

Presentations listed in alphabetical order per the last name of the presenting author.

Gene Expression of Corn Earworm (*Helicoverpa zea*) when infected with *Pseudomonas aeruginosa* Bacteria

Bayan Aljamal, Western Illinois University

The Corn Earworm, *Helicoverpa zea* (Boddie), is the second most serious economic pest of agricultural crops in North and South America. In order to study the immune response of *H. zea* to infection by various pathogens we infected them with *Pseudomonas aeruginosa* bacteria. *Pseudomonas aeruginosa* is a pathogenetic pest because of their ability to produce extracellular enzymes and toxins that destroy the physical barriers and infect host cells. This study examined *H. zea*'s immune response to infection as well as provide information on how to overcome their defense system for the development of biocontrol methods. One of the main focus of this experiment is to compare the growth, survival, and gene expression of *H. zea* when it consumed a diet treated with *P. aeruginosa* or bacteria-free diet for 72 hours. Larvae that fed on the diet containing *P. aeruginosa* had a statistically significant increase in mortality compared with control. Microarray analysis was done to measure the expression level of larvae that fed on *P. aeruginosa* diet and bacteria-free diet. The expression of 3397 genes was significantly different between the two treatment groups. Out of this total, ~31% of the genes (1067 genes) have unknown functions, and ~ 69% of the genes (2290 genes) have known functions. The main categories that had significantly different gene expression were categorized according to their specific major functions including, but not limited to, encoding for metabolism, digestive, immune system, and cell growth. Caterpillars infected with *P. aeruginosa* showed a significantly different gene expression pattern compared to control. This research determined the immune reaction of *H. zea* in response to bacterial infection. This information will be useful in figuring out how to make *H. zea* more susceptible and increasing control of this pest. **Coauthors:** Richard Musser

Effects of Harassment on Behavior and Movement of Canada Geese (*Branta canadensis*) in an Urban Park

Ryan J. Askren, Illinois Natural History Survey

Increasing abundances of Canada geese (*Branta canadensis*) wintering in urban areas have led to a host of human-wildlife conflicts including feces deposition, human health risks, and aircraft collisions. Harassment is the primary tool wildlife managers use to deal with nuisance goose abundances yet has been deemed ineffective at changing goose abundances in an area or reducing issues in longer time periods. However, the effects of harassment at the individual level are poorly studied, especially in winter when harassment may have more dire consequences. The objectives of this study were to examine the effects of targeted harassment on 1) average daily movement distances, 2) foraging and alert behaviors, and 3) overall dynamic body acceleration (ODBA) as an index of energetic expenditure. We used data from 41 geese marked with GPS transmitters in the Chicago Metropolitan Area. Harassment efforts were conducted during winters of 2017 – 2019 by US Department of Agriculture – Wildlife Services personnel at an urban park near Midway International Airport as part of ongoing efforts to reduce risk to air traffic. We compared average daily movement distance and ODBA of geese that in and out of harassment areas. In addition, we quantified differences in proportional habitat use of geese between treatments. Canada geese subjected to harassment moved more than unharassed geese December - February ($\bar{x}_{\text{harassed}} = 396.6 \pm 54.5 \text{ SE}$, $\bar{x}_{\text{unharassed}} = 238.9 \pm 38.5 \text{ SE}$) but had little effect on behaviors. The lack of behavioral response is likely a product of plasticity in habitat use, allowing

them to simply relocate as a short-term response to harassment. **Coauthors:** Michael P. Ward, Michael W. Eichholz, Heath M. Hagy, and Brian E. Washburn

Understanding Trends in Furbearer Populations Using Multiple Data Sources

Javan M. Bauder, Illinois Natural History Survey

Furbearers are economically and ecologically important species, yet long-term population monitoring of furbearers over broad spatial extents is logistically and analytically challenging. Many state wildlife agencies, including the Illinois Department of Natural Resources, collect data on furbearer abundance and harvest and these long-term datasets provide a potentially powerful approach for monitoring population trends. However, the extent to which variation in these datasets represents variation in population size is often unknown due to confounding effects of ecological, economic, and/or climatic factors and observational and sampling biases (e.g., imperfect detection). We present an overview of our ongoing efforts to evaluate and compare trends of furbearers in Illinois using data collected by five different methodologies: roadkill counts, spotlight counts, trapper harvest surveys, fur buyer records, and archery deer hunter surveys. We use these data to evaluate the influence of confounding factors, compare trends using statewide and site-level estimates, and compare trends among sampling methodologies. We illustrate these approaches using data from raccoons (*Procyon lotor*). Data from roadkill counts, fur buyer reports, and trapper harvest surveys were collected from 1977-2016, spotlight counts from 1980-2016, and archery deer hunter surveys from 1983-2012. We found that the influence of confounding factors was similar across datasets and that site-level estimates provided more robust inferences than statewide annual estimates. Our data suggest that statewide abundance of raccoons in Illinois has increased over the past three decades. We highlight the importance of collecting site- and trapper-level data to account for possible confounding factors and biases. Our analytical approaches are readily applicable to other furbearing species detected using these sampling methods. We recommend quantitatively rigorous comparisons, particularly those accounting for confounding factors and potential biases, of long-term data collected using different sampling methods for assessing the utility of such data for monitoring furbearer populations. **Coauthors:** Kirk W. Stodola, Thomas J. Benson, Craig A. Miller, and Maximilian L. Allen

Estimating Density of Bobcats in Midwestern Landscapes Using Spatial Capture-Recapture Models

Edward D. Davis, Western Illinois University

A variety of increasingly sophisticated methods are available for estimating population density from capture-recapture studies. Among these, spatial capture-recapture (SCR) models provide a rigorous analytical technique for inference that extends standard closed population models to include a spatially explicit model by accounting for the distribution of individuals in space. Spatial capture-recapture models rely on spatial information readily available with camera data and use distance between traps and animal activity centers to model spatially explicit (i.e., camera trap) encounter probabilities and have been used in population density estimation for a range of carnivores. We used Bayesian analyses to evaluate the utility of SCR models for estimating density of bobcats in an agriculturally dominated landscape of west-central Illinois. We defined the continuous state space by overlaying the trap array on a square region extending 5 to 20 km beyond camera traps in each cardinal direction. We deployed 50 camera stations over a 77-day period from 1 February-18 April 2017. We captured 23 uniquely identifiable bobcats 115 times and recaptured these same individuals 92 times. Our analysis revealed a slight effect on the posterior distribution of density for the 5-km continuous state-space model, though

posterior summary statistics for the 10-km, 15-km, and 20-km continuous state-space models were similar. Densities ranged from 1.44–1.57 bobcats per 100 km² with a 95% posterior interval of 1.07 to 1.90. Variation in the state-space extending beyond trap arrays affect bobcat density estimates and should be sufficiently large to minimize encountering individuals with activity centers (i.e., home ranges) beyond the state-space boundary. Increased size of home ranges of bobcats across Midwestern landscapes may necessitate the use of relatively coarser survey grids in SCR models to account for frequent movements to and from the state space or whose core areas are positioned beyond camera survey unit boundaries. **Coauthors:** Tim C. Swearingen, Robert W. Klaver, Charles R. Anderson, Christopher S. DePerno, Jonathan A. Jenks, Robert D. Bluett and Christopher N. Jacques

Evaluating Survival and Cause-Specific Mortality of Adult Bobcats in West-Central Illinois

