

MISSOURI COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT REPORT

November 2010 – July 2012



Cooperating Agencies:

**U. S. Geological Survey
U. S. Fish and Wildlife Service
Missouri Department of Conservation
University of Missouri
Wildlife Management Institute**

MISSOURI COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT

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The Unit Annual Report has been produced for over 30 years and includes information from the entire Department of Fisheries and Wildlife Sciences. If you desire any additional information, please contact Niki Fuemmeler at our address.

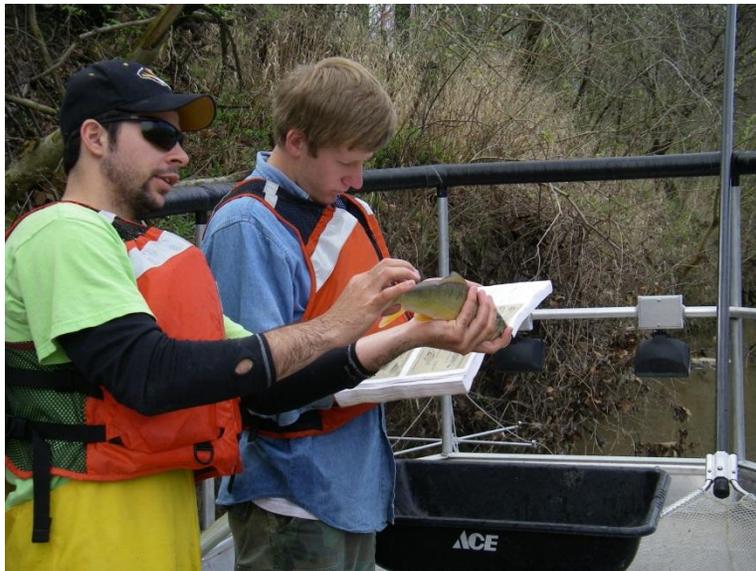


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CHANGING TIMES AT THE MISSOURI UNIT

A lot has changed since the Missouri Unit was first established in 1936 and Paul Dalke became the first leader in 1937. Our long history is linked with the Missouri Department of Conservation as we both share a 75th Anniversary this year. In fact, the Missouri Unit owes its anniversary to MDC because one of the first acts of the Missouri Conservation Commission was to establish the Missouri Wildlife Research Unit at the University of Missouri, which was really the birth of a fish and wildlife program at the University of Missouri.

In the last four years we have seen both Charlie Rabeni and David Galat retire from the Cooperative Research Unit, and the new hiring of Craig Paukert in June 2010 (Leader), Lisa Webb in May 2011 (Assistant Leader-Wildlife) and Amanda Rosenberger in June 2012 (Assistant Leader-Fisheries). Our last report in 2010 did include some of Craig's research program, but Lisa and Amanda had not started yet. You will see a lot more of their research programs in coming reports but below will give a brief introduction to both Lisa and Amanda.

Lisa Webb started with the Missouri Coop Unit in May 2011, after spending five years as an Assistant Professor of Wildlife Ecology at Arkansas Tech University. She has her BA from Washington and Lee University, MS from Southern Illinois University Carbondale, and PhD from Texas Tech University. Lisa's research expertise is primarily in waterfowl and wetland ecology, with an emphasis on quantifying factors that influence habitat quality, behavior and body condition of wetland birds during migration. However, her research program has recently expanded to include secretive marsh birds. Her research program already includes projects funded by MDC, NRCS, and other cooperators, and this report describes some of her ongoing research projects.

Amanda Rosenberger started with the Missouri Unit in June 2012 so she is just settling in to her new home and job. Amanda spent 6 years as an Assistant Professor at the University of Alaska-Fairbanks before coming to Missouri. She has her BS from Simon's Rock College of Bard, MS from University of Florida, and PhD from Virginia Polytechnic Institute and State University. Her main research interest include ecology and conservation of stream fishes at the local to landscape scale, and has worked on various issues related to the effect of climate change on Alaskan fishes, the influence of fire on western fishes, and the ecology of endangered darters in Virginia. In addition, she is working with MDC on mussel conservation in the state.

DR. DAVID GALAT

**ACTING UNIT LEADER, MISSOURI COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT,
2009 -2010**

**ASSISTANT LEADER-FISHERIES, MISSOURI COOPERATIVE FISH AND WILDLIFE RESEARCH
UNIT, 1988-2008**



Long-time Assistant Leader David Galat retired from the USGS Cooperative Research Units in December 2010 after 22 years of service to the Missouri Unit cooperators. David developed an internationally-known research program in river ecology and restoration and is a well-respected river ecologist who provided technical advice to 16 different organizations including the US Fish and Wildlife Service, Army Corps of Engineers, and The Natural Conservancy. His reputation led to appointed, elected, or invited service to high-level science panels including the Interagency Floodplain Management Review Committee, Scientific Assessment and Strategy Team from the White House Office on Environmental Policy, the National Academy of Sciences National Research Council Committee to Assess the U.S. Army Corps of Engineers Methods of Analysis and Peer Review for Water Resources Project Planning, and numerous others.

David has also been recognized through awards and honors related to his long career including Letters of Recognition from Vice President Al Gore for participation on the White House Interagency Floodplain Review Committee and Scientific Assessment and Strategy Team. He has also received the Missouri Chapter of the American Fisheries Society John L. Funk Award of Excellence for his long-term contributions to aquatic resource conservation in Missouri, Certificate of Appreciation for Outstanding Service: Committee on the Missouri River Recovery and Associated Sediment Management Issues Member, and the National Research Council of the National Academies, Water Science and Technology Board. David also received from the National Judicial College a Certificate for serving with distinction as Faculty, Dividing the Waters, National Conference in St. Louis.

David also had a long academic career that has spanned several universities; the most notable was his 23-year association with the University of Missouri (MU). At MU David has mentored 19 students and taught nine different courses in river, wetland, fish, and restoration ecology. He has over 70 peer reviewed publications, technical reports, and book chapters, often in high-level journals and the National Academy of Sciences series. Finally, David's accomplishments in the academic community are evidence by his MU Gold Chalk Award for Graduate Student Mentoring by the MU Graduate Professional Council in 2010. Congratulations, David on your continued contributions to river restoration and graduate student training and development!

THE MISSOURI COOP UNIT

The Cooperative Research Units program is comprised of 40 Units in 38 states. Each Unit is a formal partnership among the U.S. Geological Survey, a State natural resource agency, a host university, the Wildlife Management Institute, and the U.S. Fish and Wildlife Service. The structure of the program provides Federal and State agencies access to not only Unit scientists, but also facilities and expertise available at the cooperating universities. Because Unit scientists and university faculty members possess diverse areas of expertise, the program collectively encompasses a wide variety of disciplines related to fish, wildlife, and natural resource management.

The Missouri Unit is a productive member of the Unit program. Our history began in 1936 when the citizens of Missouri voted to amend the State's constitution to create a politically independent Conservation Commission. The first official act of the Conservation Commission was to establish a Cooperative Wildlife Research Unit at the University of Missouri. Objectives were settled upon quickly and were *"to conduct scientific research on the wildlife of Missouri"* and *"to educate students, both in technical phases of wildlife management and general aspects of wildlife conservation."* We have grown by adding a Fishery Unit in 1962, consolidated by becoming a single Fish and Wildlife Unit in 1985, and moved from the U.S. Fish and Wildlife Service to the National Biological Survey to the U.S Geological Survey. But through it all, we have remained true to these early guiding principles.

Projects conducted by our Unit address the expressed information needs of the Missouri Department of Conservation, the U.S. Geological Survey, and other state and federal agencies. The needs of the University of Missouri, also a primary cooperators, are met by assisting with the education mission of the University at the graduate level. The Unit assists University cooperators in various ways, including sharing Unit resources and by administering USGS and other federal funds through the Research Work Order process.

The diversity of fish and wildlife resources in Missouri requires the Unit to pursue a broad focus for research studies, although waterfowl nutritional ecology, big river ecology and management, and stream fishery resources have long been emphasized. An attempt is made to complement and strengthen existing research efforts of state and federal agencies. The concern of all cooperators is that Unit research be productive, of high quality, and ultimately useful to the management of fish and wildlife resources of the state and region.



COURSES TAUGHT BY MISSOURI UNIT STAFF AND AFFILIATES

One aspect of the Cooperative Agreement that established the Missouri Cooperative Fish and Wildlife Research Unit is that each Unit Scientist teach up to one graduate course in their area of expertise each year. Below is a summary of the courses taught by Unit Scientists and affiliates from fall 2010 to spring 2012. In addition to these courses, Unit scientists and staff guest lectured six times in Fish and Wildlife Colloquium, Ecosystem Management, Fisheries Management, and Advanced Fisheries Science. At least three additional courses are slated to be offered by Unit Scientists and post docs in fall 2012 and spring 2013.

Course	Credits	Instructor	Semester	Undergrad. Enroll.	Grad. Enroll.
FW 8001: Advanced Fisheries Science	3	C. Paukert	Spr 2012	1	7
FW 4880/7880: Waterfowl Ecology	3	L. Webb	Spr 2012	7	0
FW 8001: Lotic Community Ecology	1	*A. Pease	Fall 2011	1	10
GNHON 2950H Honors Preceptorship	2	C. Paukert	Fall 2011	1	0

*Post doctoral research associate advised by C. Paukert



UNIT AND COOPERATOR PERSONNEL ROSTER

A. Permanent Unit Personnel

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Frank R. Thompson III
Joanna Whittier

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John R. Jones
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Douglas B. Noltie
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B. Unit Coordinating Committee

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GRADUATE STUDENTS

2010 TO PRESENT

ADVISED BY UNIT SCIENTISTS

**Student received degree during the report period.*

Name	Research Project	Previous Education	Advisor
*Justin Buckler, M.S.	Assessing effects of contaminants on <i>Scaphirhynchus</i> sturgeon.	B.S. University of Missouri-Columbia	Dr. Galat
Andy Dinges, M.S.	Effects of the Light Goose Conservation Order on Waterfowl Distribution and Behavior in the Rainwater Basin	B.S. University of Nebraska	Dr. Webb
Jake Faulkner, M.S.	Seasonal habitat selection of Niangua darters.	B.S. University of Missouri	Dr. Paukert
*Jeff Fore, PhD.	Remediating effects of human threats on lotic fish assemblages within the Missouri River Basin	B.S. Oklahoma State University M.S. Eastern Illinois University	Dr. Galat
Jason Harris, M.S.	Movement and habitat selection of largemouth bass in Table Rock Lake.	B.S. South Dakota State University	Dr. Paukert
Evan Hill, M.S.	Linking wetland management decisions to distribution, habitat use and nesting efforts of secretive marsh birds in Missouri.	B.S. Gustavus Adolphus College	Dr. Webb
*Joshua Lallaman, PhD.	Ecology of paddlefish in the Osage River.	B.S. University of Wisconsin-Stevens Point M.S., Central Michigan University	Dr. Galat
*Doreen Mengel, M.S.	Amphibians as wetland restoration indicators on Wetlands Reserve Program sites in Lower Grand River basin, Missouri.	B.S. University of Georgia	Dr. Galat
Meagan Montgomery, M.S.	Restoring river-floodplain connectivity for fish spawning and nursery in the Lower Missouri River: use of a constructed fish passage facility and an actively	B.S. University of Missouri	Dr. Galat

managed wetland pool.

Emily Pherigo, M.S.	Role of tributaries for large river fish recovery.	B.S. Knox College	Dr. Paukert
Landon Pierce, PhD.	Conservation planning of fishes in the Colorado River basin.	B.S. University of Nebraska M.S. South Dakota State University	Dr. Paukert
Nick Sievert, M.S.	Assessing protected areas in conserving biodiversity in the face of climate change.	B.S. University of Wisconsin-Madison	Dr. Paukert
*Jonathan Spurgeon, M.S.	Evaluation of translocations of humpback chub in Grand Canyon.	B.S. University of Missouri	Dr. Paukert
Jessi Tapp, M.S.	Waterbird use and food availability on Wetland Reserve Program sites enrolled in the Migratory Bird Habitat Initiative.	B.S. Murray State University	Dr. Webb
*Jacob Westhoff, PhD.	Investigating the replacement of imperiled native crayfishes by an introduced crayfish.	B.S. University of Missouri M.S. Tennessee Technological University	Dr. Rabeni

POST DOCTORAL RESEARCH ASSOCIATES AND RESEARCH STAFF

Name	Research Project	Previous Education	Advisor
Dr. William Beatty	Movements and habitat selection of mid-continent Mallards.	B.S. University of Missouri M.S. Eastern Illinois University PhD. Purdue University	Drs. Webb and Kesler
Dr. Karthik Masagounder	Asian carp invasion potential into the Great Lakes.	B.S. Tamil Nadu Veterinary and Animal Sciences Univ. India M.S. Central Institute of Fisheries Education, India PhD. University of Missouri	Dr. Paukert
Dr. Allison Pease	Population-level effects of climate change on fishes.	B.S. University of Texas M.S. University of New Mexico PhD. Texas AM University	Dr. Paukert
Emily Tracy-Smith	Evaluation of ecological flows for Missouri.	B.S. University of Florida M.S. University of Missouri	Dr. Paukert
Dr. Michelle	Effects of climate change on	B.S. Boston University	Dr. Paukert

Staudinger	biodiversity.	M.S. Stony Brook University PhD. University of Massachusetts	
Dr. Jacob Westhoff	Smallmouth bass movement and thermal habitat selection.	B.S. University of Missouri M.S. Tennessee Technological University PhD. University of Missouri	Dr. Paukert
Daniel Whiting	Evaluation of translocation of humpback chub in Grand Canyon.	B.S. Southern Illinois University M.S. Southern Illinois University	Dr. Paukert

GRADUATE STUDENTS

2010 TO PRESENT

ADVISED BY FISH AND WILDLIFE DEPARTMENT COOPERATOR FACULTY

**Student received degree during the report period*

Name	Thesis Project	Previous Education	Advisor
Andrew Alba, M.S.	Captive breeding of Micronesian Kingfishers.	B.S. St. John Fisher College	Drs. Kesler and Strauch
Aniruddha Belsare, PhD.	Free-ranging dog disease ecology.	M.S. Bombay Veterinary College, India	Dr. Gompper
Amy Bleisch, M.S.	Ecology of elk reintroduced to Missouri.	B.S. Cornell University	Dr. Millspaugh
*Catherine Bodinof, M.S.	Translocation and conservation of hellbenders in Missouri.	B.S. Georgetown College	Dr. Millspaugh
Thomas Bonnot, PhD.	Large scale population viability modeling.	B.S. University of Missouri M.S. University of Missouri	Drs. Millspaugh and Thompson
*Michael Burfield, M.S.	Prairie restoration plan for George Washington Carver National Monument.	B.S. University of Cincinnati	Dr. Nilon
Michael Burfield, PhD.	Biodiversity and planning for Sustainability.	B.S. University of Cincinnati M.S. University of Missouri	Dr. Nilon
Alicia Burke, M.S.	Use of second-growth habitats by forest breeding birds: convenience or necessity?	B.S. University of Missouri	Dr. Faaborg
*Gabrielle Coulombe, M.S.	Resource selection and space use of the critically endangered Tuamotu Kingfisher (<i>Todiramphus gambieri</i>).	B.S. Carleton University	Dr. Kesler
*Allison Cox, M.S.	Red-bellied woodpecker movement and dispersal in fragmented and contiguous landscapes.	B.S. University of Florida	Dr. Kesler

Jenny Cunningham, M.S.	Nest site selection and the effect of snow cover on North Slope shorebirds.	B.S. University of New England	Dr. Kesler
Aleshia Fremgen, M.S.	Sage-grouse and wind energy in Wyoming.	B.S. Western State College of Colorado	Dr. Millsbaugh
Lyndia Hammer, M.S.	Fire history and forest community dynamics at the Wichita Mountains.	B.S. Southern Oregon University	Drs. Guyette and Stambaugh
Lianne Hibbert, PhD.	Public attitudes toward nature conservation in St. Lucia.	B.S. Grambling State University M.S. University of Missouri	Dr. Nilon
Jonathan Hogg, M.S.	Ecology of urban business parks.	B.S. University of Idaho	Dr. Nilon
*David Jachowski, Ph.D.	Movements and physiology of translocated elephants.	B.S. University of Montana M.S. University of Missouri	Dr. Millsbaugh
Hemanta Kafley, PhD.	Tiger landscape ecology.	M.S. Tribhuvan University, Nepal	Dr. Gompper
*Barbara Keller, PhD.	Forage production and overlap of ungulates.	B.S. Northland College M.S. New Mexico State University	Dr. Millsbaugh
*Kaylan Kemink, M.S.	Movement and demography in Missouri's greater prairie-chicken.	B.S. Cornell University	Dr. Kesler
Sarah Wolken Kendrick, M.S.	Bird Communities Across a Savanna-Woodland Gradient.	B.A. University of Missouri	Dr. Thompson
Jaymi LeBrun, PhD.	Managing wildlife in the face of a changing climate.	B.S. University of Wisconsin (Madison) M.S. Iowa State University	Drs. Millsbaugh and Thompson
Matthew McCloud, PhD.	Urban muskrats.	B.S. University of Missouri MBA, Webster University	Dr. Nilon
Erin McMurry, M.S.	Fire history and forest community dynamics at the Wichita Mountains.	B.S. University of Missouri	Dr. Guyette
*Rebecca Mowry, M.S.	A genetic approach to determine river otter abundance in Missouri.	B.S. University of Idaho	Drs. Eggert and Gompper

Pablo Oleiro, M.S.	Long-term climate change effects on island birds of Pacific Oceania.	B.S. University of Minnesota	Dr. Kesler
*Nathalie Olifiers, PhD.	Population and disease ecology of the brown-nosed coati (<i>Nasua nasua</i>) and the crab eating-fox (<i>Cerdocyon thous</i>) in the Brazilian Pantanal.	B.S. Federal University of Minas Gerais M.S. Federal University of Rio de Janeiro	Dr. Gompper
Sarah Pennington, M.S.	Habitat occupancy modeling of forest bats.	B.S. University of Missouri	Drs. Amelon and Gompper
*Brady Pittman, M.S.	Sediment organic carbon distribution in 4 small northern Missouri impoundments.	B.S. University of Missouri	Dr. Jones
Brandon Pope, M.S.	Outreach programs for urban youth.	B.S. Tuskegee University	Dr. Nilon
Kimberly Pope, M.S.	Sediment organic carbon distribution in northern Missouri reservoirs of differing trophic state.	B.S. University of Missouri	Dr. Jones
Christopher Rota, PhD.	Movements and resource selection of black-backed woodpeckers.	B.A. SUNY University at Buffalo B.S. University of Montana M.S. University of Florida	Drs. Kesler and Millspaugh
Leslie Schreiber, M.S.	Sage-grouse and wind energy in Wyoming.	B.S. Purdue University	Dr. Millspaugh
Trenton Smith, M.S.	Ecology of elk reintroduced to Missouri.	B.S. Auburn University	Dr. Millspaugh
Clarissa Starbuck, M.S.	Effects of savannah woodlands on bats.	B.S. University of Missouri	Dr. Thompson
Michael Stambaugh, PhD.	Fire history and forest community dynamics at the Wichita Mountains.	B.S. University of Missouri M.S. University of Missouri	Dr. Guyette
Richard Stanton Jr., M.S.	Potential for species translocation in response to climate change and habitat restoration: Brown-headed nuthatch in the Missouri Ozarks.	B.T., State University of New York at Cobleskill	Drs. Kesler and Thompson
*Lisa Sztukowski, M.S.	Survival in juvenile Sooty Terns on Wake Atoll.	B.S., University of California - Santa Cruz	Dr. Kesler

Mihai Sun, PhD.	Yellow perch and tilapia: least costs diets.	PhD. University of Missouri	Dr. Hayward
Kathryn Womack, M.S.	Research selection by Indiana bats.	B.S. Longwood College	Dr. Thompson
Guohui Wu, PhD.	Development of population and survival estimates for pallid sturgeon in the lower Missouri River.	M.S. New Mexico State	Dr. Holan
Wen-shi Yang, PhD.	Development of population and survival estimates for pallid sturgeon in the lower Missouri River.	B.S. Taiwan	Dr. Holan
Stephanie Zimmer, M.S.	Effects of commercial harvest on turtles in the Missouri River.	B.S. Michigan State University	Dr. Millspaugh

POST DOCTORAL RESEARCH ASSOCIATES AND RESEARCH STAFF

Name	Research Project	Previous Education	Advisor
Dr. Robert Gitzen	Development of an inventory and monitoring plan for the Northern Great Plains and MOFEP small mammal and amphibians.	B.S. University of Minnesota M.S. University of Washington PhD. University of Washington	Dr. Millspaugh
Christopher Hansen	Sage-grouse and wind energy.	B.S. Truman State University M.S. University of Missouri	Dr. Millspaugh
Dr. Barbara Keller	Ecology of elk reintroduced to Missouri.	B.S. Northland College M.S. New Mexico State University PhD. University of Missouri	Dr. Millspaugh
Dr. Rebecca Laws	Release scenarios for the critically endangered Micronesian Kingfisher.	PhD. University of Otago, New Zealand	Dr. Kesler
Dr. Robert Montgomery	Processes affecting wildlife distribution.	B.S. University of Minnesota M.S. University of Washington PhD. Michigan State University	Dr. Millspaugh

Dr. Maria Jose Ruiz-Lopez	Parasites and MHC variability-fitness correlations.	M.S. Universidad Complutense de Madrid PhD. Universidad Complutense de Madrid	Dr. Gompper
Dr. Larry Vangilder	MOFEP integration.	B.S. University of Missouri M.S. University of Missouri Ph.D. The Ohio State University	Dr. Millspaugh
Rami Woods	Stress physiology of wildlife.	B.S. Illinois State University	Dr. Millspaugh

RESEARCH PROJECTS



PROJECTS WITH UNIT SCIENTIST AS PRINCIPLE INVESTIGATOR

DR. DAVID GALAT

COMMITTEE ON MISSOURI RIVER RECOVERY AND ASSOCIATED SEDIMENT MANAGEMENT ISSUES

Investigators

Leonard A. Shabman, *Chair*, Resources for the Future

Thomas Dunne, Univ. CA, Santa Barbara

David L. Galat, MU

William L. Graf, Univ. of SC

Rollin H. Hotchkiss, BYU

W. Carter Johnson, SD State University

Patricia F. McDowell, Univ. of Oregon

Robert H. Meade, USGS (emeritus)

Roger K. Patterson, Metropolitan Water District of Southern CA

Nicholas Pinter, Southern IL Univ.

Sujoy B. Roy, Tetra Tech, Inc.

Donald Scavia, University of Michigan

Sandra B. Zellmer, Univ. of NE

Project Supervisor

Jeffrey Jacobs, National Research Council

Funding

U.S. Army Corps of Engineers

Cooperators

National Research Council, Water Science and Technology Board

Division of Earth and Life Studies, National Academy of Sciences

Objectives

Provide information and recommendations of interest to a broad audience on: 1) the sediment regime of the Missouri River, how it has changed over time, and its roles in river management decisions; 2) the role of sediments in Gulf of Mexico hypoxia; 3) land building in the Gulf; 4). Missouri River water quality; 5) species recovery and bed lowering, and; 6) future management actions.

Location

Missouri and Mississippi rivers

Completion

December 2010

Status

Complete

Progress and Results

To provide independent advice on Missouri River sediment and related resource management, in 2008 the Corps of Engineers requested the National Research Council (NRC) Water Science and Technology Board (WSTB) convened an expert committee to address seven sediment-related questions for the Missouri River system. The committee held five meetings over the course of its project. Public meetings were convened in four Missouri River cities: St. Louis, Omaha, Vermillion, SD, and Kansas City. A final, closed meeting was held in Washington, D.C. in early 2010 at which the committee worked on its draft report.

The Committee's report addresses the topics of Missouri River sediment, its physical and biological importance, how its dynamics and roles in the river system have changed over time, and its roles in contemporary river management decisions. Specifically, the committee considered: 1. The roles of Missouri River sediment in river ecology and restoration, and its implications for water quality and coastal restoration downstream in the northern Gulf of Mexico; 2. Environmental and economic considerations regarding nutrient and contaminant loadings; 3. Alternatives for reintroducing sediment into the system, and; 4 Current Corps of Engineers restoration actions as they relate to sediment and nutrients, and how they might be improved.

Products since 2008

National Research Council. 2011. Missouri River planning: recognizing and incorporating sediment management. National Academies Press, Washington, DC.

http://www.nap.edu/catalog.php?record_id=13019

**UPPER MISSISSIPPI NAVIGATION AND ECOSYSTEM RESTORATION PROGRAM –
INDEPENDENT SCIENCE PANEL**

Investigators

John Barko, Barko Environmental, LLC
Steven Bartell, E2 Consulting
Michael Davis, MN DNR
Robert Clevenstine, US FWS
David Galat, MU
Barry Johnson, USGS
Kenneth Lubinski, USGS
John Nestler, USACE
Larry Weber, University of Iowa

Project Supervisor

Ken Barr, USACE

Funding

U.S. Army Corps of Engineers (USACE)

Cooperators

U.S. Army Corps of Engineers
Great Rivers Cooperative Ecosystem
Studies Unit

Objectives

Provide scientific advice to the USACE for adaptive management and restoration of the UMRS ecosystem.

Facilitate determination of the current state of scientific knowledge, design of projects and actions for effective ecological performance, identification of uncertainties, identification of research needs, and development of monitoring plans and modeling approaches.

Act as a resource to provide data/information and the review of documentation, including project plans as requested by the USACE.

Location

Upper Mississippi River

Completion

May 2011

Status

Complete

Progress and Results

The Science Panel was convened to provide scientific expertise needed for adaptive management of the Upper Mississippi River System ecosystem restoration projects. Specifically, the Science Panel provides tools for integrated navigation and ecosystem restoration project planning that addresses social, economic, and environmental objectives at appropriate spatial and temporal scales. The Science Panel develops the science framework for five primary functional areas: (1) ecosystem project sequencing; (2) developing evaluation criteria for ecosystem outcomes including goods and services; (3) monitoring, including selection of response variables, adequacy of pre- and post- project monitoring, and addressing issues of scale; (4) creating tools for adaptive management such as selection of relevant ecological metrics, endpoints, and development of a ‘report card’ to assess ecosystem function; and, (5) integration of ecological, socio-economic, physical models and use of information technology to facilitate the decision making process.

Dr. Galat’s task as a member of the Science Panel has been to provide expertise on how environmental factors influence structure and function of the UMRS. He applied his adaptive management and river restoration experience to aid developing conceptual model(s), uncertainties and opportunities for restoring secondary channels, monitoring, and adaptive management on the UMRS. He also contributed to developing guidelines for applying objective science within an adaptive management framework to river restoration programs.

Due to reduced funding allocations to the NESP program during 2011 the Science Panel was discontinued in May 2011.

Products since 2010

Johnson, B.L., J. W. Barko, S. M. Bartell, R. Clevenstine, M. Davis, D. L. Galat, K. S. Lubinski, J. M. Nestler. 2010. Partial restoration of natural hydrology on the Upper Mississippi River System: an adaptive management approach for water level reductions. NESP ENV Report 12. U.S. Army Corps of Engineers, Rock Island, St. Louis, and St. Paul Districts.

Nestler, J. M., D. L. Galat, and R. A. Hrabik. 2011. Side channels of the impounded and Middle Mississippi River: opportunities and challenges to maximize restoration potential. Corps of Engineers Navigation and Environmental Sustainability Program (NESP) and Water Operations Technology Support Program (WOTS)

FISH USE OF PASSAGE FACILITY AND SEASONAL WETLAND POOLS AT EAGLE BLUFFS CONSERVATION AREA

Investigators

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Project Supervisor

Dr. David Galat, MU

Funding

Missouri Department of Conservation
CA 271

Cooperators

Missouri Department of Conservation
U.S. Geological Survey

Objectives

Predict fish species that potentially access wetland pools based on distribution, habitat-use guilds, spawning temperature ranges, and river water temperature.

Model stage relationship between lower Missouri River (LMOR) and Eagle Bluffs Conservation Area (EBCA) to predict connectivity.

Determine if similar water temperature exist during periods of LMOR-EBCA connectivity and isolation.

Quantify ingress and egress of pooled and selected Missouri River fishes through the fish passage facilities.

Determine how physiochemical variables of the wetland pool compare to optimal ranges for growth and mortality of riverine fishes.

Estimate growth of selected fish species.

Location

Eagle Bluffs Conservation Area

Expected Completion

December 2012

Status

In Progress

Progress and Results

Restoration projects are being undertaken along many large floodplain rivers, including the lower Missouri River (LMOR) to mitigate past channelization and levee construction that severed river-floodplain connectivity and denied riverine fishes access to seasonally-flooded wetlands. Two wetland pools were constructed at Eagle Bluffs Conservation Area (EBCA) as part of the Missouri River Mitigation Project. These pools were built with water-control structures to allow controlled passage of riverine fishes into EBCA for spawning and nursery. This study assessed potential benefits of fish passage structures at EBCA as well as future implementation of similar designs at other river-floodplain mitigation sites. Thirty-eight species were predicted to access the wetland pools and had a total spawning temperature range of 2.2-35.0°C. Eighty-five percent of these species were estimated to begin spawning between 10.0°C and 21.2°C, which corresponded to the *spawning window* of April 4 – June 1 (JD 95-153). Stage data from 1993-2006 used to model lateral connectivity between LMOR and EBCA was validated with data from 2007 and 2008. Highest connection frequency occurred from March to August and timing of connectivity event start date also closely matched the *spawning window*. Duration of connectivity was variable, although usually shorter than 10 days. The amount of water exchanged between LMOR and EBCA during an event varied due to event duration and magnitude of connectivity; mean water exchange at the fish passage structures was 3.05 m³day⁻¹. Environmental circumstances during the two field seasons necessitated selective application of fish sampling data to objectives analyzing lateral fish movement. Preliminary analyses demonstrate that fish access predictions were 68% accurate, based on fish data collected during 2008 ingress events, and comparing predicted and sampled assemblages yielded a Jaccard similarity coefficient of 0.62. The hydrologic model can help resource agencies manage for future flood events by determining optimal dates for enabling river-floodplain connectivity via the fishway. Designed connectivity can be used to improve integrating fish and waterbird use of riverine floodplain wetlands. Predictions of fish use of floodplains enable managers to potentially promote or regulate ingress of targeted species. A first draft of thesis is complete and in review.

MOVEMENT AND HABITAT FACTORS AFFECTING PADDLEFISH REPRODUCTIVE SUCCESS IN THE LOWER OSAGE RIVER, MO

Investigators

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Del Lobb, MDC

Project Supervisor

Dr. David Galat, MU

Cooperators

Missouri Department of Conservation
CA 284
U.S. Geological Survey, Columbia
Environmental Research Center
U.S. Fish and Wildlife Service,
Columbia Fisheries Resource Office

Objectives

Evaluate the use of plasma sex steroids to determine spawning status and identify potential spawning dates

Develop a predictive model to determine flow and temperature conditions needed for paddlefish passage past a low-head lock and dam

Determine availability and use of spawning habitat below a major hydroelectric impoundment

Identify spawning locations and evaluate paddlefish reproductive success by capturing eggs and larvae

Location

Osage River, MO

Expected Completion

December 2012

Status

In progress

Progress and Results

Large rivers and their associated fish communities have undergone severe alterations over the last century. Habitat fragmentation caused by both large and small dams, channelization to promote river transportation, and increased sedimentation from land use alterations have all negatively impacted large rivers. Paddlefish are an archetypical large river migrant that have suffered severe population declines as a result of alteration of large river habitat and may serve as a good indicator of large river conditions. Paddlefish in the lower Osage River are believed to be in good condition, yet several barriers may affect reproductive success. I developed a series of comprehensive research objectives to assess the critical components required for successful reproduction in the lower Osage River and identify potential limiting factors to focus future management efforts.

Sex steroid information indicated gravid male and female paddlefish were present in the lower Osage River and provided a timeframe for possible spawning. Paddlefish moved upstream over Lock and Dam #1 in all three study years, allowing for the successful development of a discharge and temperature model to predict upstream passage. Retrospective analysis of historical discharge and temperature conditions indicate that frequent low water years may restrict passage as frequently as one in three years. Movement and habitat use below Bagnell Dam were severely affected by large decreases in river discharge that were a result of daily hydroelectric peaking operation and mitigating floods downstream in the Missouri River.

Despite the presence of gravid fish and access to upstream spawning habitat, we observed a strong weight of evidence that suggests paddlefish reproduction below Bagnell Dam is most likely limited by altered discharges, resulting in disrupted spawning behavior or insufficient cues for spawning. Altered flows are suspected in the decline of many riverine species, yet the effects of these flows are still poorly understood. Successful management of regulated river systems for societal and biological benefits requires a more comprehensive understanding of altered flows on reproduction.

REMEDIATING EFFECTS OF HUMAN THREATS ON LOTIC FISH ASSEMBLAGES WITHIN THE MISSOURI RIVER BASIN: HOW EFFECTIVE ARE CONSERVATION PRACTICES?

Investigators

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Conservancy
Dr. David Diamond, MORAP
Dr. David Galat, MU

Project Supervisor

Dr. David Galat, MU
Dr. David Diamond, MORAP

Funding

Natural Resources Conservation
Service, Conservation Effects
Assessment Project

Cooperators

USDA Natural Resource Conservation
Service

Objectives

The goal of this project is to assess the effectiveness of NRCS conservation practices at conserving lotic fish assemblages throughout the Missouri River basin.

To develop spatially explicit models to predict the response of fish species abundance within trophic and reproductive guild to human threats and agricultural conservation practice implementation for every stream segment within the Missouri River basin

Location

Missouri River basin

Completion

June 2012

Status

Complete

Progress and Results

Threats to freshwater biodiversity are primarily driven by large-scale, private agriculture production and human modification of the landscape. As private land holdings account for approximately 70% of land ownership in the United States (US), management of these lands is integral to the success of freshwater biodiversity conservation. The US Department of Agriculture's Natural Resource Conservation Service is largely responsible for interacting with private land managers in agricultural settings and through Farm Bill legislation and funding has the ability to encourage the implementation of large-scale conservation measures on private lands. Until recently, it has not been possible to evaluate the Natural Resource Conservation Services' conservation practices to determine their success at conserving aquatic biota. Our goal is to assess effectiveness of the U.S. Department of Agriculture's Natural Resource Conservation Service (NRCS) conservation practices at conserving flowing-water (lotic) fish assemblages throughout the Missouri River basin. To date, we have developed threat indices that represent the cumulative effects of multiple agriculture, urbanization, point-source pollution, and infrastructural threats for every stream segment in the Missouri River basin. Threat indices can be used to target conservation areas for stream fishes by identifying areas where conservation entities have the potential to remediate existing threats. Models have been developed in two ecoregions within the basin that predict the response of an ecological indicator fish guild (lithophilous spawners) in wadeable streams to multiple human threats and the implementation of agricultural conservation practices. Results indicate that substantial agricultural conservation will be needed to improve ecological condition of wadeable streams in the Missouri River basin. Future work will assess the effectiveness of currently implemented NRCS conservation practices to lotic fishes.

