

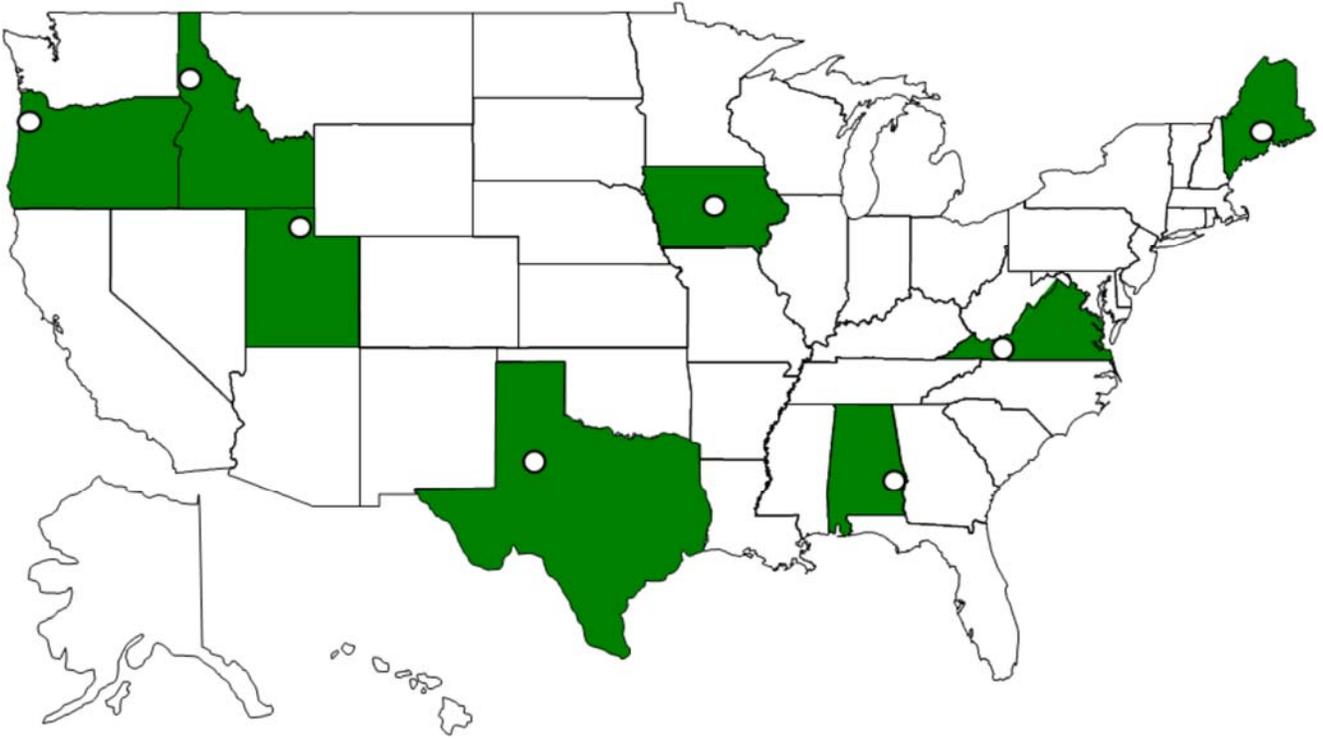
# **Idaho Cooperative Fish & Wildlife Research Unit**

**2017 Annual Report to Cooperators**

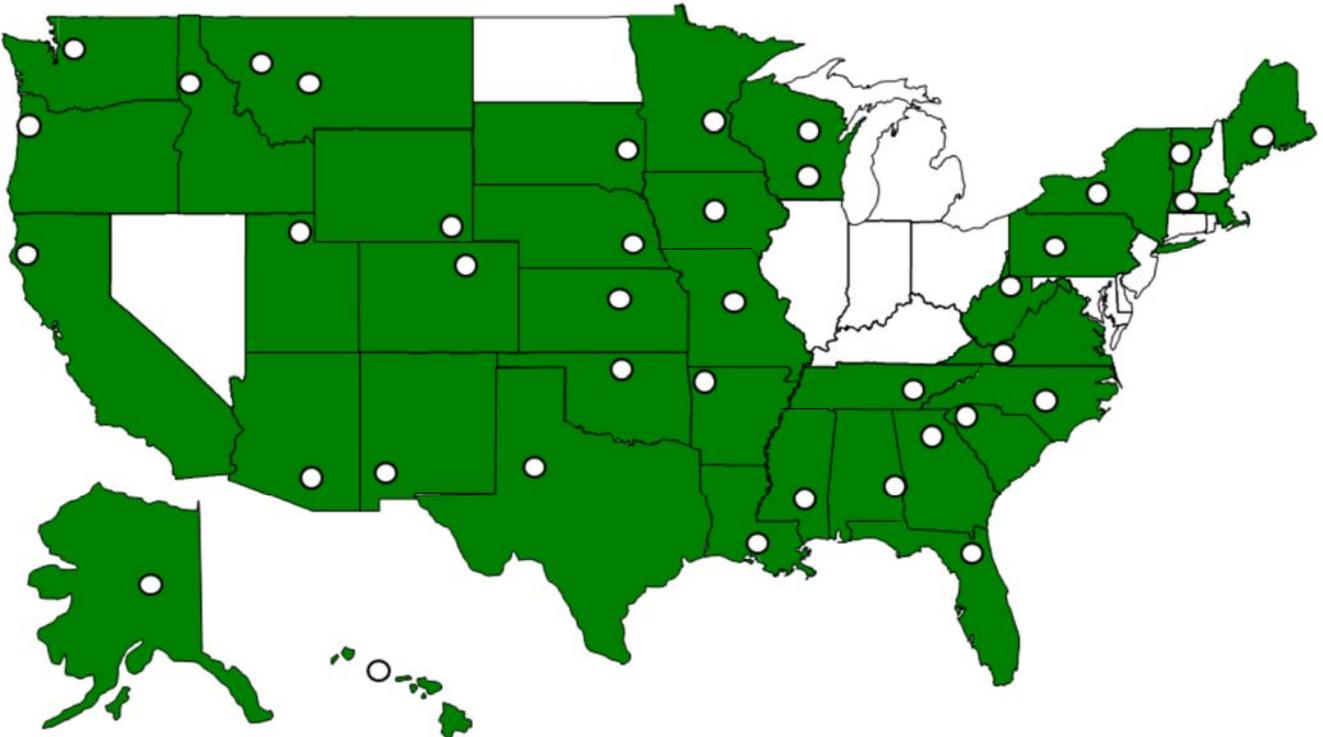
# History of Cooperative Research Units

The Cooperative Fish and Wildlife Research Unit Program was established in 1935 in response to a recognized need for trained biologists and increased scientific analysis and skills in fish and wildlife management. In 1960, the Unit Program was formally sanctioned with the enactment of the Cooperative Units Act (PL 86-686). The resulting partnership that developed among federal and state resource agencies, the land grant universities of the nation, and private entities evolved into a well-respected nationwide program. Beginning in 1984, wildlife and fishery units were combined into Cooperative Fish and Wildlife Research Units. The Unit Program operated as part of the U.S. Fish and Wildlife Service until November 1993, when the program was moved into the National Biological Survey, established by a Secretarial Order under the FY 1994 Interior Appropriations Act. In October 1996, the Unit Program was moved into the U.S. Geological Survey. Today, there are 40 Cooperative Research Units in 38 states. The Units support nearly 120 Ph.D. scientists who oversee more than 400 graduate students per year. Staff in the Cooperative Research Units conduct research on questions related to ecology and management of fish and wildlife populations; participate in the education of graduate students destined to become managers and scientists in disciplines related to fishery, wildlife, and natural resources; provide technical assistance and consultation to parties who have interests in natural resource issues; and provide various forms of continuing education for fishery and wildlife professionals.

# Idaho Coop Unit is the 8th Oldest in the Country



## Location of the 39 Active Coop Units



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# Unit Cooperators

## University of Idaho

Kurt Pregitzer, Dean  
 College of Natural Resources  
 Lisette Waits, Department Head  
 Dept. of Fish & Wildlife Sciences  
 Kim Stout, Administrative Assistant  
 Dept. of Fish & Wildlife Sciences

## Cooperative Research Units

John Organ, Chief  
 John Thompson, Deputy Chief  
 Kevin Whalen, Western Regional Supervisor

## Idaho Department of Fish & Game

Virgil Moore, Director  
 Ed Schriever, Deputy Director—Operations  
 Sharon Kiefer, Deputy Director—Programs and Policy  
 Jim Fredericks, Fisheries Bureau Chief  
 Scott Reinecker, Wildlife Bureau Chief  
 Dan Schill, Fisheries Research Manager  
 Mark Hurley, Wildlife Research Manager

## U.S. Fish & Wildlife Service

Robyn Thorson, Regional Director  
 Terry Rabot, Deputy Regional Director  
 Stephen Zylstra, Assistant Regional Director  
 Science Applications (Retired Jan. 2018)  
 Greg Hughes, Supervisor Idaho State Office  
 Paul Heimowitz, Regional Science Coordinator

## U.S. Geological Survey

William Werkheiser, Director (Acting)

## Wildlife Management Institute

Chris Smith, Western Field Representative



University of Idaho

# The Idaho Coop Unit: Our Research and Goals

The Idaho Cooperative Wildlife Research Unit was established at the University of Idaho on 20 September 1947, and the Idaho Cooperative Fishery Research Unit was established in 1963. The two units were combined into the Idaho Cooperative Fish and Wildlife Research Unit in 1985. The Unit is housed in the Department of Fish and Wildlife Sciences in the College of Natural Resources at the University of Idaho. The Unit is staffed, supported, and coordinated by the U.S. Geological Survey, the Idaho Department of Fish and Game, the University of Idaho, the U.S. Fish and Wildlife Service, and the Wildlife Management Institute.

