U.S. Geological Survey

South Dakota Cooperative Fish & Wildlife Research Unit

2018 Annual Report

October 2017 – September 2018

In Cooperation with:
South Dakota State University
South Dakota Department of Game, Fish & Parks
Wildlife Management Institute
U.S. Fish and Wildlife Service

South Dakota Cooperative
Fish and Wildlife Research Unit

FOREWORD

The U.S. Geological Survey, South Dakota Cooperative Fish & Wildlife Research Unit would like to extend our thanks to alumni, cooperators, students and staff for another productive year at South Dakota State University. Unit scientists are fortunate to work with a talented group of graduate students, research associates and agency biologists to address wildlife research needs in our state and region. Since 1963, over 255 students have received graduate degrees working with Unit scientists at the South Dakota Coop Unit.

Research at the South Dakota Coop Unit is conducted primarily by graduate students working in areas related to endangered species biology, wetland ecology, fisheries management, upland game ecology, big game management, and non-game species. The Unit is housed in the Department of Natural Resource Management at South Dakota State University, where we share a large supply of field equipment and laboratory facilities. The USGS EROS Data Center and the GIS Center of Excellence (GISCE) at SDSU provide unique resources and collaborative opportunities for the South Dakota Coop Unit.

In 2010, Professor Emeritus and Assistant Unit Leader Dr. Kenneth F. Higgins (retired) established the *Kenneth F. Higgins Waterfowl Legacy Research Endowment,* directed at supporting graduate student research that benefits wetland-dependent avian species. Contributions to the endowment can be made by contacting the SDSU Alumni Association (888.735.2257; alumni@statealum.com).

Continuing our long-standing tradition of cooperative research, the South Dakota Coop Unit looks forward to addressing research needs of our state and federal partners to better manage fish and wildlife resources in the Northern Great Plains. Feel free to contact us for more information.

Steven R. Chipps, Unit Leader
Larry M. Gigliotti, Assistant Unit Leader
Joshua D. Stafford, Assistant Unit Leader

UNIT ADDRESS: U.S. Geological Survey, South Dakota Cooperative Fish and Wildlife Research Unit, McFadden Biostress Laboratory, NRM Box 2140B, 1390 College Ave, Brookings, SD 57007; telephone: 605-688-4777; fax: 605-688-4515; e-mail: Jiyoung.Kim@sdstate.edu; http://www.coopunits.org/South_Dakota/

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UNIT STAFF AND COOPERATORS

DR. STEVEN R. CHIPPS
Unit Leader and Adjunct Professor
Fisheries Management and Ecology
Steven.Chipps@sdstate.edu

DR. JOSHUA D. STAFFORD
Assistant Unit Leader and Adjunct Associate Professor
Waterfowl and Wetlands Ecology and Management
Joshua.Stafford@sdstate.edu

DR. LARRY M. GIGLIOTTI
Assistant Unit Leader and Adjunct Assistant Professor
Human Dimensions of Wildlife Management
Larry.Gigliotti@sdstate.edu

MRS. JIYOUNG KIM
Unit Administrative Support Specialist
Jiyoung.Kim@sdstate.edu

COOPERATORS

South Dakota State University (SDSU); South Dakota Game, Fish and Parks (GFP); U.S. Geological Survey (USGS); Wildlife Management Institute (WMI); and the U.S. Fish and Wildlife Service (USFWS).

COORDINATING COMMITTEE

Tony Leif
Director
Wildl. Div. SDGFP
523 East Capitol Avenue
Pierre, SD 57501-3182

Dr. Stephen Torbit
Assistant Regional Director
USFWS-Mountain Prairie
Denver Federal Center
P. O. Box 25486, DFC
Denver, CO 80225-0486

Dr. Bill Moritz
Midwest Field Representative
Wildlife Management Institute
Lansing, MI 48909

Dr. John Killefer
Dean
College of Agriculture, Food and Environ. Sci.
SDSU, Box 2207
Brookings, SD 57007

Dr. Michael Tome
Unit Supervisor
USGS Coop. Res. Units
206 4th Avenue
Brunswick, MD 21716

RESEARCH PERSONNEL

Fulbright Scholar
Dr. Murugan Muthiah

Ph.D. candidates
Brandi Felts
Hanxiao Feng
Samantha Fino
Aaron Sundmark

M.S. candidates
Cynthia Anchor
Justin Brown
Austin Galinat
Charles "Will" Gallman
Rebecca Kolstrom
Joe Mrnak
Sarah Nevison
Sarah Potthoff
Travis Rehm
Alex Rosburg
Jill Voorhees
Kelsen Young

Undergraduate research technicians
Amber Acker
Jason Augspurger
Brianna Becher
Michael Bredeson
Wesley Bowen
Marlin Dart
Carly Folsom
Derek Hartl
Tiffany Hennigs
Ryann Mann
Matthew McBride
Jena Neirman
Isaiah Porteous
Calvin Rezak
Holiday Robley
Riley Schubert
Evan Ward
Rebecca Watkins
Sara Watkins
Kassidy Weathers
John Wolthuizen
Josh Zylstra

COOPERATING FACULTY – SOUTH DAKOTA STATE UNIVERSITY

Name	Department	Cooperative Activity
Mr. Peter Bauman	Natural Resource Management	Land use/change
Dr. Michael Brown	Natural Resource Management	Limnology studies
Dr. James Doolittle	Associate Vice President	Administration
Dr. Michele Dudash	Head, Natural Resource Management	Administration
Dr. Brian Graeb	Natural Resource Management	Fish ecology studies
Dr. Jonathan Jenks	Natural Resource Management	Wildlife ecology
Dr. Kent Jensen	Natural Resource Management	Bird studies
Dr. Carol Johnston	Natural Resource Management	Wetland ecology
Dr. Lora Perkins	Natural Resource Management	Neonicotinoids
Dr. Daniel Scholl	Vice President, Research	Administration
Dr. Nels Troelstrup	Natural Resource Management	Oak Lake Field station
Mr. Anthony Bly	SDSU Extension	Cover crop production
Mr. Gared Shaffer	SDSU Extension	Herbicides/cover crops
Dr. Tong Wang	Department of Economics	Natural Resource Economics

