

Abstracts of Presentations at the 2017 (127th) Annual Meeting of the Tennessee Academy of Science

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Oral Presentations

Agriculture

Section Chairs: Joey E. Mehlhorn and Tony Johnston

Bioenergy Crop Production: Investigating various plant characteristics of winter canola varieties in response to different rates of nitrogen fertilizer. **Priya Saini*** and **Jason P. de Koff**, Tennessee State University, Nashville, Tennessee. The unstable cost of petroleum fuel and its effect on climate change have increased interest in biofuels. Canola (*Brassica napus* L.) is gaining popularity not only for food (canola oil) and feed (canola meal), but the lower cloud point of canola oil, also makes canola an ideal source of biodiesel. With the winter hardy cultivars providing 30-40% higher yields over spring cultivars, there is an increased interest in winter canola production. Winter canola creates diversity, crop rotation alternatives and can break weed and pest cycles. This research focused on identifying the response of different rates of nitrogen fertilizer on various plant characteristics of three winter canola varieties. The effects of these treatments on several plant variables will be discussed.

Effect of fungicides and biorational products on *Rhizoctonia* root rot of viburnum. **Md Niamul Kabir***, **Terri Simmons**, and **Fulya Baysal-Gurel**, Tennessee State University, Nashville, Tennessee. *Rhizoctonia* root rot is one of the destructive diseases which affects a wide range of nursery-grown woody ornamentals. In this study the efficacy of biorational products and fungicides against *Rhizoctonia* root rot of viburnum were assessed in greenhouse and field experiments. Field plots and pots were inoculated with *Rhizoctonia solani* agar slurry. Treatments used in both experiments were RootShield PLUS, MBI110, IT-5103, TerraClean 5.0+TerraGrow, Empress, SoilGard, Mural and Paegant. All of the treatments reduced *Rhizoctonia* root rot disease severity compared to the inoculated, non-treated control in field experiments. The treatments most effective in reducing *Rhizoctonia* root rot severity were Mural, Empress, Paegant, TerraClean 5.0+TerraGrow and IT-5103 in greenhouse experiments. Both fungicides and biorational products

should be considered to improve viburnum root health in *Rhizoctonia* prone soils.

Effects of post-weaning mat-feeding frequency on piglet health and performance. **Margaret A. Nagai*** and **Emalee K. Buttrey**, The University of Tennessee at Martin, Martin, Tennessee. The effects of daily frequency of mat-feeding on post-weaning piglet performance and health were evaluated. Piglets (n=1,737; BW=6.5 kg \pm 0.14, $P=0.81$) were assigned to one of four treatment groups based on frequency of daily mat feeding (0, 1, 2, or 3 times per day for 7 days post-weaning; CON, MAT1, MAT2, and MAT3, respectively). Piglets in MAT1, MAT2, and MAT3 groups were offered 3.2 kg of pre-starter feed daily and CON received no prestarter feed. Performance and health data were collected over a 6-week period. In the first week, CON consumed less feed than all other treatments ($P = 0.001$). Performance was not affected by frequency of mat-feeding ($P > 0.06$). In the current study, mat-feeding did not improve piglet performance and health.

Instrumental texture profile analysis of cooked organic sweet potatoes as affected by different processing methods. **Sochinwechi Nwosisi***, **Ramasamy Ravi**, and **Dilip Nandwani**, Tennessee State University, Nashville, Tennessee. Different processing methods would impact sweet potato textures distinctly, thus understanding the influence of thermal treatments on the textural characteristics of sweet potatoes is needed. Six sweet potato varieties (All purple, Beauregard, Burgundy, Carolina Ruby, Ginseng and Golden Nugget) from the organic farm were subjected to baking, pressure cooking and open cooking. Textural parameters were recorded with a texture analyzer. Objectives were to evaluate the impact of thermal processing on textural properties of sweet potatoes and to generate the texture profile analysis of cooked sweet potatoes. Cohesiveness, gumminess and chewiness were highest in baked treatments. Hardness and resilience was highest in open cooked treatments. Hardness, gumminess, chewiness and resilience reduced with pressure

cooking. Based these results desirable sensory properties can be optimized to maximize consumer acceptance.

Horticulture as Therapy in Tennessee: Thirty-three Years and Growing. **Douglas Airhart**, *Tennessee Technological University, Cookeville, Tennessee*. Horticulture has become recognized as an effective individual treatment modality for persons of all ages and within a wide range of mental and physical disabilities, recovery programs, hospitals, long- and short-term residential facilities and prisons. This presentation will describe the basic requirements of horticultural therapy programming, summarize its development nationally, and review the growth and breadth of programming in Tennessee over the past three decades. Recent and current programming efforts will be included. When applied properly, horticultural therapy programming and activities can improve human well-being.

Gossypol profile's based selection of cotton lines for transcriptional analyses. **Aron Felts***, **Deependra Bhatta***, **Sarabjit Bhatti**, and **Ahmad Aziz**, *Tennessee State University, Nashville, Tennessee*. Lint is the most valuable product from cotton (*Gossypium spp.*); also cottonseed oil is an important source for vegetable oil. This study was conducted to evaluate the gossypol profile of selected cotton varieties. Two cotton parental lines TM-1 (*G. hirsutum*) and 3-79 (*G. barbadense*) along with 17 chromosomal substitution progenies (containing substituted chromosomes from *G. barbadense*) were used. To determine which cotton lines contain optimal nutritional traits, the gossypol enantiomers were quantified using high performance liquid chromatography. Transcription derived fragments analyses of both parents along with CS-B17 line were conducted on seeds. Due to high levels of polysaccharides a special protocol was devised for RNA extraction. The TDF profiles through differential expression analysis also revealed similarities between 3-79 and CS-B17.

Promoting veterinary careers to high school students through hands-on experiences. **Clint Ary and Jason Roberts**, *The University of Tennessee at Martin, Martin, Tennessee*. The veterinary profession continues to maintain a strong demand among high school students. However, many students are unfamiliar with the requirements for the job or the skills they will be expected to develop while completing veterinary school. High school students have been participating in a four-week campus experience that covers aspects of the veterinary profession. Students were surveyed regarding their experiences and perceptions. Students stated that the experience helped them to better understand the requirements of the career. Hands-on instruction was rated high (4.9/5.0) and field trips seemed to be the most impactful experience. The experience solidified many students' decision to pursue veterinary science in the future. The ability to identify careers early is very important for students choosing competitive careers such as the veterinary profession.

Effects of winter wheat grazing on subsequent crop yield. **Jordan M. Curtis*** and **Emalee K. Buttrey**, *The University of Tennessee at Martin, Martin, Tennessee*. Wheat pasture is an exceptionally high-quality forage that has the potential to support stocker cattle grazing from late fall through late winter. However, in northwest Tennessee, wheat (or another small grain) is often grown as a cover crop or strictly for grain production. There is potential for northwest Tennessee farmers and cattle producers to generate additional income from their wheat crop through cattle weight gains, however many are reluctant to try this practice due to concern about decreased grain yields as a result of grazing cattle. Crossbred steers ($n = 20$; BW = 292 kg) grazed 4 plots of wheat forage for 67 d. Four additional plots were not grazed. Steers gained 1.06 kg/d. Grain yield was not affected by grazing ($P = 0.09$).

Benefits of shelter animal use in veterinary health technology program. **Danny Walker***, **Sarah Anderson**, and **Amanda Waldon**, *The University of Tennessee at Martin, Martin, Tennessee*. Humane societies across the U.S. search for opportunities to make animals more adoptable and fit for homes. Carroll County Humane Society teamed with the Veterinary Health Technology program at The University of Tennessee at Martin to assure their animals are fit for adoption. Over the past five years, approximately 600 dogs and cats came to UTM to prepare for adoption via sterilization, vaccination, bathing, etc. This not only assures future owners they are adopting healthy animals, but also allows the veterinary technology students to learn through hands-on experiences. By performing standard clinic procedures like vaccination, fecal tests, and surgery assistance, veterinary health technology students are better prepared to attain their degree. Overall, the use of shelter animals in the program helps the students, community, and animals.

Utilizing virtual reality in a teaching methods course: Initial student perceptions. **OP McCubbins and Rachael Blackwell***, *Tennessee Technological University, Cookeville, Tennessee*. Technology usage can address complex problems in teaching. Teacher preparation programs have been charged to ensure teacher candidates can apply technology standards as they design, implement, and assess learning experiences to engage students. Technology can promote a constructivist and inquiry-oriented classroom environment. In Tennessee, agriculture teachers have been slow to adopt technologies for classroom use. Outside of the cost barrier, Tennessee agriculture teachers cite not having enough time to develop lessons that utilize technology. As such, a teaching methods course in the Agricultural Education program at TTU has been revised to include modules that allow candidates to develop virtual reality enhanced lesson plans. Feedback from participating students has been mostly positive. Students have expressed their eagerness in incorporating these lessons in their programs after graduation.

Allelopathic effect of *Arundo donax* L. aqueous extract on *Lens culinaris* Medik. **Kenneth W. Pierce and Barbara A. Darroch**, *Tennessee Technological University, Cookeville, Tennessee and The University of Tennessee at Martin, Martin, Tennessee*. Leaves of *Arundo donax* L. (a tall, aggressive, rhizomatous perennial grass) contain allelopathic compounds that can negatively affect germination of other plants. This research evaluated the effect of leaf, stem, and rhizome extracts of *A. donax* on germination and seedling growth of lentil (*Lens culinaris* Medik). The 10 g/100 ml rhizome extract reduced mean germination 4.1 percentage points compared with the control, but the primary differences noted were in the root and shoot length of the seedlings after germination. Higher concentrations of leaf, stem, and rhizome extract reduced seedling length by 52.6, 37.0, and 65.9% respectively. The study confirms that stem and rhizome tissue of *A. donax* contains allelopathic compounds that may be a potential source of bioherbicides.

Developing probabilities for enhanced student success on the national licensing exam for veterinary technologist. **Sarah Anderson, Scott Parrott, Jason Roberts, and Joey Mehlhorn**, *The University of Tennessee at Martin, Martin, Tennessee*. This study estimates probabilities of passing a national licensing exam based on specific academic categories. Previous studies have focused on simple tests to determine differences among students who passed the exam and those that failed. While these past studies are meaningful, it would be more beneficial for the faculty to better understand how students can improve their chances of passing by meeting certain benchmarks that influence exam performance. This study uses a logistic model to develop probabilities based on certain academic criteria and academic performance. The model results suggest that GPA and specialized internships choice are the highest impact opportunities associated with student success. As a result, faculty continue to improve the program by promoting high impact opportunities to students.

