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PROPHAGE SF370.1 IS THE HELPER PHAGE OF *STREPTOCOCCUS PYOGENES* CHROMOSOMAL ISLAND SPYCIM[1]

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Introduction: *Streptococcus pyogenes* is a pathogen causing a wide range of infections, from pharyngitis to toxic shock syndrome. Chromosomal island SpyCIM1 mediates a growth-dependent mutator phenotype in *S. pyogenes*. Lacking structural genes, SpyCIM1 relies upon a helper prophage to package its DNA into phage capsids. In this study, we demonstrate that pyrogenic exotoxin C (*speC*) carrying prophage SF370.1 is this helper phage.
Methods: Strains CEM1Δ1 (SpyCIM1$^+$ SF370.1$^-$), CEM1ΔΦ (SF370 cured of all prophages), OKM77 (SF370 Δ*speC*::*ermB*) and OKM78 (SF370 Δ*speC*::*ermB* ΔSpyCIM1) were used. Mitomycin C (2 μg/ml) was used to induce prophages, which were purified by centrifugation. PCR and electron microscopy were used to identify the presence of SF370.1 or SpyCIM1 phage particles. Strains CEM1Δ1 and CEM1ΔΦ were used as a hosts for phage reinfection.
Results: Electron microscopy (EM) and molecular analysis demonstrated that prophage SF370.1 must be present to package and release SpyCIM1. Strains with SF370.1 but lacking SpyCIM1 released only phages with 65 nm heads while those with both released a mixed population of differing tail fibers. Strains lacking SF370.1 produced neither phage particles. Induced SF370.1 phages tagged with *ermB* were used to demonstrate rescue of SpyCIM1 packaging following its reintroduction. Optimum infection with SF370.1 occurred in early logarithmic growth.
Conclusion: The presence of prophage SF370.1 in the S. pyogenes genome is required for the packaging and release of SpyCIM1. SpyCIM1 and related chromosomal islands are very frequent in *S. pyogenes*, and our studies are the first to demonstrate its mechanism of dissemination.

ORGANIZING CAMERA TRAP DATA ON TERRESTRIAL WILDLIFE: A CASE STUDY FROM BELIZE

T. Scott Eaton, Jr.; Jacob Ward; Erik Terdal, Ph.D.
Department of Natural Sciences, Northeastern State University, Broken Arrow, Oklahoma, USA

Background: The use of camera "trapping" has become a vital technique for mammalogists within the past decade. The technology has greatly improved with the transition from film to digital photography. Camera traps consist of motion-activated cameras placed in a forested habitat, generally in pairs on opposite sides of a trail. These traps do not harm the animal and are invaluable for providing evidence of species presence, and, in species with distinctly variable pelage markings, individual identity. Traditionally, information about images on rolls of exposed film were organized in a spreadsheet format, whether it was hand-written or input into spreadsheet software. On each row, all the information contained from a photograph including the location, date, time and species is recorded. This is a very simple solution to manage camera trap data; however, it is extremely time consuming as the

number of photographs increases. Over the past decade, film cameras have been replaced. Digital cameras have vastly greater storage capabilities than their film predecessors. This allows camera traps to be checked less frequently and yield large numbers of photographs. **Case Study:** Pairs of cameras placed in January, 2010, at 15 sites in the Mountain Pine Ridge area of west-central Belize yielded 18,576 photographs from a total of 3,812 camera nights (sum of the number of days each camera was operational) during that year. Most cameras did not operate the entire year, and some were moved during the year, adding to the organizational complexity. Identification of animals must be done by a trained technician. In this case study, undergraduate students made a first pass, followed by the authors. Numerous errors in the spreadsheet were found. This led to a search for alternative tools for organizing the gigabytes of data generated. Information about each digital image (date, time) is stored in an EXIF file imbedded in the image that can simply be uploaded to a database application such as Camera Base. Here, we present a comparison of two database applications written by biologists and shared with colleagues, including the authors. Each has software "glitches" that prevent full functionality. However, we conclude that they reduce errors over hand-entry into a spreadsheet and facilitate export to statistical software for data analysis.

LASER IMMUNOTHERAPY FOR TREATMENT OF METASTATIC TUMORS

Cody Bahavar[1], Aamr Hasanjee[1], Ethan Wood[2], Dr. Wei R. Chen[1]

[1]University of Central Oklahoma Department of Engineering and Physics, [2]University of Central Oklahoma Department of Chemistry

Metastatic tumors are the major cause of cancer patient death. So far, there is no effective treatment method for metastatic tumors. We have developed laser immunotherapy, a novel approach using the combination of laser treatment and immunological stimulation to induce anti-tumor immunity to fight metastatic tumors. Our previous pre-clinical studies have shown that laser immunotherapy is effective in curing metastatic tumors. This new therapy includes two major components: laser photothermal interaction and immunological stimulation. The former is to achieve acute tumor destruction and the latter is for long-term cancer control. Several avenues of research are being pursued, such as the introduction of cyclophosphamide as a T-regulatory cell suppressant, the integration of single walled carbon nanotubes (SWNTs) into the procedure, and the application of the treatment to various forms of metastatic cancer. In this talk, we will present the overall method of laser immunotherapy and also provide the current status and future plans of several major directions we are working on to further advance laser immunotherapy.