Edward D. Davis, Western Illinois University

Increased understanding of mortality of bobcats (*Lynx rufus*) is a prerequisite to successful management programs, particularly as it relates to population dynamics and the role of population models in adaptive species management. Survival and cause-specific mortality of bobcats have not been documented in agriculturally-dominated Midwestern landscapes. Thus, our objective was to evaluate survival and cause-specific mortality rates of adult bobcats across agriculturally dominated landscapes of west-central Illinois. We captured and radio-collared adult bobcats (n = 38; 20 males, 18 females) from January 2016 to October 2018. We used known fate models in Program MARK to investigate the influence of intrinsic (i.e., year, season, sex, weight) variables on bobcat survival. The highest-ranked model indicated that bobcat survival was best explained by a model in which survival varied by season (breeding [BS], parturition [PT]). Estimated seasonal survival rates for model S(season) were 0.95 (95% CI = 0.61–1.00), 0.59 (95% CI = 0.21–0.98), 0.92 (95% CI = 0.76–1.00), 0.93 (95% CI = 0.76–1.00), 0.79 (95% CI = 0.63–0.95), and 0.91 (95% CI = 0.80–0.98) for 2016 BS, 2016 PT, 2017 BS, 2017 PT, 2018 BS, and 2018 PT, respectively. Annual survival rates for 2016, 2017, and 2018 were 0.43 (95% CI = 0.09–0.85), 0.83 (95% CI = 0.51–0.96), and 0.77 (95% CI = 0.55–0.90), respectively. We documented 14 deaths during our study; harvest was the leading cause of mortality and accounted for 7 (50%; [3 legal, 3 illegal, 1 incidental harvest]) mortalities. We attributed remaining deaths to vehicle collision (n = 5), other (n = 1), and capture-related factors (n = 1). Bobcat survival monitoring is ongoing through 2019 and will evaluate potential effects of habitat covariates on seasonal and annual survival. **Coauthors:** Tim C. Swearingen, Robert W. Klaver, and Christopher N. Jacques

Role of Hunters, Farms and Game Birds in Long-Term Wildlife Conservation

Jared Duquette, Illinois Department of Natural Resources

Participation in hunting has declined for decades in many states, but particularly in Illinois. From the mid-1970's to 2017, the number of hunters declined by 45%. The continued decline of hunters threatens the future of wildlife conservation in Illinois for several reasons, but particularly revenue required to support wildlife conservation programs. Despite this threat, a paucity of research exists assessing factors contributing to the long-term decline of hunting in Illinois. I used generalized linear regression modeling to assess number of hunting license purchasers relative to variables in categories of farm characteristics, land use, weather and upland birds and human population from 1940–2017. Variables were modeled with same year, one-year and two-year lags. Models predicted quail abundance ($R^2 = 0.97$) and two-year lag of total number of farms and mean farm acres ($R^2 = 0.90$) best explained variability in hunting licenses. Seven other variables across categories, except weather, had $R^2 > 0.70$. Results suggested

several variables contributed to the long-term decline of hunting participation in Illinois, but predominantly indicated that as the number of farms decreased, their size became larger, presumably due to large-scale and precision farming practices decreasing the amount of habitat for upland birds, such as quail. These factors appeared to in-turn elicit a “diminishing averages” affect upon the primary cohort of hunters (i.e., Baby Boomers), who primarily hunted upland birds prior to the existence of huntable statewide populations of white-tailed deer and turkey in Illinois. Governmental policies and human behavior in relation to results are discussed.

Potential Impact of Forest Mesophication on Insectivorous Forest Dwelling Organisms

Mike Eichholz, Southern Illinois University Carbondale

Modifications to disturbance regimes have landscape-level effects on plant communities and have the potential to influence organisms at multiple trophic levels. We examined differences in the arthropod community across a gradient of oak/hickory dominance, a plant community maintained by disturbance such as periodic fires and extensive land clearing three predictions: (1) oak (*Quercus*) and hickory (*Carya*) species contain more foliage arthropod biomass and diversity than mesic tree species (e.g. American beech [*Fagus grandifolia*] and maples [*Acer* spp.]), (2) due to plant associations, arthropod communities are more diverse and abundant on host trees within oak/hickory stands than non-oak/hickory stands, and 3) because xerophytic tree species tend to produce more deeply furrowed bark that protects trees from overheating, we predicted we would catch a greater number and more diverse community of arthropods on the trunks of xeric relative to mesic tree species. Our results were consistent with the prediction that arthropod biomass, guild Shannon diversity, and guild richness are higher on oaks, hickories and tulip tree (*Liriodendron tulipifera*) than beech and maples. We also found support for the prediction that due to plant associations, % non-oak/hickory stand composition negatively influenced arthropod guild Shannon diversity and guild richness on host trees, including maples and beech. Furthermore, we found the model that included tree species to be most parsimonious when describing variation in trunk arthropod diversity, total arthropod length (as a surrogate for biomass), and arthropod abundance, but not arthropod richness. These results suggest that continued mesophication of southeastern deciduous forests may be detrimental to foliage, branch, and trunk gleaning insectivores, primarily due to the loss of hickory in the forest community. **Coauthors:** Kevin Sierzega and Elise Zarri

Efficacy of Aerial Photography for Estimating Visibility Bias and Abundance of Waterbirds During the Nonbreeding Season

Andy Gilbert, Illinois Natural History Survey

Important aspects of contemporary wildlife surveys for use in adaptive management frameworks include logistical practicality, cost efficiency, and minimal or estimable visibility bias. While logistical and financial feasibility can be readily determined before surveys, assessing visibility bias can be costly due to the number of personnel or equipment needed, impractical if timing or observer constraints prevent repeated sampling or introduce additional sources for error, and challenging to continually address if it affects resulting estimates in a biologically meaning way over time. To evaluate the efficacy of using low-altitude aerial photography to estimate visibility bias and abundance of waterfowl and other waterbirds during aerial surveys, we calculated error rates by comparing abundances obtained from aerial photographs to visibility-bias corrected abundances obtained during aerial surveys. Overall, error

rates tended to be high ($100\% \pm 48\%$) for abundance estimates calculated from aerial photographs, and those rates may be attributed to a small portion of the survey area covered by photographs combined with non-random waterbird distribution. Large variation in the number of waterfowl and other waterbirds per photograph necessitates photographing a large portion ($\geq 81\%$) of a survey location for precise abundance estimates. For this reason, low-altitude photographic-style aerial surveys would require more time and cost than traditional aerial surveys and do not appear to be a cost or logistically-efficient method for large scale monitoring of abundance and visibility bias of waterfowl and other waterbirds. **Coauthors:** Christopher Jacques, Heath Hagy, Joseph Lancaster, and Aaron Yetter

Comparison of Mink Home Range Estimation Methods and a Proposed New Estimate

Richard Halbrook, Southern Illinois University Carbondale (Emeritus) and TG&G Wildlife Consulting

Although the American mink (*Neovison vison*) is a fairly common and valued semiaquatic furbearing species, studies evaluating space use by mink in North America are scarce. We implanted radiotransmitters in 8 male and 6 female mink living within 3 km of the Hudson River between Hudson Falls and Northumberland Dam, New York, USA, during 2009–2011 and estimated Minimum Convex Polygon (MCP), Minimum Bounding Circle (MBC), and Kernel Density Estimate (KDE) home ranges. We also estimated an Ecological Home Range (EHR) using habitat characteristics known to be important to mink. The MBC, MCP, and 95% KDE estimation methods produced home ranges that appear to include area not actually used by mink, while the EHR method appeared to more accurately reflect space used at a finer scale. The mean 95% KDE home-range estimate was 2.3 times greater than the mean MCP estimated home range and 3.3 times greater than the mean EHR estimate. The size of individual mink EHRs ranged from 23 to 164 ha and did not differ between male and female. Our results indicate that mink home ranges can be quite variable and demonstrates the importance of selecting an estimation method based on management objectives. Home-range curves and asymptotes calculated using the Michaelis–Menten equation are provided; Site Fidelity and Time To Statistical Independence calculations reported in the rhr package of the Program R Statistical software are discussed. **Coauthor:** Marty Petach