REGIONAL COOPERATING SCIENTISTS

Name (South Dakota Unit Person)	Agency/University	Subject
Dr. Michael Anteau (Stafford)	USGS – NPWRC	Wetland and waterbird health
Mr. Michael Barnes (Chipps)	SD GFP/SDSU	Salmonid ecology
Dr. Brian Blackwell (Chipps)	SD GFP/SDSU	Fish ecology
Dr. James Breck (Chipps)	MI DNR	Fish bioenergetics
Dr. John Coluccy (Stafford)	Ducks Unlimited, Inc.	Conservation planning
Mr. Jake Davis (Chipps)	SD GFP	Black Hills trout
Dr. David Deslauriers (Chipps)	Canada DFO	Sturgeon bioenergetics
Dr. Michael Eichholz (Stafford)	Southern Illinois University	Migration ecology
Dr. Robert Gates (Stafford)	The Ohio State University	Spring-migration ecology
Dr. James Garvey (Chipps)	Southern Illinois University	Fish ecology
Mr. Rob Holm (Chipps)	FWS-Garrison, ND	Pallid sturgeon
Dr. Daniel James (Chipps)	FWS-Pierre, SD	Pallid sturgeon
Dr. Dylan Kesler (Stafford)	University of Missouri	Avian ecology, modeling
Dr. Wes Larson (Chipps)	University of Wisconsin-Stevens Point	Fish genetics
Mr. Dave Lucchesi (Chipps)	SD GFP	Small impoundments
Dr. Jonathan Lundgren (Stafford)	Blue Dasher Farms	Pesticides
Dr. Charlie Madenjian (Chipps)	USGS Great Lakes Science Center	Fish bioenergetics
Dr. Brian McLaren (Chipps)	Lakehead University	Lake sturgeon ecology
Mr. Rocco Murano (Stafford)	SD GFP	Waterfowl ecology
Dr. Ben O'Neal (Stafford)	Franklin College	Radar ornithology
Dr. Aaron Pearse (Stafford)	USGS – NPWRC	Biometrics
Dr. Kevin Pope (Chipps)	University of Nebraska	MOCC training
Mr. Jeff Powell (Chipps)	FWS, Gavins Point	Pallid sturgeon
Dr. James Rice (Chipps)	North Carolina State University	Fish bioenergetics
Dr. Greg Sass (Stafford)	Illinois Natural History Survey	Integrated wetland management
Mr. Greg Simpson (Chipps)	SD GFP	Black Hills trout
Dr. James Stone (Chipps)	SD School of Mines & Technology	Hg Studies
Dr. David Wahl (Chipps)	Illinois Natural History	Bioenergetics
Mr. Matt Ward (Chipps)	SD GFP	Walleye foraging
Dr. Tammy Wilson (Gigliotti)	National Park Service	Wildlife/Human dimensions
Mr. Jeff Zimprich (Chipps)	USDA – NRCS	Cover crops

ADMINISTRATIVE SUPPORT

SOUTH DAKOTA DEPARTMENT OF GAME, FISH & PARKS

The South Dakota Coop Unit works closely with SD Department of Game, Fish and Parks. We thank Tony Leif, Tom Kirschenmann, John Lott, Geno Adams, Chad Switzer, Eileen Dowd Stukel and Emmett Keyser for their administrative assistance. We are particularly grateful to Tanna Zabel for her help and assistance with Federal Aid coordination.

SOUTH DAKOTA STATE UNIVERSITY

The Unit receives administrative support from SDSU and we wish to thank Dr. Michele Dudash, Jiyoung Kim, Beth Byre, and Kathryn Tvedt from the Department of Natural Resource Management. We also thank Martha Aragon, Dean Kinchel Doerner, President Barry Dunn, Dr. James Doolittle, Dr. William Gibbons, Shirley Jensen, Dean John Killefer, Dr. Don Marshall, Jill O'Neil, Kay Scheibe, Dr. Daniel Scholl, Ann Taecker, and Doug Ward for their support of the USGS, South Dakota Coop Unit.

US GEOLOGICAL SURVEY, COOPERATIVE RESEARCH UNIT PROGRAM

The USGS-CRU Headquarters staff in Reston, VA provide guidance and assistance to Unit personnel. We thank Shana Coulby, Brenda Croston, Don Dennerline, Derek Geary, Shauna Leavitt, Amanda Maslowski, Nicholas Oris, Melissa Thode, Mike Tome, John Thompson and John Organ for their advice and assistance.

US FISH AND WILDLIFE SERVICE

We thank the Great Plains Fish & Wildlife Management Office, Gavin's Point National Fish Hatchery, Garrison National Fish Hatchery, and the National Wildlife Refuge offices for continued support of Unit-related research.

PROGRAM DIRECTION STATEMENT

The Unit's program direction is reviewed annually by our Coordinating Committee. The overall program direction will be to conduct research to benefit management of Northern Great Plains habitats, biota, and human dimensions. Wetland and upland research in the Prairie Pothole Region will incorporate landscape-level influences of natural and anthropogenic variation on the fish, wildlife, invertebrates, and plant communities in this region. Ecological services – such as water quality, livestock forage, flood reduction, ground water recharge, esthetics, and fishery potential – will be included in research efforts when appropriate. Aspects of wetland and upland research will address conservation needs, production of waterfowl and other avifauna, human dimensions of wildlife management, and integration with agricultural and aquaculture practices. Fisheries research will focus on the management, conservation, and production of native species and sport fishes. The Unit will develop collaborative and integrative research programs with state, federal, and NGO agencies to address emerging issues dealing with climate change, land-use patterns, invasive species, and conservation of fish and wildlife of the Northern Great Plains. Because of its socio-economic and recreational value, the Missouri River provides unique challenges and opportunities in the region. Thus, the study of native, endangered, and introduced fishes and wildlife of the Missouri River will continue to be a focus of Unit research.

ALUMNI NEWS

Cooperators of the South Dakota Coop Unit provide critical support for the Unit program and in return, they benefit from research products and technical training associated with graduate education. Job placement and professional accomplishment are testaments to the success of students and research associates who have moved on to careers with Federal, State, or Non-government (NGO) agencies – as well as academic institutions in the U.S. and Canada. A few recent alumni happenings:

ALEX ROSBURG (M.S. 2017) recently accepted a position as a Fisheries Biologist with South Dakota Department of Game, Fish and Parks; Alex is stationed at the Cleghorn State Fish Hatchery in Rapid City, SD.


Alex Rosburg

LAURA HEIRONIMUS (M.S. 2014) accepted a new position as a Sturgeon Biologist with the Washington Department of Fish and Wildlife in Ridgefield, Washington. Prior to this position, Laura worked for the U.S. Fish and Wildlife Service in Sacramento, California.


Laura Heironimus

MIKE GREINER (M.S. 2011) accepted a new position as the Aquatic Invasive Species Coordinator for the South Dakota Department of Game, Fish and Parks in Pierre, SD. Prior to his new position, Mike was a Resource Biologist stationed at the Missouri River Fisheries Center.

HILARY MEYER (M.S. 2011), a Fisheries Biologist at the Missouri River Fisheries Center in Pierre, SD was recently recognized by South Dakota Department of Game, Fish and Parks for her distinguished service and contributions to South Dakota fisheries.

DR. STEPHANIE SHAW (M.S. 2010) works as a Research Scientist with the Wisconsin Department of Natural Resources and is stationed at the Escanaba Lake Research Station. Prior to Stephanie's position with the Wisconsin DNR, she worked with Largemouth Bass at the University of Florida with Dr. Michael Allen.


Dr. Stephanie Shaw

COMPLETED PROJECTS

Growth Potential and Genetic Diversity of Yellow Perch in South Dakota

Yellow Perch *Perca flavescens* represent a valued sport fish throughout their. In South Dakota, two distinct population types of Yellow Perch have been characterized that differ in growth, survival, and recruitment patterns. Fast growth populations exhibit high growth rates, high mortality, low population density, and inconsistent recruitment. In contrast, slow growth populations are characterized by reduced growth rates, low mortality, high population density, and relatively consistent recruitment. The role of genetics in contributing to these population characteristics is currently unknown. To address these questions, I used high-throughput restriction-site associated DNA (RAD) sequencing to scan the Yellow Perch genome for genetic markers associated with population type. A combination of laboratory and field common garden experiments was used to compare relative growth and survival of age-0 Yellow Perch from the two population types. Eighteen markers that significantly differed between population types were identified through RAD sequencing; however, low allele frequency differences indicated weak support for correlation to the growth differences between populations. The laboratory and common garden experiments showed no significant differences in specific growth rates between fast and slow growth Yellow Perch populations. The results of this study indicate that Yellow Perch growth is influenced more by environmental conditions within individual lakes than heritable genetic differences between population types. Link to thesis: https://openprairie.sdstate.edu/etd/2163/

FUNDING
South Dakota Department of Game, Fish & Parks

STUDENT RESEARCHER
Alex Rosburg, M.S.