GENETIC ANALYSIS OF TETRACYCLINE RESISTANT FECAL COLIFORMS ISOLATED FROM REFUGE BISON AND LONGHORN VERSUS AGRICULTURAL CATTLE.

Kheir, J., Frisby, T., Kaiser, M., and Frisby, D. Cameron University, 2800 W. Gore Boulevard, Lawton, OK, 73505

Background: Antibiotics are commonly used for a variety of therapeutic and non-therapeutic purposes. Often they are used therapeutically in the fight against both human and animal infections but they are also commonly used for non-therapeutic purposes as an additive to feed in many animal farms. Although numerous studies have been conducted to address concerns about the spread of antibiotic resistance (ABR) among bacteria associated with agriculture animals and human populations where selective pressure for resistance is presumably high, there is little data available regarding the spread of antibiotic resistance in bacteria associated with wild animal populations where presumably there is low selective pressure. The present study focuses on the prevalence of tetracycline (TET) resistance in bacteria isolated from wild populations of American bison and Texas longhorn cattle in the Wichita Mountains Wildlife Refuge in comparison to agricultural cattle. The data collected

will give us insight into the relative prevalence of TET resistance genes in bacteria from wild animal populations versus agricultural animals.

Methods: Samples were collected as swabs from freshly voided feces of the test animals. Fecal coliforms were isolated on MacConkey or Eosin Methylene Blue agar as Gram-negative, lactose-fermenters. Each isolate was then tested for resistance to TET on LB supplemented with the antibiotic. Standard PCR analysis was used to test each of the isolates for genetic markers known to confer resistance to TET. The markers we are currently testing include tetA, tetB, tetC and tetM, Primers for the 16S rRNA gene were used as a PCR control for each isolate.

Results: To date, fifty TET-resistant fecal coliform isolates from the various sources have been tested. Our data thus far indicates that tetB is the most abundant genetic marker in all of the test groups. It was present in 89% of all of the bison isolates, 33% of the longhorn isolates and 68% of the agricultural isolates with an overall abundance of 78%. The 16S control genetic marker was present in 100% of the isolates. Although testing for other markers is incomplete, our current data indicate that they appear to be less abundant.

Conclusion: Our current data indicate that tetB is a common genetic marker found in fecal coliform bacteria isolated from both wild animal populations and agriculture animals. The presence of similar genetic markers in isolates from the different environments with presumably different selective pressures for TET resistance, suggests the possibility that environmental contamination and / or vector transmission (flies, rodents, etc.), may contribute to the prevalence of these markers in bacteria from wild animals.

CONSUMER NUTRITION ENVIRONMENT DISPARITIES ARE ASSOCIATED WITH NEIGHBORHOOD WELLNESS.

Kelly D. Stephens, Redlands Community College; **Kristin N. Culver,** Oklahoma City-County Health Department, Oklahoma City, OK; **Christina M. Shay,** Univ of Oklahoma Health Sciences Ctr, Oklahoma City, OK

Introduction: Food availability is recognized to influence eating behaviors leading to obesity and poor cardiovascular health. This investigation examines associations between consumer nutrition environments and level of community wellness.

Methods: The Nutrition Environment Measures Survey in Stores (NEMS-S) was used to assess availability, quality and price of food options in supermarkets located in Oklahoma County. NEMS-S assesses a variety of food products commonly purchased in the U.S., including low-fat milk, fruits, vegetables, lean meats, and whole grain breads. The Oklahoma County Wellness Score was calculated according to major health and socioeconomic indicators.

Results: Zip codes with higher wellness scores exhibited higher NEMS-S score compared to those with lower OCWS (38.0 vs. 30.6, p=0.003). Although NEMS-S food quality and price scores were similar across all zip codes, food availability scores were higher in zip codes with higher wellness score compared to those with lower scores (27.91 vs. 2.6, p=0.001). Zip codes with lower NEMS-S scores had a higher percentage of households lacking access to a vehicle (6.07 vs. 16.00, p=0.001), higher proportion of minorities (50.86 vs. 20.67, p=0.015), and lower median household income ($27,954.38 vs. $61,370.79, p=0.000) compared to those with higher wellness scores.

Conclusions: Consumer nutrition environment disparities that limit access to healthy food options are unfavorably associated with regional indicators of health and socioeconomic status. Interventions promoting healthy food availability in neighborhoods with health disparities may be a strategy for improving the CV health of the population.