Forest Bird Communities in Response to the Aerial Spraying of Honeysuckle and Prescribed Fires

Kai Hardy, University of Illinois at Urbana-Champaign

Bush honeysuckle (*Lonicera maackii*) is a non-native and invasive shrub that outcompetes native vegetation for essential resources in temperate deciduous forest ecosystems throughout much of the Eastern and Midwestern United States. To control bush honeysuckle, habitat management teams throughout west-central Illinois have recently begun using aerial herbicide applications. This method of control appears to be more efficient and economical than traditional methods. Aerial spraying presumably has the potential to become popular among agencies. However, before massive adoption takes place, more studies on the effects of aerial spraying on wildlife are needed. In our study, we investigated how aerial spraying affected the forest bird communities, with particular attention given to species of regional concern and in decline. We predicted that aerial spraying would create a more desirable habitat for declining avian species that use open woodlands. We conducted 5-minute point-count surveys twice at each station (46 point-count stations across 12 control and 10 spray sites) during the breeding season of 2017 and 2018, and identified birds by sight and sound within 100 meters. Our results suggested there was no improvement in the abundance of our target species from the aerial

spraying of honeysuckle. Furthermore, species richness did not differ between treatment and control groups. When we isolated species based on habitat guild, we found canopy species were the most abundant throughout our surveys. Eastern wood-pewees (*Contopus virens*) and Acadian flycatchers (*Empidonax virens*) were the most abundant species and species in sharp decline were the least abundant. Future analyses will incorporate honeysuckle data from count stations as there was considerable variation in honeysuckle cover across stations even among control sites. We suggest more research on the impacts of aerial spraying on avian communities and wildlife must be performed before widely implementing this management method. **Coauthor:** Justin Shew

Using Single Nucleotide Polymorphisms to Estimate Genetic Diversity Among Franklin's Ground Squirrels in Central Illinois: Preliminary Results

Matthew A. Hayes, University of Illinois at Springfield

Franklin's ground squirrel (*Poliocitellus franklinii*; FGS) are declining in Illinois. We live-trapped FGS at two sites (north and south) in Sangamon County, Illinois. We collected tissue samples in 2017 and 2018 and carcasses 2012-2018. We compared them to three carcasses collected in Canada in 2004 and 2014. We estimated genetic diversity using Single Nucleotide Polymorphism (SNPs) loci generated by genotyping-by-sequencing without a reference genome. We retained 862 SNPs after removing loci that were not in Hardy-Weinberg Equilibrium and showed linkage correlation greater than 0.2. The north site (n = 67) had the highest observed and expected heterozygosity ($H_o = 0.484$, $H_e = 0.401$) followed by the south site (n = 2; $H_o = 0.179$, $H_e = 0.096$) and Canada (n = 3; $H_o = 0.092$, $H_e = 0.051$). Similar results occurred with percent polymorphic loci (99.8%, 20.2%, and 11.1% respectively). There was little evidence of non-random mating in any population ($F_{is} = -0.21, -0.24, -0.49$ respectively). Effective number of breeders (N_b) is a measure of how many adults are producing sampled offspring. For the north site, N_b was 6.8 adults which was similar to results of a Jolly-Seber open population model for adults trapped 2014-2018 (avg. +/- SD = 9.0 +/- 7.2). Future research includes development of a SNP array to analyze low quantity, but high quality, DNA from hair samples collected from other areas in the Midwest where FGS is also in decline. Inclusion of these samples will provide a better picture of gene flow and genetic diversity throughout the southeast portion of FGS's range. Long-term conservation measures can include translocating individuals among sites to facilitate gene flow where corridors were lost, identifying and preserving corridors for local populations showing signs of gene flow, and/or re-colonizing locations where viable populations no longer exist but suitable habitat still remains.

Coauthor: Tih-Fen Ting

Protective Genetic Polymorphisms in the Prion Protein Gene (PRNP) of White-tailed Deer (*Odocoileus virginianus*)

Yasuko Ishida, University of Illinois at Urbana-Champaign

Chronic wasting disease (CWD) is a fatal neurological disease in deer. CWD is a transmissible spongiform encephalopathy caused by exposure to an abnormally folded isoform of the cellular prion protein. CWD is primarily transmitted horizontally in excreta and through contaminated environments. Clinical signs include weight loss, behavioral changes, salivary shedding, and neurological degeneration. In Illinois, CWD was first detected in Boone County in 2002, and has since expanded to other counties in northern Illinois, although the prevalence remains at 1 to 2% in the state. We have evidence of the association

between prion gene (PRNP) genetic variation and the susceptibility of deer to CWD following the genotyping CWD-positive and -negative deer collected in Illinois and Wisconsin. First, we sequenced the part of the PRNP coding region in 2433 white-tailed deer. Here, we report sequences of the complete coding region of PRNP (771 bp encoding 257 amino acids) in an additional 466 deer collected in Illinois. Our PRNP sequences total 2899 including 407 from CWD positive deer, 2347 from CWD negative deer, and 145 from deer not tested for CWD. Our initial studies identified lower susceptibility to CWD in deer with haplotypes C or F of PRNP. Further analyses of the protective PRNP variants provide insights into the epidemiology of CWD and builds on information useful for the implementation of management strategies. Deer with protective genetic variants may not only protect the individual; if the variant is present in a large proportion of the population, this may help to reduce the spread of CWD. **Coauthors:** Ting Tian, Adam L. Brandt, Amy C. Kelly, Alfred L. Roca, Jan Novakofski, and Nohra E. Mateus-Pinilla

Spring Foraging Ecology of Green-winged Teal in Illinois Wetlands

Samual Klimas, Forbes Biological Station/Western Illinois University

The Illinois River Valley (IRV) provides critical stopover habitat for migrating waterfowl during spring and autumn. Because spring migration is an important time for waterfowl as they enhance body condition in preparation for the breeding grounds, the UMRGLR Joint Venture relies on the IRV and other migratory focal areas in Illinois to protect, maintain, enhance, and restore more than 80,000 ha of wetland habitats for waterfowl. Green-winged teal (GWTE; *Anas crecca*) usually rank in the top 4 species in the Illinois duck harvest, and primarily consume natural foods during migration, often selecting for seeds and invertebrates over agricultural grains. In order to provide current information on wetland habitat needs for GWTE to wetland and natural resource managers, we experimentally collected foraging GWTE during the spring in the IRV from the confluence of the Illinois and Mississippi rivers extending north to Hennepin, Illinois, during springs 2016–2018. We removed upper digestive tracts and estimated food availability (benthic and nektonic samples) at foraging sites to evaluate food use and selection. We analyzed diets from the upper gastrointestinal (GI) tract (proventriculus and esophagus), as well as gizzards. Further, we performed proximate analysis on the teal carcasses to analyze body condition in relation to diet. We will discuss overall food use and selection by GWTE, as well as preferences of plant and invertebrate taxa in comparison with food availability. **Coauthors:** Joshua M. Osborn, Heath M. Hagy, Christopher N. Jacques, Joseph D. Lancaster, Sean E. Jenkins, and Aaron P. Yetter