FACULTY/PRINCIPAL INVESTIGATORS
Brian Blackwell (GFP), Steve Chipps (USGS), Justin VanDeHey (UWSP), Wes Larson (UWSP)

COMPLETED
November 2017

Status of Reintroduced Swift Fox in Southwestern South Dakota

Swift foxes (*Vulpes velox*) were reintroduced into Badlands National Park between 2003 and 2006 after being nearly extirpated from South Dakota in the early 1900's. Genetic analysis provided strong evidence that the reintroduction was successful, but viability analysis indicated the population might be in jeopardy with a high probability of extinction. Recently, the population has declined due to various biotic and abiotic factors (e.g., recent weather patterns, effects of plague [*Yersinia pestis*], and increased coyote [*Canis latrans*] numbers). The objectives of this study were to 1) document the current distribution of swift foxes in southwestern South Dakota; 2) estimate survival and cause-specific mortality; 3) document active dens to estimate reproductive success; and 4) assess the presence of swift foxes in areas affected by plague. Over 1,000 scent stations were deployed across a seven county area in southwest South Dakota but swift foxes were detected at only 1.7% of the stations. Forty-six swift foxes were trapped, radio-collared, and tracked around Badlands National Park, and 12 natal dens were monitored. Yearly reproductive success averaged 4.3 ± 0.3 pups per mated pair. Apparent annual survival for collared adults was 0.51 (95% CI = 0.24–0.69; n = 14), and for collared pups was 0.19 (n = 8). Cause-specific mortality of collared foxes was attributed to vehicle collision (n = 7; 33.3%), coyote (n = 7; 33.3%), raptor (n = 3; 14.3%), and unknown origin (n = 4; 19.1%). Antibodies to *Y. pestis* were found in 69.9% of sampled foxes using enzyme-linked immunosorbent assay (ELISA) analysis. Data from this study raises concern for the status of the population. An apparent decline in distribution, a decline in numbers around Badlands National Park, a decreased survival rate in pups, and the presence of plague may lead this population to extinction in the near future. Another reintroduction is not recommended until factors correlated to the decline are mitigated and swift fox presence is determined in other regions of South Dakota. Link to thesis: https://openprairie.sdstate.edu/etd/2152/

FUNDING
U.S. Geological Survey/NRPP (RWO # 111)

STUDENT RESEARCHER
Sarah Nevison, M.S.

FACULTY/PRINCIPAL INVESTIGATORS
Jon Jenks (SDSU), Josh Stafford (USGS),
Eddie Childers (NPS) and Josh Delger (NPS)

COMPLETED
December 2017

Influence of Dietary Bioprocessed Plant-Based Protein on Salmonid Rearing Performance

Carnivorous fish species, like rainbow trout, *Oncorhynchus mykiss*, require high levels of dietary protein. Historically, fish meal has been the primary protein source, but supply can be variable and relatively expensive. Alternative protein sources are needed to meet the dietary protein demand for ever-increasing aquaculture production. In addition to specific dietary requirements, salmonids may react positively to exercise during hatchery rearing, with increased growth and feed conversion. While fishmeal alternatives have received considerable research focus, no studies have examined the use of plant-based diets in conjunction with exercise. In this study, we examined the replacement of fishmeal with fermented soybean meal product in salmonid diets during typical hatchery rearing practices, and evaluated the utility of this alternative protein source in the diets of salmonids subjected to rigorous exercise during hatchery rearing. Based on the results of these experiments, bioprocessed soybean meal can replace 100% of the fishmeal in diets of Brown Trout during normal rearing, and at least 60% of the fishmeal during continual exercise. Bioprocessed soybean meal can replace at least 80% of Rainbow Trout diets, regardless of the exercise regimen. Link to thesis https://openprairie.sdstate.edu/etd/2429/

FUNDING
South Dakota Department of Game, Fish & Parks

STUDENT RESEARCHER
Jill Voorhees, M.S.

FACULTY/PRINCIPAL INVESTIGATORS
Mike Brown (SDSU), Michael Barnes (GFP) and Steve Chipps (USGS)

COMPLETED
May 2018

Influence of Fish Density on Growth Rate of Brown Trout in Spearfish Creek, South Dakota

Density-dependent growth is often observed in stream-dwelling Brown Trout *Salmo trutta* populations. In Spearfish Creek, South Dakota, biomass of adult Brown Trout (>200 mm) is about three times greater than that reported for similar Black Hills streams while mean length of adult fish is about 30% less. Here, we evaluate large-scale density reduction as a management tool for improving growth rate of stream-dwelling Brown Trout. We compared age-specific growth of wild Brown Trout in stream sections receiving 50% reductions in fish abundance. Annual growth in length and weight of older Brown Trout (> age 2) generally increased following fish removals; we observed significantly greater growth for age-3 and 4 fish (162 to 258 %) in stream sections receiving density reductions. Bioenergetics modeling revealed that annual consumption by smaller Brown Trout (ages 1 and 2) was dominated by small aquatic invertebrates (91 %) with terrestrial invertebrates comprising only (9%). In contrast, larger Brown Trout (ages 3-6) consumed more terrestrial prey (35%) in order to meet annual energy requirements. In most cases, consumption of aquatic invertebrates by large Brown Trout was insufficient to meet annual maintenance requirements. As a result, we postulate that growth rate of larger fish is more responsive to density reduction, owing to constrains imposed by availability of aquatic invertebrates. Improved growth rate and reductions in intraspecific competition during our study (~1 year) are promising for large-scale density reduction as a management technique to improve the growth of stream-dwelling Brown Trout.

FUNDING
South Dakota Department of Game, Fish & Parks

STUDENT RESEARCHER
Travis Rehm, M.S.

FACULTY/PRINCIPAL INVESTIGATORS
Steve Chipps (USGS), Jake Davis (GFP)

COMPLETED
September 2018

ONGOING PROJECTS

Investigating the Role of Super-shedders in Respiratory Disease Persistence and Transmission in Bighorn Sheep

Bighorn sheep (*Ovis canadensis*) respiratory disease is a major impediment to recovering bighorn sheep populations in western North America. Current understanding of the transmission dynamics of respiratory pathogens, believed to play a role in the etiology of this disease, is limited. The purpose of this study is to investigate aspects of these transmission processes, and specifically to determine if variability exists in the shedding rates of pathogens within individual bighorn sheep and the importance of this variability in sustaining the disease. Our hypothesis is that respiratory disease persists in bighorn sheep populations through infection of a small number of chronically infected or "super-shedder" animals that drive disease transmission in bighorn sheep herds. To test this hypothesis, we will capture free-ranging bighorn sheep with a known history of pathogen shedding and house them in a captive facility. We will then monitor their pathogen shedding patterns through time and classify individuals as either chronic, intermittent or non-shedders. Once we have established their shedding status we will perform experiments of individuals from the various groups, and monitor shedding rates to determine if an individual's shedding status changes based on its association with individuals exhibiting different shedding patterns. We will also monitor the effect of commingling on individual lamb survival. Through this experiment, we hope to elucidate the importance of pathogen shedding patterns in bighorn sheep respiratory disease that will lead to the development of effective management strategies to recover bighorn sheep populations.