HYPOGENE KARST IN THE ARBUCKLE MOUNTAINS

Kevin W. Blackwood, East Central University

The Arbuckle Mountains are an extremely complex geologic province, characterized by thick sequences of intensely folded and faulted carbonates, sandstones, shales, and granites of the Late Cambrian through Mississippian. Karst and paleokarst features occur in relatively high densities within several limestones and dolostones and play a significant role in the storage and transport of groundwater. Knowing the origins, morphology, and distribution of these karst features is necessary for understanding the storage and transport of groundwater, as well as the evolution of the karst aquifers.

Traditionally, the origins and morphology of these karst features has been viewed as being epigenic, developing from the surface downward; however, recent studies have provided compelling evidence for a much more complex evolutionary history for the karsts. Analyses of more than 70 karst and paleokarst features display signatures from multiple morphological processes, with many displaying classic signatures for having occurred as a result of hypogenic origins and morphology from ascending waters.

Hypogenic karst signatures can be found in caves throughout the Arbuckle Mountains, but appear to dominate in the deep subsurface and in the surface regimes where deformation is most severe, such as the north flank of the Arbuckle anticline. Epigenic karst processes appear to dominate in the near surface regimes where deformation is less severe, such as the south flank of the Arbuckle anticline. Furthermore, many of the caves that appear epigenic contain many classic hypogene signatures, suggesting a possible hypogene history that has since been largely overprinted by epigenic processes.

COLUMN STUDY OF BIO-ELECTRIC REMEDIATION OF NITRATE IN GROUNDWATER SYSTEMS. Linzi Thompson, Dr. Guy Sewell. East Central University, Ada, OK.

Nitrate is increasingly becoming an environmental and health hazard as it contaminates groundwater through fertilizer runoff, leaking septic tanks, sewage discharge, and the erosion of natural deposits**.** This ongoing research involves developing a new way of enhancing bio-denitrification with ubiquitous bacteria through the use of electrical proton reduction to increase dissolved hydrogen levels in a simulated aquifer.

A bacterial enrichment was created from sediments and water collected from a local lake known to contain high concentrations of nitrate. The enrichment was fed various solutions of potassium nitrate, ethanol, and yeast extract to promote bacterial nitrate reduction. The solution was then pumped continuously through two columns filled with sand and two columns filled with soil to simulate an unconsolidated aquifer. Because bacteria have now colonized the columns, the ingoing and outgoing solutions of these columns are being monitored for nitrate levels as a known nitrate concentration is pumped through. Simultaneously, a negative potential charge is being applied to an electrode within a column of each soil type. This negatively charged electrode provides a dissolved hydrogen source, via proton reduction, and thus also a bio-oxidizable energy source which could enhance denitrification. Samples for ammonia are being taken to support the conclusion that nitrogen gas is the major end-product. From this data, a concentration curve will be created to show the relationship between nitrate levels and the addition of hydrogen through proton reduction. Rather than the expensive "pump and treat" method currently used, this research is intended to provide a cost-effective method of treating nitrate insitu. Solar panels with wires extended into groundwater could be set up to provide this added energy source. The process could be implemented in areas where financial and electrical resources are limited.

DETECTION OF *N. FOWLERI*, THE CAUSATIVE AGENT OF PRIMARY AMEBIC ENCEPHALITIS, BY IT'S DNA, IN BODIES OF WATER SURROUNDING TULSA, OK, BY REGULAR AND NESTED PCR. Corey Albertson, Aaron Abraham, Warren Booth, Jordan Hendrickson, Zeinab Hassan, Camay On, Tavis Phan, Sarah Pook, Erik Shook, and Marsha Howard. The University of Tulsa.

The free-living amoeba *Naegleria fowleri* is the causative agent of primary amebic meningoencephalitis (PAM), a rapidly fatal disease of the central nervous system. This disease is generally acquired nasally, while swimming and diving in freshwater lakes, ponds and splash pads which have accumulated standing water. Our goal of the present study was to detect *N. fowleri* in the local lakes and splash pads surrounding Tulsa, OK. Water samples were collected from Lake Fort Gibson, Keystone Lake, and Grand Lake as well as splash pads from Mohawk Park and others in Tulsa, in sterile centrifuge bottles. These samples were collected completely submerged under water to decrease the risk of contamination. Samples were then filtered through 0.45µm pore size filter paper and processed using the Mo-Bio DNA Extraction kit. Extracted DNA was Nano Dropped to verify amount and quality of DNA. Regular and Nested PCR was then ran for all samples using primers specifically for *N. fowleri, B. mandrillaris,* and *Acanthamoeba* spp. DNA was visualized using horizontal agarose electrophoresis. One hundred and twelve total lake samples were collected between May and July 2013. Of those 112 samples, 79% were positive for *N. fowleri* DNA, 29 for *B. mandrillaris*, and 54% for *Acanthamoeba* spp., with 95% of the samples from Keystone Lake being positive for *N. fowleri*. Sixteen of the collected samples were from splash pads, with 100% of them showing positive banding for *N. fowleri* DNA. Nested PCR is currently in progress. Initial results (18 samples) were negative for any amebic DNA. Based on these results, many of the surrounding lakes and splash pads of Tulsa, OK, indicate high cause for concern. Current and future work will continue to explore the incidence of amebic DNA in these and other recreational water sources.

