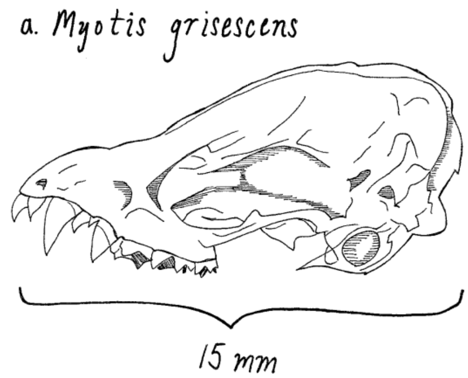
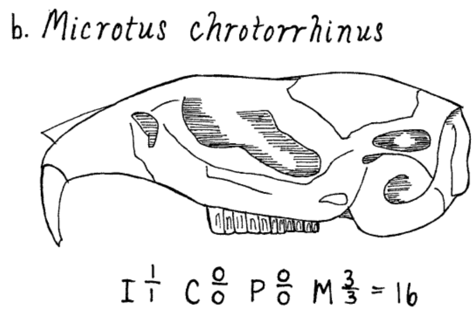
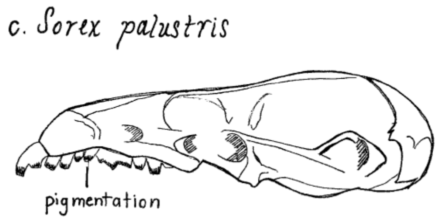
18th Annual Meeting of the Southeastern Bat Diversity Network



23rd Colloquium on the Conservation of Mammals in the Southeastern United States





Fall Creek Falls State Park, Pikeville, TN

February 14-15, 2013

Meeting Sponsors

Silver-Level Sponsors

Civil & Environmental Consultants, Inc.
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PROGRAM OVERVIEW

February 14th (Thursday) **Southeastern Bat Diversity Network Meeting and Associated Meetings**

8:00-10:00 AM	Rafinesque's Big-eared Bat Working Group	FCF Room II
10:00-10:30	Break	FCF Room I
10:30-12:00	Eastern Small-footed Bat Working Group	FCF Room II
12:00-1:00 PM	Lunch (On your own)	
12:00-5:00	Registration	FCF Foyer
1:00-1:10	Welcome and Introduction	FCF Room II
1:10-2:10	SBDN Plenary Session	FCF Room II
2:10-2:30	Break	FCF Room I
2:30-3:50	SBDN Plenary Session	FCF Room II
3:50-4:10	Break	FCF Room I
4:10-5:40	SBDN Business Meeting	FCF Room II
5:40-7:00	Dinner	Inn Restaurant
7:00-10:00	Social and Poster Session, Silent Auction	FCF Room II

February 15th (Friday) **Colloquium on the Conservation of Mammals in the Southeastern United States**

6:30-8:00 AM	Breakfast	Inn Restaurant
7:30-12:00	Registration	FCF Foyer
8:00-9:45	Oral Presentations – Session 1	FCF Room II
9:45-10:15	Break (Sponsored by S&ME, Inc.)	FCF Room I
10:15-12:00	Oral Presentations – Session 2	FCF Room II
12:00-1:15 PM	Lunch	Inn Restaurant
1:15-3:00	Oral Presentations – Session 3A	FCF Room II
1:15-3:00	Oral Presentations – Session 3B	FCF Room III
3:00-3:30	Break	FCF Room I
3:30-4:45	Oral Presentations – Session 4	FCF Room II
4:45-5:15	Awards, Announcements, Close	FCF Room II

Meeting Hosts

Dr. Brian Carver, Tennessee Technological University
Steve Samoray, Copperhead Consulting

Detailed Program

February 14th (Thursday)

8:00-10:00 **Rafinesque's Big-eared Bat Working Group**

10:00-10:30 **Break**

10:30-12:00 **Eastern Small-footed Bat Working Group**

12:00-1:00 **Lunch (On your own)**

12:00-5:00 **Registration**

1:00-3:50 **SBDN Plenary Session: Making Sense of Acoustical Software Packages: How are They Different and What are They Telling Us?**

1:00-1:10 **Welcome and Introduction**, Brian Carver – Tennessee Tech University

1:10-1:30 **BCID: Overview to a Realistic Approach for Automated Acoustic Identification**, C.R. Allen. *Bat Call Identification, Inc.*

1:30-1:50 **BAT SPECIES IDENTIFICATION FROM ZERO CROSSING AND FULL SPECTRUM ECHOLOCATION CALLS USING HMMs, FISHER SCORES, UNSUPERVISED CLUSTERING AND BALANCED WINNOW PAIRWISE CLASSIFIERS**, I. Agranat. *Wildlife Acoustics, Inc.*

1:50-2:10 **SONOBAT EXPERT SYSTEM FOR BAT ECHOLOCATION CALL ANALYSIS AND SPECIES IDENTIFICATION**, J. M. Szewczak. *Humboldt State University*

2:10-2:30 **Break**

2:30-2:50 **HOW RELIABLE ARE ALGORITHMS AND PROBABILITIES IN THE IDENTIFICATION OF SPECIES SPECIFIC CALL SEQUENCES?**, L. W. Robbins. *Missouri State University*

2:50-3:10 **COMPARISON OF FULL-SPECTRUM AND ZERO-CROSSING AUTOMATED BAT CALL CLASSIFERS**, D.I. Solick, M. Clement, K.L. Murray, C. Nations, and J. Gruver. *Western EcoSystems Technology, Inc.*

3:10-3:50 **INDIANA BAT SUMMER SURVEY GUIDELINES: THE 2013 DRAFT PLAN**, M. Armstrong, R.A. Niver, and A. King. *U.S. Fish and Wildlife Service*

3:50-4:10 **Break**

4:10-5:40 **SBDN Business Meeting**

5:40-7:00 **Dinner**

7:00-10:00 **Social and Poster Session, Silent Auction**

SBDN Business Meeting Agenda

Call to Order, Introductory Remarks	Michael J. Lacki, SBDN President
Accomplishments in 2012	
TWS's Outstanding Group Achievement Award	
Elections	
Transition to New Executive Committee Leadership	
Treasurer's Report	Tim Carter, SBDN Treasurer
Committee Reports	
Awards Committee	Stephen Burnett, Chair
Bat Blitz Committee	Trina Morris, Chair
Bat Database Committee	Eric Britzke, Co-Chair
Bats on Federal Lands Committee	Susan Loeb, Committee Member
Membership Committee	Chris Comer, Co-Chair
Newsletter	Mike Lacki, SBDN President
WNS Committee	Luke Dodd, Chair
Big-eared Bat Working Group	Mary Kay Clark, Chair
Myotis leibii Working Group	Joy O'Keefe, SBDN President Elect
Conservation and Recovery Working Group	Susan Loeb, Chair
Future Meetings	Joy O'Keefe, SBDN President Elect
Other Business from the Floor	Membership
Meeting Adjourned	Joy O'Keefe, SBDN President

POSTER SESSION 7:00-10:00 PM Thursday

CONSERVATION APPROACH FOR RAPIDLY DECLINING SPECIES, D. Arling, T. Davidson, R. Ewing, C. Johnson, K. Kirschbaum, D. Krusac, L. Prout, and K. Schultes. *Monongahela National Forest (DA and CJ)*; *Mark Twain National Forest (TD); U.S. Forest Service Eastern Region (RE); Superior National Forest (KK); U.S. Forest Service Southern Region (DK); White Mountain National Forest (LP); Wayne National Forest (KS)*

ALTERNATIVE ARTIFICIAL ROOST OPTIONS, K.M. Armstrong* and L.W. Robbins. *Missouri State University*

THE INFLUENCE OF PRECIPITATION AND TEMPERATURE ON THE REPRODUCTIVE TIMING OF MISSOURI BATS, L.J. Bishop-Boros* and L. Robbins. *Missouri State University*

HOW DOES *GEOMYCES DESTRUCTANS* INFECT BATS?, H. Blair*, E. Pannkuk, A. Fischer, K. Arter, C. Gerdes, B. Savary, and T. Risch. *Arkansas State University*

MALE BIG BROWN BAT (*EPTESICUS FUSCUS*) ASSOCIATION PATTERNS ARE INFLUENCED BY ULTRASONIC VOCALIZATIONS OF FEMALES, M.E. Grilliot, S.C. Burnett, and M.T. Mendonca. *Troy University-Montgomery (MEG); Clayton State University (SCB); Auburn University (MTM)*

ROOSTING ECOLOGY OF EASTERN RED BATS IN WEST-CENTRAL VIRGINIA, Z.A. Hann*, P.R. Moosman Jr., M.J. Hosler, and M.E. Western. *Virginia Military Institute*

SINGLE UNIT TURBINES AND EFFECTS TO BAT POPULATIONS, P.N. Jordan* and T.S. Risch, *Arkansas State University*

ROOST TREE SELECTION OF NORTHERN MYOTIS (*MYOTIS SEPTENTRIONALIS*) IN A CENTRAL APPALACHIAN HARDWOOD FOREST, M.S. Karp*, J.W. Edwards, T.M. Schuler, S.F. Owen, and J.L. Rodrigue. *West Virginia University (MSK,JWE, and SFO);United States Department of Agriculture Forest Service, (TMS and JLR)*

SEARCHING FOR BEETLES (COLEOPTERA: SCARABAEIDAE AND HISTERIDAE) ASSOCIATED WITH THE DUNG OF NATIVE ARKANSAS MAMMALS, J.B. Kelley*, J.L. Hunt, and M.B. Connior. *University of Arkansas at Monticello (JBK, JLH), South Arkansas Community College (MBC)*

INFLUENCE OF INTERCROPPING SWITCHGRASS IN INTENSIVELY MANAGED PINE FORESTS ON ULTRASOUND PRODUCED BY BATS AND RODENTS, A.M. Matteson*, J.A. Homyack, T.B. Wigley, D.A. Miller, and M.C. Kalcounis-Rueppell. *University of North Carolina at Greensboro, Greensboro (AMM, MCKR); Weyerhaeuser Company (JAH, DAM);National Council for Air and Stream Improvement Inc (TBW)*

ELEVATION AND FEMALE BAT FORAGING DISTRIBUTION IN A LOW MOUNTAINOUS REGION, P. Moore* and V. Rolland. *Arkansas State University*

GRAY BAT WINTER ACTIVTY (*MYOTIS GRISESCENS*), ARE THEY DIFFERENT?, J.D. Parris* and L.W. Robbins. *Missouri State University*

EFFECTIVENESS OF ACOUSTIC LURES FOR INCREASING INDIANA BAT (*MYOTIS SODALIS*) CAPTURES AT MIST-NET SITES, S. Samoray, T. Wetzel, and M. Gumbert. *Copperhead Environmental Consulting*

DISCOVERY OF WHITE-NOSE SYNDROME ON BATS IN ALABAMA, W.E. Stone. *Alabama A&M University*

MONITORING CAVE BATS AT MAMMOTH CAVE NATIONAL PARK, S.C. Thomas. *National Park Service*

INVENTORY OF TERRESTRIAL WILD MAMMALS AT MAMMOTH CAVE NATIONAL PARK: 2005-2010, S.C. Thomas. *National Park Service*

INDIANA BAT SUMMER HABITAT: SUGGESTIONS TO IMPROVE THE CURRENT ASSESSMENT STANDARDS, B.E. Tinsley*, J.D. Parris, and L.W. Robbins. *Missouri State University*

PREDATION OF NATIVE FRESHWATER MUSSELS BY MUSKRATS IN SHOAL CREEK, ALABAMA, K.C. Vorreiter*, T.J. Garrabrant*, and A.J. Edelman. *University of West Georgia*

February 15th (Friday)

7:30-12:00 **Registration**

8:00-9:45 **Oral Presentations – Session 1 (Acoustics, Small-footed Bats): Moderator Darren Miller**

8:00 **WEATHER PROTECTION FOR ANABAT DETECTORS**, C. Corben and K. Livengood. *Titley Scientific*

8:15 **USING AUTO-CLASSIFIERS FOR ACOUSTIC SURVEYS: DO RESULTS REFLECT REALITY? – OR – A BAT IN THE HAND IS WORTH HOW MANY DETECTORS IN THE BUSH?**, J.D. Chenger and J.D. Tyburec*. Bat Conservation and Management (JDC); JT Consulting (JDT)*

8:30 **EVALUATING THE EFFECTIVENESS OF THREE ACOUSTIC MONITORING TECHNIQUES FOR LANDSCAPE LEVEL BAT POPULATION MONITORING**, M.D. Whitby*, T.C. Carter, E.R. Britzke, and S.M. Bergeson. *Ball State University (MDW, TCC and SMB); U.S. Army Corps of Engineers Research and Development Center (MDW and ERB)*

8:45 **COMPARISON OF AUTOMATED AND MANUAL IDENTIFICATION METHODS FOR MULTIPLE PASSIVE ACOUSTIC BAT SURVEY DATASETS: IMPLICATIONS FOR FUTURE PROTOCOLS**, P. Burke, T. Peterson, S. Boyden, K. Watrous. *Stantec Consulting*

9:00 **EASTERN SMALL-FOOTED BAT (*MYOTIS LEIBII)* ECOLOGY AT ACADIA NATIONAL PARK, MAINE**, T.J. Divoll, B.C. Connery, B. Wheeler, D.G. Buck, J.L. Fiely, C.J. Anderson, and D. E. Yates. *Biodiversity Research Institute (TJD, DGB, JLF, CJA, and DEY); Acadia National Park, (BCC and BW)*