The Unit emphasizes research to help find solutions to problems affecting the fish and wildlife resources of Idaho, the Pacific Northwest, and the U.S. Special areas of focus include: studies of anadromous fish passage and ecology in the Snake

River basin; developing methods for establishing new animal populations or augmenting existing populations; developing and evaluating sample designs for monitoring fish and wildlife populations; evaluating dynamics of recreationally harvested fish and wildlife populations; improving estimators of animal abundance; determining the effectiveness of existing reserves and management areas; developing methods to assess and control the effects of invasive aquatic species; and evaluating the effectiveness of efforts to recover or prevent listing of endangered species.

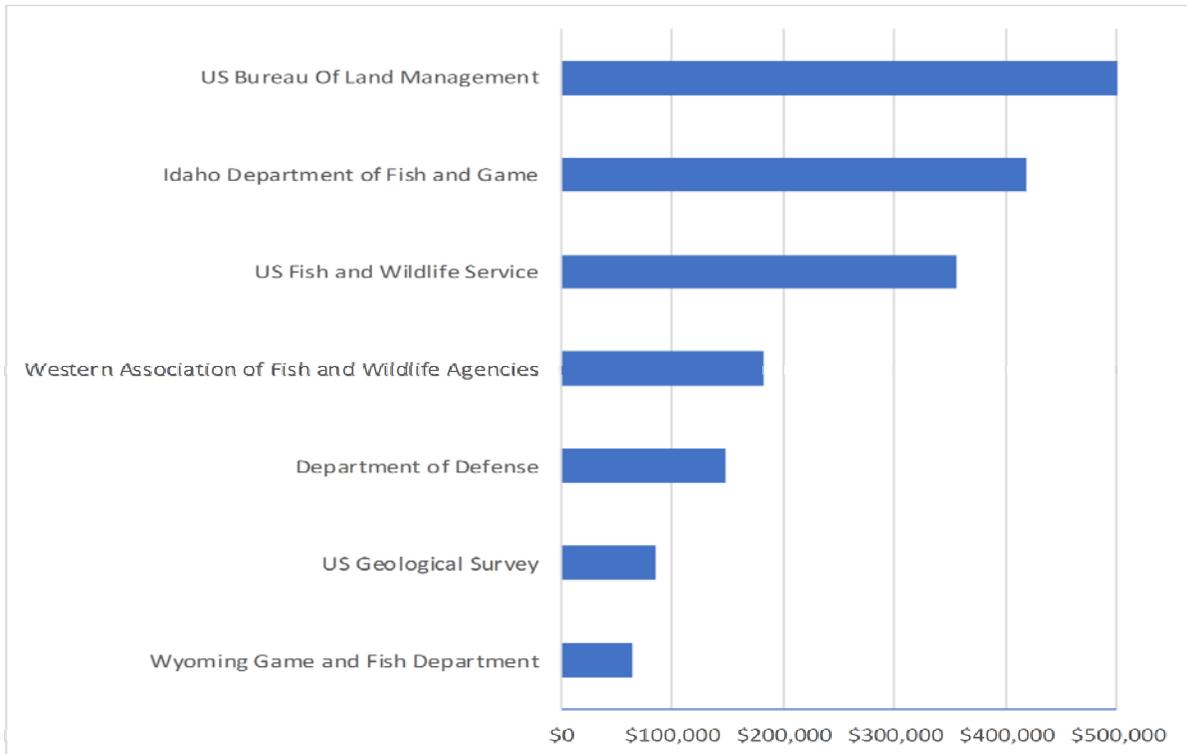
Unit personnel maintain close working and professional relationships with the University of Idaho faculty, Idaho Department of Fish and Game personnel, and other natural resource professionals. Research studies are conducted with a focus on Idaho, the Pacific Northwest, and Intermountain West, but include studies throughout North America

and at various geographic scales.

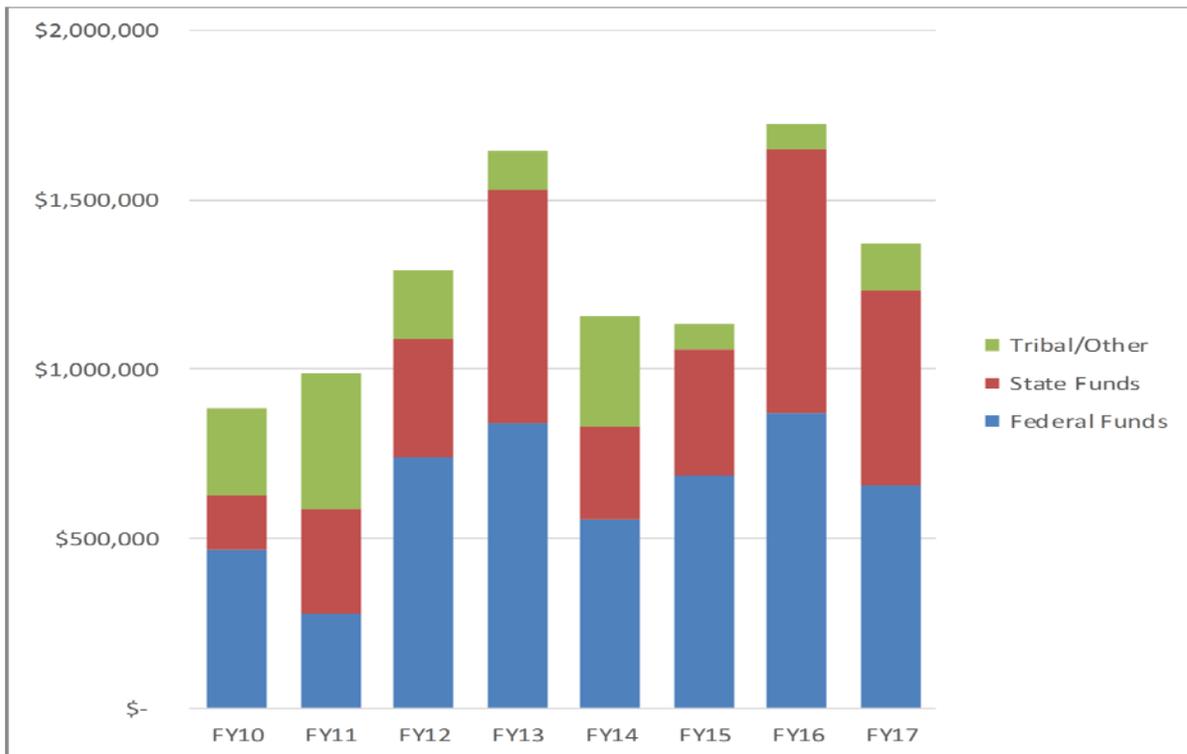
The Unit is directly supported through funding from the Idaho Department of Fish and Game, University of Idaho, and U.S. Geological Survey. Contract funds support research from federal, state, tribal, and private entities including the Idaho Department of Fish and Game, U.S. Geological Survey, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Forest Service, U.S. Department of Defense, Bureau of Land Management, Bonneville Power Administration, Northwest Power Planning Council, Columbia River Inter-tribal Fish Commission, Coeur d'Alene Tribe, Kootenai Tribe of Idaho, and National Park Service. In addition to mentoring graduate students engaged in this research, Unit personnel teach graduate-level courses, are active members of the university community, and participate in a variety of professional activities.



## 2017 Research Grant Funding by Sponsor



## Research Grants: State vs Federal vs Tribal/Other\*



\*By University fiscal year, July 1-June 30

# Federal Scientists



**Courtney J. Conway**  
Unit Leader  
(208) 885-6176  
cconway@uidaho.edu

Unit Leader and Associate Professor of Wildlife Resources. Recent research has focused on: effects of cattle grazing on demographic traits of greater sage-grouse; effects of sylvatic plague and fire suppression on northern Idaho ground squirrels; modeling range-wide habitat suitability for marsh birds; the causes of migratory behavior of burrowing owls throughout North America; the effects of management actions on wildlife populations.



**Michael C. Quist**  
Assistant Unit Leader  
(208) 885-4064  
mcquist@uidaho.edu

Assistant Unit Leader and Associate Professor of Fishery Resources. Recent research has focused on: understanding the relative importance of abiotic characteristics and biotic interactions in regulating fish population dynamics; identifying factors regulating the structure and function of fish assemblages across multiple spatial and temporal scales; harvest management, and developing and evaluating techniques that allow managers to more effectively and efficiently evaluate fish populations.