FUNDING
U.S. Geological Survey (RWO # 113)

STUDENT RESEARCHER
Brandi (Crider) Felts, Ph.D. candidate

FACULTY/PRINCIPAL INVESTIGATORS
Jon Jenks (SDSU), Dan Walsh (USGS), Francis Cassirer (IDFG) and Tom Besser (WSU)

EXPECTED COMPLETION
December 2018

An assessment of neonicotinoid exposure on USFWS high diversity grasslands in the Prairie Pothole Region

Neonicotinoids are a class of neuro-active insecticides developed in the 1990s because of widespread pest resistance and environmental objections to organophosphorus insecticides. In developed countries, neonicotinoids are predominantly used as seed treatments but their widespread use is partly due to their flexibility of use (i.e., foliar sprays on horticultural crops, direct applications to soil and water). Neonicotinoids are now the most widely used class of insecticides world-wide. However, the amount of insecticide that reaches its intended target is generally low at 2-20.0%; the remaining 80-98% accumulates in soil and water. Recent concern over neonicotinoids is, in part, due to their acute toxicity to non-target species such as birds, mammals, bees, butterflies, and aquatic invertebrates. However, limited data exists concerning the uptake of neonicotinoids on non-target plants. Given the persistence and accumulation of neonicotinoids in soil and water, uptake by non-target plant species would be expected. However, data on persistence of neonicotinoids once absorbed by plants are sparse and accumulation in plant tissue may be species-specific. In this study we will estimate rate of uptake and accumulation of neonicotinoids in native plants in South Dakota on U.S. Fish and Wildlife Service remnant native and restored grasslands as a function of surrounding land use. In addition, we will estimate presence and concentration of neonicotinoids in soils, and estimate the decay of neonicotinoids as it relates to the distance from crop fields. These data will provide important information to guide management of native and restored grasslands, especially those intended to promote the health and persistence of pollinating insects.

FUNDING
U.S. Fish and Wildlife Service (RWO #114)

INVESTIGATOR
Jonathan Lundgren, Blue Dasher Farm and the Ecdysis Foundation
Kyle Kelsey (FWS)
Kassidy Weathers, student researcher
Michael Bredeson, student researcher

FACULTY
Joshua Stafford (USGS)

EXPECTED COMPLETION
December 2020

Social & Economic Impact of Fishing in Selected Small Lakes & Impoundments in South Dakota

South Dakota Game, Fish and Parks (GFP) has expressed a need for information to estimate the Direct Economic Impact (DEI) of fishing and other water-related recreation in selected small lakes and impoundments to local and state economies. GFP's strategic plan for the East River Fisheries Management Area lists a total of 257 natural lakes and impoundments. The strategic plan for West River Fisheries Management area lists two natural lakes and over 100 small lakes and ponds under GFP management, and the strategic plan for the Black Hills Fisheries Management Area lists 47 small lakes and ponds under GFP management. Over time many of these lakes will require expensive habitat renovation projects (e.g. dam repair, dredging, docks and boat ramps, complete fish renovations, etc.) to improve or maintain quality recreational services. Economic information of the value of fishing and other water-related recreation can help inform decisions regarding expensive habitat renovation projects. Combined with usage information we will estimate the value of recreational activities at various lakes to justify projected expenditures for improving amenities and services provided by South Dakota.

FUNDING
South Dakota Department of Game, Fish & Parks

STUDENT RESEARCHER
Aaron Sundmark, Ph.D. candidate

FACULTY/PRINCIPAL INVESTIGATOR
Larry Gigliotti (USGS)

EXPECTED COMPLETION
May 2019

Structured Decision Support for Bald Eagle Monitoring in Alaska

Bald eagle (*Haliaeetus leucocephalus*) populations are susceptible to environmental contaminants. Consequently, bald eagles are a "vital sign" monitored by the Southwest Inventory and Monitoring Network (SWAN) in cooperation with Lake Clark National Park and Preserve (LACL), Katmai National Park and Preserve (KATM), and Kenai Fjords National Park. Inconsistencies in objectives and perceptions of state-variable importance between parks have made it difficult to integrate sampling designs under a regional protocol. It is important for the sustainability of the bald eagle monitoring program to conduct a formal process involving scientists and resource managers at the National Parks in Alaska that elucidates common objectives and fosters consensus and buy-in. Our goal is to develop a structured decision process that uses surveys to identify core values, set objectives, develop reasonable sampling scenarios, and choose an optimal sampling regime that optimizes objectives and minimizes cost.

FUNDING
National Park Service (RWO #115)

STUDENT RESEARCHER
Rebecca Kolstrom. M.S. candidate

FACULTY/PRINCIPAL INVESTIGATORS
Tammy Wilson (NPS), Larry Gigliotti (USGS), and Michele Dudash (SDSU)

EXPECTED COMPLETION
May 2019

Effect of water velocity and temperature on energy reserves, growth, and survival of larval Pallid Sturgeon *Scaphirhynchus albus*

As with most fishes, recruitment limitation for Pallid Sturgeon occurs during early life history. Recent work in the upper Missouri River has linked anoxic conditions in river-reservoir transition zones to recruitment failure in Pallid Sturgeon. In addition to oxygen availability, water velocity plays an important role in affecting dispersal and survival of larval Pallid Sturgeon in the Missouri River. Larval Pallid Sturgeon require longer migration distances and drift at faster rates than Shovelnose sturgeon (*Scaphirhynchus platorynchus*). As a result, we see distinct, behavioral differences between larval Pallid and Shovelnose sturgeon in the transition from drifting to benthic foraging behavior. Empirical data also reveal that larval Pallid Sturgeon can take over twice as long (~14 days post hatch, dph) as Shovelnose Sturgeon (~6 dph) to switch from endogenous to exogenous feeding. Thus, the combined effects of water velocity (i.e., dispersal rate) and water temperature (i.e., development rate) play an important role in affecting the dispersal distance of Pallid Sturgeon larvae from hatching locations. The objective of this study is to quantify the combined effects of water velocity and temperature on growth, energy reserves, survival, and estimated dispersal of endogenous larval Pallid Sturgeon.