Best practices of middle Tennessee agriculture science programs. **Ashlyn Fussell* and Will Bird**, *Montgomery Central High School, Clarksville, Tennessee and The University of Tennessee at Martin, Martin, Tennessee*. The purpose of this collective case study explored effective teaching methodologies utilized by agriculture science teachers. The research objectives were: 1) establish empirically based indicators of effective teaching strategies; 2) evaluate teachers based on indicators; and 3) assess method utilization by demographic data. Data was collected through multiple classroom observations, interviews, and instructional artifacts and analyzed using the constant comparative method. It was found that subjects utilized elements of all effective teaching indicators, but with varying levels of frequency. It was concluded that agricultural science teachers utilize a wide variety of effective teaching methodologies. It was also concluded that some methodologies are not utilized based on mediating demographic factors.

Recommendations were made for university teacher preparation programs and professional development programming for pedagogical skill enhancement.

Soybean Plant Development and Soil Conditions Affected by Planting Date and Maturity Group. **William Singer* and Barbara Darroch**, *The University of Tennessee at Martin, Martin, Tennessee*. Soybean is a vital crop in agriculture production across the United States, especially in the southeast. Its maturity groups and planting dates vary across cultivars and locations. These differences play a large role in how the plant develops and the soil conditions during and after the growing season. Four different cultivars were planted both early and late in randomized research plots. Soil samples were taken to determine various characteristics, and the plants were visually observed and measured to determine differences in growth. The goal was to determine how planting date affects growth of soybeans from different maturity groups and whether or not these growth differences affect soil properties. This research will help to provide producers information about cultivars to use with varying planting dates.

Food safety: growing concerns of the 21st century in Saudi Arabia. **Faisl Almotairi*, Enefiok Ekanem, and Mary Mafuyai**, *Tennessee State University, Nashville, Tennessee*. Estimates of deaths and illnesses from foodborne illnesses vary widely. Approximately 10% of the world's population falls ill from consuming contaminated food. This paper evaluates the awareness and risks of foodborne illnesses and discusses the role of Saudi Food and Drug Authority (SFDA) in reducing food borne illness and public education. A random sample of 250 respondents to an online survey was used to collect data. T-test and chi-square tests were used in analyzing and presenting results. Findings show that food safety was an important issue in Saudi Arabia. The SFDA plays an important role in creating awareness, preventing and reducing foodborne illnesses in Saudi Arabia. Research findings provide greater understanding of food safety and education in Saudi Arabia.

Improving skills in computer technology and data analysis. **Blessing C. Ajumobi*, Harry Felder*, Enefiok Ekanem, and Mary Mafuyai**, *Tennessee State University, Nashville, Tennessee*. Technology continues to significantly impact online learning around the globe. This paper discusses the effectiveness of training in computer and statistical software. Objectives are to: Assess knowledge and skills acquired in applied agricultural research. Results showed that respondents acquired hands on-experience in computational and statistical analysis. Workshops equipped them with software knowledge and skills for analyzing their research. Participants stated they were capable of helping producers with computer-based record-keeping systems. Some said they will take another training session or computer class and would likely recommend this training to others. This study establishes growing interest and effectiveness of systematic

computer and statistical application training in agriculture. Continuous mentoring is needed to equip students with hands-on training in survey design, data collection, and analysis for today's market.

Investigation into Timing of Cuttings for Maximum Propagation Efficiency of *Vitis aestivalis* 'Norton/Cynthiana' Grapevines. **Nolan Jolley and Tony V. Johnston**, Middle Tennessee State University, Murfreesboro, Tennessee. The goal of this research was to determine the optimal time of year for traditional propagation of Norton/Cynthiana grapes. Samples were collected weekly from a local vineyard, treated with 0.1% indole-3-butyric acid, planted in a 1:1 perlite:vermiculite mix, and placed in a plant growth room with 12 hours light/day, 70% relative humidity, and 22/15 °C day/night temperature conditions. After six weeks, cuttings were evaluated for root growth. Rooting success rates were highest in the month of June at 10%, 12 weeks after the last frost and 10 weeks after bud break. Daily high and low temperatures in the vineyard were also recorded. Highest rooting efficiency resulted when the daytime highs were consistently at their maximums for the summer.

Botany and Cell and Molecular Biology

Section Chair: Carol Baskauf

A Preliminary Vascular Plant Flora of the Bare Zone of the Copper Hill Basin, Polk County, Tennessee. **John Shelton* and Joey Shaw**, The University of Tennessee at Chattanooga, Chattanooga, Tennessee. In Polk County Tennessee, in the Southern Blue Ridge ecoregion, there exists a 10,000 acre area that is known as the Copper Hill Basin. It was mined for copper in the late 19th to the mid- 20th century. The effects of this mining were incremental, leaving three distinct zones: a forested zone, a grassy zone, and a bare zone. Since the mining was halted in the 1920's, much of the grassy and bare zones have become revegetated, due in large part to plantings of Virginia and loblolly pine by TVA. However, many species have also come into these areas naturally. To date, 224 species in 116 genera, representing 94 families have been documented. Surprisingly, there are 7 rare or conserved species.

Status update of *Smilax walteri* Pursh (Coral greenbrier) in southwest Tennessee. **Claude J. Bailey, Jr.**, Jackson State Community College, Jackson, Tennessee. *Smilax walteri* (Smilacaceae) is a native, perennial vine that occurs in bottomland hardwood forests, wet thickets, and swamps throughout the coastal plain of the southeastern United States. *Smilax walteri* is easily distinguished from other *Smilax* by red berries in the late fall/early winter and, upon close examination, several vegetative characters. According to herbarium collections at the University of Tennessee (TENN), *S. walteri* was first collected in Shelby Co. in 1977. No other herbarium specimens from Tennessee can be

located after 1977 and prior to a more recent 2005 collection. Additional recent collections between 2005 and 2016 place the taxon in three additional counties in southwest Tennessee (Chester, Fayette and Madison) with a total of four extant locations. Wetland community structure and habitat associates are discussed as well as conservation concerns.

A floristic inventory of Orchard Knob Reservation. **Alaina Krakowiak*, Andi Kur*, and Joey Shaw**, The University of Tennessee at Chattanooga, Chattanooga, Tennessee. Orchard Knob Reservation, a branch of the Chickamauga and Chattanooga National Military Park only minutes from downtown Chattanooga, houses a rich and unique flora. So far, 105 species (representing 86 genera and 42 families) have been collected from this 2-acre area—a remnant of the limestone glades that were once more abundant. In this study, along with a complete survey of the site, we explore the area's botanical history using Civil War-era herbarium specimens, as well as letters written between botanists Gattinger and Engelmann. We also assess which species present at the site are the most threatened and/or conserved, and therefore how we can best advise the Park Service to preserve their flora. Lastly, we suggest areas for future research around Chattanooga that appear to be limestone glade remnants.

Assessing functional reproductive biology among floral morphs in *P. incarnata* in Putnam, Co., Tennessee. **Elizabeth B. Jackson*, Toby Cooper, and Shawn E. Krosnick**, Middle Tennessee State University, Murfreesboro, Tennessee and Tennessee Technological University, Cookeville, Tennessee. *Passiflora incarnata* is an andromonoecious clonal species native to the southeastern United States. Previous data suggest that there are five distinct floral morphs present on individuals plants, three male and two hermaphroditic; each vary in the degrees of gynoecial development. Manipulated outcrosses were performed among three genetically distinct individuals to assess the extent of successful pollen germination, pollen tube presence in the styles, and penetration of the ovary for each of the morphs. Germination on the stigmas is possible for all morphs, but pollen tubes are generally absent from the styles and ovaries for the two least developed male morphs. In some cases, pollen tubes were found in the styles but did not penetrate the ovary. Surprisingly, the largest hermaphroditic morph also lacks pollen tubes and ovary penetration. Further investigation into reproductive anatomy is being explored to determine differences between each morph. Potential implications for reproductive ecology are also considered.

On the significance of botanical illustration. **Andi Kur* and Joey Shaw**, The University of Tennessee at Chattanooga, Chattanooga, Tennessee. Illustration has long been an important tool for communication in the botanical sciences; however, it has become apparent that botanical illustration is being phased out of modern botanical publications, in part

due to an emerging reliance on photographic technologies and a subsequent community bias of illustration as an archaic trade. Our research explores the extent and potential effects of this shift through a multipart study, consisting of a historical analysis on the co-development of botanical sciences and illustration, a practical exercise in the illustration of the *Guide to the Vascular Plants of Tennessee*, and an experiment to test and quantify the effectiveness of these illustrations in plant species identification. Ultimately, our results suggest that, if rendered with proper standards of scientific accuracy and artistic skill, botanical illustration remains to be a significantly effective and highly relevant tool to be upheld within the modernizing sphere of botanical sciences.

Modernizing field collection methods. **Caleb Powell***, **Jacob Motley***, **Stewart Chunn***, **Joey Shaw**, and **Hong Qin**, *The University of Tennessee at Chattanooga, Chattanooga, Tennessee*. Workflows for digitizing natural history collections have been designed to address 200 years of existing legacy records. The process of transcribing data from legacy records into a database is slow, labor intensive, and prone to error. Still, accessions of Plantae records aggregated onto national portals like iDigBio.org exceed 470,000 specimens, annually. Current methods for collecting new specimens continue to add to the backlog of legacy data. Modernizing field collection methods could circumvent the need to transcribe new accession data, expediting record generation while improving data quality. Here we present the development of a hand-held and desktop application to automatically generate most of the standard data accompanying a specimen, partition the data into a printer-ready label, and push the data to online portals.