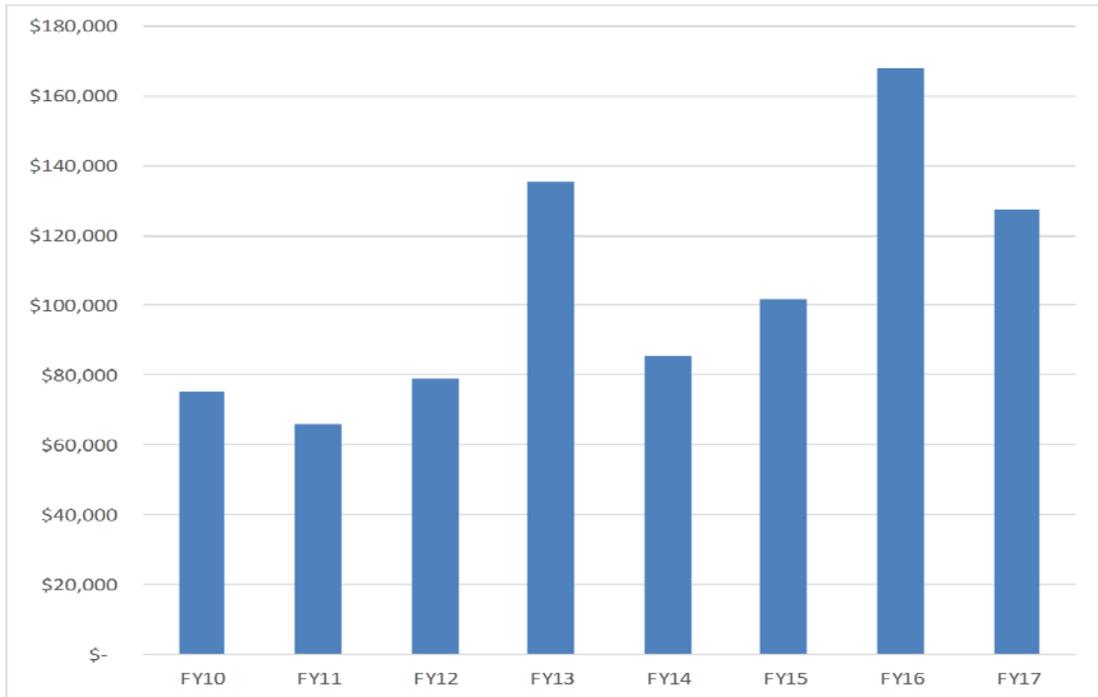
Assistant Unit Leader—Wildlife

VACANT

Assistant Unit Leader—Fisheries

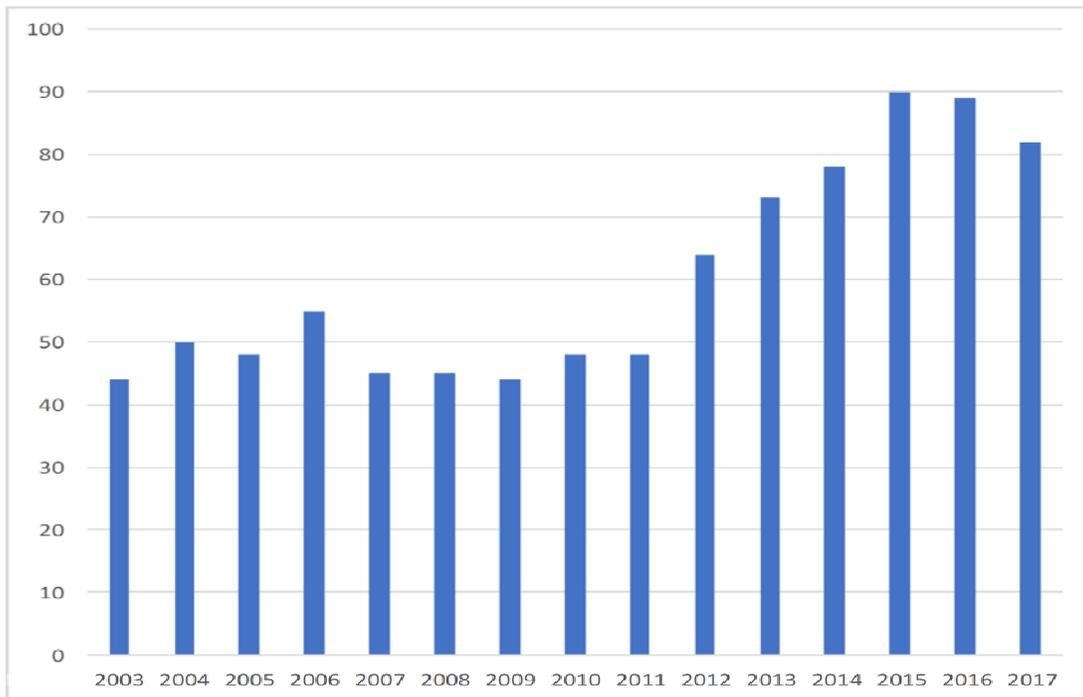
VACANT

## F&A Generated by Idaho Coop Unit Federal Scientists\*



\*By University fiscal year, July 1-June 30

## Peer-Reviewed Publications by Idaho Unit Federal Scientists\*



\*Year totals reflect a 5 year rolling mean

# Where Are They Now?

## Former Unit Graduate Students, 2001-2017\*

\*students advised by Federal Scientists only

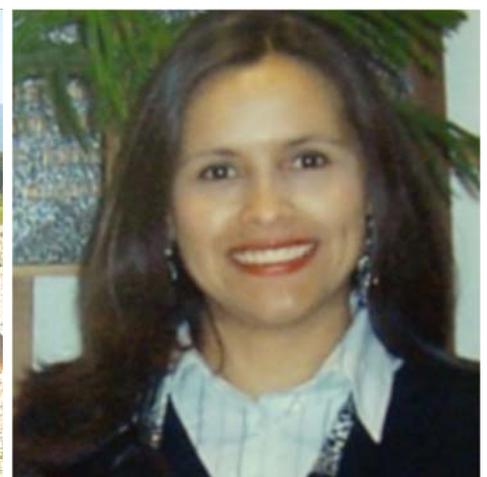
<b>Name</b>	<b>Job Title</b>	<b>Employer</b>	<b>Year Graduated</b>	<b>Degree</b>
Louise Allen	<b>Alternative Education Teacher</b>	Elcho School District, Wisconsin	2006	MS
Jon Amberg	<b>Research Scientist</b>	USGS Upper Mississippi Science Center	2008	PhD
Kara Anlauf-Dunn	<b>Biologist GIS Analyst</b>	Oregon Dept. of Fish & Wildlife	2005	MS
Amber Barenberg	<b>Biologist</b>	NOAA Fisheries	2010	MS
Zachary Beard	<b>Sport Fish Research Biologist</b>	Arizona Dept. of Game and Fish	2017	MS
Emmi Blades	<b>Deputy Attorney General</b>	Idaho Dept. of Water Resources	2007	MS
Peter Bloom	<b>Principal Zoologist</b>	Bloom Biological, Inc.	2011	PhD
Elizabeth Braker	<b>Drinking Water Coordinator</b>	Idaho Dept. of Environmental Quality	2015	MS
Phillip Branigan	<b>Fishery Research Biologist</b>	Idaho Dept. of Fish & Game	2017	MS
Jessica Buelow	<b>Regional Fisheries Biologist</b>	Idaho Dept. of Fish & Game	2011	MS
Lubia Cajas Canos	<b>Postdoctoral Research Assoc.</b>	University of Idaho	2016	PhD
John Cassinelli	<b>Regional Fisheries Biologist</b>	Idaho Dept. of Fish & Game	2008	MS
Mike Colvin	<b>Assist. Professor of Fisheries</b>	Mississippi State University	2005	MS
Marika Dobos	<b>Regional Fisheries Biologist</b>	Idaho Dept. of Fish & Game	2015	MS
Derek Fryer	<b>Biologist</b>	U.S. Army Corps of Engineers	2009	MS
Kevin Gergely	<b>Ntnl. GAP Program Mngr.</b>	USGS	2003	PhD
Tom Goniea	<b>Biologist Regulatory Affairs</b>	Michigan Dept. of Natural Resources	2002	MS
Christopher James	<b>Biologist</b>	Oregon Dept. of Fish & Wildlife	2007	MS
Bryan Jones	<b>Biologist</b>	Colville Tribe	2013	MS
Darin Jones	<b>Biologist-Midwater</b>	Alaska Science Center NOAA Fisheries	2002	MS
Janessa Julson	<b>Watershed Conservation Planner</b>	Palouse Conservation District	2017	MS
Adam Kautza	<b>Coldwater Fisheries Project Leader</b>	MA Division of Fisheries & Wildlife	2008	MS
Toby Kock	<b>Biologist</b>	USGS Western Fisheries Research Center	2004	MS



