USGS WISCONSIN COOPERATIVE WILDLIFE RESEARCH UNIT

FISCAL YEAR 2022

(October 1, 2021-September 30, 2022)



ANNUAL REPORT

Part of our Deer Ecology And Disease (DEAD) Team gearing up to collect soil and plant samples for prion detection from CWD positive deer carcass sites. Preliminary data from this pilot study played a role in the WCWRU and collaborators bringing in a $2.5 million dollar USDA-NIFA grant to study environmental transmission of CWD in southwest Wisconsin.

USGS WISCONSIN COOPERATIVE WILDLIFE RESEARCH UNIT

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COOPERATING AGENCIES:

U.S. Geological Survey
University of Wisconsin
Wisconsin Department of Natural Resources
Wildlife Management Institute
U.S. Fish and Wildlife Service

October 1, 2021-September 30, 2022

MISSION STATEMENT
OF THE
WISCONSIN COOPERATIVE WILDLIFE RESEARCH UNIT

The Cooperative Units Program of the U.S. Geological Survey has been an integral part of the Department of Wildlife Ecology at the University of Wisconsin-Madison since 1972. With direction from the Coordinating Committee, the Unit's research has been conducted on a wide variety of wildlife topics in cooperation with federal agencies, the University, the Wisconsin Department of Natural Resources, and various private organizations. The Unit's research spans the range from problem-oriented projects designed to provide cooperators with useful information on resource issues to basic scientific discovery to move the state of knowledge forward.

Work has been carried out in both terrestrial and aquatic environments. Major areas of present research include the effects of agriculture on wildlife populations, wildlife disease issues, and global climate change. The Unit, along with cooperating scientists, has the expertise to investigate environmental problems from the cellular to the landscape level. Current Unit personnel have research interests that include population ecology, community ecology, disease ecology, and landscape ecology. Future project selection is primarily dependent on the needs of the cooperators and the availability of funds.

PERSONNEL AND COOPERATORS

Coordinating Committee

Cyndy Loftin	Eastern Region Supervisor, Cooperative Research Units U.S. Geological Survey, Reston, VA
Eric Kruger	Chair, Department of Forest and Wildlife Ecology University of Wisconsin-Madison
Scott Hull (Office of Applied Science) and Jasmine Batten (Bureau of Wildlife Management)	Representatives, Wisconsin Department of Natural Resources, Madison, WI
William Moritz	Representative, Wildlife Management Institute, Johnstown, OH
Bradly Potter	Representative, U.S. Fish and Wildlife Service, East Lansing, MI

Unit Staff

Christine Ribic	Unit Leader, Wildlife, *retired July 2022*
Wendy Turner	Unit Leader, Wildlife, *starting October 2022* Assistant Unit Leader, Wildlife
Susan Laufenberg/Christine Terrien	Administrative Assistant, University of Wisconsin-Madison

Cooperating Scientists

Dr. Bruce Klein	Professor, School of Medicine and Public Health, University of Wisconsin-Madison
Dr. Zach Peery	Associate Professor, Department of Forest and Wildlife Ecology, University of Wisconsin-Madison
Dr. Ben Zuckerberg	Associate Professor, Department of Forest and Wildlife Ecology, University of Wisconsin-Madison
Dr. Stuart Lichtenberg	Scientist, Department of Soil Science, University of Wisconsin-Madison

ACADEMIC PERSONNEL

Post-doctoral Fellows

Scott Nelson (Chris Ribic) (co-mentored by B. Zuckerberg). Scott worked on climate change adaptation strategies for grassland birds in the Central Flyway. This work was in collaboration with USFWS Habitat and Evaluation team in Bismarck, ND. The purpose of the project is to conduct a comprehensive synthesis of scientific information on how climate change is interacting with other drivers of change (e.g., land management practices) to affect grassland habitats and grassland-dependent migratory birds within the Central Flyway. (*Completed December 2021*)

Laura Nunes (Chris Ribic) (co-mentored by B. Zuckerberg). Laura worked on estimating Wisconsin's grassland bird populations as well as population estimates for the Upper Mississippi River and Great Lakes Joint Venture region. (*Completed October 2021*)

Ellen Brandell (Wendy Turner). Ellen researched the effects of harvest on chronic wasting disease dynamics in white-tailed deer in the midwestern US. The goal of this project is to leverage historical information maintained by state agencies to evaluate impacts of CWD management activities on population and disease dynamics, and to establish a framework that will improve coordination and information exchange. This framework will serve as the basis for the creation of an adaptive management strategy for CWD mitigation among Midwestern, state and federal, wildlife management agencies. *(Completed April 2022)*

Kristyna Rysava (Wendy Turner). Isty characterised the evolutionary context of anthrax virulence emergence from the *Bacillus cereus* sensu lato group in dynamical environments, as part of a project investigating ecological and evolutionary drivers of anthrax outbreak variability among ecosystems. *(Completed July 2022)*

Academic Staff

Alison Ketz (Wendy Turner) (Scientist II). Alison is working in collaboration with the WDNR and the USGS National Wildlife Health Center to understand deer population dynamics in the CWD-endemic region of southwestern Wisconsin.

Marie Gilbertson (Wendy Turner) (Scientist I). Marie is studying deer movement ecology and chronic wasting disease transmission in south-west Wisconsin. Her project will investigate the impact of CWD infection on deer movement behavior, and the reverse, the impact of deer movement behaviors and contacts on CWD spread. Outcomes will include a better understanding of deer ecology, demography and population dynamics as relates to CWD transmission.

Albert Beck (Chris Ribic) (Research Specialist). Albert is working in collaboration with the US Forest Service (Rhinelander, WI) to archive long-term datasets from USFS natural research areas and experimental forests. The purpose of the project is to document previously collected data and make it available to the public as part of the USFS Research Data Archive. (*Completed July 2022*)

Erica Diehl (Chris Ribic) (Research Specialist). Erica is working in collaboration with the US Forest Service archive long-term datasets from USFS natural research areas and experimental forests. The purpose of the project is to document previously collected data and make it available to the public as part of the USFS Research Data Archive. (*Completed July 2022*)

Graduate Students

Jacy Bernath-Plasted (Chris Ribic) (Ph.D., Wildlife, co-advised by B. Zuckerberg). Jacy will be working on a project to quantify microclimates within grassland patches and evaluate their importance on the nesting biology of grassland birds. (*Completed July 2022*)

Yen-Hua Huang (Wendy Turner) (Ph.D., Wildlife). Yen-Hua is studying how environmental variability, animal movement ecology and foraging behavior affect anthrax dynamics in herbivorous wildlife in southern Africa. *(Completed May 2022)*

Zoe Barandongo (Wendy Turner) (Ph.D., Wildlife). Zoe is studying microbiological, molecular and genetic factors that may affect the persistence, infectivity and virulence of *Bacillus anthracis* strains in southern Africa, with a focus on bacteriophages in soils and bacterial genomes.