ASSESSING EFFECTS OF CONTAMINANTS ON SHOVELNOSE STURGEON

Investigators

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Project Supervisor

Dr. David Galat, MU

Funding

Missouri Department of Conservation
CA 310
University of Missouri School of
Natural Resources
US Geological Survey Cooperative
Research Unit

Cooperators

Missouri Department of Conservation
US Geological Survey: Columbia
Environmental Resource Center

Objectives

Determine current concentrations of
contaminants in feral shovelnose
sturgeon eggs and the potential toxicity
of chemical extracts from those eggs.

Evaluate developmental and
reproductive effects of contaminants on
Scaphirhynchus sturgeon.

Assess suitability of shovelnose
sturgeon as a surrogate species to the
pallid sturgeon in toxicity testing.

Location

Upper Mississippi River, Missouri

Completion

December 2011

Status

Complete

Progress and Results

Pallid sturgeon (*Scaphirhynchus albus*) and shovelnose sturgeon (*Scaphirhynchus platyrhynchus*) are endemic to the United States and populations have been in decline over the past century. Currently, shovelnose sturgeon egg and muscle tissues are being found with persistent organic pollutant (POPs) concentrations higher than those reported to affect reproduction in other fish species. Two studies were designed to assess if POP contaminants could be affecting reproduction and development in wild and hatchery-reared *Scaphirhynchus* sturgeon. The first were waterbath egg exposures with two of the most potent POPs, 3,3',4,4',5-pentachlorobiphenyl (PCB-126) and 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). The second was a reproduction assay using wild-caught Middle Mississippi River shovelnose sturgeon along with contaminant analysis and H4IIE bioassay.

Results from the egg exposure assay indicated shovelnose sturgeon are adequate surrogates for pallid sturgeon in toxicity testing. Pallid and shovelnose sturgeon were similar sensitivity to PCB-126 (LD50 values of 159 and 191 ng/g egg for pallid and shovelnose sturgeon, respectively) and TCDD (LD50 values of 12 and 13 for pallid and shovelnose sturgeon, respectively). No PCB-126 or TCDD dose-related effects on percent fertilization or hatch were observed in either species. Pathologies were similar between species and typical of dioxin and dioxin-like exposure. No relationship between bioassay derived potencies and POP concentration was observed in eggs from the reproduction assay. However, embryological and larval mortality and percent unhatched eggs were observed with increasing POP concentration in eggs used in the reproduction assay. Thus, POPs are likely one factor limiting recruitment in wild and hatchery-reared *Scaphirhynchus* sturgeon.

DR. CRAIG PAUKERT

DEVELOPMENT AND VALIDATION OF MODELS TO ASSESS THE THREAT TO FRESHWATER FISHES FROM ENVIRONMENTAL CHANGE AND INVASIVE SPECIES

Investigators

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Dr. Angela Strecker, University of Washington

Project Supervisors

Dr. Joanna Whittier
Dr. Craig Paukert

Funding

U.S. Geological Survey
RWO #110

Cooperators

National Fish Habitat Initiative
Desert Fish Habitat Partnership

Objectives

What are the primary threats to freshwater ecosystems in the Lower Colorado River Basin, and how do they vary across spatial scales?

Which fishes are at greatest risk to anthropogenic and biotic threats?

What is the association between fish communities and specific threats indices different spatial scales?

Location

Lower Colorado River Basin

Completion

September 2011

Status

Complete

Progress and Results

Freshwater ecosystems are severely threatened by a multitude of stressors. The American Southwest is the nexus of several of these threats, and as a result, many fishes in these arid ecosystems are endangered, necessitating the development of a comprehensive conservation strategy. While the predominant use of systematic conservation planning has been to evaluate and conserve areas of high biodiversity, few have considered potential tradeoffs between different aspects of diversity. Further, the ecological processes that maintain diversity are rarely considered in conservation plans. We used the program Zonation to prioritize regions in the Lower Colorado River Basin for conservation, considering scenarios of: taxonomic, functional, and phylogenetic diversity; future climate change and human population growth; contemporary threats to biodiversity; and interactions with non-native species. There was high congruence between areas of conservation priority for different aspects of biodiversity, suggesting that conservation efforts can simultaneously address all types of diversity. There were, however, some regions of mismatch between conservation priorities for different diversity scenarios, which underscores the importance of considering different diversity measures. Regions of projected human population growth were not congruent with conservation priorities; however, higher population sizes will likely have indirect effects on native biodiversity by increasing demand for water. This will come in direct conflict with projected reductions in precipitation and warmer temperatures, which have substantial overlap with regions of high contemporary diversity. Native and endemic fishes in arid ecosystems are critically endangered by both current and future threats, but our results highlight the use of systematic conservation planning for the optimal allocation of limited resources

Products

Strecker, A., J. Olden, J. Whittier, and C. Paukert. 2011. Defining conservation priorities for freshwater fishes according to taxonomic, functional, and phylogenetic diversity. *Ecological Applications* 21:3002-3013.

IDENTIFYING THE ENVIRONMENTAL FACTORS ASSOCIATED WITH PHYSIOLOGICAL, BEHAVIORAL, AND POPULATION CHANGES OF MISSOURI RIVER STURGEON

Investigators

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Project Supervisors

Dr. Craig Paukert, MU

Funding

U.S. Geological Survey
RWO 101

Cooperators

Army Corp of Engineers
U.S. Fish and Wildlife Service
Missouri Department of
Conservation
Nebraska Game and Parks
Commission

Objectives

Determine and/or develop and apply effective analytical approaches to identify the environmental factors affecting the reproductive status, movements, and habitat use of pallid sturgeon and shovelnose sturgeon in the Missouri River based on data collected through telemetry on physiology, behavior, and habitat association of sturgeon.

Determine and/or develop and apply effective analytical approaches to assess the status, distribution, and trends of Missouri River fish populations, with emphasis on sturgeon, based on data collected in association with the various USACE BiOp activities.

Location

Lower Missouri River

Completion

September 2011

Status

Complete

Progress and Results

Missouri and Mississippi river changes have been implicated in the decline of the pallid sturgeon (*Scaphirhynchus albus*), which has been listed as a United States federal endangered species. The decline of pallid sturgeon is considered symptomatic of poor reproductive success and low or no recruitment. In order to organize information about this species and provide a basis for a future development of a predictive model to help guide recovery efforts, we presented an expert-vetted, conceptual life-history framework model that incorporates the factors that affect reproduction, growth, and survival of shovelnose and pallid sturgeons. Approaches using telemetry, precise reproductive assessments, and surgically implanted DSTs were used in combination with novel applications of analytical techniques for fish movement studies to describe patterns in migratory behavior and predict spawning success of gravid shovelnose sturgeon. Functional cluster modeling of telemetry data from the spawning season suggested two common migration patterns of gravid female shovelnose sturgeon. There was no apparent difference in migration patterns between successful and unsuccessful spawners. Hierarchical Bayesian modeling of DST data indicated that variation in depth usage patterns was consistently different between successful and unsuccessful spawners. To aid in habitat rehabilitation efforts, we evaluated habitat selection of gravid, female shovelnose sturgeon during the spawning season in two sections (lower and upper) of the Lower Missouri River in 2005 and in the upper section in 2007.

Products

- Wildhaber, M.L., A.J. DeLonay, D.M. Papoulias, D.L. Galat, R.B. Jacobson, D.G. Simpkins, P.J. Braaten, C.E. Korschegen, and M.J. Mac. 2011. Identifying structural elements needed for development of a predictive life-history model for pallid and shovelnose sturgeons. *Journal of Applied Ichthyology* 27:462-469.
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- Bonnot, T.W., M.L. Wildhaber, J.J. Millspaugh, A.J. DeLonay, R.B. Jacobson, and J.L. Bryan. 2011. Discrete choice modeling of shovelnose sturgeon habitat selection in the Lower Missouri River. *Journal of Applied Ichthyology* 27:291-300.

SEASONAL CHANGES IN INSTREAM HABITAT SELECTION BY NIANGUA DARTERS

Investigators

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Project Supervisors

Dr. Craig Paukert, MU

Funding

U.S. Geological Survey, National
Climate Change and Wildlife
Science Center
U.S. Geological Survey, Cooperative
Research Units
RWO 107

Cooperators

Missouri Department of Conservation

Objectives

What factors affect the distribution of Niangua darters, with particular attention to how climate change may affect the distribution?

Does microhabitat selection of Niangua darters differ among seasons?

Location

Osage River Basin, MO

Expected Completion

December 2012

Status

In progress

Progress and Results

Understanding temporal and spatial habitat relationships is important to the recovery of the federally threatened Niangua darter *Etheostoma nianguae*, and other imperiled freshwater fishes, particularly in the face of projected climate and land use change. We evaluated microhabitat selection of adult Niangua darters at three Missouri Ozark stream reaches (mean= 503 m). Each reach was snorkeled (mean= 2.9 m/min) to identify Niangua darters locations where we measured nine instream habitat variables believed to be important to Niangua darter. These same variables were measured at three random locations within 100 m of each used location to represent available habitat. We used an information theoretic framework to develop models representing hypotheses related to Niangua darter microhabitat selection. We developed six models containing depth, velocity, substrate, distance to nearest cover, and cover size which we fit using discrete choice analysis. The model containing depth and 60% velocity had the lowest AIC_c value with all other models having a $\Delta AIC_c > 4$. During cooler months, adult Niangua darters selected deeper depths and slower velocities compared to warmer months. Selection for shallower/intermediate depths and faster velocities during warmer months may optimize feeding opportunities whereas deeper depths and slower velocities may maximize energy conservation during cooler months.

MANAGING THE NATIONS FISH HABITAT AT MULTIPLE SPATIAL SCALES IN A RAPIDLY CHANGING CLIMATE

Investigators

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Dr. Allison Pease, Post Doc, MU
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Dr. Steve Hostetler, USGS
Dr. Lucinda Johnson, U. of MN-Duluth
Dr. Ty Wagner, Penn St. U.
Dr. Lizhu Wang, Int'l Joint Commission
Dr. Julian Olden, U. of Washington
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Mr. Pete Jacobson, Minnesota DNR
Mr. Gary Whelan, Michigan DNR
Dr. Bryan Pijanowski, Purdue U.
Plus 9 post docs and PhD students nationwide

Project Supervisor

Dr. Craig Paukert, MU

Funding

U.S. Geological Survey:
National Wildlife Climate Change
Science Center
RWO 107

Cooperators

National Fish Habitat Initiative

Objectives

What aquatic habitats need conservation as climate and land use changes?

What are the nationwide aquatic habitat alterations from projected climate and land-use changes?

What are the commonalities in the effects of climate and land-use changes across regions and scales?

Location

Nationwide

Expected Completion

March 2013

Status

In progress

Progress and Results

We are using downscaled Atmosphere-Ocean General Circulation Models and projected land use models to identify how future climate and land use will impact the vulnerability of fish and fish habitat at national, regional, and local scales. The future climate simulations for air temperature and precipitation are being used to assess water temperature, stream flow, and nutrient loads in streams and lakes. To project future land uses, we simulated changes in both agricultural and urban areas within stream and river catchments across the conterminous United States using the Land Transformation Model. Changes in land use have been projected to 2040 and climate simulations are complete for much of the conterminous US for 1968 – 1999 and 2010 – 2100. For the national stream assessment, we are conducting an indicator species analysis to identify fish species that are the most sensitive to changes in stream temperature and flow regimes. At the regional level, we have sufficient stream temperature and flow data to develop water temperature and flow models for the Midwest Glacial Lakes and Northeast regions but not for the Desert Southwest. Finally, we are using bioenergetics to simulate the effects of climate change on smallmouth bass (SMB) growth and consumption in streams in Oklahoma, Missouri, Iowa, and Minnesota. Projections indicated that the Missouri and Oklahoma sites are expected experience net air temperature increases of 2-4°C. Minnesota and Iowa SMB populations showed an increase in growth by 2060 of 4.3% and 3.3%, respectively, based on the mean of the simulations for the three global climate models. In the Missouri and Oklahoma populations, simulations with 2060 temperature projections from the three models resulted in mean growth increases of 10.0% and 18.8%, respectively.

Products

Fact sheet: Potential effects of climate change on smallmouth bass growth in streams of the central U.S.

MOVEMENT AND HABITAT SELECTION OF LARGEMOUTH BASS: IMPLICATIONS FOR RESERVOIR FISH HABITAT IMPROVEMENTS

Investigators

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Project Supervisors

Dr. Craig Paukert, MU

Funding

Missouri Department of Conservation
CA 338

Cooperators

National Fish Habitat Partnership

Objectives

Determine if use of habitat augmentation structures by largemouth bass differ seasonally in a large reservoir.

Determine if the use of habitat augmentation structures by largemouth bass differ through the different daily time periods (day, night) in a large reservoir?

Location

Table Rock Lake, MO

Expected Completion

June 2013

Status

In progress

Progress and Results

Deteriorating reservoir fish habitat is a concern throughout the US so the Missouri Department of Conservation and cooperators placed approximately 1,600 structures (trees, stumps, and rock piles) throughout Table Rock Lake, Missouri to improve fish habitat for largemouth bass *Micropterus salmoides* and other species. Our objective was to determine movement and habitat selection of largemouth bass and to determine if these fish select for the augmentation structures within the lake. Sixty largemouth bass (>380 mm total length) were implanted with radio transmitters in April 2011 and relocated monthly since May 2011. Discrete choice analysis results indicate that largemouth bass selected for cover (boat docks, rock ledges, and coarse woody debris) compared to open water, but submerged trees were the only augmentation structure selected. Movement rates of up to 20 fish per month that were relocated every 3-4 hours for one, 24-hour period per month were greatest during summer (mean=53 m/h) and lowest during fall (mean=16 m/h) and winter (mean=19 m/h) and were 2-3 times greater during the day than night. Largemouth bass may select for structure, but not necessarily all types, and that increased summer movement may mean fish may use more reservoir habitat in summer.

ECOLOGICAL FLOW LINKAGES: IDENTIFYING RELEVANT RECENT ADVANCES AND REFINING THE MISSOURI HYDROLOGICAL ASSESSMENT TOOL

Investigators

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Project Supervisors

Dr. Craig Paukert, MU

Funding

Missouri Department of Conservation

Cooperators

Missouri Department of Conservation
CA 335

Objectives

Document the most relevant literature, ongoing studies, and unpublished information related to ecological flows.

Refine the list of flow metrics that can be used in refinement of MOHAT.

Further identify the biological links to stream flow alteration based on the literature, and ongoing and current studies relevant to Missouri streams.

Identify additional available spatial data that could be useful in the assessment of hydrologic alteration and ecological flows.

Recommend for further evaluation a draft classification that uses the additional spatial data to sub-divide the hydrological classification.

Location

statewide

Expected Completion

June 2013

Status

In progress

Progress and Results

Stream flow is a critical, yet complex driver of ecological processes in streams. Numerous studies have attempted to identify metrics that best represent hydrologic alteration caused by dams, diversions, withdrawals, land use, and other anthropogenic activities. However, there is no consensus on how these hydrologic indices are linked to ecological processes and fishes. The science related to ecological flows is rapidly evolving and many studies may not be published or are in progress. Our objective was to determine the number of studies that identify biological links to stream flow alteration metrics. We summarized metrics used to link flow alteration to biological responses from over 400 references including peer-reviewed literature, agency reports, flow assessment programs, and software. Our review showed that there are over 100 stream flow metrics used, but only a small fraction directly linked to a biotic response. More common metrics linked to biotic responses included changes in mean annual flow, monthly flows, peak flows and variability (CV). Any successful method in determining ecological flows needs to account for the relationships between flow and ecological response. Our review will help identify future research needs and provide examples of flow metrics that could be incorporated into ecological flow assessments.

CONSERVATION PLANNING FOR FISHES IN THE UPPER COLORADO RIVER BASIN

Investigators

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Landon Pierce, PhD student, MU
Dr. Julian Olden, University of
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Project Supervisors

Dr. Joanna Whittier, MU
Dr. Craig Paukert, MU

Funding

U.S. Geological Survey, National Gap
Analysis Program
RWO 109

Cooperators

Colorado Department of Wildlife
Wyoming Game and Fish
Utah Department of Natural Resources
Arizona Game and Fish Department

Objectives

Identify landscape-level habitat metrics associated with native and non-native fish presence in the Upper Colorado River Basin.

Identify areas of high conservation value that captures quality habitat for all native species.

Provide stakeholders with conservation assessment that they could use to inform conservation and adaptive management decisions.

Location

Upper Colorado River Basin – AZ, CO, NM, WY, UT.

Expected Completion

September 2013

Status

In progress

Progress and Results

This project builds on previous and on-going research we have been conducting on fish communities in the Lower Colorado River Basin. Aquatic systems across the nation are perhaps the most endangered ecosystems and the Upper Colorado River Basin (UCRB) is no exception. There are only 14 native fish species in the UCRB and most have declined in their range and abundance in the last 100 years. Adverse impacts include modifications to natural flow regimes, physical habitat, stream temperatures and other human-induced agents of environmental change, in addition to the negative effects of invasive species. Therefore, the development of criteria for conservation will aid future considerations to protect aquatic species in the basin. We have compiled a suite of environmental characteristics and threats frequently associated with presence or absence of freshwater fish species. Federal and state agencies from all the states encompassing the UCRB have contributed nearly 800,000 records of fish sampled from the late 1800's to 2010. Future work will include developing community distribution models and threat indices to inform spatially explicit conservation prioritization for the UCRB. This research will provide a seamless integration of both the lower and upper basin to provide a uniform GAP analysis for the entire Colorado River watershed.



INVASIVE BIGHEAD AND SILVER CARPS AND THE GREAT LAKES: EVALUATION OF ALTERNATIVE NATURAL FOOD SOURCES.

Investigators

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Doc, MU
Duane Chapman, USGS

Project Supervisor

Dr. Craig Paukert, MU

Funding

U.S. Geological Survey
RWO 111

Cooperators

U.S. Environmental Protection
Agency

Objectives

Evaluate bioenergetic model for juvenile bighead and silver carp in aquaria, using a food of known energetic content consumed by the fish.

Evaluate the bioenergetic model using larger adult or subadult fish in mesocosms.

Location

Great Lakes and Columbia, MO

Expected Completion

July 2013

Status

In progress

Progress and Results

The invasive silver carp (*Hypophthalmichthys molitrix*) now threaten to invade the Great lakes where they may out compete native planktivores for food. A recently developed bioenergetics model for silver carp predicted that the fish could colonize embayments, but not much of the open-water regions of the Great Lakes. However, the models are yet to be validated. The objectives of this study were (i) to validate the carp bioenergetic model and (ii) to identify the sources of model errors. Two growth trials were conducted for silver carp, one for juveniles and the other for subadults. The juvenile model growth prediction was evaluated at 10, 18, and 27 °C under three feeding regimes (low, moderate and high). The subadult model was validated at three 11, 17, and 26 °C under high feeding level. Fish were fed a commercial catfish feed daily for 15 (juveniles) or 30 days (subadults). The model for juveniles underestimated growth at low feeding level at 27 °C and overestimated growth at moderate and high feeding levels for the three different temperatures. However, no differences were found between the predicted and the observed fish weights at low feeding level for 11 and 17 °C rearing temperatures. Error rates in the model increased with the temperature for low and high feeding levels and with consumption levels across all the three temperatures. Model predictions for subadults showed over estimation of weight gain and under estimation of consumption for all the three temperatures. Error rates were detected in the prediction of consumption, basal metabolic cost and egestion cost for both juveniles and subadults. Our study recommends the use of energy density of silver carp determined in the current study and the need of improving model parameters for consumption (CA and CB), and the importance of using specific egestion cost for different food types.

THERMAL CONDITIONS AND STREAM HABITAT ASSOCIATIONS FOR FISHES AT OZARKS NATIONAL SCENIC RIVERWAYS

Investigators

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Project Supervisors

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Funding

U.S. Geological Survey, NRPP Program
RWO 116

Cooperators

Missouri Department of Conservation

Objectives

Test the feasibility of rapidly and inexpensively monitoring local temperature conditions throughout the entire Riverways.

Link the information to a physical habitat classification system in a GIS.

Use this information to assess habitat selection of smallmouth bass.

Location

Current and Jack's Fork rivers, MO

Expected Completion

September 2013

Status

In progress

Progress and Results

We will refine a habitat classification for Ozark streams and make it more biologically relevant by incorporating information on water temperature. Mapping physical habitat and water temperature is the first step at identifying possible biotic responses to climate change and other disturbances. Therefore, we will then link the thermal mapping with habitat use of smallmouth bass, which was chosen because it is an excellent ecological indicator, has been studied it extensively in Ozark streams so we have an understanding of its requirements for physical habitat, its bioenergetics, and some gross indication of how thermal conditions influence its behavior. MDC and the National Park Service I and M Program researchers implanted transmitters into smallmouth bass in 2010 and our work will build on their initial results to track smallmouth bass for 12 months to determine seasonal movement and habitat selection, particularly temperature. A total of 24 smallmouth bass were implanted in winter 2012 and will be tracked though 2012 to monitoring movement and temperature selection. Mesohabitat mapping of the Ozark National Scenic Riverways is ongoing and will be completed in summer 2012. The temperature selection of smallmouth bass will be particularly interesting given the warm, dry conditions in 2012.

EFFECTS OF CLIMATE CHANGE ON BIODIVERSITY

Investigators

Dr. Craig Paukert, MU
Dr. Michelle Staudinger, Post Doc, MU

Project Supervisors

Dr. Craig Paukert, MU

Funding

U.S. Geological Survey, National
Climate Change and Wildlife
Science Center
Great Rivers Cooperative Ecosystem
Studies Unit

Cooperators

Over 60 stakeholders nationwide

Objectives

Coordinate the Biodiversity sector of
the 2013 National Climate Assessment.

Identify the key data and knowledge
gaps related to how climate change will
affect biodiversity.

Location

Nationwide

Expected Completion

September 2013

Status

In progress

Progress and Results

Building on past assessments of how climate change and other stressors are affecting ecosystems in the United States and around the world, we approach the subject from several perspectives. First, we review the observed and projected impacts on biodiversity. Next, we examine how climate change is affecting ecosystem structural elements as related to the fluxes of energy and matter. People experience climate change impacts on biodiversity and ecosystems as changes in ecosystem services. We review newly emerging research to determine how human activities and a changing climate are likely to alter the delivery of these ecosystem services. This technical input also examines two cross-cutting topics. First, we recognize that climate change is happening against the backdrop of a wide range of other environmental and anthropogenic stressors which have caused dramatic ecosystem degradation already. This broader range of stressors interacts with climate change, and complicates our abilities to predict and manage the impacts on biodiversity, ecosystems, and the services. The second cross-cutting topic is the rapidly advancing field of climate adaptation, where there has been significant progress in developing the conceptual framework, planning approaches, and strategies for safeguarding biodiversity and other ecological resources. At the same time, ecosystem-based adaptation is becoming more prominent as a way to utilize ecosystem services to help human systems adapt to climate change. This work will inform the 2013 National Climate Assessment and a special issue in *Frontiers in the Ecology and Environment* is planned.

Products

M. D. Staudinger, N. B. Grimm, A. Staudt, S. L. Carter, F. S. Chapin III, P. Kareiva, M. Ruckelshaus, B. A. Stein. 2012. *Impacts of Climate Change on Biodiversity, Ecosystems, and Ecosystem Services: Technical Input to the 2013 National Climate Assessment*. Cooperative Report to the 2013 National Climate Assessment. 296 p. Available at: <http://assessment.globalchange.gov>

EVALUATION OF CONSERVATION NETWORKS TO PROTECT AQUATIC BIODIVERSITY IN MISSOURI

Investigators

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Nick Sievert, M.S. student

Project Supervisors

Dr. Craig Paukert, MU

Funding

U.S. Geological Survey, National
Climate Change and Wildlife
Science Center
Great Rivers Cooperative Ecosystem
Studies Unit

Cooperators

Missouri Department of Conservation

Objectives

Develop and evaluate methods to assess vulnerability of aquatic biota to climate change.

Assess the potential role that existing protected lands has on the protection of aquatic biodiversity at smaller spatial scales.

Location

Missouri

Expected Completion

September 2013

Status

In progress

Progress and Results

The use of conservation networks is an important tool for the conservation of aquatic biodiversity, but we need to understand how well species were represented within these areas to determine their effectiveness. We analyzed 1176 samples from randomly selected sites from wadeable Missouri streams between 2000 and 2011 to determine if Missouri's publicly managed lands (PMLs), Conservation Opportunity Areas (COAs), and Priority Watersheds (PWs) represented aquatic biodiversity. We aimed to identify species which were unrepresented or under-represented within these networks. We also analyzed how efficiently these conservation networks represented biodiversity by comparing the species richness of sites within the conservation networks to sites across the state. A total of 173 species were detected statewide, but 29 species were not represented within COAs, 14 in PWs, and 49 in PMLs. Using a 2-way ANOVA we found that species richness varied by subregion (Mississippi Alluvial Basin=18; Ozarks=17; Plains=15), but did not differ by conservation network status. Although, species richness was similar among conservation status lands, rare species (less than 1% occurrence rate) were underrepresented within conservation networks 60-80% of the time. Effective conservation of aquatic biodiversity will require better representation of rare species within Missouri's conservation networks.



EVALUATION OF HUMPBACK CHUB TRANSLOCATIONS IN GRAND CANYON TRIBUTARIES

Investigators

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Dr. Joanna Whittier, MU
Brian Healy, NPS
Emily Omana, NPS
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Dave Speas, Bureau of Reclamation

Project Supervisor

Dr. Craig Paukert, MU

Funding

Grand Canyon National Park
U.S. Bureau of Reclamation
U.S. Geological Survey
Great Rivers Cooperative Ecosystem
Studies Unit

Cooperators

National Park Service
U.S. Bureau of Reclamation
U.S. Fish and Wildlife Service
Arizona Game and Fish Dept.

Objectives

How does the fish abundance and community differ in Grand Canyon tributaries?

How many humpback chub remain following translocations?

What is the survival and growth of translocated humpback chub?

Do humpback chub or other species fill a niche vacated by non-natives?

Location

Grand Canyon, Arizona

Expected Completion

September 2013

Status

In progress

Progress and Results

We examined humpback chub response, in terms of growth and body condition, apparent survival, and dispersal, following translocation of approximately 300 individuals annually in June 2009, 2010, and 2011 into Shinumo Creek, a tributary stream of the Colorado River within Grand Canyon National Park.

Therefore, we also evaluated trophic structure of the Shinumo Creek fish community to determine potential diet overlap among native and non-native fishes. Growth of translocated humpback chub in Shinumo Creek was consistent among year classes and sampling periods with no evidence low condition indicating humpback chub were effectively exploiting food resources. About 42% of translocated humpback chub left Shinumo Creek with approximately 33% of humpback chub leaving within the first few days after translocation indicating dispersal immediately following translocation was high. Also, larger individuals at translocation had a higher probability of dispersal. Stable isotope analysis indicated omnivory was prevalent throughout the fish community which spanned two trophic positions (range = 1.60 to 3.75). However, introduced fishes (i.e. rainbow trout and humpback chub) occupied higher trophic positions than resident natives. Stomach content analysis revealed macroinvertebrates dominated rainbow trout diets with relatively few fish in stomachs (i.e. piscivory rate = 4.2%). Successful establishment of humpback chub populations into Colorado River tributaries may depend on alternative release strategies (e.g. soft releases) which may decrease initial dispersal and continued removal of rainbow trout freeing potential diet sources including both aquatic and terrestrial invertebrates and fish. Coupling food web analysis with more traditional assessments of translocation studies (i.e. survival analysis, growth, and dispersal) can reveal potential niche vacancies or overlap with non-natives in receiving systems that may influence establishment and increase success of translocation as a conservation tool for large-river fishes.

Products

Spurgeon, J. 2012. Translocation of humpback chub (*Gila cypha*) and food-web dynamics in Grand Canyon National Park tributary streams. M.S. Thesis, University of Missouri. C. P. Paukert, advisor.

FOOD WEB DYNAMICS IN BRIGHT ANGEL CREEK, GRAND CANYON: IMPLICATIONS FOR NATIVE FISH CONSERVATION

Investigators

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Dave Speas, Bureau of Reclamation

Project Supervisor

Dr. Craig Paukert, MU

Funding

Grand Canyon National Park
U.S. Bureau of Reclamation
U.S. Geological Survey
RWO 108

Cooperators

National Park Service
U.S. Fish and Wildlife Service
Arizona Game and Fish Dept.

Objectives

Determine seasonal fish communities and food habits of fishes in Bright Angel Creek.

Determine if competition for food exists between native and non-native fishes.

Estimated consumption of invertebrates and fish by non-native fishes.

Location

Grand Canyon, Arizona

Expected Completion

September 2013

Status

In progress

Progress and Results

Non-native trout removal is being conducted by the National Park Service and other stakeholders to restore and enhance native fish communities in Bright Angel Creek (BAC), Grand Canyon. To assess resource availability and evaluate the effects non-native brown (BNT) and rainbow (RBT) trout have on the food web in BAC, we sampled fish, benthic invertebrates, and drifting invertebrates seasonally from November 2010 to September 2011. Food habits of BNT and RBT were evaluated from stomach samples collected during invertebrate sampling periods, and annual resource consumption by trout was estimated using bioenergetics models. Invertebrate drift rates varied seasonally ranging from 95.3 g dry mass (DM) day⁻¹ to 169.5 g DM day⁻¹. Native fish (speckled dace and bluehead sucker) and *Corydalis* sp. were the dominant food types found in BNT stomachs, whereas *Baetis* mayflies and filamentous algae dominated RBT stomachs. Piscivory rates were 18% and 5% for BNT and RBT, respectively. Annual resource consumption was similar between BNT (186 g DM yr⁻¹) and RBT (150.7 g DM yr⁻¹), however this pattern varied between food types. Our results indicate BNT and RBT can affect native fishes through resource consumption and BNT are more likely to have an impact through predation.

THE ROLE OF TRIBUTARIES ON ECOSYSTEM RECOVERY OF THE MISSOURI RIVER

Investigators

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Tracy Hill, USFWS
Wyatt Doyle, USFWS

Project Supervisors

Dr. Craig Paukert, MU

Funding

U.S. Geological Survey, SSP Program
RWO 115

Cooperators

U.S. Fish and Wildlife Service

Objectives

Determine how the fish assemblage differs seasonally from the mouth of the Missouri River upstream on the Osage River, and a reference river, the Gasconade River.

Determine the contribution of large river fish larvae from the Osage River to the Missouri River.

Location

Osage and Gasconade rivers

Expected Completion

June 2014

Status

In progress

Progress and Results

Tributaries of the Missouri River are considered critical in ecosystem recovery as they provide spawning and nursery habitat for mainstem Missouri River fishes such as blue sucker, sauger, paddlefish, pallid sturgeon, lake sturgeon, and American eel. Protection and/or restoration of these tributaries will be essential in the continued recovery of the Missouri River as changes in hydrology, land use, and habitat associated with climate change will affect the entire ecosystem. One tributary, the Osage River, has a lock and dam 12 miles upstream from the mouth of the Missouri River and impediments to fish passage by the lock and dam may hamper recovery of native fishes in the Missouri River by altering habitat and blocking migration in these tributaries. This study will identify how mainstem Missouri River fishes use tributaries, and if use differs between the highly regulated Osage River and unregulated Gasconade River. In addition, we will determine if fish community structure differs seasonally upstream and downstream of the lock and dam on the Osage River. A pilot study to determine suitable sampling gears was conducted in spring and summer 2012 and fish sampling has commenced and will continue through summer 2013.

EVALUATION AND VALIDATION OF ENVIRONMENTAL DNA AS A TOOL FOR ASIAN CARP DETECTION

Investigators

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Dr. Lori Eggert, MU
Dr. Katy Klymus, Post Doc, MU

Project Supervisors

Dr. Craig Paukert, MU

Funding

U.S. Geological Survey
Environmental Protection Agency
RWO 118, 119

Cooperators

U.S. Geological Survey

Objectives

Determine the amount and stochasticity of eDNA given off by bighead and silver carp of different sizes under different temperature, feeding, and densities.

Estimate amount of eDNA in sex products released and the degradation rate of the eDNA.

Develop a model to estimate eDNA concentrations under different environmental conditions and biomass or abundance of bigheaded carps.

Location

Columbia, MO

Expected Completion

September 2014

Status

In progress

Progress and Results

Environmental DNA (eDNA) has promise as tool for detecting Asian carp. This is an environmental surveillance method in which DNA material from an organism that is released into the environment (water) through slime, skin cells, urine, or feces, and can be detected in a species-specific manner. The detection of the DNA material in the water samples is currently being used as an early warning indicator for the presence of bigheaded carps in Michigan, Illinois, and in portions of the Great Lakes to determine possible Asian carp presence. The eDNA technique uses Polymerase Chain Reaction (PCR) technology to amplify specific rare DNA strands present in the environment to measureable concentrations. However, there are still questions on what a positive eDNA result means. For example, it is unclear if a positive eDNA detection means a live fish was actually in the vicinity, if the concentration of eDNA can be used to estimate relative abundance of Asian carp in the system, or how long the eDNA remains in the water before degradation. The study, which began in summer 2012, will help answer those questions and be used to better understand the results of eDNA analysis to more effectively determine response strategies to control or eradicate Asian carp.

DR. ELISABETH WEBB

EFFECTS OF THE LIGHT GOOSE CONSERVATION ORDER ON BEHAVIOR OF WATERFOWL AND HUNTING PARTICIPANTS IN THE RAINWATER BASIN OF NEBRASKA

Investigators

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Dr. Elisabeth Webb, MU
Dr. Mark Vrtiska, Nebraska Game and Parks Commission

Project Supervisor

Dr. Elisabeth Webb, MU

Funding

Nebraska Game and Parks Commission
U.S. Geological Survey
RWO 117

Cooperators

Nebraska Game and Parks Commission

Objectives

Quantify duration, distribution and frequency of participation in the Light Goose Conservation Order in the Rainwater Basin.

Evaluate habitat use and behavior of light geese and non-target species during the Light Goose Conservation Order in the Rainwater Basin.

Determine factors influencing stakeholder opinions and participation in Light Goose Conservation Order in Nebraska.

Location

Rainwater Basin, Nebraska

Expected Completion

December 2012

Status

In progress

Progress and Results

Spring is an energetically important time period for migratory waterfowl and the Rainwater Basin (RWB) of Nebraska is an important spring staging area for millions of waterfowl each year. Special regulations have been set in this region to protect non-target species from hunting disturbance during the Light Goose Conservation Order (LGCO). Current regulations in the RWB prohibit hunting on 16 public wetlands and restrict hunting to four days a week during the LGCO. The goal of this project is to determine how waterfowl are reacting to hunting disturbance in relation to these special regulations and to gather hunter opinions on current and future management strategies to regulate this hunting season.