Zachary Beard



Phillip Branigan



Lubia Cajas Canos

# Where Are They Now?

## Former Unit Graduate Students, 2001-2017\*

\*students advised by Federal Scientists only

Name	Job Title	Employer	Year Graduated	Degree
Josh McCormick	<b>Biometrician</b>	Idaho Dept. of Fish & Game	2012	MS
Ryan Monello	<b>Biological Resource Mgmt.</b>	National Park Service	2009	MS
Elizabeth Ng	<b>PhD Candidate</b>	University of Washington	2015	MS
Jordan Nielson	<b>Project Coordinator</b>	Trout Unlimited	2008	MS
Zachary Penney	<b>Science Director</b>	Columbia River Inter-tribal Fish Commision	2013	PhD
Maggie Picard	<b>Technician</b>	Nez Perce Tribe	2012	MS
Amy Pinson-Dumm	<b>Grant Writer</b>	Partnership for the Umpqua Rivers	2005	MS
John Plumb	<b>Fishery Biologist</b>	USGS Western Fisheries Research Center	2012	PhD
Paul Reyes	<b>Program Advisor</b>	Cornell University	2010	MS
Kimberly Sager	<b>Wildlife Biologist</b>	Elwah Tribe	2005	MS
Maura Santora	<b>Biologist</b>	U.S. Forest Service	2004	MS
Jan Schipper	<b>Postdoctoral Research Assoc.</b>	Arizona State University	2009	PhD
Christopher Smith	<b>Regional Fisheries Biologist</b>	Minnesota Dept. of Natural Resources	2013	MS
Kelly Stockton	<b>Consultant</b>	KASF Consulting, LLC	2011	MS
Leona Svancara	<b>Spatial Ecologist</b>	Idaho Dept. of Fish & Game	2010	PhD
Zach Swearingen	<b>Regional Habitat Manager</b>	Idaho Dept. of Fish & Game	2015	MS
John Walrath	<b>Regional Fisheries Biologist</b>	Wyoming Game & Fish Dept.	2013	MS
Carson Watkins	<b>Regional Fisheries Biologist</b>	Idaho Dept. of Fish & Game	2014	MS
Tom Welker	<b>Fishery Scientist</b>	U.S. Dept. of Agriculture	2002	PhD
Steven Whitlock	<b>PhD Candidate</b>	Oregon State University	2013	MS
Jim Wilder	<b>Forest Wildlife Biologist</b>	U.S. Forest Service	2003	MS
Jeffrey Yanke	<b>Regional Fish Manager</b>	Oregon Dept. of Fish & Wildlife	2006	MS
Don Zaroban	<b>Quality Assurance Manager</b>	Idaho Dept. of Environmental Quality	2011	PhD

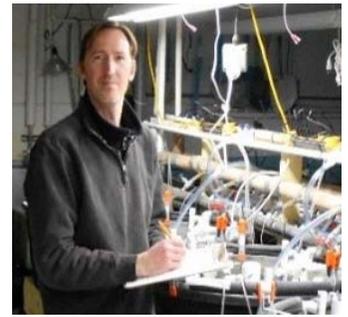
Employers of Unit Students	
State Agencies	41%
Federal Agencies	24%
Education	15%
Other	11%
Tribal	9%

Number of Degrees Earned	
M.S.	36
Ph.D.	10

# Graduate Students



**Austin Allison**  
M.S. Wildlife Resources  
Advisor: C. Conway



**Neil Ashton**  
Ph.D. Fishery Resources  
Advisor: K. Cain



**Tara Ball**  
M.S. Forest, Range & Fire  
Advisor: E. Strand



**Nicole Bilodeau**  
M.S. Wildlife Resources  
Advisor: R. Long



**Shannon Blackburn**  
M.S. Fishery Resources  
Advisor: M. Quist



**Tucker Brauer**  
M.S. Fishery Resources  
Advisor: M. Quist



**Stacey Feeken**  
M.S. Fishery Resources  
Advisor: M. Quist



**Amanda Goldberg**  
Ph.D. Wildlife Resources  
Advisor: C. Conway



**Dave Gotsch**  
M.S. Wildlife Resources  
Advisor: C. Conway



**Kayte Groth**  
M.S. Wildlife Resources  
Advisor: S. Gilbert



**John Guthrie**  
M.S. Wildlife Resources  
Advisor: S. Gilbert



**Eamon Harrity**  
M.S. Wildlife Resources  
Advisor: C. Conway



**John Heckell IV**  
M.S. Fishery Resources  
Advisor: M. Quist



**Zach Klein**  
Ph.D. Fishery Resources  
Advisor: M. Quist



**Deo Lachman**  
M.S. Wildlife Resources  
Advisor: K. Vierling & C. Conway



**Carl Lundblad**  
Ph.D Wildlife Resources  
Advisor: C. Conway



**Conor McClure**  
M.S. Fishery Resources  
Advisor: M. Quist



**Ian Riley**  
M.S. Wildlife Resources  
Advisor: C. Conway



**Sierra Robotcek**  
M.S. Wildlife Resources  
Advisor: R. Long



**Curtis Roth**  
M.S. Fishery Resources  
Advisor: M. Quist



**Lindsey Sanders**  
Ph.D. Wildlife Resources  
Advisor: C. Conway



**Marc Wiseman**  
M.S. Wildlife Resources  
Advisor: R. Long



**College of Natural Resources Faculty with Unit Projects in 2017**

Ken Cain, Professor, Department of Fish & Wildlife Sciences  
 Sophie Gilbert, Department of Fish & Wildlife Sciences  
 Ryan Long, Assistant Professor, Department of Fish & Wildlife Sciences  
 Janet Rachlow, Professor, Department of Fish & Wildlife Sciences  
 Eva Strand, Assistant Professor, Department of Forest, Rangeland, & Fire Sciences  
 Lisette Waits, Professor & Department Head, Department of Fish & Wildlife Sciences

**Postdocs & Research Scientists**

Jennifer Adams  
 Kimberly Andrews  
 Jocelyn Aycrigg  
 Soraia Barbosa  
 Jack Connelly  
 Kristen Dillon  
 Holly Goyert  
 Andrews Meyers  
 Bryan Stevens

**Staff**

Eric Everett—Program Specialist for the Idaho Cooperative Fish and Wildlife Research Unit. Eric provides support for research and cooperative agreements for federal and state contracts.

Contact information:  
 (208) 885-6336  
 ericeverett@uidaho.edu



## Doris Duke Conservation Scholars Program: The National Education Partnership for Diversity in Conservation Science

### Objectives

- Increase diversity in the fish and wildlife professions by training and mentoring undergraduate students
- Give students training in study design and research methods
- Assist students in developing a professional network
- Provide students with on-the-job training with our partner agencies

### Achievements of our Doris Duke Students

- 100% student retention of our undergraduate research fellows
- University Alumni Awards for Excellence (E. Gosselin and J. Jarolimek; 2017)
- Outstanding Wildlife Undergraduate Award, University of Idaho (E. Brown; 2016)
- Barry M. Goldwater Scholarship (E. Gosselin, 2016)
- Best Graduate Student Essay, Martin Luther King Essay Contest, University of Idaho (M. Mejia; 2016)
- National Science Foundation Graduate Research Fellowship Award (K. Huggler; 2016—2018)
- Two peer-reviewed publications
- Thirteen conference poster presentations

Funding Doris Duke Charitable Foundation, U.S. Geological Survey	Undergraduate Research Fellows			
	2014 Cohort	2015 Cohort	2016 Cohort	2017 Cohort
Faculty Mentors Kerri Vierling, Courtney Conway, and Michael Quist	Emily Brown	Kaela Bush	Erika Alvarado	Daniel Janson
	Elyce Gosselin	Michael Briggs	James Carriere	Melissa Galindo
Graduate Student Mentor Jamie Jarolimek, Deo Lachman	Katey Huggler	Anna Miera	Alyssa Gomez	Kali Nelson
	Emily Rankin	Viviana Baeza Nunez	Isabel Robles	Tasia North
	Bethany Guzman	Aron Oliveras		

# Fisheries and Aquatic Research Projects

## Survival, Movement, Distribution, and Habitat and Species Associations of Juvenile Burbot in a Tributary of the Kootenai River

Burbot *Lota lota* in the lower Kootenai River have been the focus of extensive conservation efforts. The objectives of this study were to evaluate survival, movement, and distribution of Burbot released into Deep Creek. In 2014, 3,000 age-0, 200 age-1, 16 age-2, and 16 age-4 Burbot were released at two different locations in Deep Creek. In 2015, 3,000 age-0 Burbot were released at six different locations (i.e., 550 fish/location). Stationary passive integrated transponder (PIT) tag antennas were installed prior to stocking in 2014. Stationary and mobile PIT tag antennas relocated 3,372 (56%) of the Burbot released in Deep Creek in 2014 and 2015. Eighty eight percent of tags relocated during mobile PIT tag surveys were within 1 km of a release location. Mobile PIT tag antenna surveys also suggested poor dispersal from stocking locations. Initial 7-month survival was 0.27 and improved to 0.63 after the first seven months. Although survival did not differ between years or release groups, managers may consider releasing Burbot at lower densities across multiple locations.