Energetic Carrying Capacity of Submersed Aquatic Vegetation in Semi-permanent Wetlands in the Upper Midwest

Joseph D. Lancaster, Illinois Natural History Survey – Forbes Biological Station

The Midwest, USA contains many wetlands that provide important resources for waterfowl and other wetland-dependent species of migratory birds. However, intensive land use practices have resulted in extensive wetland loss and significant declines of submersed aquatic vegetation (SAV) from many wetlands across the region. Limited by a lack of biomass and energy estimates for wetlands containing SAV, conservation planners currently are unable to accurately account for their energetic contribution in bioenergetics models. Therefore, we estimated energetic carrying capacity of 21 semi-permanent wetlands containing SAV identified as important stopover locations for migrating waterfowl and other waterbirds in the Midwest. Energy density of SAV ($\bar{x} = 786 \pm 82$ EUD/ha) was generally less than many other wetland types in the region, varied by National Wetland Inventory class, and had a great degree of

annual (85–1,107 EUD/ha) and spatial variation (8–2,134 EUD/ha). We developed a visual rapid assessment index ($R^2_m = 0.43$) that will allow wetland managers or researchers to quickly estimate energy density from SAV. Energetic carrying capacity estimates of wetlands containing SAV will allow conservation planners to more precisely estimate energy supply on the landscape for waterfowl and wetland managers to evaluate trade-offs among alternative management strategies. **Coauthors:** Margaret C. Gross, John W. Simpson, Brendan T. Shirkey, Sarah E. McClain, Christopher N. Jacques, J. Brian Davis, and Heath M. Hagy

Estimating Abundance and Distribution of Shorebirds Through Aerial Surveys in the Illinois River Valley

Luke Malanchuk, Illinois Natural History Survey – Forbes Biological Station

The Illinois River Valley (IRV) serves as a crucial stopover area for migratory shorebirds in the midwestern United States despite the high prevalence of row crop agriculture and extensive wetland loss and degradation in the region. Aerial surveys are commonly used to quantify waterfowl abundance and estimate population size, but few attempts have been made to evaluate aerial surveys for other guilds of wetland birds. We investigated whether aerial surveys provide an accurate estimate of shorebird use of stopover sites in the IRV, and the amount of available mudflat habitat during the migration season. During July-September 2016-2018, and April-May 2018, we conducted concurrent ground and aerial surveys at 5-7 sites per week. Additionally, a single observer counted and assigned all shorebird detections to either "large" (killdeer (*Charadrius vociferous*) and larger) or "small" (pectoral sandpiper (*Calidris melanotos*) and smaller) size classes, and recorded wetland habitat characteristics at a total of 96 surveyed sites in the IRV. The use of ground counts during the aerial survey allows for the calculation of aerial detection probability and count bias to gain a better understand of aerial survey accuracy. Aerial surveys detected 89% (N = 93, Range = 0%-250%) of individuals counted during ground surveys. The total number of shorebirds counted in the IRV each week ranged from 1,705 to 83,525, with an average of 15,084 birds. Shorebirds used a total of 14,764.92 out of 18,268.37 available hectares of wet mud (80.82%) in the falls 2017-2018, and 5,353.49 out of 6,584.50 (81.30%) available hectares of wet mud in spring 2018. Aerial surveys appear to be an accurate and efficient method to quantifying shorebird abundance along large-river systems. Future plans include questions associated with stopover duration and which species are present in the IRV. **Coauthors:** Michael P. Ward, Heath M. Hagy, Kirk W. Stodola, and Aaron P. Yetter

Chronic Wasting Disease in Illinois. 16 Years Later. Now What?

Nohra Mateus-Pinilla, Illinois Natural History Survey

Infectious-Prions are transmissible proteins that induce abnormal folding of normal cellular proteins. Misfolded proteins are toxic to the brain, causing irreversible, slow, progressive and fatal Neurodegenerative Diseases (ND) in humans and animals. Chronic Wasting Disease is a ND (a transmissible spongiform encephalopathy (TSE)) of cervids, detected in the Illinois free ranging white-tailed deer since 2002. An "adaptive management strategy" consisting of removal of deer from infected areas reduces animal-animal contact rates and infected individuals shedding infectious proteins. Following 16 years of this adaptive management strategy, Illinois has become a leader in the management of CWD, protecting the health of free ranging white-tailed deer from this disease. We

analyzed 3,884 females and 4,781 fetuses and documented 85.8% of the adult female deer and 20.5% of the fawns as pregnant with 1 to 2 fetuses (litter size increased with age). Reproductive output is a reflection of health in a herd. Maternal age influenced estimated conception date (adult and yearling fetuses November 8 and November 11, respectively with fawn females conceiving later, at a mean of December 2. We evaluated the impact of the first 5 years and the past 15 years of management on reducing prevalence of CWD. Models of the probability of CWD infection in hunter-harvested deer over the past 15 years revealed that every year before sharpshooting began the odds of CWD infection increased by 11% but after sharpshooting was implemented, the odds of CWD decreased by 9%. Our findings continue to indicate that sharpshooting reduces the probability of a deer acquiring CWD. Sharpshooting (SS) efforts maintained low prevalence of CWD throughout Northern Illinois after initial prevalence reductions. Cessation CWD management will result in rapid rise of CWD prevalence across the region. Infected areas without management are a source of CWD and should participate in the CWD management program. **Coauthor:** Jan Novakofski

Building a Strong Wildlifer Community Within Our North Central Section - We are the Cogs & Wheels

Gary E. Potts, The Wildlife Society

Why should you be an active Wildlifer within the North Central Section? Because your talents, perspective, and passion build a more connected, effective community of leaders in wildlife science, management and conservation. Every one of us is an important cog or wheel in building a stronger Society. Learn about the North Central Section, its opportunities and benefits, and how broadening your engagement in TWS is a smart investment in you, your Wildlifer community, and the future of conservation. **Coauthor:** Jodie Provost

Comparing Management Programs to Reduce Red-tailed Hawk Aircraft Collisions at O'Hare International Airport

Craig Pullins, USDA/APHIS/Wildlife Services

Wildlife-aircraft collisions (wildlife strikes) pose a serious safety risk to aircraft. Raptors (i.e., hawks and owls) are one of the most frequently struck guilds of birds within North America. Although raptors [most notably red-tailed hawks (*Buteo jamaicensis*)] are commonly managed at most airports and military bases, there is no scientifically valid information available regarding comparisons of the efficacy of raptor management programs for reducing raptor-aircraft collisions. Therefore, we conducted a study to examine the efficacy of 2 integrated wildlife damage management programs implemented at Chicago's O'Hare International Airport (ORD). The first raptor management program occurred during August 2010 – June 2013 (Phase I) and was characterized by intensive and sustained live-trapping and translocation efforts. The second raptor management program occurred during July 2013 – November 2016 (Phase II) and involved live-trapping and translocation of specific age classes and increased levels of lethal control. Compared to Phase I, there were 37% fewer red-tailed hawk strikes (41 in Phase I and 26 in Phase II) and 67% fewer damaging red-tailed hawk strikes (6 in Phase I and 2 in Phase II) during Phase II. Our findings demonstrate that airport wildlife management decisions based on scientific data and biological information can aid in reducing wildlife strikes, financial losses, and ultimately airport liability while increasing human safety. The decision matrix regarding the components of an airport raptor management program involves a variety of biological, geographic, logistical, economic, and socio-

political variables. This study represents an important scientific foundation for informing such management decisions. **Coauthor:** Travis Guerrant, Scott Beckerman, and Brian Washburn

How does Conservation Practice and Site Age Influence Plant Physiognomy and Avian Abundance at Restored Fields?