The Effect of Sulfide-rich Water on Seedling Growth and Photosynthesis. **Danelle Solomon***, **DeEtra Young**, and **T.D. Byl**, *Tennessee State University, Nashville, Tennessee (DS, DY)*, *U.S. Geological Survey, Nashville, Tennessee (TDB)*. Previous research found water artificially enriched in sulfide stimulated plant biomass. This study's objective was to determine if groundwater from Tennessee State University's farm wells, naturally rich in sulfide, stimulated plant growth. Lettuce, radish and oat raised using waters from a well (OW1) containing high sulfide (65-115 mg/L) were compared to water (OW3) with no sulfide. Seeds were germinated in the experimental waters and raised in a growth chamber at 20°C. The oat plants raised in OW1-water had 3x more lateral roots and 18% greater biomass than plants raised in OW3-water. Lettuce and radish plants raised in OW1 were 35% and 13% larger than those raised in OW3-water, respectively. Cell wall peroxidase activity was 40% higher and CO₂ uptake was 350% greater in plants raised on sulfide waters.

A Story Map of the Remaining Collections of Augustin Gattinger. **John Shelton***, **Caleb Powell***, **Erica Rylander***, and **Joey Shaw**, *The University of Tennessee at Chattanooga, Chattanooga, Tennessee*. There are approximately 1100

surviving specimens of the first botanist of the state of Tennessee, Augustin Gattinger. Much of Gattinger's collection was lost in the Morrill Hall fire at the University of Tennessee in 1934. A team from The University of Tennessee at Chattanooga imaged and databased over 400 of Gattinger's herbarium specimens in 2017. Using these specimens, and another 700 specimens found on the SERNEC database, an ArcGIS story map was created to visually show when and where the accessions were collected in the past.

A distributional study of the narrowly endemic Nashville Bladderpod. **Edward W. Chester**, *Austin Peay State University, Clarksville, Tennessee*. The Nashville Bladderpod, *Paysonia lescurii* (A.Gray) O'Kane & Al-Shehbaz (Brassicaceae or Cruciferae) is apparently endemic to 10 contiguous counties in central Tennessee, one county in south-central Kentucky, and ostensibly one county in northern Alabama. Extensive herbarium and field studies have been conducted in Kentucky and Tennessee for several decades, and in Alabama during the spring of 2017. Results show that the one known Kentucky location is well documented, but the species has not been seen there since 1985. The species should, at this time, be considered historic in that state. Field work in Alabama was unsuccessful and documentation is apparently lacking for the Alabama reports; the species, at this time, should not be considered part of the flora of that state.

Rediscovery of *Rhynchosia latifolia* Nutt.ex Torr. & A. Gray (Prairie snoutbean) in Chester County, Tennessee. **Claude J. Bailey, Jr.**, *Jackson State Community College, Jackson, Tennessee*. *Rhynchosia latifolia* (Fabaceae) was rediscovered in Tennessee in August 2017 on a grassy, roadside barren in Chester County. Prior to the rediscovery, the first and only collection of *R. latifolia* from Tennessee was made by A. J. Sharp, A. Clebsch, and E. Clebsch in 1947 from Chester County. Based on the Sharp et al. collection data, it is very likely that the rediscovery site is the same as or in close proximity to the original 1947 site. About 70 plants were located along approximately 300m of roadside habitat. Habitat associates include several species of warm season grasses (*Andropogon* spp., *Aristida* spp.), *Agalinis purpurea*, *Chrysopsis mariana*, *Cyperus retrofractus*, *Lechea mucronata*, *Rhexia mariana* var. *interior*, *Sericocarpus linifolius*, *Solidago nemoralis*, *S. odora*, and *Vernonia missurica*. Other habitat associates are discussed in an attempt to characterize roadside barrens in central southwestern Tennessee. Threats to the site include roadside and power line right of way maintenance, especially regarding the use of herbicides.

Digitizing one million herbarium specimens in Tennessee. **Joey Shaw**, **Caleb Powell***, **Dwayne Estes**, and **Ashley Morris**, *The University of Tennessee at Chattanooga, Chattanooga, Tennessee (JS, CP)*, *Austin Peay State University, Clarksville, Tennessee (DE)*, and *Middle Tennessee State University, Murfreesboro, Tennessee (AM)*. There are 13 Tennessee

herbaria and collectively they contain ~1,000,000 specimens. UT Knoxville is the largest single herbarium with ~32% of the total vascular plant specimens. Vanderbilt University contains ~29% and the 11 small herbaria collectively contain ~39% of Tennessee's vascular plant specimens. Very few herbarium specimens from the smaller collections have been utilized when gathering data toward Tennessee's broad botanical works. As such, broadscale botanical knowledge in Tennessee overlooks ~39% of the available data. In 2014, we began digitizing Tennessee's vascular plant specimens to make these data publically available. To date we have digitized ~600,000 specimens and we hope to complete this work by spring 2018. Digitized specimen data are being pushed to national and international online portals as well as to a new online Plant Atlas for Tennessee. Establishing a Tennessee Herbarium Consortium will facilitate governance of these data and their usage.

DNA-Protein binding specificities of PRMT1 (histone methylase enzyme) to their potential target genes in the model bioenergy crop species of *Panicum hallii*. **Shohana Huq* and Suping Zhou, Tennessee State University, Nashville, Tennessee.** Transcription factors (TFs) control gene expression through binding to specific cis-regulatory sequences in the promoters of their target genes. In our study we choose PRMT1 that belongs to the family of methyltransferases (arginine specific) and leads to the formation of an epigenetic transcriptional memory. We found more significant narrow peaks than broad peaks. Next, we tried to identify if the direct downstream targets of any transcription factor can be determined from the annotated peaks of ChIPed DNA because this may also lead to the transcription-regulatory proteins at specific DNA sites. The browser track information provides all the peaks identified, roughly 1300 to 34,746 peaks where some of them fall in annotated gene regions which are indeed enriched above the background. 13 and 257 transcription factor motifs were identified respectively from the control and drought treated samples to show the transcriptional activity along with DNA-protein binding association in *Panicum hallii*.

Chemistry

Section Chair: Stephen Everly

Microwave-assisted acetylation of terminal alkynes. **Benjamin Ide* and Phillip Shelton, The University of Tennessee at Martin, Martin, Tennessee.** A process has been developed by which terminal alkynes undergo Markovnikov hydration followed by tautomerization without the use of a mercury catalyst. The use of sulfuric acid in the presence of excess acetic acid and simultaneous microwave exposure causes a reaction that yields acetophenone from phenylacetylene in good yield. Several other compounds containing alkyne groups have been explored to test the scope of this process. The preclusion of mercury catalyst is an environmentally

beneficial aspect from the optimization and implementation of this process.

A Direct Estimation of Methane Emissions from Beef Cattle in a Feedlot Using Continuous Wave Cavity Ring-down Spectroscopic Technique. **Lahiru Gamage* and Wilson K. Gichuhi, Tennessee Technological University, Cookeville, Tennessee.** In this work, a continuous-wave cavity ring down spectroscopic technique is utilized to quantify enteric methane emissions from a beef cattle feedlot in Hyder-Burks Agricultural Pavilion farm by examining the correlation between carbon dioxide (CO₂) and methane (CH₄). Linear regression analysis using the linear squares approach is used to estimate the CH₄/CO₂ ratios using the corresponding above background CH₄ levels. During the spring of 2017, an average CH₄/CO₂ ratio of 5.864 ppb/ppm was observed. These preliminary results suggest that the cw-CRDS can be used as a direct technique to estimate gas emissions from livestock systems.

Infrared Spectroscopic Studies of Propane and Ethane as the Main Methane Tracers in the Atmosphere. **Samuel M. Hines*, William G. Qualls*, and Wilson K. Gichuhi, Tennessee Technological University, Cookeville, Tennessee.** As the two main volatile non-methane (CH₄) hydrocarbons (NMHC), ethane (C₂H₆) and propane (C₃H₈) play a critical role in regulating the oxidizing capacity of the troposphere by serving as important atmospheric sinks for the OH radical. As a result, accurate measurements of C₂H₆/CH₄ and C₃H₈/CH₄ ratios are often used to identify the source of CH₄ emissions within a local or regional ecosystem. In this work, we present IR spectroscopic measurements of CH₄, C₂H₆ and C₃H₈ in the C-H stretching and C-C stretching vibration regions using natural gas as a sample. The obtained spectra enable direct determination of the C₂H₆:CH₄ and C₃H₈:CH₄ ratios from natural gas sample. The results of this study are used as a test-bed to show how future adoption of a long-path FTIR spectroscopic technique can enable parts per billion (ppb) detection of C₂H₆ and C₃H₈ ppb precision leading to more precise values of C₂H₆:CH₄ and C₃H₈:CH₄ ratios.

Lipid Extraction of Wet Algal Biomass via Osmotic Shock. **Amber Ansari*, Alison Parker, and Rachel Rigsby, Belmont University, Nashville, Tennessee.** Finding auxiliary methods for replacing fossil fuels and environmentally harmful process of bioenergy and biofuel production is a global challenge and necessity. Microalgae serve as a promising alternative fuel source; however, conventional methods are expensive and non-scalable due to costly techniques of rupturing rigid cell walls for accessible lipid body extraction as well as energy-demanding drying techniques. Osmotic shock is a promising greener, economically feasible approach that focuses to rupture cell walls in order to attain maximum yield potential at low costs. Therefore, this study targets the lipid extraction from wet algal biomass at varying growth phases via methods ranging solvents for osmotic shock

treatment as well as their intensities in order to rupture the cell walls of microalgae strains *Chlorella vulgaris* and *Chlamydomonas reinhardtii* (+), and also focuses to serve as a comparable model for the amount of lipid bodies extracted in contrast to other conventional but more costly techniques.

Ecology and Environmental Science

Section Chair: Joe Schiller

Two factors affecting retreat site selection in *Vaejovis carolinianus* populations from Tennessee's Upper Cumberland region. **Bob A. Baggett***, *Tennessee Technological University, Cookeville, Tennessee*. My study examined Tennessee's native scorpion species, *Vaejovis carolinianus*. Objectives were to determine if: (1) *V. carolinianus* selected cover objects based on surface area; and (2) *V. carolinianus* preferred moister soils under cover objects. Scorpions were captured from two different locations in the Upper Cumberland region during two field seasons. Transects were established at both field locations to count and measure rocks that may serve as retreat sites. In laboratory trials, scorpions were allowed to choose among retreat sites of either three different sizes or three soil moisture levels. *Vaejovis carolinianus* selected large objects as retreat sites most often, but overall retreat site selection did not differ from that expected based on random choice when weighted by cover object size. Soil moisture trial results varied, with no statistical significance in results from the two populations captured in 2013; however, the population captured in 2014 seemed to prefer wet soil.