Amélie Dolfi (Wendy Turner) (Ph.D., Wildlife). Amélie is developing models of anthrax transmission dynamics. She uses agent-based models to investigate the interactions of *Bacillus anthracis* with its herbivorous hosts comparing two ecosystems in southern Africa that vary in outbreak dynamics.

Kimberlie Vera (Wendy Turner) (Ph.D., Wildlife). Kimberlie is investigating anthrax transmission dynamics in a guild of herbivorous mammals, using camera trapping and quantitative ecology methods to investigate how seasonal changes in host density affect anthrax transmission dynamics comparing two ecosystems in southern Africa.

Heather Inzalaco (Wendy Turner) (Ph.D., Comparative Biomedical Sciences). Heather is studying the indirect transmission pathway for chronic wasting disease, looking at prion accumulation in soils at carcass sites, supplemental feeding/bait sites, natural areas of deer aggregation and in ticks.

Samantha Hoff (Wendy Turner) (Ph.D., Ecology and Evolutionary Biology, University at Albany, co-advised by Ing-Nang Wang). Samantha is studying the ecology of the northern long-eared bats, a species experiencing drastic population declines due to the fungal disease white-nose syndrome. She is investigating mechanisms supporting persistence of coastal populations despite infection, including factors influencing occupancy, hibernation behavior, and population genetics.

Sunday Ochai (Wendy Turner) (M.S., Veterinary Tropical Diseases, University of Pretoria, co-advised by Henriette van Heerden). Sunday is studying host immunity against *Bacillus anthracis* across ecosystems and gradients of anthrax incidence in southern Africa, and how haemoparasite coinfections affect host immune response.

Matt Hunsaker (Wendy Turner) (M.S., Wildlife). Matt is investigating how movement patterns, activity patterns, and mate search strategies of male white-tailed deer change over the breeding season, and how these are affected by the timing of hunting season.

Stephanie Katicioglu (Wendy Turner) (M.S., Wildlife). Steph is developing a project on prion detection from soils of different composition and how prion concentrations vary between hypothesized areas of prion aggregation, including deer scrapes, food plots and CWD positive deer carcass sites.

Casey Pendergast (Wendy Turner) (M.S., Ecology and Evolutionary Biology, University at Albany, co-advised by Ing-Nang Wang). Casey is studying foraging activity and diet of coastal Northern long eared bat populations during the hibernation period.

Kamini Govender (Wendy Turner) (M.S., Veterinary Science, University of Pretoria, co-advised by Henriette van Heerden). Kamini is studying *Bacillus anthracis* spore persistence among pathogen strains and in different soil types from Kruger and Etosha National Parks in southern Africa.

Prudent Mokgokong (Wendy Turner) (M.S., Veterinary Science, University of Pretoria, co-advised by Henriette van Heerden). Prudent is conducting whole genome analysis of virulence factors in isolates of *Bacillus anthracis* from Kruger National Park, South Africa.

NEW PROJECTS STARTED IN FY22

Modeling host behavior and environmental transmission of chronic wasting disease

Investigators: *Wendy Turner, USGS, Wisconsin Cooperative Wildlife Research Unit; Jun Zhu, University of Wisconsin-Madison; Dan Walsh, USGS, Montana Cooperative Wildlife Research Unit; Jim Powell, Utah State University*

Funding: *USDA NIFA, NSF-NIH-USDA Ecology and Evolution of Infectious Diseases program*

Expected Completion: *August 31, 2027*

Understanding the principles of infectious disease transmission is crucial for identifying management tools for disease control and prevention. Elucidating such principles is challenging in host-pathogen systems when transmission occurs both directly and indirectly through the environment. Researchers must disentangle diverse multi-scale drivers, from fine-scale host interactions with pathogens in environmental reservoirs to large-scale movements of natural populations in heterogeneous landscapes. A general analytical framework is lacking to link direct and environmental transmission processes and data streams across spatiotemporal scales. This gap limits understanding and management of a broad range of human and animal pathogens transmitted both directly and environmentally: from cholera in humans, to African swine fever in livestock, to white nose syndrome and chronic wasting disease (CWD) in wildlife. We will address this gap by developing a broadly applicable model framework, linking landscape structure, host movement ecology, pathogen distribution and transmission modes, and allowing examination of how individual-level processes affect spatiotemporal dynamics of disease within a population. This analytical approach will be applied to CWD, a fatal prion disease of free-ranging cervids. CWD is an ideal study system because the infectious agent, a mis-folded protein known as a prion, can be transmitted directly or from environmental reservoirs. Heterogeneities in host habitat, behavior, and movement mediate direct transmission, but also deposition of prions into the environment and subsequent environmental transmission. Prion kinetics in heterogeneous environments further shape transmission risk. We propose a deterministic model scaffold that formally incorporates heterogeneities in social behavior and movement with pathogen retention, transport, and infection potential in complex landscapes. A novel application of multi-scale homogenization to our models will analytically link fine-scale pathways of infection with large-scale population processes. Lab, field, and statistical analyses will parameterize prion transmission and host movement, leveraging data and expertise from Wisconsin Department of Natural Resources. We will embed competing models in an uncertainty framework that allows us to assess the relative importance of transmission pathways and to evaluate system responses to population management and landscape disturbance.

Investigating causes and impacts of pneumonia on white-tailed deer

Investigators: *Pauline L. Kamath, University of Maine, Orono; Wendy Turner, USGS, Wisconsin Cooperative Wildlife Research Unit; Marie Pinkerton, University of Wisconsin-Madison; Daniel Walsh, USGS, Montana Cooperative Wildlife Research Unit; Daniel Storm, Wisconsin DNR*