9:15 **SPATIAL PATTERNS AND ROOST ASSOCIATIONS AMONG A BRIDGE-ROOSTING POPULATION OF *MYOTIS LEIBII***, T.J. Thomson* and J.M. O'Keefe. *Indiana State University*

9:30 **DIETARY NICHE OF *MYOTIS LEIBII* AND ITS ASSOCIATES INFERRED FROM FECAL CONTENTS AND STABLE ISOTOPE ANALYSIS**, P.R. Moosman, Jr., M.J. Hosler, P.A.P. deHart, and H.H. Thomas. *Virginia Military Institute (PRM, MJH, and PAD); Fitchburg State University*

9:45-10:15 **Break**

10:15-12:00 **Oral Presentations – Session 2 (Flying Squirrels, Northern Long-eared Bats, Social Networks): Moderator Ben Wigley**

10:15 **USE OF ACOUSTICAL SURVEYS IN DETECTING AND IDENTIFYING ENDANGERED CAROLINA NORTHERN FLYING SQUIRRELS (*GLAUCOMYS SABRINUS COLORATUS*) AND SOUTHERN FLYING SQUIRRELS (*G. VOLANS*)**, L.M. Gilley, C.A. Kelly, and T.L. Best. *University of North Carolina, Wilmington (LMG); North Carolina Wildlife Resources Commission (CAK); Auburn University (TLB)*

10:30 **SPRING BREAK 2012: WHERE THE CAROLINA NORTHERN FLYING SQUIRRELS ARE**, W.M. Ford, C.A. Kelly, J.L. Rodrigue, R.H. Odom, L.M. Gilley and C.A. Diggins. *U.S. Geological Survey, Virginia Cooperative Fish and Wildlife Research Unit (WMF); North Carolina Wildlife Resources Commission (CAK); U.S. Forest Service Northern Research Station (JLR); University of North Carolina-Wilmington (LMG); Virginia Tech (RHO and CAD)*

10:45 **TOWARD A BETTER UNDERSTANDING OF THE DISTRIBUTION AND MONITORING NEEDS OF THE CAROLINA NORTHERN FLYING SQUIRREL**, C.A. Kelly, W.M. Ford, L.M. Gilley, C.A. Diggins, and A.M. Evans. *North Carolina Wildlife Resources Commission (CAK); U.S. Geological Survey, Virginia Cooperative Fish and Wildlife Research Unit (WMF); University of North Carolina-Wilmington (LMG); Virginia Tech (AME and CAD)*

11:00 **SUMMER ROOSTING ECOLOGY OF THE NORTHERN LONG-EARED BAT (*MYOTIS SEPTENTRIONALIS*) AT CATOOSA WMA**, A.E. Lereculeur*, H.T. Mattingly and B.D. Carver. *Tennessee Tech University*

11:15 **IDENTIFICATION AND DELINEATION OF *MYOTIS SEPTENTRIONALIS* DAY-ROOST NETWORKS**, A. Silvis*, W.M. Ford, E.R. Britzke and J.B. Johnson. *Virginia Polytechnic Institute and State University (AS and WMF), US Geological Survey, Virginia Cooperative Fish and Wildlife Research Unit, Blacksburg, VA 24061 (WMF), US Army Engineer Research and Development Center (ERB), Pennsylvania Game Commission (JBJ)*

11:30 **NETWORK STRUCTURE AND SOCIAL ASSORTMENT BY THE INDIANA BAT AT AN OHIO MATERNITY SITE**, A.B. Kniowski*, A. Silvis, S.D. Gehrt, and W.M. Ford. *Virginia Polytechnic Institute and State University (ABK and AS); The Ohio State University (SDG), Virginia Cooperative Fish and Wildlife Research Unit and Department of Fisheries (WMF)*

11:45 **USING SOCIAL NETWORK ANALYSIS TO INVESTIGATE SOCIALITY IN *OCTODON DEGUS***, G.T. Davis* and L.D. Hayes. *University of Tennessee at Chattanooga*

12:00-1:15 **Lunch**

1:15-3:00 **Bats & Other Mammals: Moderator TBA**
FCF II

1:15 **ROOSTING HABITAT SELECTION OF THE NORTHERN YELLOW BAT (*LASIURUS INTERMEDIUS*) ON TWO GEORGIA BARRIER ISLANDS**, R. Craig Bland*, K.M. Morris, and S.B. Castleberry. *University of Georgia (RCB and SBC); Georgia Department of Natural Resources (KMM)*

1:30 **SPECIES COMPOSITION OF BATS (CHIROPTERA) ALONG LAKESHORE HABITATS IN WESTERN SOUTH CAROLINA**, J.E. Williams* and W.D. Webster. *University of North Carolina Wilmington*

1:45 **YEAR ROUND ACTIVITY OF PERIPHERAL BAT POPULATIONS IN THE NORTH CAROLINA COASTAL PLAIN**, J.F. Grider*, J.A. Homyack, and M.C. Kalcounis-Rueppell. *University of North Carolina at Greensboro (JFG and MCKR); Weyerhaeuser Company (JAH)*

1:15-3:00 **Other Mammals: Moderator TBA**
FCF III

1:15 **HOW MUCH DO WE ACTUALLY KNOW ABOUT MAMMALS OF THE SOUTHEASTERN U.S.?**, A.J. Edelman and M.N. Smith. *University of West Georgia*

1:30 **DISTRIBUTION AND STATUS OF THE NORTHERN AND SOUTHERN SHORT-TAILED SHREWS (*BLARINA BREVICAUDA AND B. CAROLINENSIS*) IN NORTH CAROLINA**, B. M. Hess*, R.A. Powell, and W.D. Webster. *North Carolina State University (BMH and RAP); North Carolina Museum of Natural Sciences (BMH); University of North Carolina Wilmington (WDW)*

1:45 **STATUS OF LONG-TAILED SHREWS (GENUS SOREX) IN NORTH CAROLINA**, W.D. Webster, J.E. Williams, and A. Cherry-Millis. *University of North Carolina Wilmington*

2:00 **AN OVERVIEW OF LITTLE BROWN BAT HABITAT PREFERENCES AT FORT DRUM MILITARY INSTALLATION**, L. Coleman*, C.A. Dobony, W.M. Ford, and E.R. Britzke. *Virginia Polytechnic Institute and State University (LC); U.S. Army, Environmental Division, (CAD); U.S. Geological Survey, Virginia Cooperative Fish and Wildlife Research Unit (WMF); U.S. Army Engineer Research and Development Center (ERB)*

2:15 **VARIATION IN SURFACE LIPID CONTENT OF BATS**, E. Pannkuk, N. Fuller, D. Gilmore, B. Savary, and T. Risch. *Arkansas State University, Jonesboro, AR 72467 (EP, DG, BS and TR); Boston University (NF)*

2:30 **ENVIRONMENTAL INFLUENCES ON THE CALL STRUCTURE OF A SOCIAL SUBTERRANEAN RODENT, THE CORURO (*SPALACOPUS CYANUS*)**, M.L. Stewart*, M. Soto-Gamboa, R. Vásquez, C. Cecchi, L.D. Hayes. *University of North Carolina, Greensboro, (MLS); Universidad Austral de Chile (MS) Universidad de Chile (RV and CC) University of Tennessee, Chattanooga (LDH)*

2:00 **EFFECTS OF AN ONGOING OAK SAVANNA RESTORATION ON SMALL MAMMALS IN SOUTHWEST MICHIGAN**, A. Larsen*, J. Jacquot, and P. Keenlance. *University of North Carolina at Greensboro (AL); Grand Valley State University (JJ and PK)*

2:15 **EFFECTS OF INTERCROPPING SWITCHGRASS (*PANICUM VIRGATUM L.*) AND LOBLOLLY PINE (*PINUS TAEDA*) ON RODENT COMMUNITY STRUCTURE AND POPULATION DEMOGRAPHICS**, K.L. King*, J.A. Homyack, T.B. Wigley, D.A. Miller, and M.C. Kalcounis-Rüppell. *University of North Carolina at Greensboro (KLK and MCKR)*; *Weyerhaeuser Company (JAH and DAM)*; *National Council for Air and Stream Improvement, Inc.(TBW)*

2:30 **ANALYSIS OF CYTOCHROME B MITOCHONDRIAL SEQUENCES IN CONTEMPORARY AND MUSEUM SPECIMENS OF VIRGINIA ALLEGHENY WOODRATS (*NEOTOMA MAGISTER*)**, J.M. Kanine*, T.C. Glenn, M.T. Mengak, and S.B. Castleberry. *University of Georgia*

2:45 **MAMMAL DIVERSITY, ABUNDANCE, AND ACTIVITY PATTERNS AT JEAN LAFITTE NATIONAL PARK, LOUISIANA: PRE- AND POST-KATRINA**, C.S. Hood, and L.E. Nolfo-Clements. *Loyola University (CSH); Suffolk University (LEN)*

3:00-3:30 **Break**

2:45 **ASSESSING INTERSPECIFIC RELATIONSHIPS BETWEEN WHITE-TAILED DEER AND EASTERN WILD TURKEY IN WESTERN TENNESSEE**, L.A. Madeira*, A.E. Houston, S.W. Stephenson, and M.L. Kennedy. *The University of Memphis (LAM and MLK); Ames Plantation, The University of Tennessee (AEH); Milan Army Ammunition Plant (SWS)*

3:00-3:30 **Break**

3:30-4:45 **Oral Presentations – Session 4 (Bats): Moderator John Hunt**

3:30 **INDIANA BATS LOST THE ROCK-PAPER-SCISSORS CONTEST: LITTLE BROWN BAT ROOSTING ECOLOGY PREVAILED**, S.M. Bergeson*, T.C. Carter, and M.D. Whitby. *Indiana State University (SMB); Ball State University (TCC). US Army Corps of Engineers (MDW)*

3:45 **PRESENCE ONLY MODELING OF INDIANA BAT (*MYOTIS SODALIS*) SUMMER ROOSTING HABITAT IN THE SOUTHERN APPALACHIAN MOUNTAINS**, K. R. Hammond*, J.M. O'Keefe, S.P. Aldrich, and S. Loeb. *Indiana State University (KRH, JMO, and SPA; USDA Forest Service, Southern Research Station (SL)*

4:00 **SUMMARY OF SIX INDIANA BAT (*MYOTIS SODALIS*) MIGRATION EVENTS FROM TENNESSEE CAVES**, M. Gumbert, P. Roby, J. Hawkins, J. Adams, and P. Sewell. *Copperhead Environmental Consulting, Inc.*

4:15 **BRANDENBARK™ MITIGATION AND HABITAT ENHANCEMENT TOOL FOR TREE BARK ROOSTING BATS**, M. Gumbert, P. Sewell, P. Roby, J. Adams, J. Schwierhohann and M. Brandenburg, *Copperhead Environmental Consulting, Inc.(MG, PR, JA,and JS); Fort Knox Military Installation (MB)*

4:30 **TEMPERATURES UNDER LEAF LITTER DURING WINTER PRESCRIBED BURNS: CAN BATS SURVIVE UNDER LITTER?**, R.W. Perry and V.L. McDaniel. *USDA Forest Service, Southern Research Station*

4:45-5:15 **Awards, Announcements, Close**

2013 SOUTHEASTERN BAT DIVERSITY NETWORK

PLENARY SESSION ABSTRACTS

IN ALPHABETICAL ORDER BY FIRST AUTHOR

BAT SPECIES IDENTIFICATION FROM ZERO CROSSING AND FULL SPECTRUM ECHOLOCATION CALLS USING HMMS, FISHER SCORES, UNSUPERVISED CLUSTERING AND BALANCED WINNOW PAIRWISE CLASSIFIERS

I. Agranat. *Wildlife Acoustics, Inc., Concord, MA 01742*

A new classification technique for the identification of bats to species from their echolocation calls is presented. Three different datasets are compiled and split in half for training and testing classifiers. Combined, the data include 9,014 files (bat passes) with 226,432 candidate calls (pulses or extraneous noise) representing 22 different species of bats found in North America and the United Kingdom. Some files are of high quality consisting of hand-selected search phase calls of tagged free flying bats while others are from a variety of field conditions including both active (attended) and passive (unattended) recordings made with a variety of zero crossing and full spectrum recording equipment from multiple vendors. Average correct classification rates for the three datasets on test data are 100.0%, 97.9%, and 88.8% respectively with an average of 92.5%, 72.2%, and 39.9% of all files identified to species. Most importantly, classifiers in the third dataset for two species of U.S. endangered bats, *Myotis sodalis* (MYSO) and *Myotis grisescens* (MYGR) have a correct classification rate of 100% and 98.6% respectively and identify 67.4% and 93.8% of all files to species suggesting that the classifiers are well suited to the accurate detection of these endangered bats.