In both 2011 and 2012 dabbling duck densities were greater on wetlands closed to hunting during early season when over 90% of hunting parties were recorded on study wetlands. There were no differences in densities for both years between open and closed wetlands during late season when hunting pressure subsided. In 2011 mallards (*Anas platyrhynchos*) and Northern pintails (*A. acuta*) spent more time foraging in wetlands closed to hunting during early season, but no differences in behavior were detected in late season. In 2012 ducks spent more time foraging in both early and late seasons on wetlands open to hunting and habitat quality could have played more of a role in observed differences this year. Migration chronology also occurred over a much shorter time frame in 2012 and with individual birds spending less time in the area, hunting disturbance may not been as likely to affect behavior. No differences in behavior were detected for both greater white-fronted geese (*Anser albifrons*) and lesser snow geese (*Chen caerulescens*) among hunting categories for both years. Survey data for these goose species is highly variable and has not yet been analyzed. A four page mail questionnaire was sent to over 4,000 hunters after the conclusion of the 2012 LGCO. Survey questions gauged hunter opinions about current regulations and hypothetical regulation changes for the future. Hunters generally agreed that restrictive regulations during the LGCO in the RWB are important. Hunters were most in favor of a season that was open to hunting seven days a week with more public wetlands closed to hunting, while the second most favorable choice selected by hunters was the restrictive regulations currently in place. Given the results from field data collected we believe restrictive regulations in place to protect non-target species are an important management strategy. These data along with information gathered from the mail questionnaire will be evaluated together to make future decisions regarding regulations in the RWB during the LGCO.

**LINKING WETLAND MANAGEMENT DECISIONS TO DISTRIBUTION, HABITAT USE,
AND NESTING EFFORTS OF SECRETIVE MARSH BIRDS IN MISSOURI**

Investigators

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Doreen Mengel, MDC
Dr. Andy Raedeke, MDC

Project Supervisor

Dr. Elisabeth Webb, MU

Funding

Missouri Department of Conservation
CA 354

Cooperators

Missouri Department of Conservation

Objectives

Validate wetland management planning models for secretive marsh birds

Evaluate MDC management strategies as they pertain to the distribution, habitat selection, and nesting success of SMBs across the range of predicted habitats and management strategies

Quantify the distribution, habitat selection, and nesting success of SMBs on MDC wetland areas

Inform conservation management decisions for pilot areas

Location

Missouri

Expected Completion

August 2015

Status

In Progress

Progress and Results

The Missouri Department of Conservation's wetland managers endeavor to provide a wide range of habitats for a variety of wetland-dependent wildlife. These management strategies vary spatially and temporally in an effort to simulate natural system processes. In order to create more accurate predictions on the outcome of a given management strategy, MDC managers have recently expressed a need for more efficient and effective methods to learn from past management decisions. The primary objective of this study will be to provide information to be included in the decision support tool used by MDC wetland managers who wish to manage their wetlands for secretive marsh birds (SMBs). We will obtain this information by evaluating how effective current management strategies are in providing for the life history needs of SMBs by quantifying the distribution, habitat preferences, and nesting effort on MDC wetland areas.

Our study sites will be selected from MDC Conservation Areas and USFWS National Wildlife Refuges in northwest Missouri, northeast along the Mississippi River floodplain, and along the Missouri River floodplain in central Missouri. Using Conway's Standardized North American Marsh Bird Monitoring Protocol, we will survey wetlands from March to June for five species of SMB; Sora, Virginia, and King rails and American and Least Bitterns. Study sites where adult birds were detected will be systematically searched for nests and/or broods and the vegetative cover and water depth within a 50 m radius of each survey and nest/brood locations will be recorded. These data will be used to calculate detection probabilities for SMBs during nesting and migration using the PRESENCE data analysis software. We will then determine how different habitat and landscape classifications influence detection probability and site occupancy using an information-theoretic approach.

MOVEMENTS AND HABITAT SELECTION OF MID-CONTINENT MALLARDS

Investigators

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Dr. Elisabeth Webb, MU

Project Supervisors

Dr. Dylan Kesler, MU
Dr. Elisabeth Webb, MU

Funding

Arkansas Game and Fish Commission
Ducks Unlimited
Missouri Department of Conservation
CA 346
Natural Resource Conservation Service

Cooperators

Arkansas Game and Fish Commission
Ducks Unlimited
Missouri Department of Conservation
Natural Resource Conservation Service

Objectives

Test for differential selection of private wetlands compared to publicly managed areas by Mallards.

Quantify the influence of spatial variance in energetic carrying capacity on movement and habitat selection of Mallards.

Identify important habitat types to migrating and wintering populations in Arkansas and Missouri.

Location

North America

Expected Completion

August 2013

Status

In progress

Progress and Results

Although numerous studies have analyzed waterfowl habitat selection, research has been limited to local scales due to the logistical constraints of radio-tracking migratory birds. As a result, there is a need to thoroughly evaluate movement and resource selection of migratory waterfowl across multiple spatial scales. Thus, we outfitted 40 Mallard (*Anas platyrhynchos*) hens with satellite transmitters from May 2010 to February 2011 to assess movement patterns and habitat use of this species at local, regional, and continental scales. A total of 22,086 locations were collected from May 2010 to April 2012, and the average number of locations per individual varied extensively ($\bar{x} = 538.7$, $SD = 497.7$). Data analysis is currently underway and will include a test for differential selection between privately owned wetlands (e.g. wetlands enrolled in the Wetland Reserve Program) and publicly managed areas (e.g. National Wildlife Refuges). Moreover, the effects of land-use practices and associated local carrying capacity on movement patterns will be analyzed. Important migrating and wintering habitats for mid-continent mallards will also be identified, with a specific focus on Arkansas and Missouri. The results of this project will inform landscape conservation planning and aid managers in assessing habitat suitability for mid-continent waterfowl populations.

WATERBIRD USE AND FOOD AVAILABILITY ON WETLAND RESERVE PROGRAM SITES ENROLLED IN THE MIGRATORY BIRD HABITAT INITIATIVE

Investigators

Jessica Tapp, MS student, MU
Dr. Elisabeth Webb, MU

Project Supervisor

Dr. Elisabeth Webb, MU

Funding

Love Foundation
Natural Resource Conservation Service

Cooperators

Missouri Department of Conservation
Natural Resources Conservation Service
Mississippi State University
U.S. Fish and Wildlife Service

Objectives

Quantify food availability for shorebirds during migration on Wetland Reserve Program lands in the Mississippi Alluvial Valley.

Quantify food availability for migrating and wintering waterfowl on Wetland Reserve Program lands in the Mississippi Alluvial Valley.

Assess local and landscape factors influencing waterbird density and species richness on Wetland Reserve Program sites.

Location

Southeast Missouri, eastern Arkansas

Expected Completion

May 2013

Status

In progress

Progress and Results

The Natural Resource Conservation Service implemented the Migratory Bird Habitat Initiative (MBHI) in summer 2010 to mitigate potential loss of wetland habitat caused by the Deepwater Horizon oil spill. The goal of MBHI was to improve wetland habitats on private farmlands, catfish ponds, and Wetland Reserve Program (WRP) easements in the Lower Mississippi Alluvial Valley to provide additional habitats for wintering and migrating waterbirds. Priorities for WRP lands included addressing waterbird food habitats, providing habitat structure, and additional management activities such as planting and/or disking on moist-soil wetlands. Objectives collectively aim to evaluate MBHI management on WRP sites and determine the importance of private lands to migrating waterbirds. Waterbird surveys and food density data collection has been completed, and seed and invertebrate samples are currently being processed in the laboratory. In the October 2011-February 2012 season, we detected greater dabbling duck densities on sites where landowners had the ability to pump water ($F=13.01$, $p = .0004$). We observed that drought conditions may have had an effect since many landowners did not inundate sites until mid-November. Mowing, planting, time since initial restoration, or hunter disturbance did not affect waterbird densities. That individual management activities did not best explain variation in waterbird densities supports results from previous studies, despite evidence that management can improve food availability and habitat structure and increase waterfowl densities. Variation in waterbird densities may also be explained by local and landscape features, which are currently being assessed. Further research assessing the value of WRP to shorebirds during fall migration is recommended in years with average precipitation.

OTHER COOPERATORS WITH PROJECTS THROUGH THE UNIT

DR. JOHN FAABORG

USE OF EARLY-SUCCESSIONAL HABITATS BY FOREST BREEDING BIRDS: CONVENIENCE OR NECESSITY?

Investigators

Dr. John Faaborg, MU
Alicia Burke, MS student, MU

Project Supervisor

Dr. John Faaborg, MU

Funding

U.S. Fish and Wildlife Service
RWO 113

Cooperators

Missouri Dept. of Conservation

Objectives

Recent studies have suggested that many mature forest-breeding migratory birds may use early successional habitats after breeding, but it is unclear the extent that this use is necessary as part of the annual cycle of such birds.

We will use radio-tracking of Ovenbird, Worm-eating Warbler, and Red-eyed Vireo to determine the extent that young birds of these species require early-successional habitats after they become independent of their parents.

Location

Missouri Ozark Forests

Expected Completion

June 2013

Status

In progress

Progress and Results

Studies in the Midwest and elsewhere have suggested that a variety of mature forest breeding birds spend a portion of the post-breeding season in early successional habitats such as clearcuts. Anders et al. 1998 was among the first papers to demonstrate this with the Wood Thrush, where all radio-tracked birds moved from mature forest breeding habitat to early successional habitat after independence from their parents. Others have shown similar behavior by this species elsewhere. Several studies using mist nets have captured many other forest-breeding species in clear cuts after independence, and it has often been assumed that these birds stay in the cuts for long periods of time, but netting does not provide good data in this regard.

In this study, we netted a variety of clearcuts for two summers to determine use of such cuts by forest birds, then in the last summer we captured hatching-year individuals of Ovenbird, Worm-eating Warbler, and Red-eyed Vireo in clear cuts and put radio transmitters on some of these birds. These birds were then followed for the duration of the life of their radio (ideally 20 days).

Initial observations from our radio-tracking suggests that young Ovenbird and Worm-eating Warbler move to clear cuts after becoming independent of their parents and they stay there for long periods of time (up to 20 days). Young Red-eyed Vireo were captured in the clear cuts but moved back to mature forest soon after the radios were put on them and these birds moved extensively after that.

We will do formal analysis of capture rates and locations for our radio-tracked individuals this fall to provide a quantitative analysis of bird movements.

DR. RICHARD GUYETTE

FIRE HISTORY OF THE NATIONAL PARKS, MONUMENTS, AND HISTORIC SITES IN THE GREAT PLAINS

Investigators

Dr. Richard Guyette, MU
Dr. Michael Stambaugh, MU

Project Supervisors

Dr. Gary Willson, NPS
Dr. Charles Rabeni, USGS
Dr. David Galat, MU

Funding

U.S. Geological Survey
U.S. National Park Service
RWO 100

Cooperators

Missouri Cooperative Fish and
Wildlife Research Unit
Texas State Parks
Wichita Mountains National
Wildlife Refuge
Charles Russell National
Wildlife Refuge
National Park Service
The Nature Conservancy
Nebraska Forest Service
Kansas Forest Service

Objectives

Collect and analyze quantitative
data on Great Plains fire
regimes

Location

US Great Plains, Texas to
Montana

Completion

December 2010

Status

Complete

Progress and Results

Fire regimes of the Great Plains ecosystems have had little quantitative descriptions and data analyses. Knowledge of fire regimes over the long-term is needed in assessing the present state of ecosystems and in making management decisions, restoration plans, and in addressing national fire plans. The long-term patterns of fire disturbance influence fuels, species, and ecosystem function, especially in the Great Plains national park units where fire has historically played a significant role. The objective of this project was to quantify fire regimes at national park units within the Great Plains using existing studies and dendrochronological methods. Fire histories from dated fire scars on trees include the frequency, extent, and conditions of past burning and provide a science based guide to fire regime reference conditions. A regression analysis is used to identify the fire regime characteristics of National Park units without local data from existing information and this project's fire history results. The many results of this project are available in the publications and final report to the National Park Service listed below.

Products

Guyette, R.P., M.C. Stambaugh, D.C. Dey, and R.M. Muzika. 2012. Estimating fire frequency with the chemistry of climate. *Ecosystems* 15:322-335.

Stambaugh, M.C., J. Sparks, R.P. Guyette, and G. Willson 2011. Fire history of a relict oak woodland in northeast Texas. *Rangeland Ecology and Management* 64:419-423

Guyette, R.P., M.C. Stambaugh. 2010. Fire history of the national parks, monuments, and historic sites in the Great Plains. Final Report for the National Parks Service.

Stambaugh MC Guyette RP McMurry ER Marschall JM and Willson G. 2008. Six centuries of fire history at Devils Tower National Monument with comments on region wide temperature influence. *Great Plains Res.* 18:177-87.

DR. SCOTT HOLAN

DEVELOPMENT OF POPULATION AND SURVIVAL ESTIMATES FOR PALLID STURGEON IN THE LOWER MISSOURI RIVER

Investigators

Dr. Scott Holan, MU
Guohui Wu, PhD student, MU

Project Supervisors

Dr. Scott Holan, MU

Funding

U.S. Geological Survey
Missouri Cooperative Fish and
Wildlife Research Unit
RWO 106

Cooperators

U.S. Army Corp of Engineers
U.S. Fish and Wildlife Service
Missouri Department of
Conservation
Nebraska Game and Parks
Commission

Objectives

Develop pallid sturgeon population and survival estimates that will predict numbers of fish surviving from hatchery outputs and ultimate population size in future decades.

Develop a model to predict hatchery reared pallid sturgeon survival and dispersal (short- and long-term) related to stocking size, location, season, and genetic origin.

Location

Lower Missouri River

Expected Completion

July 2014

Status

In progress

Progress and Results

Similar to other fish species, previous capture probability, survival rate, and population size estimates for the federally-listed as endangered pallid sturgeon have been obtained using capture-recapture models (e.g., Cormack-Jolly-Seber (CJS) with and without Robust Design). We present a Bayesian-based approach to estimate capture probability, survival rate, and population size of shovelnose and pallid sturgeon in the Lower Missouri River using open population capture-recapture CJS and Jolly Seber models. There are several advantages to using a Bayesian approach, including straightforward, accurate quantification of uncertainty for the estimated parameters and for deterministic functions of the estimated parameters. In our analysis, models with time-varying capture probability and gear effort covariates were preferred. Short-term, timeframe-specific sampling was a poor substitute for year-round sampling. Assuming high tag retention rates, there were estimated to be around 4000 hatchery and 1400 wild pallid sturgeon as of 2009 with population size not increasing with stocking. Concurrently, shovelnose sturgeon overall population size seemed stable throughout the study period; however, age-2, age-3, and age-4+ age group population sizes were lowest by the end of the study with overall population size estimated around 600 thousand in March through June 2010.

DR. DYLAN KESLER

DEVELOPING RESCUE SCENARIOS FOR THE GUAM MICRONESIAN KINGFISHER

Investigators

Dr. Rebecca Laws, Post Doc,
MU
Dr. Dylan Kesler, MU

Project Supervisor

Dr. Dylan Kesler, MU

Funding

U.S. Fish and Wildlife Service,
Missouri Cooperative Fish
and Wildlife Research Unit
RWO 112

Cooperators

U.S. Fish and Wildlife Service
Association of Zoos and
Aquariums

Objectives

Model and identify suitable
candidate islands to establish
the Guam Micronesian
Kingfisher in Pacific Oceania

Ground truth candidate islands
to determine suitability

Model captive and release
population dynamics to
identify suitable release
individuals and predict post
release dynamics

Location

Pacific Oceania, Guam,
Federated States of
Micronesia, French Polynesia,
Marshall Islands,
Commonwealth of the Mariana
Islands, Republic of Palau

Expected Completion

May 2013

Status

In progress

Progress and Results

A large proportion of historic avian extinctions have been island forms, and many more island species are on the brink of extinction. Species re-introductions and translocations have been successfully used as conservation tools. However, the science and methods underlying site selection are often hindered by a lack of information. For this project, information is being gathered from the literature and expert opinions to underpin a Bayesian network model that will serve as a decision support tool to identify potential release sites for the critically endangered Guam Micronesian Kingfisher. The model will be used to help identify candidate islands under multiple release, recovery, and management scenarios. Top candidate islands will then be surveyed to determine suitability, and to establish collaborative research and conservation ties. Population modeling will then be used to test multiple release and translocation approaches, and to help determine which individuals might be selected for re-introductions or translocations, while simultaneously maintaining a robust captive donor population of the critically endangered birds.

Products

Laws, R., and D.C. Kesler. 2011. A Bayesian network model for selecting candidate release sites for the critically endangered Micronesian Kingfisher (*Todiramphus cinnamominus cinnamominus*). Report delivered to U.S. Fish and Wildlife Service, Honolulu, HI.

Laws, R. J., and D. C. Kesler. 2012. A Bayesian network approach for selecting translocation sites for endangered island birds. *Biological Conservation* 155:178-185.

DR. MICHAEL STAMBAUGH

FIRE HISTORY AND FOREST COMMUNITY DYNAMICS AT THE WICHITA MOUNTAINS

Investigators

Dr. Michael Stambaugh, MU
Dr. Richard Guyette, MU

Project Supervisor

Dr. David Galat, MU

Funding

U.S. Fish and Wildlife Service
RWO 105, 120

Cooperators

Missouri Cooperative Fish and
Wildlife Research Unit

Objectives

Reconstruct historic fire events
to characterize fire regime and
describe demographics and
growth of eastern redcedar

Location

Wichita Mountains National
Wildlife Refuge

Expected Completion

September 2013

Status

In progress

Progress and Results

A total of three new fire history sites were established at the refuge and all data have been collected for these sites. Sites were located at Hollis Canyon, Rain Gauge Flat, and Cache Creek. A total of 189 trees were sampled at these sites and additional trees were sampled opportunistically in other locations within the Special Use Area. Currently we are summarizing the fire histories for each individual site and for the larger refuge area. All fire history records span a common period of 1746 to 2005. The earliest record extends back to 1637 and the earliest fire detected was in 1712. Transects were used to characterize the tree vegetation at the fire history sites. An absolutely dated tree-ring width chronology has been constructed from dead and living eastern redcedar trees on the refuge. The chronology extends back to the 13th century. We have begun analyses to characterize the climate-growth response of redcedar. Vegetation plot sampling to characterize eastern redcedar expansion has been completed. Two different models are being developed: 1) a predictive model of the age of redcedar based on topographic, vegetation, and environmental conditions and, 2) a set of probability models for the presence of red cedars in different age classes.

FISH AND WILDLIFE FACULTY COOPERATOR PROJECTS

2010 TO PRESENT

DR. MATTHEW GOMPPER

DOG MASS VACCINATION AND POPULATION GROWTH: ASSESSING MANAGEMENT OUTCOMES

Investigators

Dr. Matthew Gompper, MU
Aniruddha Belsare, PhD
student, MU

Project Supervisor

Dr. Matthew Gompper, MU

Funding

University of Missouri
Graduate School and
Research Board

Objectives

The specific objectives of this work are: (a) to gain field data on the demographics of free-ranging domestic dogs in India; (b) to simultaneously gain field data on the seroprevalence of several important pathogens of domestic dogs; (c) to conduct an experimental vaccination to understand if and how vaccination programs may alter dog demographics.

Location

India

Expected Completion

May 2013

Status

In progress

Progress and Results

Many regions of the world have high densities of free-ranging dogs. These dog populations are central concerns for public health, wildlife conservation, and human-wildlife conflict. In rural regions, dog populations act as disease reservoirs for important pathogens of human and wildlife health concern. Dogs also are predators of wildlife, including endangered species, and in some case are the primary causes of wildlife mortality. Furthermore, dog densities are often so high that dogs become a primary component of the diet of large predators, sustaining those predator populations and increasing rates of human-wildlife conflict. Mass vaccination of dogs has been recommended to control disease, and especially to eradicate rabies. However, because disease may be the primary limiting agent for these dog populations, mass vaccination campaigns conducted without fully addressing dog demographics may result in increased survival, reproduction, and population growth.

An increase in abundance of dogs could then result in increased viral prevalence, increased risk of epidemics, and further negative dog-human and dog-wildlife interactions. Three critical information voids hinder more informed management: field data on dog demographics, measures of the prevalence for important pathogens, and data on how diseases, and disease control, influence dog demographics. We are collecting this data for multiple dog populations in rural India. We are also conducting a mass vaccination campaign for the study populations to monitor the effects of mass vaccination on the dog demographic parameters that underpin population growth rates. This work will provide immediate applied and theoretical insights by identifying limiting factors for dog populations and by identifying outcomes of potential dog vaccination management strategies.

INVESTIGATION OF FLEA ECOLOGY AND PLAGUE DYNAMICS IN PRAIRIE DOG POPULATIONS

Investigators

Dr. Matthew Gompper, MU
Dr. Joshua Millspaugh, MU
David Jachowski, PhD student,
MU

Project Supervisor

Dr. Matthew Gompper, MU

Funding

Utah Division of Wildlife
Resources,
U.S. Fish and Wildlife Service

Objectives

The specific objectives of this work are: (a) to identify the species of fleas that occur on Utah prairie dogs; (b) to reveal patterns of flea community structure and patterns in the temporal and spatial dynamics of flea populations on Utah prairie dogs and (c) assess outcome of systemic flea control trials.

Location

Utah, South Dakota, Missouri

Completion

May 2012

Status

Complete

Progress and Results

Sylvatic plague, caused by the bacterium *Yersinia pestis*, is known to be a major threat to prairie dog conservation, including the federally endangered Utah prairie dog, but we have a poor understanding of how this disease behaves and which prairie dog populations are at greatest risk. Investigations into flea ecology on black-tailed prairie dogs have provided valuable insight into plague dynamics. Different flea species are more abundant at different times of year and certain species are more likely to carry and transmit the disease, and seasonal variations in flea species have been found to correlate with plague outbreaks. In contrast to black-tailed prairie dogs, little is known about the ecology of fleas on Utah prairie dogs. Basic information on seasonal and elevation variations in flea dynamics could provide insight into plague ecology and provide information to managers about when and where prairie dog populations are most at risk.

We examined the potential value of a novel flea control agent (Imidacloprid) on black-tailed and Utah prairie dogs. We observed mixed results; the product generally was effective at reducing flea prevalence, abundance, and intensity on prairie dogs at some sites and not at others, and the effectiveness within a site varied over time. Thus At the application rates we evaluated, the imidacloprid product is likely not as effective at controlling fleas on prairie dogs as the more commonly used topical insecticide containing deltamethrin. However, managers should also consider the risk of flea species developing resistance following the repeated application of a single flea-control product. Furthermore, because we observed a higher than expected diversity of flea species on Utah prairie dogs, future work should be undertaken to investigate how other mammalian host species might mediate flea population dynamics, plague ecology, and the outcome of flea management approaches

Products

Jachowski, D.S., N.L. Brown, M. Wehtje, D.W. Tripp, J.J. Millspaugh, and M.E. Gompper. 2012. Mitigating plague risk in Utah prairie dogs: Evaluation of a systemic flea-control product. *Wildlife Society Bulletin* 36:167-175.

Jachowski, D.S., Skipper, S., and M.E. Gompper. 2011. Field Evaluation of Imidacloprid as a Systemic Approach to Flea Control in Black-tailed Prairie Dogs (*Cynomys ludovicianus*). *Journal of Vector Ecology* 36:100-107.

RELATIVE IMPORTANCE OF GENETIC VARIABILITY FOR PREDICTING PARASITISM

Investigators

Dr. Matthew Gompper, MU
Dr. Lori Eggert, MU
Dr. Maria Jose Ruiz-Lopez,
Post Doc, MU
Dr. Ryan Monello, NPS

Project Supervisor

Dr. Matthew Gompper, MU

Funding

National Science Foundation

Objectives

The specific objectives of this work are: (a) identify the relationships between neutral and MHC genetic variability and the likelihood and extent of parasitism of a host; (b) assess the relative importance of any observed genetic correlations relative to demographic and abiotic factors that are also known to influence extent of parasitism.

Location

Missouri

Expected Completion

May 2013

Status

In progress

Progress and Results

Strong associations exist between an individual's level of genetic variability and the likelihood and extent of parasitism. These associations are observed for neutral loci (e.g. microsatellites), as well as for regions of the genome such as the major histocompatibility complex (MHC) where selection for genetic variability is strong and particular alleles may influence the likelihood of an individual being parasitized. These observations result in two important questions that are addressed in this project. First, is neutral genetic variability and MHC variability associated with the likelihood of parasitism even in large outcrossing populations and do such patterns persist across diverse parasitic species? Second, if associations between genetic variability or the presence of specific alleles and the likelihood or extent of parasitism exist, what is the relative importance of these genetic predispositions compared to other strong predictors of parasitism? These issues are addressed by examining relationships between genetic variability and parasitism based on data derived from a study of ten free-ranging raccoon populations collectively totaling over 700 known individuals. We have observed high levels of microsatellite and MHC variability which is typical of large outcrossing populations, but also broad variance in measures of genetic variability across individuals. Several strong associations between genetic variability and parasitism have been identified, including relationships between genetic variability and ectoparasite abundance, endoparasite species richness, and viral seroconversion.

Products

Gompper, M.E., Monello, R.J., and L.S. Eggert. 2011. Genetic variability and viral seroconversion in an outcrossing vertebrate population. *Proceedings of the Royal Society* 278: 204-210

LANDSCAPE ECOLOGY OF TIGERS IN NEPAL

Investigators

Dr. Matthew Gompper, MU
Hemanta Kafley, PhD student, MU

Project Supervisor

Dr. Matthew Gompper, MU

Funding

World Wildlife Fund
University of Missouri Graduate School
Mizzou Tigers for Tigers

Objectives

To develop habitat suitability models for tigers and other sympatric carnivores in the Terai Arc landscape (TAL) of Nepal.

To identify the trend of the Land use / Land cover change in the TAL and analyze its impact on tiger habitat suitability

To evaluate the ability of the corridors to connect different identified tiger subpopulations in the TAL.

To understand the ecological importance of tiger on the light of spatial and temporal habitat separation / overlap between and among Carnivores and their prey species in the Chitwan National Park, Nepal.

Location

Nepal

Expected Completion

May 2014

Status

In progress

Progress and Results

The chances for a long-term survival of megafauna small and isolated protected areas are slim unless they are linked by intact natural habitat corridors that permit dispersal and provide critical habitat requirements. In Nepal, the tiger now occurs only in small, isolated protected areas (viz. Suklaphanta Wildlife Reserve – 305 sq.km, Bardia National Park- 968 sq.km, Chitwan National Park- 932 sq.km and Parsa Wildlife Reserve- 499 sq.km) connected by different habitat types at varied level of fragmentation and managed for different objectives. In isolation, these protected areas in Nepal are not large enough to support viable tiger population. Therefore, an important step of shifting management from protected areas level to ecosystem or landscape level has been taken in Nepal. The Terai Arc Landscape (TAL) program was designed to restore and maintain the critical forest corridors and bottlenecks with an overall goal to conserve the biodiversity, soils and watersheds of the Terai and Churia Hills to ensure ecological, economic and socio-cultural integrity of the region. However, to date no study has been done to oversee the landscape dynamics of the TAL and its function to serve as a refuge to support tiger and other megacarnivores. This study will identify the critical habitat parameters responsible for the perpetual existence of the tigers and map suitable habitat in the TAL. Impact on tiger habitat suitability due to changes in the land use / land cover along TAL will be analyzed. Simultaneously, remnant viable corridor for the movement of tigers in the TAL will be identified and mapped. This study also aims to understand the response of other carnivores and prey species in Chitwan National Park to the presence of tigers.

ADDRESSING PARASITISM OF HATCHERY RAINBOW TROUT BY A GILL COPEPOD

Investigators

Dr. Matthew Gompper, MU
Jeff Koppleman, MDC
Wes Swee, MDC
Danielle Mocker, B.S. student, MU

Project Supervisor

Dr. Matthew Gompper, MU

Funding

Missouri Department of Conservation
McNair Foundation

Objectives

To understand the dynamics of a parasitic copepod on hatchery-reared rainbow trout, and to test the value of brook trout in helping to reduce the parasite loads in rainbow trout.

Location

Nepal

Expected Completion

May 2013

Status

In progress

Progress and Results

Ectoparasitic copepods of salmonids attach to the body surface and branchial cavity. Extensive parasitism of an individual host can result in morbidity and decreased probability of survival. A specific copepod, *Salmincola californiensis* parasitizes several species of trout, most notably rainbow trout. This study was conducted to document the ontogeny of the parasite-host interaction by recording how newly hatched, uninfected fish that are released in an infected hatchery develop their parasite infropopulations (that is, the parasite population of a single fish) and component population (the parasite population of an entire population of hosts). The study was conducted at the Meramec Spring Trout Hatchery and each individual fish was surveyed biweekly to count the number of viable copepods present on the animal. There was no significant preference of parasites asymmetries between the left and right gills, but the site of initial infection influenced future parasitism, and host length and weight impacted the copepod abundance.

ASSESSING HOW THE EXTENT OF HOST PARASITISM INFLUENCES TICK REPRODUCTIVE ECOLOGY

Investigators

Dr. Matthew Gompper, MU
Dr. Lori Eggert, MU
Dr. Maria Jose Ruiz-Lopez,
Post Doc, MU

Project Supervisor

Dr. Matthew Gompper, MU

Funding

National Science Foundation

Objectives

Project objectives are two-fold: (1) to test the hypothesis that the reproductive success of ticks differs as a function of the population density under which the ticks occur on a host and as a function of demographic and genetic make-up of the hosts themselves; (2) to test the hypothesis that the mating system of ticks varies with tick population density on an individual host.

Location

Missouri

Expected Completion

May 2015

Status

In progress

Progress and Results

Parasitic individuals tend to be highly aggregated, such that most hosts have small populations of parasites while a few hosts have large populations. The aggregation of most parasites on relatively few hosts produces a pattern comprising a series (equal to the size of the host population) of parasite infrapopulations (the parasites that inhabit an individual host) that typically fit a negative binomial distribution. This over-dispersal of parasite counts is well recognized by disease ecologists and epidemiologists, forming the basis of many strategies for parasite management. An important assumption, however, is that the parasites that inhabit different hosts are effectively identical in their fundamental ecology. Yet little work has examined the implications of this aggregation on the ecology of the parasites themselves. The tendency for aggregation among hosts results in most parasitic individuals occurring on a few hosts at high population densities, while a small but demographically significant portion of parasitic individuals occur on hosts at low population densities. This variance in the extent of crowding of parasitic individuals is likely to have an important influence on the individual parasites. In particular, it is hypothesized that the reproductive strategies and reproductive success (analogous to the competency of the host) of the parasite differ as a function of the size of the parasite infrapopulation (that is, the location of the parasite on the negative binomial distribution). This hypothesis are being tested by examining relationships between the reproductive ecology of a common and epidemiologically important ixodid tick and the extent of parasitism of its primary vertebrate host. The proposed work builds on studies of how host genetics and demographics influence the likelihood and extent of parasitism by this tick, as well as studies of the phenology of the tick species, the shape of its aggregated distribution, and the occurrence of multiple paternity in the species.

Products

Ruiz-López, M.J., S. Chaskelson, M.E. Gompper, and L.S. Eggert. 2012. Multiple paternity in the American dog tick, *Dermacentor variabilis* (Acari: Ixodidae). *Journal of Parasitology* 98: 498-501.

DR. ROBERT HAYWARD

LEAST-COST DIET STUDIES FOR GROW-OUT STAGE YELLOW PERCH AND NILE TILAPIA

Investigators

Dr. Robert Hayward, MU
Dr. Jeffre Firman, MU
Mihai Sun, PhD Student, MU

Project Supervisor

Dr. Robert Hayward

Funding

North Central Regional Aquaculture
Center
Michigan State University

Cooperators

Division of Animal Sciences, University
of Missouri

Objectives

Develop least-cost, nutritionally
complete diets for grow-out-stage
yellow perch and Nile tilapia

Location

Nationwide

Completion

September 2011

Status

Complete

Progress and Results

We have completed the first stages of projects for Nile tilapia and yellow perch. Literature searches have been conducted on feedstuffs' amino acid compositions, and amino acid requirements of the two fishes. We have completed digestibility studies for grow-out-stage Nile tilapia. Nine common feedstuffs including fish meal, poultry byproduct meal, meat and bone meal, blood meal, soybean meal, peanut meal, corn gluten meal, as well as wheat and corn have been evaluated. Digestible energy as well as protein and amino acids have been evaluated. These data will be used mainly for the ideal protein diet formulation and least-cost diet formulation.

We have conducted the experiment to determine lysine requirement of grow-out Nile tilapia. This experiment was run for 8 weeks, and will ultimately determine the exact lysine requirement of grow-out Nile tilapia.

In addition, we will evaluate body amino acid compositions of Nile tilapia and yellow perch. The body amino acid profiles will provide a reference for formulating a protein- and amino acid balanced diet for the two focal species.

It is noted that, early on, we experienced difficulty in securing ~250, 6-7" yellow perch. We continued our efforts to secure suitable-sized yellow perch and found an approach to secure sufficient numbers and sizes of perch. We have completed all experiments and analyses associated with the yellow perch project.

DR. JOHN R. JONES

THE LAKES OF MISSOURI VOLUNTEER PROGRAM

Investigators

Anthony Thorpe, MU
Daniel Obrecht, MU

Project Supervisor

Dr. John R. Jones, MU

Funding

Missouri Department of Natural Resources

Cooperators

National Fish Habitat Initiative

Objectives

To determine current water quality of Missouri lakes

To monitor Missouri lakes for changes over time

To educate the public about nonpoint source pollution, water quality issues and lake ecology

Location

Statewide

Expected Completion

Ongoing

Status

In progress

Progress and Results

The Lakes of Missouri Volunteer Program (LMVP) has recruited citizens to collect water quality samples in Missouri's lakes for the past 20 years. The goals of the LMVP are to determine current water quality in Missouri's lakes, to monitor for changes in water quality over time and to educate the public about lake ecology and water quality issues. In 2011 the LMVP engaged volunteers to collect over 800 water samples at 120 lake sites across the state. The data are used by the Missouri Department of Natural Resources, the Missouri Department of Conservation, the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, watershed groups, lake managers and citizens to address various water quality data needs. The LMVP website (lmvp.org) hosts the program's newsletters and data reports and receives thousands of visitors each month.