### Funding

Idaho Department of Fish and Game

### Principal Investigators

Michael C. Quist

### Graduate Student

Zachary Beard

### Project Period

2014—2017



## Effects of Habitat Restoration Activities on Fish Assemblages and Populations in the Kootenai River, Idaho

The Kootenai River is one of Idaho's most unique resources that supports a diversity of native species. The Kootenai Tribe of Idaho has been moving forward with ambitious plans to restore habitat and ecosystem function in the Kootenai River and its floodplain. Fish and microhabitat data were collected at 542 locations during the summers and autumns of 2014 and 2015 to evaluate the effects of habitat rehabilitation on the fish assemblage. Samples were collected from locally treated and locally untreated areas of the river to investigate habitat conditions related to the occurrence and relative abundance of fishes. Fishes sampled from backwaters composed 71% of the overall catch and 84% of the catch from locally untreated areas of the river. Water depth and current velocity were the most important microhabitat variables influencing fish assemblage structure. Specifically, shallow habitats with low current velocities were important for small-bodied native fishes and likely serve as rearing areas. Prioritizing the conservation and enhancement of these areas in large, regulated rivers would enable natural channel forming processes for the benefit of native fishes.

### Funding

Kootenai Tribe of Idaho

### Principal Investigator

Michael C. Quist, Bradley B. Shepard

### Graduate Student

Phillip Branigan

### Project Period

2014—2017



## Management of Kokanee in Idaho Lakes: Kokanee Population Dynamics, *Mysis*-Kokanee Interactions, and Sampling Techniques

Kokanee *Oncorhynchus nerka* are arguably one of the most important fishes in Idaho and are a major focus of natural resource agencies. In an effort to address knowledge gaps associated with the management of kokanee, we sought to 1) assess the potential size selectivity of mid-water trawls, 2) investigate the hypothesis that *Mysis diluviana* (*Mysis*) compete with kokanee, and 3) evaluate the performance of kokanee breeding groups (early-run, late-run). Over 7,000 kokanee were sampled from nine lakes and reservoirs in Idaho using mid-water trawls and gill nets. Comparisons between gill nets and mid-water trawls suggest that mid-water trawls are largely ineffective for sampling kokanee greater than 200 mm. Kokanee, *Mysis*, and zooplankton samples collected from Lake Pend Oreille are currently being processed, but will be used to elucidate potential competition between *Mysis* and kokanee. Experiments evaluating compensatory growth in kokanee will begin in early 2018 and help to identify potential factors contributing to increased growth in hatchery-reared kokanee. Cumulatively, these data will be used to improve management of kokanee across Idaho and North America.

### Funding

Idaho Department of Fish and Game

### Principal Investigator

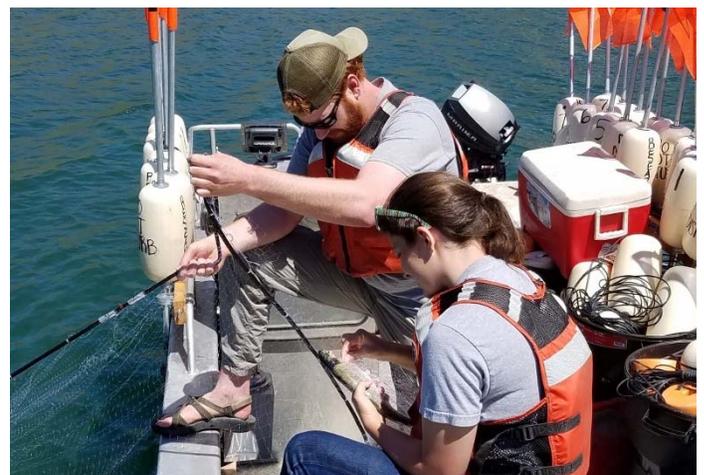
Michael C. Quist

### Graduate Student

Zachary Klein

### Project Period

2015—2019



## Temperature Effects on Early Life Stages of Burbot

The lower Kootenai River once supported a thriving native population of Burbot with major ecological and cultural importance to northern Idaho and southeastern British Columbia. Hydropower operations have dramatically altered the river regime and potentially pushed this wild population to the brink of extirpation. The funded project is a collaborative effort with state, federal and tribal agencies to assess how the altered thermal regime of the river influences early life history and recruitment. A University of Idaho graduate student is testing the effects of different river temperature profiles on spawning, embryogenesis and larval development. Preliminary results suggest that elevated wintertime temperatures either due to climate change and/or discharges from Koochanusa Reservoir do not likely inhibit spawning, but may significantly reduce embryo survival and increase larvae deformity. Discharge of cold reservoir waters in spring may also inhibit larval swimming and feeding. Collectively, the results from these experiments highlight the potential importance of a natural thermal regime (i.e., wintertime ice cover followed by rapid spring-time warming) on the early life history and recruitment of Burbot.

### Funding

Idaho Department of Fish and Game, Kootenai Tribe of Idaho, U.S. Fish and Wildlife Service

### Principal Investigator

Kenneth Cain

### Graduate Student

Neil Ashton

### Project Period

2015—2018

## Distribution and Movement of Wild and Hatchery Steelhead: Interactions Among Populations and Overlap with Angling Effort

Steelhead *Oncorhynchus mykiss* support an important trophy fishery in the Clearwater River, Idaho. The Clearwater River supports both wild and hatchery steelhead, with wild steelhead listed as threatened under the Endangered Species Act. To aid in management, the Idaho Department of Fish and Game uses run-reconstruction efforts to evaluate steelhead populations and creel surveys to monitor the fishery. This study focuses on describing the distribution and movement of wild and hatchery steelhead, as well as anglers. In total, 178 steelhead were radio-tagged in 2016-2017 and 120 in 2017-2018. Steelhead and angler data have indicated limited overlap between wild steelhead and anglers. Anglers tend to target hatchery steelhead in a spatially confined area throughout most of the fishing season, suggesting a highly compartmentalized fishery in the Clearwater River. Data collection of steelhead movements and angler locations will continue through 2018.

### Funding

Idaho Department of Fish and Game

### Principal Investigator

Michael C. Quist

### Graduate Student

Stacey Feeken

### Project Period

2016—2018



## Population Dynamics and Movement of Smallmouth Bass in the Snake River

The Snake River between Swan Falls Dam and Brownlee Reservoir supports a popular Smallmouth Bass *Micropterus dolomieu* fishery. During 2016, we sampled 49 sites and 4,929 fish via electrofishing surveys on the Snake River and its major tributaries (i.e., Boise, Payette, and Weiser rivers). Information from this portion of the study indicated that fish are widespread, grow fast, and are in good condition. In 2017, a radiotelemetry study was performed to determine fish movement in the study area. One hundred and forty nine Smallmouth Bass were tagged and their movement among Brownlee Reservoir, the Snake River, and three major tributaries was tracked over a nine-month period. The data collected were used to describe the home range and seasonal movement patterns of Smallmouth Bass. Movement varied with movements of less than several kilometers to over 150 km being observed. Results from this study will provide the Idaho Department of Fish and Game with the information they need to better manage the fishery for the angling public.

### Funding

Idaho Department of Fish and Game

### Principal Investigator

Michael C. Quist, Daniel J. Schill

### Graduate Student

Conor McClure

### Project Period

2016—2018

## Effects of Air Exposure on Survival and Fitness of Yellowstone Cutthroat Trout

Catch-and-release regulations are among the most commonly implemented types of fishing regulations. However, concerns have been raised regarding exposure of fish to air during catch-and-release events. The specific objectives of our research are to: 1) evaluate how long anglers typically expose fish to air during catch-and-release events on the South Fork Snake River, 2) evaluate how air exposure effects survival of Yellowstone Cutthroat Trout *Oncorhynchus clarkii bouvieri* (YCT), Bull Trout *Salvelinus confluentus*, and Rainbow Trout *O. mykiss*, and 3) evaluate how air exposure effects fitness of YCT. We observed anglers and found that total air exposure averaged 19.3 s (SD = 15.0) for a catch-and-release angling event. Additionally, we evaluated the influence of air exposure on survival and found no effect with up to 60 s of air exposure in all three species. Lastly, our results indicated that air exposure of up to 60 s had no effect on progeny production or the percentage of fish that spawned. Results of these studies suggest that air exposure is not a concern in catch-and-release fisheries.

### Funding

Idaho Department of Fish and Game

### Principal Investigator

Michael C. Quist, Daniel J. Schill

### Graduate Student

Curtis Roth

### Project Period

2016—2018



## Population Dynamics and Management of White Sturgeon in the Sacramento-San Joaquin River Basins

White Sturgeon *Acipenser transmontanus* are a species of high conservation concern in the Sacramento-San Joaquin River system (SSJ). The objectives of this study were to describe the population demographics of White Sturgeon in the SSJ and assess potential management actions. Population age structure, growth rates, and mortality were estimated during sampling events from 2014–2016. White Sturgeon fork length varied from 53 to 217 cm and sexually immature individuals (< 102 cm) composed 58.2% of the sample. Total annual mortality was estimated as 18.7% and exploitation was 13.6%. Using these data, population projection matrices were used to evaluate population growth rates under various management scenarios and identify age classes with the greatest influence on population growth. Model projections indicated that under current harvest regulations, the population was declining ( $\lambda = 0.97$ ). Survival of reproductive adults contributed the most to the population growth rate. An adequate replacement rate (i.e.,  $\lambda = 1.0$ ) could be achieved by reducing exploitation to zero and, thus, decreasing annual mortality to 5.4%.