Distribution and Status of the Western Pygmy Rattlesnake (*Sistrurus miliarius streckeri*) in Tennessee. **Shawn D. Snyder*** and **William B. Sutton**, *Tennessee State University, Nashville, Tennessee*. Globally, reptile populations are declining at a rate quicker than most other vertebrates. The Western Pygmy Rattlesnake (*S. miliarius streckeri*) occurs in a narrow range in west-central Tennessee along the Tennessee River drainages and Western Highland Rim. Little is known about the spatial ecology or habitat requirements of this species in Tennessee where it is listed as State Threatened. Previous studies on this species have reinforced the rarity of this species in the state with as little as 30 confirmed occurrences coming in the last 30 years. Our primary research objectives are to evaluate the distribution of the Western Pygmy Rattlesnake in Tennessee by using a variety of field-based survey methods and species distribution modeling techniques. Our preliminary habitat suitability model suggests most of the suitable habitat for pygmy rattlesnakes in Tennessee occurs on the East side of the Tennessee River and is predominantly associated with riverine and stream systems.

The Use of Environmental DNA and Occupancy Modeling to Evaluate the Distribution of the Eastern Hellbender

(*Cryptobranchus alleganiensis*) in Tennessee, U.S.A. **Jeronimo Da Silva Neto***, **William Sutton**, **Stephen Spear**, and **Michael Freake**, *Tennessee State University, Nashville, Tennessee (JDSN, WS)*, *The Wilds, Cumberland, Ohio (SS)*, and *Lee University, Cleveland, Tennessee (MF)*. The Eastern Hellbender (*Cryptobranchus alleganiensis*) is a long-lived, fully-aquatic salamander that inhabits cool, well-oxygenated streams and rivers in the eastern United States. Although once abundant, *C. a. alleganiensis* populations have experienced major declines across the historical range due primarily to habitat degradation. Even though Tennessee provides some of the best remaining habitat for *C. a. alleganiensis*, standardized state-wide distribution assessments have been limited to known populations, and status of other *C. a. alleganiensis* populations remains unknown. We used environmental DNA (presence/absence) data to identify important conservation areas with potential remaining *C. alleganiensis* populations and estimate site occupancy at 292 sites across Tennessee. Site occupancy was estimated to be 0.45 (130 sites), and the detection probability was 0.55. The overarching goals of this project is to encourage efficient use of time and resources to effectively manage and conserve the few remaining secure, yet declining, hellbender populations throughout the state of Tennessee.

Fish and coral species richness across different levels of protection along the Meso-American Barrier Reef. **Dedra E. Irwin*** and **LaRoy S. E. Brandt**, *Lincoln Memorial University, Harrogate, Tennessee*. The purpose of this study was to study the diversity of fish and coral species along the Meso-American Barrier Reef near Ambergris Caye, Belize. Our objective was to compare fish and coral species richness across three areas: Historically Protected, Newly Protected, and Not Protected. Fish and coral species were identified from video recordings of snorkeled transects in the different area types. Species richness estimates for each area type were compared to evaluate the success of protection efforts. We estimate the overall coral species richness to be 38 (± 3.84 , 95% C.I.). We also estimate the overall fish species richness to be at 105 (± 7.84 , 95% C.I.). Although fish and coral species richness varied across snorkeling sites, there was no statistical difference between the area types. Furthermore, the fish species richness was not correlated with the coral species richness.

Engineering and Engineering Technology

Section Chair: Khalid Tantawi

Production of Biodiesel Using a Solar Powered Thermally-Efficient High-yield Ultrasonic Processor. **Mary Seelam**, **Ivaylo Hardalov***, **Ian Doss**, **Joseph Hodge**, **Jahmal Cannon**, **Samuel Cafferty**, **James Rust**, and **Darien Jackson**, *Tennessee Technological University, Cookeville, Tennessee*. The production of biodiesel from waste vegetable oil (WVO) provides a solution towards economic, environmental and waste

management. Biodiesel is produced from vegetable oils by transesterification of fatty acids with methanol and lye to give methyl ester (biodiesel) and glycerin. In batch production, biodiesel is produced using heat and mechanical mixing energies. The goal of this study is to automate the biodiesel production from WVO with less electric heating energy using solar power. In addition, besides the mechanical mixing, ultra-sonication was used to reduce the processing time and the amount of methoxide needed to perform a base-catalyzed transesterification. The processing time was further reduced using a high voltage source to help electrostatically separate the biodiesel/glycerin mixture. An Arduino Uno is used for data acquisition and the process control from different sensors. This paper will report the results of this investigation, discuss the results, and provide suggestions on improving the current design.

Network resource management for cloud based networked control systems via adaptive sampling. **Mohammad A. Rahman***, **Liang Hong** and **L.H. Keel**, *Tennessee State University, Nashville, Tennessee*. A recent advancement in computing technology, referred to as cloud computing, enables control systems to access computational and storage resources over communication networks. Motivated by the benefits of using the cloud, several research efforts are going on to incorporate cloud into the traditional control system. However, signals, including control actions, are transmitted over a communication link which is associated with bandwidth limitation that could cause delay, packet drops which ultimately affects the performance and stability of the underlying control system. In this paper, we propose a real-time network resource management strategy to manage network resources to overcome such drawbacks. The proposed fuzzy based algorithms are implemented in an experimental platform to demonstrate the effectiveness of maintaining the successful operation of the plant under limited network resources.

The coupling of light with piezoelectric properties in graphene oxide (GO) doped polyvinylidene fluoride (PVDF). **Omari Paul***, **Akinwunmi Joaquim***, **Yuri A. Barnakov**, **Akira Ueda**, **Richard Mu**, and **Frances Williams**, *Tennessee State University, Nashville, Tennessee (OP, AJ, YB, RM, FW) and Fisk University, Nashville, Tennessee (AU)*. The coupling of high frequency electromagnetic radiation (light) with low-frequency functionalities of dielectrics and liquid crystals is a long-standing problem of fundamental and applied science. An ability to turn "on" and "off" the pyro-, piezo-, or ferroelectric properties of materials on demand by optical means leads to fascinating device applications and is central to modern photostriction, where material strain is generated by light. In this work, we report on the interesting finding of the light intensity induced phase transitions observed in 0.05 % weight GO doped piezoelectric PVDF films with 100 μm thicknesses. Two effects were discovered in the Raman studies with wavelength of incident beam 532 nm: (i) an alternated modulation of integrated intensities of 797 and

840 cm^{-1} as a function of time, where wavenumbers stand for vibration modes of CH_2 rocking of α non-piezoelectric and β piezoelectric phases, respectively and (ii) reversible switching between α and β phases depending on the light intensity (power within the range of 10 – 40 mW). We provide a hypothesis on the mechanism and origin of observed effects within the framework of pyroelectricity of GO doped PVDF.

Integrating a Human Machine Interface Panel and a Vision System in a Low-Cost Supervisory Control System, **Blake Johnson***, **Noah Dixon**, and **Khalid Hasan Tantawi**, *Motlow State Community College, Smyrna, Tennessee*. A low-cost supervisory control system that is based on a master-slave network of Programmable Logic Controllers (PLC) with an object-oriented-like function library is demonstrated here. The PLCs are connected via an ethernet-based network to control a process. All control functionalities are performed on the HMI panel, and demonstrated on a three-station bearing ball packaging process. A vision data acquisition system is used for color and shape-based classification for quality control. The program functions are added to a function library. The library of functions that is created from this and previous projects, contain independent functions that perform different communication, motor and process control functionalities, and as a package, works as a toolbox for low-cost supervisory control and data acquisition (SCADA).

Strain engineering to modify functional properties of piezoelectric polyvinylidene fluoride (PVDF) nanocomposites. **Akinwunmi Joaquim***, **Omari Paul***, **Yuri A. Barnakov**, **Ranganathan Parthasarathy**, **Lizhi Ouyang**, and **Frances Williams**, *Tennessee State University, Nashville, Tennessee*. Strain engineering is an innovative and prominent concept in the field of materials science. The coupling of materials' strain/stress with their functional properties leads to a number of unprecedented phenomena ranging from surface enhanced Raman spectroscopy (SERS) enhancement in corrugated plasmonic structures to modification of the energy landscape in catalytic systems, from improving of nanoscale ferroelectricity in coherent epitaxial films to an increase of energy harvesting efficiency in photovoltaic devices. Herein, we report on preliminary results of our work related to modification and improvement of piezoelectric properties of PVDF nanocomposites by employing strain technology. Two experimental approaches are utilized to produce polymer nanocomposites: (i) mechanical stretching of PVDF matrix with doped ferroelectric BaTiO_3 (barium titanate) nanoparticles and (ii) doping of PVDF with mechanochemically synthesized BaTiO_3 nanoparticles. The overall goal is to improve elasticity of polymer composites in order to enhance their piezoelectric functionalities. The mechanical, structural and electrical properties of the synthesized materials will also be discussed.

An investigation into the use of biomass gasification in electric power generation. **Corbin Catlett*, Mark Cato, Chase Cline, Cody Dorris, Caleb Hale and Andrew Shoemaker, Tennessee Technological University, Cookeville, Tennessee.** Gasification is the process of converting biomass into syngas. Syngas is intended to run a small liquid propane generator to produce electricity. The available gasifier does not produce enough syngas to run the electric generator. The ultimate goal of this project is to improve the performance of the current gasifier using instrumentations. Sensors are installed to monitor the process during gasification and gather data about temperatures and volume of gas going through the different parts of the gasifier. In addition, a vacuum gauge was installed in the tube between the combustion chamber and the cyclone filter. An Arduino, Uno is used for data acquisition from the temperature sensors and vacuum in the reactor. This paper will report the results of this investigation, discuss the results, and provide the suggestions on improving the current design.

Enhancing the Design of a Solar Powered Mineral Feeder, Tracker and Pesticide Sprayer for Livestock at Tennessee Tech Farm. **Michael Dill, Adam Deatherage, Jeremy Johnson, and Daniel McGee, Tennessee Technological University, Cookeville, Tennessee.** The main goal this project is to develop a self-sustaining integrated mineral feeder acts as a relay to a central hub for collecting data on the cattle information. In the developed feeder, an RFID is mounted to read the tag located on the left ear of each cow and will identify if that cow is due for an insecticide spray. The data will be logged into a developed cattle-management system, which has an integrated section of the feeder to automatically detect and spray the cattle with pesticides. A mesh network was created throughout the ranch and connecting a Raspberry Pi 3 to the central hub to relay vital information such as how often the cattle are visiting feeder, their age, or when they are predicted to give birth. The paper will include a full description of the system, discussion of the data collected and suggestions for future improvements.