Products

The Water Line (LMVP Newsletter):

<http://lmvp.org/publications.htm>

Website: <http://lmvp.org/publications.htm>

Annual Data Reports: <http://lmvp.org/Data/2009/index.htm>

STATEWIDE LAKE ASSESSMENT PROJECT

Investigators

Dr. John R. Jones, MU
Daniel Obrecht, MU

Project Supervisor

Dr. John R. Jones, MU

Funding

Missouri Department of Natural
Resources

Objectives

To generate Missouri lake and reservoir water quality data. The data are used to document existing conditions, evaluate trends, model lake processes and assist with management decisions.

Location

Statewide

Expected Completion

Ongoing

Status

In progress

Progress and Results

The Statewide Lake Assessment Project is an ongoing effort aimed at determining water quality in Missouri's lakes. Each summer approximately 75 lakes throughout the state are sampled on four occasions each. Of these lakes, 40 are monitored each summer to allow for tracking of long-term regional trends. The other monitored lakes are selected from a list of approximately 200 Missouri water bodies on a rotating basis. Data collected through the project are shared with the Missouri Department of Natural Resources to help the state meet Clean Water Act requirements, to the Missouri Department of Conservation to aid in fisheries management, to municipalities managing drinking water reservoirs and to citizens interested in water quality in their favorite lake.

Products

Jones, J. R. 2010. Missouri reservoirs in the Glacial Plains: evaluating small impoundments. *Verh. Internat. Verein. Limnol.* 30:1629-1633.

SPATIAL DISTRIBUTION OF ORGANIC CARBON IN THE SEDIMENTS OF SMALL MISSOURI RESERVOIRS AND ESTIMATE OPTIMAL SAMPLING FOR ESTIMATING CARBON BURIED IN THESE SYSTEMS.

Investigators

Dr. John R. Jones, MU
Brady Pittman, M.S. student, MU
Dr. Joshua Millspaugh, MU
Dr. Robert Kremer, MU
Dr. John Downing, Iowa State University

Project Supervisor

Dr. John R. Jones, MU

Funding

Missouri Department of Natural Resources

Objectives

Determine the spatial distribution of organic carbon in the sediments of small Missouri reservoirs and estimate optimal sampling for estimating carbon buried in these systems.

Location

Statewide

Expected Completion

Ongoing

Status

In progress

Progress and Results

Four small impoundments (5 to 25 ha) in the Glacial Plains of the Midwestern USA were intensively sampled to determine sediment organic carbon concentration (OC, 31–40 cores per reservoir, averaging 2.7 samples per ha). Sediment averaged 39.4 mg OC per g dry sediment (n=136) and mean values varied from 20.3 to 54.8 mg OC per g dry sediment among the 4 reservoirs; these values are near the mid-range of those reported in the literature. This finding is consistent with their trophic state characteristics and geographic setting. Values of OC generally increased from the inflow to the outflow of these reservoirs and a sample collected along the longitudinal mid-line at mean depth provides a reasonable estimate of the geometric mean value. Based on simple random sampling 10 core samples provide precision of 25% and equates to about 0.8 samples per ha. This analysis of sampling effort will be useful for global up-scaling of carbon sequestration by small impoundments.

Products

Pittman, B. A. 2011. Spatial analysis of organic carbon and nitrogen sedimentation in four northern Missouri reservoirs: implications for optimal sampling. M.S. Thesis. 161 pp.

DR. DYLAN KESLER

NATAL DISPERSAL OF RED-BELLIED WOODPECKERS IN A FRAGMENTED LANDSCAPE

Investigators

Allison Cox, M.S. student, MU
Dr. Dylan Kesler, MU

Project Supervisor

Dr. Dylan Kesler, MU

Funding

Love Foundation Fellowship
University of Missouri Research Board
Wilson Ornithological Society
University of Missouri Conservation
Biology Program
TransWorld Airlines Scholarship
American Ornithologists' Union
Audubon Society of Missouri.

Objectives

Identify how landscape composition and configuration affect movements of dispersing resident birds.

Identify how landscape fragmentation affects post-fledging survival of a resident bird.

Location

Central Missouri

Completion

May 2011

Status

Complete

Progress and Results

Identifying the most effective ecological reserves designs has been a challenge to conservation biology for decades. One aspect of prime importance relates to facilitating animal movement between isolated patches of protected areas. Despite repeated calls for empirical assessments of landscape configuration on the movements of dispersing animals, quantitative information is still lacking for avian species. To address this information gap we used radiotelemetry to track the movements of dispersing juvenile Red-bellied Woodpeckers (*Melanerpes carolinus*). Work was conducted in areas of fragmented and contiguous forest in central Missouri. Movement data were analyzed and results evidenced a complex dispersal behavior in the resident woodpeckers. Further they provided quantitative guidelines for land managers concerned with maintaining intact avian populations. Data allowed us to model post-fledging survival of Red-bellied Woodpecker, with which we tested effects of intrinsic, social, temporal, and landscape features on post-fledging survival. Results contributed to our understanding of the impacts of landscape composition and configuration on avian survival and movement.

Products

Cox, A. 2011. Natal dispersal and survival in Red-bellied Woodpeckers. University of Missouri-Columbia. M.S. Thesis

Cox, A. S., and D. C. Kesler. 2012. Prospecting behavior and the influence of landscape on natal dispersal in a resident bird. Behavioral Ecology: *In Press*.

Cox, A. S., and D. C. Kesler. 2012. Reevaluating the cost of natal dispersal: post-fledging survival in a resident bird species. Condor 114:341-347.

SURVIVAL AND MOVEMENT OF MISSOURI'S GREATER PRAIRIE-CHICKEN

Investigators

Kaylan Kemink, M.S. student, MU
Dr. Dylan Kesler, MU
Dr. Tom Thompson, MDC
Max Allegar, MDC
Kevin Sullivan, MDC
Brent Jamison, USFWS

Project Supervisor

Dr. Dylan Kesler, MU

Funding

Missouri Department of Conservation
Audubon Society of Missouri
Webster Groves Nature Study Society
Prairie Biotic Research Inc.

Cooperators

Missouri Department of Conservation

Objectives

Examine and compare survival and movements of translocated and resident adult and juvenile Greater Prairie-Chickens.

Identify landscape habitat compositions and configurations that benefit populations of Greater Prairie-Chickens

Location

Wah'Kon-Tah Prairie, Missouri
Taberville Prairie, Missouri

Completion

July 2012

Status

Complete

Progress and Results

The Missouri Department of Conservation has engaged in a range of recovery efforts to address the declining population of Greater Prairie-Chickens (*Tympanuchus cupido*). Despite substantial progress, there are remaining gaps in the information needed to ensure success. Specifically, foundational information is needed about Greater Prairie-Chicken adult and juvenile vital rates. The relationship between Greater Prairie-Chicken demography and habitat composition and configuration is also a subject requiring further study. To address these information gaps we designed a radiotelemetry study of resident birds and birds captured in Kansas and released in Missouri. Extensive radio-tracking of both resident and translocated prairie chickens was completed through the 2010 and 2011 spring and summer seasons. Over 4,000 locations were obtained, presenting us with a unique and exciting opportunity to model movement and survival for these birds. We answered important management questions about Greater Prairie-Chicken conservation, translocation and reintroduction.

Products

Kemink, K. M. 2012. Survival, habitat use, and movement of resident and translocated Greater Prairie Chickens. University of Missouri-Columbia, M.S. Thesis.

Kemink, K. M., and D. C. Kesler. *in review*. Using movement ecology to inform translocation efforts for endangered species. Animal Conservation.

CONSERVATION OF INSULAR SEABIRDS IN PACIFIC OCEANIA

Investigators

Lisa Sztukowki, M.S. student, MU
Dr. Dylan Kesler, MU

Project Supervisor

Dr. Dylan Kesler, MU

Funding

Chugach Support Services, Inc.
U.S. Air Force, 15th Airlift Wing
U.S. Department of Defense Legacy
Resource Management Project

Cooperators

Chugach Support Services, Inc.
U.S. Air Force, 15th Airlift Wing

Objectives

Assess the likelihood of rodenticide bait consumption by nesting Sooty Terns on Wake Island

Assess the relative influence on hatch-year survival of body condition, rat predation, interspecific aggression, climate conditions, parental attendance, and vegetation.

Identify the developmental stage at which Sooty Tern chicks suffer the highest rate of mortality.

Location

Wake Island, HI

Completion

May 2011

Status

Complete

Progress and Results

Invasive introduced mammals can cause catastrophic effects on delicate island ecosystems. Introduced new world rats (*Rattus* spp.) have been identified as one of the greatest threats to insular systems of Pacific Oceania and managers have responded with large-scale eradication projects. The US Air Force has scheduled a rat eradication on Wake Island to protect and restore the island's ecosystems and to improve military effectiveness. We initiated work to reduce impacts on non-target species. We assessed the likelihood of rodenticide bait consumption by nesting seabirds and identifying the factors influencing hatch-year survival. We used color band mark and resight techniques, radiotelemetry, and automated photography to monitor survival and behavior in breeding seabirds on Wake Island during 2008, 2009 and 2010. Data were analyzed and results indicated that although some birds do ingest poison bait, the frequency of such ingestions were exceedingly low.

Products

Sztukowski, L. A., and D. C. Kesler. 2012. Environmental fluorescence and conservation bait consumption by Sooty Terns (*Sterna fuscata*): implications for eradication programs. Bird Conservation International: *In Press*.

Sztukowski, L. 2011. Conservation of Sooty Terns on Wake Atoll Complex. University of Missouri-Columbia, M.S. Thesis

Kesler, D. C. 2010. Data summary for 2010 biological monitoring on Wake Island. Technical report submitted to United States Air Force, Hickam Air Force Base, Hawaii (technical report).

SPACE USE AND TERRITORIALITY IN CRITICALLY ENDANGERED TUAMOTU KINGFISHER

Investigators

Gabrielle Coulombe, M.S. student, MU
Dr. Dylan Kesler, MU

Project Supervisor

Dr. Dylan Kesler, MU

Funding

Disney Worldwide Conservation Fund
Pacific Islands Conservation Research
Association
Société d'Ornithologie de Polynésie
Manu
University of Missouri Conservation
Biology Program

Cooperators

Société d'Ornithologie de Polynésie
Manu
Disney's Animal Kingdom

Objectives

Identify key habitats needed for
Tuamotu Kingfisher conservation.

Identify resource requirements needed
at translocation destination.

Location

Niau Atoll, Tuamotu Archipelago,
French Polynesia

Completion

September 2011

Status

Complete

Progress and Results

Our investigation is aimed at identifying the ecological requirements of the critically endangered Tuamotu Kingfisher (*Todiramphus gambieri*) and providing management recommendations that help prevent the bird's extinction. The species is confined to the lowland forests on Niau Atoll in French Polynesia, with a total population of fewer than 250 individuals. A multi-scale resource selection study was based on island-wide surveys and radiotelemetry relocation data from 2006-2010. The birds avoided atoll forest vegetation and appeared to rely on agricultural coconut plantations. The plantations were managed with prescribed burning, coconut harvest, and understory clearing. Coconut plantations provided foraging habitat with open understory and visible ground where the kingfishers hunted lizards and other prey items. Such habitat conditions might resemble those of the original lowland forest, which no longer occur on most Tuamotu islands. A subsequent test was made of factors that have the potential to influence space use, and results showed that variation in territory characteristics correlated with the spatial configuration of foraging patches. The Tuamotu Kingfishers appeared to have a maximum territory length limited by their ability to effectively defend territory boundaries, guard nests, and provision nestlings. Thus, regions where habitats occur in very linear or distant patches may be unsuitable for translocations and conservation colonizations. Translocation was identified as a potential conservation strategy for Tuamotu Kingfishers, and additional criteria were provided for island selection to establishing a rescue population.

Products

Kesler, D. C., R. J. Laws, A. S. Cox, A. Gouni, and J. D. Stafford. 2012. Survival, territory resources, and population persistence in the critically endangered Tuamotu Kingfisher. *Journal of Wildlife Management* 76:1001-1009.

Kesler, D. C., A. S. Cox, G. Albar, A. Gouni, J. Mejeur, and C. Plasse. 2012. Translocation of Tuamotu kingfishers, post-release exploratory behavior and harvest effects on the donor population. *Pacific Science* 66:available online and paper: *In Press*.

Coulombe, G. C., D. C. Kesler, and A. Gouni. 2011. Factors influencing occurrence and habitat use of Tuamotu Kingfishers at landscape and territory scales. *Auk* 128:283-292

- Kesler, D. C. 2011. Non-permanent radiotelemetry leg harness for small birds. *Journal of Wildlife Management*. 75:467-471.
- Coulombe, G. L. 2010. Resource selection and space use of the critically endangered Tuamotu Kingfisher (*Todiramphus gambieri*). MS Thesis, University of Missouri.
- Kesler, D. C., T. Ghestemme, E. Portier, and A. Gouni. 2010. Cooperative Breeding of the Society Kingfisher (*Todiramphus veneratus*). *Wilson Journal of Ornithology* 122:46-50.

NEST-SITE SELECTION IN NORTH SLOPE SHOREBIRDS: RELATIVE IMPACTS OF SNOW, HABITAT, AND BEHAVIORAL FACTORS

Investigators

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Dr. Richard Lanctot, U.S. Fish and
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Project Supervisor

Dr. Dylan Kesler, MU

Funding

U.S. Fish and Wildlife Service

Objectives

Identify ecological, social, and physical features that influence nest-site selection in Arctic-breeding shorebirds.

Location

Barrow, Alaska

Expected Completion

May 2014

Status

In progress

Expected Completion

May 2014

Status

In progress

Progress and Results

The Arctic is experiencing a rate of climate change nearly twice the global average. Rising temperatures could inflict considerable change on Arctic ecology and landscape composition, and potentially affect the reproductive success of millions of shorebirds that migrate to the region each summer to breed. To anticipate how a changing Arctic landscape may affect shorebirds, we are evaluating how current physical, ecological, and social features influence where shorebirds choose to nest. The locations of 1,928 shorebird nests including Dunlin (*Calidris alpina*), Red Phalarope (*Phalaropus fulicarius*), Pectoral Sandpiper (*Calidris melanotos*), Semipalmated Sandpiper (*Calidris pusilla*), Long-billed Dowitcher (*Limnodromus scolopaceus*), and American Golden Plover (*Pluvialis dominica*) were documented over nine field seasons at fixed study plots in Barrow, Alaska. A geographically referenced vegetation and land cover classification map was used to attribute habitat data to nests, and preliminary analyses on selected habitats and spatial distributions of each species have been completed. During the 2012 field season, we monitored tundra snow recession as it relates to climactic conditions and nest initiation dates to infer how snow cover influences or limits nest-site selection. Models comprised of combinations of variables associated with habitat, conspecific and heterospecific population characteristics, and snow cover will be composed to represent hypotheses for shorebird nest-site selection. Additionally, we are examining marked populations of Dunlin and Semipalmated Sandpiper to infer how mate fidelity and sex influence nest-site habitat selection and breeding territory fidelity in individuals. Understanding the parameters of shorebird nest-site selection in the Arctic will permit us to infer how change may alter the range and demographics of several shorebird species.

Products

Cunningham, J. A., D.C. Kesler, and R. B. Lanctot. 2011. Nest-site selection in North Slope shorebirds: Relative impact of ecological and behavioral factors. Summary printed in Alaska Shorebird Group's 'Ongoing or new studies of Alaska shorebirds annual summary compilation'.

Kesler, D. C., and J. A. Cunningham. 2012. Development and testing of predictive nest site selection models for

shorebirds breeding in Barrow, Alaska. Progress report submitted to U. S. Fish and Wildlife Service, Anchorage, AK.

POTENTIAL FOR SPECIES TRANSLOCATION IN RESPONSE TO CLIMATE CHANGE AND HABITAT RESTORATION: BROWN-HEADED NUTHATCH IN THE MISSOURI OZARKS

Investigators

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Dr. Frank Thompson III,
USFS

Project Supervisor

Dr. Dylan Kesler, MU
Dr. Frank Thompson III,
USFS

Funding

U.S. Forest Service

Cooperators

USDA Forest Service,
Northern Research Station

Objectives

Study Brown-headed Nuthatches in northern portions of the range to develop a resource utilization function

User results to identify potential translocation sites in the Missouri Ozarks

Identify landscape factors associated with the dispersal of birds into unoccupied habitat.

Locations

Missouri Ozarks
Arkansas Ouachitas and Ozarks

Expected Completion

May 2013

Status

In progress

Progress and Results

Climate change is predicted to result in the northward advance of pine woodlands from the American southeast. Southern pine systems are home to a fire-adapted endemic avifauna that include the Red-cockaded Woodpecker (*Picoides borealis*), Bachman's Sparrow (*Aimophila aestivalis*), and the Brown-headed Nuthatch (*Sitta pusilla*). The Brown-headed Nuthatch is a cooperatively breeding resident bird that has been little studied in the shortleaf pine habitats in the northern portions of its range, including the Ouachita and Ozark mountains of Arkansas. Extensive pine woodland restoration efforts in the Missouri Ozarks have created potentially suitable habitat for the nuthatch. This project aims to develop tools that facilitate the northward movement of the birds through conservation colonizations. We will study the Brown-headed Nuthatch in Arkansas with a combination of surveys and mark and resight techniques. Data will be used to develop a resource-selection function and a multiscale model that will subsequently be used to evaluate potential reintroduction sites in Missouri. We hope to identify sites suitable for translocating Brown-headed Nuthatches by accounting for both local habitat and landscape factors.

EFFECTS OF THREE DECADES OF LANDSCAPE CHANGE ON INSULAR AVIFAUNA

Investigators

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Project Supervisor

Dr. Dylan Kesler, MU

Funding

U.S. Fish and Wildlife Service
Pacific Island Conservation
Research Association
(PICRA)

Cooperators

Conservation Society of
Pohnpei
College of Micronesia

Objectives

Assess current avian
populations on islands of
Kosrae and Pohnpei. Compare
results to previous studies to
identify population trends.

Identify avian responses to
anthropogenic changes in the
landscape in the last 30 years.

Utilize results to model future
responses to future
anthropogenic changes and
climate change.

Locations

Pohnpei, Federated States of
Micronesia

Expected Completion

May 2014

Status

In progress

Progress and Results

This project is intended to model avifaunal ecological responses to long-term and large-scale landscape change on Pohnpei Island, Federated States of Micronesia. Spatially explicit data from bird surveys in 1983, 1994, and 2012 are being used in combination with three decades of vegetation mapping to derive density and occupancy models for the island's host of endemic and threatened birds. Those models will then be used to construct a predictive GIS model that can be utilized to evaluate potential impacts of future island-scale climate-related habitat changes on Pohnpei's avifauna. Simulations will be run to evaluate a range of potential future effects of climate and anthropogenic habitat changes to island avifauna. Avian surveys have been completed on the islands of Pohnpei and Kosrae, Federated States of Micronesia using occupancy modeling techniques, time to detection techniques, and distance techniques.

IMPORTANCE OF MOUNTAIN PINE BEETLE INFESTATIONS AND FIRE AS BLACK-BACKED WOODPECKER HABITAT IN THE BLACK HILLS, SOUTH DAKOTA

Investigators

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Dr. Mark Rumble, U.S. FS
Dr. Chad Lehman, South
Dakota Department of
Game, Fish, and Parks

Project Supervisor

Dr. Joshua Millsbaugh, MU
Dr. Dylan Kesler, MU

Funding

U.S. Forest Service
South Dakota Department of
Game, Fish and Parks

Cooperators

U.S. Forest Service
South Dakota Department of
Game, Fish and Parks
Wind Cave National Park

Objectives

How is black-backed woodpecker space-use affected by resource distribution within a home range?

What is the relative value of habitat created by wildfire, mountain pine beetle infestation, and prescribed fire to black-backed woodpeckers?

What factors affect long-distance movement of black-backed woodpeckers?

Location

Black Hills, South Dakota

Expected Completion

May 2013

Status

In progress

Progress and Results

Wildfire and beetle infestations are naturally occurring events in most western forests, but these disturbances are often considered undesirable. However, recent and ongoing research suggests that disturbed forests provide important habitat for rare species, and prescribed burning is being tested as a management tool. The black-backed woodpecker (*Picoides arcticus*) is a disturbance-associated species of conservation concern that has recently been petitioned for listing as Threatened or Endangered under the Endangered Species Act. Effective conservation and management at multiple scales requires detailed knowledge of how the distribution of resources within a home range affects woodpecker space-use, how demographic rates differ between habitat created by wildfire, prescribed fire, and beetle infestations, and how woodpeckers move between habitats at landscape scales. We collected home range, demographic, and movement data from 234 individually marked birds year-round from April 2008 through August 2012. Our project thus represents one of the largest black-backed woodpecker datasets in existence. We will evaluate resource selection by correlating space-use within each home range with associated vegetation characteristics. We will evaluate the relative quality of habitat created by wildfire, prescribed fire, and mountain pine beetle infestations by estimating habitat-specific survival and reproductive success. Finally, we will evaluate the factors affecting large-scale movements by correlating known dispersals with factors thought to influence movements, such as breeding failure or the time since a disturbance. Our results will provide resource managers in South Dakota and beyond with information necessary for effective conservation of black-backed woodpeckers.

DR. JOSHUA MILLSPAUGH

EVALUATION OF SILVICULTURAL MANAGEMENT IN MISSOURI OAK-HICKORY FORESTS (MOFEP): THE EFFECTS OF EVEN-AGED, UNEVEN-AGED, AND NO-HARVEST MANAGEMENT ON AMPHIBIAN, REPTILE, AND SMALL MAMMAL COMMUNITIES

Investigators

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Rochelle Renken, MDC
Alex Wolf, MDC
Dr. Sherry, Gao, MDC

Project Supervisor

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Funding

Missouri Department of Conservation

Cooperators

Missouri Department of Conservation

Objectives

Implement Quality Assurance and Control for MOFEP herpetofauna and small mammal data.

Assess comparability and recommend strategies for integrating data from initial (1992-2010) and modified MOFEP herpetofauna sampling protocols.

For herpetofauna and small mammals, quantify magnitude of MOFEP treatment impacts 12-14 years after the initial treatments using suitable modern analytical approaches (occupancy modeling, N-mixture approaches, and hierarchical mark-recapture modeling).

Location

Columbia, Missouri

Expected Completion

Spring 2016

Status

In progress

Progress and Results

The Missouri Ozark Forest Ecosystem Project (MOFEP) is a long-term MDC experimental study of the effects of alternative forestry-management practices on numerous ecological attributes. In 2008-2010, sampling for amphibians, reptiles, and small mammals was conducted to evaluate responses 12-14 years after the first round of MOFEP treatments and to assess the implications of modifying the herpetofauna protocol in future MOFEP sampling. We implemented extensive quality-assurance / data-cleaning on 1992-2010 MOFEP herpetofauna and small mammal data sets, leading MDC to greatly improve QA/QC procedures for new data. Based on paired sampling using the existing and alternative herpetofauna protocols, we documented consistent differences in the resulting data, and are collaborating with MDC to assess the implications of these differences for integrating past and future data. For assessing MOFEP treatment impacts, we are evaluating the applicability of, and implementing, recently developed analytical tools intended to adjust for potential measurement biases and allow more precise estimates for both abundant and relatively uncommon species. For herpetofauna, hierarchical occupancy modeling is being implemented to assess treatment impacts and potentially bridge results from the traditional and modified MOFEP herpetofauna protocols. For small mammals, hierarchical mark-recapture modeling is integrating data from 8 years of small mammal sampling to estimate treatment effects while accounting for measurement bias (incomplete and variable detectability). Such analytical tools are essential for ensuring managers receive accurate results which meet current scientific standards for defensibility. Manuscripts are in preparation to report these results.

**RESPONSES OF SMALL MAMMALS TO FUELS TREATMENTS AT MOUNT RUSHMORE
NATIONAL MEMORIAL, SOUTH DAKOTA**

Investigators

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Bruce Weisman, NPS
Cody Wienk, NPS

Project Supervisor

Dr. Joshua Millspough, MU
Dr. Robert Gitzen, MU

Funding

National Park Service Wildland Fire
Reserve Fund
Mount Rushmore National Memorial

Cooperators

National Park Service
Great Rivers Cooperative Ecosystem
Studies Unit

Objectives

Estimate small mammal species
occupancy rates across Mount
Rushmore National Memorial (MORU).

Examine whether patterns of species
occurrence and changes in occurrence
between 2010 and 2012 are related to
recent fuels-reduction treatments and
selected habitat characteristics.

Collaborate with park managers, NPS
fire ecologists, and other NPS scientists
to assess management implications of
the study results and develop suitable
management recommendations.

Location

Rapid City, South Dakota

Expected Completion

Spring 2013

Status

In progress

Progress and Results

In ponderosa pine (*Pinus ponderosa*) forests of Mount Rushmore National Memorial (MORU), fire suppression for more than a century has led to high tree densities, greatly increasing the risk of high-severity fires and widespread mortality from mountain pine beetles. The National Park Service has implemented treatments to reduce fuel loads and tree densities, but decisions about such treatments are hindered by the lack of information regarding broader ecological effects of such treatments in the Black Hills region, particularly for animal communities. In summer 2010 through separate funding from MORU, we completed a park-wide occupancy survey at 65 randomly selected sites to assess small mammal species occurrence in relation to past fuels treatments, and at 250 sites to assess occurrence of red squirrel middens. We completed additional exploratory surveys which confirmed the occurrence of the northern flying squirrel, a species of concern in the region. In late summer 2010, the park conducted large-scale thinning of roughly 50% of the park area to reduce small-tree densities and fuel loads. In summer 2012, we resampled all sites visited in 2010, plus additional sites, to examine changes in species occurrence and relative abundance and potential impacts of 2010 treatments. After completion of data entry and processing, a combined analysis of 2010 and 2012 data will utilize occupancy and mark-recapture modeling to assess species and community patterns in dynamics in relation to 2010 and previous treatments. This information will be used by NPS in planning future fuels-management treatments at MORU.

DEVELOPMENT OF A LONG-TERM MONITORING PLAN FOR NATIONAL PARKS IN THE NORTHERN GREAT PLAINS

Investigators

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Project Supervisor

Dr. Joshua Millspaugh, MU

Funding

National Park Service Northern Great Plains Network (NGPN)

Cooperators

National Park Service NGPN

Objectives

Complete a “Vital Signs” Monitoring Plan outlining monitoring priorities, objectives, sampling designs, protocol-development timelines, and general data-management, reporting, and administrative procedure for the NGPN.

Guide the NGPN and NPS Partners in addressing quantitative issues related to development of sampling designs for monitoring vegetation, water quality, and other attributes.

Develop and publish an edited book with contributions from statistical experts on quantitative design and analysis in long-term monitoring efforts.

Implement additional ecological and adaptive-management investigations for NGPN parks.

Location

Rapid City, South Dakota

Completion

July 2012

Status

Complete

Progress and Results

As one of 32 networks in the National Park Service (NPS) Inventory and Monitoring (IandM) Program, the Northern Great Plains Network (NGPN) is developing and implementing a long-term monitoring program for 13 NPS units in North and South Dakota, eastern Wyoming, and northern and western Nebraska. In this project, we worked with the NGPN IandM staff and park managers to identify, prioritize, and develop monitoring objectives for tracking the condition of selected natural-resource attributes and stressors. Through close collaboration with the NGPN, we successfully completed the NGPN Vital Signs Monitoring Plan, allowing the Network to begin operational monitoring. In addition to general scientific guidance, we provided quantitative guidance to the NGPN related to development of specific monitoring protocols, particularly related to the Network’s top priorities of monitoring vegetation and water quality in its parks. To obtain and disseminate recommendations from top monitoring experts worldwide on quantitative issues in monitoring, we completed an edited volume, “Design and Analysis of Long-term Ecological Monitoring Studies.”

Products

Gitzen, R. A., J. J. Millspaugh, A. B. Cooper, and D. S. Licht. 2012. Design and analysis of long-term ecological monitoring studies. Cambridge University Press, Cambridge UK. 600 pages.

Gitzen, R. A., and J. J. Millspaugh. 2012. Ecological monitoring: The heart of the matter. Pp. 3-22 in R. A. Gitzen, J. J. Millspaugh, A. B. Cooper, and D. S. Licht. 2012. Design and analysis of long-term ecological monitoring studies. Cambridge University Press, Cambridge, UK.

Gitzen, R. A., M. Wilson, J. Brumm, M. Bynum, J. Wrede, J. J. Millspaugh, and K. J. Paintner. 2010. Northern Great Plains Network Vital Signs Monitoring Plan. Natural Resource Report NPS/NGPN/NRR—2010/186. National Park Service, Fort Collins, CO.

FORAGE PRODUCTION, RESOURCE SELECTION, CARRYING CAPACITY AND SPATIAL OVERLAP AMONG AN UNGULATE ASSEMBLAGE IN CUSTER STATE PARK, SOUTH DAKOTA

Investigators

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Park
Dr. Chad Lehman, Custer State
Park

Project Supervisor

Dr. Joshua Millspaugh, MU

Funding

South Dakota Department of
Game, Fish and Parks
Custer State Park
Rocky Mountain Elk Foundation

Objectives

Develop spatially-explicit model to predict forage production.

Determine seasonal composition and overlap of ungulate diets.

Determine resource selection of bison and pronghorn.

Evaluate hypotheses regarding seasonal spatial overlap among ungulate assemblage.

Integrate forage production, diet selection and resource selection into automated carrying capacity model.

Location

Custer State Park, SD

Completion

July 2011

Status

Complete

Progress and Results

Custer State Park supports populations of bison (*Bison bison*), elk (*Cervus elaphus*), pronghorn (*Antilocapra americana*), mule deer (*Odocoileus hemionus*), white-tailed deer (*O. virginianus*), and bighorn sheep (*Ovis canadensis*). Park managers currently estimate carrying capacity based on untested assumptions regarding forage production, and space-use, diet composition and competition among ungulate species. We measured biomass in Custer (2005-2008) using the clipping and weighing technique. Our forage production model predicted 28,499,216 kg of palatable forage were produced in a year of average spring precipitation and date of last spring frost. We used microhistological techniques to estimate diet composition of each ungulate species. Overall, dietary overlap was high between bison and elk, pronghorn and mule deer, elk and white-tailed deer, and white-tailed deer and mule deer. We evaluated spatial overlap among 5 ungulate species in CSP and assessed how habitat features modified overlap. In general, spatial overlap was most associated with quality resources (high forage biomass and water) at the edges of habitat patches. We used spatially-explicit information of forage production, diet selection, space-use, and spatial overlap of the ungulate assemblage in CSP to develop a forage allocation model to predict carrying capacity for ungulates. Seasonal carrying capacity estimates incorporating all factors were highest during the winter (2864 ungulates), intermediate during spring (1636 ungulates) and fall (1353 ungulates), and lowest during the summer (1012 ungulates). Comparison of current stocking densities to forage production suggest utilization of many forage species may be above 25% but generally below 50%. In general, tradeoffs existed between maximizing bison and elk, elk and white-tailed deer, and pronghorn and mule deer populations. The model we produced will be most useful to examine theoretical relationships related to stocking densities and forage production, and tradeoffs in optimizing ungulate population numbers, rather than a strictly applied estimate of ungulate carrying capacities.

Products

Keller, B. J. 2011. Factors affecting spatial and temporal dynamics of an ungulate assemblage in the Black Hills, South Dakota. Dissertation, University of Missouri.

ECOLOGY AND MANAGEMENT OF REINTRODUCED ELK (*CERVUS ELAPHUS*) IN MISSOURI

Investigators

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MU
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Dr. Lonnie Hansen, MDC
Jason Summers, MDC
Ryan Houf, MDC

Project Supervisor

Dr. Joshua Millspaugh, MU

Funding

Missouri Department of
Conservation
Rocky Mountain Elk Foundation

Objectives

Evaluate resource selection and
space use of reintroduced elk in
Missouri.

Evaluate demographics of
reintroduced elk in Missouri.

Develop an aerial sightability
model to monitor abundance of the
reintroduced elk herd in Missouri.

Evaluate the population dynamics
of the Missouri elk population.

Assess how stress and disturbance
may affect elk in Missouri.

Location

Southern Missouri

Expected Completion

July 2016

Status

In Progress

Progress and Results

The Missouri Conservation Commission approved a plan to restore a wild elk (*Cervus elaphus*) population to Missouri in October 2010. Since that time, a total of 64 elk have been translocated from Kentucky to Missouri. The Missouri Department of Conservation (MDC) and the University of Missouri compiled a research and management plan for elk restoration which outlined 5 research objectives. The overall goal of this research project is to build the foundation necessary for effective management of the elk population. Every adult elk released in Missouri was fitted with a GPS-PTT radio-collar that enables us to monitor movements and habitat use of the animal. We attempted to capture all juvenile elk shortly after birth and fit each with VHF collars to monitor survival. To date, we have received over 50,000 locations via the GPS-PTT collars. Fidelity to the release site is high, 94% of locations have been within the Peck Ranch Conservation Area, and 99% of locations have been within the Elk Restoration Zone identified by MDC. Based on preliminary results, elk select areas of low slope, in close proximity to foodplots, and away from paved and public-access gravel roads, but close to roads within Peck Ranch. Calf production is comparable to other recently reintroduced populations, and was 67% in both 2011 and 2012. We are using fecal glucocorticoid metabolites as an indicator of physiological stress in the population, and comparing elk locations to hunter locations to examine the behavioral response of elk to disturbance. We found that elk responded to an increase in human disturbance on the landscape both physiologically and behaviorally, but the elk adapted well and exhibited dampened responses to subsequent disturbance events. We will continue to monitor resource use, population dynamics, and behavior of this population to help guide management as the elk population continues to grow and adapt to the Missouri landscape.

BLACK-FOOTED FERRET RESOURCE SELECTION AND BEHAVIORAL ECOLOGY

Investigators

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Research

Project Supervisor

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Funding

National Fish and Wildlife
Foundation
South Dakota Department of Game,
Fish, and Parks
U.S. Geological Survey

Cooperators

University of Missouri
U.S. Geological Survey
U.S. Fish and Wildlife Service
Prairie Wildlife Research

Objectives

Evaluate a recently developed ferret
resource utilization functions and
resource selection functions

Investigate ferret behavioral ecology

Location

Central South Dakota

Completion

May 2011

Status

Complete

Progress and Results

We have been conducting research on black-footed ferret ecology over the past 7 years. Once extirpated from the wild, despite concerted efforts to reintroduce the species, successful recovery is far from certain. To facilitate recovery, there is a need for insights into ferret behavioral patterns and habitat requirements in the wild. Findings from our work in Montana and South Dakota have shed light on fine scale ferret resource selection patterns, behavioral ecology and ethology. Collectively, these findings have helped inform managers regarding the successful monitoring and management of this critically endangered species.