### Funding

California Department of Fish and Wildlife,  
U.S. Fish and Wildlife Service

### Principal Investigator

Michael C. Quist

### Graduate Student

Shannon Blackburn

### Project Period

2016—2018



## Movement Dynamics, Population Structure, and Population Characteristics of Burbot in the Upper Green River System, Wyoming

Burbot *Lota lota* were illegally introduced into the Green River system of Wyoming in the mid-1990s and the Wyoming Game and Fish Department is exploring the efficacy of a removal program. In total, 875 Burbot were marked with passive integrated transponder (PIT) tags and 40 Burbot were implanted with radio-telemetry transmitters. Fish movements from Fontenelle Reservoir into the Green River occurred in mid-December of both 2016 and 2017. Migration distances were relatively short compared to other adfluvial populations within their native distribution (<5km). To describe reservoir population dynamics, calcified structures and ovaries were collected from Burbot in Fontenelle Reservoir ( $n = 139$ ) and Flaming Gorge Reservoir ( $n = 155$ ). Overall, lentic Burbot grew faster, matured earlier, and exhibited lower mortality rates than lotic Burbot populations. Age-structured population models suggest that higher rates of exploitation are required to suppress Burbot in lentic environments than in lotic environments. This information will guide management efforts and aide in the management of Burbot in their native distribution.

### Funding

Wyoming Game and Fish Department

### Principal Investigator

Michael C. Quist

### Graduate Student

Tucker Brauer

### Project Period

2016—2018



## Life History Characteristics, Distribution, and Habitat Use of Westslope Cutthroat Trout in the St. Maries River Basin

Despite having a broad distribution throughout Idaho, the extent to which Westslope Cutthroat Trout *Oncorhynchus clarkii lewisi* (WCT) use the St. Maries River basin is poorly understood. This project serves to fill this knowledge gap by providing a foundational understanding of the population structure, distributions, and important habitat relationships associated with WCT in the St. Maries River basin. Sampling for WCT was conducted in the mainstem of the St. Maries River, Coeur d'Alene Lake, and 33 different tributaries in the St. Maries River basin. Otolith microchemistry has been used to evaluate life history structure of WCT. Preliminary results from microchemistry analysis ( $n = 723$ ) indicate that WCT in the St. Maries River basin exhibit resident, fluvial, and adfluvial life history strategies. Furthermore, initial results suggest that WCT persist throughout the St. Maries River tributaries, and migratory WCT are estimated to be in the system from March to May. Site-specific and largescale habitat assessments will provide information at multiple spatial scales on habitat characteristics that are important for WCT.

### Funding

Idaho Department of Fish and Game

### Principal Investigator

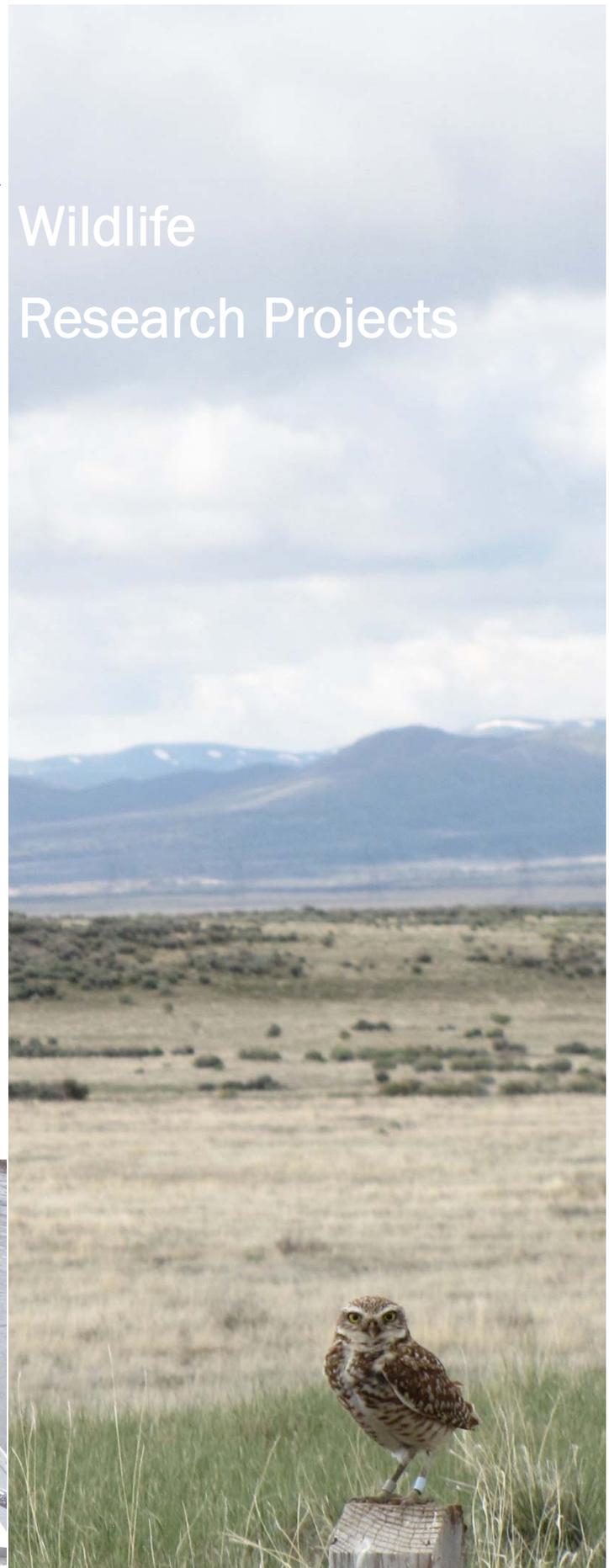
Michael C. Quist

### Graduate Student

John Heckel IV

### Project Period

2016—2018



## Effects of Forest Fire Suppression on Demography of the Northern Idaho Ground Squirrel

Northern Idaho ground squirrels (*Urocitellus brunneus*) were listed as federally Threatened. The reason for the decline in northern Idaho ground squirrels (NIDGS) is not known. Experts believe that the declines were caused by forest encroachment into meadows (habitat loss) due to a century of fire suppression. We are implementing a large-scale, replicated field experiment to test 2 management treatments: 1) thin-and-burn forest adjacent to currently NIDGS habitat (9 sites), and 2) burn-only within currently occupied habitat (4 sites). We have completed 5 years of pre-treatment data collection on the thin-and-burn treatments and 3 years on the burn-only treatments. We have also conducted extensive vegetation surveys and deployed 117 radio transmitters. We have also attached a total of 71 light loggers to VHF collars beginning in 2015 to document: 1) change in activity prior to entering hibernation, 2) hibernation immergence and emergence dates, 3) body temperature throughout hibernation, and 4) number and length of arousals from hibernation.

### Funding

U.S. Forest Service, U.S. Fish and Wildlife Service, Idaho Chapter of the Wildlife Society, Idaho Department of Fish and Game

### Principal Investigator

Courtney J. Conway

### Graduate Student

Amanda R. Goldberg, Austin Z. Allison

### Project Period

2013—2023



## Migratory Routes and Wintering Grounds of Burrowing Owls Throughout Western North America

Many migratory populations of Burrowing Owls (*Athene cunicularia*) have declined over the past 40 years, but populations vary widely in their population trajectory over that time span. The causes for these declines, and for the spatial variation in population trend, are not known. Our ability to understand possible causes for these declines would be enhanced if we knew where populations spent their winter months and the migratory routes they followed. Along with our partners, we have attached geolocators (light sensors) and satellite transmitters to >220 Burrowing Owls in the U.S. and Canada over the past 5 years. These data are revealing broad-scale patterns of migratory connectivity among Burrowing Owl populations, identifying important migratory stopover areas, and will reveal whether the steepest population declines are associated with owls that winter in certain locations of North America.

### Funding

Department of Defense, Utah Division of Wildlife Resources, U.S. Fish and Wildlife Service, Arch Coal

### Principal Investigator

Courtney J. Conway

### Graduate Student

Carl Lundblad

### Project Period

2013—2018



## Prevention of Depredation by Deer and Elk Using Nutrition- and Fear-based Treatments

Ungulates cause significant damage to crops across Idaho, yet effective tools for managers to deter ungulate depredations are lacking. This project is testing novel treatments for deterring ungulate depredations, broadly focused on increasing fear or decreasing nutritional rewards in order to change ungulate foraging behavior. In northern Idaho, white-tailed deer are the primary cause of depredation. We have 40 female deer GPS-collared (with capture efforts ongoing), and will test 4 fear-increasing treatments. In southern Idaho, where elk are the primary depredators, we have GPS-collared 11 cows, and will capture additional elk in spring 2018. We will then test the effectiveness of 2 fear-increasing and 2 nutrition-reducing treatments. For individual deer, and elk groups, ~25% of collared individuals/groups will be left untreated as “controls,” and treatments will operate on 2 week intervals (treated/untreated) throughout the growing season (June-September/October). The efficacy of treatments will be quantified based on changes to resource selection and foraging/movement patterns dependent on treatments and controlling for environmental variables. Next year, we anticipate refining effective treatments and testing additional treatments if necessary.