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AMBROSIA ASYMPTOMATIC VIRUS 1 AND ITS CHARACTERIZATION.

Mukta Dutta, Nemat Sokhandan Bashir and Ulrich Melcher, Department of Biochemistry and Molecular Biology, Oklahoma State University, 246 NRC, Stillwater, OK 74078-3035 USA

The Plant Virus Biodiversity and Ecology project was undertaken to better understand the nature of plant-viral interactions and the possibility of the presence of non-pathogenic viruses. Plants from the Tallgrass Prairie Preserve (TPP) were systematically surveyed over 2005-2008 for the presence of viruses, resulting in the detection, using a virus-like particle enrichment method, of the genome a novel virus, Ambrosia asymptomatic virus 1 (AAV1), from *Ambrosia psilostachya* DC (western ragweed) and seven other viruses of the *Alpha-* or *Betaflexiviridae*. Here we present the genomic organization and genetic variability of AAV1. The virus has a single-stranded RNA genome of about 7448 nt which has six open reading frames (ORFs). Phylogenetic analysis of the coat protein ORF of the virus revealed similarities to those of members of the genus *Potexvirus* but whole genome and replicase ORF phylogenetic analysis strongly indicates that the virus should be placed in the genus *Mandarivirus*. No evidence of recombination was detected.

ANDROID APPS AND AI: UNDERGRADUATE RESEARCH PROJECTS.

Patrick Harrington, Northeastern State University.

This presentation addresses two undergraduate research projects in Computer Science supervised by the author. Undergraduate research typically takes place in our professional development, or "capstone," course at NSU. These two projects I supervised were noteworthy in that the project which addressed more traditional computing, in the area of artificial neural networks, directly led to the student procuring employment after graduation. The other student who worked on a project in a more cutting-edge and widely-used area of Java did not seek or obtain employment in this area of computer science.

WHAT SHOULD STUDENTS KNOW ABOUT COMPUTING?

Richard Matzen and Rad Alrifai, Northeastern State University

Students need computing skills to be successful in college and in the personal, professional, and societal aspects of their lives after they graduate, but there is no consensus or list of best practices on what knowledge and skills they need to have to. A survey was conducted at a national conference on Computer Science education to help evaluate the gap between what students should know and what they actually do know about computing by the time that they graduate. The survey results can help CS faculty and university administrators evaluate their curriculum in this important area.

IDENTIFYING EPITOPES FOR A COLLECTION OF ANTI-BACMV MONOCLONAL ANTIBODIES USING A LAMBDAVIRUS EXPRESSION LIBRARY

Kendall Hughes, BJ Redding, E.L. Blewett, Biochemistry and Microbiology, OSU-CHS 1111 W 17 St. Tulsa, OK 74107 (918) 561-8405

We studied Baboon Cytomegalovirus strain OCOM4-37 (BaCMV) for a model for understanding Human Cytomegalovirus. MAB are important tools for with any virus. We determined which viral protein anti-BaCMV MAB bound to. We cloned BaCMV genomic DNA into Lambda TriplEx to create an expression library. Using each monoclonal that worked in Western Blot, we screened the expression library to find positive clones. Positive clones were grown up, DNA extracted and submitted to the core facility for sequencing. The result-

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BIOINFORMATICS IN THE CLASSROOM.

E.L. Blewett, Oklahoma State University – Center for Health Sciences, Tulsa, OK

The amount of freely available nucleic acid and protein sequence data in public databases is increasing exponentially. We use a number of free, public domain or educationally licensed programs to search these databases, download sequences and analyze them. The students are able to install the software on their own computers and retain the software when the course is complete. This presentation will examine: Staden package for DNA analysis and trace alignment, pDraw for basic analysis and presentation, Clustal for nucleic acid or protein alignment, BLAST for nucleic acid or protein database searches and MEGA for inference of phylogeny. These programs run on Windows XP through – Windows 7 OS's and to some extent on Mac OS's. The programs and further information can be obtained at the following locations: Staden (staden.sourceforge.net), pDraw (www.acaclone.com), Clustal (www.clustal.org), BLAST (blast.ncbi.nlm.nih.gov/Blast.cgi) and MEGA (www.megasoftware.net). Sample data sets will be available at www.earlblewett.net. Uses of these programs in the classroom setting, uses in the laboratory and potential problems will be discussed.