Products

Eads, D.A., D.S. Jachowski, D.E. Biggins, T.M. Livieri, M.R. Matchett and J.J. Millspaugh. 2012. Resource selection models are useful in predicting distributions of black-footed ferrets in prairie dog colonies. *Western North American Naturalist: In press.*

Eads, D.A., D.S. Jachowski, J.J. Millspaugh and D.E. Biggins. 2012. Lunar and temporal influences on post-breeding spotlight surveys of adult black-footed ferrets *Mustela nigripes*. *Western North American Naturalist: In press.*

Eads, D.A., J.J. Millspaugh, D.E. Biggins, T.M. Livieri and D.S. Jachowski. 2011. Post-breeding resource selection by adult black-footed ferrets in Conata Basin, South Dakota. *Journal of Mammalogy* 92:760-770.

Jachowski, D.S., J.J. Millspaugh, D.E. Biggins, T.L. Livieri, M.R. Matchett and C.D. Rittenhouse. 2011. Resource selection by black-footed ferrets in South Dakota and Montana. *Natural Areas Journal* 31:218-225.

Eads, D.A., D.E. Biggins, J.J. Millspaugh, D.S. Jachowski and T.M. Livieri. 2011. Evaluation of a black-footed ferret resource utilization function model. *Journal of Wildlife Management* 75:1155-1163.

Jachowski, D.S., J.J. Millspaugh, D.E. Biggins, T.L. Livieri and M.R. Matchett. 2010. Home range size and the spatial organization of black-footed ferrets in South Dakota. *Wildlife Biology* 16:66-76.

EVALUATION OF BLACK-FOOTED FERRET REINTRODUCTION

Investigators

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Project Supervisor

Dr. Joshua Millspaugh, MU

Funding

University of Missouri
National Fish and Wildlife
Foundation
South Dakota Department of Game,
Fish, and Parks

Cooperators

U.S. Fish and Wildlife Service,
Wyoming Game and Fish,
Colorado Division of Wildlife

Objectives

Evaluate a recently developed ferret
resource utilization function
generated from observations of
ferrets on an adjacent colony

Develop new resource selection
functions that consider influences of
predators and resource connectivity

Location

Multiple states across western US

Completion

May 2012

Status

Complete

Progress and Results

Objective evaluations of wildlife reintroductions are vital for increasing the success of future efforts to re-establish endangered species. Attempts to reintroduce one of the most endangered mammals in North America, the black-footed ferret (*Mustela nigripes*), have been ongoing for 18 years with no quantitative assessment of factors related to reintroduction success. We examined relationships between ferret reintroduction success and factors associated with prairie dog (*Cynomys* sp.) distribution and abundance, disease outbreaks, and release strategies at 11 reintroduction sites. The most important factor related to ferret reintroduction success was a cumulative metric incorporating both size of the area occupied by prairie dogs and density of prairie dog burrows within that area. Each of the 4 successful sites had prairie dog populations that occupied an area of at least 4,300 ha. No sites with < 4,300 ha of prairie dogs were successful in maintaining ≥ 30 adult individual ferrets over multiple years without augmentation even if they had a high prairie dog burrow density. The overarching importance of the availability of high-quality habitat suggests managers should prioritize actions that maintain and enhance the availability of large areas with high prairie dog burrow density, which are becoming increasingly rare due to anthropogenic impacts and disease outbreaks.

Products

Jachowski, D.S., R. Gitzen, M.B. Grenier, B. Holmes and J.J. Millspaugh. 2011. The importance of thinking big: Large-scale prey conservation drives black-footed ferret reintroduction success. *Biological Conservation* 14:1560-1566.

PHYSIOLOGICAL AND BEHAVIORAL RESPONSE OF AFRICAN ELEPHANTS TO REINTRODUCTION

Investigators

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Dr. Rob Slotow, UKZN
Dr. Bob Montgomery, Post Doc, MU

Project Supervisor

Dr. Joshua Millsaugh, MU

Funding

National Research Foundation (South Africa)
University of KwaZulu-Natal (Amarula Elephant Research Programme)

Cooperators

University of KwaZulu-Natal
University of Missouri
iSimangaliso Wetland Park
Pilanesburg National Park Phinda Game Reserve
Mabula Game Reserve
Hluhluwe-Umfolozi Game Reserve

Objectives

Investigate causes of high stress hormone concentrations in elephants

Investigate behavioral responses to chronic stress

Investigate how elephant physiological state influences movement patterns

Location

South Africa

Completion

May 2012

Status

Complete

Progress and Results

Reintroduction of elephants is a valuable conservation tool given the ecological and economic importance of maintaining elephant populations. However, translocated elephants can exhibit destructive behavior such as the top-down altering of vegetative structure and ecosystem processes, as well as killing of rhinos and increased aggression toward or killing of humans. Managers need to know what drives elephant behavior in order to limit potential detrimental effects. We investigated the physiological and behavioral response of elephants to reintroduction in 5 different parks and reserves in South Africa. First, knowledge of the potential cues of stress in elephants could provide a better understanding of factors that put elephants on edge and how to potentially limit dangerous and destructive behaviors. Therefore, we assessed potential environmental (e.g., rainfall and temperature) and biological (e.g., size and density of elephants) factors which explain park to park differences in observed stress hormone levels. We found that the amount of time that had elapsed since release was the single most important factor, and that elephants can take up to 10 years to physiologically adjust to their new home. Second, we assessed the influence of physiological state on movement of elephants and found that when elephants are in an elevated physiological state they are less likely to leave refugia and cover. Collectively this study has provided important information to managers so that they can identify how long elephants require to physiologically adjust following reintroduction, and be able to better predict when and where areas of potential human-elephant conflict are likely to be greatest.

Products

Jachowski, D.S., R. Slotow and J.J. Millsaugh. 2012. Physiological stress and refuge behavior by African elephants. PLoS ONE 7:e31818.

PROCESSES DETERMINING THE ABUNDANCE OF TERRESTRIAL WILDLIFE COMMUNITIES ACROSS LARGE SCALES

Investigators

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Dr. William McShea, Smithsonian

Project Supervisor

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Dr. Roland Kays, NCMNS

Funding

National Science Foundation

Cooperators

University of Missouri

North Carolina Museum of Natural
Sciences (NCMNS)

Smithsonian Institute

Objectives

Standardize camera trapping protocol
for determining animal abundance

Establish a multi-scale approach for
modeling animal abundance/distribution

Design an infrastructure for citizen
science modeling

Location

Throughout East Coast of USA

Expected Completion

July 2015

Status

In progress

Progress and Results

In the dynamic 21st century providing mechanistic explanations of the local abundance and distribution of animals is of paramount importance. If the environmental conditions affecting these distributions can be determined, predictive models across vast spatial and temporal scales can be developed to assist species conservation and management initiatives. In this project we are developing a citizen science sampling and modeling program to identify the factors influencing animal abundance and distribution throughout the East Coast of the United States. The role of citizen scientists has been essential to comparable efforts to model bird communities across vast spatial scales. Our program will be based on motion-sensitive camera traps, deployed across the study area, to document species presence. The data resulting from these traps will then be used to estimate relative species abundance and distribution. In this effort we intend to sample and model greater than 60% of the terrestrial fauna in the eastern USA. Our goal will be to develop robust models predicting both abundance and distribution of the detectable terrestrial species in this region. Citizen scientists will be incorporated into all aspects of this assessment including data collection, data manipulation, and predictive modeling. We plan to compare the performance of citizen science models to those models developed by academic or government-level research initiatives. This experimental design will allow us to evaluate the contribution of local knowledge to predictive species distribution modeling. Furthermore, the monitoring program developed for this assessment will provide a template for implementation of similar programs over much larger areas. Thus, the factors influencing species abundance and distribution could be assessed at continental or even global scales.

EFFECTS OF COMMERCIAL HARVEST ON TURTLES IN THE MISSOURI RIVER

Investigators

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Dr. Robert Gitzen, Post Doc, MU
Stephanie Zimmer, M.S. student, MU

Project Supervisor

Dr. Joshua Millspaugh, MU

Funding

Missouri Department of Conservation

Objectives

To determine what level of commercial turtle harvest is sustainable

To determine the impact of commercial harvesting on the size structure, sex ratio, and fecundity of harvested turtle populations

To develop a stage-based population model from existing data and information obtained from this study that can assess alternative harvest strategies

To collect tissue from each species from each of the commercial waters' rivers and from other non-commercial waters across the state for analyses of microchemistry (isotopes) indicators in order to determine if source of origin for each species can be distinguished

Location

Missouri - Statewide

Expected Completion

August 2013

Status

In progress

Progress and Results

The effects of commercial turtle harvest practices on turtle populations are poorly understood. The purpose of this project is to determine the sustainable harvest rate for game turtle species in the Missouri River - the common snapping turtle (*Chelydra serpentina*), the spiny softshell turtle (*Apalone spinifera*), and the smooth softshell turtle (*Apalone mutica*). During the summer of 2011 and currently in 2012, using methods developed during the 2010 pilot season, we intensively trapped four sites in the Missouri River, and two sites in each of two Missouri River tributaries, the Osage and Gasconade Rivers. Because commercial harvest is illegal within the tributaries, we will compare information from those areas to areas that are open to harvest (i.e. the Missouri River). In addition to collecting basic age and size structure information, we will conduct a mark-recapture study to estimate abundance, as well as simulated harvests within the field sites that are based on methods used by one of Missouri's leading commercial turtle harvesters. A stage-based population model will be developed using demographic data collected during the field seasons and existing data found in the primary literature. This model will be used for population projections and to assess the impacts of harvest.

As turtles are potentially being commercially harvested from legal (Missouri River) and illegal (confluences and tributaries) waters in Missouri, the ability to determine the origin of collected turtles could be a useful tool in regulating the commercial trade. Nail samples will be taken from individuals inhabiting each of the 3 rivers included in this study and analyzed. Ratios of trace elements or isotopes from the nail samples will be compared to those of individuals that are captured in other watersheds to determine if watershed of origin can be distinguished for an individual specimen. Similar studies have been successfully carried out using analysis of otoliths from freshwater fish species to distinguish origin.

IMPORTANCE OF MOUNTAIN PINE BEETLE INFESTATIONS AND FIRE AS BLACK-BACKED WOODPECKER HABITAT IN THE BLACK HILLS, SOUTH DAKOTA

Investigators

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Project Supervisor

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Funding

U.S. Forest Service
South Dakota Department of Game, Fish and Parks

Cooperators

U.S. Forest Service
South Dakota Department of Game, Fish and Parks
Wind Cave National Park

Objectives

How is black-backed woodpecker space-use affected by resource distribution within a home range?

What is the relative value of habitat created by wildfire, mountain pine beetle infestation, and prescribed fire to black-backed woodpeckers?

What factors affect long-distance movement of black-backed woodpeckers?

Location

Black Hills, South Dakota

Expected Completion

May 2013

Status

In progress

Progress and Results

Wildfire and beetle infestations are naturally occurring events in most western forests, but these disturbances are often considered undesirable. However, recent and ongoing research suggests that disturbed forests provide important habitat for rare species, and prescribed burning is being tested as a management tool. The black-backed woodpecker (*Picoides arcticus*) is a disturbance-associated species of conservation concern that has recently been petitioned for listing as Threatened or Endangered under the Endangered Species Act. Effective conservation and management at multiple scales requires detailed knowledge of how the distribution of resources within a home range affects woodpecker space-use, how demographic rates differ between habitat created by wildfire, prescribed fire, and beetle infestations, and how woodpeckers move between habitats at landscape scales. We collected home range, demographic, and movement data from 234 individually marked birds year-round from April 2008 through August 2012. Our project thus represents one of the largest black-backed woodpecker datasets in existence. We will evaluate resource selection by correlating space-use within each home range with associated vegetation characteristics. We will evaluate the relative quality of habitat created by wildfire, prescribed fire, and mountain pine beetle infestations by estimating habitat-specific survival and reproductive success. Finally, we will evaluate the factors affecting large-scale movements by correlating known dispersals with factors thought to influence movements, such as breeding failure or the time since a disturbance. Our results will provide resource managers in South Dakota and beyond with information necessary for effective conservation of black-backed woodpeckers.

GREATER SAGE-GROUSE BROOD SUCCESS AND HABITAT SELECTION PRIOR TO WIND ENERGY DEVELOPMENT IN WYOMING

Investigators

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Christopher Hansen, MU

Project Supervisor

Dr. Joshua Millspaugh, MU

Funding

Power Company of Wyoming
Wyoming Game and Fish Department
U.S. Forest Service, Rocky Mountain
Research Station

Cooperators

U.S. Forest Service, Rocky Mountain
Research Station
University of Missouri
Power Company of Wyoming
Wyoming Game and Fish Department
Bureau of Land Management
SWCA Environmental Consultants
Overland Trail Cattle Company

Objectives

Evaluate sage-grouse nest site selection at multiple spatial scales.

Evaluate sage-grouse brood-rearing site selection at multiple spatial scales.

Estimate sage-grouse productivity and chick survival.

Location

Saratoga, Wyoming

Completion

May 2015

Status

In progress

Progress and Results

Greater sage-grouse (*Centrocercus urophasianus*) are highly dependent on sagebrush-dominated ecosystems. The potential effects of wind energy development on sage-grouse populations and habitat are unknown. The Power Company of Wyoming LLC (PCW) proposes to build a 1,000 turbine, 2,000 – 3,000 megawatt wind farm south of Rawlins, Wyoming on the Overland Trail Ranch, providing an ideal site to evaluate the potential impacts of wind energy development on sage-grouse. Our objective is to investigate and quantify construction and operational effects of wind energy facilities on female sage-grouse through study of survival, movements, and habitat use on the Overland Trail Ranch, using a Before-After Control-Impact design.

Approximately 50 female sage-grouse are tagged with Geographic Positioning System Passive Terminal Transmitters which collect up to 12 locations each day, and have collected >140,000 locations since spring 2010. Using the GPS data, we intensively monitor grouse movements and survival during the breeding, nesting, and brooding life-stages.

Micro-site resource selection of nesting sage-grouse is assessed by characterizing vegetation at nests and 5 random locations varying distances from the nest. We estimate sagebrush density, visual obstruction, and canopy cover of grasses, forbs, shrubs, and sagebrush at each site. These data will be used to evaluate resource selection of nesting female sage-grouse using a discrete choice model.

We assess micro-site resource selection of brooding hens by characterizing vegetation at brood sites and 3 random locations varying distances from the brood site. These data will be used to evaluate resource selection of brooding female sage-grouse using a discrete choice model. In addition to characterizing vegetation, we also estimate relative abundance of insects at each brood site and associated random sites using a gasoline-powered backpack aspirator. We will use these data to evaluate the influence of relative insect abundance on brood site selection.

Nighttime spotlighting surveys are effective for monitoring broods. We locate brooding hens using the UHF function of the transmitter and approach them on foot with hand-held spotlights to count the chicks. These counts will be used in a logistic-exposure model to estimate chick survival and brood success.

MALE GREATER SAGE-GROUSE LEK ATTENDANCE, INTERLEK MOVEMENTS, AND SIGHTABILITY IN CARBON COUNTY, WYOMING

Investigators

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Christopher Hansen, MU

Project Supervisor

Dr. Joshua Millsbaugh, MU

Funding

Power Company of Wyoming
National Wind Coordinating
Collaborative
U.S. Forest Service, Rocky Mountain
Research Station
Wyoming Game and Fish Department
National Fish and Wildlife Foundation
Bureau of Land Management
National Renewable Energy Lab

Cooperators

U.S. Forest Service, Rocky Mountain
Research Station
University of Missouri
Power Company of Wyoming
Wyoming Game and Fish Department
Bureau of Land Management
SWCA Environmental Consultants
Overland Trail Cattle Company

Objectives

Determine attendance rates per lek and per individual male.

Estimate frequencies of male sage-grouse interlek movements.

Evaluate male sage-grouse sightability and population size from lek counts.

Location

Carbon County, Wyoming

Expected Completion

May 2015

Status

In progress

Progress and Results

The impacts of wind energy developments on Greater Sage-grouse (*Centrocercus urophasianus*) are unknown, but studies with other grouse species or in oil and gas developments indicate that there may be avoidance responses to turbines, or lower populations at leks. This study is part of a larger, long-term Before-After-Control-Impact study assessing impacts of wind energy development on sage-grouse. This project is in the pre-construction phase of a 1,000 turbine wind energy development, and focuses on male breeding ground (lek) ecology.

Global Positioning System Passive Terminal Transmitters (GPS-PTT) and VHF transmitters are being placed on male sage-grouse to determine how frequently individual males attend leks, lek attendance rates per lek, and the variables that may increase or decrease attendance. Using the marked birds, we will also assess the frequency and direction of movements between leks during spring. We currently have 25 GPS-PTT transmitters and 43 VHF transmitters on males, and have collected about 35,000 locations from our GPS-PTT tagged males since spring 2011. We will increase the number of tagged males to 50 with GPS-PTT transmitters and 50 with VHF transmitters.

In addition we are evaluating sightability of male sage-grouse to determine a detection probability. During the 2012 breeding season, we collected >30 sightability observations. We will determine the detection probability using a variety of possible characteristics of each sighting event related to the environment, observer, lek, bird, light, and vegetation. The detection probability will be used with lek count data to more accurately estimate population size.

DEVELOP, MONITOR, AND EVALUATE MOURNING DOVE HARVEST MANAGEMENT OPPORTUNITIES IN AN AGROFORESTRY COMPLEX

Investigators

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Project Supervisor

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Funding

Missouri Department of Conservation
University of Missouri Center for
Agroforestry

Cooperators

Missouri Department of Conservation
U.S. Forest Service

Objectives

This project will determine how doves respond to various management practices (i.e., alternative food sources, mowing) in an agroforestry setting. Specifically, we will: (1) develop techniques for establishing and growing nut bearing and saw log trees in agroforestry plantings; (2) determine how agroforestry plantings affect mourning dove harvest rates.

Location

James A. Reed Memorial Wildlife Area,
Lee's Summit, MO

Completion

September 2011

Status

Complete

Progress and Results

Increasingly, there has been broad-scale support for improving the reliability of the information used in harvest management of mourning doves (*Zenaidura macroura*). We present estimates of recruitment and harvest mortality that includes crippling loss in Missouri's mourning dove population. We applied a ratio-based method to estimate local and statewide recruitment across 7 public hunting areas in Missouri from 2005–2011. Additionally, we estimated harvest rates and crippling rates for radio-marked doves by monitoring their fates during managed hunts on one of the areas. Data pooled statewide provided recruitment estimates of 3.1 offspring/female (± 0.3 SE) or 4.1 offspring/female (± 0.3 SE). During 2005–2008, harvest mortality of radio-marked doves was 27%, with one quarter of this mortality coming from crippled doves. Crippling rates ranged from 18–50% of harvest mortality in radio-marked doves. In comparison, hunter-reported crippling rates during 2005–2011 (14–18%) were, on average, 30% lower but more consistent than estimates from radio-marked doves. These results demonstrate crippling was a sizeable component of dove harvest.

Products

- Bonnot, T. W., Schulz, J. H., and J. J. Millspaugh. 2011. Factors affecting mourning dove harvests in Missouri. *Wildlife Society Bulletin* 35:76-84.
- Schulz, J. H., T. W. Bonnot, and J. J. Millspaugh. 2012. Harvest and crippling rates of mourning doves in Missouri. *Wildlife Society Bulletin: In press.*
- Schulz, J. H., T. W. Bonnot, T. W. Mong, and J. J. Millspaugh 2012. Statewide and local recruitment of mourning doves in Missouri. *Journal of Wildlife Management: In press.*

APPLICATION OF WILDLIFE HABITAT SUITABILITY AND VIABILITY MODELS TO EVALUATE EFFECTS OF FIRE AND ECOSYSTEM RESTORATION

Investigators

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Project Supervisor

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Funding

U.S. Forest Service

Cooperators

U.S. Forest Service
University of Missouri

Objectives

Develop new or refine existing wildlife habitat suitability models and apply them to these management scenarios involving fire and ecosystem restoration

Develop spatially explicit population models for key wildlife species and link them to the above landscape simulation models

Validate key aspects of the above models with existing or newly collected data

Location

Central Hardwoods Bird Conservation Region

Completion

September 2011

Status

Complete

Progress and Results

Efforts to conserve regional biodiversity in the face of global climate change, habitat loss and fragmentation will depend on approaches that consider population processes at multiple scales. By combining habitat and demographic modeling, landscape-based population viability models effectively relate small-scale habitat and landscape patterns to regional population viability. We demonstrate the power of landscape-based population viability models to inform conservation planning by using these models to evaluate responses of prairie warbler (*Dendroica discolor*) and wood thrush (*Hylocichla mustelina*) populations in the Central Hardwoods Bird Conservation Region to simulated conservation scenarios. We assessed the relative effectiveness of habitat restoration, afforestation, and increased survival and included different placements and levels of effort for implementing those approaches. Population projections of the two species confirmed the potential for large-scale conservation to sustain regional populations. For example, abundances of prairie warblers and wood thrush tripled under afforestation and increased survival scenarios, respectively. Furthermore, responses to conservation actions were driven by interacting local and large-scale population processes such as source-sink interactions and dispersal. Consequently, relying on randomly placed habitat conservation was ineffective and potentially counterproductive whereas strategic placements resulted in greater populations and viability of prairie warbler and wood thrush. These models offer a valuable advance in conservation planning because they allow an understanding of the effects of local actions on regional growth, which is necessary for translating regional goals into local actions.

Products

Bonnot, T. W., F. R. Thompson, III, and J. J. Millsbaugh. 2011. Extension of landscape-based population viability models to ecoregional scales for conservation planning. *Biological Conservation* 144:2041-2053.

**SURVIVAL, MOVEMENTS, AND RESOURCE SELECTION OF CAPTIVE-REARED OZARK
HELLBENDERS TRANSLOCATED TO THE NORTH FORK OF THE WHITE RIVER,
MISSOURI**

Investigators

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Project Supervisor

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Funding

Missouri Department of Conservation
Saint Louis Zoo

Cooperators

University of Missouri
Missouri Department of Conservation
Saint Louis Zoo

Objectives

To investigate the use of translocation to improve hellbender populations.

Determine survival rates of translocated hellbenders

Quantify post-release movements and space use of translocated hellbenders

Assess resources selection of translocated hellbenders

Location

Missouri

Completion

July 2011

Status

Complete

Progress and Results

We implanted 36 Ozark hellbenders (*C. a.bishopi*) that had been reared in captivity at the Saint Louis Zoo for 5.5 years with radio transmitters and translocated them to 2 sites on the North Fork of the White River, Missouri. We collected 3,635 hellbender locations between May 2008 and August 2009. At the end of our study 16 hellbenders were alive, 13 were dead and we were unable to confirm status of 7 animals. Annual survival rates for captive-reared hellbenders were 55 % higher at the lower site (0.7467), though site specific factors driving the difference were not obvious. In addition to exhibiting reduced survival rates, upper site hellbenders tended to gain less weight post release, and a greater proportion carried chytrid fungus, leech parasites and accrued injuries and open sores. We also observed site differences in post-release dispersal. While only 7 of 36 hellbenders dispersed outside of 'core habitat', mean distance between release and last observation in the study over twice as long and more variable at the upper site (318.28 m [SE 115.39]), where rock density was lower and the extent of core habitat was smaller than at the lower site (121.95 m [SE 34.13]). At both sites, daily movements of hellbenders were fewer and covered shorter distances, and home range sizes were reduced in the second season of monitoring, suggesting most hellbenders had settled at least semi-permanently in the wild. Hellbender resource selection was positively associated with presence of coarse substrate and bedrock relative to fine substrates; and with decreasing distance to nearest rock in all meso-habitats (i.e., pool, run, riffle). The negative association between increasing distance to rock and selection was intensified as benthic water velocity increased, suggesting the importance of considering substrate arrangement in future release sites. We demonstrated that captive-reared hellbenders were capable of remaining and settling in release sites, while maturing in a wild environment, for over 1 year. However, the site differences we observed in survival and dispersal of captive-reared hellbenders emphasizes the importance of selecting suitable release sites. We suggest selecting future release sites with densely arranged coarse substrate at a fine scale (e.g., within 20 m²) as well as a larger extent.

Products

- Bodinof, C. M. 2010. Translocation and conservation of hellbenders (*Cryptobranchus alleganiensis*) in Missouri. M.S. Thesis, University of Missouri.
- Bodinof, C. M., J. T. Briggler, M. C. Duncan, J. Beringer, and J. J. Millspaugh. 2011. Historic occurrence of the amphibian chytrid fungus *Batrachochytrium dendrobatidis* in hellbender *Cryptobranchus alleganiensis* populations from Missouri. *Diseases of Aquatic Organisms* 96:1-7.
- Bodinof, C. M., J. T. Briggler, R. E. Junge, J. Beringer, M. D. Wanner, C. D. Schuette, J. Ettling, and J. J. Millspaugh. 2012. Habitat attributes associated with short-term settlement of Ozark hellbender (*Cryptobranchus alleganiensis bishopi*). *Freshwater Biology* 57:178-192.
- Bodinof, C. M., J. T. Briggler, T. W. Mong, and J. J. Millspaugh. 2012. Survival and body condition of captive-reared juvenile Ozark hellbenders (*Cryptobranchus alleganiensis bishopi*) following translocation to the wild. *Copeia* 2012:150-159.
- Bodinof, C. M., J. T. Briggler, R. E. Junge, J. Beringer, M. D. Wanner, C. D. Schuette, J. Ettling, R. A. Gitzen, and J. J. Millspaugh. 2012. Post-release movements of captive-reared Ozark hellbenders. *Herpetologica* 68:160-173.

RUFFED GROUSE OCCUPANCY IN THE BLACK HILLS NATIONAL FOREST

Investigators

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Project Supervisor

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Funding

U.S. Forest Service, Rocky
Mountain Research
Station and Black Hills
National Forest
South Dakota Department of
Game, Fish, and Parks

Cooperators

U.S. Forest Service, Rocky
Mountain Research
Station and Black Hills
National Forest
South Dakota Department of
Game, Fish, and Parks
University of Missouri

Objectives

Evaluate ruffed grouse
occupancy and detection
probabilities.

Develop a monitoring
protocol for ruffed grouse.

Determine the vegetative
characteristics that affect
ruffed grouse selection of
drumming structures.

Location

Black Hills National Forest
(SD and WY)

Completion

December 2010

Status

Complete

Progress and Results

Ruffed grouse (*Bonasa umbellus*) are important game birds and the management indicator species for quaking aspen (*Populus tremuloides*) in the Black Hills National Forest (BHNF). As a result, a robust monitoring protocol which reflects the status, trends, and habitat associations of ruffed grouse is necessary. To evaluate these processes, we used ruffed grouse drumming counts combined with occupancy modeling. Ruffed grouse occupancy in the BHNF was low (0.12) and positively influenced by the amount of aspen. Detection probability was also low (0.27) and primarily influenced by date, wind speed, and time of the survey. Using occupancy and detection estimates, we evaluated multiple occupancy sampling designs to determine which design required the least effort to achieve occupancy estimates with a desired level of precision. The most efficient sampling design was the standard multi-season design with 3 repeat surveys at each site. However, site requirements using this design were high due to low ruffed grouse occupancy and detection rates in the BHNF. Thus, managers must decide how to allocate and distribute effort towards monitoring. We also addressed ruffed grouse micro-site selection of drumming sites (activity centers) to determine what structure and adjacent vegetative characteristics were correlated with selection of activity centers. Selection was driven by vegetative cover above 1 meter in height, suggesting ruffed grouse selected activity centers that provided protection from predators.

Products

Hansen, C. P., J. J. Millsbaugh, and M. A. Rumble. 2010. Monitoring ruffed grouse in the Black Hills: Protocol and user's manual for the occupancy spreadsheet program. Gen. Tech. Rep. RMRS-GTR-246WWW. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 36 p.

Hansen, C. P., J. J. Millsbaugh, and M. A. Rumble. 2011. Occupancy modeling of ruffed grouse in the Black Hills National Forest. *Journal of Wildlife Management* 75:71-77.

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MANAGING WILDLIFE IN THE FACE OF CHANGING CLIMATE

Investigators

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Project Supervisor

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Funding

U.S. Forest Service

Cooperators

U.S. Geological Survey

Objectives

What are the impacts of current land cover and climate on the abundance of focal bird species in the Midwestern United States?

What is the response of focal bird species abundance to landscape change under alternative climate and forest management scenarios focused on resilience, adaptation, and carbon sequestration to mitigate climate change effects in the Missouri Ozark Highlands?

What are the economic tradeoffs of managing forests for resilience, adaptation, carbon sequestration, and avian species through timber revenues and carbon credits in the Missouri Ozark Highlands?

Location

Midwestern United States
Missouri

Expected Completion

May 2013

Status

In progress

Progress and Results

Climate change is becoming a major concern for avian species and has the potential to compound current human-induced pressures (e.g. habitat loss and degradation) to wildlife both directly (e.g. phenology, temperature regulation and mortality) and indirectly (e.g. fire frequency and vegetation changes).

Climate projections for the Midwestern United States call for southerly climates to shift north. These shifts have the potential to alter ecosystem structure and function, affecting vegetation and avian species across North America. Currently, birds are experiencing phenological shifts on both breeding and wintering grounds potentially creating a divergence between available habitat and suitable climatic conditions for breeding birds. Using a Bayesian hierarchical framework, we will determine the impacts of current land cover and climate on the abundance of focal bird species in the Midwestern United States. We will then link these models with downscaled General Circulation Models (GCMs) and landscapes simulated in LANDIS to predict the response of forest and wildlife species to forest management focused on mitigating and adapting to the projected changes in climate for the Missouri Ozark Highlands. Currently, we have calculated landscape (at 1-km and 100-m buffered Breeding Bird Survey routes) and climate variables for four Bird Conservation Regions within the central United States. We have also run landscape and climate models under current conditions for Northern Bobwhite (*Colinus virginianus*), Blue-winged Warbler (*Vermivora cyanoptera*), Worm-eating Warbler (*Helmitheros vermivorus*) and Prairie Warbler (*Setophaga discolor*). The resulting models will allow us to evaluate the potential long-term impacts on avian abundance and conservation activities used to mitigate the negative impacts associated with a changing climate.

ADVANCEMENT OF ECOREGIONAL, LANDSCAPE-BASED POPULATION MODELS FOR USE IN CONSERVATION PLANNING IN RESPONSE TO CLIMATE CHANGE

Investigators

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Project Supervisor

Dr. Joshua Millspaugh, MU
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Funding

Gulf Coastal Plains and Ozarks LCC
U.S. Forest Service

Cooperators

U.S. Forest Service
Gulf Coastal Plains and Ozarks LCC
Central Hardwoods Joint Venture
University of Missouri

Objectives

Model responses of regional wildlife populations to landscape change

Validate model components that relate wildlife population processes to habitat and landscape patterns

Incorporate structured decision making and optimization to guide regional conservation planning.

Location

Central Hardwoods Bird Conservation Region

Expected Completion

August 2016

Status

In progress

Progress and Results

Sustaining wildlife populations in the face of global change and habitat fragmentation and loss requires conservation planning and actions at large scales. Landscape-based population models offer a valuable advance in conservation planning because they allow an understanding of the effects of local actions on regional growth, which is necessary for translating regional goals into local actions. Having demonstrated their power to inform conservation planning by evaluating responses of forest songbirds to simulated conservation scenarios, we must now adapt these models to incorporate dynamic landscapes so that the impacts of land-use and climate change can be evaluated. We will apply the models to landscapes output from coupled climate, ecosystem, and forest dynamics models to evaluate wildlife responses to such changes. Simultaneously, we will continue validating model components that relate wildlife population processes to habitat and landscape patterns. Finally, we will incorporate structured decision making and optimization to guide regional conservation planning.

DR. CHARLES NILON

COMPARATIVE ECOLOGY OF CITIES: WHAT MAKES AN URBAN BIOTA “URBAN”?

Investigators

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Dr. M. Hedblom, Swedish Agricultural
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Dr. C. Lepzyk, University of Hawaii,
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Project Supervisor / Investigators

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Funding

National Center for Ecological Analysis
and Synthesis (NCEAS)

Objectives

Compile and synthesize large, diverse
datasets of the flora and avifauna of
cities globally.

Compare the patterns and ecological
responses of birds and plants in urban
habitats.

Status

Complete

Progress and Results

The rapid urbanization of the world has profound effects on global biodiversity and urbanization has been counted among the processes contributing to the homogenization of the world's biota. However, there are few generalities of the patterns and drivers of urban biota and even fewer global comparative studies. A comparative approach of urban biota is needed to produce comparable methodologies to understand, preserve, and monitor biodiversity in cities. We propose an NCEAS working group involving researchers from cities worldwide to develop synthesis of urban ecology. We ask the overarching question: “What makes an urban biota ‘urban’?” and with that, “Are the patterns of urban biota and the processes that shape them the same across the world's cities?” We have identified several factors that may serve as filters determining species distributions. We propose a hierarchical series of filters: 1) regional scale biogeographic context, 2) metropolitan scale urban intensification, and 3) local scale socioeconomic/cultural factors.

We compiled the largest global dataset to date of bird and plant records from 147 cities. Contrary to common perceptions, we found that cities house a considerable proportion of the world's bird (20%) and plant (5%) diversity. The majority of urban bird (94%) and plant (70%) species are native. Only a small number of plants and birds are cosmopolitan, with *Columba livia* (rock pigeon, in 94%) and *Poa annua* (annual meadow grass, in 96%) being the most common. We also found that cities are not taxonomically homogenized at the global scale and tend to contain unique assemblages of species, primarily reflecting their biogeographical region. Urban species richness is predicted primarily by anthropogenic features of the city related to population size, urban landcover and intact vegetation cover. The proportion of urban non-native plants is predicted equally by both non-anthropogenic, related to climate, and anthropogenic factors suggesting their prevalence is not determined exclusively by human activities. Despite worldwide biodiversity loss, cities are not depauperate concrete jungles but can play a critical role for biodiversity conservation, restoration and community

Understand the social constraints and effects of biodiversity in cities.

Develop recommendations for monitoring biodiversity in urban areas.

Location

Santa Barbara, CA / Worldwide

Completion

January 2012

education.

ASSESSING PRAIRIE MANAGEMENT FOR GEORGE WASHINGTON CARVER NATIONAL MONUMENT

Investigators

Dr. Charles Nilon, MU
Mike Burfield, M.S. student, MU

Project Supervisor

Dr. Charles Nilon, MU
Lana Henry, NPS

Funding

National Park Service
Great Rivers Cooperative Ecosystem
Study Unit

Cooperators

George Washington Carver National
Monument

Objectives

Research data from this project will be used along with information gathered from the park/partners to form a summary of recommendations to meet integrated management objectives.

This project will integrate interpretive and cultural/natural resource management objectives, and bridge the gap between natural resource science and implementation of practical management practices.