Funding: *Wisconsin DNR*

Expected Completion: *August 31, 2024*

Within the United States, deer represent an important source of food and revenue, while also hosting pathogens that put healthy deer populations at risk and jeopardize human health and food security. Developing tools for disease surveillance in important recreational and sustenance species like deer will thus be paramount for detecting and responding to outbreaks and spillover events. In Wisconsin, the Department of Natural Resources has been monitoring the white-tailed deer (*Odocoileus virginianus*) population for chronic wasting disease (CWD) since 1999. Recently, surveillance efforts have identified additional mortalities in deer attributed to pneumonia. Interestingly, such mortalities have been observed in deer both with and without CWD, suggesting the presence of a yet unknown etiologic agent in this population. This study will compare the respiratory tract microbial communities of deer that died with pneumonia to those that died without pneumonia, and to hunter-harvested deer. Preliminary results show high prevalence (9.8-41.4% of BLAST-ed reads) of the Gram-negative bacteria *Fusobacterium necrophorum* in pneumonia-positive individuals, and a lack thereof in control individuals. While *F. necrophorum* has been previously identified as a cause of mortality in deer, it remains unclear whether it is the direct cause of pneumonia-related mortality in this case or an opportunistic colonizer of already diseased deer. This project aims to confirm the etiologic agent(s) responsible, characterize their distribution, identify risk-factors underlying host mortality, and understand the association with CWD. Ultimately, this information will help inform management strategies and developing disease surveillance systems for the Wisconsin deer population

Contamination of environmental constituents with chronic wasting disease prions

Investigators: *Stuart Lichtenberg, University of Wisconsin-Madison; Daniel Walsh, USGS, Montana Cooperative Wildlife Research Unit; Daniel Storm, Wisconsin DNR; Allen Herbst, USGS NWHC*

Funding: *USGS Biological Threats Program*

Expected Completion: *August 31, 2025*

Chronic wasting disease (CWD) is a fatal neurologic disease of cervids, is a major concern for the health of herds in affected regions of North America. Conservation activities for game and non-game species of many wildlife agencies are funded by hunter license sales, and therefore negative effects of CWD on cervid populations and/or hunter participation will have broad, down-stream impacts on wildlife conservation. CWD can be transmitted directly among hosts or indirectly through the environment, but little is known about environmental transmission pathways and their importance in disease dynamics. This project investigates environmental transmission of CWD in white-tailed deer in southwestern Wisconsin. The objectives of the project are to: 1) examine prion intensity in soils and on plants at potential reservoir sites and how these change over time, and 2) the capacity for prion uptake and retention in plant tissue.

Investigating environmental transmission of chronic wasting disease

Investigators: *Wendy Turner, Wisconsin Cooperative Wildlife Research Unit; Stuart Lichtenberg, University of Wisconsin-Madison; Daniel Walsh, USGS, Montana Cooperative Wildlife Research Unit; Daniel Storm, Wisconsin DNR; Allen Herbst, USGS NWHC*

Funding: *USGS Biological Threats Program*

Expected Completion: *August 31, 2025*

Chronic wasting disease is a fatal disease affecting deer species, which has negative effects on affected populations and wildlife conservation. Chronic wasting disease is caused by an infectious misfolded protein, called a prion. These prions can be transmitted directly, from an infected to a susceptible host through close contact, or indirectly, through host contact with prions in the environment. Little is currently known about the environmental transmission pathway, and its importance in disease spread in deer populations. This project investigates environmental transmission of chronic wasting disease in white-tailed deer (*Odocoileus virginianus*) in southwestern Wisconsin. The first objective is to examine prion amounts found in soils and on plants at suspected prion reservoir sites and how these change over time. The second objective is to evaluate deer behavior at potential environmental reservoirs to assess exposure risks through both environmental reservoirs and specific host behaviors. Project outcomes will directly benefit the Wisconsin Department of Natural Resources, with findings on environmental transmission risk conducted in a high-prevalence area where the disease was first detected in Wisconsin. Our results will also benefit stakeholders working to understand and slow the spread of chronic wasting disease across North America, including federal, state and tribal agencies in at-risk areas.

CWD-prion accumulation dynamics at bait sites for free-ranging deer

Investigators: *Wendy Turner, USGS, Wisconsin Cooperative Wildlife Research Unit; Stuart Lichtenberg, University of Wisconsin-Madison*

Funding: *USDA APHIS Wildlife Services, Wild Cervid Chronic Wasting Disease Management and Response Activities*

Expected Completion: *August 31, 2023*

Attracting deer with food or minerals to specific locations for the purpose of sport hunting, observation, or tagging is a common practice. CWD-infected deer shed prions into the environment, raising the possibility that bait sites in CWD zones may become “hot spots” of prion deposition. Regulation of deer baiting is inconsistent across jurisdictions, and no empirical data have been reported regarding the impact of deer baiting on prion deposition onto the landscape. The project directly addresses this critical knowledge gap and provides tangible data that can be used to inform regulatory decision making. This project quantifies the extent of prion deposition at former and active bait sites within CWD zones in southern Wisconsin and Tennessee. This will provide insight into environmental transmission risk and for future decisions regarding management regulations and recommendations for deer baiting.

CONTINUING PROJECTS

Influence of chronic wasting disease and predators on deer survival and population dynamics in southwest Wisconsin

Investigator: *Wendy Turner, USGS, Wisconsin Cooperative Wildlife Research Unit; Alison Ketz, University of Wisconsin-Madison*
Funding: *Wisconsin Department of Natural Resources*
Expected Completion: *June 30, 2024*

Chronic wasting disease (CWD) was discovered in Wisconsin white-tailed deer harvested in fall 2001. Since then, CWD prevalence has increased in all sex and age classes and increased in spatial extent. For example, in the highest-prevalence areas, prevalence exceeds 30 percent in adult males and 15 percent in adult females. It is uncertain what impact CWD is currently having on deer populations and what impact it may have as prevalence increases. Studies in the western USA have found that CWD negatively impacts elk and mule deer survival and population size, but no field research has documented the impact of CWD on white-tailed deer survival or population growth in Wisconsin. Further, there is not any ongoing work in the Midwest that specifically addresses the direct impact of CWD on deer survival. Additionally, there is evidence for a genetic basis in variation in CWD-susceptibility, but it is not known if survival differs between deer of differing genetic makeup. Not knowing the contribution of CWD, predators, habitat change, or other potential factors makes it difficult to develop an effective management strategy. A better understanding of factors affecting survival and population growth would enable more informed deer population management, by facilitating antlerless quota adjustment in the face of changes in mortality rates from other sources. Studying the impact of CWD, or of any one source of mortality, on survival and population growth is difficult. The impact depends in part on competing sources of mortality and reproduction rates, all of which need to be quantified. A robust and sophisticated modeling framework is needed to understand spatiotemporal patterns in CWD prevalence and deer demographic rates. The goal of this research is to provide technical information, scientific guidance, and related assistance to WDNR scientists and policy makers regarding deer population dynamics in the CWD-endemic region of southwestern Wisconsin. This project is being done in collaboration with Daniel Storm (Wisconsin Department of Natural Resources) and Dan Walsh (US Geological Survey).