Bryan Reiley, Illinois Natural History Survey

Farmland set aside programs provide important habitat for many wildlife species, yet little information exists regarding how vegetation structure and species respond to conservation practice and site age. Here, we describe how vegetation structure and avian species respond to conservation practice and time since restoration at 172 sites enrolled in the Conservation Reserve Enhancement Program (CREP) in Illinois. To do this we surveyed 172 sites enrolled in four different conservation practices (CPs) within CREP during the breeding seasons of 2012 – 2015 using point counts and vegetation surveys. Vegetation structure and composition varied among CPs with hardwood tree plantings (CP3A) having the greatest amount of understory vegetation, tree and shrub cover, and lowest distance to nearest tree. Conversely, permanent wildlife habitat (CP4D) had the greatest distance to nearest tree, grass cover, and least tree cover. Avian densities varied among CP types, however only dickcissels (*Spiza americana*) were significantly greater in sites enrolled as permanent wildlife habitat and, similarly, Bell's vireo (*Vireo bellii*) and field sparrow (*Spizella pusilla*) were greater in hardwood tree plantings. Dickcissel density decreased and field sparrow density increased as fields aged, but these relationships were not consistent among CP types. Differences among CPs largely resulted from differences in dominance in woody vegetation due to differing management goals. Interestingly, many of our focal species had wider successional tolerances than previously suggested. Overall, our results demonstrate that conservation benefits change over time depending on the starting CP and this information can be used to predict temporal changes in habitat suitability and target conservation benefits toward conservation priority species.

Coauthor: Thomas J. Benson

Textural Discontinuity Hypothesis, Wildlife Paleobiology, and Humans as Invasive Species

Dennis R. Ruez, Jr., University of Illinois at Springfield

The textural discontinuity hypothesis (TDH) describes how some ecological factors, such as the body mass distribution of terrestrial mammals, appear to be arranged in clusters, and it has been suggested that this discontinuous pattern has predictive power in determining taxa more subject to extinction or more likely to be successful invaders. While subsequent studies have generally agreed with those statements, they were only comparing two time slices. The advantage paleobiology has to look at series of communities, over long timespans, in a single location. Using body masses from seven stratigraphic layers from Die Kelders, South Africa, we can see how the body mass gaps change over time, and where an invasive species (humans) fall in relation to the gaps. While the number of taxa fluctuates between layers, the presence of humans is consistently near the high end of clusters. The layers are likely missing some of the lighter taxa, but they would not occur within the cluster including humans anyway. Future studies integrating more fossil localities may give some added insight to the future invasive species of Illinois. Perhaps we can put the dead to work for us today.

Hunter Recruitment, Retention, and Reengagement: A Data-Driven Approach

Dan Stephens, Illinois Natural History Survey

Hunters in Illinois have long faced constraints to hunting. Socioeconomic and demographic trends suggest that the public is becoming isolated from the relevancy and importance of hunting. The Illinois Department of Natural Resources and the Illinois Natural History Survey have partnered on an adult hunter recruitment initiative aimed at addressing a long-term decline in hunter numbers. In order to develop an objective strategy to mitigate the decline of hunting participation in Illinois, an analysis of market segments, constraints, and motivations is needed to guide hunter recruitment, retention, and reengagement (R3) efforts. Using web tracking, hunter harvest surveys, license buying data, focus groups, and socioeconomic data the Learn to Hunt program was able to define distinct market segments, common constraints, and motivations of new adult hunters in Illinois. **Coauthor:** Craig A. Miller

Monitoring and Occupancy of Domestic Cats and Native Mesopredators in a Suburban Preserve Matrix

John P. Vanek, Northern Illinois University

Free-ranging domestic cats are a major threat to global biodiversity, responsible for the extirpation of at least 30 species worldwide. However, we know little about their ecology in urban areas. Similarly, despite the importance of native mesopredators, our knowledge of their ecology is heavily biased towards rural areas. To further our understanding of both domestic cats and native mesopredators, we assessed data collected during an ongoing and long-term wildlife monitoring program in a heavily urbanized suburb of Chicago (Lake County, IL). Specifically, our objectives were to (1) estimate the occupancy and detectability for mesopredators and domestic cats within suburban forest preserves and (2) determine the relationship between urbanization and these parameters. To address these objectives, we analyzed camera trap data at 235 monitoring points within 55 preserves collected during 2009-2018. Overall, we detected seven species of native mesopredator, as well as domestic cats and domestic dogs. Naïve occupancy was highest for common raccoons (*Procyon lotor*) and Virginia opossums (*Didelphis virginiana*) (> 95% of preserves), and surprisingly low for red fox (< 5% of preserves). Notably, we did not detect grey fox (*Urocyon cinereoargenteus*), despite > 9000 trap nights over 10 years, suggesting local extirpation in accordance with state and regional trends. Overall, domestic cat occupancy was low and the interior of many preserves were predicted to be cat free. Cat occupancy increased with proximity to nearest building (range: 0.02 - 0.46) and detectability increased with decreasing preserve area (range 0.10 - 0.67), suggesting that domestic cats in our study area are subsidized or owned by humans and not feral. Urban covariates were generally uninformative at predicting native mesopredator occupancy and detectability. Our results highlight regional conservation needs and we will discuss management implications. **Coauthors:** Andrew U. Rutter, Gary A. Glowacki, and Tim Preuss

The Impact of Variation in the Toll-like Receptor 3 Gene on Epizootic Hemorrhagic Disease in White-Tailed Deer (*Odocoileus virginianus*)

Jacob Wessels, University of Illinois at Urbana-Champaign

Epizootic hemorrhagic disease (EHD) causes death in white-tailed deer, often within a few days, although some animals can recover from the disease. A double-stranded RNA virus causes EHD. Biting insects transmit the EHD virus (EHDV) to deer. Toll-like receptors (TLRs) are part of the gene family coding for pathways in the innate immune response system and recognize pathogen associated molecular patterns. Upon infection, double stranded RNA viruses including EHDV are recognized by TLR3, which then induces an immune response. For this study, we will sequence the TLR3 gene in deer that have died from EHD, and in a control group of healthy deer from the same geographic regions. We will compare genotypes of the TLR3 gene between deer that died from EHD and deer that did not die due to EHD. Differences in TLR3 genotypes between the two groups would suggest that some genotypes are more susceptible or resistant to EHDV than others. Studies on cattle have detected genetic signatures of balancing selection on TLR3; this signature is attributed to infections by double-stranded RNA viruses. This leads us to hypothesize that heterozygote advantage or other types of balancing selection may leading to high genetic diversity in the TLR3 gene in white-tailed deer, which would be revealed by our study. These findings will help us to understand genetic mechanisms that may impact outbreaks of EHD. We extend the opportunity for stakeholders to donate tissue samples from deer that have died from EHD, to be used in in this study. **Coauthors:** Yasuko Ishida, Alfred L. Roca, Jan Novakofski, and Nohra E. Mateus-Pinilla

Relationships between Deer, *Ixodes scapularis* Tick, and Lyme Disease in Illinois: A Spatiotemporal Perspective