Location

Diamond, Missouri

Completion

May 2011

Status

Complete

Progress and Results

George Washington Carver National Monument (GWCA) is a 97 ha historic site in southwest Missouri. Park managers are responsible for management of more than 90 ha of grassland and woodland. There have been several efforts to develop a long-term monitoring program to support cultural and historical interpretation programs at GWCA. Our study was a cooperative project to develop Integrated Vegetation Management Recommendations (IVMR) for GWCA that includes input from multiple agencies and stakeholders. A key aspect of the plan was the use of Habitat Suitability Index (HSI) models and presence/absence surveys for four prairie indicator species (Henslow's sparrow, ornate box turtle, northern bobwhite quail, and prairie vole) to evaluate 53 314-m² circular plots for existing prairie structure. In 2009 and 2010 we found that there were areas of mixed quality across the prairie units, and management recommendations were provided to GWCA to address limiting habitat characteristics (scores <0.50) from HSI data. Two additional products were provided for GWCA. Iwe compiled and evaluated prairie management practices since 1981 in the *George Washington Carver National Monument Prairie Restoration Management Review*. We also created a guidebook for using HSI models at GWCA, allowing park staff to prescribe applicable management techniques based on ranges of HSI scores. GWCA staff will be trained to implement an adaptive approach to management based on this project's habitat evaluation procedures.

Products

- Burfield, M.P. 2011. Integrated vegetation management recommendations for George Washington Carver National Monument. M.S. Thesis, University of Missouri, Columbia.
<https://mospace.umsystem.edu/xmlui/bitstream/handle/10355/14319/research.pdf?sequence=2>
- Burfield, M.P., and C.H. Nilon. 2011. George Washington Carver National Monument: Integrated Vegetation Management Recommendations. National Park Service, George Washington Carver National

Monument, Diamond, MO.

Burfield, M.P., and C.H. Nilon. 2011. George Washington Carver National Monument: Prairie Restoration Management Review. National Park Service, George Washington Carver National Monument, Diamond, MO.

Burfield, M.P., and C.H. Nilon. 2011. George Washington Carver National Monument: Prairie Management Guidebook Using Habitat Suitability Index Models. National Park Service, George Washington Carver National Monument, Diamond, MO.

BALTIMORE ECOSYSTEM STUDY BIRD MONITORING PROJECT

Investigators

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Dr. Paige Warren, University of
Massachusetts-Amherst

Funding

Cary Institute for Ecosystem Studies
National Science Foundation

Objectives

The BES Bird Monitoring Project is a breeding bird survey designed to find out what birds are found in the breeding season in Baltimore and where. Our monitoring efforts will show associations among block group socioeconomic variables, land cover, land use, and habitat features with breeding bird abundance, to provide information for land managers on possible consequences of land use changes on bird communities.

A distinguishing feature of the bird monitoring at BES LTER, relative to other urban bird work, is the capacity for long-term monitoring of features at multiple scales through links to other parts of the project. Different processes influence habitat for birds at different scales, e.g. ongoing household level human decision-making at lot scale vs. block or neighborhood scale abandonment/re-development. Our project seeks to understand how these processes impact bird occurrence, abundance, and composition differ at the lot, block and neighborhood scale.

Location

Baltimore, MD

Expected Completion

September 2016

Status

In progress

Progress and Results

We will continue annual monitoring of the breeding bird communities at 82 sites drawn from the 202 UFORE plots in Baltimore City and 50 sites drawn from the more intensive UFORE sampling in WS263. Co-location of bird monitoring with these plots will facilitate use of other BES data on local environmental features and household- and neighborhood-scale management by humans collected from the same sites. Previous BES research has identified at least 4 distinct urban bird communities in Baltimore, including two communities associated with distinct residential landscape types: mature trees and open-but-shrubby neighborhoods. The presence of each community type is significantly correlated with local factors such as urban tree canopy cover, management of decaying wood (e.g. dead tree branches), and horticultural decisions (e.g. amount of shrub versus lawn cover). In BES III, we will expand on this work to address whether neutral processes (extinction and colonization) are also contributing to the distribution of bird species among sites of the same community type. Through spatial analysis of long-term monitoring data, we will test whether community similarity declines with distance (regional factors dominate) versus whether community similarity increases with environmental similarity (local factors dominate). We hypothesize that for the urban bird community associated with mature tree cover, regional factors such as patch size and isolation dominate but that local factors also play a role, such as tree care practices that affect dead and decaying wood. By contrast, the urban bird community associated with shrub-dominated residential areas is expected to be more actively human-facilitated, e.g. effects of gardening, bird feeding, pet ownership. Thus, we hypothesize that for the open-but-shrubby community, environmental similarity rather than distance predicts community similarity. We will use HERCULES to identify patches of mature forest cover around bird sampling locations and street side transects to characterize dead and decaying wood. Questions on bird-related behaviors such as pet ownership, bird feeding, and gardening will be incorporated into the BES telephone survey. Sociodemographic predictors of actions that affect birds will be drawn from US Census and PRIZM datasets. Prior BES research shows that tree canopy cover is correlated with median income, but that the presence of

dead wood in live trees is not. By contrast, poverty status, race, and college education are predictors of abundance of selected bird species. This information is used to develop spatial models for bird species.

Products

Picket, S., G. Brush, A. Felson, B. McGrath, J. M. Grove, C. Nilon, K. Szlavecz, C. Swan, and P. Warren. 2012. Understanding and working with urban biodiversity: The Baltimore Ecosystem Study. *CityGreen* 4:68-77.

Pickett, S.T.A., M.L. Cadenasso, J.M. Grove, C.G. Boone, P.M. Groffman, E. Irwin, S.S. Kaushal, V. Marshall, B.P. McGrath, C.H. Nilon, R.V. Pouyat, K. Szlavecz, A. Troy, P. Warren. 2011. Urban ecological systems: Scientific foundations and a decade of progress. *Journal of Environmental Management* 92:331-362.

PLAYGROUNDS WITHOUT BORDERS: EVALUATING PLAYGROUND ENVIRONMENTAL INTERVENTIONS AMONG LOW-INCOME ELEMENTARY SCHOOLCHILDREN

Investigators

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Dr. Charles Nilon, MU
Dr. Shannon White, MU
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Project Supervisor

Dr. Stephen Sayers, MU

Funding

Robert Wood Johnson Foundation
Active Living Research

Cooperators

Columbia Public Schools

Objectives

Determine the effect of a playground environmental intervention on: a) School recess and lunch-time MVPA% (percent of available time spent engaged in MVPA). b) Total daily MVPA (minutes of available time spent in MVPA in and outside of school). c) Open space MVPA (minutes of MVPA that take place in outdoor open spaces). d) Aggregate proportion of schoolchildren who are active on school playgrounds.

Assess why children use their school and neighborhood environments as they do.

Elicit parents' and children's perceptions regarding a) intervention planning and construction processes and b) how their school and neighborhood context impacts children's response to the intervention

Location

Columbia, MO

Expected Completion

January 2013

Status

In progress

Progress and Results

Playground environmental interventions provide a prime opportunity to promote children's activity as they can reach large populations of children from all racial, ethnic and socioeconomic groups, and provide a safe environment for active play. These interventions may increase the proportion of available playtime at school in which children participate in moderate to vigorous physical activity (MVPA). Some issues remain unclear: how such interventions can be successfully tailored to benefit low-income and ethnic minority U.S. children (since most were conducted in Europe and not among minority students); whether increases in PA at school are matched by increases outside school, both temporally and spatially; whether benefits last beyond the immediate post-intervention period; and to what extent children's social and physical neighborhood environment influences their response to the intervention. We will investigate these issues by evaluating a school-based, quasi-experiment environmental intervention that seeks to increase PA by modifying school playground environments in Columbia, MO. Our overall goal is to assess when, where and to what extent school playground environmental interventions increase children's PA, and to use these results to inform local advocacy efforts to prevent obesity in low-income and minority children. We will evaluate 4 schools, 2 of which will receive the environmental intervention early (Fall 2011) and 2 late (Spring 2012). We will measure PA at baseline (Spring 2011), and every 6 months thereafter during the study.

Products

LeMaster, J., T. Matisziw, J. McElroy, C. Nilon, S. Sayers, and S. Wilhelm Stanis. 2011. Playgrounds Without Borders: Methods for a playground environmental intervention among U.S. schoolchildren. *The Internet Journal of Epidemiology* 10(1)
http://www.ispub.com/journal/the_internet_journal_of_epidemiology/volume_10_number_1_17/article/playgrounds-without-borders-methods-for-a-playground-environmental-intervention-among-u-s-schoolchildren.html

DR. FRANK THOMPSON

UNIVERSITY OF MISSOURI CONTRIBUTIONS TO NORTHEAST CLIMATE SCIENCE CENTER CONSORTIUM

Investigators

Dr. Frank Thompson III, USFS
Dr. Richard Guyette, MU
Dr. Hong He, MU
Dr. Anthony Lupo, MU
Dr. Joshua Millspaugh, MU
Dr. Craig Paukert, MU
Dr. Joanna Whittier, MU
Dr. Andre Cox, Post Doc, MU
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Project Supervisor

Dr. Frank Thompson III, USFS

Funding

U.S. Geological Survey

Cooperators

University of Massachusetts Amherst
College of Menominee Nation
Columbia University
Marine Biological Laboratory
University of Minnesota
University of Missouri
University of Wisconsin-Madison
U.S. Forest Service

Objectives

To provide scientific information, tools, and techniques that managers and other parties interested in land, water, wildlife and cultural resources can use to anticipate, monitor, and adapt to climate change in the Northeast region.

Location

Northeast United States

Expected Completion

2017

Status

In progress

Progress and Results

The Northeast Climate Consortium was formed in 2012 to host the DOI Northeast Climate Science Center and to provide USGS with resources for successfully meeting the regional needs for climate impact science assessment, education and stakeholder outreach throughout the NE region. While the center is physically located at Amherst MA, University PIs represent 7 institutions across the Northeast. In addition to the host institutions, the NECSC will include several resource management partners, including Landscape Conservation Cooperatives (LCCs) that exist, in part or whole, within the NE CSC bounds. The University of Missouri will provide expertise to the consortium to develop standardized approaches to integrate models and forecasts of both physical processes and ecological models to assess climate vulnerabilities. The diverse expertise of investigators in the University Of Missouri School Of Natural Resources will enable them to comprehensively address this goal. The general approach is to link climate models with ecosystem models and link ecosystem models with dynamic landscape models. This approach will allow us to assess vulnerabilities of fish, wildlife, and ecosystems to climate and landscape change through a scenario modeling approach. Furthermore because these approaches can be used to evaluate mitigation scenarios we will provide a wide range of resource managers with tools and information to adapt to and mitigate climate change impacts.

BIRD COMMUNITIES ACROSS A SAVANNA-WOODLAND GRADIENT

Investigators

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Jennifer Reidy, MU
Dr. Frank Thompson III, USFS
Dr. Dylan Kesler, MU

Project Supervisor

Dr. Frank Thompson III, USFS

Funding

U.S. Forest Service, Northern Research Station

Objectives

Determine how abundance of winter resident birds relates to fire history and habitat structure across savannas, woodlands, and closed canopy forests.

Determine relationships bird abundance and breeding demography (i.e. breeding density, nest success, clutch size, hatching success, fledging rate, and parasitism rate) of focal bird species to management and structure across gradient consisting of savanna, woodland, and closed canopy forest.

Location

Ozark Highlands of Missouri

Expected Completion

May 2013

Status

In progress

Progress and Results

Federal and non-government organizations have implemented large-scale restoration programs in Missouri's Ozark Highlands in an attempt to recover the habitat. Our objective is to study changes in bird communities across a gradient ranging from savannas and woodlands managed by mechanical thinning and fire, to unmanaged closed canopy forests. We are determining breeding and winter bird abundances and nesting success of focal species and relating it to habitat characteristics. Our results will provide land managers with a broad perspective of the effects of restoration on winter and breeding bird communities. To gain better understanding of how species demography varies across this habitat gradient, we are also studying in greater detail the breeding demography of the Eastern Wood-Pewee (*Contopus virens*). This bird uses a gradient of habitats, from savanna to closed canopy forest, which enables us to evaluate a range of habitat management intensities. Results will aid managers in gauging effects of habitat gradients and disturbances using fire. M.S. Student Sarah Wolken completed and defended her thesis and has two journal manuscripts in review. Jennifer Reidy is leading analyses and manuscript preparation for 2 papers that will be submitted in the next 6 months on songbird reproductive success and breeding densities across this habitat gradient.

Products

Thompson III, F. R., J. L. Reidy, S. W. Kendrick, J. A. Fitzgerald. 2012. Songbirds in managed and non-managed savannas and woodlands in the central hardwoods region. In Proceedings of the fourth annual fire in eastern oak forests conference. USDA Forest Service Northern Research Station General Technical Report: *In Press*.

Kendrick, Sarah Wolken. 2012. Winter bird densities and eastern wood-pewee breeding demography across a savanna-woodland-forest gradient in the Missouri Ozarks. M.S. Thesis

DR. JOANNA WHITTIER

DEVELOPMENT OF STREAM TEMPERATURE MODELS FOR SELECTED MISSOURI STREAMS

Investigators

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Dr. Craig Paukert, MU
Del Lobb, MDC
Dr. Steve Hostetler, Oregon State University
Dr. Bryan Pijanowski, Purdue University

Project Supervisor

Dr. Joanna Whittier, MU

Funding

Missouri Department of Conservation
CA 349

Objectives

Characterize current and future water temperature patterns for Missouri streams.

Examine the relationship between water temperature and flow rates for Missouri streams.

Location

Missouri state-wide

Expected Completion

June 2015

Status

In progress

Progress and Results

Water temperature is one of the most important drivers of ecosystem function in aquatic systems and an important indicator for impacts of natural and anthropogenic influences. Not only can water temperature affect the presence or absence of aquatic organisms, it can also influence food consumption, growth and metabolism, aquatic invertebrate composition, and food webs. Therefore, stream thermal regimes often dictate management decisions such as selection of species to stock at a given location, harvest regulations as affected by growth, and mitigation of anthropogenic disturbances affecting native species distributions. In this study, we are focusing on the influences of stream type, flow rate, and climate on stream temperature throughout Missouri. Recent research has identified three primary stream types in Missouri (intermittent, perennial/runoff dominated, and perennial/groundwater dominated) and four secondary stream types (perennial runoff - flashy, perennial runoff - moderate baseflow, perennial groundwater - stable, and perennial groundwater - super stable) that are typically in geographically-distinct subregions. We are distributing water temperature loggers across the perennial stream types where USGS gage stations currently are collecting continuous flow rate measurements and that avoid direct impacts from anthropogenic modifications. We intend to collect a minimum of two years of continuous data to develop stream temperature models and assess relationships between flow rates and water temperatures. Using the relationships established, we will incorporate projected climate and land use metrics available to us, to predict water temperatures for the stream types with empirical data. This will enable us to project future stream habitat conditions that could be utilized by land managers to focus on the potentially most impacted regions.

We have established water temperature locations from 40 sites throughout Missouri and are in the process of adding 20 sites to this dataset. This project will provide land managers with relationships between flow metrics and water temperature to aid in the evaluation of projects impacting water flow within the stream subtypes established for Missouri.

DEVELOPING STREAM TEMPERATURE AND FLOW MODELS: IDENTIFICATION OF GAPS IN THE DISTRIBUTION AND AVAILABILITY OF STREAM TEMPERATURE AND FLOW DATA

Investigators

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Dr. Craig Paukert, MU
Dr. Austin Polebitski, University of Massachusetts.
Dr. Yi-Chen Yang, University of Massachusetts.
Dr. Keith Nislow, USFS
Dr. Richard Palmer, University of Massachusetts.
Dr. Casey Brown, University of Massachusetts.
Dr. Than Hitt, USGS, Leetown
Dr. Ben Letcher, USGS, Leetown
Jana Stewart, USGS, Middleton
Dr. Jim McKenna, USGS, Great Lakes Science Center
Dr. Dana Infante, Michigan St. University
Dr. Kevin Wehrly, Michigan DNR

Project Supervisor at MU

Dr. Joanna Whittier, MU

Funding

Northeast Climate Science Center
Great Rivers Cooperative Ecosystem Studies Unit

Objectives

Gather local, State, and Federal stream temperature data within upper Midwest and Northeast by leveraging existing relationships with state agencies, consortia members, the LCC's, USFWS, USGS, USFS, and EPA.

Evaluate the ability of multiple models to replicate stream temperature at a fine-grained spatial scale and the ability of the models to scale to larger regional contexts.

Location

Upper Midwest and Northeast U.S.

Completion

September 2013

Status

In progress

Progress and Results

Stream temperature has a direct and indirect effect on many biological, physical, and chemical processes in the freshwater environment. For example, metabolic rates of most stream organisms are controlled directly by temperature. Feeding and breeding behaviors are altered when temperature changes, resulting in divergent preferences for habitat for cool-water and warm-water species. Conservation and management decisions regarding aquatic systems face new challenges as future temperatures are projected to rise markedly and flow timing is projected to shift for many watersheds under climate change impacts.

A critical and timely research question is: “*What data and modeling frameworks are needed to provide scientists reliable, climate-informed, water temperature estimates for freshwater ecosystems that can assist watershed management decision making?*” This project will answer this through two primary activities: 1) a monitoring campaign that consists of gathering existing stream temperature data within the Upper Midwest-Northeast region (Fig. 1) and deploys data loggers where additional data are needed, and 2) an intercomparison of state-of-the-art statistical and deterministic stream temperature models that evaluates their ability to replicate point stream temperature measurements as well as model scalability to non-gaged sites.

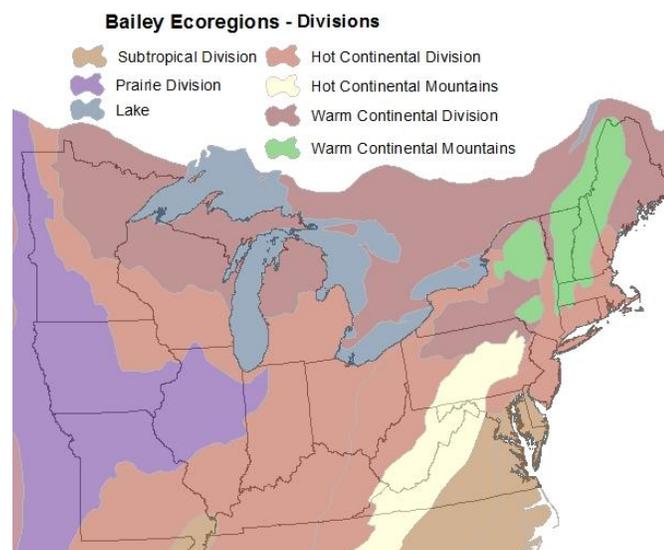


Fig. 1. States comprising the study area for this project.

PEER REVIEWED AND TECHNICAL PUBLICATIONS



PUBLICATIONS BY UNIT SCIENTISTS AND STUDENTS

* Denotes Graduate Student or Post doc

** Denotes Undergraduate Student

Books and Book Chapters

- Hanlon, R. T., K. Buresch, H. Moustahfid, and *M.D. Staudinger. *In press*. *Doryteuthis pealeii*, Longfin inshore squid. *In*: Rosa, R., Pierce, G., and R. O'Dor (eds) *Advances in Squid Biology, Ecology, and Fisheries*. Nova Science Publishers, Inc. Hauppauge, NY.
- Paukert, C. P. and D. L. Galat. 2010. Warmwater rivers. Pages 699-736 in W. Hubert and M. Quist (editors). *Inland fisheries management*. American Fisheries Society, Bethesda, MD.
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Peer Reviewed Journal Articles

- *Bouska, W. W., and C. P. Paukert. 2010. Effects of visible implant elastomer mark color on the predation of red shiners by largemouth bass. *Fisheries Management and Ecology* 17:294-296.
- *Bouska, W. W., and C. P. Paukert. 2010. Road crossing designs and their impact on fish assemblages of Great Plains streams. *Transactions of the American Fisheries Society* 139:214-222.
- *Bouska, W. W., T. Keane, and C. P. Paukert. 2010. The effects of road crossing design on geomorphology and classification of prairie streams. *Journal of Freshwater Ecology* 25:499-506.
- Cooke, S., C. Paukert, and Z. Hogan. 2012. Endangered river fish: Factors hindering conservation and restoration. *Endangered Species Research* 17:179-191.
- DiStefano, R. and *J. Westhoff. 2011. Range expansion by an invasive crayfish and subsequent range contraction of imperiled endemic crayfish in Missouri (USA) Ozarks streams. *Freshwater Crayfish* 18:37-44.
- *Eitzmann, J. L., and C. P. Paukert. 2010. Longitudinal differences in habitat complexity and fish assemblage structure of a Great Plains River. *American Midland Naturalist* 163:14-32
- *Eitzmann, J. L., and C. P. Paukert. 2010. Urbanization in a Great Plains river: effects on fishes and food webs. *River Research and Applications* 26:948-959.
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- *Jeffress, M., C. Paukert, B. Sandercock, and P. Gipson. 2011. Factors affecting the detectability of river otters during sign surveys. *Journal of Wildlife Management* 75:144-150.
- *Jeffress, M., C. Paukert, J. Whittier, B. Sandercock, and P. Gipson. 2011. Scale-dependent factors affecting North American river otter distribution in the Midwest. *American Midland Naturalist* 166:177-193.
- * Klymus, K., S.C. Humfeld, V.T. Marshal, D. Canatella, and H.C. Gerhardt. 2010. Molecular patterns of differentiation in canyon treefrogs (*Hyla arenicolor*): evidence for introgressive hybridization with the Arizona treefrog (*Hyla wrightorum*) and correlations with advertisement call differences. *Journal of Evolutionary Biology*. 23 (7): 1425-1435.

- *Klymus, K., Humfeld, S. C., and H. C. Gerhardt. 2012. Geographic variation in male advertisement calls and female preference of the wide-ranging canyon treefrog, *Hyla arenicolor*. *Biological Journal of the Linnean Society: In Press*.
- *Klymus, K. E., and H. C. Gerhardt. 2012. AFLP markers resolve intra-specific relationships and infer genetic structure among lineages of the canyon treefrog, *Hyla arenicolor*. *Molecular Phylogenetics and Evolution: In Press*.
- Paukert, C., *K. Pitts, J. Whittier, and J. Olden. 2011. Development and assessment of a landscape-level ecological threat index of the Lower Colorado River Basin. *Ecological Indicators* 11:304-310.
- *Pease, A., A. Gonzáles Díaz, R. Rodiles Hernández, and K. Winemiller. 2012. Functional diversity and trait-environment relationships of stream fish assemblages in a large tropical catchment. *Freshwater Biology* 57:1060-1075.
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- *Reeves, K. S. and D. L. Galat. 2010. Do larval fishes exhibit diel drift patterns in a large, turbid river? *Journal of Applied Ichthyology*. 26:571-577.
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Technical and Popular Publications

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- *Bonnot, T. W., J. H. Schulz, R. Bredesen, and J. J. Millspaugh. 2011. Mourning dove demographics and harvest management in an agroforestry complex. Final report submitted to webless migratory

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- *Burfield, M.P., and C.H. Nilon. 2011. George Washington Carver National Monument: Integrated Vegetation Management Recommendations. National Park Service, George Washington Carver National Monument, Diamond, MO.
- *Burfield, M.P., and C.H. Nilon. 2011. George Washington Carver National Monument: Prairie Restoration Management Review. National Park Service, George Washington Carver National Monument, Diamond, MO.
- *Burfield, M.P., and C.H. Nilon. 2011. George Washington Carver National Monument: Prairie Management Guidebook Using Habitat Suitability Index Models. National Park Service, George Washington Carver National Monument, Diamond, MO.
- *Cunningham, J. A., Kesler, D. C., and R. B. Lanctot. 2011. Nest-site selection in North Slope shorebirds: Relative impact of ecological and behavioral factors. Summary printed in Alaska Shorebird Group's 'Ongoing or new studies of Alaska shorebirds annual summary compilation'.
- Esley, J., R.A. Pierce II and E. Flinn. 2012. Managing for white-tailed deer in Missouri: Establishing a wildlife management cooperative. MU Extension Guide G9490. 5pp.
- Flinn, E., R.A. Pierce II and J. Sumners. 2012. Potential diseases and parasites of white-tailed deer in Missouri. MU Extension Guide G9489. 4pp.
- Flinn, E., R.A. Pierce II and J. Sumners. 2012. Estimating deer populations on your property: implications for management. MU Extension Guide G9488. 6pp.
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- *Hansen, C P., M. A. Rumble, J. J. Millspaugh. 2010. Monitoring ruffed grouse in the Black Hills: Protocol and user's manual for the occupancy spreadsheet program. General Technical Report RMRS-GTR-246WWW. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. Fort Collins, CO, USA. 36 pages.
- Hicks, C.E. and R.A. Pierce II. 2012. Converting unused agriculture facilities for aquaculture use: swine barn conversion for fish culture. MU Extension and Lincoln University Fisheries and Aquaculture Guide Series G9472. 8pp.
- Hicks, C.E. and R.A. Pierce II. 2012. Bluegill sunfish production in Missouri. MU Extension and Lincoln University Fisheries and Aquaculture Guide Series G9473. 10pp.
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- Kesler, D.C. 2012. Tools for managing Missouri's Greater Prairie Chicken Populations: Phase 1, assessing foundational demography and movement. Final report submitted to Missouri Department of Conservation, Jefferson City, MO.
- Kesler, D. C. 2010. Data summary for 2010 biological monitoring on Wake Island. Technical report submitted to United States Air Force, Hickam Air Force Base, Hawaii.

- Kesler, D. C., and J. A. Cunningham. 2012. Development and testing of predictive nest site selection models for shorebirds breeding in Barrow, Alaska. Progress report submitted to U. S. Fish and Wildlife Service, Anchorage, AK.
- Kesler, D.C.,* R.A. Stanton, and F.R. Thompson III. 2012. Potential for species translocation in response to climate change and habitat restoration: brown-headed nuthatch in the Missouri Ozarks- 2011 Progress Report. United States Forest Service. Saint Paul, Minnesota.
- McGowan, C. P., D. C. Kesler, and M. R. Ryan. 2011. Endangered species management. Network of Conservation Educators and Practitioners available online.
http://ncep.amnh.org/index.php?globalnav=resourcesandsectionnav=modulesandsectionsnav=module_filesandmodule_id=245 .
- Millsbaugh, J. J., D. C. Kesler, R. W. Kays, *R. A. Gitzen, J. H. Schulz, J. L. Belant, *C. T. Rota, *B. J. Keller, and *C. M. Bodinof. 2011. Wildlife radiotracking. ENVIS Bulletin on Telemetry in Wildlife Science. Wildlife Institute of India.
- Moorman, B., R.A. Pierce II and E. Flinn. 2012. Managing for white-tailed deer in Missouri: setting and accomplishing management goals. MU Extension Guide G9491. 6pp.
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- North American Bird Conservation Initiative, US. Committee, 2011. The state of the birds 2011 report on public lands and waters. Washington, DC: U.S. Department of Interior. 48 p. . (F. R. Thompson III was a contributor).
- Reinbott, T. and R.A. Pierce II. 2011. Demonstration and management of biofuel crops for biomass, forage and wildlife habitat. 2010 USDA NRCS Conservation Innovation Grant Annual Report. 8pp.
- Reinbott, T and R.A. Pierce II. 2010. Demonstration of farm profitability utilizing management techniques that promote soil, water and wildlife conservation practices. USDA NRCS Conservation Innovation Grant Final Technical Report. 36pp.
- Pierce, R.A. II, T. Reinbott, R. Wright, B. White and L. Potter. 2012. Establishing and managing early-successional habitats for wildlife on agricultural lands: a case study featuring habitat practices designed to benefit bobwhite quail conducted at the MU Bradford Research Center. MU Extension Miscellaneous Publication 907. 20pp. *In Press*
- Pierce, R.A. II. 2012. Controlling rats. MU Extension Guide G9446. 6pp.
- Pierce, R.A. II, and C. Hicks. 2012. Managing Missouri fish ponds during an extended drought. MU Extension Guide G9401. 4pp.
- Pierce, R.A. II, E. Flinn and B. Vandeloecht. 2011. Nutritional requirements of white-tailed deer in Missouri. MU Extension Guide G9487. 6pp.
- Pierce, R.A. II, J. Sumners and E. Flinn. 2011. Aging a deer by examining its jawbone. MU Extension Guide G9484. 4pp.
- Pierce, R.A. II, J. Sumners and E. Flinn. 2011. Estimating deer populations on your property: collecting harvest data. MU Extension Guide G9483. 4pp.
- Pierce, R.A. II, J. Sumners and E. Flinn. 2011. Estimating deer populations on your property: gathering observational data. MU Extension Guide G9482. 4pp.
- Pierce, R.A. II, J. Sumners and E. Flinn. 2011. Estimating deer populations on your property: conducting a camera survey. MU Extension Guide G9481. 4pp.

- Pierce, R.A. II, J. Sumners and E. Flinn. 2011. Implementing quality deer management on your property. MU Extension Guide G9480. 8pp.
- Pierce, R.A. II, J. Sumners and E. Flinn. 2011. Ecology and management of white-tailed deer in Missouri. MU Extension Guide G9479. 8pp.
- Pierce, R.A. II, and R. Hinnah. 2011. Controlling nuisance woodpeckers. MU Extension Guide G9449. 4pp.
- Pierce, R.A. II, R. Martensen and S. Swafford. 2011. Solving wildlife damage problems in Missouri. MU Extension Guide G9425. 6pp.
- Pierce, R.A. II. 2011. Nest boxes for wildlife. MU Extension Guide G9413. 4pp.
- Pierce, R. A. II, and K. McGrath. 2010 (Revised 2011). Controlling nuisance pigeons. MU Extension Guide G9448. 6pp.
- Pierce, R.A. II. 2011. Controlling nuisance muskrats in Missouri ponds and lakes. MU Extension Guide G9400. 2pp.
- Pierce, R.A. II, and S. Hime. 2011. Missouri Master Naturalist Annual Accomplishment Report. MU Extension and Missouri Department of Conservation. 21pp.
- Pierce, R.A. II, and S. Hime. 2010. Missouri Master Naturalist Annual Accomplishment Report. MU Extension and Missouri Department of Conservation. 25pp.
- *Rota, C.T., D.C. Kesler, C.P. Lehman, M.A. Rumble, and J.J. Millsbaugh. 2012. The importance of wildfire and mountain pine beetle infestations as Black-backed Woodpecker habitat. Final Report to the South Dakota Department of Game, Fish, and Parks.
- *Rota, C. T. 2011. Solar energy and a diversified energy future. Missouri Wildlife 72: 5-6.
- *Stanton, R., D.C. Kesler, and F.R. Thompson III. 2012. Assessing the Potential for Brown-headed Nuthatch Reintroduction in Missouri: Habitat Selection at Multiple Spatial Scales—Report on 2011 Graduate Research Scholarship. Bluebird 79:45-47.
- Thompson III, F. R.,* J. L. Reidy, S. W. Kendrick, J. A. Fitzgerald. 2012. Songbirds in managed and non-managed savannas and woodlands in the central hardwoods region. In Proceedings of the fourth annual fire in eastern oak forests conference. USDA Forest Service Northern Research Station General Technical Report: *In Press*.
- Thompson III, F. R., J. L. Reidy, S. W. Kendrick, J. A. Fitzgerald. 2012. Songbirds in managed and non-managed savannas and woodlands in the central hardwoods region. In Proceedings of the fourth annual fire in eastern oak forests conference. USDA Forest Service Northern Research Station General Technical Report: *In Press*.

ORAL AND POSTER PRESENTATIONS



PRESENTATIONS BY UNIT SCIENTISTS AND STUDENTS

* Denotes Graduate Student or Post doc

** Denotes Undergraduate Student

- **Anglin, D., *L. Pierce, and R. Hayward. 2012. Knowledge vs. habit: can angler's behavior be changed? Lessons learned from a class project. Midwest Student Fisheries Colloquium, Champaign-Urbana, IL.
- Blanchard, P, D. Lobb, and E. Tracy-Smith. 2011. Preliminary evaluation of the hydroecological integrity assessment process for Missouri streams. Instream Flow Conference, Nashville, TN.
- Boesch, D., D. Galat, L. Scarlett, R. Twilley. 2011. Establishing successful science/policy linkages. 4th National Conference on Ecosystem Restoration, Baltimore, MD (Invited panel member).
- *Buckler, J., J. Candrl, M. McKee, D. Papoulias, D. Tillitt, and D. Galat. 2011. Poster. Persistent organic pollutant effects on shovelnose sturgeon reproduction and early life stages. Society of Environmental Toxicology and Chemistry Annual Meeting, Boston, MA.
- Daniels, M.D., *J. Fischer, *J. Gerken J. K. Costigan and C. Paukert. 2011. Using hydroacoustic technology to assess the impacts of in-channel dredging on hydraulic habitat conditions in the Kansas River. USGS National Surface Water Conference, Tampa, FL.
- Daniels, M. K., *J. Fischer, K. Costigan, *J. Gerken, and C. Paukert. 2011. Making sense of an intensively modified sediment regime: measuring the relative impact of in-channel dredging amidst reservoir trapping and network-scale incision in the Kansas River basin. International Symposium on the Interactions Between Sediment and Water. Dartington, England.
- Davenport, S., *E. Pherigo, C. Vishy, K. Chojnacki, D. Papoulias, A. Delonay, and C. Paukert. 2011. Use of the Osage River by telemetry tagged pallid sturgeon. Midwest Fish and Wildlife Conference, Des Moines, IA.
- *Dinges, A., E. Webb, and M. Vrtiska. 2012. Effects of the Light Goose Conservation Order on Dabbling Duck Behavior and Distribution in the Rainwater Basin of Nebraska Rainwater Basin. 17th Annual Informational Seminar, Hastings, NE.
- *Dinges, A., E. Webb, and M. Vrtiska. 2011. Effects of the Light Goose Conservation Order on Waterfowl Behavior and Distribution in the Rainwater Basin of Nebraska. Midwest Fish and Wildlife Conference, Des Moines, IA.
- *Faulkner, J., and C. Paukert. 2011. Effects of season on microhabitat selection by Niangua Darters. Missouri Natural Resources Conference, Osage Beach, MO.
- *Faulkner, J., and C. Paukert. 2011. Seasonal microhabitat selection of Niangua Darters. Midwest Fish and Wildlife Conference, Des Moines, IA.
- *Fischer, J. *J. Gerken, C. Paukert, and M. Daniels. 2011. Habitat and fish community response to sand dredging in a large Great Plains river. American Fisheries Society Annual Meeting, Seattle, WA.
- *Fischer, J., *J. Gerken, C. Paukert, and M. Daniels. 2011. Habitat and fish community response to sand dredging in a large Great Plains river. Midwest Fish and Wildlife Conference, Des Moines, IA.
- *Fischer, J., C. Paukert, *J. Gerken, and M. Daniels. 2010. Fish community response to habitat alteration: impacts of sand dredging in the Kansas River. Midwest Fish and Wildlife Conference, St. Paul, MN.
- *Fischer, J., C. Paukert, *J. Gerken, and M. Daniels. 2011. Influence of sand dredging on fish communities in the Kansas River. Kansas Natural Resources Conference, Wichita, KS.