FUNDING
U.S. Department of Energy (WAPA)

STUDENT RESEARCHER
Joseph Mrnak, M.S. candidate

FACULTY/PRINCIPAL INVESTIGATORS
Steve Chipps (USGS) and Dan James (FWS)

EXPECTED COMPLETION
September 2019

Evaluation of cover crops for grassland nesting waterfowl and upland game birds in Eastern South Dakota

Eastern South Dakota lies in the Prairie Pothole Region, and is the primary breeding ground for most (50-80%) North American waterfowl. Historically, the region was dominated by mixed and tallgrass prairies, interspersed with wetlands, resulting in exceptional breeding habitat for waterfowl and other grassland nesting birds. Widespread conversion to cropland, however, has resulted in the loss of >70% of native grasslands, with concomitant declines in many grassland obligate avifauna. Government conservation programs, such as the Conservation Reserve Program (CRP), have resulted in the restoration of croplands to perennial grass cover, with beneficial results for birds. However, high commodity prices have led many landowners to convert expiring CRP contracts back to row crops, resulting in widespread loss of suitable habitat. One important method that may provide cover for grassland dependent wildlife is the use of cover crops. Cover cropping involves planting supplemental stands of annual grasses and/or broadleaf vegetation in conjunction with growing crops or in between conventional cash crop rotations. Agronomic and environmental benefits to cover cropping systems are diverse including increased soil quality, nutrient scavenging, reduced soil loss, nitrogen fixation, water management, and reduced compaction. Although the economic and environmental impacts of cover cropping have been documented, potential benefits to ground nesting birds have not been evaluated.

FUNDING
Ducks Unlimited, Inc.; South Dakota Department of Game, Fish & Parks

STUDENT RESEARCHER
Charles "Will" Gallman, M.S. candidate

FACULTY/PRINCIPAL INVESTIGATOR
Joshua Stafford (USGS)

EXPECTED COMPLETION
December 2019

Influence of mink predation on Brown Trout survival and size-structure in Rapid Creek, South Dakota

Beginning in the early 2000s, declines in brown trout (*Salmo trutta*) abundance in Rapid Creek, South Dakota concerned fisheries managers. Annual population surveys indicated that abundance of adult brown trout (> 200 mm total length) had declined by approximately 70%. Although environmental conditions such as drought can influence standing stock of brown trout, factors affecting trout survival are poorly known. Recent data from Rapid Creek shows that growth and condition of adult trout is high compared to other populations in the Black Hills. Additionally, diet analysis of brown trout in Rapid Creek shows that food availability is an unlikely source of mortality. However, recent work by Davis et al. (2016) showed that predation by mink (*Mustela vison*) accounted for up to 32% of brown trout mortality in Rapid Creek, with over 83% of mink-related predation events occurring during the spring. Limited refuge habitat (e.g., deep pools) combined with high water clarity in Rapid Creek may enhance capture and foraging success by mink on adult trout. Moreover, the lack of stationary ice cover in tail water reaches such as that below Pactola Reservoir has been linked to increased predation on trout by predators such as mink and river otter (*Lutra lutra*). At present, factors affecting mink-trout interactions within and downstream of the catch-and-release area is unknown. The purpose of this project is to assess impacts of mink predation on trout populations in Rapid Creek, Pennington County, South Dakota. Data gathered in this study will provide insight into the effectiveness of management techniques such as instream habitat improvements and (or) predator block management on trout populations.

FUNDING
South Dakota Department of Game, Fish & Parks

STUDENT RESEARCHER
Austin Galinat, M.S. candidate

FACULTY/PRINCIPAL INVESTIGATORS
Steve Chipps (USGS) and Jon Jenks (SDSU)

EXPECTED COMPLETION
December 2019

Post-fledging ecology of hatch year mallards in North and South Dakota

Mallards (*Anas platyrhynchos*) are one of the most studied waterfowl species, yet sparse research investigated their ecology during the post-fledging period, prior to fall migration. The behavior and physiology of young mallards during this time may be unique as they learn to fly and navigate, exploit new forage and wetland types, develop settling and social cues, molt, avoid predators, changes social status and bonds, and anticipate migration. Indeed, these life-history events differ considerably from those of adult mallards, suggesting there may be important differences in movement patterns and habitat requirements between adults and juveniles. Past waterfowl studies of movement ecology faced technical limitations due to transmitter size, strength and range of tracking equipment, and cost. However, the advent of new satellite technology, reduced transmitter size and cost, and increased battery life now allows investigation of avian movements over larger spatial and temporal extents. Survival of juvenile mallards during the autumn is also an integral component of recruitment to the breeding population, and the ability to these new technologies, specific to hatch year mallards during this sensitive time, will provide critical information to inform management decisions in North and South Dakota.

FUNDING
North Dakota Game and Fish Department; South Dakota Department of Game, Fish & Parks

STUDENT RESEARCHER
Cynthia Anchor, M.S. candidate

FACULTY/PRINCIPAL INVESTIGATOR
Joshua Stafford (USGS)

EXPECTED COMPLETION
December 2020

Predator Dynamics and Nest Success: Changes in Foraging Patterns as a Function of the Predator Community and Landscape Composition

Predator-prey interactions influence vital rates and predation is a major cause of nest failure of ground-nesting birds (i.e., ring-necked pheasants, waterfowl). Understanding the ecology of predation and predator movements is critical to explain predator-prey interactions, habitat use (spatial and temporal), and foraging of nest predators. Predator movements are influenced by patch dynamics and spatial configuration of patches on the landscape and grassland patch dynamics are known to influence nest success of ground-nesting birds. Larger blocks of grassland have been associated with increased nest success of waterfowl, whereas multiple patches of intermediate-sized grassland within agricultural landscapes were associated with low nest success, most likely from predation. Finally, variation in the composition of the predator community can influence nest survival and influence nest-site selection. Identifying habitat characteristics associated with high reproduction and survival of grassland-nesting birds is an important research priority, particularly with respect to the "predator context". Understanding how habitat dynamics influence predator-prey interactions and nest success of ground-nesting birds will improve development of comprehensive management recommendations for remaining grasslands, restoration or reclamation efforts, and for active management programs that wish to modify grassland regimes or predator communities themselves to improve nesting habitat and nest survival.

FUNDING
South Dakota Department of Game, Fish & Parks, Ducks Unlimited Canada (Bonnycastle Fellowship), & Ducks Unlimited, Inc.

STUDENT RESEARCHER
Samantha Fino, Ph.D. candidate

FACULTY/PRINCIPAL INVESTIGATOR
Joshua Stafford (USGS)

EXPECTED COMPLETION
May 2021

Post-stocking survival of Rainbow Trout in Black Hills impoundments

Harvest rate of stocked Rainbow Trout in small lakes and reservoirs (<40 acres) of the Black Hills, South Dakota is often below management objectives, raising concerns about the costs (trout production) and benefits (angler use) of the Rainbow Trout stocking program. To improve the cost/benefit of the Rainbow Trout stocking program, a better understanding is needed of factors affecting survival of post-stocked trout. The influence of stocking density, food availability, water quality and catch-and-release fishing on survival of stocked Rainbow Trout are poorly understood. Low survivorship of stocked trout may be linked to physiological and behavioral attributes of hatchery-reared trout when stocked into natural environments. The goals of this study are to evaluate factors affecting mortality of stocked Rainbow Trout in Black Hills lakes and make recommendations that enhance Game, Fish & Parks put-and-take stocking program.