Programming by Robots. **S. Tigrek and T. Tigrek, The University of Tennessee at Martin, Martin, Tennessee.** In 1980s, the programming moved from using punch cards to the CRT screens, mainframes to PCs. At the time, it was a tradition and an amazing accomplishment of C programming to produce "Hello World" as the first program. Since then, PCs have been developed much more further, screens and applications became more colorful, but unfortunately traditional programming classes did not go beyond using black and white screens and "Hello World" as a first example. It is proposed to change the paradigm of programming; "programming by robots". A curriculum is being developed to teach the essence of C programming by physical components (LEDs, buttons, sensors, servo motor etc.) attached to a microcontroller (Zilog). The system is composed of a breadboard and a controller with cables and

components. It is time to teach programming and algorithms that interact with to the real world.

Design Labs for Electromechanical Devices and Instrumentation. **Russ Longhurst, Austin Peay State University, Clarksville, Tennessee.** For practicing engineers, often they must design devices and systems that are multidisciplinary in nature. This requires integrating electrical and mechanical components into a single unit. In recent years, the mechatronics field has formed to integrate these disciplines. Sometimes by necessity, their design process focuses more on the integration of components and not as much on the design of the components. The design of components has traditionally been performed by the discipline specific professionals such as mechanical or electrical engineers. To provide engineering students with a multidiscipline design experience, labs assignments have been created that require students to perform component level design as well as integration between the mechanical and electrical components. The presented labs require the design, build, and performance testing of a strain-gauge based load cell, D.C. motor, and a servo control system. The labs have shown to provide students with a challenging and practical design experience.

Geology and Geography

Section Chairs: Michael Gibson and Mark Simpson

Unusual deposits of pyrite with glauconite in Waulsortian mudmound-like carbonates near Celina, TN. **Ashley R. Parkans* and H. W. Leimer, Tennessee Technological University, Cookeville, Tennessee.** Road construction in Clay County, Tennessee has unearthed a Waulsortian mound-like deposit separating the normal stratigraphy for the area. This mound lies beneath the Fort Payne Formation with a thick layer of green shale situated above and below, which is lined by a thin layer of pyrite clusters in glauconite at its base. This pyrite is unusual in that, given the comparatively small surface areas in which it formed, the morphologies appear to vary greatly from one crystal to the other. Our initial objective was to determine if there is a relationship between the pyrite crystal habits and its relative location, and after extensive XRD and hand sample analysis, we now hypothesize that there could be a possible link between the surrounding geochemistry and pyrite morphologies.

Preliminary observations of organism-substrate relationships of *Astraeospongia*, *Astylospongia*, *Hindia*, and *Palaeomanon* from the Brownsport Formation (Middle Silurian), Western Tennessee. **Nathaniel Newlin* and Michael A. Gibson, The University of Tennessee at Martin, Martin, Tennessee.** The Brownsport Formation (Middle Silurian) contains abundant well-preserved *Astraeospongia*, *Astylospongia*, *Hindia*, and *Palaeomanon* sponges. We studied organism-sediment relationships and taphonomic character-

istics of 102 sponges to elucidate biotic interactions (with associated brachiopods, pelmatozoans, and corals) and sponge-substrate paleoecology. Sponges are intact, of low-profile, semi-infaunal between thinly-laminated mudstone to packstone interlaminated with thin shale (*Astraeospongia*) to epifaunal (*Astylospongia*, *Hindia*, *Palaeomanon*). Sponge preservation fine-grained sediment is anomalous given that sponge ostia would clog. Sponges never occur as epibionts, never have epi- or endobionts, and have indistinct attachments. Bedding contact occurrence, fine-grained infill of the concave atrium, shale drapes, overturned sponges, and low profile indicate episodes of rapid burial during turbid water kill-events (obrution?) occurred frequently during otherwise time-averaged clear-water Brownsport deposition.

Preliminary results regarding the influence of urban expansion on surface water runoff in the Jackson, Tennessee area. **Thomas (Lan) DePriest**, *The University of Tennessee at Martin, Martin, Tennessee*. This work describes the growth and expansion of the Madison County, Tennessee area from 1992-2011. The objectives of this study are to quantify LULC changes and composition for Madison County, TN over the 20-year study period, to determine if any significant relationships exist between socio-demographic factors and the quantified LULC changes, and determine what impact, if any, this may have on surface water runoff in the study area. Preliminary results suggest that a significant relationship between percent change in population density, percent change in urban land, percent change in agricultural land, and percent change in forested lands does exist. The summation of land-use and population changes for Madison County indicates that population and urban areas are increasing as forested and agricultural areas are decreasing. Study into the impact of Madison County's urban expansion on surface water runoff is ongoing.

A review of conditions that influence harmful algal blooms. **Tom Byl**, *U.S. Geological Survey, Nashville, Tennessee*. Cyanobacteria, known as harmful algal blooms (HABs), are increasingly becoming a water quality concern across the United States due to their production of cyanotoxins. Toxin-producing algae were found in 74% of the 79 Southeastern United States streams and rivers surveyed in 2015; cyanotoxins were found in over 35% of the 79 rivers. Middle and east Tennessee are particularly vulnerable to HABs because many farmers and water utilities pull water directly from surface waters which are vulnerable to HABs. However, very little is known about the spatial and temporal occurrence of HABs in middle and east Tennessee. This lack of understanding is due to lack of studies. Conditions that influence the production of HABs, such as weather, nutrient runoff, temperature, and hydrologic conditions will be discussed.

Groundwater/Surface-water interaction along the western edge of the Blue Ridge province, Blount and Sevier Counties, Tennessee **Michael Bradley, John Carmichael, Greg Johnson, and Ben Miller**, *U.S. Geological Survey,*

Nashville, Tennessee. Sevier and Blount Counties in East Tennessee lie along the transition from metamorphic rocks of the Blue Ridge to sedimentary formations of the Valley and Ridge. The variable aquifer characteristics and ground-water/surface-water interactions along this zone can affect the water resources for water supply and to support aquatic biota. The USGS conducted seepage investigations in Abrams Creek basin in Blount County (July 2017) and Little Pigeon River basin in Sevier County (December 2015 and July 2016). During low base-flow conditions (July), in both counties, streamflow generally declined and flow per square mile decreased as streams crossed from metamorphic to carbonate units. During high base-flow conditions (December), streamflow in Sevier County increased with distance downstream but the flow per square mile decreased after streams moved onto the carbonate units. Groundwater/surface-water interaction was typical of karst areas with stream reaches gaining and losing flow once streams in both basins were flowing on the carbonate formations.

The connection between hydrology and water quality in Tennessee State University's wetland. **Shakarah Nelson*, JeTara Brown, De'Etra Young, and Tom Byl**, *Tennessee State University, Nashville, Tennessee (SN, JTB, DY) and U.S. Geological Survey, Nashville, Tennessee (TB)*. The 500-acre Tennessee State University campus in the heart of Nashville has a dynamic wetland that provides ecosystem services and habitat for aquatic life. The wetland area was once farmland, but was modified in 1996 due to construction of new roads (Ed Temple Blvd and Walter Davis Blvd). The objective of this study was to document the change in wetland size, hydrologic conditions and water quality. A study of orthophotos, 1996 -2016, found that the wetland has doubled in size every 5 years. The watershed grew from a 1.6 acre to a 26-acre wetland. Concurrent with the size increase from 2007-2016, the mean residence time doubled from 111 to 227 hours. The increasing stagnation may contribute to escalating eutrophication conditions each summer, demonstrating a connection between wetland hydrology and water quality.

Health and Medical Sciences

Section Chair: D. Nicholas Ragsdale

Elucidating the role of dysregulated manganese homeostasis in DNA damage response signaling in Huntington's Disease, **Ilyana R Ilieva, Piyush Joshi, and Aaron Bowman**, *Vanderbilt University, Nashville, Tennessee*. Huntington's disease (HD) is a dominant, neurodegenerative disorder that is characterized by an expansion of a polyglutamine-encoding CAG repeat in the Huntingtin gene (HTT), and a loss of GABAergic medium spiny neurons (MSN's) in the striatum. Previous studies have observed a manganese (Mn) uptake deficiency and decreased Mn-induced signaling in several striatal HD models. We intend to determine the concentra-

tion and duration of Mn exposure required for optimal DNA damage response signaling in HD in human induced pluripotent stem cells (hiPSCs) and early neuroprogenitors. We hypothesize that supplementation of Mn will upregulate Mn-dependent DNA damage response proteins and lead to the rescue of DNA damage response pathways in HD. Ultimately, this study seeks to establish a mechanism by which dysregulated Mn homeostasis leads to the disruption of neuronal function in HD via ineffective DNA damage response signaling: potentially leading to restorative effects on phenotypes.

Fate and biofilm formation of wild-type and rifampicin-resistant *Cronobacter sakazakii* in biotic and abiotic environments. **Kayla Sampson***, **Akilyah Sumlin***, **Kristine Day***, **Abimbola Allison***, **Shahid Chowdhury**, and **Aliyár Fouladkhah**, *Tennessee State University, Nashville, Tennessee*. Infections caused by *Cronobacter sakazakii* are often fatal in infants born premature and those younger than two months. Current study investigated biofilm formation of wild-type and spontaneous rifampicin-resistant phenotypes of *Cronobacter sakazakii* and survival of the phenotypes in biotic and abiotic environments. In randomized complete block design trials, four strain-mixture of wild-type and rifampicin-resistant *Cronobacter sakazakii* was inoculated into surface of stainless steel coupons and powdered infant formula. In excess ($P < 0.05$) of 3.0 log CFS/g and 2.0 log CFS/cm² multiplication of both phenotypes were observed in inoculated powdered infant formula and the stainless-steel coupons, respectively. Phenotypes showed comparable ($P \geq 0.05$) proliferation and inactivation under the condition of the experiments.