- *Fischer, J., C. Paukert, M. Daniels. 2012. Influence of in-stream and watershed alterations on sandbars and islands in the Kansas River. Kansas Natural Resources Conference, Wichita, KS.
- *Fore, J. D., S. P. Sowa, G. M. Annis, D. D. Diamond, D. L. Galat, and C. Rewa. 2011. Assessing NRCS conservation practice effectiveness using stream fishes. Annual Meeting of the Soil and Water Conservation Society, Washington D.C.
- *Fore, J. D., S. P. Sowa, G. M. Annis, D. D. Diamond, D. L. Galat, and C. Rewa. 2011. An initial assessment of NRCS conservation practices effects on stream fishes. Annual Meeting of the American Fisheries Society, Seattle, WA.
- *Fore, J. D., S. P. Sowa, G. M. Annis, D. D. Diamond, D. L. Galat, and C. Rewa. September 2011. Poster. An initial assessment of NRCS conservation practices effects on stream fishes. Annual Meeting of the American Fisheries Society, Seattle, WA.
- *Fore, J. D., S. P. Sowa, G. M. Annis, D. D. Diamond, D. L. Galat, and C. Rewa. 2011. An assessment of the effects of human threats and agricultural BMPs on stream fishes. Midwest Fish and Wildlife Conference, Des Moines, IA.
- Galat, D. L., and D. Schorr. 2010. The ecology and economy of America's longest river and the larger basin. The National Judicial College, Dividing the Waters National Education Conference: The Impact of Water Adjudication along America's Longest River, St. Louis, MO.
- Galat, D. L. March 2011. Endangered species recovery, politics, and policies of Missouri River management. Invited Plenary Panel address. Missouri River Natural Resources Conference, Nebraska City, NE.
- Galat, D. L., B. L. Johnson, and C. Smith. 2011. Applying adaptive management to restoring Mississippi river basin large rivers. International Conference on the Status and Future of the World's Large Rivers, Vienna, Austria.
- Galat, D. L., M. Reuter, and D. Rudin. 2011. Great rivers for people and nature. International Conference on the Status and Future of the World's Large Rivers, Vienna, Austria.
- Galat, D. L. 2011. Adaptive management and the Missouri River spring rise. Missouri River Recovery Program, Independent Science Advisory Panel, Kansas City, MO.
- Galat, D. L., D. Baratta, G. Benjamin, D. Blodgett, S. Davis, D. DeGeus, S. Haase, S. McMahon, M. Reuter, D. Rudin, T. Strole, and Y. Yin. 2011. Great rivers for people and nature. 4th National Conference on Ecosystem Restoration, Baltimore, MD.
- Galat, D. L., T. Strole, M. Reuter, and J. Higgins. 2011. Identifying globally "great" rivers for integrated river basin management. 2nd Biennial Symposium of the International Society for River Science, Berlin, Germany.
- Galat, D. L. Integrating adaptive management into Integrated River Basin Management. 2011. River Symposium. Invited Special Session: Advancing Integrated River Basin Management, Science and Policy for Healthy River Basins. Brisbane, Australia.
- Galat, D. L. Great rivers that work for people and nature. 2011. World Rivers in the 21st Century, Workshop sponsored by the IGERT Program in Watershed Science and Policy, Southern Illinois University-Carbondale, IL. (Invited speaker and member of discussion panel).
- Galat, D. L. 2012. 75 years of Missouri River conservation: From Pick-Sloan to the Missouri River Recovery Program. Missouri Natural Resources Conference, Osage Beach, MO.
- *Gerken, J., and C. Paukert. 2010. Floods and fishes: examining the role of high flows on fish and invertebrates in a large Great Plains River. Midwest Fish and Wildlife Conference, St. Paul, MN.

- *Gerken, J., and C. Paukert. 2011. Age-specific demography of silver carp: implications for management and control. American Fisheries Society Annual Meeting, Seattle, WA.
- *Gerken, J., and C. Paukert. 2011. Can silver carp be controlled? Population level response to various management regimes. Midwest Fish and Wildlife Conference, Des Moines, IA.
- *Gerken, J., and C. Paukert. 2011. The importance of high flows and floodplain inundation for fish and invertebrates of the Kansas River. Kansas Natural Resources Conference, Wichita, KS.
- Grimm, N., Chapin, T., Carter, S., Groffman, P., *Staudinger, M., and A. Staudt. 2012. Current and future impacts of climate and global change on biodiversity and the structure and functioning of ecosystems. Ecological Society of America Annual Meeting, Portland, OR.
- *Harris, J., C. Paukert, S. Bush, M. Allen, and M. Siepker. 2011. Movement and habitat selection of largemouth bass related to supplemental habitat structure in Table Rock Lake, Missouri. Midwest Fish and Wildlife Conference, Des Moines, IA.
- *Harris, J., C. Paukert, S. Bush, M. Allen, and M. Siepker. 2011. Movement and habitat selection of largemouth bass in Table Rock Lake. Missouri-Arkansas White River Fisheries Partnership Meeting, Yellville, AR.
- *Harris, J., C. Paukert, S. Bush, M. Allen, and M. Siepker. 2012. Movement and habitat selection of largemouth bass in Table Rock Lake, Missouri. Missouri Natural Resources Conference, Osage Beach, MO.
- Healy, B., E. Omana-Smith, *J. Spurgeon, D. Whiting, and C. Paukert. 2011. Humpback chub translocations to Grand Canyon tributaries: preliminary results. 11th Biennial Conference of Research on the Colorado Plateau, Flagstaff, AZ.
- Jacobson, R.J., and D. L. Galat. 2011. Got Mud? The science and policy of Missouri River sediment. Missouri River Relief, Big Muddy Speaker Series, Rocheport, MO.
- Jacobson, R. D. L. Galat, and C. B. Smith. 2010. Science roles and interactions in adaptive management of large river restoration projects, Midwest United States. Applying River and Watershed Research to Facilitate Management and Guide Policy. American Geophysical Union, Fall Meeting, San Francisco, CA.
- Kaemingk, M., J. Jolley, C. Paukert, D. Willis, R. Holland, G. Wanner, and M. Lindvall. 2012. Do common carp deserve their bad reputation? Nebraska Chapter of the American Fisheries Society Annual Meeting, Gretna, NE.
- Kaemingk, M., J. Jolley, C. Paukert, R. Holland, M. Lindvall, and D. Willis. 2011. The role of common carp and their effects on fishes, invertebrates, and water quality in shallow lakes. Midwest Fish and Wildlife Conference, Des Moines, IA.
- *Klymus, K., S. Humfeld, V. Marshall, and H. Gerhardt. 2011. Behavioral differentiation within a possible cryptic species complex, the canyon treefrog, *Hyla arenicolor*. Animal Behavior Society, Bloomington, IN.
- *Klymus, K., and H. Gerhardt. 2011. Using AFLPs to explore intra-specific and inter-specific divergences in the canyon treefrog, *Hyla arenicolor*, and related species. Evolution Conference, Norman, OK.
- Koske, A. K., *M. D. Staudinger, and F. Juanes. 2011. Heavy metal food chain: relating diet and mercury bioaccumulation of top pelagic predators in the Northwest Atlantic. American Fisheries Society. Seattle, WA.
- *Lallaman, J., and D. L. Galat. 2010. Modeling physical factors to predict upstream paddlefish passage over a low-head lock and dam. Midwest Fish and Wildlife Conference, Minneapolis, MN.

- *Masagounder, K., D. Chapman, and C. Paukert. 2011. Validation of bioenergetics model for bighead and silver Carps. Midwest Fish and Wildlife Conference, Des Moines, IA.
- **Moore, M., *L. Pierce, and C. Paukert. 2012. Correlations of human activity with non-native fish species in North America at two spatial scales. Midwest Student Fisheries Colloquium, Champaign-Urbana, IL.
- *Neuswanger, J., N. Hughes, M. Wipfli, and A. Rosenberger. 2012. Territoriality and shadow competition in Chinook salmon in the Chena River, Alaska. American Fisheries Society Annual Meeting, Minneapolis, MN.
- *Olmstead, V. and E. Webb. 2010. Evaluation of management strategies on moist-soil seed distribution on Wetland Reserve Program Sites in the Mississippi Alluvial Valley. International Society of Wetland Scientists Meeting, Salt Lake City, UT.
- *Olmstead, V. and E. Webb. 2010. Evaluation of management strategies on moist-soil seed production on WRP sites. Wildlife Habitat Restoration on Private Lands Conference, Little Rock, AR.
- Paukert, C. 2011. Rivers and stream research at the Missouri Cooperative Fish and Wildlife Research Unit. Missouri Chapter of the American Fisheries Society Rivers and Streams Technical Committee, Jefferson City, MO.
- Paukert, C. Some like it hot: quantifying fish habitat in a changing climate. 2011. Annual Meeting of the Texas Cooperative Fish and Wildlife Research Unit, Athens, TX.
- Paukert, C. 2012. Rivers and streams funding from USGS. Missouri Chapter of the American Fisheries Society Rivers and Streams Technical Committee, Jefferson City, MO.
- Paukert, C. and *J. Gerken. 2010. The Importance of secondary channels to main channel fishes in the Kansas River. Big River Confab, Jefferson City, MO.
- Paukert, C., *J. Spurgeon, D. Whiting, E. Omana, and B. Healy. 2012. Evaluations of humpback chub translocations in Shinumo Creek with insights from food web dynamics from Bright Angel Creek. Glen Canyon Dam Adaptive Management Program Technical Working Group Meeting, Phoenix, AZ.
- Paukert, C., and *A. Pease. 2012. Effects of a warming climate on growth and consumption of smallmouth bass across a latitudinal gradient. 6th World Fisheries Congress, Edinburgh, Scotland.
- *Pease, A. and C. Paukert. 2011. Potential impacts of climate change on growth and performance of stream dwelling smallmouth bass populations in the central U.S. Midwest Fish and Wildlife Conference, Des Moines, IA.
- *Pease, A. 2011. Functional trait diversity and trait-environment relationships in Central Texas stream fish assemblages: implications for biomonitoring. Annual Meeting of the Ecological Society of America, Austin, TX.
- *Pease, A. 2012. Impacts of environmental change on the functional structure and diversity of stream fish communities. Department of Natural Resources Management, Texas Tech University, Lubbock, TX.
- *Pease, A. Influences of environmental change on the functional structure of stream fish communities. Biology Departmental Seminar, Stephen F. Austin State University, Nacogdoches, TX.
- *Pease, A. 2012. Impacts of environmental change on the functional structure and diversity of stream fish communities. School of Agricultural, Forest and Environmental Sciences, Clemson University, Clemson, SC.

- *Pease, A., and C. Paukert. 2011. Potential effects of climate change on growth of smallmouth bass in streams of the central U.S. American Fisheries Society Annual Meeting, Seattle, WA.
- *Pierce, L., C. Paukert, and J. Whittier. 2011. The effects of abiotic and biotic factors on native and nonnative fish species diversity in headwater streams. Midwest Fish and Wildlife Conference, Des Moines, IA.
- *Pierce, L., B. Graeb, and J. Sorensen. 2010. Stocking success of paddlefish in Lake Francis Case, South Dakota: population assessment and sport fishery potential. Midwest Fish and Wildlife Conference, Minneapolis, MN.
- Rosenberger, A. Landscape ecology of Alaska fishes. Guest Presentation for the Missouri Department of Conservation, Columbia, MO.
- *Spurgeon, J., C. Paukert, B. Healy, and D. Whiting. 2011. Beyond stocking: using population modeling to increase translocation success. Midwest Fish and Wildlife Conference, Des Moines, IA.
- *Spurgeon, J., C. Paukert, J. Whittier, and B. Healy. 2010. Translocation success of humpback chub into Shinumo Creek: implications for future management actions. Midwest Fish and Wildlife Conference, St. Paul, MN.
- *Spurgeon, J., C. Paukert, J. Whittier, and B. Healy. 2011. Translocation success of humpback chub into Shinumo Creek: implications for future management actions. Arizona/New Mexico American Fisheries Society Meeting, Pinetop, AZ.
- *Spurgeon, J., D. Whiting, C. Paukert, and B. Healy. 2011. Trophic structure of fish communities in Grand Canyon National Park tributary streams. American Fisheries Society Annual Meeting, Seattle, WA.
- *Staudinger, M. D. 2011. Challenges to collecting diet data from fish landed at recreational fishing tournaments. Tuna Conference, Lake Arrowhead, CA.
- *Staudinger, M. D. 2011. Predation on early juvenile fishes and cephalopods by large pelagic predators. Annual Larval Fish Conference, Wilmington, NC.
- *Staudinger, M. D., A. K. Koske, F. Juanes, and F. Scharf. 2011. Trophic ecology of pelagic predators in the South Atlantic Bight determined from stable isotope analysis. Tidewater Chapter of the American Fisheries Society, Gloucester Point, NC.
- *Staudinger, M. D., A. K. Koske, *B. Salmon, M. Bell, F. Juanes, and F. S. Scharf. 2011. Trophic ecology of apex predators in pelagic food-webs determined from food habits and stable isotope analyses. American Fisheries Society, Seattle, WA.
- *Staudinger, M. D., R. McAlarney, A. D. Pabst, and W. A. McLellan. 2011. The feeding ecology of the pygmy sperm whale (*Kogia sp.*) inferred from diet and stable isotope analyses. Southeast and Mid-Atlantic Marine Mammal Symposium, Wilmington, NC.
- *Staudinger, M.D. 2012. Impacts of global change on biodiversity, ecosystem processes, and ecosystem services in the United States. University of Missouri, Department of Fisheries and Wildlife Sciences, Columbia, MO.
- *Staudinger, M.D. 2012. Climate change impacts on biodiversity, ecosystems, and ecosystem services. Developing a federal response to the PCAST Report on Sustaining Environmental Capital, Inter-Federal Agency Workshop, Washington DC.
- *Staudinger, M.D. 2012. Size-based predation on shortfin squid (*Illex illecebrosus*) in the Northwest Atlantic Ocean. American Malacological Society, Philadelphia, PA.

- *Staudinger, M.D. 2012. The trophic role of cephalopods in Northwest Atlantic Ocean food-webs: implications for fisheries and climate change. Gulf Coast Research Laboratory, MS.
- *Tapp, J. L. and E.B. Webb. 2011. Waterbird use and food availability on Wetland Reserve Program Sites enrolled in the Migratory Bird Habitat Initiative. Midwest Fish and Wildlife Conference, Des Moines, IA.
- *Tidwell, P.R., E.B. Webb, M. Vrtiska, and A. Bishop. 2011. Food habits and energetics of spring migrating waterfowl through the Rainwater Basin. Annual Meeting of The Waterbird Society, Grand Island, NE.
- **Tindall, M. and E.B. Webb. 2010. Food preferences of wintering waterfowl on Wetland Reserve Program sites in Arkansas. International Society of Wetland Scientists Meeting, Salt Lake City, UT.
- **Tindall, M., **K. Wewers, *V. Olmstead, and E.B. Webb. 2010. Moist-soil seed availability and depletion on Wetland Reserve Program sites in Arkansas. International Society of Wetland Scientists Meeting, Salt Lake City, UT.
- Webb, E.B., *P.R. Tidwell, M.P. Vrtiska, and A.A. Bishop. 2012. Effects of landscape context on waterfowl food selection and lipid acquisition. Rainwater Basin Joint Venture Informational Seminar, Hastings, NE.
- Webb, E.B., L.M. Smith, M. Vrtiska, and T.G. LaGrange. 2011. Factors influencing waterfowl habitat use and behavior during migration through the Rainwater Basin. Annual Meeting of The Waterbird Society, Grand Island, NE.
- Webb, E.B. and R.W. Johnson. 2010. Effects of mechanical manipulation and time on lead pellet distribution in wetlands. Southeastern Association of Fish and Wildlife Agencies Conference, Biloxi, MS.
- *Westhoff, J., and C. Paukert. 2012. Thermal and physical habitat mapping of the Ozark National Scenic Riverways. Missouri Natural Resources Conference, Osage Beach, MO.
- *Westhoff, J., and C. Rabeni. 2012. Use and selection of habitat by two species of crayfish determined by passive integrated transponder (PIT) telemetry. Society of Freshwater Science Annual Meeting, Louisville, KY.
- *Westhoff, J. T., C. F. Rabeni, and R. J. DiStefano. 2011. Potential impacts of the invasive Woodland Crayfish in the St. Francis River drainage of Missouri. Missouri Natural Resources Conference, Osage Beach, MO.
- *Westhoff, J. T., C.F. Rabeni, and S. P. Sowa. 2011. Intolerant invader: The role of natural and anthropogenic factors in the displacement of two native crayfishes by an invasive. 19th Annual Meeting of the Southern Division of the American Fisheries Society, Tampa, FL.
- Whiting, D., C. Paukert, *J. Spurgeon, and B. Healy. 2012. Diets and food availability of non-native trout in Bright Angel Creek, Grand Canyon: implications for native fish conservation. Society of Freshwater Science Annual Meeting, Louisville, KY.
- Whittier, J, and C. Paukert. 2011. Priority watershed planning in the Colorado River basin: new tools and approaches. Missouri Chapter of the American Fisheries Society Rivers and Streams Technical Committee, Jefferson City, MO.
- Whittier, J. C. Paukert, J. Olden, *K. Pitts, and A. Strecker. 2011. Developing conservation priorities for native fish in the Lower Colorado River Basin. American Fisheries Society Annual Meeting, Seattle, WA.

- Whittier, J., C. Paukert, D. Infante, E. Varela-Acevedo, B. Pijanowski, S. Hostetler, L. Wang, L. Johnson, T. Wagner. 2010. Assessing how the nation's fish habitats respond to climate and land use changes: a multi-scale approach. Midwest Fish and Wildlife Conference, St. Paul, MN.
- Whittier, J., C. Paukert, J. Olden, A. Strecker, and *K. Pitts. 2011. Developing conservation priorities for the Lower Colorado River basin. Arizona/New Mexico American Fisheries Society Meeting, Pinetop, AZ.
- Whittier, J., C. Paukert, J. Olden, A. Strecker, J. Olden, and *K. Pitts. 2012. Linking protected lands with streams of high biological conservation potential in arid systems: now and in the future. 6th World Fisheries Congress, Edinburgh, Scotland.



PRESENTATIONS BY FISH AND WILDLIFE FACULTY AND STUDENTS

* Denotes Graduate Student or Post doc

** Denotes Undergraduate Student

- Amelon, S. A, and F. R. Thompson III. 2011. Roosting and foraging resource selection for eastern red bat (*Lasiurus borealis*). Annual meeting of the Wildlife Society, Kona, HI.
- *Ayers, C. R., J. L. Belant, J. J. Millspaugh, and *C. M. Bodinof. 2011. Relating resource use to body mass change and survival of individual hellbenders (*Cryptobranchus alleganiensis*). Southeastern Association of Fish and Wildlife Agencies, Nashville, TN.
- *Ayers, C.R., J.L. Belant, J.J. Millspaugh, D.A. Eads, and *D.S. Jachowski. 2011. Effects of resource use on recruitment of black-footed ferrets. 18th Annual Wildlife Society Conference, Waikoloa, HI.
- Belant, J.L., J.J. Millspaugh, and D.R. Etter. 2010. Estimating fisher and American marten abundance using statistical population reconstruction. Tri-State Furbearer Conference, Ashland, WI.
- *Belsare, A., and M.E. Gompper. Rabies control in India: A model-based assessment of mass vaccination strategies. 2010. Research and Creative Activities Forum (RCAF), University of Missouri Graduate Professional Council, Columbia, MO.
- *Bodinof, C.M., J.T. Briggler, R.E. Junge, J. Beringer, M.D. Wanner, C.D. Schuette, and J.J. Millspaugh. 2010. General observations of captive reared Ozark hellbenders released in the North Fork of the White River, Missouri. Missouri Natural Resources Conference. Tan-Tar-A Resort, Osage Beach, MO.
- *Bonnot, T. W., F. R. Thompson, III, and J. J. Millspaugh. 2010. Extension of landscape-based population viability models to ecoregional scales. The Wildlife Society Annual Conference, Snowbird, UT.
- *Bonnot, T. W., F. R. Thompson III, J. J. Millspaugh, and D. T. Jones-Farrand. 2011. It's not how much to restore but where to restore it: Using landscape-based population viability models to inform conservation planning of regional bird populations. 18th Annual Wildlife Society Conference, Waikoloa Village, HI.
- *Bonnot, T. W., J. H. Schulz, and J. J. Millspaugh. 2011. Factors affecting mourning dove harvest in Missouri within an adaptive resource management program. Missouri Natural Resources Conference, Osage Beach, MO. .
- Brown, H., * J.D. Fore, and D.B. Noltie. 2011. How pebble size affects logperch (*Percina caprodes*) foraging behavior. 96th Ecological Society of America Annual Meeting, Austin, TX.
- Brown, N.L. and *D.S. Jachowski. 2010. Mitigating plague risk in prairie dogs: a systemic approach to flea control. 90th meeting of the American Society of Mammalogists, Laramie, WY.
- *Burke, A.D., and J. Faaborg. 2011. Capture traits of forest-breeding birds in second-growth vegetation in the Missouri Ozarks. Talk in symposium "Post-fledging use of second-growth vegetation by forest-breeding migratory birds." American Ornithologists Union, Jacksonville, FL.
- Chaskelson, S., *M. Ruiz-Lopez, M.E. Gompper, and L. Eggert 2011. Preliminary Assessment of Multiple Paternity in the American Dog Tick *Dermacentor variabilis*. Life Sciences Week, University of Missouri, Columbia, MO.
- *Cox, A. S. and D. C. Kesler. 2010. Nesting ecology and dispersal of the Red-bellied Woodpecker.

- Audubon Society of Missouri Fall Meeting. Lake of the Ozarks, MO.
- *Cox, A. S., and D. C. Kesler. 2011. Prospecting behavior, post fledging survival, and the influence of forest cover during natal dispersal in a resident bird. 129th stated meeting of the American Ornithologists' Union. Jacksonville, FL .
- *Cunningham, J. A., D. C. Kesler, and R. B. Lanctot. 2012. Effects of experience on male and female breeding habitat selection in arctic-breeding shorebirds. 2012 North American Ornithological Conference. Vancouver, Canada.
- *Cunningham, J. A., D.C. Kesler, and R. B. Lanctot. 2012. Influence of mate experience on male and female nest-site selection in Dunlin (*Calidris alpina*). Poster presentation at North American Ornithological Conference, Vancouver, Canada.
- *Eads, D.A., J.J. Millspaugh, D.E. Biggins, *D.S. Jachowski and T.M. Livieri. 2010. Evaluation of a black-footed ferret resource utilization function model. Front Range Student Ecology Symposium, Fort Collins, CO.
- Faaborg, J. 2011. Introduction to the symposium. Talk in symposium "Post-fledging use of second-growth vegetation by forest-breeding migratory birds." American Ornithologists Union, Jacksonville, FL.
- Gallagher, E., R.A. Pierce II, B. White and T. Reinbott. 2011. Missouri Bobwhite Quail Summit. Conservation Federation of Missouri, Missouri Department of Conservation, MU Extension and MU CAFNR. Professional Development and Continuing Education Program. MU Bradford Research Center. Columbia, MO.
- *Gitzen, R. A., J. J. Millspaugh, and *B. J. Keller. 2011. Utilization distributions and resource selection. Invited presentation scheduled for the 2011 Annual Conference of the Wildlife Society, Waikoloa, HI.
- *Gitzen, R. A., and J. J. Millspaugh. 2011. Integrating statisticians and ecologists in ecological monitoring. The International Environmetrics Society's 3rd North American Regional Meeting, La Crosse, WI.
- Gompper, M.E., J. Ray, J. Malcolm, D. Lesmeister, and R. Kays. 2011. Habitat preferences or intraguild interactions: what structures the Adirondack carnivore community? Annual Meeting, American Society of Mammalogists. Portland, OR.
- Gompper, ME. Insights from long-term studies of raccoon disease ecology. 2012. Midwest Furbearers Workshop Conference, Potosí, MO.
- *Hibbert, L., C.H. Nilon. 2011. An examination of the outreach and education programs and protocols of the St. Lucia Forestry Department. Midwest Fish and Wildlife Conference, Des Moines, IA.
- He, J.H., S. Shifley, F. R. Thompson III, and D. Larsen. 2011. Challenges of forest landscape modeling. 26th annual meeting of US-IALE, symposium sustainability in dynamics landscapes.
- Hicks, C.E. and R.A. Pierce II. 2011. Aquaculture in Missouri. MU Extension and Lincoln Cooperative Extension In-Service Education. Sustainable Agriculture Research and Extension. Lincoln University Carver Farm. Jefferson City, MO
- Hirsch-Jacobson, R. W. *A. Cox, F. Thompson III and J. Faaborg 2011. Parents or predators: examining intraseasonal variation in nest survival for a migratory passerine. 129th Stated Meeting American Ornithologists' Union.
- *Hogg, J. and C.H. Nilon. 2011. Occupancy modeling of habitat associations of birds of prey in urban business parks. Midwest Fish and Wildlife Conference, Des Moines, IA.

- Hostetler, M., R.A. Pierce II and C.H. Nilon. 2011. Workshop on *Conserving and restoring biodiversity in urban, suburban and rural environments*. MU CAFNR, MU Extension and University of Florida. Series of Two Workshops and presentations conducted at the St. Charles and Boone County MU Extension Center
- *Jachowski, D. S., R. Slotow and J. J. Millspaugh. 2011. Physiological stress and refugia behavior by African elephants. 18th Annual Wildlife Society Conference, Waikoloa, HI.
- *Jachowski, D.S., N. Brown, M. Wehtje, D. Tripp, J. J. Millspaugh and M. E. Gompper. 2011. Flea ecology and control on Utah prairie dogs: insights in plague risk mitigation. Utah Prairie Dog Recovery Implementation Program Meeting, Cedar City, UT.
- *Jachowski, D.S. and J.J. Millspaugh. 2011. Glucocorticoid stress hormones and refugia behavior by African elephants. 28th Annual University of Missouri Research and Creative Activities Forum, Columbia, MO.
- *Jachowski, D. S., R. A. Gitzen, M. B. Grenier, B. Holmes and J. J. Millspaugh. 2010. The importance of thinking big: Large scale prairie dog conservation drives black-footed ferret reintroduction success. 37th Annual Natural Areas Conference, Osage Beach, MO.
- *Jachowski, D. S., R. A. Gitzen, M. B. Grenier, B. Holmes and J.J. Millspaugh. 2010. Evaluating attempts to reintroduce black-footed ferrets to North America. 90th meeting of the American Society of Mammalogists, Laramie, WY.
- *Jachowski, D. S. and N. L. Brown. 2010. Evaluation of a systemic approach to flea control in the Genus *Cynomys*. Utah Chapter of the Wildlife Society annual meeting, Moab, UT.
- Jochems, B., *D. Jachowski and M Gompper. Mitigating plague risk in Utah prairie dogs: A look at flea phenology. 2011. Office of the Director of National Intelligence CAE Regional Colloquium, Columbia, MO.
- Jochems, B., *D. Jachowski and M. Gompper. 2010. Mitigating plague risk in Utah prairie dogs: A look at flea phenology. Summer Undergraduate Research and Creative Achievements Forum, Columbia, MO.
- Jones, J. R. and J. A. Hubbart. 2010. Algal biomass and transparency in Missouri reservoirs: influence of non algal seston. Meeting of the International Society of Limnology, Cape Town, South Africa.
- Jones, J. R., G. D. Cooke and E. B. Welch. 2010. Tenkiller Reservoir: Eutrophication of Oklahoma's most beautiful lake by non-point inputs from agriculture. Meeting of the International Society of Lake and Reservoir Management, Oklahoma City, OK.
- Jones, J. R., D. Obrecht and T. Thorpe. 2011. Chlorophyll maxima and chlorophyll-total phosphorus ratios in Missouri reservoirs. Meeting of the International Society of Lake and Reservoir Management, Spokane, WA
- Jones, J. R. 2011. Cropland and reservoir trophic state relations. Agriculture and water quality forum. University of Kansas, Lawrence, KS.
- Jones, J.R., D. V. Obrecht, J. L. Graham, J. A. Downing and M. B. Balmer. 2012. Seasonal CO₂ influx and efflux in meso- to eutrophic impoundments. Associated Sciences of Limnology and Oceanography, Otsu, Japan.
- Jones-Farrand, D. T., A. M. Pidgeon, F. R. Thompson III, and J. A. Fitzgerald. 2010. Assessing the impact of housing development on high priority forest birds. Annual Meeting of the Wildlife Society, Snowbird, UT.
- *Joos, C., J. Faaborg, and F. R. Thompson III. 2011 Settlement Order and Productivity of Bell's Vireos. Annual meeting of AFO/COS/WOS, Kearney, NE.

- *Keller, B., J. J. Millspaugh, G. Brundige and C. Lehman. 2011. Mechanisms affecting pronghorn resource selection in the Black Hills, SD. Annual Meeting of the Central Mountains and Plains Section of The Wildlife Society, Gering, NE.
- *Keller, B, J. J. Millspaugh, G. Brundige and C. Lehman. 2011. Analysis of factors influencing spatial overlap among an ungulate assemblage in the Black Hills, SD. Annual Meeting of the Central Mountains and Plains Section of The Wildlife Society, Gering, NE.
- *Kemink, K. M., D. C. Kesler, and T. Thompson. 2011. Missouri Greater Prairie-Chickens: demography and movement. The 29th Prairie Grouse Technical Council. Hays, KS
- Kendrick, S. W., and F. R. Thompson III. 2011. Winter bird densities across a savanna-woodland-forest gradient in the Missouri Ozarks. Annual meeting of the Wildlife Society, Snowbird, UT.
- Kesler, D. C., and *R. J. Laws. 2012. Recovery of the endangered Micronesian Kingfisher: options and directions. Invited WebEx presentation to the Honolulu field office and Portland, Oregon regional office of the U.S. Fish and Wildlife Service. WebEx to Honolulu, HI and Portland, OR.
- Kesler, D. C. 2012. A Bayesian network modeling approach for guiding conservation site selection. Complexity Modeling Group. University of Missouri, Columbia, MO. Kesler, D. C. 2012. Communications plan for the Society for Ornithology. Invited presentation to the Ornithological Council and presidents from international ornithological societies. Dallas, TX.
- Kesler, D. C. 2012. Conservation when seas are rising – modeling climate change effects on island birds. Saturday Morning Science Series. University of Missouri, Columbia, MO
- Kesler, D. C. 2011. Translocation as a conservation tool for insular avifauna. Invited technical session presentation to the Department of Defense Strategic Environmental Research and Development Program meeting. Washington, DC.
- Kesler, D. C. 2011. Translocation and conservation of insular avifauna. Invited presentation to the Columbia chapter of the Audubon Society, Columbia, MO. Kesler, D. C. 2011. Can the winged cross the gap? How landscape influences bird movement and dispersal. Arkansas Urban Forestry Council Annual Conference, Hot Springs, AR
- Kesler, D. C. 2010. Invited panel member and presentation for workshop titled “How to get the most out of collaborations with non-academic institutions” at the 128th meeting of the American Ornithologists’ Union in San Diego, CA.
- Kesler, D. C. 2010. Radio telemetry, bird movements, and resource use analysis for small birds. International MIGRATE group meeting. Campos do Jordão, Brazil.
- Kesler, D. C. 2010. Attachment techniques for radiotelemetry equipment on migrant birds. International MIGRATE group meeting. Campos do Jordão, Brazil.
- Kesler, D. C., *A. S. Cox, G. Albar, and A. Gouni. 2011. Translocation, exploratory movements, and vacancy filling in Tuamotu Kingfishers. 129th stated meeting of the American Ornithologists’ Union. Jacksonville, FL.
- *Laws, R. J., and D. C. Kesler, 2012. Micronesian Kingfisher population status and options for assisted colonization. Invited presentation to the American Zoo and Aquarium Association Mid Year Meeting. Palm Springs, CA.
- *Laws, R. J, D. C. Kesler. 2011. Using Bayesian network modeling to evaluate the suitability of islands for a wild population of Guam Micronesian Kingfishers outside their historic range. 129th stated meeting of the American Ornithologists’ Union. Jacksonville, FL (national oral presentation).
- *LeBrun, J. J., W. Thogmartin; F.R. Thompson, and J. Millspaugh. 2011. The effects of climate versus habitat and landscape factors on avian abundance in the Midwestern United States. Annual

- meeting of the Wildlife Society, Snowbird, UT.
- *LeBrun, J. L., W. Thogmartin, F. Thompson, and J. Millsbaugh. 2011. The effects of climate versus habitat and landscape factors on avian abundance in the Midwestern United States. 18th Annual Wildlife Society Conference, Waikoloa, HI.
- Middendorf, G. and C.H. Nilon. 2011. Guidelines for engaging outside the ecological community: Fostering local and regional interactions with communities in need. Annual Meeting of the Ecological Society of America, Austin, TX.
- Mocker, D., J. Koppelman, W. Swee and M.E. Gompper. 2012. Understanding spatial and temporal variation in the site of attachment by the parasitic copepod *Salmincola californiensis* on rainbow trout. Missouri Natural Resources Conference, Osage Beach, MO.
- *Monello, R., M.E. Gompper and L Eggert. 2010. Genetic variability and viral seroconversion in an outcrossing vertebrate population. Annual Meeting, The Wildlife Society, Snowbird, UT.
- *Mowry, R., L. Eggert, M.E. Gompper, and J. Beringer. 2010. A genetic approach to determine river otter (*Lontra canadensis*) abundance and effects on fish populations in Missouri. Missouri Natural Resources Conference, Lake of the Ozarks, MO.
- *Mowry, R., L. Eggert, M.E. Gompper, and J. Beringer. 2010. A genetic approach to determine river otter (*Lontra canadensis*) abundance in Missouri. Missouri Life Sciences Week, Columbia, MO.
- Nilon, C.H. 2011. Incorporating urban biodiversity theory and research into monitoring, design and planning. Annual Meeting of the Ecological Society of America, Portland, OR.
- Nilon, C.H. 2011. Preparing students for graduate school and careers in ecology: Best practices from NSF undergraduate research and mentoring programs – UMEB/URM. Annual Meeting of the Ecological Society of America, Portland, OR.
- Nilon, C.H. 2011. Comparative studies of wildlife in cities. URBIO Symposium 1: Benchmarking biodiversity towards a sustainable city. Eighth World Congress of the International Association for Landscape Ecology, Beijing, China.
- Nilon, C.H. and R.A. Pierce II. 2011. *Enhancing Biodiversity at the Missouri Research Park: Developing an Educational Model for Determining Stakeholder Motivations and Constraints*. Series of Two Workshops conducted with Novus International and the Missouri Research Park. St. Charles, MO
- Nilon, C.H., C. Lepczyk, P. Warren, and M. Katti. 2011. Comparative studies of birds in cities. Urban Wildlife Management National Conference, Austin, TX.
- *Oliifiers, N., R.C. Bianchi, M.E. Gompper, A.M. Jansen-Franken, P. Sérgio D'Andrea. 2010. Effect of hemoparasites *Trypanosoma cruzi*, *T. evansi* and *microfilariae* sp. on the health of free-ranging coatis from the Pantanal wetlands, Brazil. Annual Meeting, European Wildlife Disease Association, Vlieland, Netherlands.
- Pierce, R.A. II. 2012. Prevention and control of nuisance wildlife. Cole County Master Gardener Annual Conference. Jefferson City, MO.
- Pierce, R.A. II. 2012. Integrating habitat practices for bobwhite quail farms in Missouri – update on MU Extension Wildlife Programs. Missouri Department of Conservation Professional Development Workshop, Private Lands Division. Linn, MO.
- Pierce, R.A. II. 2012. Basic ecological principles and introduction to wildlife biology and management. Missouri Master Naturalist Program and Training. Hi Lonesome Chapter. Cole Camp, MO.
- Pierce, R.A. II, T. Reinbott and B. White. 2012. 7th Annual Bobwhite Quail and Agriculture Field Day and Workshops - Integrating bobwhite quail and pollinator habitat on farms in Missouri. MU

Bradford Research Center. Columbia, MO.