Movement of deer in southwest Wisconsin and its role in CWD spread

Investigator: *Wendy Turner, USGS, Wisconsin Cooperative Wildlife Research Unit*
Funding: *Wisconsin Department of Natural Resources*
Expected Completion: *June 30, 2024*

This project focuses on the spatiotemporal context of how landscape heterogeneity, seasonality, and deer movement behavior (individually and in aggregate) affect chronic wasting disease (CWD) spread. The goal is to better understand the mechanisms of CWD spread and the causes of the observed directional (rather than uniform) CWD diffusion and growth across the landscape. The project will investigate the impact of CWD infection on deer movement behavior, and the reverse, the impact of deer movement behaviors and contacts on CWD spread. Understanding the times and places where deer are most likely to congregate and the

weather, landscape, phenological and demographic factors that alter movement patterns and direct and indirect contact rates will help predict CWD dynamics and may inform management activities. Further, better understanding how sex- and age-specific movements and habitat selection vary according to landscape composition and configuration, weather, plant and crop phenology is of interest to ecologists and the general public and may help managers understand variation in deer population dynamics.

Looking backwards to know where to go: leveraging historical data to guide CWD management

Investigator: *Wendy Turner, USGS, Wisconsin Cooperative Wildlife Research Unit; Daniel Walsh, USGS, Montana Cooperative Wildlife Research Unit; Daniel Storm, Wisconsin DNR*
Funding: *USGS Emerging Diseases*
Expected Completion: *August 31, 2023*

Management of chronic wasting disease (CWD) is one of the most significant challenges facing many wildlife agencies in North America. One of the difficulties in managing this disease is that CWD-affected species range across jurisdictional boundaries; yet currently there is little communication or coordination among management agencies regarding CWD response. Unified efforts to evaluate the effectiveness of the suite of management actions that agencies have applied for disease control are lacking. This project is aimed at filling these gaps by leveraging historical information maintained by state agencies to evaluate impacts of CWD management activities on population and disease dynamics and establishing a framework that will improve coordination and information exchange. This framework will serve as the basis for the creation of an adaptive management strategy for CWD mitigation among Midwestern, state and federal, wildlife management agencies. The objectives of this project are to investigate the impacts of deer harvest regulations on the realized harvest within and between states in the Midwest, tie the analytical results to CWD dynamics to determine the harvest regulations most likely to have the desired outcome for managing CWD, and plan an adaptive management workshop for participating state agencies to effectively use the results of the modeling effort regarding harvest strategies.

Transmission and Evolution of a Persistent Pathogen: Anthrax Infection Dynamics Comparing Two Natural Systems

Investigators: *Wendy C. Turner, USGS, Wisconsin Cooperative Wildlife Research Unit; Pauline L. Kamath, University of Maine, Orono; Henriette van Heerden, University of Pretoria*
Funding: *National Science Foundation, Division of Environmental Biology, Ecology and Evolution of Infectious Diseases Program*
Expected Completion: *November 30, 2024*

Anthrax is a globally distributed disease of wildlife, livestock, and humans. Successful prediction of and response to outbreaks of anthrax is limited by a lack of understanding of the geographic differences in the ecology of the pathogen as well as the pattern of disease outbreaks. This project investigates the roles of host, pathogen, and environment to understand how the pathogen-host interaction evolves and contributes to the differences in anthrax

occurrence between two study areas: Etosha National Park, Namibia, and Kruger National Park, South Africa. The project builds on detailed records of disease and population dynamics in each park as well as archived pathogen samples and new data collection and analyses and mathematical modeling to understand these different dynamics. We are linking variability in *B. anthracis* genomes to phenotype (i.e., pathogen survival in the environment, virulence to hosts, and transmission across host and geographic range). We are identifying host immunological signatures of infection and genes under pathogen-mediated selection in four species: plains zebra (*Equus quagga*), greater kudu (*Tragelaphus strepsiceros*), blue wildebeest (*Connochaetes taurinus*) and common impala (*Aepyceros melampus*). We are building landscape-level models of epidemiology and population dynamics incorporating host movement, transmission routes, pathogen virulence, and host resistance. Finally, we will develop models predicting anthrax transmission dynamics across ecosystems. In a broader sense, this research will facilitate the development of predictive tools to better manage public health and related policies for complex, multi-host zoonotic diseases such as anthrax.

Finding safe haven in a warming world: Microclimatic buffering in grasslands and its influence on threatened birds

Investigator: *Benjamin Zuckerberg, University of Wisconsin-Madison, and Christine A. Ribic, USGS, University of Wisconsin-Madison*
Funding: *USDA Hatch Formula Funds*
Expected Completion: *September 30, 2023 (ends July after Chris's retirement)*

Many species and ecosystems are vulnerable to a rapidly changing climate, and the most effective route for reducing this vulnerability is through climate-change adaptation. A common adaptation strategy is to increase the resistance of ecosystems by maintaining or creating climate change refugia. In modern conservation, the concept of refugia applies to areas characterized by local climatic conditions (i.e., microclimates) that persist despite widespread changes at regional and global scales. Landscape features, such as topographic complexity, promote a diversity of cool and warm microclimates considered important for "buffering" refugial populations during periods of rapid climate change and even reduce extinction risk for climate-sensitive species. If microclimate buffering reduces the vulnerability of species from the negative consequences of climate change, then identifying and managing the features that promote microclimate diversity is a critical complement of conserving threatened ecosystems. Prairies were once widespread across North America (Samson et al. 1998), but are now one of the most endangered and least protected ecosystems in the world. Agriculture and residential development have reduced once extensive prairies into a patchwork of "surrogate" grasslands consisting of hayfields and grazing pastures. Concurrent with habitat loss, rising temperatures and shifting precipitation patterns are disproportionately affecting temperate grasslands. Many temperate grasslands are in low-lying regions, and as a result, the pace of modern climate change has been fastest in open habitats compared to any other terrestrial biome in the world. The degradation of grassland ecosystems has been detrimental to its fauna, including many grassland birds that are declining faster than any other bird guild across North America (Sauer et al. 2012). In response to the widespread population declines of many grassland birds, conservation agencies employ a number of strategies such as maintaining large grasslands, land acquisition, and promoting restoration practices, but little work has addressed the importance of climate-change adaptation in the conservation of grassland birds. Given the ongoing loss of

grassland habitat, adaptation strategies will likely need to focus on building the resilience of existing grasslands for maintaining current and future biodiversity in a warming world. Herein, we propose a novel, multi-scaled quantification of microclimates within grassland fragments and evaluate their importance on the nesting biology of declining grassland bird populations. By exploring the drivers of microclimates in remnant grasslands, we offer a unique empirical evaluation of how microclimatic buffering influences the demography and distribution of grassland-dependent species.

