US Army Corps of Engineers®
Engineer Research and Development Center

Threatened and Endangered Species

Research Update Newsletter

November 2005

Introduction

Welcome to the second issue of the Threatened and Endangered Species (T&E species) newsletter. The purpose of this newsletter is to communicate *ongoing* T&E species research conducted by the Engineer Research and Development Center (ERDC) and the potential applications of these various technologies for other T&E species.

This newsletter focuses on emerging technologies and disseminating knowledge *early* in the research process. This approach provides installation personnel and other interested parties access to this information on a more timely basis. This newsletter will also provide a forum to share information regarding ongoing projects and new starts for which technical reports, journal articles, etc. are not yet complete.

Conservation Research Requirements & the 7 Priority T&E Species

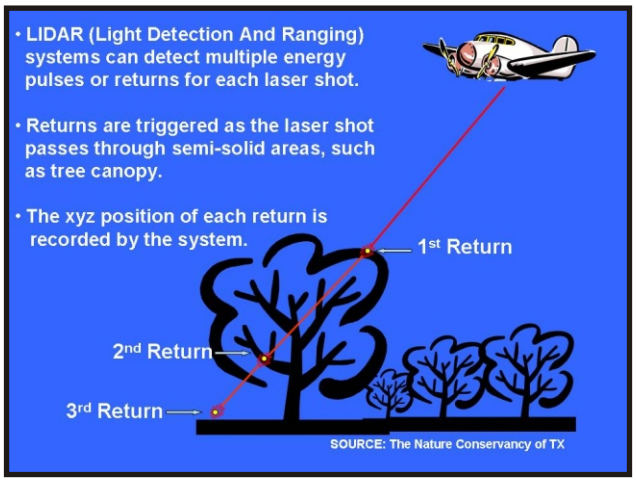
The Army's top two conservation research requirements are: 1) reducing impacts of T&E species on military readiness, and 2) maintaining readiness by improving T&E species monitoring capabilities. The first two research projects highlighted in this issue address monitoring capabilities and the last two projects focus on potential impacts of military training on endangered species. The seven priority T&E species that pose the greatest potential for impeding training, testing, and combat readiness are the red-cockaded woodpecker, golden-cheeked warbler, black-capped vireo, gopher tortoise, desert tortoise, Indiana bat, and gray bat. It is anticipated that the technologies and methodologies used in conducting this research will have potential cross-applications to other T&E species.

Current Research Highlights

The goal of this newsletter is to increase your awareness of ongoing research to provide knowledge that may help determine if the methodologies and/or technologies are potentially applicable to your situation. In addition, your particular circumstances may provide insights to researchers on building flexibility and adaptability into their finished products, thereby resulting in more useful end products.

Remote Sensing for T&E Species Habitat

Field surveys to delineate, assess, and monitor potential T&E species habitat are often costly and inefficient. To address these problems, new remote sensing protocols are under development. Remote sensing has particular applications where field surveys are not possible such as large, inaccessible areas, including impact areas, live fire areas, and privately owned lands outside of installation boundaries. However, traditional, optical multi-spectral imagery and photography are not well-suited for assessing vertical structure of vegetation, which is a key habitat parameter for a number of T&E species. This is due to limited capabilities for sensing sub-canopy, mid-story, and under-story habitat characteristics. Conversely, Light Detection and Ranging (LIDAR) has the ability to penetrate



the canopy so that vertical forest structure can be assessed and quantified in terms of height, density, volume, and canopy closure. This project involves using LIDAR and multispectral imagery to characterize vertical vegetation structure and composition in areas of potential habitat for the black-capped vireo (BCVI) and golden-cheeked warbler (GCWA) at Fort Hood, Texas, and the red-cockaded woodpecker (RCW) at Fort Bragg, North Carolina.

For black-capped vireo habitat, LIDAR data was analyzed to identify individual shrubs and shrub patches providing preferred habitat height and structure. The LIDAR data was used to estimate habitat type (classical, mixed, donut, linear). These estimations were then verified against field surveys, resulting in an overall accuracy of 76%. For golden-cheeked warbler habitat, LIDAR was used to determine canopy closure, density, height, and variance in height by species as surrogate measures of stand age. A combination of multispectral imagery and LIDAR will be used to develop a model to estimate spatial variation in habitat quality across areas of known potential GCW habitat. Species abundance and productivity data of the GCW will be utilized to assess the model. For red-cockaded woodpecker habitat, multispectral and hyperspectral imagery will be used to determine percentages of Longleaf, Loblolly, and other pine species in the canopy. A combination of multispectral imagery and LIDAR data will be utilized to determine the presence or absence of mid-story hardwoods.