BCID: OVERVIEW TO A REALISTIC APPROACH FOR AUTOMATED ACOUSTIC IDENTIFICATION

C.R. Allen. *Bat Call Identification, Inc., 733 W. 44th Terrace, Kansas City, MO 64111*

The USFWS recently released a new draft protocol for Indiana bat (Myotis sodalis) surveys in which automated acoustic identification is required. BCID is a candidate program to meet this requirement. Given this mandate, it is important for all parties involved (user, client, agency) to understand the inner workings, options, results, and limitations of these software packages. BCID provides a user-friendly, extremely fast, flexible, repeatable and quantitative approach to echolocation identification. The software allows the user to select the possible species in a given location, eliminating the potential for erroneous false positives. It includes options for filtering noise and un-identifiable calls, while letting the user strike a balance between quantity and quality of the results. Results for individual files and folder summaries are provided in an easy to use spreadsheet and data can be organized as the user sees fit. Released in 2007, BCID has been continually updated to provide the most accurate species identifications possible; however, it is not a perfect solution. False positive and negative results are a reality of using any automated identification system and are affected by a variety of factors; recording environment, species distribution, background noise and equipment used. Unfortunately, quantifying these factors can be extremely difficult. Therefore, it is unclear if a valid one size fits all statistic for determining the likelihood that a species identified is truly present exist. BCID does not currently utilize the Maximum Likelihood Estimate per the USFWS draft protocol, but will continue to work towards meeting this

directive. In the end, BCID is a powerful tool that has the potential to fulfill the need for automated acoustic identification, given realistic expectations of this process.

INDIANA BAT SUMMER SURVEY GUIDELINES: THE 2013 DRAFT PLAN

M. Armstrong, R.A. Niver, and A. King. *U.S. Fish and Wildlife Service, Frankfort, KY 40601 (MA), U.S. Fish and Wildlife Service, Cortland, NY 13045 (RAN), U.S. Fish and Wildlife Service, Bloomington, IN 47403 (AK)*

Over the past year and a half, the U.S. Fish and Wildlife Service (Service) has led a multi-agency team in the development of draft revised summer survey guidance for the Federally-listed endangered Indiana bat (*Myotis sodalis*). Since the 2012 SBDN meeting, several steps have occurred to move the revision process forward. The Service released the guidance for peer review between 3 February and 2 March 2012 and received 57 comment letters. The guidance team then reviewed all comments received, as well as initial results from the 2012 field season, and prepared revisions to the draft guidance. We also developed "Frequently Asked Questions" and "Glossary of Acoustic Bat Survey Terms" documents in response to many of the comments received. The Service initiated a public comment period in January 2013. The public comment period has been extended until 11 March 2013. Based on the input from the public review, we will decide how best to proceed before finalizing the survey guidance for the 2013 field season.

HOW RELIABLE ARE ALGORITHMS AND PROBABILITIES IN THE IDENTIFICATION OF SPECIES SPECIFIC CALL SEQUENCES?

L. W. Robbins. *Biology Department, Missouri State University, 901 S. National Ave., Springfield, MO 65897*

Species identification software is now being tested and used to determine species and species groups using echolocation data. Many studies have shown the value of these data in conjunction with other survey methods. Of immediate concern is the requirement by the USFWS to use species identification software to absolutely determine presence, or presumed absence, of Indiana bats at a specific location, with or without other collaborating data. For the purposes of this presentation, consider the individual pulses in a call sequence to be letters in the bat's signature. In this case each letter can be present multiple times or totally absent, but enough letters need to be present for name recognition. However if a letter or letters are present that only occur in a different species, the original identification should be reconsidered. The existing software focus on the identification of a specific sequence to a specific species based on the characteristics present in each pulse of the sequence. Species identifications are based on the number or percentage of pulses within a sequence that have the necessary known call parameters consistent with those produced by a specific species. However, there is a high level of variation within individual call sequences. This can lead to misidentifications when only a subset or a set number of pulses are used to make an identification. Using results from identifications from some software programs, I will discuss a new algorithm called a Teacher's T-test that may be used to confirm what species is identified by the sequence, but more importantly, what species it is not.

COMPARISON OF FULL-SPECTRUM AND ZERO-CROSSING AUTOMATED BAT CALL CLASSIFERS

D.I. Solick, M. Clement, K.L. Murray, C. Nations, and J. Gruver. *Western EcoSystems Technology, Inc., Cheyenne, WY 82001*

Identification of bat echolocation calls to species is becoming increasingly important, particularly for assessing the risk to bat species posed by wind-energy development and for monitoring the spread and long-term effects of White-Nose Syndrome. Calls recorded using full-spectrum detectors (e.g., Pettersson) contain more acoustic information than calls recorded using zero-crossing detectors (e.g., AnaBat™), and it is commonly assumed that this leads to better species discrimination. We tested this assumption using 652 full-spectrum reference calls for nine eastern bat species. Calls were analyzed using SonoBat™ 3.04 Northeast, and classified using three types of output: Consensus, By Vote, and Mean Classification. The full-spectrum calls were then converted to zero-crossing data using Anabat Converter 0.8. Call parameters were extracted using Analook and were analyzed using BCID software, EchoClass software, and a discriminant function analysis for New York. Average correct classification rates for all methods ranged from 14.3% (*Myotis leibii*) to 93.5% (*Perimyotis subflavus*). Incorrect classification rates were lower for SonoBat methods (range = 4.4 – 7.0%) than for zero-crossing methods (36.4 – 45.9%). In general, zero-crossing methods outperformed SonoBat for *Myotis* species, while SonoBat was better at classifying non-*Myotis* species. SonoBat did not identify any *M. sodalis* calls, while zero-crossing methods correctly classified 30.8 – 38.5%. Our results illustrate some of the limitations of automated classification, and suggest that species presence and probable absence should be determined from multiple lines of evidence rather than any single data source.

SONOBAT EXPERT SYSTEM FOR BAT ECHOLOCATION CALL ANALYSIS AND SPECIES IDENTIFICATION

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SonoBat grew out of the need to address the specialized methods to acquire, process, view, and interpret bat calls and sequences using the full information content of full-spectrum data. Just as humans can outperform computers for extracting subtle visual content from challenges such as captcha images, the design and concept of SonoBat intended to facilitate applying human observational skills to bat call recognition and comparisons of unknown bat recordings with known reference recordings. Humans can often spot trends that automated systems miss because through experience humans learn to emphasize and integrate subsets of discerning (and situational appropriate) factors and disregard confounding information. Over the intervening twenty years from its inception the implementation of SonoBat has progressed to include automated call trending, parameterization, evaluation of signal integrity, and species classification, all using expert systems that meld automated machine approaches with guiding logic that incorporates the expertise gained through years of human experience from analyzing bat calls. This hybrid approach (expert system) of machine analysis and classification that incorporates supplemental and redundant logic based on human experience has proven to outperform any direct machine approaches such as artificial neural networks, Bayesian networks, etc. Perhaps more importantly, beyond demonstrated performance on test data sets of reference recordings, the many internal checks and steps refined through years of field testing render optimal performance on actual field data.

2013 MAMMAL COLLOQUIUM

ORAL PRESENTATION ABSTRACTS

IN ALPHABETICAL ORDER BY FIRST AUTHOR

INDIANA BATS LOST THE ROCK-PAPER-SCISSORS CONTEST: LITTLE BROWN BAT ROOSTING ECOLOGY PREVAILED

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To date, the variation between the population statuses of the endangered Indiana bat (*Myotis sodalis*) and the, relatively, abundant little brown bat (*Myotis lucifugus*) has not been investigated. While it is relatively clear what is causing declines in *Myotis sodalis* populations, it is unclear how the *Myotis lucifugus* became so common throughout most of North America. Because summer maternity habitat loss is known to be a cause of *Myotis sodalis* declines, it is possible that a difference in the roosting ecologies between the 2 species may have caused this variance in population status. To determine whether the 2 species have differing maternity roosting ecologies, we conducted radio-telemetry, within 4 study areas located in southern Illinois and south-central Indiana, to track female *Myotis sodalis* and *Myotis lucifugus* back to their roosts during the summers of 2007 and 2009-2011. Roost and stand characteristics were recorded for each roost. Thirty-nine *Myotis sodalis* and 32 *Myotis lucifugus* were tracked to 76 and 20 maternity roosts, respectively. While both species roosted within similar land cover types, they tended to use different roost types; *Myotis lucifugus* primarily using crevices/cavity roosts (58% of roosts) while *Myotis sodalis* used primarily exfoliating bark roosts (87% of roosts). This seeming predilection for crevice/cavity roosts in *Myotis lucifugus* may explain their distribution wide frequent use of anthropogenic roosts, which tend to mimic crevice/cavity roost characteristics. This may also suggest that *Myotis lucifugus* were preadapted to use anthropogenic roosts prior to European settlement. With increasing urbanization, the number of natural tree roosts decreased and the number of potential anthropogenic roosts increased. We propose that *Myotis lucifugus* were ready-and-able to adapt to this increase in anthropogenic roosts while *Myotis sodalis* were not, due to their preference for exfoliating bark roosts, which are not commonly mimicked by anthropogenic roosts.

ROOSTING HABITAT SELECTION OF THE NORTHERN YELLOW BAT (*LASIURUS INTERMEDIUS*) ON TWO GEORGIA BARRIER ISLANDS

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In the southeastern U.S., northern yellow bats (*Lasiurus intermedius*) have been found to roost primarily in Spanish moss (*Tillandsia usneoides*), but are also known to roost under the fronds of cabbage palms (*Sabal palmetto*). Although hardwood habitats are important in roost site selection, specific habitat composition that provides optimal roosting habitat is unknown. We examined roosting habitat selection of the northern yellow bat on two Georgia barrier islands, one dominated by pine/mixed pine habitats and

one dominated by hardwood habitats. We captured and radiotagged 16 adult males, one adult female, and one juvenile female. We tracked bats to their diurnal roosts daily until the transmitter battery died or the glue failed. Roost site characteristics were measured at roosts and random trees. Out of 177 roosts 98% were located in Spanish moss on hardwood trees and 2% were located under palm fronds. Consistent with previous research, our preliminary analyses indicated that roost trees had a larger DBH than the surrounding trees. We additionally found that percent canopy coverage was higher at random sites than at roost sites. Our results support the general supposition that hardwood habitats are important roost locations, but site-level factors may play a role in selection. Future analyses will examine additional site-level, as well as landscape level characteristics influencing roost site selection.

COMPARISON OF AUTOMATED AND MANUAL IDENTIFICATION METHODS FOR MULTIPLE PASSIVE ACOUSTIC BAT SURVEY DATASETS: IMPLICATIONS FOR FUTURE PROTOCOLS

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The U.S. Fish and Wildlife Service recently revised guidelines regarding standardized protocols for assessing the presence or probable absence of the federally listed Indiana bat (*Myotis sodalis*). These recommendations identify a need to move away from traditional mist-net surveys in favor of passive acoustic survey methodology using automated acoustic identification software to identify species. Currently, no Service-approved acoustic ID software is available, although two candidate programs have been identified: Echoclass (Version 1.1) and BCID (Version 2.4.1.1). Our study objective was to determine the degree of congruence between results of these currently-available identification tools. We compare results of manual and automatic identification methods for several passive acoustic bat survey datasets collected in the Southern Appalachians and New England between 2011 and 2012. Echoclass and BCID software were used to automatically process acoustic data for all species, while a portion of these datasets were manually analyzed and identified to species and/or guild, as is often done for passive acoustic bat datasets. We compare species groupings, overall activity levels, and the extent to which various methods agree and disagree for particular species groups and discuss implications of these differences for guiding future protocol decisions.

USING AUTO-CLASSIFIERS FOR ACOUSTIC SURVEYS: DO RESULTS REFLECT REALITY?
– OR –
A BAT IN THE HAND IS WORTH HOW MANY DETECTORS IN THE BUSH?

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The development of automatic classifiers for analyzing both full-spectrum and zero-cross bat echolocation recordings has added much-needed efficiency to the tedious process of extracting call parameters and verifying species by hand. But how can we measure the accuracy of results from our auto-classifiers when there is no way to verify which species were echolocating over the microphone when the recordings were made? Also most of the call characteristics that unknown files are measured against, were collected under ideal or controlled conditions, not at all like those encountered during typical deployments conducted during surveys. This presentation considers the following questions: (1) How do results from acoustic inventories compare to those from physical capture records? (2) Does species richness affect our expectations of accuracy from acoustic surveys? (3) How do results from different auto-classifiers compare to each other when applied to the same data set? Answers will come from reviewing over 30,000 acoustic recordings, collected from over 100 survey sites, in six regions of North America: central Pennsylvania, the Mississippi River area of central Illinois and Missouri, western

Kentucky, northern California, and southeastern Arizona. Recordings were post-processed using appropriate regional classifiers from the current leading software packages including: BCID, EchoClass, and SonoBat. Each acoustic site was also paired with physical capture sites where nets and traps confirmed species presence. Results will show that neither inventory method alone presents an accurate picture of bat presence. Additionally, each classifier returned different results on the same data set. This has important implications for the interpretation of acoustic surveys across the continent. As such, the use of bat detectors to determine bat presence in a habitat should be viewed as just a single tool for bat surveys, and should likely rarely be relied upon as the sole, definitive proof of bat presence without confirmation from "a bat in the hand."