History of Science

Section Chairs: Kevin Ryan and Martin V. Stewart

The Archimedes Palimpsest. **John J. Schommer**, *The University of Tennessee at Martin, Martin, Tennessee*. A PBS Nova documentary titled Infinite Secrets (produced in 2002) tells the story of the Archimedes palimpsest, which arose from obscurity at an auction in 1998. A palimpsest is essentially any manuscript whose medium was considered so valuable that an original text might be erased and the medium reused to produce a new manuscript. In this case, a 10th century parchment containing several of Archimedes' works was scraped, washed, and overwritten to produce a liturgical text for use in the 13th century. Among other works of Archimedes, this particular palimpsest contains the only known copy of his Method of Mechanical Theorems. In this talk we will focus on what might be inferred from the very existence of this palimpsest about mathematics in the 10th century.

Contributions of MTSU in establishing the Tennessee Academy of Science. **Martin V. Stewart and Hunter D.**

Hudson, *Middle Tennessee State University, Murfreesboro, Tennessee*. The Tennessee Academy of Science (TAS) was founded 1912, which was only one year after the first fall quarter of Middle Tennessee State Normal School (MTSNS) that began September 11, 1911. This presentation summarizes the contributions of the faculty of Middle Tennessee State University (MTSU), from normal school beginnings through its evolution into a college, in helping to establish the Academy. The scope of this work will extend through 1946, when Dr. J. Eldred Wiser joined the faculty, and the character of science departments began to modernize into their present form. This history demonstrates that the tendency of MTSU science faculty in outreach activities began during the earliest days of the institution and helped to avoid its isolation. A related presentation in the poster session will focus on the involvement of Archibald Belcher, the first faculty member for chemistry and physics at MTSNS.

Mathematics and Computer Science

Section Chair: Nicholas Kirby

Neighborhood-prime labelings of tree graphs. **Malori E. Cloys*** and **N. Bradley Fox**, *Austin Peay State University, Clarksville, Tennessee*. A neighborhood-prime labeling of a graph is a variation of a prime labeling in which the vertices are assigned labels from 1 to $|V(G)|$ such that the greatest common divisor of the neighborhood of each non-degree 1 vertex is equal to 1. In this talk, we examine neighborhood-prime labelings of several types of tree graphs, such as caterpillars, firecrackers, spiders, banana trees, and complete binary trees. These labelings support the theory that all tree graphs have a neighborhood-prime labeling.

Doubly-inflated negative binomial model using Gaussian copula. **Joseph Mathews*** and **Sumen Sen**, *Austin Peay State University, Clarksville, Tennessee*. Studies involving count data appear frequently in the social and natural sciences. Moreover, this data often has a non-normal structure making it difficult to model. Many of these models have inflation points centered around zero and potentially at an additional inflation point. We present a model for doubly inflated count data using the negative binomial distribution. To maintain the correlation structure, we also use Gaussian copula methods. We provide visuals of the bivariate negative binomial Gaussian copula as well as the bivariate doubly-inflated negative binomial model. Additionally, we give the expression for the proposed model's marginal distribution and the n th order moments. Finally, we present an algorithm for estimating the doubly inflated Negative Binomial model's parameters. A table of the results is given with the mean square error values for each parameter obtained.

Population projections for Clarksville – Montgomery County Tennessee. **Menique Brewer*** and **Vajira A. Mana-**

thunga, Austin Peay State University, Clarksville, Tennessee. The knowledge of the size of future population enable counties to act on future needs of their societies such as housing, schools, hospitals and all other services. In this research we will present population projections for Clarksville - Montgomery County, Tennessee. We will use past historical data and mathematical models such as Malthusian model, logistic model, Gompertz curve and generalized logistic curve to model the population growth. We will assess the best model using Akaike information criteria and mean squared error. The selected best model is then used to predict population growth of Clarksville-Montgomery county for next 10 years.

Modeling yield rates on US bonds. **Tinchie F Stevye* and Vajira A Manathunga, Austin Peay State University, Clarksville, Tennessee.** US treasury bills are regarded as zero risk investment. Therefore, interest rates on US Treasury bills often referred as risk-free interest rates. We will model US Treasury bill rates, which often called as short rates, using following single factor models: Vasicek model and Cox-Ingersoll-Ross model. Both models are then used to project yield rates for US bonds with different maturity dates.

Diagnosing cirrhosis: A fractional calculus perspective. **Kindyl L. King* and Samuel N. Jator, Austin Peay State University, Clarksville, Tennessee.** Hepatic fibrosis, an excessive buildup of connective tissue in the liver, is closely related to cirrhosis and has historically been diagnosed by an invasive biopsy. We propose a way to more accurately diagnose the stages of hepatic fibrosis through the use of mathematical modeling of Magnetic Resonance Elastography data, which is collected by a non-invasive MRI-based technique. Our mathematical model is based on fractional calculus, which involves taking non-integer orders of differentiation. We will present an analysis of liver stiffness relating to hepatic fibrosis and the potential applications and limitations of our results.

Code Folio. **Bob Bradley, The University of Tennessee at Martin, Martin, Tennessee.** Code Folio is an online integrated development environment and learning management system (LMS) being developed for teaching introductory programming classes. Students can create, edit, compile, interactively run and submit their coding assignments totally within the browser on a desktop, notebook or tablet. (It works from a smart phone too, but it works best with Chrome on a bigger screen.) C++ and python3 are currently supported. Instructors can create coding assignments, grade assignments, and give feedback to students. Instructors can also post documents such as syllabi, schedules, links and videos to their class. The purpose of this talk is to demonstrate the system, with the objective of recruiting some beta testers who would be willing to try the system in their classes.

Microbiology

Section Chair: Chris Barton

Decontamination of raw milk from *Listeria monocytogenes* using high pressure pasteurization. **Abimbola Allison*, Shahid Chowdhury, and Aliyar Fouladkhah, Tennessee State University, Nashville, Tennessee.** Recent CDC epidemiological studies indicate approximately 99% of illnesses caused by *Listeria monocytogenes* are foodborne in nature, leading to hospitalizations in 94% of cases, and are responsible for collective annual death of 266 American adults. Current study investigates effects of elevated hydrostatic pressure on cell reduction and inactivation rates of *Listeria monocytogenes* at 4, 25, and 55°C. Various times (0 to 12 minutes) and intensity levels (0 to 380 MPa) of elevated hydrostatic pressure were investigated for inactivation of *Listeria monocytogenes* inoculated into raw milk as well as background microflora. Treatments below three minutes were less efficacious ($P \geq 0.05$) against the pathogen and background flora. The reduction ($P < 0.05$) of >3.0 log CFS/mL were observed as result of an optimized high-pressure pasteurization. Results of this study and calculated inactivation indices could be incorporated as part of a risk assessment and predictive microbiology for reducing the public health burden of listeriosis.

Heme-like gallium protoporphyrin IX inhibits catalase activity in *Acinetobacter baumannii*. **Brock Arivett, Middle Tennessee State University, Murfreesboro, Tennessee.** *Acinetobacter baumannii* is a bacterium that a serious threat to human health because of its occurrence in hospitals and increased rate of drug resistance leading to CDC estimates of 12,000 infections and 500 deaths per year. Most *A. baumannii* strains are multidrug resistant and some are not susceptible to any current antibiotic treatment. However, gallium protoporphyrin IX (GaPPIX), has recently been shown to kill multidrug resistant *A. baumannii*. Our goal is to understand the mechanism by which GaPPIX kills *A. baumannii*. We show *A. baumannii* treated with GaPPIX are more susceptible to hydrogen peroxide and catalase function is greatly diminished. Therefore, we suggest that GaPPIX is incorporated into catalase causing dysfunction and ultimately leading to cell death. These findings may provide critical information for iron metabolism in this important human pathogen, as well as support further inquiry into GaPPIX as a possible therapeutic option for recalcitrant *A. baumannii* infections.

Re-evaluation of CspZ, a complement regulator-acquiring surface protein of *Borrelia burgdorferi*, as a possible vaccine target for Lyme disease in a canine host. **Nerina Jusufovic* and Chad S. Brooks, Austin Peay State University, Clarksville, Tennessee.** Previous studies support the importance of complement regulator-acquiring surface protein 2 (CRASP2) also known as CspZ to the survival of *Borrelia burgdorferi* (Bb), the causative agent of Lyme disease, against host complement regulatory proteins such as

complement regulator factor H (CFH) and factor H-like protein 1 (CFHL-1). CspA (CRASP1) was discovered to be the main CRASP in humans, however, our data suggests CspA is not the main CRASP in canines. When mutant Bb containing CspA but lacking CspZ was exposed to dog serum, the mutant did not survive while wildtype Bb survived. The aim of this study was to evaluate if CspZ is the predominant CRASP allowing evasion of the alternate complement system in a canine host. Through cloning, experimentation to characterize CspZ was enabled. The data generated by this study should underscore the relevance of CspZ and may be the first step to an improved vaccine for canine-Lyme disease.

Mining microbial genomes of biotechnological significance, through metagenomic screening in goat rumen. **Santośh Thapa***, **Hui Li**, **Sarabjit Bhatti**, and **Suping Zhou**, *Tennessee State University, Nashville, Tennessee*. The uncatalogued cellulolytic bacteria in the goat rumen is hypothesized to depict an inexhaustible source of genomic innovation. A ruminal metagenomic library was constructed and functionally screened for cellulase and hemi-cellulase activities. Following assembly and annotation, fourteen gene clones encoding for cellulases, and hemicellulases were cloned and ten of them were further sub-cloned using TA and TOPO cloning strategy respectively. Gene sequences were confirmed using Sanger sequencing and submitted to the NCBI database. The identification of endo 1, 6 beta D- glucanase, endoglucanase D and endoglucanase E putatively responsible for its cellulolytic activity, the cloning and the recombinant expression of the gene in *Escherichia coli*, was characterized revealing to exhibit a relevant clear halo zone formation around the colonies on phytigel plates. Carboxyl-Methyl-Cellulose (CMC) assay demonstrated that endo 1, 6 beta D- glucanase was more efficient. This community could serve as an arsenal of novel multi-functional enzymes in biotechnological applications.