### Funding

Idaho Department of Fish and Game

### Principal Investigator

Sophie Gilbert, Jon Horne, Mark Hurley

### Graduate Student

Kayte Gorth, John Guthrie

### Project Period

2017—2020



## Development of Range-wide Habitat Models for Predicting Marsh Bird Occupancy in North America

Populations of many marsh-bird species have declined across North America, along with the wetlands upon which these birds depend. As such, conservation of remaining marsh bird habitat is vital to ensure population persistence for this group of birds. We are using multi-scale data from the National Wetland Inventory database, land cover disturbance data provided by the GAP analysis program, and spatial data describing watershed-scale hydrological disturbances to develop optimally predictive models of occupancy for each of 14 species of marsh birds across their breeding ranges within the continental U.S. Moreover, we are translating statistical predictive models into spatially-explicit maps depicting habitat suitability on areas located within DOD military installations and the USFWS National Wildlife Refuge System. These models will help land and resource management agencies set priorities for land acquisition and habitat conservation for each of these 14 species. We have completed analyses to identify optimally predictive multi-scale occupancy models for all 14 species, and are currently in the process of translating statistical predictions into spatially-explicit maps of habitat suitability.

### Funding

Department of Defense, U.S. Fish and Wildlife Service, U.S. Geological Survey, Nebraska Game & Parks Commission

### Principal Investigator

Courtney J. Conway

### Research Scientists

Bryan Stevens

### Project Period

2012—2019



## Disease Transmission in Bighorn Sheep: the Role of Nutrition and Movement

Over the past several decades the population of bighorn sheep in Idaho has decreased by an order of magnitude. Because poor nutrition can impact the behavior and demography of wild sheep through reduced recruitment and increased vulnerability to disease, it is critical to understand relationships between bighorn sheep populations and the nutritional landscapes they occupy. This study will take a two-pronged approach to quantifying the potential effects of variation in forage availability and quality on movement behavior and disease transmission in bighorn sheep. First, we will evaluate how early lamb survival is affected by varying levels of forage biomass and quality, and whether disease is more prevalent in landscapes with low abundance of high-quality forage. Second, we will evaluate how the nutritional landscape influences the movement of bighorn within and among populations in Idaho, and to what degree this movement facilitates the transmission of pneumonia. For the next two summers we will be collaring neonatal sheep in two locations in central Idaho with different nutritional landscapes to estimate survival rates and determine sources of mortality. Concurrently, we will be sampling vegetation within the study areas to assess, in conjunction with GPS locations from collared animals, how bighorn sheep are utilizing the nutritional landscape.

### Funding

Idaho Department of Fish and Game

### Principal Investigators

Ryan Long

### Graduate Students

Nicole Bilodeau, Marc Wiseman

### Project Period

2017—2018



## Ecological Drivers of Geographic Variation in Demographic Traits, Reproductive Effort, and Life Histories of Burrowing Owls

Burrowing Owls (*Athene cunicularia*) have declined throughout most of their range over the past 40 years, but the causes for these declines are not known. Burrowing Owls are declining most steeply in the northern portions of their range despite laying larger clutches in those areas. Explaining this paradox will reveal what aspects of Burrowing Owl fitness drive population trajectories and allow us to develop management strategies to reverse the species' decline. We are examining the comparative demography of burrowing owls at study sites in California, Nevada, Utah, Idaho, and Oregon. We have placed nest cameras and temperature loggers in > 130 Burrowing Owl nests in 5 states over the past 3 years to understand patterns and causes of variation in incubation behavior, hatching and fledging rates, and reproductive success. We are also examining how thermal variability affects patterns of laying, incubation, hatching, nestling development, and nestling survival, which will allow us to develop mechanistic predictions about how climate change might impact Burrowing Owl demographic rates.

### Funding

Department of Defense, National Science Foundation, University of Idaho Ehrenreich Family Fellowship

### Principal Investigator

Courtney J. Conway, Carl Lundblad

### Graduate Student

Carl Lundblad

### Project Period

2013-2018



## Status of Northern Idaho Moose Forage Quantity and Quality

Forested lands in the western USA have undergone changes in management and condition that are resulting in a shift towards climax vegetation. To evaluate how management of forested landscapes might affect nutrition for Shiras moose at large spatial scales, we evaluated the effect of summer diet composition, forage availability and selection, and forage quality on population dynamics for moose across 21 game management units (GMUs) in northern Idaho. By adapting established field sampling methods and integrating them with recent advances in remote sensing analyses in a modeling framework, we predicted current and past (i.e., 1984) quantity of forage shrubs across northern Idaho. Predicted quantities of forage shrubs varied markedly across the study area and were estimated to have declined in about half of the GMUs, with the greatest declines predicted for high-energy forage species. Population performance indices were correlated with multiple forage quality and quantity parameters. Our results demonstrated that spatial and temporal variability in forage quantity and quality exists and was correlated with indices of moose population performance, supporting the hypothesis that forage is likely affecting population dynamics for moose in northern Idaho.

### Funding

Idaho Department of Fish and Game

### Principal Investigator

Janet Rachlow

### Graduate Student

Tom Schrempp

### Project Period

2014—2017



## Effects of Plague on Demography of the Northern Idaho Ground Squirrel and Sympatric Small Mammals

Plague is an introduced disease to which many species of mammals in the United States show little natural resistance. Sylvatic plague may be responsible for local declines or extirpations of Northern Idaho ground squirrels (NIDGS), but this threat has never been evaluated. We are testing this hypothesis by removing fleas (plague vector) on a subset of NIDGS colonies using a paired experimental design. Preliminary data suggests that apparent annual survival of adults was greater on flea-removal plots compared to control plots: ~17% greater for NIDGS, ~10% greater for Columbian ground squirrels, and ~14% greater for chipmunks. We have identified 7 species of fleas (all known to be capable of transmitting plague) from a total of 3,556 fleas collected from the 3 species. In 2017, we experimentally tested the viability of a plague vaccine to evaluate whether it affects survival of chipmunks and deer mice and preliminary results provide some tentative support for our flea-removal experiment.

### Funding

U.S. Fish and Wildlife Service, U.S. Geological Survey

### Principal Investigator

Courtney J. Conway

### Graduate Student

Amanda R. Goldberg

### Project Period

2014—2018



## Sage-Grouse Long-term Monitoring Protocol for the NPS Upper Columbia Basin Network

The greater sage-grouse is decreasing in numbers and range throughout much of the western U.S. NPS approached us to develop a monitoring protocol for sage grouse and grouse habitat within national parks in Idaho. This project is intended to develop a detailed monitoring protocol that conforms to standard NPS I&M protocol formats for monitoring sage-grouse in National Parks while also being compatible with the long-term lek count sampling coordinated by the Idaho Department of Fish and Game (IDFG). We have produced a draft protocol that is undergoing internal review, and we hope that the final document will contribute to the state-wide multi-agency efforts to assess the status of sage-grouse populations.

### Funding

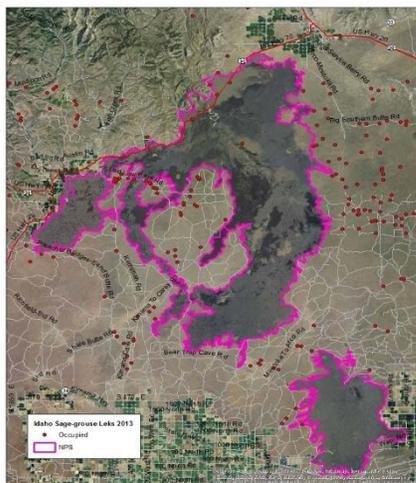
National Park Service Upper Columbia Basin I&M Network

### Principal Investigators

Courtney J. Conway, Edward O. Garton, Jack Connelly

### Project Period

2014—2017



## Grouse & Grazing: Effects of Cattle Grazing on Greater Sage-Grouse

Despite many studies of Greater Sage-Grouse (*Centrocercus urophasianus*) habitat requirements, we know surprisingly little about the effects of livestock grazing on Sage-Grouse populations. As a result, various groups make claims about the presumed effects of livestock grazing on Sage-Grouse, and litigation over this issue is common. We are implementing replicated field experiments to evaluate the effects of different cattle grazing regimes on demographic traits and habitat characteristics of sage-grouse. The results will help guide management actions (and inform policy and litigation decisions) throughout southern Idaho and throughout the species' range. For the past 4 years, we have attached radio transmitters to Sage-Grouse hens at five sites in southern Idaho. We have located >400 nests of radio-marked hens, and we have measured vegetation characteristics, sampled insects, measured Sage-Grouse demographic traits, and measured grazing intensity within 20 experimental pastures. This is an on-going study with our state and federal cooperators.