FUNDING
South Dakota Department of Game, Fish & Parks

STUDENT RESEARCHER
Kelsen Young, M.S. candidate

FACULTY/PRINCIPAL INVESTIGATORS
Steve Chipps (USGS), Jake Davis (GFP), Mike Barnes (GFP), Jeremey Kientz (GFP)

EXPECTED COMPLETION
December 2020

Soil health economics in South Dakota

With an average annual soil erosion rate estimated at 7 tons per acre, U.S. cropland productivity can be greatly compromised now and in the future. Farmers and ranchers play a critical role in reversing this trend towards degradation. Their decisions to adopt conservation practices such as conservation tillage, diversified crop rotations, cover crops and integrated livestock crop production systems can help directly improve soil health. However, when it comes to adoption decisions, agricultural producers care about not only soil health but also the economic feasibility of these new conservation practices. Therefore, the goal of the project is to analyze the economics and risks associated with conservative farming practices, in addition to quantifying and characterizing the soil health impacts of such practices. Other things to test will be whether such ecologically based management practices increase crop yields and improve soil health indicators. One of the major difficulties for our project is the recruitment of neighboring farm pairs with different agricultural practices across South Dakota. So far, we have recruited five pairs of farmers for economics comparison purpose. Soil samples have also been taken from those farms. Meanwhile, we have completed the drafting of our survey questionnaire, covering sections such as general farm information, yield and input, machinery and land information as well as sections on conservative farming practices. We will also collect yield and soil health information on cross-the-fence fields for comparison purpose. The questionnaires will be distributed to at least five pairs of farmers during 2018, and we will continue recruiting more farm pairs for the next 2 years.

FUNDING:
USDA, Natural Resources Conservation Service (RWO 116)

STUDENT RESEARCHERS: Hanxiao Feng, Ph.D. candidate; Udayakumar Sekaran, Postdoc

FACULTY/PRINCIPAL INVESTIGATORS:
Tong Wang (SDSU), Sandeep Kumar (SDSU), Jack B. Davis (SDSU), Anthony Bly (SDSU), Hailong Jin (SDSU)

EXPECTED COMPLETION:
December 2020

Cover crop nutrient cycling in South Dakota

Cover Crop use is steadily becoming a field practice on South Dakota croplands. The many reasons for using a cover crop include forage for livestock, wildlife habitat, capture of inorganic nutrients that might harm the environment, and building of soil health through additions of carbon and formation of beneficial soil structure and aggregates. A popular question from agriculture producers is how do cover crops affect the cycling of soil nutrients and how does this influence the growth and yield of cash crops? A three-year project evaluating the nutrient cycling in the soil began in the fall of 2017 on 30 farm fields across South Dakota. The on-farm sites encompass three objectives that include (1) determine the influence of cover crop composition on nutrient cycling and production of cash crops, (2) quantify how cover crop composition and rate of nutrient loss effect crop yield and soil moisture and (3) evaluate how cover crop C:N ratio effects corn and sorghum nitrogen requirements. Cover crop residue and soil samples were obtained from plots during the fall of 2017 and spring of 2018. Nitrogen rates applied for corn were measured in the spring of 2018 and corn plots monitored for response to nitrogen addition. Soil moisture monitoring is currently underway at three locations across South Dakota.

FUNDING:
USDA, Natural Resources Conservation Service (RWO #117)

STUDENT RESEARCHER: Justin Brown, M.S. candidate

FACULTY/PRINCIPAL INVESTIGATORS: Anthony Bly (SDSU), David Karki (SDSU), Ruth Beck (SDSU), Chris Graham (SDSU), Howard Woodard (SDSU), Peter Sexton (SDSU), Shannon Osborn (USDA), Michael Lehman (USDA) and Jason Miller (USDA)

EXPECTED COMPLETION: December 2020

Herbicide residual effects on cover crops after corn silage and wheat

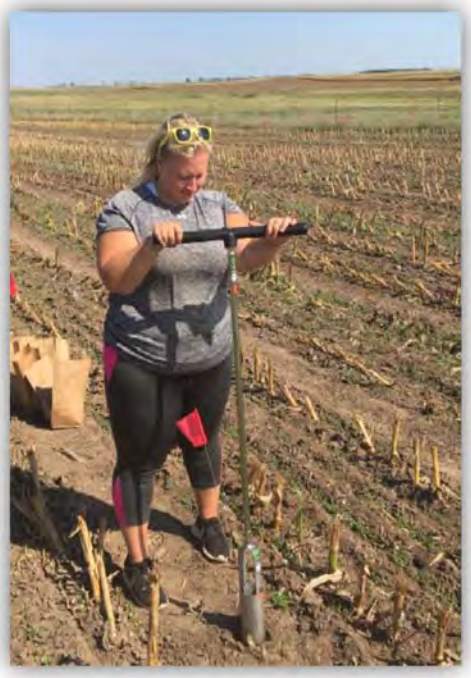
Interest in cover crops among South Dakota crop growers has increased in recent years. Producers have realized the need for scientific information on residual effects of commonly used herbicides on cover crops for proper incorporation of these species into their cropping systems. Therefore, it is imperative that information about herbicide residuals effects on cover crops is investigated in South Dakota. Surrounding states that include Minnesota, Iowa, Nebraska and Wisconsin have researched this topic to give their producers educational opportunities in learning how to integrate cover crops into their operations. This research will assist producers and consultants to continue making wise and informed decisions in common South Dakota cropping systems. Seven research sites have been established for the 2018 growing season. Four wheat stubble plots have been sprayed and drilled with cover crops. Three plot locations have been established with herbicide treatments and cover crops. Data collection will be accomplished in autumn 2018. The primary goal of this project is to increase grower knowledge of herbicide residuals from common herbicide programs used in silage corn and to help growers fine-tune their herbicide program. The research plots may be used for late season grower and professional agronomist tours and training events.

FUNDING:
USDA, Natural Resources Conservation Service (RWO #118)

STUDENT RESEARCHER:
Sarah Potthoff, M.S. candidate

FACULTY/PRINCIPAL INVESTIGATORS:
Gared Shaffer (SDSU), David Karki (SDSU), Anthony Bly (SDSU), Sara Bauder (SDSU), Ruth Beck (SDSU), and Paul Johnson (SDSU)

EXPECTED COMPLETION:
December 2020



TEACHING

STEVE CHIPPS

SPRING 2018: WL717 *Aquatic Trophic Ecology* (3 credits)

Analysis of selected biological processes influencing the organization of aquatic communities. Complex trophic interactions and their effects on the life histories and bioenergetics of aquatic organisms are examined.

FALL 2018: NRM 791 *Independent Study* (3 credits)

baseR for Biologists introduces students to concepts on data management and manipulation in R, including extracting subsets of data, data splitting, data control structures, merging and combining data, sorting, ranking and ordering data and looping data in R. The course also introduces basics of graph construction in R, including scatter plots, line plots, bar charts, and histograms. The on-line course was developed by Dr. Thomas Edwards, USGS, Utah Cooperative Fish & Wildlife Research Unit.

LARRY GIGLIOTTI

SPRING 2018: WL 724 *Advanced Human Dimensions (*3 credits)

This course is designed to provide students with an understanding of the social aspects of management and some practical applied human dimensions skills, via readings of a broad range of human dimensions literature and discussions of human dimensions concepts applied to natural resource issues.