Physics and Astronomy

Section Chair: J. Allyn Smith

Neutron inelastic scattering on ^{134}Xe at $E_n = 5 - 8$ MeV. **Mary Kidd**, **Werner Tornow**, **Sean Finch**, **FNU Krishichayan**, and **Megha Bhike**, *Tennessee Tech University, Cookeville, Tennessee (MK)*, *Duke University, Durham, North Carolina (WT, SF, FNUK, MB)*. Neutrinoless double-beta decay ($0\nu\beta\beta$) studies are both the best way to determine the Majorana nature of the neutrino and determine its effective mass. The two main experiments searching for $0\nu\beta\beta$ -decay of ^{136}Xe (Q value = 2457.8 keV) are Kamland-Zen and EXO-200. Though both experiments have enriched ^{136}Xe targets, these targets still contain significant quantities of ^{134}Xe . Recently, a new nuclear level was discovered in ^{134}Xe that decays to the ground state emitting a 2485.7 keV gamma ray [1]. The γ -ray production cross section for this branch was

found to be on the order of 10 mb for incident neutron energies of 2.5 – 4.5 MeV. Here, we have extended the investigation of this level to higher incident neutron energies, and further explore the potential neutron-induced backgrounds on both ^{134}Xe and ^{136}Xe for extended neutron energies. We will report our preliminary results for neutron inelastic scattering on ^{134}Xe in applications to $0\nu\beta\beta$ decay searches.

Development of an open source, LED based, tunable light source. **William Kuenzinger*** and **Jason Alexander**, *The University of Tennessee at Martin, Martin, Tennessee*. Quantifying the sensitivity that photoreceptors (neurons in the retina that detect light) have to the different wavelengths across the visible spectrum requires and are usually based on learned responses by animals trained to monochromatic light (single color) as the rewarding stimulus. This requires a light source this widely tunable across the UV-VIS spectrum but with a narrow linewidth. Commercially available monochromators use xenon or tungsten lamp sources requiring expensive filters to maintain a constant light intensity as the wavelength of light is changed to satisfy the experimental conditions. Our monochromator design is based on LED sources, which can be temperature stabilized and current controlled for a flat output intensity. The control hardware and software is open source so that the device is a fraction of the cost of commercial sources. The monochromator will be used for behavioral analysis experiments to test the visual capacities and foraging preferences of various species.

Austin Peay State University's participation in the Citizen CATE Experiment. **Benton D. Fagan***, **Spencer L. Buckner**, and **J. Allyn Smith**, *Austin Peay State University, Clarksville, Tennessee*. During the 2017 solar eclipse, a team participated in The Citizen CATE (Continental-America Telescopic Eclipse) Experiment; one of sixty-eight observation sites set along the path of totality to image the corona during totality. Throughout summer prior to the eclipse, many hours were spent going over the procedures needed to achieve best view of the corona during totality. Part of the practice time was used to work with the Christian County, KY team on the proper telescope assembly and alignment procedure. Multiple test runs were completed, all without the removal of the solar filter. Prior to the eclipse the telescopes were assembled and properly aligned on site. During the experiment when the solar filter was removed, one flaw was discovered, and wasn't discovered in any of the training runs. There were other issues were uncovered, but these didn't detract from the experiment. The lessons learned will be implemented during the next eclipse.

Analysis of the generation of an anemone-type magnetic field by magnetic flux emergence in an on-disk coronal hole. **Mitzi L. Adams**, **Navdeep K. Panesar**, **Ronald L. Moore**, **Allyn F. Tennant**, and **Robert Woolley**, *NASA Marshall Space Flight Center, Huntsville, Alabama (MA, AF)*, *NASA Universities Space Research Association, Huntsville, Alabama*

(NP), University of Alabama in Huntsville, Huntsville, Alabama (RM), and Basis Chandler, Chandler, Arizona (RW). We report magnetic-flux emergence seen in a small coronal hole (~120" across), beginning approximately 19:00 UT on March 3, 2016. The event was observed by an amateur astronomer (RW) in an H-alpha movie from the Global Oscillation Network Group (GONG); the rapid emergence attracted the attention of the observer. We use data from the Atmospheric Imaging Assembly (AIA) of the Solar Dynamics Observatory (SDO), wavelengths 193 Å, 211 Å, 304 Å, and 94 Å, and magnetic-field data from the Helioseismic and Magnetic Imager (HMI). Data analysis and calibration activities are accomplished with SunPy. Flux emergence begins with the appearance of a bipole inside the coronal hole, followed by anemone expansion; the anemone eventually fills the coronal hole. We will discuss the magnetic evolution of this structure, how it is related to intensity brightenings seen in the various SDO/AIA wavelengths, and how this event compares with the *standard-anemone* picture.

How to find an exoplanet in a haystack of speckles. **Elizabeth J. Young**, Rhodes College, Memphis, Tennessee. The field of directly imaging exoplanets is rapidly advancing in a quest to image Earth-like planets and look for signs of life. This presentation will discuss the three main components needed to directly image an exoplanet: a coronagraph, a deformable mirror, and an algorithm. This presentation is an overview of each step with emphasis on the algorithm step. A significant challenge in the field is the fact that quasi-static speckles and planets appear to be similar within an image. However, speckles are derived from a single coherent source (the star) and are incoherent with the light from a planet. Therefore, the speckle pattern in an image can be changed, while leaving any planet light unaffected, by moving a deformable mirror within the coronagraphic system. I will present a technique to analyze a series of images containing different speckle patterns in order to confidently identify planets.

Searching for variables in the SDSS calibration fields. **J. Allyn Smith, Melissa J. Butner, Douglas L. Tucker, and Sahar S. Allam**, Austin Peay State University, Clarksville, Tennessee (JAS), Stanford Linear Acceleratory Center, Stanford, California (MJB), and Fermi National Accelerator Lab, Batavia, Illinois (DLT, SSA). We are searching the Sloan Digital Sky Survey (SDSS) calibration fields for variable stars. The valuable SDSS dataset taken by the 0.5m telescope, contains nearly 200,000 stars in more than 100 fields which were observed over the course of 8+ years during the observing portion of the SDSS-I and SDSS-II surveys. During the course of the survey, each field was visited from ~10 to several thousand times, so our initial pass is just to identify potential variable stars. Our initial "quick-look" effort shows several thousand potential candidates and includes at least one nearby supernova. We are present our plans for a follow-up observational program for further identification of variable types and period determinations.

Science and Math Teaching

Section Chair: Weston Dulaney

The STEM Center for Teaching and Learning. **John W. Overcash and Steve Elliott**, The University of Tennessee at Martin, Martin, Tennessee. The STEM Center for Teaching and Learning is part of a five-year, \$3.3 million U.S. Department of Education teacher quality partnership grant to the University of Tennessee at Martin. The center designs and delivers professional development workshops for K-12 mathematics and science teachers, provides loans of teaching equipment for classroom use, and emphasizes the importance of STEM education through visits to schools and civic organizations. The author will exhibit equipment available for loan and will share lessons learned from two years during which the center led more than fifty workshops.

STEM Academy: A summer program for NSF S-STEM Scholars. **Robbie Montgomery, Phillip Shelton, Michael Gibson, Jason Devito, Ray Witmer, and Bob Bradley**, The University of Tennessee at Martin, Martin, Tennessee. The STEM Academy is a two-week summer program to prepare students to be successful in their STEM courses at The University of Tennessee at Martin. The program is being developed to assist in increasing student preparedness in challenging STEM courses and in turn increase retention rates of STEM majors. Currently students receiving the S-STEM Scholarship at UTM are required to participate in the academy each summer. The program is designed to meet the needs of the scholars and covers courses in chemistry, biology, geosciences, mathematics, computer science and engineering. The course content is tailored to the needs of the scholars to review material that they are weak in and to introduce material they will see in the upcoming semester to ideally give them a head start. This presentation will focus on the design and implementation of the program, as well as the successes and failures of the academy to date.

Take a shot: Using simple calculations to explore how immunization programs protect populations from disease. **Darrell L. Ray**, The University of Tennessee at Martin, Martin, Tennessee. Many fields within the biological sciences lend themselves to quantitative and statistical methods, but few can bring home a more directly applicable lesson to students than the use of community immunization programs to protect populations against infectious diseases. Building on immunity concepts, this student participation exercise demonstrates why immunization programs are effective a) by first modeling a population challenged by an agent against which no one has immunity, then b) by applying a "herd immunity" plan to demonstrate how diseases can be controlled better through community immunization. In each example, students calculate values for descriptive measurements including incidence proportion and period prevalence to compare the patterns of new cases and active cases in a population. The basic protocol can be modified to reflect known pathogens with contemporary or historical interest,

and further modified to reflect death and recovery rates. Suitable for Middle School through Lower Division College/University.

Investigating the impacts of coal mining in a mountain-top removal watershed: an environmental case study for the college classroom. **LaRoy Brandt and Agnes Vanderpool**, *Lincoln Memorial University, Harrogate, Tennessee*. The Appalachian Wildlife Foundation (AWF) sits atop a 127 km² mountaintop removal mining site in Bell County, Kentucky. Last mined in the 1970s, the AWF property includes three first-order headwater streams that reach a confluence at the mountain's base. As such, the site provides a setting to investigate parameters indicating the impacts of coal mining on water quality. Furthermore, the location, provides a framework to guide students through an exercise tracking the source of a contaminant leak into one of the three tributaries that results in a fish kill in the mainstem stream. Methods for conducting this investigation in a college classroom are provided. Supplemental materials for the exercise include data sets and instructions to complete a chemical water quality analysis, a macro-invertebrate water quality index, and an analysis of species richness for fish collected from the tributary streams before and after introduction of the contaminant.

Using art to teach general and organic chemistry laboratories. **Sarah S. Pierce**, *Cumberland University, Lebanon, Tennessee*. Using art activities to teach chemistry has been shown to increase student engagement in the laboratory. Research has shown that when students learn chemical concepts through the lens of art, they understand the material better than their peers who were exposed to traditional methods of teaching. Within the last year, art activities were added to the curriculum in both general and organic chemistry at Cumberland University. The students learned about precipitation reactions by making sidewalk chalk, investigated oxidation reduction reactions by anodizing aluminum to make jewelry, synthesized Prussian blue to paint a picture, synthesized mauveine to dye a scarf, explored freezing point depression by making candles, and conducted microchemical tests that art conservators use. During this presentation, the use of each experiment will be discussed as well as student engagement.