Fikriyah Winata, University of Illinois at Urbana-Champaign

Tick-borne diseases are an increasing public health concern in the United States. Lyme disease is the most common tick-borne disease in the United States, caused by the *Borrelia burgdorferi* bacterium and transmitted by *Ixodes scapularis* or blacklegged/deer ticks. In Illinois, Lyme disease is the most commonly reported tick-borne disease. Deer play an important role in the distribution and spread of ticks, and previous studies in Illinois have found a large quantity of *I. scapularis* on deer. By applying a spatial regression lag model, this study aims to examine the spatiotemporal relationships between Lyme disease, observed tick locations, and deer distributions in Illinois. This analysis used spatial weighting in GeoDa 1.10 (Queen contiguity with order = 3) to individually model the years 2006 and 2014. Data used were historical tick observations (previously collected), Lyme disease cases reported to the Centers for Disease Control and Prevention, and the annual deer harvest reports and deer-vehicle accident (DVA) data from Illinois Department of Natural Resources. Results from both 2006 and 2014 models show significant negative relationships between Lyme disease cases and the number of deer harvests (p-value < 0.005 in both models), while the number of DVAs had a significant positive relationship with Lyme disease (p-value < 0.001 in both models). Tick observations were also significantly and positively correlated with Lyme disease cases (p-value < 0.001 in both models). High DVAs are associated with high deer density, and deer movement could increase the probability of deer using urban sites, thus increasing the exposure of humans to ticks. These preliminary results support that an increase in the removal of deer may be associated with reduced Lyme disease risk in Illinois. However, exposure to Lyme disease could have occurred outside the counties where Lyme disease was reported. The role of

deer densities and deer movement on the spread of Lyme disease continues to require further evaluation. **Coauthors:** Peg Gronemeyer, Rebecca Lee Smith, Marilyn O’Hara Ruiz, Sulagna Chakraborty, Lee Ann Lyons, and Nohra E. Mateus-Pinilla

Ducks, Geese, Coots, and Nesting Waterbirds - Oh My! A 12 Year Summary of Emiquon and the Illinois River Valley

Aaron P. Yetter, Illinois Natural History Survey – Forbes Biological Station

The Illinois River Valley (IRV) has historically been important to migrating, and more recently, wintering waterfowl. Prior to 2007, Chautauqua NWR was generally the most important migratory waterfowl refuge in the IRV; however, the distribution of migratory waterfowl and waterbirds shifted following restoration of the Emiquon Preserve and Emiquon NWR. These sites, collectively called Emiquon, currently outrank the other waterfowl sanctuaries aerially surveyed by the INHS ($n = 24$ in the IRV) in terms of migratory waterfowl use days. Emiquon on average hosts nearly 20% to the total duck use days during fall migration and nearly 70% of the American coot numbers from 2007–2018. When managed cooperatively, Emiquon Preserve, Emiquon NWR, and Chautauqua NWR provide ~11,200 acres of diverse, emergent marsh that give us a glimpse of what the historic Illinois Valley was like prior to prior to European settlement. **Coauthors:** Christopher S. Hine, Andy D. Gilbert, Joseph D. Lancaster, and Samuel T. Klimas

Evaluating the Physiological Response of Sub-lethal Infections of *Sphaeridiotrema* spp. and *Cyathocotyle bushiensis* Trematodes in Captive Lesser Scaup

Cheyenne R. Beach, Western Illinois University

During fall and spring migrations throughout the Upper Midwest, U.S., thousands of lesser scaup (*Aythya affinis*) die from *Cyathocotyle bushiensis* (Cb) and *Sphaeridiotrema* spp. (Ss) (Class: Trematoda) intestinal infections after consuming exotic faucet snails (*Bithynia tentaculata*). Lesser scaup serve as the final host for Cb and Ss while the faucet snail serves as the first and second intermediate host. As recommended by previous literature, this experimental study will evaluate the effects of sub-lethal trematode infections on the cellular immunological response, body condition, and survival of migrating lesser scaup across the Upper Mississippi River System. Female lesser scaup (n=48) will be captured at key mid-latitude stopover sites (Pool 19 of the Mississippi River) and held at Forbes Biological Station, Havana, IL. Faucet snails will be collected by hand from Pool 7 of the Mississippi River and dissected to recover mature Cb and Ss metacercariae for infection of birds. The captive lesser scaup will undergo repeated or single dose trematode infections and will be euthanized 10 days post-infection. Information collected during this experiment will provide data to evaluate temporal changes in health along a continuum from initial infection to shedding eggs to point of euthanasia. Addressing basic questions related to physiological responses of lesser scaup to infection with trematodes will aid in potential management strategies to minimize co-occurrence of lesser scaup and infected faucet snails. **Coauthors:** Christopher N. Jacques, Rebecca A. Cole, Joseph D. Lancaster, Aaron P. Yetter, and Heath M. Hagy

Spatiotemporal Clustering of Chronic Wasting Disease in Northern Illinois: What Do We Know About Disease Reservoirs, Deer Refuges, and Congregation Areas?

William M. Brown, University of Illinois at Urbana-Champaign

Chronic Wasting Disease (CWD) in white-tailed deer continues to diffuse from the initial area of infection along the Illinois-Wisconsin border. Contagion through close contact and shedding of prions in the deer habitat leads to the disease establishing temporary “hot spots” or becoming locally endemic at various rates of prevalence. The primary management strategy in Illinois is to monitor CWD from the fall harvest and establish foci for herd reduction in areas where deer test positive, preferably within a range of two miles from the kill site of a positive animal. These sharpshooting sites are used repeatedly over several seasons to achieve a much-lowered deer density to decrease animal-to-animal transmission. We provide an overview of the progression of CWD in Illinois and how areas of concentrated disease have changed. We present several landscape scenarios that can affect transmission, including disease reservoirs within deer populations that are difficult to hunt (deer refuges), areas of congregation due to availability of winter cover or food resources, and human activity or development that can affect herds. Some of these risk factors can be implied from landscape layers such as forest cover, urban development, public/private ownership, agricultural use, and migration deterrents. We seek our stakeholders’ input to rate specific locations by these risk factors, placing markers on a map and recording observations in a journal. **Coauthors:** Paul Shelton, Jan Novakofski, and Nohra Mateus-Pinilla

An Evaluation of Immobilization Drugs During Bobcat (*Lynx rufus*) Field Processing Events

Edward D. Davis, Western Illinois University

Chemical immobilization of wild animals is used to safely handle wildlife for research, management, and veterinary procedures. We evaluated two drug combinations on bobcat (*Lynx rufus*) field processing events in Illinois during winter 2017/2018. We processed 17 bobcats and alternated between ketamine-xylazine (KX) and pre-compounded BAM™; KX consisted of ketamine hydrochloride (HCL; \bar{x} = 11.65 mg/kg) and xylazine HCL (\bar{x} = 1.78mg/kg) and BAM™ consisted of butorphanol (\bar{x} = 0.91 mg/kg), azaperone (\bar{x} = 0.304 mg/kg), and medetomidine (\bar{x} = 0.36 mg/kg). We reversed KX and BAM™ with tolazoline (4.54 mg/kg) and atipamezole (1.56 mg/kg), respectively. We used multivariate analysis of variance (MANOVA) to evaluate potential effects of drug type, sex, weight, and body temperature on post-agonist recovery (agonist to head up [HU], sternal recumbency [SR], standing [ST], and full recovery [FR]) parameters (hereafter, recovery parameters). Our analyses revealed no significant 2-way interactions between drug type, sex, or weight on recovery parameters, thus we reported results only for main effects. Recovery parameters did not differ by sex, weight, or temperature, but was influenced by drug type (Pillai's λ = 0.98, $F_{2,5} = 23.44$, $P = 0.04$). Mean time from agonist to ST differed ($F_{1,12} = 12.91$, $P = 0.004$) between KX (\bar{x} = 52.71 min, SE = 11.83) and BAM™ (\bar{x} = 8.22 min, SE = 1.14). Similarly, mean time from agonist to FR varied ($F_{1,12} = 31.43$, $P < 0.001$) between KX (\bar{x} = 111.88 min, SE = 13.50) and BAM™ (\bar{x} = 52.11 min, SE = 4.11). Our study provides the first account of BAM™ for processing bobcats, and provides a detailed comparison of its effectiveness to commonly used KX. BAM™ was significantly faster than KX and can be reversed instantaneously, thereby providing a safe and efficient alternative to KX for current and future bobcat research and management. **Coauthors:** Robert W. Klaver and Christopher N. Jacques