For each of these avian species, LIDAR data and multispectral imagery has led to the development of spatially explicit estimates of biophysical variables critical for determining habitat potential. The combination of these estimates with other geospatial data has greatly improved the efficiency for determining habitat potential, especially in areas generally inaccessible to field surveys (e.g., impact areas, live fire areas, and privately owned lands outside the installation boundaries). Techniques and protocols developed for analyzing LIDAR are not only adaptable for assessing other T&E species habitats, but may have applicability in other situations that require assessing vertical distribution and structure of vegetation.

ERDC-CERL is collaborating on this research with The Nature Conservancy, US Geological Survey National Biological Information Infrastructure (USGS-NBII), US Fish and Wildlife Service (USFWS), Mississippi State University, and the Conservation Management Institute at Virginia Tech University. (POC: Scott Tweddale, scott.a.tweddale@erdc.usace.army.mil).

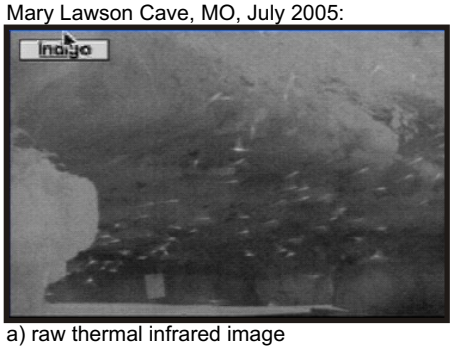
Censusing Gray Bats Using Digital Image Processing Techniques

Determining the number of bats emerging from a cave or mine roost during an evening emergence can be an overwhelming task for researchers. A large emergence of bats is generally a chaotic process with flight behavior that is neither uniform nor unidirectional. A technology is needed with the capability to detect bats against various background clutter without requiring any assumptions on their flight behavior. The lack of an objective and repeatable technique has limited studies regarding population recovery trends of the endangered gray bat. To address this problem, digital image collection and processing techniques are being developed in an attempt to automate the detection, tracking, and counting of bats emerging from cave and mine roosts.

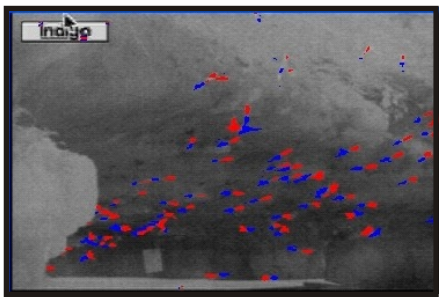
Infrared imagery, essentially heat pictures, is useful for detecting various warm-blooded animal species against cooler background environments. However, the current technology for detecting and counting remains a largely manual, labor-intensive process requiring a trained interpreter. In this research project, a fully automatic digital image processing technique has been demonstrated that can detect, track, and count emerging bats.

The process involves several key steps. First, differencing of sequential video frames, collected from a stationary position, eliminates background

Mary Lawson Cave, MO, July 2005:



a) raw thermal infrared image



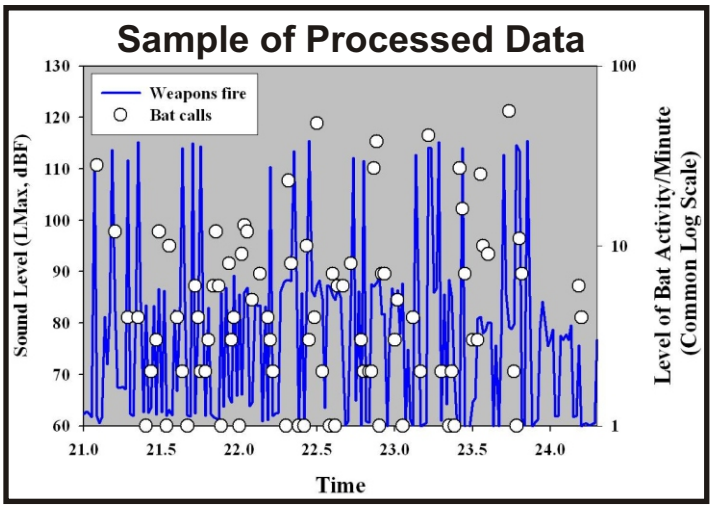
b) image enhanced by frame differencing to improve detection and tracking (red is position in current frame, blue is position in previous frame).