THE ECONOMIC IMPACT OF TOURISM

Syed M. Ahmed, Bill W. Burgess, Jr., Business Research Center, School of Business, Cameron University

This study used the REMI model to determine the economic impact of Wichita Mountains Wildlife Refuge on the Comanche county economy. Tourism has significant economic impacts on the economy through job creation and income generation. These effects can be divided into: 1) direct impact 2) indirect impact and 3) induced impact. Direct impact results from the infusion of money directly into the economy from purchases on food, gas and other items by visitors to the refuge. Indirect impact results when sectors of the economy impacted directly by visitor spending have effects on other sectors of the economy. Induced impacts are additional impacts that are generated through new spending and creation of new jobs, stimulated by increased economic activities that result from the tours. Simulation for the economic impact of tourism on Comanche County was run using 2012-2013 data. The number of total visitors to the WMR refuge in year 2012-2013 was estimated to be 1.5 million. 34% of total visitors lived within 50 miles of the refuge. Assuming $45.00 per person for

food and other expenses (estimate given by the wildlife refuge office), total expenditure by local visitors is estimated to be $22,950,000. Assuming $55.00 per person for food, gas and other expenses, total money spent by outside visitors is estimated to be $49,500,000. The study finds that the Refuge contributes $14.00 million toward Gross Regional Product in year 2013 and $8 million toward Personal Income current dollars. The refuge creates 366 jobs in the county in year 2013.

FROM MAMMOTHS TO MEDICINE BLUFFS: THE CULTURE HISTORY OF THE WICHITA MOUNTAINS

Robert L. Brooks, Oklahoma Archeological Survey, University of Oklahoma, Norman, OK 73019

The Wichita Mountains has long served as a source of natural resources for native people as revealed by the prehistoric and early historic archaeological record. This presentation examines the nature of these natural resources and the opportunities they provided to these early inhabitants of southwest Oklahoma. I then turn attention to some 1000 archaeological sites on record for Comanche and Kiowa counties and the history of this work. Following sections of this study examine how native people adapted to changing environmental conditions while inhabiting the Wichita Mountains and surrounding landscape. The archaeological record represents an intriguing story of change in their livelihood over some 20,000 years. I will detail changing patterns in settlement, subsistence, and social practices, derived from archaeological research at key sites within the region. Concluding comments pertain to more recent history of the Wichita Mountains and how the presence of Europeans transformed this history.

HISTORICAL INDIGENOUS PEOPLES OF THE WICHITA MOUNTAINS REGION

Michael L. Cox, Department of History & Government, Cameron University, Lawton, OK 73505.

This paper examines the historic legacy of indigenous peoples in the greater Wichita Mountains region from early contacts with the Spanish in the 16th century to the establishment of the Wildlife Refuge in 1901.

The primary focus of the paper is an historical overview of key developments in the lives of the peoples of the southern Plains in this period. Of particular import was the introduction of European trade goods to peoples of the region. The horse, for example, revolutionized the lives of numerous people in the region, allowing numerous groups to establish the nomadic horse cultures of the 18th and 19th centuries for which Plains peoples became famous. Beginning in the Civil War period, pressures from the expanding United States coupled with the catastrophic decline of the bison population resulted in the establishment of the reservation system in southwest Oklahoma, where groups such as the Wichita, Caddo, Delaware, Kiowa, Plains Apache, Comanche, and Ft. Sill Apache eventually found themselves restricted to a reduced land base, with a substantial number, such as the Chiricahua Apache leader Geronimo, facing the additional reality of imprisonment at Ft. Sill. The late 19th century found indigenous peoples struggling to adapt to the dramatic changes wrought by reservation life. Many children entering either missionary sponsored or government-run schools designed to quickly assimilate them. Among adults, many worked to adapt to ranching or agricultural economies. Some became Christians, while others engaged in new religious practices such as the American Indian Church, which developed in the region under the leadership of the Comanche chief Quanah Parker, among others. Ultimately the allotment of tribal lands in southwest Oklahoma in the late 1890s dismantled the reservation system, resulting in both the influx of non-Native American settlers and the establishment of the Wichita Mountains Wildlife Refuge.

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Cody Bahavar[1], Aamr Hasanjee[1], Ethan Wood[2], Dr. Wei R. Chen[1]
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WICHITA MOUNTAINS: OKLAHOMA OUTPOST FOR THE ENDANGERED BLACK-CAPPED VIREO

Joseph A. Grzybowski, College of Mathematics and Science, University of Central Oklahoma, Edmond, OK 73034

Walter Munsterman; U.S. Fish and Wildlife Service, Wichita Mountain Wildlife Refuge, 32 Refuge Headquarters, Indiahoma, OK 73552,

Victor W. Fazio, III; 18722 Newell Rd., Floor 2, Shaker Heights, OH 44122.