Estimating grassland bird populations to inform landscape-level conservation in Wisconsin

Investigator: *Benjamin Zuckerberg, University of Wisconsin-Madison, and Christine A. Ribic, USGS, University of Wisconsin-Madison*
Funding: *U.S. Fish and Wildlife Service*
Expected Completion: *April 3, 2023*

A primary goal of the Upper Mississippi River and Great Lakes Joint Venture (UMRGL JV) is to “strive for sustainable populations of all birds through regionally coordinated conservation actions based on the best (or state-of-the-art) scientific information and techniques available." To achieve this goal, accurate and unbiased bird population estimates are needed. Flawed inferences about population status can waste limited resources or prevent managers from recognizing when populations are vulnerable. Thus, the need for robust population estimates is apparent. The goal of this project is to provide an assessment of Partners-In-Flight (PIF) population estimates in comparison to those derived from Wisconsin’s 2nd BBA point-count project, and to integrate Breeding Bird Atlas (BBA) and Breeding Bird Survey (BBS) data for analysis of Wisconsin’s grasslands as well as to predict population estimates to the entire UMRGL JV region. We will use Wisconsin’s BBA point-count data to build species-specific hierarchical models that incorporate habitat and detection covariates to derive population estimates for 20 species that vary in their abundance and breeding habitat and compare PIF and our BBA derived estimates for all focal species, construct a shared model that integrates BBA and BBS data and compares those estimates to both “single” (BBS only and BBA only) data estimates, demonstrate the applicability of our shared model to determine the importance of three focal grassland landscapes in Wisconsin for two “umbrella” grassland species, and estimate population size for the 20 species across the UMRGL region using BBA data from three states (MN, OH, WI) that have at least two years of BBA point-count data, and BBS data from all states within the UMRGL JV region.

A Retrospective Analysis of California Spotted Owl Territory Occupancy in Southern California

Investigator: *M. Zachariah Peery, Department of Forest and Wildlife Ecology, University of Wisconsin-Madison*
Funding: *U.S. Fish and Wildlife Service*
Expected Completion: *December 31, 2022*

Spotted owls reside at the epicenter of forest management debates in the western US. The current status of the southern California spotted owl population is not well understood following the end of our demographic study in the San Bernardino Mountains in 1998.

However, semi-regular occupancy surveys have been conducted since that time that include most, if not all, of the territories surveyed as part of the original demography study. This project will analyze spotted owl occupancy data, spanning a 32-year period (1988 to 2019), to address determine the current territory occupancy rate of California spotted owls in the San Bernardino Mountains, the trend in the territory occupancy rate from 1998 to 2019, and how territory occupancy has been affected by factors such as habitat loss due to wildfire and fuels treatments.

PROJECTS COMPLETED THIS YEAR

Strategies for reducing the vulnerability of grassland birds to climate change within the Central Flyway

Investigator: *Benjamin Zuckerberg, University of Wisconsin-Madison, and Christine A. Ribic, USGS, University of Wisconsin-Madison*
Funding: *USGS National Climate Adaptation Science Center*
Expected Completion: *September 19, 2022*

Prairies were once widespread across North America, but are now one of the most endangered and least protected ecosystems in the world. Agriculture and residential development have reduced once extensive prairies into a patchwork of remnant prairies and "surrogate" grasslands (e.g., hayfields, planted pastures). Concurrent with habitat loss, rising temperatures and shifting precipitation patterns are disproportionately affecting temperate grasslands. The degradation of grassland ecosystems has been detrimental to its fauna, including many grassland birds that are declining faster than any other bird guild across North America. In response to the widespread population declines of many grassland birds, conservation agencies employ a number of strategies such as maintaining large grasslands, funding land acquisition, and promoting prairie restoration, but little work has addressed the importance of climate-change adaptation in the conservation of grassland birds. To incorporate climate-change adaptation into grassland conservation, we will conduct a synthesis of climate change vulnerability for grassland ecosystems and grassland-dependent birds within the Central Flyway. Our goal is to produce a synthesis of strategies for grassland managers interested in developing climate adaptation plans. In doing so, we will i) organize a steering committee to identify current strategies in grassland management and priority grassland birds of conservation concern; ii) conduct a literature review and survey of our steering committee to describe the state of scientific knowledge on climate change impacts on grassland habitats and grassland-dependent birds; and iii) organize a meeting to produce a scientific review of current and future adaptation strategies for the conservation of grassland ecosystems and grassland-dependent birds.

Understanding the Importance of the Landscape Scale for Wildlife Management in the Chequamegon-Nicolet National Forest and Developing Best Practices for Archiving Research Data

Investigators: *Christine A. Ribic, USGS, University of Wisconsin-Madison,*
Funding: *US Forest Service*
Expected Completion: *July 31, 2022*

We are working collaboratively with the US Forest Service Northern Research Station to (1) evaluate two long-term projects: amphibian use of ephemeral ponds and wetlands within forested systems and beaver colony activity along trout streams and (2) investigate archiving and presentation of data sets used for analysis and high impact data collections. For the long-term projects, we will evaluate the datasets and determine additional environmental and spatial variables required to address management concerns. Once evaluation is completed, we will retrieve identified environmental (e.g., water quality, climate data) and spatial (e.g., surrounding land cover/use of surrounding landscape) data and incorporate all data into a GIS. We will calculate landscape metrics identified in the conceptual model and analyze both data sets. Other areas of research of interest to the Forest will also be developed, such as Kirtland's Warbler management and the use of fire to restore pine barrens ecosystems.

Besides the data used in the analysis, high impact USFS data collections will be archived. We will work with the US Forest Service to develop protocols and standards for archiving research data collected by the US Forest Service Research & Development branch. The primary focus of this work is on historical data collected on the Experimental Forest System, with additional sub-projects coming from any of the Research Stations or the International Institute of Tropical Forestry. We propose to process the historical record of at least seven Experimental Forests, and identify at least 15 data sets for archiving. Formal metadata will be created to document each data set, along with other descriptive material as appropriate for the particular data set. As appropriate, we will also engage in the administrative deposit activities associated with an OAIS-compliant data repository.