clutter so that only moving objects remain. Second, these moving objects appear as pixel clusters that can be identified as individual bats. These detected individual bats are tracked frame by frame during the entire time they are within the field of view. Third, an analysis of the first and last tracked positions determines whether the tracking indicates an exit or a return to the roost. This technique was successfully demonstrated at a test site inhabited by Southeastern myotis bats. Counts using the fully automatic digital image process were compared to bat counts from a trained wildlife biologist, who viewed the videotapes and manually counted bats exiting and returning to the roost. The differences between the automated and manual counts were within a few percentage points for exit and return counts.

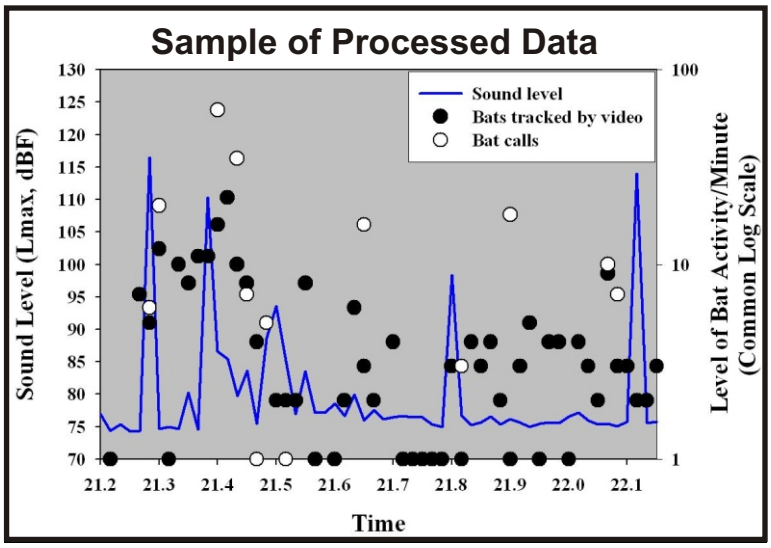
Additional research, using video imagery collected from summer gray bat roosts at 10 caves in Alabama, Tennessee, Kentucky, Arkansas, and Missouri, is ongoing. The completed software, accompanying documentation, and user manuals are scheduled for release in FY06. (POC: Bruce Sabol, bruce.m.sabol@erdc.usace.army.mil).

Effects of Military Training Noise on Bat Behavior

The effects of military training noise on bats are largely undocumented. This represents a concern for DoD installations and for the US Fish and Wildlife Service. Noise disturbance studies of wild animals that have been conducted are often anecdotal and have failed to quantitatively measure either behavioral or physiological response to noise. Quantitative studies of bat response to high-energy noise sources have been especially lacking. In addition, at least 20 DoD installations are known to support populations of federally listed bat species. To address these issues, current research is investigating military noise effects, especially high-caliber weapons fire, on several bat species. Potential impacts to populations of endangered Indiana and gray bats were of particular concern. Results from this research will be useful in documenting any potential conflicts between military training and these endangered species.



Scientists from the ERDC-EL and ERDC-CERL collaborated to investigate the effects of military noise on bats. Fort Knox, Kentucky, was selected based on its high-caliber weapons fire training exercises, and known populations of Indiana and gray bats. Research objectives were to evaluate the impacts of military training noise on bat navigation and selection of foraging areas. The study obtained measurements of bat vocalizations using ultrasonic detectors, thermal infrared imagery, and military noise monitoring technology. Field work was conducted during six sampling events at 34 sites in 2003 and 2004. Quantitative data consisted of simultaneous measurements of bat activity and noise events, simultaneous measurements at firing and non-firing sites, and measurements collected before, during, and after firing events at multiple locations.



Statistical analysis of bat vocalizations, thermal infrared detection, and military noise data

indicated extremely large variations in bat response variables across space and time. There were no consistent significant differences in measures of bat activity associated with military noise at a fixed site (i.e., firing and non-firing times at the same site), firing and non-firing sites, or type of military noise. Thus, results indicated that elevated noise levels associated with high-caliber weapons fire, as tested, did not have a significant effect on bat navigation and foraging activity at the established Fort Knox firing ranges. (POC: Chester Martin, chester.o.martin@erdc.usace.army.mil).