The Black-capped Vireo (*Vireo atricapilla*) is a small songbird that occupied early-successional scrubland habitat from south-central Kansas south to the mountains in Coahuila, Mexico. It occurred in cross-timbers and prairie through central and west-central Oklahoma. Although little information exists, early accounts through the 1950s considered it locally common at some Oklahoma locations. However, in the mid-late 1980's, systematic searches for the vireo in Oklahoma found it at only 4 small areas. One of those, the Wichita Mountains, was estimated to contain about 50-70 pairs, most within an extensive burn zone from a few years previous; fewer than 20 pairs were located in the rest of the State. Threats to the vireo were identified as fire-suppression allowing its scrub habitat to mature, and brood parasitism by Brown-headed Cowbirds (*Molothrus ater*).

Management and monitoring began on the Wichita Mountains Wildlife Refuge and Fort Sill Military Reservation and included removal of cowbirds. Prescribed burns, wildfires and edaphic features of the Wichita Mountains helped maintain areas with appropriate habitat features. By 1993, the effective breeding population fluctuated to about 100 pairs. With improved management, and some opportunistic wildfires, vireo numbers increased through 2011 to reach more than 5000 pairs. The past two years have seen a small decline, likely in response to drought, but numbers are still above 5000 breeding pairs. Only a handful of birds are known to occur outside the Wichita Mountains in Oklahoma, making the Wichitas a unique outpost for this endangered species.

FAUNAL DIVERSITY OF THE WICHITA MOUNTAINS: A RESOURCE FOR TOURISM, CITIZEN SCIENCE, AND RESEARCH

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Situated mid-continent longitudinally and near the southern edge of the Great Plains, the granite uplift creating the Wichita Mountains sits perched in a climatological transition zone. The ecotonal vegetational habitats support an impressive array of animals. There are more than 290 bird species, 60 mammal species, 55 reptile species, 19 amphibian species, 36 fish species, and 2,000 species of insects (including 97 butterfly species and 97 odonate species) documented. This faunal diversity has been a tremendous draw for people in historical times for sightseeing, photography, surveys, hunting/fishing, wildlife management, and basic research. The Wichita Mountains Wildlife Refuge (WMWR), Great Plains State Park, Quartz Mountain State Park, and Fort Sill Military Reservation have preserved a significant portion of the range, much of which is available for tourism, citizen science, and research.

The WMWR remains one of the most visited refuges in the national system by the general public. Opportunities linking tourism and research include several ongoing citizen science projects, such as Christmas Bird Counts (CBC), Fourth of July Butterfly Counts, Breeding Bird Surveys, and feeder watches. The WMWR has held a CBC annually since 1968, with as many as 31 volunteers annually. The WMWR and Great Plains State Park have both hosted an annual Fourth of July Butterfly Count since the mid-1990s. Recent animal research conducted in the Wichita Mountains chain includes studies of collared lizards (*Crotaphytus collaris*), prairie lizards (*Sceloporus consobrinus*), Painted Buntings (*Passerina ciris*), Black-capped Vireos (*Vireo atricapillus*), Scissor-tailed Flycatchers (*Tyrannus forficatus*), elk (*Cervus canadensis*), bison (*Bison bison*), and prairie dogs (*Cynomys ludovicuianus*).

CONSUMER NUTRITION ENVIRONMENT DISPARITIES ARE ASSOCIATED WITH NEIGHBORHOOD WELLNESS.

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Introduction: Food availability is recognized to influence eating behaviors leading to obesity and poor cardiovascular health. This investigation examines associations between consumer nutrition environments and level of community wellness.

Methods: The Nutrition Environment Measures Survey in Stores (NEMS-S) was used to assess availability, quality and price of food options in supermarkets located in Oklahoma County. NEMS-S assesses a variety of food products commonly purchased in the U.S., including low-fat milk, fruits, vegetables, lean meats, and whole grain breads. The Oklahoma County Wellness Score was calculated according to major health and socioeconomic indicators.

Results: Zip codes with higher wellness scores exhibited higher NEMS-S score compared to those with lower OCWS (38.0 vs. 30.6, p=0.003). Although NEMS-S food quality and price scores were similar across all zip codes, food availability scores were higher in zip codes with higher wellness score compared to those with lower scores (27.91 vs. 2.6, p=0.001). Zip codes with lower NEMS-S scores had a higher percentage of households lacking access to a vehicle (6.07 vs. 16.00, p=0.001), higher proportion of minorities (50.86 vs. 20.67, p=0.015), and lower median household income ($27,954.38 vs. $61,370.79, p=0.000) compared to those with higher wellness scores.

Conclusions: Consumer nutrition environment disparities that limit access to healthy food options are unfavorably associated with regional indicators of health and socioeconomic status. Interventions promoting healthy food availability in neighborhoods with health disparities may be a strategy for improving the CV health of the population.

