bats in flight. *Proceedings International Society of Optical Engineering (SPIE)*, 5811:24-33.

Available Training

Training may be obtained at ERDC or at the customer's site. Training is offered on a reimbursable basis.