A bat skin model to identify therapeutic approaches that enhance fungal recognition and augment innate immune response to white-nose syndrome

Investigators: *Bruce Klein, School of Veterinary Medicine, School of Medicine and Public Health, University of Wisconsin-Madison*
Funding: *U.S. Geological Survey (National Wildlife Health Center)*
Completion: *November 30, 2022*

The introduced fungus *Pseudogymnoascus destructans* (Pd) infects the skin of little brown bats (*Myotis lucifugus*) of North America, killing them by the millions due to WNS1. Keratinocytes represent 95% of the epidermal cells in skin and are the first barrier against microbes in bats, secreting antifungal peptides and cytokines, recruiting leukocytes, and initiating adaptive immunity 2–5. The goal of this project is to define how keratinocytes detect Pd compared to a non-pathogenic cutaneous fungus *Trichophyton rendellii* (Tr) 6 in order to develop a method of topical immunization against WNS. We hypothesize that keratinocytes detect the two fungi differently, driving distinct innate immune responses that are, in part, responsible for different infection outcomes. During hibernation bats become torpid and immune quiescent with periodic arousal and immune activation 7–9. Despite such immune restriction, hibernating little brown bats do clear infection by native, Pd-like, ascomycete fungi such as Tr 6. Although innate immune response is upregulated in the skin of WNS bats, this response is insufficient to halt Pd invasion of skin. There are remarkably similar paradigms involving human fungal infections. In chromoblastomycosis, a chronic, severe skin fungal infection caused by a Pd-like ascomycete *Fonsecaea pedrosoi*, innate immune recognition by a pattern recognition receptor

(PRR) called Mincle is weak and insufficient to clear the fungus10. Yet, engagement of a second PRR, TLR7, together with Mincle clears the fungus. Chromoblastomycosis can thus be treated successfully by cutaneous application of Imiquimod® cream, which promotes Mincle and TLR7 co-receptor engagement and resolution of infection10,11. Based on this paradigm, we propose that understanding how keratinocytes recognize and respond to Pd (as compared to non-pathogenic Tr) will enable a rational basis for developing a preventive strategy to bolster innate immunity in hibernating bats, enabling them to resist infection with Pd. We have 3 specific aims: 1) Identify the PRR(s) that recognize Pd using reporter cells and validate results with bat keratinocytes; 2) Compare the innate response of keratinocytes on interaction to Pd and Tr; 3) Test commercial PRR ligands that trigger, together with Pd, an augmented innate response in bat keratinocytes (in vitro) and on little brown bats (in vivo).

PUBLICATIONS AND PROFESSIONAL PAPERS

Peer-reviewed articles
Unit Staff (bolded) and students/scientists/postdocs (underlined)

Brandell, E.E., D.J. Storm, T.R. Van Deelen, D.P. Walsh, **W.C. Turner**. 2022. A call to action: standardizing white-tailed deer harvest data in the Midwestern United States and implications for quantitative analysis and disease management *Frontiers in Ecology and Evolution,* 10:943411. https://doi.org/10.3389/fevo.2022.943411

Dougherty, E.R., D.P. Seidel, J.K. Blackburn, **W.C. Turner**, W.M Getz. 2022. A framework for integrating inferred movement behavior into disease risk models, *Movement Ecology*, 10:31. https://doi.org/10.1186/s40462-022-00331-8

Gilbertson, M.L.J., A. Ketz, M. Hunsaker, D. Jarosinski, W. Ellarson, D.P. Walsh, D.J. Storm, **W.C. Turner**. 2022. Agricultural land use shapes dispersal in white-tailed deer (*Odocoileus virginianus*), *Movement Ecology*, 10:43. https://doi.org/10.1186/s40462-022-00342-5

Gilbertson, M.L.J., E.E. Brandell, M. Pinkerton, N. Meaux, M. Hunsaker, D. Jarosinski, W. Ellarson, D.P. Walsh, D.J. Storm, **W.C. Turner**. 2022. Cause of death, pathology, and chronic wasting disease status of white-tailed deer mortalities in Wisconsin, *Journal of Wildlife Diseases.* In press.

Huang, Y.-H., K.L. Kausrud, A. Hassim, S.O. Ochai, O.L. van Schalkwyk, E.H. Dekker, A. Buyantuyev, C.C. Cloete, J.W. Kilian, P.L. Kamath, H. van Heerden, and **W.C. Turner**. 2022. Environmental drivers of biseasonal anthrax outbreak dynamics in two multi-host savanna ecosystems. *Ecological Monographs,* e1526. https://doi.org/10.1002/ecm.1526

Ketz, A. C., Robinson, S. J., Johnson, C. J., & Samuel, M. D. (2022). Pathogen-mediated selection and management implications for white-tailed deer exposed to chronic wasting disease. *Journal of Applied Ecology*, 59, 982– 996. https://doi.org/10.1111/1365-2664.14109

Levengood, A.L., K. Melillo-Sweeting, **C.A. Ribic**, A.J. Beck, and K.M. Dudzinski. 2022. Atlantic spotted and bottlenose dolphin sympatric distribution in nearshore waters off Bimini, The Bahamas, 2003-2018. *Caribbean Journal of Science* 52(2): 162-176. https://doi.org/10.18475/cjos.v52i2.a3

Nunes, L.A., **C.A. Ribic**, and B. Zuckerberg. 2021. Identifying mismatches between conservation area networks and vulnerable populations using spatial randomization. *Ecology and Evolution*, 11:16006-16020. DOI: http://dx.doi.org/10.1002/ece3.8270

Ochai, S.O., J. Crafford, A. Hassim, C. Byaruhanga, Y.-H. Huang, A. Hartmann, E.H. Dekker, O.L. van Schalkwyk, P.L. Kamath, **W.C. Turner**, and H. van Heerden. 2022. Immunological evidence of variation in exposure and immune response to *Bacillus anthracis* in herbivores of Kruger and Etosha National Parks. *Frontiers in Immunology*, 13:814031. https://doi.org/10.3389/fimmu.2022.814031

Olah, A. M., **C. A. Ribic**, K. Grveles, S. Warner, D. Lopez, and A. M. Pidgeon. 2022. Kirtland's Warbler breeding productivity and habitat use in red pine-dominated habitat in Wisconsin, USA. *Avian Conservation and Ecology* 17(1):3. https://doi.org/10.5751/ACE-02009-170103

Turner, W.C., S. Périquet, C.E. Goelst, K. Vera, E.Z. Cameron, K.A. Alexander, J.L. Belant, C.C. Cloete, P. du Preez, W.M. Getz, R.S. Hetem, P.L. Kamath, M. Kasaona, M. Mackenzie, J. Mendelsohn, J.K.E. Mfune, J.R. Muntifering, R. Portas, H.A. Scott, W. M. Strauss, W. Versfeld, B. Wachter, G. Wittemyer, and J.W. Kilian. 2022. Africa's drylands in a changing world: Challenges for wildlife conservation under climate and land-use changes in the Greater Etosha Landscape, *Global Ecology and Conservation,* 38:e02221. https://doi.org/10.1016/j.gecco.2022.e02221

Unit Affiliates

Tempel, D. J., Kramer, H. A., Jones, G. M., Gutiérrez, R. J., Sawyer, S. C., Koltunov, A., Slaton, M., Tanner, R., Hobart, B. K., and Peery, M. Z.. 2022. Population decline in California spotted owls near their southern range boundary. *Journal of Wildlife Management* 86:e22168. https://doi.org/10.1002/jwmg.22168.