HYPOGENE KARST IN THE ARBUCKLE MOUNTAINS

Kevin W. Blackwood, East Central University

The Arbuckle Mountains are an extremely complex geologic province, characterized by thick sequences of intensely folded and faulted carbonates, sandstones, shales, and granites of the Late Cambrian through Mississippian. Karst and paleokarst features occur in relatively high densities within several limestones and dolostones and play a significant role in the storage and transport of groundwater. Knowing the origins, morphology, and distribution of these karst features is necessary for understanding the storage and transport of groundwater, as well as the evolution of the karst aquifers.

Traditionally, the origins and morphology of these karst features has been viewed as being epigenic, developing from the surface downward; however, recent studies have provided

compelling evidence for a much more complex evolutionary history for the karsts. Analyses of more than 70 karst and paleokarst features display signatures from multiple morphological processes, with many displaying classic signatures for having occurred as a result of hypogenic origins and morphology from ascending waters.

Hypogenic karst signatures can be found in caves throughout the Arbuckle Mountains, but appear to dominate in the deep subsurface and in the surface regimes where deformation is most severe, such as the north flank of the Arbuckle anticline. Epigenic karst processes appear to dominate in the near surface regimes where deformation is less severe, such as the south flank of the Arbuckle anticline. Furthermore, many of the caves that appear epigenic contain many classic hypogene signatures, suggesting a possible hypogene history that has since been largely overprinted by epigenic processes.

COLUMN STUDY OF BIO-ELECTRIC REMEDIATION OF NITRATE IN GROUNDWATER SYSTEMS

Linzi Thompson, Dr. Guy Sewell. East Central University, Ada, OK.

Nitrate is increasingly becoming an environmental and health hazard as it contaminates groundwater through fertilizer runoff, leaking septic tanks, sewage discharge, and the erosion of natural deposits. This ongoing research involves developing a new way of enhancing bio-denitrification with ubiquitous bacteria through the use of electrical proton reduction to increase dissolved hydrogen levels in a simulated aquifer.

A bacterial enrichment was created from sediments and water collected from a local lake known to contain high concentrations of nitrate. The enrichment was fed various solutions of potassium nitrate, ethanol, and yeast extract to promote bacterial nitrate reduction. The solution was then pumped continuously through two columns filled with sand and two columns filled with soil to simulate an unconsolidated aquifer. Because bacteria have now colonized the columns, the ingoing and outgoing solutions of these columns are being monitored for nitrate levels as a known nitrate concentration is pumped through. Simultaneously, a negative potential charge is being applied to an electrode within a column of each soil type. This negatively charged electrode provides a dissolved hydrogen source, via proton reduction, and thus also a bio-oxidizable energy source which could enhance denitrification. Samples for ammonia are being taken to support the conclusion that nitrogen gas is the major end-product. From this data, a concentration curve will be created to show the relationship between nitrate levels and the addition of hydrogen through proton reduction. Rather than the expensive "pump and treat" method currently used, this research is intended to provide a cost-effective method of treating nitrate insitu. Solar panels with wires extended into groundwater could be set up to provide this added energy source. The process could be implemented in areas where financial and electrical resources are limited.

DETECTION OF N. FOWLERI, THE CAUSATIVE AGENT OF PRIMARY AMEBIC ENCEPHALITIS, BY IT'S DNA, IN BODIES OF WATER SURROUNDING TULSA, OK, BY REGULAR AND NESTED PCR.

Corey Albertson, Aaron Abraham, Warren Booth, Jordan Hendrickson, Zeinab Hassan, Camay On, Tavis Phan, Sarah Pook, Erik Shook, and Marsha Howard. The University of Tulsa.

The free-living amoeba Naegleria fowleri is the causative agent of primary amebic meningoencephalitis (PAM), a rapidly fatal disease of the central nervous system. This disease is generally acquired nasally, while swimming and diving in freshwater lakes, ponds and splash pads which have accumulated standing water. Our goal of the present study was to detect N. fowleri in the local lakes and splash pads surrounding Tulsa, OK. Water samples were collected from Lake Fort Gibson, Keystone Lake, and Grand Lake as well as splash pads

from Mohawk Park and others in Tulsa, in sterile centrifuge bottles. These samples were collected completely submerged under water to decrease the risk of contamination. Samples were then filtered through 0.45μm pore size filter paper and processed using the Mo-Bio DNA Extraction kitÔ. Extracted DNA was Nano Dropped to verify amount and quality of DNA. Regular and Nested PCR was then ran for all samples using primers specifically for N. fowleri, B. mandrillaris, and Acanthamoeba spp. DNA was visualized using horizontal agarose electrophoresis. One hundred and twelve total lake samples were collected between May and July 2013. Of those 112 samples, 79% were positive for N. fowleri DNA, 29 for B. mandrillaris, and 54% for Acanthamoeba spp., with 95% of the samples from Keystone Lake being positive for N. fowleri. Sixteen of the collected samples were from splash pads, with 100% of them showing positive banding for N. fowleri DNA. Nested PCR is currently in progress. Initial results (18 samples) were negative for any amebic DNA. Based on these results, many of the surrounding lakes and splash pads of Tulsa, OK, indicate high cause for concern. Current and future work will continue to explore the incidence of amebic DNA in these and other recreational water sources.