SPRING 2018: WL 430 *Human Dimensions of Wildlife and Fisheries (*3 credits)

In this course students explore interactions among various stakeholders, resource management agencies, and the wildlife and fisheries resources using both national and international platforms. Topics such as public attitudes, motivations and expectations; agency structure, administration, and policy; tangible and intangible values of fish, wildlife, and their habitats; public relations; the philosophy and ethics of resource use and management; and, wildlife and fisheries law and its enforcement are included.

SPRING 2018: WL 792 *Adaptive Management & Structured Decision Making / Natural Resource Management planning (*1 credit)

This graduate course provided a basic understanding of the concepts and terms of strategic planning, adaptive management and structured decision-making.

AWARDS AND HONORS

SAMANTHA FINO was awarded the *Bonnycastle Fellowship in Prairie Ecosystem Studies* from Ducks Unlimited Canada in February 2018. This prestigious Fellowship provides substantial funding to support Sam's research and is renewable for up to 3 years.

SAMANTHA FINO was selected to receive the C. *David Ankney and Sandi Johnson Waterfowl and Wetlands Graduate Research Scholarship* in May 2018. This scholarship honors the memory of Dr. Dave Ankney, who was a well-known and extensively published waterfowl ecologist from Ontario, Canada.

CHARLES "WILL" GALLMAN was selected as the 2017 *Outstanding Undergraduate in Wildlife and Fisheries* at Clemson University in November 2017. The award is supported by the South Carolina Chapter of The Wildlife Society.

JOSEPH MRNAK was awarded the *Robert A. Klumb Memorial Student Travel Award* to attend the Missouri River Natural Resources Conference, Nebraska City, NE, March 2018.

JOSEPH MRNAK was selected to receive the *Robert A. Klumb Habitat, Aquatics, and Management of the Missouri River System (HAMMS) Award* by the Department of Natural Resource Management, South Dakota State University, Brookings, SD, April 2018.

JOSEPH MRNAK was a 2018 recipient of the *John E. Skinner Memorial Award* – presented at the 149th Annual meeting of the American Fisheries Society in Atlantic City, NJ, August 2018. The "Skinner Award" is one of the most prestigious student awards presented by the American Fisheries Society.

FRED OSLUND was selected to receive the 2019 *Susan "Gay" Simpson Memorial Award.* The award recognizes outstanding graduate research in waterfowl and wetlands ecology and is presented by the Central Flyway Technical Section Committee.

AARON SUNDMARK was selected to receive the 2018-19 *NRM Lloyd and Alice Fredrickson Memorial Scholarship in Fisheries Graduate Studies*, SDSU, Natural Resource Management (2018).

TRAVIS REHM was the 2018 recipient of the *Great Plains Fishery Worker Association Scholarship* presented by the Department of Natural Resource Management, South Dakota State University, April 2018.

Joseph Mrnak (left) is presented with the 2018 *John E. Skinner Memorial Scholarship* by Dr. Steven McMullin (center), President of the American Fisheries Society.

SCIENTIFIC PRESENTATIONS

1. Fino, S. R., J. D. Stafford, A. T. Pearse, J. A. Jenks, and R. C. Lonsinger. 2018. Relating predator community dynamics and duck nest survival in eastern South Dakota. 78th Midwest Fish and Wildlife Conference, Milwaukee, Wisconsin.

2. Fino, S. R., J. D. Stafford, A. T. Pearse, J. A. Jenks, and R. C. Lonsinger. 2018. Relating predator community dynamics and duck nest survival in eastern South Dakota. South Dakota Chapter of the Wildlife Society Annual Meeting, Chamberlain, South Dakota.

3. Fino, S.R., J.D. Stafford, A.T. Pearse, and J.A. Jenks. 2017. Predator community and duck nest success in eastern South Dakota. CRU Annual Meeting. Brookings, South Dakota.

4. Fopma, S., and L.M. Gigliotti. 2018. Assessing the opinions of native fish management in the Black Hills of South Dakota. 54th Annual Meeting of the Dakota Chapter American Fisheries Society. Brookings, South Dakota.

5. Galinat, A.G., S.R. Chipps, J.A. Jenks, J.L. Davis, and G. Simpson. 2018. Influence of Mink Predation on Brown Trout Survival and Size-Structure in Rapid Creek, South Dakota. 54th Annual Meeting of the Dakota Chapter American Fisheries Society, Brookings, South Dakota.

6. Gallman, C.W. and J.D. Stafford. 2018. Breeding waterfowl use and nest survival of fall-seeded cover crops in eastern South Dakota. South Dakota Ducks Unlimited State Convention, Chamberlain, South Dakota.

7. Gallman, C.W., J.D. Stafford, K.M. Carrlson. 2018. The evaluation of cover crops for grassland nesting waterfowl in eastern South Dakota. South Dakota Chapter of the Wildlife Society Annual Meeting, Chamberlain, South Dakota.

8. Gallman, C.W., J.D. Stafford, K.M. Carrlson. 2018. The evaluation of cover crops for grassland nesting waterfowl in eastern South Dakota. 78th Midwest Fish and Wildlife Conference, Milwaukee, Wisconsin.

9. Gigliotti, L.M., and L.A. Sweikert. 2017. Understanding North Dakota landowners' values, attitudes, and behaviors towards wildlife and wildlife habitat. North Dakota Administrators and Land Managers Meeting, Bismarck, North Dakota.

10. Gigliotti, L.M. and L.A. Sweikert. 2018. Understanding Montana landowners' values, attitudes and behaviors towards wildlife and wildlife habitat. 56th Annual Conference of the Montana Chapter of The Wildlife Society, Butte, Montana.

11. Gigliotti, L.M. and L.A. Sweikert. 2018. Human dimensions of habitat loss in the Plains and Prairie Pothole Region. Iowa Wildlife Bureau Statewide Meeting. Honey Creek State Park Lodge, Moravia, Iowa.

12. Gigliotti, L.M. 2018. Developing a mixed-mode harvest survey for collecting furbearer harvest data. Midwest Furbearer Workshop. Medora, North Dakota.

13. Kolstrom, R., T. Wilson, and L.M. Gigliotti. 2018. Developing a standardized monitoring program for Bald Eagles in Southwest Alaska National Parks. Joint Annual Meeting of The Alaska Chapter of The Wildlife Society & Northwest Section of The Wildlife Society, Anchorage, Alaska.

14. Kolstrom, R., L.M. Gigliotti, and T. Wilson. 2018. Development of a standardized monitoring program for bald eagles in the Southwest Alaska Network of National Parks. 78th Midwest Fish and Wildlife Conference, Milwaukee, Wisconsin.

15. Mrnak, J.T., S.R. Chipps, and D.A. James. 2018. Effect of water velocity on growth, survival, and energy reserves of endogenous Pallid Sturgeon *Scaphirhynchus albus* larvae. 54th Annual Meeting of the Dakota Chapter American Fisheries Society, Brookings, South Dakota.

16. Mrnak, J.T., S.R. Chipps, and D.A. James. 2018. Effect of water velocity on energy reserves and survival of endogenous Pallid Sturgeon *Scaphirhynchus albus* larvae. Missouri River Natural Resources Conference, Nebraska City, Nebraska.

17. Mrnak, J.T., S.R. Chipps, and D.A. James. 2018. Influence of water velocity on rheotactic behavior and energy reserves of endogenous Pallid Sturgeon *Scaphirhynchus albus* larvae. 149th Annual Meeting of the American Fisheries Society, Atlantic City, New Jersey.