Posters and Papers Presented at Professional Meetings
Unit Staff and Students underlined

Brandell, E.E., D.P. Walsh, D.J. Storm, **W.C. Turner**. White-tailed deer management structures and the effects of management on harvest. Wisconsin Chapter of The Wildlife Society Winter Meeting March, 2022 (Contributed Oral)

Dudzinski, K.M., **C.A. Ribic**, H.M. Hill, and T. Bolton. 2022. Bottlenose dolphin calf initiated pectoral fin contact exchanges with mother, other kin, and non-kin. Poster, The Society for Marine Mammalogy, 24th Biennial Conference on the Biology of Marine Mammals, Palm Springs, FL, 1-5 August 2022.

Gilbertson, M.L.J., E.E. Brandell, M.E. Pinkerton, N.M. Meaux, M. Hunsaker, D. Jarosinski, W. Ellarson, D.P. Walsh, D.J. Storm, **W.C. Turner**. Cause of death, pathology, and chronic wasting disease status of white-tailed deer mortalities in Wisconsin. 70th Annual International Conference, Wildlife Disease Association, Madison, Wisconsin, 23-29 July 2022. (Contributed Oral)

Gilbertson, M.L.J., E.E. Brandell, M.E. Pinkerton, N.M. Meaux, M. Hunsaker, D. Jarosinski, W. Ellarson, D.P. Walsh, D.J. Storm, **W.C. Turner**. Cause of death, pathology, and chronic wasting disease status of white-tailed deer mortalities in Wisconsin. Wisconsin Chapter of The Wildlife Society Winter Meeting March, 2022 (Contributed Oral)

Inzalaco, H.N., S.S. Lichtenberg, F. Bravo Risi, R. Morales, D.P. Walsh, D.J. Storm, **W.C. Turner**, J.A. Pedersen. Black-legged ticks (*Ixodes scapularis*) harbor and excrete chronic

wasting disease prions from infected blood meals. 70th Annual International Conference, Wildlife Disease Association, Madison, Wisconsin, 23-29 July 2022. (Contributed Oral)

Ketz, A. C., Storm, D. J., **Turner, W. C.**, Walsh, D. P., Force of Infection Models of Chronic Wasting Disease Transmission: Long-term disease Dynamics, Oral Presentation for the Wisconsin Department of Natural Resources Office of Applied Sciences Seminar Series August 25, 2022,(Invited Oral)

Ketz, A. C., Storm, D. J., Barker, R. E., Apa, A. D., Oliva-Aviles, C., & Walsh, D. P., Assimilating ecological theory with empiricism: Using constrained generalized additive models to enhance survival analyses. Oral Presentation at the Ecological Society of American and Canadian Society of Ecology and Evolution, August 2022, Montreal, QC. (Contributed Oral)

Ketz, A. C., Storm, D. J., & Walsh, D. P., Integrating spatiotemporal epidemiological models with time-to-event age-period survival models. Oral presentation at the International Statistical Ecology Conference, June 2022. (Contributed Oral)

Melillo-Sweeting, K., **C.A. Ribic**, A.J. Beck, and K.M. Dudzinski. 2022. Nearshore habitat use of Atlantic spotted and bottlenose dolphins off Bimini, The Bahamas. Presentation, The Society for Marine Mammalogy, 24th Biennial Conference on the Biology of Marine Mammals, Palm Springs, FL, 1-5 August 2022.

Ochai, S.O., J. Crafford, A. Hassim, C. Byaruhanga, Y.-H. Huang, A. Hartmann, E.H. Dekker, O.L. van Schalkwyk, P.L. Kamath, **W.C. Turner,** and H. van Heerden. 2022. Immunological evidence of variation in exposure and immune response to *Bacillus anthracis* in herbivores of Kruger and Etosha National Parks. 19th Annual Congress, Southern African Society for Veterinary Epidemiology and Preventative Medicine, East London, South Africa, 24-26 August 2022. (Contributed Oral)

Prentice, M.B., M.L.J. Gilbertson, D.J. Storm, **W.C. Turner**, D.P. Walsh, M.E. Pinkerton, P.L. Kamath. Metagenomic sequencing to identify the etiologic agent responsible for pneumonia-related mortality in Wisconsin white-tailed deer. 70th Annual International Conference, Wildlife Disease Association, Madison, Wisconsin, 23-29 July 2022. (Contributed Oral)

W.C. Turner and Y.-H. Huang. 2022. Environmental variation and host behaviors alter spatiotemporal patterns of anthrax outbreaks contrasting two African savannas. 10th International Conference on *Bacillus anthracis*, *B. cereus* and *B. thuringiensis* in Paris, France, April 24-28, 2022. (Contributed Oral)

W.C. Turner and J.W. Kilian. 2022. Challenges for wildlife conservation under climate and land-use changes in the Greater Etosha Landscape, Namibia. Wisconsin Chapter of The Wildlife Society Winter Meeting, March, 2022. (Contributed Oral)

W.C. Turner. 2022. Changing environments and wildlife disease: what might the future bring? South African Wildlife Management Association Annual Meeting, Bonamanzi, South Africa, 4-9 September 2022 (Invited Plenary)

W.C. Turner. 2021. Deer movement ecology, harvest management and CWD research at the Wisconsin Cooperative Wildlife Research Unit, USDA-APHIS Chronic Wasting Disease (CWD) Tribal Nations and Stakeholder Update Meeting, December 7-9, 2021 (Invited Oral)

Unit Affiliates
None.

Data Publications
Gilbertson, M.L.J., **W.C. Turner**, D.J. Storm. 2022. White-tailed deer necropsy data from Wisconsin, 2017-2021: U.S. Geological Survey data release. DOI: *https://doi.org/10.5066/P9BXKOI2*.