Burrow Collapse Effects on the Gopher Tortoise

The gopher tortoise is a species of concern throughout the Southeast. Currently, Camp Shelby Training Site, Mississippi, is the only military installation where the Gopher tortoise is federally listed as Threatened. However, declining populations throughout their range could potentially impact the military and land management mission at 17 other military installations. In addition, the Gopher tortoise is a keystone species throughout its range.

During forest thinning and harvest practices, and during military training exercises, tortoise burrows are often accidentally run over. However, no formal studies of the potential for tortoise injury resulting from burrow collapse had been conducted in the natural environment. The USFWS coordinator for the Gopher tortoise originally proposed studying this issue. ERDC-CERL proposed expanding the study to include Army equipment, and to conduct the research in the unlisted range of the species at Fort Benning, GA. Faculty and students at Auburn University conducted the field and laboratory studies.

This research was designed to determine the potential for tortoise injury from the direct crushing of the burrows or loss of life through their inability to escape from a collapsed burrow. These parameters were studied for 40 intentional burrow collapses in 2003 and 2004. In addition, data were acquired on pre- and post-collapse movement patterns and several general health and physiological measures.

An M113 armored personnel carrier (APC) and a 16-ton logging skidder were the two types of equipment studied. The APC took several passes to crush the burrows with most of the damage involving the burrow mouth. In contrast, burrows were thoroughly crushed in one pass by the logging skidder with damage to the burrow mouth and underlying structure. Greater burrow damage by the logging skidder resulted from its heavier weight and greater PSI (pounds per square inch) per tire compared to the lighter armored personnel carrier, whose weight was distributed along its tracks.

All tortoises self-evacuated, with evacuation intervals ranging from an hour to 85 days. Upon examination of the tortoises after emergence, none appeared to have any life-threatening injury, including broken shells or limbs from the burrow collapse. All tortoises remained within a normal home range of their collapsed burrow, resulting in little change in movement patterns after burrow collapse. The extent to which the tortoises re-used

the collapsed burrow depended on the location and extent of the damage. Tortoises were more likely to reuse the burrow if only the burrow mouth had been damaged. If the collapse occurred further from the burrow mouth, the tortoises were less likely to reuse the burrow. In addition, the more severe the damage to the burrow, the more likely the tortoise would abandon the site.

In the short term, it does not appear that there is any significant change in home range, number of burrows used, daily movement patterns, or the mean distance moved by the tortoises. In the long term, there does not appear to be any significant change in tortoise movement or size of their home range. Analysis of the physiological measures (including stress response and immune response) is ongoing and will be included in the final report. (POC: Dr. Hal Balbach, hal.e.balbach@erdc.usace.army.mil).

Announcements

T&E Species Research Funding Opportunity

On November 10, the Department of Defense, through the Strategic Environmental Research and Development Program (SERDP) issued its solicitation for research proposals against high priority departmental needs. Included in this list of topics is a statement of need titled "Methods to Assess Cumulative Effects on Threatened and Endangered Species." Persons who have an interest in submitting a proposal against this topic area should consult the SERDP website at: http://www.serdp.org/funding/index.cfm for further information. If you have any questions, do not hesitate to contact Steve Hodapp, Co-Chair SERDP Sustainable Infrastructure Working Group, at: stephen.e.hodapp@erdc.usace.army.mil, (800) 872-2375, ext 7228, or (217) 373-7228.

Conference Proceedings Available

Conference proceedings from the June 7-9, 2005 ERDC/SERDP Technical Symposium & Workshop: Threatened, Endangered, and At-Risk Species (TER-S) on DoD and Adjacent Lands, are posted on the SERDP website at: http://www.serdp.org/tesworkshop.

List of Products Completed Since April 2005 Newsletter

The complete text of any T&E species technical report can be accessed through the ERDC-CERL website (http://www.cecer.army.mil/td/tips/browse/publications.cfm?AREA=10).

Ambient Light Encroachment at Military Installations. Lozar, Robert C. and Richard Schneider, Report Number ERDC/CERL TN-05-2 (2005).

Analysis of Gopher Tortoise Population Estimation Techniques. Carthy, Raymond R., Madan K. Oli, John B. Wooding, Joan E. Berish and William D. Meyer, Report Number ERDC/CERL TR-05-27 (2005).