AN OVERVIEW OF LITTLE BROWN BAT HABITAT PREFERENCES AT FORT DRUM MILITARY INSTALLATION

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ORAL PRESENTATION ABSTRACT—Understanding animal-spatial use of the environment is a paramount task of wildlife management. We suggest that assessing the apparent habitat preferences of myotid bats in the Northeast and elsewhere is critical to guide the development of effective monitoring protocols following white-nose syndrome associated declines. In the summers of 2010 and 2012, we captured and radio-tagged adult female little brown bats (*Myotis lucifugus*) from an artificial bat house at Fort Drum Military Installation in northwestern New York. We conducted fixed-station simultaneous telemetry to determine nocturnal spatial use. Successful location estimates were used to calculate minimum convex polygons (MCP) for bats with > 30 locations (n=8) and to perform subsequent habitat analyses. In the summers of 2011 and 2012, we deployed a grid of 4 x 4 Anabat acoustic detectors over 5 sampling periods in various riparian and non-riparian environments near the same artificial bat house. The total group MCP mean home range of 194 ha (21-1104 ha) overlapped our area used for the acoustic grid. Rankings of habitats using Euclidean distances revealed a higher proportional use of water ($P = 0.05$) and forested riparian ($P < 0.0001$) habitats than other habitat types at the home range and landscape scales, respectively. Pair-wise comparisons of habitat types indicates that bats were found significantly closer to forested riparian habitats than to water, development, open areas, shrubs, and other riparian habitats (P-values < 0.0001) at the landscape scale. Although acoustic detector occupancy estimates were 1.0 in non-riparian habitats versus 0.43 in riparian habitats, detection probabilities were 0.23 and 0.08 in riparian versus non-riparian sites, respectively. Despite potentially lower occupancy rates, these data suggest that riparian habitat conditions may be optimal for successful detection of little brown bats in Northeastern landscapes similar to Fort Drum where severe population declines have made monitoring difficult.

WEATHER PROTECTION FOR ANABAT DETECTORS

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There are many schemes which can be used to protect bat detector microphones from adverse weather. Most involve reflecting the incoming signal into a microphone which is physically hidden from the elements. For example, a microphone could be safely pointed downwards while having an axis of greatest sensitivity which points upwards into the weather. Some such schemes have been the subject of studies purporting to compare their effectiveness, but such comparisons have been complicated or invalidated by misunderstandings about the physics of sound and just what was being measured. We have conducted a number of comparisons of various weather-protection devices suitable for Anabat microphones, and present our findings here, along with a brief introduction to some of the important concepts, which we hope will help users better comprehend how to get the most out of their equipment.

USING SOCIAL NETWORK ANALYSIS TO INVESTIGATE SOCIALITY IN *OCTODON DEGUS*

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Historically, the investigation of a species' social structure has relied upon analysis of indirect population-level social parameters, such as mating system, social group size, etc. However, these approaches do not address the variation in interactions between individuals or the combined effects these individual interactions have on the social structure as a whole. Thus, a challenge to developing a comprehensive model of sociality is to quantify all associations between individuals as well as the way these associations interact to form the overall social structure at the population level. An emerging tool for such endeavors is social network analysis. Social network analysis uses social interactions between individuals to model a network where nodes represent individuals and the lines connecting the nodes represent social associations between the individuals. The primary objective of our study was to use social network analysis to investigate sociality in the degu (*Octodon degus*), a social rodent endemic to central Chile. We used previously collected live trapping data from two geographically and ecologically distinct degu populations (n=98 and n=48) to create a matrix of social association values based on how frequently each pair of individuals was trapped together. We then used this association matrix in SOCPROG 2.4 to assign values to each individual for a series of social network parameters, including association strength, reach, and affinity. Currently, we are investigating these network parameters to look for both intra- and inter-population differences. This will allow us to investigate individual variation in degu sociality within a population, as well as any population-level differences in social structure between the two distinct populations. Further, such work helps demonstrate the broad applicability of social network analysis, which may be used for a variety of ecological applications outside of social behavior, such as modeling disease transmission through a population.

EASTERN SMALL-FOOTED BAT (*MYOTIS LEIBII)* ECOLOGY AT ACADIA NATIONAL PARK, MAINE

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Between 2008 and 2012, we have captured 166 individual *M. leibii* while foraging on Mount Desert Island at Acadia National Park (ANP) in Maine. Of those banded (n = 155), 11 have been recaptured with some of those two years after their original banding date. In addition to mist netting and acoustic surveying our studies have included mercury (Hg) analysis, stable isotope (SI) analysis, and radio telemetry to locate roosting sites. A very brief overview of these methods will be presented to highlight that *M. leibii* at ANP appear to maintain a stable population with elevated Hg levels, do not appear to migrate very far, and, in late summer, prefer roosting on top of small mountains under granite rocks in the open on gently sloping granite slabs. Maternity roosting sites remain unknown at this location with compelling data to suggest they may roost in a man-made structure. Post-maternity season foraging area requirements were estimated and suggest that this species prefers a mix of heavily wooded forest trails with adjacent open meadows and ponds along with semi-open wetlands. Hibernacula have yet to be discovered here but *M. leibii* are the first species to be captured in mist nets (April 6) and among the last on the latest date of sampling (September 29), alongside *M. lucifugus* and *M. septentrionalis*.

HOW MUCH DO WE ACTUALLY KNOW ABOUT MAMMALS OF THE SOUTHEASTERN U.S.?

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The southeastern U.S. is home to a diverse mammalian community of over 130 native and introduced species. We compared the relative knowledge of southeastern U.S. mammal species through a literature search of electronically abstracted scientific publications. We estimated the number of scientific publications for each mammal species in Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, and Tennessee. The number of publications per species was typically small with a mode of 0 in every southeastern state. States differed in their published knowledge of resident mammals with the median number of publications per species greatest in Florida and lowest in Alabama. There were inequalities in published literature based on taxonomic group with a disproportionately large number of publications on Order Artiodactyla and small numbers of publications on diverse groups such as Orders Chiroptera and Rodentia. Our results indicate that the general knowledge of mammals in the southeastern U.S. is far from complete. These gaps in knowledge limit our ability to effectively conserve and manage many mammal species.

SPRING BREAK 2012: WHERE THE CAROLINA NORTHERN FLYING SQUIRRELS ARE

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We radio-tracked 3 female and 2 male endangered Carolina northern flying squirrels (*Glaucomys sabrinus coloratus*) during late winter and early spring 2012 in the Mount Hardy area of the Pisgah National Forest in Haywood County, North Carolina. Over the survey period, northern flying squirrels used 13 yellow birch (*Betula alleghaniensis*; dbh 26.2 ± 2.1 cm) and 9 red spruce (*Picea rubens*; dbh 49.3 ± 4.9 cm) as diurnal dens. Ten of the 13 yellow birch dens were located in the cavities whereas the remainders were dreys. Conversely, 8 of the red spruce dens were dreys and only one was located in a cavity. The 95% adaptive kernel home ranges for the 2 males and 3 females were 12.6 ± 0.9 ha and 6.5 ± 2.2 ha, respectively. The 50% adaptive kernel "foraging core use" home ranges for the 2 males and 3 females were 1.45 ± 0.05 ha and 0.9 ± 0.3 ha, respectively. Northern flying squirrels used red spruce-dominated stands with canopies > 20 m in height greater than expected based on availability at the landscape- and both 95% and 50% adaptive kernel home range-scales. Home range size we observed was comparable to other Carolina northern and Virginia northern flying squirrels (*G. s. fuscus*) tracked where red spruce or red spruce-fraser fir (*Abies fraseri*) communities were present and home ranges were smaller than those recorded in wholly northern hardwood habitats without a red spruce component. Our results provide additional evidence that although a hardwood component is important for denning habitat, mature red spruce-dominated habitats with complex structure are preferred foraging habitats and also are used as denning habitat. These data can inform efforts to improve the structural condition of extant red spruce forests and/or increase overall red spruce acreage to potentially benefit northern flying squirrels.

USE OF ACOUSTICAL SURVEYS IN DETECTING AND IDENTIFYING ENDANGERED CAROLINA NORTHERN FLYING SQUIRRELS (*GLAUCOMYS SABRINUS COLORATUS*) AND SOUTHERN FLYING SQUIRRELS (*G. VOLANS*)

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Acoustical surveys have long been a commonly used practice in documenting presence of species of birds and amphibians. More recently, with advancements in recording and analyzing high-frequency sounds, these same methods have been applied successfully to detecting and distinguishing individual species of bats and cetaceans. Because of the success seen in acoustic surveys for bats, this technique may be useful in detecting ecologically similar species such as flying squirrels. We assessed the efficacy of using acoustical surveys to document presence of North American flying squirrels (*Glaucomys sabrinus* and *G. volans*). Acoustic surveys were conducted in Alabama where *G. volans* occur, and in western North Carolina where southern flying squirrels and endangered Carolina northern flying squirrels (*G. s. coloratus*) occur. Recordings of flying squirrels from acoustic surveys conducted in the wild were quantified and discriminant-function analysis was used to compare calls to an existing call library of flying squirrels in captivity. Acoustic detection of *G. volans* in Alabama occurred at 20 of 44 sites for a detection-success rate of 45.5%. Two new types of calls were discovered from field-surveys for *G. volans* including chirps and downsweeps. Discriminant-function analysis and cross validation correctly classified each group of calls 100% of the time. Acoustic detection of flying squirrels in western North Carolina occurred at 66 of 136 sites surveyed for a detection-success rate of 48.5%. Carolina northern flying squirrels were recorded at 44 sites and southern flying squirrels at 22 sites. Sympatry occurred at 15 sites. Results suggest that acoustical surveys may be significantly more effective in documenting presence of flying squirrels than techniques used previously. Such surveys may be useful in detecting and monitoring endangered populations of northern flying squirrels and disjunct or locally rare populations of southern flying squirrels in eastern Canada, Central America, and the mid-western United States.

YEAR ROUND ACTIVITY OF PERIPHERAL BAT POPULATIONS IN THE NORTH CAROLINA COASTAL PLAIN

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Conservation efforts should be directed to peripheral populations when there is a major threat to core populations, as is the case with White Nose Syndrome (WNS). The objective of our study was to determine the distribution and year-round activity of peripheral bat populations of WNS-impacted and conservation concern species in the North Carolina Coastal Plain. We conducted mist netting between 15 May - 5 August of 2012. Over 60 nights of mist-netting occurred in two managed pine and two bottomland hardwood forest sites in eastern North Carolina. In addition, we established four acoustic recording stations (one at each site; song meter SM2Bat+ detectors) in the summer of 2012 to record bat ultrasound from sunset to sunrise for two years. We caught 452 bats including: 20 Rafinesque's big-eared bat (*Corynorhinus rafinesquii)*, 43 southeastern Myotis (*Myotis austroriparius)*, 50 tricolored bat (*Perimyotis subflavus)*, 8 northern long-eared bat (*Myotis septentrionalis)*, 35 big brown bat (*Eptesicus fuscus)*, 173 eastern red bat (*Lasiurus borealis)*, 7 Seminole bat (*Lasiurus seminolus)*, and 116 evening bat (*Nycteciеus humeralis)*. Total number of bats captured and species richness were higher in bottomland hardwood forests compared to intensively managed pine forests. Rafinesque's big-eared bat

and southeastern Myotis were captured in bottomland hardwood forests but not in pine forests. Further, total number of bat echolocation sequences was higher in bottomland hardwood forests when compared to intensively managed pine forests. Recorded calls are currently being analyzed using Sonobat 3.1 to determine presence and seasonal activity of bat species through the year. Preliminary acoustic results suggest that relative bat activity was highest between July and August and there is evidence of winter activity comparable to summer activity on warm winter nights through December. We will discuss significance of these results in relation to WNS and coastal wind turbine development.

SUMMARY OF SIX INDIANA BAT (*MYOTIS SODALIS*) MIGRATION EVENTS FROM TENNESSEE CAVES

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Relatively little is known about the migratory behavior of Indiana bats, and movements have historically been described as straight line connections between banding and recapture sites. This neglects valuable data on an important and complex life history component of the species. Our primary objective was to identify summer grounds for bats hibernating in Tennessee caves. Secondarily we collected data on how bats migrate with regards to direction, tortuosity, flight speed, use of stopover sites, and weather effects. We used active radio-telemetry to track female Indiana bats during spring migration from 4 caves in eastern Tennessee over 4 consecutive spring migration seasons: 2009-2012. Bat movements were documented using ground and aerial tracking. A total of 25 transmitters were attached to 22 female Indiana bats during 6 tracking phases (three bats were radio-tagged twice). Three summer grounds have been located: Carroll Co., KY (230.7 km); Gilmer Co., GA (148.1 km); Cleburne Co., AL (226.1 km). The farthest tracked bat was 263.8 km but the signal was lost north of Birmingham, AL. Bats from the northern counties in Tennessee migrated north, while bats from central Tennessee migrated south. During migration flights, bats followed a relatively straight line as evidence of low tortuosity values. Migration flights were faster ($\bar{x}$ = 18.1±0.4 kph, range: 0.7-40.0 kph) than non-migrating behavior ($\bar{x}$ = 10.9±0.4 kph, range: 0.02-39.7 kph). All bats tracked for >1 night utilized stopover areas during the night to feed or night roost. When the weather became inclement (e.g., <50°F, significant rain), bats stopped migrating. Although the straight line migration assumed by band recoveries is somewhat valid, active tracking showed us that many bats made abrupt direction changes to take advantage of landscape features before continuing on their initial trajectory. In addition, active tracking allowed for data collection on various other bat behaviors not possible with band recoveries alone.