WICHITA MOUNTAINS WILDLIFE REFUGE BISON MANAGEMENT

Daniel T. McDonald, U. S. Fish & Wildlife Service, Wichita Mountains Wildlife Refuge, 32 Refuge Headquarters, Indiahoma, OK 73552

North American plains bison (Bison bison), which in the 17th century numbered over 25 million and occurred over much of the continental United States, southern Canada and northern Mexico, were by the end of the 19th century limited to less than 30 animals in Yellowstone National Park and isolated individuals in zoos or private captivity. Through the efforts of the American Bison Society and the New York Zoological Society, on October 11, 1907, 15 bison from the New York Zoological Park were shipped by rail to the Wichita Mountains Wildlife Refuge. An additional four bison from Fort Niobrara National Wildlife Refuge were added to the herd in 1940. From those humble beginnings the current population is approximately 550 bison and has reached levels of almost 1,000. Management philosophy has changed over the years to the present framework of conservation genetics and using a metapopulation approach. Loss of genetic variation in bison herds is more likely when numbers of breeding animals is small. Our best estimates are that bison populations can generally be considered of sufficient size for genetic purposes when the population size is 1,000 animals or more and the size of the population is stable over time. Because most Department of Interior (DOI) bison herds are below the target level of 1,000+ animals, it has been important to develop satellite herds to attain population targets. As such, DOI has developed a metapopulation structure between herds, whereby animals from one herd may be moved to another to sustain genetically healthy animals over time. To accomplish this, annual roundups are conducted to keep the population within Refuge carrying capacity and to conduct herd health monitoring. As part of the conservation genetics framework, in 2007 we began inserting microchips (PIT tags), behind the left ear, to identify individuals and determine baseline genetic diversity. To accomplish this, tail hair and blood samples are collected from each animal not already "tagged". In addition to genetics analysis, disease exposure is also monitored. Because of the small size (500-1,000) of the Refuge bison herd genetic analysis is important to maintain the genetic diversity, reduce genetic drift, and preserve animals with rare alleles on the Refuge. In doing so, we play an important role in the long-term conservation of this iconic animal.

A WINDOW TO THE WICHITAS – THE ART AND PHOTOGRAPHY OF KATHERINE LIONTAS-WARREN AND THOMAS RUSSELL

Katherine Liontas-Warren, Department of Art, Cameron University, Lawton, OK 73505
Thomas Russell, Associate Professor Emeritus, Cameron University, Lawton, OK 73505

During the Wichita Mountains Symposium Katherine Liontas-Warren presented a series of eleven engravings and charcoal sketches of scenes in the Wichita Mountains. Thomas Russell presented a series of 40 color photographs of scenes in the Wichita Mountains.

Mr. Russell was born in a small town in southwest Oklahoma and notes that his love for the Wichita Mountains began at a very early age. On weekends during summers he and his family spent many weekends in the mountains. He has fond memories of the lakes where he swam, the original entry arch by Medicine Park, and climbing on the rocks. When he was about eight years old he received a camera as a birthday present and has been taking photographs ever since. He is now a 64 year old amateur photographer and his favorite place in the world to take pictures is the Wichita Mountains. The photos Mr. Russell included in this exhibition reflect his favorite areas of the Wichita Mountains, including the Narrows, Monolith Boulder, Panther Creek, and more. For many of these photos he used a digital photo technique called High-Dynamic-Range (HDR) imaging that allowed him to make three or more lighter to darker images of the same subject, and then blend them together to more accurately reflect the range of light intensity levels found in the actual subjects. HDR imaging thus generates photographs that more accurately portray the appearance of the image that was actually seen through the camera lens.

Additional invited speakers presented during the Wichita Mountains Symposium but their abstracts were not available for inclusion in this publication, including the following:

SIGNIFICANCE OF THE WICHITA MOUNTAINS IN THE FLORA OF OKLAHOMA

Bruce Hoagland, Oklahoma Biological Survey and Department of Geography and Environmental Sustainability, University of Oklahoma

A DECADE OF FIRE ECOLOGY RESEARCH IN THE WICHITA MOUNTAINS

Ralph Godfrey, U.S. Fish and Wildlife Service, Wichita Mountains Wildlife Refuge, 32 Refuge Headquarters, Indiahoma, OK 73552

THE CLIMATE OF THE PAST, PRESENT, AND FUURE AND THE IMPACT ON OKLAHOMA

Gary McManus, Oklahoma Climatological Survey, The University of Oklahoma. 120 David L. Boren Blvd., Suite 2900, Norman, OK 73072