- Pierce, R.A. II, T. Reinbott, and R. Wright. 2011. Integrating agriculture production, soil conservation and wildlife habitat management at the MU Bradford Research Center. Missouri Natural Resources Conference. Osage Beach, MO.
- Pierce, R.A. II. 2011. Prevention and control of nuisance wildlife, parasites and diseases. MU Campus Facilities Safety Workshop. Columbia, MO.
- Pierce, R.A. II and J. Knudsen. 2011. Integrating wildlife habitat educational demonstrations at MU Agricultural Experiment Stations. MU CAFNR AES Workshop. Novelty, MO.
- Pierce, R.A. II. 2011. Bobwhite quail ecology and habitat management. Missouri Bobwhite Quail Summit. MU Bradford Research Center. Columbia, MO.
- Pierce, R.A. II. 2011. Conducting bobwhite quail habitat appraisal on your farm. Missouri Bobwhite Quail Summit. MU Bradford Research Center. Columbia, MO.
- Pierce, R.A. II. and S. Swafford. 2011. Controlling nuisance vertebrate species in Missouri vineyards. Missouri Grape and Wine Conference and Field Day. Waverly, MO.
- Pierce, R.A. II, T. Reinbott and B. White. 2011. 6th Annual Bobwhite Quail and Agriculture Field Day and Workshops – Integrating bobwhite quail, grassland birds and small game habitat with agriculture. MU Bradford Research Center. Columbia, MO.
- Pierce, R.A. II. and S. Hime. 2011. Missouri's chapter-based Master Naturalist Program –successes and lessons learned. 1st Missouri Master Natural Program Leadership Academy. Jefferson City, MO.
- Pierce, R.A. II. 2011. The Missouri Master Naturalist Program Model: partnerships, the key to success. 1st Missouri Master Natural Program Leadership Academy. Jefferson City, MO.
- Pierce, R.A. II. 2011. Basic ecological principles and introduction to wildlife biology and management. Missouri Master Naturalist Program and Training. Osage Trails, Confluence, Meramec Hills, Boone and Lake of the Ozarks Chapters, MO
- Pierce, R.A. II. 2010. Conducting habitat appraisal for bobwhite quail. Missouri Quail Forever State Conference. MU Bradford Research Center. Columbia, MO.
- Reinbott, T., R.A. Pierce II, R. Wright and W. Wehtje. 2011. Growing biofuel crops while improving wildlife habitat. Missouri Bobwhite Quail Summit. MU Bradford Research Center. Columbia, MO
- Reinbott, T., R.A. Pierce II and R. Wright. 2011. Can a Highly Diverse/Low Input System Provide Sufficient Biomass for Biofuel Production, Wildlife Habitat, and Quality Forage for Livestock? Agronomy Society, Crop Science Society and Soil Science Society International Conference, San Antonio, TX
- Reinbott, T., R.A. Pierce II, R. Wright and W. Wehtje. 2010. Alternative methods of biofuel production to enhance farm productivity while improving wildlife habitat and soil and water conservation. International Meetings of the American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America. Long Beach, CA.
- Reinbott, T., R.A. Pierce II, R. Wright, and B. White. 2010. Integrating northern bobwhite (*Colinus virginianus*) habitat enhancement practices on MU Agriculture Experiment Stations: an educational model that puts knowledge into action. 2010 International Meetings of the American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America. Long Beach, CA.
- *Rota, C.T., J.J. Millsbaugh, D.C. Kesler, C.P. Lehman, M.A. Rumble, and C. Bodinof. 2012. A

- Bayesian modified case-control model for estimating absolute probability of use from use-availability data. Ecological Society of America 97th Annual Conference, Portland, OR.
- *Rota, C.T., D.C. Kesler, C.P. Lehman, M.A. Rumble, and J.J. Millspaugh. 2012. Black-backed woodpecker home range size and resource selection in habitat created by mountain pine beetle infestations in the Black Hills of South Dakota. Invited Symposium, Vertebrate Responses to Bark Beetles, Laramie, WY.
- *Rota, C.T., D.C. Kesler, C.P. Lehman, M.A. Rumble, and J.J. Millspaugh. 2011. Do mountain pine beetle infestations provide similar foraging resources for Black-backed Woodpeckers as recently burned forests? Midwest Fish and Wildlife Conference, Des Moines, IA.
- *Rota, C.T., D.C. Kesler, C.P. Lehman, M.A. Rumble, and J.J. Millspaugh. 2011. Foraging behavior of Black-backed Woodpeckers in burned forests and mountain pine beetle infestations. 129th Stated Meeting of the American Ornithologists Union, Jacksonville, FL.
- *Ruiz-Lopez, M., R. Monello, M.E. Gompper, L. Eggert. 2010. Relative importance of neutral genetic variability for predicting parasitism. Joint annual meeting of the Society for the Study of Evolution, the Society of Systematic Biologists, and the American Society of Naturalists, Portland, OR.
- *Ruiz-López, M.J., M. Wehtje, M.E. Gompper, and L. Eggert. 2010. Factors influencing contact rates in raccoons: the role of genetic relatedness. Missouri Life Sciences Week, Columbia, MO.
- *Ruiz-Lopez, M.J., S. Lance, *R. Monello, M.E. Gompper, and L. S. Eggert. 2011. Characterization of the major histocompatibility complex (MHC) DRB Exon 2 in raccoons using next-generation sequencing. American Genetic Association Annual Symposium, Irapuato, Mexico.
- Schneiderman, J.H. He, F.R. Thompson III, and W. Dijak. 2012. Assessing forest landscape response to future climate projections in the Missouri Ozark Highlands. 27th Annual Meeting of US-IALE, Landscape Ecology Symposium Informing Decisions in a Changing World, Portland, OR.
- Schneiderman, J, H. He, F.R. Thompson III and W. Dijak. 2011 Modeling species establishment under the projected warming climate in the Missouri Ozark highlands. 26th annual meeting of US-IALE, Symposium on sustainability in dynamics landscapes, Portland, OR.
- Schulz, J. H., *T. W. Bonnot, and J. J. Millspaugh. 2012. Statewide and local recruitment of mourning doves in Missouri. Missouri Natural Resources Conference, Osage Beach, MO.
- *Stanton, R., D.C. Kesler, and F.R. Thompson III. 2012. Can Missouri support a reintroduced population of brown-headed nuthatches? River Bluffs Audubon Society Meeting, Jefferson City, MO.
- *Stanton, R., D.C. Kesler, and F.R. Thompson III. 2012. Can Missouri support a reintroduced population of brown-headed nuthatches? Missouri Bluebird Society Annual Conference, Jefferson City, MO
- *Swee, W., J. Koppelman, B. Havens, J. Gironde, C. Landstad, *D. Mocker, and M.E. Gompper. 2012. An evaluation of brook trout as a biological control of the parasitic copepod *Salmincola californiensis* at Meramec Spring Hatchery. Missouri Natural Resources Conference, Osage Beach, MO.
- * Sztukowski, L. A., and D. C. Kesler. 2012. Environmental fluorescence and conservation bait consumption by Sooty Terns (*Sterna fuscata*): implications for eradication programs. Bird Conservation International: *In Press*.
- Thompson, F.R., III. 2010. Approaches to modeling abundance and viability of birds. Workshop on the conservation of the golden checked warbler. Austin TX.
- Thompson, F.R., III. 2011. Approaches to modeling landscape change and wildlife response to climate change in the Midwestern U.S. Workshop on the restoration of shortleaf pine ecosystems in the

Midwestern U.S. Springfield, MO.

- Thompson, F.R., III, *J. L. Reidy, S. Wolken, J. A. Fitzgerald. 2011. Abundance of Breeding songbirds in managed and non-managed savanna and woodland sites in the Ozark Highlands. Invited presentation. Fire in eastern oak forest conference, Springfield, MO.
- Thompson, F. R., III. 2012. Approaches to linking landscape, wildlife, and climate models. USDA Forest Service First Friday All Climate Change Webinar.
- Thompson, F. R., III. 2012. Linking ecosystem, landscape, wildlife, and climate models to predict changes to central hardwood landscapes and wildlife. Northeast Climate Science Center Webinar.
- Thompson, F. R., III. 2012. Linking climate, ecosystem, landscape models to predict landscape change in the central hardwoods region. Northern Institute of Applied Climate Science Expert Panel Workshop. St Louis, MO.
- *Walter, W. D., D. M. Baasch, S. E. Hyngtrom, B. D. Trindle, A. J. Tyre, J. J. Millspaugh, C. J. Frost, J. R. Boner, and K. C. VerCauteren. 2011. Space use of sympatric deer in riparian corridors in western Nebraska: implications to spread of chronic wasting disease in an endemic. Annual Meeting of the Central Mountains and Plains Section of The Wildlife Society, Gering, NE.
- Wehtje, W., and D. C. Kesler. 2012. Migration directionality of European Starlings (*Sternus vulgaris*) in Europe predicts the species' North American migration patterns. 2012 North American Ornithological Conference. Vancouver, Canada.
- Wong, S.T., J. L. Belant, J. J. Millspaugh, R. A. Gitzen, A. Heard, and J. Ross. 2011. Radiotelemetry and remote monitoring of tropical carnivores. 1st Borneo Carnivore Symposium, Kota Kinabalu, Malaysia.
- Wicks, C. M., T. Aley, D. Ashley, D. B. Noltie. 2011. Combining data to assess of the habitat suitability of patches of streambed. Hydrological, Geomorphological, Biological, and Geochemical Processes in Karst Aquifers I session, American Geophysical Union, 44th Annual Fall Meeting, San Francisco, CA.
- Wicks, C. M., D. B. Noltie, E. W. Peterson, and T. Dogwiler. 2010. Disturbances in the habitat of *Macrocotyla glandulosa* (Kenk). Joint Meeting with ASLO (American Society of Limnology and Oceanography) and NABS (North American Benthological Society), Santa Fe, NM
- *Womack, K., S. A. Amelon, and F. R. Thompson III. 2011. It's not just pickles and ice cream: resource selection by female Indiana bats during the maternity season. Annual meeting of the Wildlife Society, Kona, HI.

THESIS AND DISSERTATIONS

STUDENTS ADVISED BY UNIT SCIENTISTS

- Buckler, J. December 2011. Persistent organic pollutant effects on Middle Mississippi River *Scaphirhynchus* sturgeon reproduction and early life stages. M.S. Thesis, University of Missouri, Columbia. D. L. Galat and D. M. Papoulias, co-advisors
- Fore, J. August 2012. Remediating effects of human threats on lotic fish assemblages within the Missouri river basin: how effective are conservation practices? PhD Dissertation, University of Missouri, Columbia. D. L. Galat and S. Sowa, co-advisors.
- Mengel, D. 2010. Amphibians as wetland restoration indicators in Missouri. M.S. Thesis, University of Missouri. D.L. Galat, advisor.
- Spurgeon, J. 2012. Translocation of humpback chub (*Gila cypha*) and food-web dynamics in Grand Canyon National Park tributary streams. M.S. Thesis, University of Missouri. C. P. Paukert, advisor.
- Westhoff, J. T. 2011. Investigation of an invasive crayfish and its relation to two imperiled native crayfishes; anthropogenic influences, multi-scale habitat associations, and conservation options. PhD Dissertation, University of Missouri, Columbia, Missouri. 254 pp. C. Rabeni, advisor.

STUDENTS ADVISED BY FISH AND WILDLIFE FACULTY COOPERATORS

- Bodinof, C. M. 2010. Translocation and conservation of hellbenders (*Cryptobranchus alleganiensis*) in Missouri. M.S. Thesis, University of Missouri. J.J. Millsbaugh, advisor.
- Burfield, M.P. 2011. Integrated vegetation management recommendations for George Washington Carver National Monument. M.S. Thesis, University of Missouri. C.H. Nilon, advisor
- Coulombe, G. L. 2010. Resource selection and space use of the critically endangered Tuamotu Kingfisher (*Todiramphus gambieri*). M.S. Thesis, University of Missouri. D.C. Kesler, advisor.
- Cox, A. 2011. Natal dispersal and survival in Red-bellied Woodpeckers. University of Missouri-Columbia. M.S. Thesis. D.C. Kesler, advisor.
- Jachowski, D. S. 2012. Demographic, behavioral, and physiological responses of wildlife to reintroduction. Ph.D. Dissertation, University of Missouri. J.J. Millsbaugh, advisor.
- Keller, B. J. 2011. Factors affecting spatial and temporal dynamics of an ungulate assemblage in the Black Hills, South Dakota. Ph.D. Dissertation, University of Missouri. J.J. Millsbaugh, advisor.
- Kemick, K. 2012. Survival, habitat use, and movement of resident and translocated Greater Prairie-Chickens. M.S. Thesis, University of Missouri. D.C. Kesler, advisor.
- Olifiers, N. 2010. Population and disease ecology of the brown-nosed coati (*Nasua nasua*) and the crab eating-fox (*Cerdocyon thous*) in the Brazilian Pantanal. Ph.D Dissertation, University of Missouri. M.E. Gompper, advisor.
- Mowry, R. 2010. A genetic approach to determine river otter abundance in Missouri. M.S. Thesis, University of Missouri. M.E. Gompper, advisor.

Pittman, B. 2011. Sediment carbon and nitrogen: Sampling methodology. M.S. Thesis, University of Missouri. J.R. Jones, advisor.

Sztukowski, L. 2011. Conservation of sooty terns on Wake Atoll Complex. M.S. Thesis, University of Missouri. D.C. Kesler, advisor.

COMMITTEES AND OTHER PROFESSIONAL SERVICE

2010 TO PRESENT

UNIT SCIENTISTS AND STUDENTS

David Galat –

- Upper Mississippi River System Navigation and Ecosystem Sustainability Program's Science Panel, 2005 – 2011.
- Platte River Recovery Implementation Program, Independent Science Advisory Committee, 2009 – 2011.
- National Academy of Sciences, National Research Council Committee on Missouri River Recovery and Associated Sediment Management Issues. 2008 – 2010.
- Missouri River Recovery Implementation Committee (MRRIC). Alternate Representative Fish and Wildlife, member Science and Adaptive Management Working Group, 2011 to Present.
- Associate Editor, *River Research and Applications*, 2003-
- Co-editor, Special Issue of *Ecology and Society: Advancing Collaborative Adaptive Management (CAM)* 2011 to Present.

Craig Paukert –

- President Elect, Education Section of the AFS, 2011 to Present.
- Secretary/Treasurer, Education Section of the AFS, 2009 – 2011.
- National Climate Assessment, Technical Input Committee, Biodiversity, Ecosystems and Ecosystem Services Technical Committee, 2011 – 2012.
- Steering Committee, 2014 Midwest Fish and Wildlife Conference, 2011 to Present.
- Program Chair, 2014 Midwest Fish and Wildlife Conference, 2011 to Present.
- Invited Member, Science Committee, National Fish Habitat Initiative, 2005 to Present.
- Invited Member, USGS Large River Monitoring Forum, 2012 to Present.
- Associate Editor, *North American Journal of Fisheries Management*, 2003 – 2011.
- Graduate Affairs Committee, Fisheries and Wildlife Sciences, MU, 2010 to Present.
- Guest Editor, *Endangered Species Research*, 2010 – 2012.
- Adjunct Associate Professor, Kansas State University, 2009 to Present.
- Invited participant, USGS Floodplain Connectivity Workshop, 2012.
- Session moderator, World Fisheries Congress, Edinburgh, Scotland, 2012.
- Session moderator, Fisheries Society of the British Isles Conference, Belfast, 2010.

Amanda Rosenberger

- Space Allocation Committee, University of Missouri College of Natural Resources. 2012 to present.
- Chair, Time and Place Committee of the AFS. 2011-Present.
- Secretary Treasurer, Habitat Section of the AFS. 2009-Present.
- Excellence in Education Award Committee Member, Education Section of the AFS. 2009-Present.
- Co-organized 'Beyond distribution and abundance' symposium, Annual Meeting of the American Fisheries Society, Minneapolis, MN.

- Co-organized ‘Using remote sensing techniques for quantifying fish habitat’ symposium, Annual Meeting of the American Fisheries Society, Minneapolis, MN.
- AFS Education Section Western Division Representative (elected position), 2011
- AFS Education Section, Sub-committee on distance continuing education, 2011
- COSEE (Center for Ocean Sciences Education Excellence) Seminar. K-12 training on the ecology of Pacific Salmon: Enhancing “Salmon in the Classroom,” 2010.

Elisabeth Webb –

- Program Committee member (Wildlife Chair), 2014 Midwest Fish and Wildlife Conference, 2012 - present
- Associate Editor, *Wildlife Society Bulletin*, 2011 to Present.
- Scientific Committee Member, Ecology and Conservation of North American Waterfowl Symposium, 2011 to Present.
- Organized ‘Migration Ecology’ symposium, Annual Meeting of The Waterbirds Society, 2011.
- Board Member, Arkansas Chapter of The Wildlife Society, 201 to Present.
- Board Member, South-central Chapter, Society of Wetland Scientists, 2010.

Jake Faulkner, M.S. Student Advised by Paukert –

- North Central Division Representative, Student Subsection of the American Fisheries Society, 2011.
- Volunteer, Missouri River Relief, 2011.
- Fisheries Management Presentation. Harrisburg Middle-School, MO, 2012.

Jeff Fore, Ph.D. Student Advised by Galat –

- President, Student Subsection of the Education Section of the American Fisheries Society, 2011 to Present.
- Editor, Student Angle Columns in Fisheries, 2011.
- American Fisheries Society Continuing Education Committee, 2009 to Present.

Katy Klymus, Post-doctoral Researcher Advised by Paukert –

- Graduate Teaching Assistant, University of Missouri, 2010 – 2012.
- Graduate Certificate in Science Outreach, University of Missouri, 2011.
- Instructor, Women in Science, Girl Scouts of America, Columbia MO, 2010 – 2011.

Allison Pease, Post-doctoral Researcher Advised by Paukert –

- Subcommittee chair, American Fisheries Society Publications Award Committee, 2011 to Present.
- Guest lecturer, University of Missouri, FW 8001-Advanced Fisheries Science, 2012.
- Instructor, University of Missouri, FW 8001- Lotic Community Ecology, 2011.

Emily Pherigo, M.S. Student Advised by Paukert –

- President, MU Wildlife and Fisheries Graduate Student Organization, 2012 to Present.
- Travel Award Co-Coordinator, MU Wildlife and Fisheries Graduate Student Organization, academic year 2011 – 2012.
- Member, Fisheries and Aquatic Sciences Society, MU student chapter of Missouri AFS, 2012 to Present.

Landon Pierce, Ph.D. Student Advised by Paukert –

- Newsletter co-editor, Education Section of the American Fisheries Society, 2012 to Present.
- Secretary-Treasurer, Student Subsection of the American Fisheries Society, 2011 to Present.
- Graduate Teaching Assistant, Fisheries Management, 2011.
- Reviewer, *North American Journal of Fisheries Management*, 2011 to Present.
- Volunteer, Wonders of Wildlife, 2012.

Nick Sievert, M.S. Student Advised by Paukert –

- Newsletter Editor, Fisheries Information and Technology Section of the American Fisheries Society, 2012 to Present.
- Vice President, MU Wildlife and Fisheries Graduate Student Organization, 2012 to Present.
- Travel Award Coordinator, MU Wildlife and Fisheries Graduate Student Organization, 2011 to Present.
- Seminar and guest speaker coordinator, MU Wildlife and Fisheries Graduate Student Organization, 2012 to Present.

Jon Spurgeon, M.S. Student Advised by Paukert –

- Volunteer, Missouri River Relief, 2011.

Michelle Staudinger, Post-doctoral Researcher Advised by Paukert –

- Adjunct Faculty, Department of Biology and Marine Biology, University of North Carolina Wilmington, Wilmington, NC, 2011 to Present.
- Guest lecturer, University of Missouri, FW 8001-Advanced Fisheries Science, 2012.

Jessi Tapp, M.S. Student Advised by Webb –

- Secretary, University of Missouri Wildlife and Fisheries Graduate Student Organization, 2012 to Present.
- Student Panel Discussion and Mentor/Mentee Special Session Committee Member, North American Duck Symposium and Workshop, 2012 to Present.

Jacob Westhoff, Post-doctoral Researcher Advised by Paukert –

- Member, Rivers and Streams Technical Committee, Missouri Chapter American Fisheries Society, 2010 to Present.
- Member, Awards Committee, Missouri Chapter American Fisheries Society, 2010.

- Editorial Board, *Freshwater Crayfish* – Freshwater Crayfish 18, 2011 to Present.
- Hallsville R-IV Aquatic Day volunteer 2010 – 2011.

FISH AND WILDLIFE FACULTY AND STUDENTS

John Faaborg –

- President, American Ornithologists' Union 2010-2012.

Matt Gompper –

- EPA Proposal Panel Review (STAR Program).
- Associate Editor, *Acta Theriologica*.
- NSF Proposal Review Panel (Population and Community Ecology).
- Associate Editor, *Journal of Wildlife Management*.
- Co-coordinator, Mizzou Tigers for Tigers.
- Invited Member, International Union for the Conservation of Natural and Native Resources/Species Survival Commission (IUCN/SSC). Small Carnivore Specialist Group (formerly Mustelid, Viverrid and Procyonid Specialist Group).
- Curator of Mammals and Birds, University of Missouri Museum of Vertebrate Zoology.
- Missouri Natural Heritage Mammal Working Group.
- Editor *Animal Conservation*.

Rob Hayward –

- Member of the NCRAC Board of Directors, 2006 – 2011.
- Chair of the NCRAC Research Technical Committee, 2006 – 2011.
- Chair of the North Central Regional Aquaculture Center (NCRAC) Technical Committee/Research Subcommittee, 2006 – 2011.

John (Jack) Jones –

- Member of the College Tenure and Promotions Committee (elected), 2009 – 2011.
- Associate Editor, *Journal of Lake and Reservoir Management*, 1991 – 2011.
- Editorial Board, *Aquatic Ecosystem Health and Management*, 2008 to Present.
- Editor-in-Chief, *Inland Waters*, *Journal of the International Society of Limnology*, 2010 to Present.

Dylan Kesler –

- Invited expert reviewer for IUCN Red List of threatened species for birds in French Polynesia and Federated States of Micronesia, 2012.
- Invited expert contributor for IUCN Red List of threatened species and Invasive Alien Vertebrates on Islands database, 2012.
- Invited “Practitioner of Movement Studies” member of international Migratory Connectivity Project, 2011.
- Invited steering committee member on international NSF-sponsored MIGRATE project, 2010.
- Society for Ornithology Executive Planning Committee, 2012.
- Special advisor to the Committee to Form the Society for Ornithology, 2012.
- Conservation Committee for the Society for Ornithology, 2011.
- Chair of Communications Committee for the Society for Ornithology, 2012.

- Publications Committee for the Society for Ornithology, 2012.
- Editor for VHF radiotelemetry web page for Migratory Connectivity Project, 2011.
- Chair of the Movement and Dispersal Symposium at the 128th meeting of the American Ornithologists' Union in San Diego, CA, 2010.
- Missouri Department of Conservation hiring committee member for the organization's grassland ecologist, 2010.
- University of Missouri Department of Fisheries and Wildlife Sciences representative to the National Association of University Fisheries and Wildlife Programs Research Roadmap for Natural Resources, 2012.
- Participant in the interdisciplinary faculty group composing a Mizzou Advantage proposal to expand faculty and capacity, 2012.
- Faculty advisor to The Wildlife Society student chapter, 2010.
- Faculty advisor to the School of Natural Resources Science Society, 2011.
- Faculty member helping advise the conservation biology certificate program, 2010.

Joshua Millspough –

- Associate Editor, *Ecological Applications*, 2007 – 2010.
- Associate Editor, *Journal of Wildlife Management*, 2009 to Present.
- University of Missouri Research Board, 2011 to Present.
- Director of Graduate Studies, Department of Fisheries and Wildlife Sciences, 2005 – 2012.
- Chair, School of Natural Resources Promotion and Tenure Committee, 2010 – 2012.
- Director, Baskett Wildlife Research Area, 1999 – 2010.
- Session Organizer with R. A. Gitzen: Integrative statistical methods for design and analysis of long-term ecological monitoring efforts. Invited session for The International Environmetrics Society's 3rd North American Regional Meeting, 2011, La Crosse, WI.

Charles Nilon –

- Associate Editor, *Urban Ecosystems*, 2003 to Present.
- Advisory Board Member – Urban Biodiversity and Design Network, 2008 to Present .

Douglas Noltie –

- Editorial Board Member, 2007 to Present.
- Manuscript reviewer, 2009 to Present.
- Ozark Cavefish Working Group, MDC, 1994 to Present. Regular Member.
- Student Support Committee, MO Chapter, AFS, 2009 to Present. Regular Member.
- CAFNR Learning Improvement Committee, 2009 to Present. Regular Member.
- SNR Policy Committee, 2006 -2010. Regular Member.
- Curator, Fish Museum, 1990 to Present.
- Board of Directors, Liahona House student residence, 1991 – 2011.
- Advisor, Liahona Fellowship.
- Advisor, MU Aquarium Club, 2011 to Present.
- FandW – Undergraduate Curriculum Committee, 2003 - 2012. Regular Member.
- FandW – Fisheries and Aquatic Sciences Society Advisor, 2010 to Present.

- FandW – Undergraduate advisor.
- FandW – Dissertation committee member.
- FandW – Director of Graduate Studies, 2012.
- UM System - University Rules on Sexual Assault/Collected Rules and Regulations, University of Missouri, 200.010 - Standard of Conduct - Student Conduct rules and regulations revision group, 2011 – 2012. Regular Member.
- Student Conduct Self Assessment Team, 2011 – 2012. Council for the Advancement of Standards in Higher Education review of the University's Student Conduct program. Regular Member.
- Conservation Biology Program, 1999 to Present. Regular Member.
- Water Resources Emphasis Area planning group, 2011 to Present. Participated in the planning meetings for the Water Resources Emphasis Area graduate program planning effort.

Robert Pierce –

- MU Bradford Research Extension Center Advisory Committee.
- MU Wurdack Farm Advisory Committee.
- Advisor: Novus International Ecological Sustainability Team.
- Board of Directors: Alliance of Natural Resources Outreach and Service Programs, 2008 - 2010
- USDA NRCS State Technical Committee.
- Missouri Bobwhite Quail and Grassland Bird Technical Committee.
- Board of Directors: Pinnacles Youth Park.
- Missouri Association of Extension Professionals: Sea Grant/Aquaculture-Natural Resources Committee Chair, 2010 - 2011.
- USDA Southern Regional Aquaculture Center Publication Review Committee.
- National Extension Wildlife Damage Team – CoP.
- eXtension wildlife and natural resources program specialist.
- eXtension aquaculture community of practice (CoP), fisheries and aquaculture program specialist
- State 4-H Wildlife Habitat Evaluation Program Committee.
- Reviewer and co-editor: Covey Headquarters Quarterly Newsletter - cooperatively developed by the Missouri Department of Conservation, USDA NRCS and MU Extension.
- Missouri Master Naturalist Program – a partnership between MU Extension and Missouri Department of Conservation (State Co-Director: MU Extension).
- MU Extension CAFNR, Animal Sciences, Fisheries and Wildlife Sciences, “Missouri Venison University” Program Planning Committee.
- MU Extension CAFNR Biomass and Bioenergy State Committee.
- 14th Wildlife Damage Management Conference. Program Committee and Chair of Abstract Submissions, Nebraska City, NE 2010 – 2011.

Frank Thompson III–

- Editor in Chief of the Journal of Wildlife Management, The Wildlife Society. July 1, 2009 – 2011.

Joanna Whittier –

- Member, Management Committee of the AFS, 2011 to Present.
- Member, Governing Board of the AFS, 2011 to Present.
- President, Fisheries Information and Technology Section of the AFS, 2011 to Present.
- Co-coordinator for the Charles Schwartz seminar series, 2011 to Present

Christopher Rota, Ph.D. Student Advised by Millspaugh and Kesler –

- President, Wildlife and Fisheries Graduate Student Association, 2010 – 2012.

Richard Stanton Jr., M.S. Student Advised by Kesler and Thompson –

- Coordinator, Charles W. Schwartz Seminar Series, Fall 2011.
- Treasurer, Wildlife and Fisheries Graduate Student Organization, 2011 to Present.



AWARDS AND RECOGNITION

2010 TO PRESENT

UNIT SCIENTISTS AND STUDENTS

David Galat –

- Certificate of Appreciation for Outstanding Service: Committee on the Missouri River Recovery and Associated Sediment Management Issues Member (2008-2010). National Research Council of the National Academies, Water Science and Technology Board

Craig Paukert –

- USGS STAR Award, Superior Performance Achievement, 2010-2012 (3).
- Outstanding Graduate Faculty Award, University of Missouri, 2012.
- Letter of Appreciation from the Executive Office of the President, Office of Science and Technology Policy for contribution to the National Climate Assessment Technical Input on Biodiversity, Ecosystems, and Ecosystem Services, 2012.
- Invited presentation, Glen Canyon Dam Adaptive Management Program Technical Working Group Meeting, 2012.
- Keynote Presentation, Annual Meeting of the Texas Cooperative Fish and Wildlife Research Unit, 2011.
- Invited presentation, University of Missouri School of Natural Resources Alumni Meeting, 2011.
- Invited presentation, Missouri Department of Conservation Expanded Staff Meeting, 2011.
- Invited presentation, Midwest Fish and Wildlife Conference, 2010.

Amanda Rosenberger

- Awarded Affiliate Faculty status, School of Fisheries and Ocean Sciences, University of Alaska Fairbanks, 2012.
- Invited presentation, Standardized Sampling Symposium, 2012.
- Invited presentation, Habitat and Remote Sensing Techniques, 2012.
- Invited presentation, Beyond Distribution and Abundance, 2012.

Elisabeth Webb –

- Invited presentation, Rainwater Basin Joint Venture Informational Symposium, 2012.
- Invited presentation, Playa Ecology Symposium, Annual meeting of The Waterbird Society, 2011

Jake Faulkner, M.S. Student Advised by Paukert –

- Outstanding Graduate Student, Department of Fisheries and Wildlife Sciences, MU, 2012.
- Second Place, Best Student Poster, Missouri Chapter of the Society for Conservation Biology, 2012.
- Janice Lee Fenske Memorial Award finalist, 2011.
- Joan Duffy Travel Grant, 2011.

Jason Harris, M.S. Student Advised by Paukert –

- Best Student Aquatics Presentation, Missouri Natural Resources Conference, 2012.

Allison Pease, Post-doctoral Researcher Advised by Paukert –

- Invited presentation, Texas Tech University, 2012.
- Invited presentation, Clemson University, 2012.
- Invited presentation, Stephen F. Austin University, 2011.
- Selected as one of 10 presentations highlighted by USGS at the AFS Meeting, Seattle, 2011.

Landon Pierce, Ph.D. Student Advised by Paukert –

- American Fisheries Society Skinner Memorial Award, 2012.

Jon Spurgeon, M.S. Student Advised by Paukert –

- Finalist, Best Student Presentation at the American Fisheries Society Annual Meeting, 2012.
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Jason Neuswanger, Ph.D. Student Advised by Rosenberger –

- Best Student Presentation at the American Fisheries Society Annual Meeting, 2012.

Micah Tindall, Undergraduate Researcher Advised by Webb –

- Best Student Presentation, Society of Wetland Scientists South-central Chapter Meeting, 2010.

Dan Whiting, Sr. Research Technician supervised by Paukert –

- University of Missouri Staff Development Award, 2012.

FISH WILDLIFE FACULTY AND STUDENTS

Lianne Hibbert, Ph.D. Student Advised by Nilon –

- Awarded MU STEM GK-12 Graduate Fellowship 2011-1012

David Jachowski, Ph.D. Student Advised by Millspaugh –

- TransWorld Airlines Scholarship (2011-2012)
- The Wildlife Society Student Travel Grant (2011)

John (Jack) Jones –

- 2011 Outstanding Research Award, North American Lake Management Society.

Dylan Kesler –

- American Ornithologists Union *Elective Member*. Honored for academic accomplishments in ornithology.

Robert Pierce

- Pheasants and Quail Forever Partnership Award in collaboration with T. Reinbott, Superintendent, MU Bradford Research Center, 2012

Christopher Rota, Ph.D. Student Advised by Millspaugh and Kesler –

- South Dakota Game, Fish and Parks Wildlife Diversity Small Grants Program. 2012.
- Student Travel Scholarship. University of Missouri Graduate Professional Council. 2012
- TransWorld Airlines Scholarship. University of Missouri. 2012.
- Judy Southern Fellowship. Univ. of Missouri Dept. of Fisheries and Wildlife Science. 2012.
- James D. Chambers Memorial Scholarship. Missouri Chapter of the Wildlife Society. 2012.
- Student Travel Grant. University of Missouri Organization Resource Group. 2011.
- Graduate Fellowship Award. Missouri Chapter of the Wildlife Society. 2011.

Richard Stanton Jr., M.S. Student Advised by Kesler and Thompson –

- Student Travel Grant, University of Missouri Organization Resource Group, 2012.
- Student Travel Award, North American Ornithological Conference, 2012.
- Carl Morrow Graduate Scholarship, Conservation Foundation of Missouri, 2012.
- Graduate Research Scholarship, Audubon Society of Missouri, 2011.
- Menke Scholarship for Wildlife Habitat, Webster Groves Nature Study Society 2011.

Frank Thompson –

- U.S. Forest Service Wings Across the Americas 2010 Award for Outstanding Achievement in Conservation for contributions to Bird Conservation Partnerships in Mesoamerica.

Joanna Whittier –

- Invited presentation, Symposium on Climate Change, AFS, 2010.