BRANDENBARK™ MITIGATION AND HABITAT ENHANCEMENT TOOL FOR TREE BARK ROOSTING BATS

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Few tools are available to land managers as mitigation or habitat enhancement for the Indiana bat (*Myotis sodalis*). Fewer still directly address the summer habitat needs for this species. To address this issue, we developed BrandenBark, a new tool specifically designed to mitigate for the loss of summer maternity habitat for Indiana bats. The bark mimics natural trees used typically used as maternity roosts. From 2009 – 2012, sixteen BrandenBark roosts have been erected at a known Indiana bat maternity colony at Fort Knox, Kentucky: 10 bark pieces on existing snags, 6 on untreated wooden utility poles (artificial trees). In over 80 survey days, at least one roost was used by bats, with multiple roosts typically used each day. Seventy percent (70%) of snags fitted with BrandenBark had consistent use by Myotine bats. Emergence counts conducted throughout the maternity seasons show consistent bat usage with a high

count of 260 individuals. One-hundred percent (100%) of the BrandenBark artificial trees were used within two months of construction, including one with an emergence count of 242 bats. To date, 221 bats have been captured exiting BrandenBark roosts. Reproductively active female (n=151), juvenile (n=31) and adult male (n=4) Indiana bats accounted for the majority of captures (85%). BrandenBark has been approved by USFWS as a mitigation tool for linear corridor projects in West Virginia. BrandenBark artificial trees are simple to install, require little to no maintenance, and are easily monitored. As such, BrandenBark is an invaluable mitigation and habitat enhancement tool for any tree roosting species.

PRESENCE ONLY MODELING OF INDIANA BAT (*MYOTIS SODALIS*) SUMMER ROOSTING HABITAT IN THE SOUTHERN APPALACHIAN MOUNTAINS

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Indiana bat habitat in the southern Appalachians is made up of dense contiguous forest where suitable habitat does not seem to be limited. Thus, managers have difficulties determining what areas are critical to Indiana bats when planning large scale timber harvests and prescribed fires. Our objectives were to create a spatial prediction of summer roosting habitat and identify the critical landscape variables using the presence-only modeling approach of maximum entropy (MaxEnt). Our study area is made up of >200,000 ha in the Great Smoky Mountains National Park, the Cherokee National Forest and the Nantahala National Forest. From 2008 to 2012, we found 82 known reproductive female and juvenile roost locations that we used to create our spatial model. Traditional variables such as elevation, slope and aspect were included as environmental variables. However we also used unique variables such as distance to ridge line and ridge curvature to characterize roost features we observed while tracking Indiana bats in this region. Preliminary analyses of the global model including 9 environmental variables has given early support for elevation and forest type as being critical indicators of Indiana bat roosting habitat on a landscape scale in the southern Appalachians. Our results will enable managers to make more informed land-use decisions considering Indiana bat summer roosting habitat and to identify potential high use areas, which may be particularly helpful in remote areas where traditional presence-absence surveys are difficult.

DISTRIBUTION AND STATUS OF THE NORTHERN AND SOUTHERN SHORT-TAILED SHREWS (*BLARINA BREVICAUDA AND B. CAROLINENSIS*) IN NORTH CAROLINA

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Two species of short-tailed shrews (genus *Blarina*) exist in North Carolina. The northern (*Blarina brevicauda*) and the southern (*Blarina carolinensis*) short-tailed shrews can be morphometrically distinguished in most cases. Throughout most of North Carolina, these two shrew species are parapatric with very little overlap. In the Middle Atlantic Coastal Plains and Southeastern Plains ecoregions, both species may coexist. Morphometric data, consisting of 15 cranial and dental characters, were collected from museum voucher specimens of *B. brevicauda* and *B. carolinensis* within the state of North Carolina. There were no differences between sexes so data were pooled to increase sample sizes. Multivariate Principal Components and Maximum Likelihood Analyses were used to determine the factors contributing to the variation in measurements. The resulting plots show a clear separation of the two species including the suggestion of a localized subspecies, which was further supported by Classification

and Regression Tree Analysis. Based upon the museum locality data, each specimen was geo-referenced and mapped to view the current distribution for the genus *Blarina* in North Carolina with its current taxonomic designation. Future genetic analysis will test for concordance with the morphological findings for the species and subspecies, and look for evidence of gene flow.

MAMMAL DIVERSITY, ABUNDANCE, AND ACTIVITY PATTERNS AT JEAN LAFITTE NATIONAL PARK, LOUISIANA: PRE- AND POST-KATRINA

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Established in 1978, the Barataria Preserve of Jean Lafitte National Park. has been used and modified by people of the region for nearly 2000 years and is currently undergoing major urban and environmental impacts. We conducted the first mammal inventory of the park in 2003-2005, with field studies terminating just prior to Hurricane Katrina. Bat monitoring, live-trapping small and medium-sized mammals, and motion-triggered cameras documented occurrence and habitat distribution of 24 species. Field work for a re-assessment of mammal diversity and habitat use was just completed (2012) and is reported here. Sampling localities for the re-assessment included the sites studied in the pre-Katrina survey, but added many other sites, especially in swamp habitats. All seven species of bats documented pre-Katrina were captured/recorded post-Katrina, however, abundances were higher in some sampling locations post-Katrina and more bat species (7 vs. 4) were documented in hardwood forest habitats. Rodent diversity and abundances are low (only 2 native species, *Peromyscus leucopus* and *Ozyzomys palustris* are commonly encountered), both pre- and post-Katrina. Large mammals are very abundant in all habitats, with significant increase in the abundance of deer and carnivores (coyote, bobcats), post-Katrina. Feral hogs were not present pre-Katrina, but have now established a large breeding population that is expanding into all major habitats within the park. These results speak to the resilience of mammals in an area impacted by major hurricanes, but also to the opportunities presented for introduction of invasive species (feral hogs) that are now re-shaping the functional ecology of the park.

ANALYSIS OF CYTOCHROME B MITOCHONDRIAL SEQUENCES IN CONTEMPORARY AND MUSEUM SPECIMENS OF VIRGINIA ALLEGHENY WOODRATS (*NEOTOMA MAGISTER)*

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Allegheny woodrat (*Neotoma magister*) populations have been declining over the last 30 years throughout their range. Although causes of the declines are uncertain, decreased genetic diversity may have contributed to declines or may have negative future consequences in declining populations. As a part of a larger study designed to examine genetic structure of Allegheny woodrats in Virginia, we previously demonstrated the ability to successfully amplify MtDNA from museum specimens dating back to the 1860s. In an effort to further elucidate the genetic relatedness of Allegheny woodrats in Virginia we sequenced the MtDNA chytochrome B fragment of contemporary and museum specimens. Sequences lengths were either 138 or 266 base pairs dependent on DNA quality and success of the sequence lengths in previous PCR trials. To date, we have analyzed sequences of 150 contemporary woodrats, collected between 2008-2011, and 58 museum woodrats, collected between 1860-1989, and determined the variable positions present within the sequences. By examining sequences and variations within them we can infer the phylogeny of the contemporary samples, historic samples, and the combination of samples from both time periods. Furthermore we can apply the phlogeny to the landscape and possibly determine maternal lineage groupings present in Virginia.

TOWARD A BETTER UNDERSTANDING OF THE DISTRIBUTION AND MONITORING NEEDS OF THE CAROLINA NORTHERN FLYING SQUIRREL

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Changes in Carolina northern flying squirrel (*Glaucomys sabrinus coloratus*) survey approaches have altered our understanding of this endangered subspecies' distribution and habitat associations in North Carolina. Until recently, the flying squirrel was only known from nine Geographic Recovery Areas in the Southern Appalachians. In 2011-2012, acoustic surveys documented four previously unknown populations in North Carolina occurring in northern hardwood or mixed red spruce (*Picea rubens*)-northern hardwood forest above 1200 m. These new populations, combined with an analysis of mark-recapture data from nest boxes, have prompted questions about the best long-term approach for monitoring in the state. Our analysis of the mark-recapture data from nest boxes failed to generate population estimates because of low capture rates. However, subsequent analysis of the nest box data using occupancy models demonstrated that northern flying squirrel populations probably are stable in North Carolina. Predictive models based on nest box data undervalue the known importance of montane conifer communities, such as red spruce, to flying squirrels because of biases associated with box placement and failure to document foraging habitat. In contrast, acoustics have facilitated rapid surveys of both den and foraging sites, perhaps suggesting that this technique will be most valuable for long-term monitoring and creating better distribution models. Overall, long-term occupancy monitoring may entail a mixed method approach whereby acoustics would be used in recovery areas where nest boxes have failed to produce flying squirrels despite high quality habitat and in areas of newly discovered populations. Nest box networks will be retained in a few select focal areas to allow periodic documentation of persistence as measured by presence of females or juveniles, as well as provide individuals for more in-depth denning and foraging habitat studies.

EFFECTS OF INTERCROPPING SWITCHGRASS (*PANICUM VIRGATUM L.*) AND LOBLOLLY PINE (*PINUS TAEDA*) ON RODENT COMMUNITY STRUCTURE AND POPULATION DEMOGRAPHICS

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Rodents are important components of forest ecosystems. They disperse seeds and fungi, regulate invertebrate populations, and are prey for higher order consumers. Intercropping switchgrass (*Panicum virgatum* L.) in loblolly pine plantations (*Pinus taeda*) is a potential way to grow and harvest a biofuel feedstock without encumbering additional arable lands. In 2008, Catchlight Energy LLC (CLE), a Chevron/Weyerhaeuser Joint Venture was formed, in part, to assess large-scale viability of such a management system. Intercropping switchgrass changes the understory vegetation composition of pine forests, which could influence rodent community structure and population demographics. We tested the hypothesis that intercropping switchgrass in intensively managed pine plantations influences rodent

population demographics and community structure. We conducted seven intensive live-trapping sessions from 2 June - 27 July 2012 in Kemper County, Mississippi on 4 intensively managed pine plots (control) with trees planted in 2005 and 4 intensively managed pine plots with trees planted in 2005 and switchgrass planted between tree rows in 2009. We calculated community metrics including species richness and Simpson's Diversity Index. We estimated population abundances, survival, and recruitment for common species using Program MARK. We captured 374 individuals, including *Peromyscus leucopus, P. gossypinus, Oryzomys palustris*, *Reithrodontomys humulis*, and *Sigmodon hispidus* on both plot types. *Microtus pinetorum* was captured on one pine plot intercropped with switchgrass. Richness did not differ between plot types ($Z = 0.44$, $P = 0.37$), but pine plots intercropped with switchgrass had lower rodent community diversity than control pine plots ($Z = 2.03$, $P = 0.03$). Preliminary results suggest that abundances of *Sigmodon hispidus* were higher in pine plots intercropped with switchgrass, but there was no difference between abundances of other rodent species. Preliminary results also suggest that there was no difference in survival and recruitment among common species. Our findings show that intercropping switchgrass in managed pine plantations may have altered rodent community diversity in this study by altering evenness, and increasing abundance of *S. hispidus*, but not other species.

NETWORK STRUCTURE AND SOCIAL ASSORTMENT BY THE INDIANA BAT AT AN OHIO MATERNITY SITE

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In summer, female Indiana bats (*Myotis sodalis*) are known to form maternity colonies in one or more primary roost locations and use an array of other roosts in a hierarchical fashion. However, few data are available regarding individual social assortment and network structure of maternity colonies. We analyzed the social assortment and day-roost network structure of the Indiana bat at a known maternity colony in a highly agricultural landscape in central Ohio over two years. We found that the Indiana bat colony exhibited inconsistent social dynamics between years, showing strong fission-fusion characteristics in only one year. Between years, Indiana bat day-roost networks and network metrics changed substantially, possibly reflecting day-roost habitat induced changes in social dynamics. Because data on Indiana bat day-roost network structure are not available elsewhere, we compared these data to the social assortment and day-roost network structure of the conspecific northern bat (*Myotis septentrionalis*) from closed-canopy western mixed mesophytic forest in north-central Kentucky. Indiana bat and northern bat day-roost network characteristics differed drastically. Indiana bats exhibited a more concentrated use of individual day-roosts than northern bats and the extent of Indiana bat networks was much larger than that of northern bats. Unlike Indiana bats, northern bat networks varied little between years surveyed. The differences in Indiana bat social dynamics that we observed between years may be related to the ephemeral nature and micro-climatic specific requirements for their day-roosts. Understanding the network structure and social assortment of Indiana bats is essential for conservation and management of roosting habitat at the stand- and landscape-level.

EFFECTS OF AN ONGOING OAK SAVANNA RESTORATION ON SMALL MAMMALS IN SOUTHWEST MICHIGAN

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Oak savannas have declined drastically in the Midwestern United States since European settlement and fire suppression. Species that are closely linked to these habitats, such as the federally endangered Karner blue butterfly (*Lycaeides melissa samuelis*), help to promote and fund oak savanna restoration projects. However, it is essential that other species are monitored throughout restoration and the small mammal community, being important to the ecosystem, is particularly useful to study. The United States Forest Service is currently conducting an oak savanna restoration in the Manistee National Forest in Lower Michigan using thinning and burning. Our objective was to assess whether the small mammal community was impacted by the restoration methods that were implemented. We live trapped small mammals in each of the mechanically thinned plots (i.e., bulldozer, masticator, and shear cutter) and control plots in five blocks over four years (2008-2011). We compared small mammal diversity and relative abundance among treatments using one-way randomized block analysis of variance (ANOVA) tests. We also measured and analyzed vegetation variables over the four years using ANOVAs. Diversity significantly increased from 2008 to 2011 in all of the thinned and burned plots compared to the control plots (which were only burned). Two oak savanna species were captured in the site three years after the thinning and one year after the burn. We found canopy cover to be significantly lower in thinned than control plots and woody debris was significantly higher in thinned than control plots until after the prescribed burn. Current restoration efforts were beneficial to the small mammal community overall and promoted oak savanna species to immigrate into the restored area.