Characterizing Landuse Change Trends Around the Perimeter of Military Installations. Lozar, Robert C., William D. Meyer, Joel D. Schlagel, Robert H. Melton, Bruce A. MacAllister, Joseph S. Rank, Daniel P. McDonald, Paul T. Cedfeldt, and Pat M. Kirby, Report Number ERDC TR-05-4 (2005).

Delisting Process for Endangered Species and Relevance to Populations on Army Lands. Graber, Jana Sterling and Timothy J. Hayden, Report Number ERDC/CERL TR-05-28 (2005).

Gopher Tortoise Nest Detection at Camp Shelby, Mississippi. Bennett, Hollis H. Jr., Janet E. Simms, Lewis B. Smithhart, Michael L. Hargrave, Tad Britt, and Harold Balbach, Report Number ERDC TR-05-6 (2005).

Guidelines for Developing Habitat-based Threatened and Endangered Species Population Goals on U.S. Army Installations. Shapiro, Ann-Marie and Matthew Hohmann, Report Number ERDC/CERL TR-05-30 (2005).

Military Munitions-Related Compounds Fate and Effects: A Literature Review Relative to Threatened and Endangered Species. von Stackleberg, Katherine, Craig Amos, and Thomas Smith, Report Number ERDC/CERL TR-05-10 (2005).

Military Smokes and Obscurants Fate and Effects: A Literature Review Relative to Threatened and Endangered Species. von Stackleberg, Katherine, Craig Amos, Thomas Smith, Don Cropek, and Bruce MacAllister, Report Number ERDC/CERL TR-04-29 (2005).

Modeling Fog Oil Obscurant Smoke Penetration into Simulated Tortoise Burrows and Bat Colony Trees. Guelta, Mark and Harold Balbach, Report Number ERDC/CERL TR-05-31 (2005).

Remote Sensing for Threatened and Endangered Species Habitat Assessment on Military Lands: A Literature Review. Tweddale, Scott A. and Robert H. Melton, Report Number ERDC/CERL TR-05-11 (2005).

Summary of Threatened and Endangered Bat-related Restrictions on Military Training, Testing, and Land Management. Shapiro, Ann-Marie and Matthew G. Hohmann, Report Number ERDC/CERL TR-05-13 (2005).

Training Restrictions on Army Lands Due to High Priority Endangered Species. Guertin, Patrick, Report Number ERDC/CERL TR-05-12 (2005).

Use of the Corridor Tool in Support of Threatened and Endangered Species Habitat Fragmentation: Input Procedure and Initial Results. Lozar, Robert C., William Hargrove, and Forrest Hoffman, Report Number ERDC/CERL TR-05-23 (2005).

Pending Reports (To Be Released Soon)

- Effects of Tracked Vehicle Training Activity on Gopher Tortoise (Gopherus polyphemus) Behavior at Fort Benning, GA. Hal Balbach (hal.e.balbach@erdc.usace.army.mil).
- Emerging Species of Concern in the Perimeters of Military Installations Due to Urbanization Encroachment by 2020. Daniel MacDonald (daniel.p.macdonald@erdc.usace.army.mil)
- Human disturbance does not elicit a chronic stress response as measured by corticosterone in white-eyed vireos. Hayden, T.J. and M. Wilkelski. Accepted. *Hormones and Behavior.* (timothy.j.hayden@erdc.usace.army.mil)
- Mitigating Invasive Effects on TES: Nonindigenous Species. Patrick Guertin (patrick.j.guertin@erdc.usace.army.mil).
- Response of Gopher Tortoises to Habitat Manipulation by Prescribed Burning. Hal Balbach (hal.e.balbach@erdc.usace.army.mil)
- Screening Level Ecological Risk Assessments for Selected Threatened and Endangered Species. Thomas Smith (thomas.smith@erdc.usace.army.mil)

This newsletter and prior issues are located on the DENIX website:

For DoD Users (password required): https://www.denix.osd.mil/denix/DOD/Library/NCR/endangered_sp.html

For Public Users: https://www.denix.osd.mil/denix/Public/Library/NCR/endangered_sp.html

For general questions or comments about this newsletter, please contact Steve Hodapp, stephen.e.hodapp@erdc.usace.army.mil or Sarah Nemeth, sarah.b.nemeth@erdc.usace.army.mil.