Evaluating Hunter Surveys at Oakwood Bottoms Greentree Reservoir in Southern Illinois

Ethan Dittmer, Southern Illinois University Carbondale

Human-dimensions research provides wildlife managers with feedback from the users of sites they manage. These user data can help managers to make informed decisions that aim to reach long-term management goals while addressing users' opinions. Today, with the advent of smartphones and growing internet connectivity, wildlife managers are interested in using online methods to collect feedback from site users. Online surveys are substantially lower cost compared to more traditional, paper or mail-in type surveys. During our first field season, we tested two different methods – online “open-web” surveys and paper “mail-in” surveys – to garner feedback from hunters at Oakwood Bottoms Greentree Reservoir (hereafter Oakwood) in southwestern Illinois. From November 10th 2018 to January 8th 2019 we drove a standardized route at Oakwood every morning to complete 30 days of online surveys and 30 days of paper surveys. Hunters were asked to complete a paper survey if we placed one on their vehicle, and to otherwise complete an online survey (accessible by a URL or QR code on signs at the 10 primary access locations at the site). By surveying all 60 days of the duck-hunting season, we were able to calculate an apparent individual response rate of 20.9% for paper surveys and a 2% response rate for online surveys, demonstrating that online surveys alone will be ineffective for getting feedback from hunters at Oakwood. During the 2019-2020 season we will compare the response rates of surveys placed on vehicles to surveys picked up by hunters from several survey stations on the site. We hope to learn if the survey stations can provide a similar response rate to the actively placed

surveys, providing a lower cost option for long-term use by area managers. **Coauthors:** John O'Connell, Michael Eichholz, and Micah Miller

Assessing Density, Survival, and Population Structure of Bobcats Within an Agricultural Landscape of North-Central Illinois

Christopher N. Jacques, Western Illinois University

A fundamental motivation for our research will be to continue evaluating the efficacy of camera traps for estimating bobcat (*Lynx rufus*) abundance in agriculturally-dominated landscapes of Illinois. Quantifying key population demographics (reproductive parameters, survival and dispersal rates) will aid in refining population models and precision of statewide abundance estimates. In addition, knowledge of patterns and processes of population (genetic) structure may aid in identifying landscape features that facilitate and limit recolonization movements, and in turn identify appropriate spatial scales at which future management efforts should be directed. Work conducted during 2015–2019 provided preliminary density and home range estimates obtained throughout west-central Illinois, which may aid in improving our understanding of bobcat spatial requirements in relation to variation in seasonal detection probabilities. Survival analyses are ongoing throughout west-central Illinois, though continued research across similar landscapes will aid in better understanding potential effects of intrinsic (e.g., sex, age, body mass, year, season, social status) and habitat (e.g., %forest/wetland/grassland/row-crop/CRP cover, road density) factors on seasonal and annual survival of bobcats across regions of Illinois characterized by agriculturally dominated landscapes. Anticipated future research will provide rigorous estimates of bobcat population size, survival, density, reproductive parameters, microhabitat selection, and factors influencing site occupancy in northcentral (i.e., Bureau, Marshall, Peoria, Putnam, Tazewell, Woodford counties) Illinois. Further, this study will link information on landscape composition, movement behavior by individuals, and fine-scale genetic structure to gain a mechanistic understanding of how spatial heterogeneity may influence population structure of bobcats in fragmented landscapes of Illinois. Results will benefit the Illinois Department of Natural Resources by providing important information for compliance with Federal regulations (CITES), implementation of monitoring programs, and refinement of management programs. **Coauthor:** Stan McTaggart

Variation in the Thrill Seeking Gene (DRD4) of White-tailed Deer (*O. virginianus*)

Evan W. London, Illinois Natural History Survey

Animal behavior is, in part, dictated the various neurotransmitter networks of the brain. One such network involves the neurotransmitter dopamine, and this network plays a role in response to rewarding stimuli. Previous studies have shown that genetic variation in a gene coding for a dopamine receptor (DRD4) can lead to behavioral phenotypes such as 'thrill seeking' or 'novelty seeking' in mammals, birds, and insects. White-tailed deer (*Odocoileus virginianus*) are known to express DRD4, however little is known about the genetic variation within this gene that they may possess. By better understanding the variation in this gene we may be able to correlate behavior of deer to their DRD4 sequences. DRD4 variation could potentially be an underlying factor in some behaviors of deer such as; automobile collision, migration patterns, the spread of Chronic Wasting Disease, urban habitation, etc. Once variation of the white-tailed deer DRD4 gene has been qualified, then further studies can be

conducted wherein variation is demonstrated to be correlated to thrill seeking behavior. **Coauthors:** Yasuko Ishida, Jan Novakofski, and Nohra Mateus-Pinilla

The National Great Rivers Research and Education Center's (NGRREC) Undergraduate Summer Internship Program

Natalie Marioni, The National Great Rivers Research and Education Center

One priority of the National Great Rivers Research and Education Center (NGRREC) at Lewis and Clark Community College is to provide professional training for the next generation of natural resource professions, including scientists, educators, and policy makers. Through NGRREC's annual summer internship program, interns gain real experience in variety of environmental careers such as ecological research, fisheries science, education, policy, and social science, giving them important experiences that will impact their academic and career paths in the natural sciences. NGRREC's internship program is unique because students from across the country are matched with professionals and scientists at various host institutions and organizations throughout the Mississippi River Watershed, not just to projects hosted by NGRREC researchers and educators. While the projects are diverse in scope, each intern is united by NGRREC's overall mission to study the ecology of the big rivers, the workings of the watersheds that feed them, and the ties to the river communities that use them. Through this program, students gain valuable research experience, but are also exposed to and gain an understanding of the importance of the collaborative nature of institutions like NGRREC and its various partner organizations. A total of 57 organizations throughout the Mississippi River Watershed have hosted projects serving 385 students (2003-2018). Throughout the program's history, NGRREC has received applications from students attending 197 schools in 33 states and three countries (U.S., Canada, and India). For 2019's cycle, 18 students will be selected from an applicant pool of 151 students, making this program an ever more competitive experience. The success of the program is further demonstrated through the manuscripts a number of interns have published as a result of their internship with NGRREC, and many interns have become leaders in science, natural resource, environmental arenas where they are making worthy contributions to society.