SUMMER ROOSTING ECOLOGY OF THE NORTHERN LONG-EARED BAT (*MYOTIS SEPTENTRIONALIS*) AT CATOOSA WMA

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Understanding the ecological requirements of a species is essential to developing conservation strategies. The Northern long-eared bat (*Myotis septentrionalis*) has been heavily affected by the fungal disease White-Nose Syndrome and thus has been proposed for listing under the Endangered Species Act. Our objective was to identify factors that affect roost selection of both male and female northern bats at different spatial scales. From May to August 2012 we mist-netted in three habitat types in Catoosa WMA, TN and caught 135 bats belonging to 5 species. Northern bat was the most frequently captured species in the area, followed by the Big brown bat (*Eptesicus fuscus*). We tracked 11 females and 10 males to 101 roost trees. We measured and identified each roost tree, sampled the surrounding habitat (1-ha plot) and compared these characteristics with those measured in randomly sampled habitat and suitable but unused trees. The tracked bats roosted in 14 different tree species: 82% hardwood, 18% pine; 57% dead, 43% alive. Roost tree and habitat characteristics were similar between males and females but females roosted in larger colonies ($p = 0.021$) and in stands with higher tree density ($p = 0.007$). On average, roost trees had a smaller dbh than unused trees. Most bats roosted in mature forest with a relatively high Shannon-Wiener diversity index but habitat characteristics were otherwise similar to those measured in random stands. The average minimum roosting area was 6.4 ± 2.0 ha and the mean 95% AKM home range was 20.8 ± 5.9 ha. In general, northern bats in Catoosa WMA appear relatively flexible in their habitat selection. Other noteworthy observations during our study included (1) northern and big brown bats roosting in the same maternity colony and (2) predation on a pregnant northern bat by a Gray rat snake (*Pantherophis spiloides*).

ASSESSING INTERSPECIFIC RELATIONSHIPS BETWEEN WHITE-TAILED DEER AND EASTERN WILD TURKEY IN WESTERN TENNESSEE

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White-tailed Deer (*Odocoileus virginianus*) and Eastern Wild Turkey (*Meleagris gallopavo*) make an interesting model for the study of interspecific association between two distantly related species. The study was conducted during 2011 and 2012 at the Meeman Biological Station, Milan Army Ammunition Plant, and Ames Plantation in western Tennessee. We used time-stamped remote photography with infrared-triggered cameras at bait stations to assess co-occurrence. Data were analyzed using Cole's coefficient of association and chi-square tests. Co-occurrence between the species was documented. Results are discussed in light of previous works relating to interspecific associations.

DIETARY NICHE OF *MYOTIS LEIBII* AND ITS ASSOCIATES INFERRED FROM FECAL CONTENTS AND STABLE ISOTOPE ANALYSIS

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Relatively little is known about the foraging habits of *Myotis leibii*. Furthermore, White Nose Syndrome (WNS) has changed structure of bat communities in eastern North America by decimating populations of formerly abundant species. It is unclear how such changes may influence dietary niche breadth of species that persist. We studied the diet of bats in a community in New Hampshire dominated by *M. leibii*, *M. lucifugus*, *M. septentrionalis* and *Eptesicus fuscus* from 2005-2011 in order to: 1) understand foraging by *M. leibii*, and 2) form predictions about how its foraging niche may change in the absence of its congeners. Diet was studied using visual identification of fecal contents (452 samples, across 4 species) and analyses of $\delta^{13}C$ and $\delta^{15}N$ in fur (62 samples, across 3 species). Volumetrically, diet of *M. leibii* (mean ± SE) was dominated by moths (53.5±3.9%), followed by beetles (17.9±2.8%), flies (15.2±2.9%) and a variety of minor constituents. Multivariate Analysis of Variance indicated $\delta^{13}C$ and $\delta^{15}N$ in *M. leibii* differed significantly from those of *E. fuscus* and *M. septentrionalis*. Similarity indices suggested diets of the 3 *Myotis* were more similar to each other than to the diet of *E. fuscus*. A Discriminant Function model classified *M. leibii* best based on the fact that it ate more moths than *M. lucifugus* and fewer unidentified arthropods than *M. septentrionalis*. Changes in the diet of *M. leibii* associated with the arrival of WNS generally were not detectable, except greater volumes of minor constituents were eaten after other *Myotis* had been largely removed from the community. Continued monitoring will be needed to verify whether this shift in diet was related to changes in composition of the bat community. Overall, our results agree with previous studies indicating *M. leibii* is flexible in its foraging habits.

VARIATION IN SURFACE LIPID CONTENT OF BATS

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The mammalian integument contains sebaceous glands that secrete an oily residue onto the surface known as sebum. Sebum production is part of the innate immune system and is protective against pathogenic

microbes. Abnormal sebum production and chemical composition is also a clinical sign of specific skin diseases. The lipid portion of sebum is a complex mixture of compounds and is species specific. Insights into the chemical composition of sebum among bats may provide clues into species specific differences in contracting/surviving the fungal disease White-Nose Syndrome (WNS). Intraspecific differences between infected and non-infected individuals may provide additional clinical signs for disease diagnosis. Broad lipid class of bat tissue was determined by thin-layer chromatography (TLC) and gas chromatography/mass spectrometry (GC/MS). Bat sebum is composed of sterols, free fatty acyls (FFAs), monoacylglycerides (MAGs), triacylglycerides (TAGs), wax/sterol esters, and squalene. Species differences of fatty acid methyl esters (FAMEs) were determined by GC/MS. Bat species that are not cave obligate hibernators show a trend towards higher total 16:0 acyl concentration as compared to cave-hibernating species. Preliminary studies of little brown bats by HPTLC and GC/MS profiling indicate WNS^+ bats may produce lower total lipid amounts than WNS^- bats. We have quantitatively determined broad class and molecular makeup of bat integumentary lipids. Our results indicate there are species differences in lipid profiles and lipid production may be a clinical sign of WNS. These studies also provide baseline information necessary for future work establishing response and metabolism of these compounds by *G. destructans* and possible disruption of fungal growth requirements.

TEMPERATURES UNDER LEAF LITTER DURING WINTER PRESCRIBED BURNS: CAN BATS SURVIVE UNDER LITTER?

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During colder periods of winter, red bats and Seminole bats roost in leaf litter on the forest floor, where temperatures may remain warmer and more stable than ambient temperatures. However, prescribed burns are often conducted during winter, and potential effects of burning on torpid bats in the litter need further investigation. Studies suggest red bats may arouse and exit roosts during prescribed burns, but the time necessary to arouse and escape is dependent on level of torpor, which may be dictated by their surrounding temperature. Consequently, we are studying survival probabilities for bats in litter roosts during winter based on temperatures recorded during prescribed burning. We placed temperature probes below leaf litter (and above the duff layer) and measured temperatures every 10 seconds during winter (1 November-15 March) prescribed burns. Based on preliminary data, maximum temperatures recorded under litter ranged from 155 to 1241°F. If bats cannot escape on-coming flames, initial data (only 14 burn plots under 2 prescribed burns) suggest that temperature profiles in 93% of sub-litter sites were likely fatal (greater than 145°F sustained over >60 seconds). Additional plots and prescribed burns will be sampled to fully evaluate potential temperature profiles.

IDENTIFICATION AND DELINEATION OF *MYOTIS SEPTENTRIONALIS* DAY-ROOST NETWORKS

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New insights on bat day-roosting dynamics relative to social assortment patterns and more importantly, the delineation of roost networks have potential implications for managing maternity habitat in forested landscapes. We identified day-roost networks of the northern bat (*Myotis septentrionalis*) at Fort Knox, Kentucky, using a simple movement based approach and described them using standard network measures (i.e. centralization, clustering and degree distribution). We assessed this approach by comparing network area utilization distribution spatial overlap and by examining patterns of movement of individual bats that were not assigned to a network. Additionally, we compared our movement based networks to networks assembled using an analysis of non-random social assorting group dynamics. We found that northern bat day-roost networks delineated using a movement-based approach exhibited clear activity centers and that bats not assigned to networks never crossed between core areas of separate networks. Furthermore, where present, spatial overlap of utilization distributions occurred only at the margin of the distribution, and patterns of use in areas of overlap were independent. Conversely, networks assembled using non-random social groups incorporated only a small number of tracked bats and their day-roosts and were of limited utility in delineating network areas. Additionally, the structure of our movement-based networks was scale-free, consistent with patterns reported elsewhere and with the fission-fusion dynamics of this bat species. Conservation implications will be discussed.

ENVIRONMENTAL INFLUENCES ON THE CALL STRUCTURE OF A SOCIAL SUBTERRANEAN RODENT, THE CORURO (*SPALACOPUS CYANUS*)

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Characteristics of acoustic signals can vary across geographical ranges and can be population-specific. An important question to ask is “What are the environmental sources of intraspecific variation in auditory signals?” Variation in frequency, intensity and duration of vocalizations may be imposed by site-specific environmental conditions. A comparative study was conducted on the acoustic variation in alarm calls of a social subterranean rodent endemic to Chile, the coruro *Spalacopus cyanus*, where body mass varied in two populations separated by geographic distance. The two sites were chosen along a gradient of elevation. Vocalizations of individuals from distinct colonies located in the central valley matorral (33°23’S, 70°31’W, altitude 495 m) and the Andean mountain wetlands (33°19’52.88”S, 70°17’12.38”W, altitude 2,722 m) were recorded. The variation in acoustic features of vocalizations was linked to body mass. Linear regression models predict the range in frequency (Hz) and intensity (dB) in which the alarm call trill of coruros will fall, irrespective of population location. Temporal variations in vocalizations within the geographic distribution of coruros were linked to influences of environmental characteristics such as vegetation growth within and between populations. Determining these and other sources of geographical variation in animal signals contributes to a greater understanding of the evolution of communication systems.

SPATIAL PATTERNS AND ROOST ASSOCIATIONS AMONG A BRIDGE-ROOSTING POPULATION OF *MYOTIS LEIBII*

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Little is known about roost selection in bats, especially in males, because of the inaccessibility of roosts and focus on reproductive females. Sex-specific differences in roost selection reflect differences in reproductive and thermoregulatory strategies as roosts are often chosen based on microclimate and intraspecific associations. We studied a population of mostly male *Myotis leibii* that roost in two bridges in the southern Appalachian Mountains. Our objectives were to (1) examine whether individuals chose roost locations within the bridges non-randomly and whether choices were associated with temperature, and (2) investigate whether individuals associated with one another and if they did, whether these

associations were random or non-random. We PIT tagged 44 bats, checked expansion joints for bats in both bridges, and simultaneously recorded air temperature from 17 May – 26 September 2012. From 22 June – 25 September 2012 we recorded temperature within a subset of the expansion joints as well. We recorded 842 “bat observations” and observed 53 instances of associations. Bats chose expansion joints non-randomly and tended to roost alone. We will use regression models to assess the effects of site-specific and temporal factors on the number of bats observed in each crevice each day. Males may prefer cooler roosts for energy conservation, but predation risk and distance to tree cover could also be important. Associations may be rare because expansion joints with optimal temperatures are common, or there may be no great advantage to associating if factors like predation risk are of little concern. These data may help managers understand the thermal and spatial requirements of *M. leibii* when creating artificial roosts, such as bridges.

STATUS OF LONG-TAILED SHREWS (GENUS SOREX) IN NORTH CAROLINA

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Eight taxa of long-tailed shrews (genus *Sorex*) currently are known from North Carolina. Prior to 1982, only seven taxa had been documented in North Carolina and many of these were represented by only a handful of specimens. For example, the American water shrew (*S. palustris*) was known on the basis of five specimens from one locality, the rock shrew (*S. dispar*) was known on the basis of five specimens from two counties (four sites), and the American pygmy shrew (*S. hoyi*) was known on the basis of four specimens from two counties (three sites). Each of these taxa has been listed at the state level until recently. In the last 30 years, pitfall trapping has demonstrated that these taxa are more widespread than previously believed. American water shrews are now represented by specimens from eight counties (35 sites), all south of the French Broad River. Rock shrews are now represented by specimens from 10 counties (34 sites), both north and south of the French Broad River. American pygmy shrews are now represented by specimens from 16 counties (60 sites), mostly from the western mountains but also including the Great Dismal Swamp in northeastern North Carolina. The Dismal Swamp southeastern shrew (*S. longirostris fisheri)*, once so poorly known that it was listed federally as Threatened, is now known to be so widespread in eastern North Carolina that it has been removed from the Endangered Species list. Disjunct populations of the smoky shrew (*S. fumeus*) have been discovered east of the Blue Ridge Escarpment, and an undescribed taxon of long-tailed shrew has been discovered in two counties (four sites) in eastern North Carolina.