Forbes, Brieanne K.; Reilly, Sean P.; Clark, Matthew L.; Ferrell, Ryan M.; Kelly, Allison C.; Krause, Paris D.; Matley, Corbin D.; O'Neil, Michael W.; Villasenor, Michelle T.; Disney, Mathias I.; Wilkes, Phil; Bentley, Lisa P. 2021. Plot-level ladder fuel estimation from a suite of remote sensing and field methods. Fort Collins, CO: Forest Service Research Data Archive. https://doi.org/10.2737/RDS-2021-0101

Carman, Richard; Kellerman, Todd. 2021. Nebraska Windbreaks original plantings (1935-1942). Fort Collins, CO: Forest Service Research Data Archive. https://doi.org/10.2737/RDS-2021-0102

Bunzel, Ken J.; Ager, Alan A.; Day, Michelle A.; Evers, Cody R.; Ringo, Chris D. 2022. Smoothed raster of wildfire transmission to buildings in the continental United States. Fort Collins, CO: Forest Service Research Data Archive. https://doi.org/10.2737/RDS-2022-0015

Thomas-Van Gundy, Melissa A.; Nowacki, Gregory J.; Cogbill, Charles V. 2022. Fire-adapted witness trees across the northeastern United States including four National Forests. Fort Collins, CO: Forest Service Research Data Archive. https://doi.org/10.2737/RDS-2022-0017

Dendy, Julian T.; Collins, Paul; Mesubed, Dino; Cordell, Susan; Giardina, Christian; Uowolo, Amanda L.; Iida, Akiko. 2021. Palau historical vegetation cover. Fort Collins, CO: Forest Service Research Data Archive. https://doi.org/10.2737/RDS-2022-0020

Loeffler, Dan R.; Anderes, Stefan; Houtman, Rachel M.; Ager, Alan A.; Day, Michelle A. 2022. Forest management activity costs in the continental United States (2012-2018). Fort Collins, CO: Forest Service Research Data Archive. https://doi.org/10.2737/RDS-2022-0021

Volger, Kevin C.; Thompson, Matthew P.; Scott, Joe H.; Miller, Carol. 2022. Wildfire risk under alternative fuel management strategies: spatial datasets of in situ and transmitted risk for populated areas in north-central New Mexico and Sierra Mountain Range within California. Fort Collins, CO: Forest Service Research Data Archive. https://doi.org/10.2737/RDS-2022-0026

Loehman, Rachel A.; Heyerdahl, Emily K.; Pederson, Gregory T.; McWethy, David B. 2022. Demography of ancient western juniper (Juniperus occidentalis var. occidentalis) trees on Horse Ridge in central Oregon, USA. Fort Collins, CO: Forest Service Research Data Archive. https://doi.org/10.2737/RDS-2022-0031

Potter, Brian E.; McEvoy, Daniel. Fire growth and associated weather data for selected Fires of Unusual Size (FOUS) and other fires from 2004-2018. Fort Collins, CO: Forest Service Research Data Archive. https://doi.org/10.2737/RDS-2021-0040

Locke, Dexter H. 2022. Census block groups converted to singlepart polygons and with water removed, 2013-2017. Fort Collins, CO: Forest Service Research Data Archive. https://doi.org/10.2737/RDS-2022-0054

Minocha, Rakesh; Long, Stephanie. 2022. Data on the effects of environmental pollution on carbon and nitrogen metabolism of one-, two-, and three-year-old needles and sapwood plugs collected in 2004 from Norway Spruce from 6 forested sites within the Czech Republic. Fort Collins, CO: Forest Service Research Data Archive. https://doi.org/10.2737/RDS-2021-0059

Zillig, Martha W.; Fleishman, Erica. 2022. Insect biomass and abundance in the Wassuk, Toiyabe, Toquima, and Monitor ranges, Nevada, and on the east slope of the Sierra Nevada, California. Fort Collins, CO: Forest Service Research Data Archive. https://doi.org/10.2737/RDS-2021-0060

Zillig, Martha W.; Fleishman, Erica. 2022. Daily temperature measurements in the Wassuk, Shoshone, Toiyabe, Toquima, and Monitor ranges, Nevada, and on the east slope of the Sierra Nevada, California. Fort Collins, CO: Forest Service Research Data Archive. https://doi.org/10.2737/RDS-2021-0061

Zillig, Martha W.; Fleishman, Erica. 2022. Plant phenology in the Wassuk, Toiyabe, Toquima, and Monitor ranges, Nevada, and on the east slope of the Sierra Nevada, California. Fort Collins, CO: Forest Service Research Data Archive. https://doi.org/10.2737/RDS-2021-0062

Locke, Dexter H. 2021. Green stormwater infrastructure in New Haven, Connecticut and socioeconomic variables within neighborhoods and census block groups. Fort Collins, CO: Forest Service Research Data Archive. https://doi.org/10.2737/RDS-2021-0104

Theses and Dissertations

Yen-Hua Huang, 2022. *Effects of Environmental Fluctuations and Herbivore Ecology on Anthrax Dynamics in Southern Africa,* Ph.D. Dissertation, Wildlife Ecology program, Department of Forest and Wildlife Ecology, University of Wisconsin-Madison.

PROFESSIONAL ACTIVITIES AND OUTREACH

Professional Activities

Unit Leader:

- Member, wildlife subcommittee, Wisconsin State Technical Committee, USDA-Natural Resources Conservation Service (July 2006-present)

Assistant Unit Leader:

- Member of the Scientific Program Committee for the Wildlife Disease Association 2022 meeting in Madison, Wisconsin
- Associate Editor, Journal of Wildlife Diseases (August 2022-present)
- Academic Editor, PLOS ONE (December 2018 – present)
- Member, Center for Ecology and the Environment Executive Committee, UW-Madison (2021-present)

Teaching

Turner, W. C. 2022. Disease and Biodiversity. Guest lecture in Forest and Wildlife Ecology 360 Extinction of Species, University of Wisconsin-Madison, September 26, 2022.

Outreach

Unit research featured in the following:
Article. USGS research helps protect vulnerable grassland birds from climate change. Wildlife Management Institute Outdoor News Bulletin volume 76 issue 7 (July 2022). Online at: https://wildlifemanagement.institute/outdoor-news-bulletin/july-2022/usgs-research-helps-protect-vulnerable-grassland-birds-climate

HONORS AND AWARDS

Group STAR award USGS-CRU, June 2022
Recognizes Abby Powell and the other members of the DEI Committee: Amanda Rosenberger, Wendy Turner, Angela Fuller, Grace DiRenzo, Mark Henderson, and Mark Scheuerell for their work to identify the need, organize, and conduct the first CRU-wide Workshop on Recruiting and Retaining Students from Diverse Backgrounds