Differences between Bovine and Avian Tuberculosis in white-tailed deer

Kelsey Martin, University of Illinois at Urbana-Champaign and Illinois Natural History Survey

Bovine Tuberculosis (bTB) and Avian Tuberculosis (aTB) are bacterial infections caused by *Mycobacterium bovis* and *Mycobacterium avium*, respectively. These infectious diseases can be found in wild white-tailed deer, and can spread from animals to humans. However, many hunters are not aware of how to recognize the infections. Our objectives are to: 1) list key differences in bTB and aTB in white-tailed deer and, 2) inform hunters on how to detect signs of disease and how to mitigate transmission to humans during field dressing. We used a literature search to list similarities between bTB and aTB. Emaciation, loss of fat and diarrhea were the common signs. Small white lesions characterize both diseases. However, lesions localization differ between bTB and aTB. The bTB lesions are found in lymph nodes, lungs, or surface of chest cavity, whereas in aTB, the lesions are found in the intestinal tract. The most important difference between these two diseases is the route of transmission from animal to human. Bovine Tuberculosis is transmitted via respiratory droplets, while aTB is transmitted fecal-orally. We conducted the diagnostic tests for two Illinois deer that raised concerns about bTB in 2018. One deer was 96%-97% homologous with *M. avium*, but further tests to determine the subspecies are

pending. The second case also tested positive for Mycobacterium, but species determination are pending. We note that bTB is not present in Illinois deer, but constant and large-scale movements, and opportunities for unnatural aggregations under illegal supplemental feeding, could increase the risk for bTB entering Illinois. We suggest that during field dressing, hunters remain cautious, wear appropriate personal protective equipment, and be watchful of white lesions on organs. If a hunter suspects TB, he/she should contact their local DNR or wildlife biologist immediately for testing. **Coauthors:** Nelda A. Rivera, Roshni Mathur, Shih-Hsuan Hsiao, Kaylie Dyer, Evan London, Jan E Novakofski, and Nohra Mateus-Pinilla

Do Opossums and Raccoons Shed Leptospira?

Roshni Mathur, University of Illinois at Urbana-Champaign and Illinois Natural History Survey

Raccoons (*Procyon lotor*) and opossums (*Didelphis virginiana*) can be infected with the zoonotic bacterium *Leptospira*; yet, their role as reservoir hosts (shedding the bacteria in their urine) is unclear. Shedding of the bacteria could contribute to persistence of *Leptospira* in natural environments. Reservoir hosts contribute to the life cycle of pathogenic leptospirosis that could have a negative effect on the health of humans and pets. *Leptospira* can be found in soil and water contaminated with urine from reservoir hosts. Infection can occur when a host's broken/damage skin, mucus and conjunctival membranes are in contact with infected urine or when the host inhales infected aerosol droplets. Following infection, the *Leptospira* replicates in multiple organs such as lungs, liver, kidney, CNS and genital tract. *Leptospira* persist largely in kidney tubules thereafter, which may result in kidney failure. Leptospirosis causes illness in all mammal species. Clinical manifestations may include low fertility in cattle and pigs, abortion in horses, jaundice in humans, and kidney failure in humans and dogs. Our objective is to determine exposure in raccoons and opossums, and evidence of their role as reservoir hosts for *Leptospira*. We collected blood, kidney, liver and urine samples for 8 opossums and 3 raccoons in 2018. We used qPCR analysis for urine and tissue samples, and microscopic agglutination test (MAT) for serum samples. We found two raccoons and one opossum sero-positive to *Leptospira* (positive MAT for at least 1 of 7 serovars), and one raccoon and one opossum qPCR positive. All urine samples were negative. Our results— based on serology—suggest exposure to *Leptospira* in opossums and raccoons. qPCR kidney/liver results are suggestive of reservoir status. Lack of *Leptospira* detection in urine indicates that they were not shedding leptospires to the environment at the time of sampling.

Coauthors: Nelda A. Rivera, Vanessa DeShambo, Emma Trone, Kelsey Martin, Kaylie Dyer, Evan London, Jan E Novakofski, and Nohra Mateus-Pinilla

Evaluating Nest Switching Behavior and Microhabitat Partitioning of Southern Flying Squirrels in West Central Illinois

Katherine Rexroad, Western Illinois University

Southern flying squirrels (*Glaucomys volans*; SFS) are forest-dependent, nocturnal, non-hibernating, arboreal mammals that den in tree cavities. Previous studies suggest that several structural attributes of overstory hardwood trees are essential to SFS life-history needs, especially locomotion, den site selection, and food sources. Nevertheless, little information is available on the influence of vegetation structure on microhabitat use across fragmented Midwestern landscapes. To date, no studies have evaluated whether proximate factors (e.g., structural differences in overstory vegetation) influence microhabitat partitioning between activity areas of male and female SFS across Midwestern landscapes.

The goal of this research is to continue the long-term SFS research program to better understand the additive or antagonistic effects of intrinsic factors (sex, age, nutritional condition), microhabitat features, habitat fragmentation, and parasite loads on home range dynamics and nest-switching behavior of SFS. Specific project objectives include 1) quantifying nest occupancy patterns, and rates of nest switching/reuse by SFS between sexes and across activity areas, 2) investigating associations between microhabitat (tree diameter-at-breast height, snag density, tree height, availability of mast trees), habitat fragmentation (patch size, distance to nearest habitat edge) and home range (size, shape) metrics of SFS, and 3) estimating prevalence and intensity of infection with parasites in local populations of SFS. Increasing basic knowledge of interactions and interrelationships between intrinsic and habitat effects on SFS nesting patterns, particularly in regions characterized by low habitat quality and animal densities will provide greater insight into future conservation strategies for SFS along the western boundary of their geographic range. **Coauthors:** Shelli Dubay and Christopher Jacques

Using Artificial Intelligence to Aid in Classifying Camera Trap Images

Thomas A. Rothfus, University of Illinois at Springfield

Remote camera traps provide an effective, inexpensive and non-invasive way of collecting data on a range of species. UIS's Therkildsen Field Station at Emiquon (TFSE) has an on-going camera trapping project in the Nature Conservancy's Emiquon Preserve monitoring the animals which make use of the wetland restoration. While camera traps assist greatly in wildlife monitoring, they generate an incredibly large amount of data which must be processed by researchers (i.e the images need to be sorted and identified). In addition, due to the sensitivity of the cameras, a large number of "false" images might be captured mistakenly due a variety of environmental factors. Excluding these false-positive images manually further increases processing time. The constraints surrounding how many images can be processed limits the duration of the study, the spatial spread of the study, and the density at which traps can be deployed. In order to reduce processing time, exclude the false positives, and increase classification accuracy, we developed a fully automatic wildlife monitoring system with animal detection and species classification. This system was based on a novel artificial intelligence model, varied channels region proposal and classification network (VCRPCN) based on deep convolutional neural network (DCNN). 311 animal images were used to verify the proposed method. These consist primarily of common animals, such as coyotes, opossums, raccoons, river otters, and skunks. Initially, the focus was on images captured at night. These images have low contrast, and in some cases the animals are occluded by grass or trees, which make the animal detection and classification more challenging. The experimental results on evaluation metrics demonstrate the proposed VCRPCN achieved high accuracy on both animal detection and species classification. **Coauthors:** Yanhui Guo, Lei Si, and Tih-Fen Ting

A Common Constraint Among Illinois Hunters

Adam Wojciechowski, Illinois Natural History Survey

The Illinois Learn to Hunt program is a collaborative effort between the Illinois Natural History Survey and the Illinois Department of Natural Resources designed to recruit, retain, and reactivate adult hunters. Using web tracking, hunter harvest surveys, license buying data, focus groups, and socioeconomic data the Learn to Hunt program was able to define the need for an adult-centered R3 program in Illinois. Adults pose a uniquely accessible market for R3 efforts due to availability of time, disposable income, and willingness to learn a new skill of their own volition. Learn to Hunt program

events (e.g. workshops, seminars, mentored hunts) were carefully designed to address common constraints for adults and allowed for testing various program designs. Moving forward, R3 programs will need to develop programs that cater to adults and define metrics that will allow for a long-term comparison of the efficacy of youth vs adult R3 programs. **Coauthors:** Dan Stephens and Craig A. Miller