EVALUATING THE EFFECTIVENESS OF THREE ACOUSTIC MONITORING TECHNIQUES FOR LANDSCAPE LEVEL BAT POPULATION MONITORING

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Understanding population trends of any species is essential for conservation and management. However, population status of many bat species at a landscape level is poorly understood due to the difficulty sampling these species. In an effort to resolve this issue, especially with emerging threats (e.g. White-nose Syndrome and wind energy) a national mobile acoustic monitoring protocol was developed to survey summer bat populations. We compared species richness and abundance along car and boat mobile acoustic transects to identify the most efficient method. We further compared species richness to stationary acoustic detectors placed along the route to better understand the capabilities of mobile acoustic transects compared to traditional survey methods. Using sample-based rarefaction, there was no difference at the 95% confidence level in species richness (species/individual), density (species/sample), or diversity (Shannon-Weaver and Simpson's indices) between transect methods. However, car transects tended to show slightly higher measures. While over 1.5 as many calls were recorded and identified along boat transects, there were no clear advantages to boat transects (except for sampling *Myotis grisescens*). Additionally, car transects were less variable and least time consuming, leading us to conclude that car transects are the most efficient mobile acoustic method to monitor species. However, only two species (*Perimyotis subflavus* and *Lasiurus borealis*) were likely in sufficiently high abundance using either method to allow detection of small trends. Nonetheless, mobile acoustic transects offer the only measure of summer abundance and car transects likely provide opportunity to monitor 2-4 species in the eastern United States.

SPECIES COMPOSITION OF BATS (CHIROPTERA) ALONG LAKESHORE HABITATS IN WESTERN SOUTH CAROLINA

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The management of bat communities can be a difficult task as the relationships between bats and the limiting factors that affect their distributions are poorly understood. Environmental factors, habitat complexity, and prey base are three factors that influence bat community composition. However, it is not understood how these factors interact with each other to determine individual species distributions. The goal of this study was to identify factors that predict the presence of bat species along lakeshore habitats of Lake Keowee and Lake Jocassee in western South Carolina. Thirty-two sites were sampled during 3 survey periods (April, July, October), each lasting 6 days and centered on the new moon. Twelve sites were surveyed actively using SonoBat software and 20 were surveyed passively using AnaBat software. Species composition was determined at each site during each survey period. Nine species were recorded during the 3 survey periods. Tricolored bats (32 sites), eastern red bats (31), big brown bats (30), hoary bats (30), and silver-haired bats (28) were widespread. The small-footed myotis (10) and Rafinesque's big-eared bat (3) were recorded only in the upper reaches of Lake Jocassee and Eastatoe Creek, which drains into Lake Keowee, survey sites that are steeply sloped and dominated by mesic hemlock/hardwood forests. The little brown myotis (8) was recorded at many of these same sites, but also in less rugged upper Piedmont marshes. The evening bat (9) was recorded in April and July, but not October. Species presence data will be correlated with habitat variables, climate variables, and land-use categories through the use of multivariate analyses to determine which variables predict the presence of a particular species.

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POSTER PRESENTATION ABSTRACTS

IN ALPHABETICAL ORDER BY FIRST AUTHOR

CONSERVATION APPROACH FOR RAPIDLY DECLINING SPECIES

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Across the Eastern states, the USDA Forest Service actively manages large, contiguous blocks of forest land and protects thousands of caves and mines. Such places represent important summer and winter habitat for bats, including those affected by White-nose Syndrome (WNS). Managers are now faced with how to address rapidly declining bat populations during project planning and implementation on the Eastern national forests. These population declines are not due to habitat management, but to WNS - a factor outside the agency's control. The Forest Service is undertaking a multi-step conservation approach to address declining bat populations. The end result will be a Conservation Strategy which will outline beneficial management actions for bats on National Forest System lands and identify protective measures designed to avoid additive effects to populations already impacted by WNS. The Conservation Strategy will include: a) the addition of WNS-affected bat species with significant population declines to the Regional Forester Sensitive Species list, b) an assembly of existing and recommended bat conservation measures, c) a compilation of the best available science for use in species conservation assessments and viability evaluations, and d) range-wide trend analyses of WNS-affected populations. The Conservation Strategy is a tool that can be used to develop Conservation Agreements with the U.S. Fish and Wildlife Service or other partners. The Forest Service team is actively seeking feedback on this approach.

ALTERNATIVE ARTIFICIAL ROOST OPTIONS

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Four free-standing artificial bat roost designs were constructed in northern Missouri. Design one, designated as a bat mansion, consisted of a modified commercially available carport that was fully enclosed and had untreated oak slats inside, mimicking that of a typical attic or barn. Design two, called a rocket box, was composed of large, cylindrical PVC pipe with oak slats inserted in an alternate layering pattern. Designs three and four, the metal wrap and artificial bark wrap, respectively, were structurally similar. Both consisted of a repurposed telephone pole that was "wrapped" in oak slats positioned in an alternate layering manner. Based on acoustic surveys adjacent to the artificial roosts, big brown bats (*Eptesicus fuscus*), Indiana bats (*Myotis sodalis*), little brown bats (*Myotis lucifugus*) and the Northern bats (*Myotis septentrionalis*) are present in the area from spring to late summer. Each of these species have been documented using other manmade structures during this period. All designs were constructed and placed on site during spring and summer of 2012. Thus far, no occupancy has been recorded, but

monitoring will continue. Land development reduces habitat that could negatively impact the foraging and roosting activities of the Indiana bat and other *Myotis* (Sparks, Ritzi, Duchamp, Whitaker, Jr. 2005). Artificial roosts should not be used to replace natural habitat, but should be considered if disturbance has altered or reduced the presence of natural roosts. Artificial roosts should also be considered if the adjacent, but not yet suitable, forests are being preserved and/or managed for this purpose. Hence, the need for further study in the effectiveness of artificial roost designs.

THE INFLUENCE OF PRECIPITATION AND TEMPERATURE ON THE REPRODUCTIVE TIMING OF MISSOURI BATS

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Understanding the influence of climate on reproductive events is critical for documenting population demographics and developing appropriate management strategies, because climate may vary significantly even within regions of a state resulting in intraspecific variation of reproductive timing. The timing of birth varies with latitude in several species of bats, and this effect may be due to variations in the ambient temperature and precipitation (affecting the available insect prey density). I examined which major stimulus, precipitation or temperature, is preferentially used by bats to optimize reproductive timing. Capture data from 6,668 bats representing 10 species from 24 counties and 571 sites, from April through October, were used to examine the influence of precipitation, temperature, and latitude on the annual reproductive timing of bats in Missouri. We found precipitation had the greatest effect on the timing of reproduction. Large precipitation events during the spring resulted in delayed onset of each reproductive condition (pregnant, lactating, post-lactating and volant juveniles). Differences in reproductive timing between northern and southern Missouri were not significant, although a visual trend indicated delayed reproduction following heavy precipitation events in southern Missouri, despite the cooler temperatures of northern Missouri.

HOW DOES *GEOMYCES DESTRUCTANS* INFECT BATS?

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Geomyces destructans is a psychrophilic fungus that causes cutaneous infections in cave dwelling bats and high mortality in North American populations. *G. pannorum* is a closely related psychrotolerant species that is a rare pathogen of humans. Cold tolerant organisms can adjust lipogenic activity to lower membrane viscosity and thus survive rugged habitats by increasing lipid unsaturation, decreasing triacylglyceride (TAG) synthesis, and producing shorter carbon acyls. Lipid profiles may partially explain fungal ecological niche and *G. destructans* pathogenicity to bats. Additionally, profiles are species specific and may be utilized to differentiate closely related species and detect disease. In this study, we incubated *Geomyces* at 5°, 8°, 15°, and 22° C. Broad lipid classes of *Geomyces* were determined to be primarily sterols, free fatty acyls (FFAs), and triacylglycerides (TAGs) with minor amounts of mono-/diacylglycerides and sterol esters. TAG molecular species were determined by matrix-assisted laser desorption-ionization time-of-flight mass spectrometry. Total acyl unsaturation was determined with gas chromatography/mass spectrometry. *G. destructans* produced higher proportions of unsaturated 18 C acyls and TAGs than *G. pannorum*. *Geomyces* produced more 18:3 acyl and TAGs at five degrees than at higher temperatures; however, *G. destructans* made higher proportions of FFAs to TAGs at higher temperatures. These results indicate *Geomyces* alter lipogenic activity to survive cold temperatures by increasing lipid unsaturation. *G. destructans* may not produce increased TAGs at higher

temperatures leading to FFAs reaching toxic levels and prohibiting growth. Future studies should focus on temperature optima of enzymes involved in TAG synthesis and disruption of lipogenic metabolic processes. Lipid profiles among multiple *Geomyces* species should be further investigated as a method of disease detection.

MALE BIG BROWN BAT (*EPTESICUS FUSCUS*) ASSOCIATION PATTERNS ARE INFLUENCED BY ULTRASONIC VOCALIZATIONS OF FEMALES

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It generally is accepted that bats emit ultrasonic vocalizations that function for echolocation purposes as well as for communication. I determined whether male or female big brown bats (*Eptesicus fuscus*) responded to variation in ultrasonic vocalizations of the opposite sex in a manner that would suggest that vocalizations are used in a mating context. I presented 31 female and 10 male big brown bats with ultrasonic playbacks of differentially mating (i.e., high frequency copulators = HM vs. low-frequency copulators = LM) individuals of the opposite sex. I measured 1) which side of the arena each subject selected first (HM vs. LM), and 2) duration spent (seconds) on each side of the arena (HM vs. LM). For both of these measures (i.e., first choice and duration) male subjects were more likely to select the ultrasonic vocalization of HM females, but the same respective tests determined that female subjects did not select ultrasonic vocalizations of frequently copulating males over vocalizations of infrequently copulating males. My results support the possibility that ultrasonic vocalizations of big brown bats function for communication during the mating season, and may be a precopulatory mechanism of mate selection.

ROOSTING ECOLOGY OF EASTERN RED BATS IN WEST-CENTRAL VIRGINIA

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The eastern red bat (*Lasiurus borealis*) is one of the most common species of bats in eastern North America but is experiencing population declines little is known of their roosting ecology. This lack of knowledge may hinder implementation of conservation measures. We captured 4 adult male red bats in the Blue Ridge Mountains of Virginia in June of 2012. Transmitters were placed on four bats and we successfully tracked two bats to their roosts. Diameter of roost trees and trees in the surrounding area were measured using a diameter tape and height was estimated using a laser range-finding hypsometer. Bats were located an average of 4.5 days, where they roosted in white oaks (*Quercus alba*) and suckers of American chestnuts (*Castanea dentata*) 4.1 to 10.7 meters from the ground. Roost trees displayed large variation in diameter and height. Neighboring trees displayed large variation in diameter and height when compared to roost trees. Bats usually did not use roosts longer than one day. Roosts were $\geq$ 2.75 km from capture sites, which was greater than distance reported in previous studies. Our data concur with other research, indicating that red bats have flexible roosting habits.

SINGLE UNIT TURBINES AND EFFECTS TO BAT POPULATIONS

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Northern Arkansas is home to 15 species of bats. This includes three endangered species (i.e. Gray myotis, Indiana myotis, and Ozark big-eared bat) and three species listed as special concern in Arkansas

(i.e. Eastern small footed bat, Rafinesque's big-eared bat, and Southeastern bat). Necessary investigation into possible causes of bat fatalities in Arkansas is vital due to the spread of White Nose Syndrome and concerns of declining populations due to fatalities at commercial wind farms. In lower wind producing regions (Arkansas ≤ Class 4 wind speed), single unit turbines are preferred over large acreage wind farms. These units have not been investigated as a possible cause of bat fatalities. Beginning in 2012, we surveyed six wind turbines in two different Arkansas regions (karst vs. delta) using Anabat SD2, carcass searches, mist netting activity, and visual observation. Anabats were placed on or close to the turbines to determine bat presence within the vicinity of the turbine. Carcass searches were performed at a 20 meter^2 area beneath the turbine and mist netting/visual observations were performed ≤ 1.6 kilometers of all turbines. Survey methods detected bat presence in all turbine vicinities. One turbine (delta region) is likely responsible for bat fatalities. During the investigation, 11 Eastern red bats and one tricolored bat were found dead ≤ 12 meters from the turbine base. Future investigation will use infrared lights and night vision at this turbine in order to further elucidate mechanism of bat mortality at this turbine.

ROOST TREE SELECTION OF NORTHERN MYOTIS (*MYOTIS SEPTENTRIONALIS*) IN A CENTRAL APPALACHIAN HARDWOOD FOREST

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As habitat degradation along with disease continues to negatively impact bat populations in hardwood forests, land management agencies can contribute to the conservation and possible recovery of myotis species through habitat creation by means of prescribed fire and herbicide. Within the Fernow Experimental Forest in West Virginia, three separate compartments were subjected to burning to better understand the effects of disturbance. Within each compartment, random plots were treated with herbicide along with fire to expedite tree decay. During the summer of 2011 and 2012, 38 northern myotis roost trees were located in treatment areas and non-treatment areas. Measurements were taken on three spatial scales: individual roost tree, surrounding trees in the stand, and the area outside of the immediate stand. Female and male northern myotis were captured during a total of 11 capture nights, attached with radio transmitters and located during daylight hours using radio telemetry. Both female and male northern myotis were found in areas of treatment and non-treatment. Females selected roost trees slightly larger in size and with less bark remaining than males. Female roost trees were also slightly further from surrounding trees than male roost trees. Females were 6 times more likely to roost in areas of disturbance than males. Slope at roost locations was significant in model selection, as well as the percent canopy gap in the direction north of roost trees. Black locusts, red maple, and red oak were selected by both female and male bats more than other tree species. Snags were used by the majority of female bats, in both treatment and non-treatment areas. As the burn compartments within the FEF continue to decay and regeneration is allowed to progress, the effect of disturbance on roost selection can be better quantified and allow forest managers to develop models for predicting roost tree characteristics on a local and landscape scale.