Zoology

Section Chair: Tom Blanchard

Differential occurrence of ticks on small mammals based on age and sex. **Rebecca A. Butler***, **Rebecca Trout-Fryxell**, **Allan E. Houston**, **David Paulsen**, and **Michael L. Kennedy**, *The University of Memphis, Memphis, Tennessee (RAB, MLK)*, *The University of Tennessee, Knoxville, Tennessee (RTF, DP)*, *Ames Plantation, Grand Junction, Tennessee (AEH)*. An assessment of the occurrence of ticks on small

mammals, based on age and sex, was conducted at the Ames Plantation in Fayette and Hardeman counties, Tennessee, during 2013. Rodents were captured in forest and field habitats utilizing Sherman live traps baited with rolled oats. Following capture, animals were examined for ticks; sex and age determined, and body weight and standard external measurement recorded. Ticks were placed in 70% ethanol for later examination. Four species of ticks: deer tick (*Ixodes scapularis*), American dog tick (*Dermacentor variabilis*), gulf coast tick (*Amblyomma maculatum*), and lone star tick (*Amblyomma americanum*) were found to occur on five species of rodents: hispid cotton rat (*Sigmodon hispidus*), white footed deer mouse (*Peromyscus leucopus*), North American deer mouse (*Peromyscus maniculatus*), woodland vole (*Microtus pinetorum*), and golden mouse (*Ochrotomys nuttalli*). No statistically significant differences were detected in numbers of ticks associated with age or between males and females.

Comparisons of physiological limitations and genomic synteny in populations of *Mnemiopsis leidyi* (Ctenophora). **Logan N. Campbell***, **Alexandra M. Hernandez**, and **Joseph F. Ryan**, *Whitney Laboratory for Marine Bioscience, St. Augustine, Florida (LC, AH, JR)* *University of Florida, Gainesville, Florida (LC, AH, JR)*, and *The University of Tennessee at Martin, Martin, Tennessee (LC)*. *Mnemiopsis leidyi* is abundant along the Atlantic coast of both North and South America and can be found in a wide range of temperatures and salinities. Evidence from biogeography suggests major differences in stress tolerance between Massachusetts and Florida populations. No direct experiments have been conducted to confirm this, and the genomic basis underlying these differences is not well understood. Here we investigate the stress tolerance of Florida *M. leidyi* and compare a new unpublished genome of a Florida individual to the published genome of a Massachusetts individual. *M. leidyi* development under a combination of temperature and salinity stresses showed optimal development at a higher temperature and typical salinity when compared to published data. We compared all scaffolds with three or more genes from our Florida genome assembly to the Massachusetts assembly and found that 18 out of 32 had syntenic breaks. In conclusion, the results closely resembled our hypotheses.

Seasonal-activity patterns of the eastern woodrat (*Neotoma floridana illinoensis*). **Jessica Davin*** and **Michael L. Kennedy**, *The University of Memphis, Memphis, Tennessee*. Seasonal (fall, winter, spring, and summer) patterns of activity were determined for the eastern woodrat (*Neotoma floridana illinoensis*) at the Edward J. Meeman Biological Station in western Tennessee. The study site was located in temperate deciduous forest in northwestern Shelby County. We tested the hypothesis that there were differential patterns of activity across seasons. Activity was assessed utilizing infra-red triggered cameras at bait stations at multiple sites over a period of 2 years. Photographs were examined to

determine periods of activity. Results revealed that greatest-seasonal activity was during the fall and winter. In all seasons, nocturnal activity was greatest, but there was some activity throughout the 24-hour day; Results are discussed in light of the other studies.

Using scent-station procedures to monitor medium and large mammals. **James W. Gaines*** and **Michael L. Kennedy**, *Edward J. Meeman Biological Station and The University of Memphis, Memphis, Tennessee*. Scent-station procedures were used to assess species richness and develop scent-station indices to monitor medium and large mammal taxa. The study was conducted at the Milan Army Ammunition Plant in Gibson and Carroll counties in western Tennessee over multiple years. Standard scent-station procedures utilizing a circle of smooth sand (1 meter in diameter) with a cottonball saturated with an odor attractant placed in the center of the station was used to attract taxa. Presence of an identified track in the sand verified the presence of a species at the station. Stations were generally spaced about 322 meters apart with 10 station in a transect. Biodiversity was generally high with raccoons (*Procyon lotor*), Virginia opossums (*Didelphis virginiana*), and white-tailed deer (*Odocoileus virginianus*) being among the most common. Scent-station indices varied by species. Results are discussed in light of the literature.

An assessment of species richness of mammals at two urban sites in western Tennessee. **Felice A. Murden*** and **Michael L. Kennedy**, *Edward J. Meeman Biological Station and The University of Memphis, Memphis, Tennessee*. Species richness of mammals was examined at Shelby Farms Park and the Edward J. Meeman Biological Station in western Tennessee (during 2016 and 2017). Shelby Farms was located in the City of Memphis and the Edward J. Meeman Biological Station just north of the City. Occurrence of mammals was detected utilizing infrared triggered cameras in selected habitats. Results revealed several species at each site, both of which were dominated by raccoons (*Procyon lotor*) and white-tailed deer (*Odocoileus virginiana*). Occurrence of animals at the camera sites was greatest during the dark hours, but animals were observed throughout the 24-hour day.

Agricultural pest management yields new insight into movement of western pocket gophers (*Thomomys sp.*) **Brittany M. Pope***, **Juliann L. Waits**, **Roger A. Baldwin**, and **Michael L. Kennedy**, *The University of Memphis, Memphis, Tennessee (BP, ML)*, *Southwest Community College, Memphis, Tennessee (JW)*, and *University of California, Davis, Davis, California (RB)*. Sequence data for the cytochrome b gene from mitochondrial DNA was used to assess species recognition among samples of pocket gophers (*Thomomys sp.*) from various localities in agricultural lands spanning northern to southern California. The presence of rare species and species of special concern were central to the investigation. Specimens were collected using

standing trapping procedures and transported to the laboratory for examination. Sequences were compared to known samples provided from GenBank, and species recognition delineated. Specimens showed considerable variation in morphology and pelage color as well as in genetic variability. Northward expansion of one common species, *Thomomys bottae*, was observed. Explanations for movement are discussed in light of the literature.

An assessment of biodiversity of small mammals in anthropogenic edge habitat: is there an edge effect? **Sarah E. Swing*** and **Michael L. Kennedy**, *The University of Memphis, Memphis, Tennessee*. Biodiversity (including species richness, species evenness, total abundance, species diversity index, and dominance) were determined for small mammals in the eastern deciduous forest across three habitats (forest, field, and forest-field edge) using live-trapping procedures. The following predictions were tested: 1) biodiversity measures in edge habitat are different from measures in forest and field habitats, which indicates an edge effect; 2) temporal variability in biodiversity measures within individual habitat types is similar across years; and 3) patterns of annual biodiversity measures are correlated among habitats. Results did not indicate an edge effect, but annual variability within habitat types was observed. These results provide new insight into usage of habitats by small mammals, which should provide valuable information for management decisions.

Differences in habitat use among species of aquatic snakes in the Reelfoot Lake area of northwestern Tennessee. **Erik F. Velazquez*** and **Tom A. Blanchard**, *The University of Tennessee at Martin, Martin, Tennessee*. Although some studies have been conducted on microhabitat selection in aquatic snakes, few have addressed habitat use on a larger scale. We examined habitat use in six species of aquatic snakes in the Reelfoot Lake area of northwest Tennessee. We conducted visual surveys in six different habitat types associated with the Reelfoot Lake system. Three of the most frequently observed species were *N. rhombifer*, *N. fasciata*, and *N. erythrogaster*. All displayed a non-random pattern of habitat use. *Nerodia erythrogaster* used temporarily flooded wetland habitats more frequently than expected, whereas *N. rhombifer* was observed more often in lakeshore habitats. *Nerodia fasciata* used both temporarily flooded wetland and ditch/slough habitats more often than expected. *Nerodia rhombifer* tended to be found in areas near open canopy, but *N. erythrogaster* seemed to be more restricted to forested habitats farther from open water. *Nerodia fasciata* occurred in closed-canopy habitats and in more open areas.

Hibernation and hibernacula attributes associated with the timber rattlesnake (*Crotalus horridus*) at Centere Hill Lake in Dekalb County, Tennessee. **Danny L. Bryan**, *Cumberland University, Lebanon, Tennessee*. The timber rattlesnake (*Crotalus horridus*) is facing serious threats throughout the United States, with population studies indicating a decreas-

ing trend throughout its range. Maintaining protected hibernacula is critical to the viability and survival of the species. Identification of important habitat characteristics is needed to define optimal habitat. Natural hibernacula in this study were located on southwest-facing slopes with exposed limestone seams. Plots were established at 16 hibernacula and at 20 random locations to measure percent slope, aspect, percent exposed rock, total number of trees, total basal area, and densities of tree species to determine if differences existed. To summarize, percent exposed rock, presence of an exposed limestone rock seam, total number of trees, total basal area, slope position, and aspect are contributing factors when timber rattlesnakes are selecting hibernacula sites.

Life at the "Peay'Clipse" and Beyond: Observations on the behavior of several organisms in Tennessee and adjacent states during the Great American Eclipse of 21 August 2017. **Donald Sudbrink, Rodney Mills, Robert L. Moore, Emily Rendleman, John Fussell, Amy Wright, Mitzi Adams, Christina Galben, Thomas Payne, Lynn Faust, Hebron Smith**

and Stephen Smith. *Austin Peay State University, Clarksville, Tennessee (DS, RM, RLM, ER, JF, AW, CG, HS and SS), NASA Marshall Space Flight Center, Huntsville, Alabama (MA), Woodlawn, TN (TP), and Knoxville, TN (LF).* Numerous organismal behaviors have been observed and recorded during previous total solar eclipses ranging from no-effects to significant alteration of diurnal behaviors. To further investigate some of these phenomena during the Great American Eclipse of 21 August 2017, a series of observations of behaviors of several species of organisms were taken in Montgomery and Knox Counties in Tennessee, Todd County, Kentucky and Rutherford County, North Carolina. Behaviors of several species of insects, reptiles, birds, mammals, and plants were observed during this event. While a few organisms showed no effects near or during the totality of the eclipse, most observations indicated at least a temporary alteration of typical diurnal behavior for each organism studied. Typical diurnal behaviors of organisms were observed to resume after totality, albeit somewhat delayed in a number of species studied.