18. Muruganandam M., and S.R. Chipps. 2017. Revisiting natural lakes for water quality assessment and management. Eastern South Dakota Water Conference, Brookings, South Dakota.

19. Rehm, T.R., S.R. Chipps, K.L. Young, J.L. Davis, and G. Simpson. 2018. Brown Trout movement in response to large scale population reduction. 78th Midwest Fish & Wildlife Conference, Milwaukee, Wisconsin.

20. Rehm, T.R., S.R. Chipps, J.L. Davis, and G. Simpson. 2018. Influence of Density Reduction on the Growth Rate of Individual Brown Trout. 54th Annual Meeting of the Dakota Chapter American Fisheries Society, Brookings, South Dakota.

21. Sundmark, A., and L.M. Gigliotti. 2018. Economic and spatial assessments of angling at small South Dakota lakes. 78th Midwest Fish and Wildlife Conference. Milwaukee, Wisconsin.

22. Sundmark, A., and L.M. Gigliotti. 2018. Factors explaining angler satisfaction in South Dakota: Is angler satisfaction related to angler evaluation of the South Dakota Game, Fish and Parks' customer service? 54th Annual Meeting of the Dakota Chapter American Fisheries Society. Brookings, South Dakota.

23. Sundmark, A., and L.M. Gigliotti. 2018. Economic contribution of angling at small South Dakota lakes. South Dakota Game, Fish and Parks' Summer Fisheries Meeting, Chamberlain, South Dakota.

24. Sundmark, A., and L.M. Gigliotti. 2018. Factors shaping the social value of small lakes to local communities in South Dakota. 148th Annual Meeting of the American Fisheries Society, Atlantic City, New Jersey.

25. Voorhees, J.M., M.L. Brown, S.R. Chipps, and M.E. Barnes. 2018. Inclusion of bioprocessed soybean product in diet and the effects exercise has on rearing performance of Brown Trout (*Salmo trutta*). 54th Annual meeting of the Dakota Chapter American Fisheries Society, Brookings, South Dakota.

26. Voorhees, J.M., M.L. Brown, S.R. Chipps, and M.E. Barnes. 2018. Impacts on Rainbow Trout *(Onchorhynchus mykiss)* rearing performance of dietary bioprocessed plant-based protein and water velocity. 54th Annual Meeting of the Dakota Chapter American Fisheries Society, Brookings, South Dakota.

27. Young, K.L., T.R. Rehm, S.R. Chipps, and J.L. Kientz. 2018. Nonlethal determination of gender in Brown Trout using morphometric measurements. 78th Midwest Fish & Wildlife Conference, Milwaukee, Wisconsin.

WORKSHOPS & TRAINING

STEVE CHIPPS: U.S. Department of Interior, MOTORBOAT OPERATOR CERTIFICATION COURSE. Brookings, South Dakota, June 2018.

LARRY GIGLIOTTI: Minnesota Department of Natural Resources, UNDERSTANDING MINNESOTA LANDOWNERS' VALUES, ATTITUDES AND BEHAVIORS TOWARDS WILDLIFE AND WILDLIFE HABITAT. Lamberton, Minnesota, March, 2018.

JOSHUA STAFFORD: U.S. Department of Interior, ATV/UTV CERTIFICATION COURSE. Brookings, South Dakota, May 2018.

THESES AND DISSERTATIONS

NEVISON, S.A. 2017. Swift Foxes in Southwestern South Dakota: Assessing the Current Status of a Reintroduced Population. M.S. Thesis. South Dakota State University. 130 pp. https://openprairie.sdstate.edu/etd/2152/

REHM, T.R. 2018. Influence of Fish Density on Growth Rate of Brown Trout in Spearfish Creek, South Dakota. M.S. Thesis. South Dakota State University. 92 pp. https://openprairie.sdstate.edu/

ROSBURG, A.J. 2017. Growth Potential and Genetic Diversity of Yellow Perch in South Dakota. M.S. Thesis. South Dakota State University. 59 pp. https://openprairie.sdstate.edu/etd/2163/

VOORHEES, J. 2018. Impacts on Salmonid Rearing Performance with Use of Dietary Bioprocessed Plant-Based Protein and Water Velocity. M.S. Thesis. South Dakota State University. 252 pp. https://openprairie.sdstate.edu/etd/2429/

PEER-REVIEWED PUBLICATIONS

1. Behney, A.C., R. O'Shaughnessy, M.W. Eichholz, and J.D. Stafford. 2018. Indirect risk effects reduce feeding efficiency of ducks during spring. Ecology and Evolution 8:961–972.

2. Deslauriers, D., S.R. Chipps, J.E. Breck, J.A. Rice, and C.P. Madenjian. 2017. Fish Bioenergetics 4.0: An R-based modeling application. Fisheries 11:586-596.

3. Deslauriers, D., L.A. Heironimus, T. Rapp, B.D.S. Graeb, R.A. Klumb, and S.R. Chipps. 2018. Growth potential of age-0 Pallid Sturgeon in the Missouri River: insight from an individual based model. Ecology of Freshwater Fish 27:198-208.

4. Gigliotti. L.M., and L. Chase. 2017. Importance of fishing as a segmentation variable in the application of a Social Worlds model. Proceedings of the South Dakota Academy of Science 96:58–76.

5. Gigliotti. L.M., and A.W. Don Carlos. 2017. Wildlife value orientations stability among South Dakota residents: Setting the stage for a longitudinal analysis. Proceedings of the South Dakota Academy of Science 96:77–93.

6. Hennig, J., T. Benson, J. Stafford, A. Yetter, H. Hagy, and K. Stodola. 2017. A grid-based sampling method to estimate nonbreeding duck abundance. Wildlife Society Bulletin 41:678–684.

7. Radigan, W.J., A.K., Carlson, J.L. Kientz, S.R. Chipps, M.J. Fincel, and B.D.S. Graeb. 2018. Species- and habitat-specific otolith chemistry patterns inform riverine fisheries management. River Research and Applications 34:279-287.

8. Squillace, M.K., H.L. Sieverding, H.H. Betemariam, N.R. Urban, M.R. Penn, T.M. DeSutter, S.R. Chipps, and J.J. Stone. 2018. Historical sediment mercury deposition for select South Dakota, USA, lakes: implications for watershed transport and flooding. Journal of Soils and Sediments https://doi.org/10.1007/s11368-018-2014-3.

9. Voorhees, J.M., M.E. Barnes, S.R. Chipps, and M.L. Brown. 2018. Direct substitution of fishmeal with bioprocessed soybean meal in Brown Trout diets. Journal of Fisheries and Aquaculture Development: DOI: 10.29011/2577-1493.

10. Voorhees, J.M., M.E. Barnes, S.R. Chipps, and M.L. Brown. 2018. Rearing performance of juvenile Brown Trout (*Salmo trutta*) subjected to exercise and dietary bioprocessed soybean meal. Open Journal of Animal Sciences 8:303-328.

11. Yetter, A.P., H.M. Hagy, M.M. Horath, J. Lancaster, C.S. Hine, R.V. Smith, and J.D. Stafford. 2018. Mallard survival, movements, and habitat use during autumn. Journal of Wildlife Management 82:182–191.