SEARCHING FOR BEETLES (COLEOPTERA: SCARABAEIDAE AND HISTERIDAE) ASSOCIATED WITH THE DUNG OF NATIVE ARKANSAS MAMMALS

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Beetles are important ecological components of natural ecosystems. One primary function is the fragmentation and recycling of animal dung. Two of the families of beetles associated with dung are Scarabaeidae and Histeridae. Scarab beetles fragment and bury excrement, while Histerid beetles prey on organisms living within these habitats (*i.e.*, dung). Little is known about the ecological impact of beetles associated with the dung of mammals native to Arkansas. Thus, we surveyed the dung of native mammals within Arkansas to determine the species and distributional patterns associated with dung. We opportunistically searched and collected beetles *in situ* from the dung or nests of native mammalian species within Arkansas. We also set simple pitfall traps using dung of various Arkansas mammals as bait. Preliminary results of our survey are presented.

INFLUENCE OF INTERCROPPING SWITCHGRASS IN INTENSIVELY MANAGED PINE FORESTS ON ULTRASOUND PRODUCED BY BATS AND RODENTS

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Muroid rodents produce ultrasonic vocalizations (USVs) for intraspecific communication which is an important component of their behavioral repertoire. Physical properties of sound such as spreading loss, acoustic impedance, absorption, and scattering can impact sound propagation. Further, vegetation type and density may impact how animal sounds propagate, especially high frequency sounds like USVs. Intensively managed pine forests provide habitat for a diversity of wildlife species, including muroid rodents and bats. In Kemper Co, MS, Catchlight Energy LLC, a Chevron | Weyerhaeuser joint venture, is investigating intercropping switchgrass between rows of intensively managed loblolly pine (*Pinus taeda*) plantations for biofuel production. Planting switchgrass changes understory composition of managed pine forests and may impact how USVs propagate. Therefore, we quantified density of understory vegetation and distance (m) pure tone and animal (bat and rodent) produced ultrasound sound travels in an intensively managed pine forest, a pine stand intercropped with switchgrass, and a gravel road adjacent to treatment stands for a “no vegetation” control. Pure tone, rodent, and bat ultrasound was broadcasted at 20kHz, 30kHz, 40kHz, and 60kHz at 80dB sound pressure level (SPL) and 90dB SPL. Vegetation density differed among treatments and was highest in pine stands intercropped with switchgrass. Across all sound types, sound pressure levels, and frequencies, sound attenuated least in the no vegetation control treatment and most in pine stands intercropped with switchgrass. Sound attenuation was intermediate in intensively managed pine forests. These results correspond with observed differences in vegetation density in our treatments. Future work will determine if bats and rodents in intercropped plots modify their vocalization in response to increased attenuation.

ELEVATION AND FEMALE BAT FORAGING DISTRIBUTION IN A LOW MOUNTAINOUS REGION

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Reproductive female bats have high energy demands during the gestation and lactation periods. This constrains them to forage in habitats characterized with stable temperature and high prey density; typically, valleys associated with waterways. A previous study has reported a decrease in the proportion of female captured along an elevation gradient. However, this study was limited to unmarked individuals captured after July 1, at high elevations (>1030m). Here, we aim to determine the influence of relative (valley vs. mountaintop) and absolute elevation on sex-specific foraging distribution of bats, during two periods of different energy needs (pre- vs. post-fledging), in an area of low mountains. Specifically, logistic regression analyses will be conducted on sex ratio using 720 adults of four species *(Lasiurus borealis, Nycticeus humeralis, Eptesicus fuscus, Myotis septentrionalis*) captured and marked at 114 sites in the Ozark-St. Francis National Forest (Arkansas), during the May-August 2012 Indiana Bat compliance survey. We hypothesize that females forage more in valleys than mountaintops regardless of the elevation, and less so after weaning. We thus predict a lower sex ratio in valleys/low elevations and before fledging. Implications, assumptions and limitations will be discussed.

GRAY BAT WINTER ACTIVTY (*MYOTIS GRISESCENS*), ARE THEY DIFFERENT?

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Nine species are documented to be affected by white-nose syndrome (WNS) including the endangered gray bat (*M. grisescens*). The first records of suspect cases of WNS in gray bats occurred in the spring of 2010 and the first confirmed case of WNS was recorded in May of 2012. To date, mortality of gray bats, due to WNS, has not been documented. Over the last 2 winters we acoustically monitored bat activity, both at the cave entrance and at nearby foraging areas at 3 hibernacula in Missouri—1 was a major gray bat hibernaculum in Shannon County. Acoustic data over the last 2 winters suggests higher gray bat winter activity relative to other *Myotis* species. At the entrance of the major gray bat hibernaculum, bats were recorded during all winter months and total winter bat passes exceeded 50,000 passes/winter. Acoustic data collected at foraging areas near 2 other caves in Washington and Shannon counties indicated a higher proportion of gray bat activity relative to the proportions of gray bats represented within the hibernacula. Monitoring at these sites has continued during the winter of 2012-13 and a second major gray bat hibernaculum was added in Laclede County, and winter captures are being conducted. Preliminary capture data from the 2 gray bat hibernacula indicate that gray bats are active during the first third of winter and feed when conditions are appropriate. Between December 1 2012 and January 31 2013 we captured a total of 172 bats of 4 species. *M. grisescens* represent 124 of these captures. We captured gray bats routinely at temperatures < 7º C and a single gray bat at -1.5º C.

EFFECTIVENESS OF ACOUSTIC LURES FOR INCREASING INDIANA BAT (*MYOTIS SODALIS*) CAPTURES AT MIST-NET SITES

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Certain bat species may be more adept at avoiding capture in mist-nets. In particular, some studies have shown that the Indiana bat may be more difficult to capture using mist-netting methods. This has also been noted for Myotine bats in Britain. In areas where Bechstein's bat (*Myotis bechsteinii*) is known to occur in large numbers, they are rarely captured in mist-nets. By playing back ultrasonic social calls of conspecifics, researchers there were able to increase the number of mist-net captures of this species. Our study tested the effectiveness of using similar acoustic lures to increase the capture success of Indiana bats using three types of pre-recorded, echolocation calls. We conducted our study during May and June of 2012. At each test site two, 6 meter long mist-nets were set in atypical fashion (parallel to corridors, in open fields, etc.) in an effort to decrease incidental captures. A Binary Acoustic Technology AT100 transmitter was placed in the center of each net at a height of 1 meter. The GTools software was used to play back echolocation calls during 10 minute play back trials. Silent-control trials were used between each play back to compare lure success. Trials were also recorded with a digital video camera and bat activity was monitored acoustically using AnaBat SD1 bat detectors. Our study resulted in only 13 bat captures including only one Indiana bat. However of those 13 captures, 11 occurred during a playback treatment. Video analysis showed that bats were attracted to the acoustic lure and capture rates could be increased by orienting mist-nets in a more traditional configuration.

DISCOVERY OF WHITE-NOSE SYNDROME ON BATS IN ALABAMA

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The Alabama Bat Working Group (ABWG) has been conducting a statewide survey of priority gray bat (*Myotis grisescens*) caves in the state for 3 winters in expectation of the arrival of the fatal bat disease: White-nose syndrome (WNS) (*Geomyces destructans*). As part of this larger effort, I conducted a survey for WNS in the Russell Cave National Monument, located in Jackson County AL, in early March 2012 assisted by two National Park staff members. After surveying a number of smaller entrances, we entered the main cave and counted nearly 500 tri-colored bats (*Perimyotis subflavus*) and one N. Long-eared bat (*Myotis septentrionalis*) without WNS symptoms. We were within an hour of exiting a cave entrance on private land when the first suspicious bat (a tri-colored bat) was detected hanging on the cave ceiling at head height along our route. Its nose was covered with a white fungus. As we approached the private cave entrance, we tallied 35 tri-colored bats that clearly had the same white fungus. At least that many more appeared to have WNS, but were higher up and/or harder to see. Approximately 10% of the 700 bats observed in the cave appeared affected by WNS. Oddly, no dead bats were found clinging to the cave ceiling or on the floor. Two tricolored bats with heavy WNS symptoms were euthanized with cervical dislocation during this trip and a wildlife disease lab later confirmed the *G.d.* fungus in Alabama. WNS surveys by the ABWG will continue this winter to monitor the spread in Alabama.

MONITORING CAVE BATS AT MAMMOTH CAVE NATIONAL PARK

S.C. Thomas. *National Park Service, Cumberland Piedmont Network, Mammoth Cave, KY 42259*

Cave-roosting bats are important to the nutrient-poor cave ecosystem because they import organic material which supports a specialized cave invertebrate community. Nine of thirteen bat species found at Mammoth Cave National Park are generally associated with caves at some time of the year. Two of the species that inhabit park caves are on the Federal Endangered Species List: gray bat (*Myotis grisescens*) and Indiana bat (*M. sodalis*). Regular population monitoring of hibernating endangered bats has occurred in a few park caves since the early 1980s. Since the early 2000s, cave bat monitoring on the park has expanded to include additional caves, species, seasons, and methods. On-park bat population trends are declining for some species, increasing for others, and stable for additional species. The need to regularly obtain reliable information on cave bat populations is underscored, since white-nose syndrome potentially threatens all of the cave-using species in the park.

INVENTORY OF TERRESTRIAL WILD MAMMALS AT MAMMOTH CAVE NATIONAL PARK: 2005-2010

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An inventory aimed at documenting the occurrence of at least 90% of the terrestrial wild mammal species potentially present on Mammoth Cave National Park took place from 2005 to 2010. Documentation of mammal occurrence was accomplished via visual encounters and trapping. Visual encounters included methods like sighting individuals, conducting spotlight surveys by boat, locating mammal sign, hearing mammal calls, and finding dead individuals. A variety of trapping methods were used, including remote "trail" cameras, live traps, pitfall traps, drift fence-pitfall arrays, and several other opportunistic capture methods. 663 mammal records were documented by visual encounter or some trapping method representing six orders, 13 families, and 32 species. Of the 37 species potentially present in 2005, 32 species (87%) were confirmed present in 2010. Total trapping effort (# of trap-nights) was 118,567. A total of 163 specimens was collected as vouchers. No federally listed species of terrestrial wild mammals were documented.

INDIANA BAT SUMMER HABITAT: SUGGESTIONS TO IMPROVE THE CURRENT ASSESSMENT STANDARDS

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Alterations to the current and newly proposed U. S. Fish and Wildlife Service habitat suitability survey are suggested here in order to improve the standards to better identify *Myotis sodalis* habitat in Missouri and the surrounding region. They are not meant to be, nor should they be, considered for range-wide estimates of suitability. The suitability of summer habitat should not be assessed until suitable summer habitat is present. During this survey each of the forest blocks identified received a sampling intensity of 10%, which required one 1/10th acre sample plot (37.2 radial feet) for each forested acre. A score on this scale can range from 0-10, 0 representing no suitable Indiana bat habitat and 10 representing excellent habitat. Characteristics include 1) understory clutter, 2) number of trees/acre >15 in dbh, 3) percent of dominant trees that are preferred tree species, 4) number of snags, and 5) overall stem density stems/acre. Each of these characteristics is assigned a score 0-2 based on data gathered at sample plots and summed to provide a 0-10 habitat score. An additional 10 points are based on landscape characteristics. These include the presence of a known Indiana bat maternity roost (primary or secondary) within 5 miles (+6), or the presence of a maternity colony within the same county, or an adjacent one (+4), the capture of pregnant or lactating females within 25 miles (+2), forest cover within 5 miles between 20% and 60% (+2), and water resource characteristics with forest edge border within 2.5 miles (+2).

PREDATION OF NATIVE FRESHWATER MUSSELS BY MUSKRATS IN SHOAL CREEK, ALABAMA

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North America has the highest diversity of freshwater mussels in the world, but approximately 70% of these species are extinct or imperiled. Habitat degradation and fragmentation have made many freshwater mussel populations more susceptible to stochastic events such as intense localized predation. Muskrats (*Ondatra zibethicus*), in particular, are known to be voracious predators of freshwater mussels. We investigated the scale of muskrat predation on freshwater mussels at Shoal Creek, Alabama. At least 7 species of freshwater mussels are endemic to Shoal Creek including two federally endangered species

(*Pleurobema georgianum* and *Hamiota altilis*). We visually surveyed the water and banks of a 7 km stretch of Shoal Creek for mussel shell middens containing remnants of muskrat predation. Within each identified midden we categorized shells into native and non-native (*Corbicula fluminea)* species groups. We recorded the number of whole shells and half shells, determined the species of each shell, and measured shell length. A total of 1,455.5 shells were collected of which an average of 13% shells per midden were native species and 87% per midden were non-native *C. fluminea*. The endangered *P. georgianum* and *H. altilis* accounted for over 20% of predated native mussel shells in middens. *S. connasaugaensis* was the most commonly predated native species representing over 75% of native shells in middens. Our results suggest that muskrats are consuming relatively few native species compared to non-native species. However, the biomass of native species consumed by muskrat is disproportionally greater than expected due to their larger body size.

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