### Funding

Idaho Department of Fish and Game, Bureau of Land Management, U.S. Fish and Wildlife Service, Office of Species Conservation, Little Endowment, Idaho Cattle Association

### Principal Investigators

Courtney J. Conway, Karen Launchbaugh, Shane Roberts, David Musil

### Graduate Students

Dave Gotsch, Ian Riley, Janessa Julson, Lindsey Sanders

### Project Period

2014—2024



## Efficacy of Greater Sage-Grouse Population Trend and Productivity Metrics

Greater sage-grouse (*Centrocercus urophasianus*) populations and distribution have declined since European settlement. Consequently, sage-grouse species have been considered for protection under the Endangered Species Act and are also a game bird on most parts of their range. Biologists use sage-grouse display grounds (i.e., leks) and summer brood flush counts as metrics to infer population and demographic trends. The objective of my thesis is to evaluate new techniques that may improve count metrics and the inferences from lek and brood flush counts. For one objective, we are evaluating aural lek point-count surveys that could improve the rigor of data from lek route surveys by providing estimates of unknown lek numbers within a defined area (i.e., true density). For my second objective, we are comparing brood survival estimates based on two survey methods: brood flush counts (the commonly used method) and brood fecal surveys (a novel method). We will also examine environmental factors that influence brood survival. Lastly, we will evaluate if fecal morphometrics from nighttime roost sites can be used to predict brood age.

### Funding

Idaho Department of Fish and Game, Bureau of Land Management, Department of Veteran's Affairs

### Principal Investigators

Courtney J. Conway, Karen Launchbaugh, Shane Roberts, David Musil

### Graduate Student

Ian Riley

### Project Period

2015—2018



## Effects of Cattle Grazing on Greater Sage-Grouse Food Resources

Greater sage-grouse chicks require insects, particularly ants, beetles, and grasshoppers as an essential component in their diet. Cattle grazing may affect insect abundance through a variety of mechanisms and, thereby, affect growth and survival of Sage-Grouse chicks. We sampled insects at each of 60 sampling locations for three weeks in 2015 and 120 sampling locations for nine weeks in 2016 within four study sites across southern Idaho to document the effects of cattle grazing intensity on relative abundance and biomass of insects. We counted the number of ant mounds at each sampling location to document ant mound density (i.e., an index of ant abundance). We also experimentally manipulated cattle manure deposition to document the effects of manure on insect abundance and biomass. We have analyzed 415 samples so far and have presented results at several conferences. The grad student, David Gotsch, has taken a leave of absence but plans to graduate in May 2018. We collected more insect samples at our study sites in 2017 to complement the samples from the past 2 years and so that we have some post-treatment data to include in the resulting papers.

### Funding

Idaho Department of Fish and Game, Bureau of Land Management

### Principal Investigators

Courtney J. Conway, Shane Roberts

### Graduate Student

Dave Gotsch

### Project Period

2015—2017



## Influence of Livestock Grazing on Vegetation Characteristics in Sage-Grouse Nesting Habitat

Recent concern for sagebrush obligate species has increased the need to understand how land uses, including livestock grazing, affect sagebrush steppe habitat. Population declines of greater sage-grouse (*Centrocercus urophasianus*) have prompted land managers to focus on critical aspects of sage-grouse habitat. This graduate project is focused on defining vegetation characteristics around nests and examining how livestock grazing affects attributes including height of perennial bunchgrasses. Grass height is often measured to assess biomass, utilization levels, and cover for wildlife. Livestock grazing influences the height of grass and may have an effect on nesting cover for sage-grouse. Janessa was a MS student in the Range program who graduated in Dec 2017. Her thesis included: 1) a thorough synthesis of the literature regarding the relationship between grass height and sage-grouse nest fate, and 2) a detailed effort to document that factors that influence grass height within sagebrush steppe ecosystems in southern Idaho based on the extensive dataset from the Grouse & Grazing project.

### Funding

Idaho Department of Fish and Game, Bureau of Land Management, Office of Species Conservation, Little Endowment, Idaho Cattle Association, Public Lands Council

### Principal Investigators

Karen Launchbaugh, Courtney J. Conway, Shane Roberts, David Musil

### Graduate Student

Janessa Julson

### Project Period

2015—2017



## Changes in Carrying Capacity of Alaskan Seabird Populations

We reconstructed the population sizes of five long-lived seabird species in Alaska (AK), and analyzed their population dynamics from the past four decades: Black-legged Kittiwakes, Red-legged Kittiwakes, Common Murres, Thick-billed Murres, and Tufted Puffins. We evaluated the efficacy of a set of candidate models, some that allowed for either density independence or density dependence, and some with or without a time trend in carrying capacity (K). Carrying capacity increased significantly over the 40 years for Murres, remained relatively stable for Red-legged Kittiwakes, and decreased significantly for Black-legged Kittiwakes and Tufted Puffins, particularly in the Gulf of Alaska, following the 1989 Exxon Valdez oil spill. Our population viability analyses suggested that, in the next 100 years, Tufted Puffins are likely to become extirpated from the sites where they occur currently in the Gulf of Alaska. However, these seabird populations demonstrated negative density-dependence, which can help to prevent extirpation. Identifying population fluctuations around a changing carrying capacity is essential to conserving declining populations. We incorporated climate and habitat covariates in population models to explain the observed population dynamics. Holly completed her postdoc in spring 2017 and published 2 journal papers.

### Funding

U.S. Fish and Wildlife Service

### Principal Investigators

Heather M. Renner, Aaron J. Poe, Edward O. Garton, Courtney J. Conway

### Postdoc

Holly F. Goyert

### Project Period

2015—2017



## Dispersal Behavior of Yuma Ridgway's Rail

Yuma Ridgway's rails (*Rallus obsoletus yumanensis*) are federally endangered marsh birds endemic to wetlands throughout the Lower Colorado River basin. Yuma Ridgway's rails depend on wetland habitat patches that are separated by large expanses of non-habitat. Yuma Ridgway's rails are thought to be largely non-migratory, but recent rail mortalities at solar energy facilities suggest that these rails fly over desert regions during dispersal or migratory movements. Efforts to prevent future mortalities require information on dispersal and migratory behavior of these rare birds. We attached solar satellite transmitters to Yuma Ridgway's rails in 2016 and 2017 to document dispersal behavior and 3 of the radio-marked rails moved as far as 250km south to estuaries along the Gulf of California. These movements are the first documented records of rails moving from the U.S. to Mexico. We will attach more transmitters to Yuma Ridgway's rails in 2018. Additional information on the dispersal behavior of Yuma Ridgway's rails will help inform land management decisions in the region, especially at solar facilities that may need to account for their impact to this endangered species.

### Funding

U.S. Fish and Wildlife Service, Bureau of Land Management, National Park Service, National Fish and Wildlife Foundation

### Principal Investigator

Courtney J. Conway

### Graduate Student

Eamon Harrity

### Project Period

2015—2020



## Diet, Population Connectivity, and Adaptive Differences Among Populations of Northern Idaho Ground Squirrels and Southern Idaho Ground Squirrels

Northern Idaho ground squirrels (NIDGS) eat forbs and grasses and declines in quality or quantity of important grasses and forbs could reduce reproductive output and decrease survival. We are using a metabarcoding DNA sequencing method to document relative abundance of species of grasses and forbs in NIDGS fecal samples. We are also measuring the functional or adaptive component of genetic variation among and within populations of these 2 species. We plan to identify the habitat features that affect fitness and whether these features are consistent among populations throughout each species' range. We have collected 858 noninvasive cheek swab samples at 18 sites for NIDGS and 113 samples from 5 sites for SIDGS.

### Funding

U.S. Fish and Wildlife Service, U.S. Geological Survey

### Principal Investigators

Courtney J. Conway, Lisette Waits, David Tank, Kim Andrews

### Graduate Student

Amanda R. Goldberg

### Project Period

2015—2018



## Predicting Nutritional Condition and Pregnancy of Elk from Remotely Sensed Vegetation Indices

The focus of this study is to investigate the potential for nutritional limitation of elk population productivity in Idaho. Over two summers, we collected 4,076 biomass samples and 2,052 forage quality samples within the Sawtooth and Diamond Creek elk zones. We are also working with the Clearwater Basin Collaborative to obtain similar data for the South Fork drainage. Currently, we are using the Forage Resource Evaluation System for Habitat (FRESH) model, which integrates biomass and quality data, along with critical nutritional requirements for adult female elk, to estimate usable forage biomass for elk at sampled locations. We will then estimate usable biomass in areas not sampled by developing a spatio-temporally dynamic nutritional landscape model that is based on remotely-sensed variables. In order to gather temporally-matched pregnancy data that reflect use of the nutritional landscape in our sampled elk zones, we collected fecal samples in March 2017 and blood samples from hunter-harvested adult cow elk this winter. Summer-fall collar data from adult cows in each study area will be used to develop seasonal, population-level RSFs. This will allow us to evaluate the degree to which adult cow elk are utilizing high-quality habitat, and to draw inferences about both the nutritional and behavioral mechanisms underlying poor herd productivity.

### Funding

Idaho Department of Fish and Game, University of Idaho

### Principal Investigator

Ryan Long

### Graduate Student

Sierra Robotcek

### Project Period

2015—2018



## Development of a Vegetation Map for Predicting Nutritional Condition of Ungulate Habitat in Idaho

Vegetation maps with finer spatial and thematic resolution are needed for characterizing the nutritional landscape available to ungulates, as well as management planning, decision-making, and research. To obtain finer spatial and thematic resolution data, we segmented all of Idaho into millions of polygons based on spectral values of the National Agriculture Imagery Program (NAIP) imagery (1-meter resolution, see photo below). We also compiled and created spatial data to use as modeling covariates (e.g., elevation, soil characteristics, wildfire severity, temperature, precipitation, solar radiation index, etc.). We gathered understory plant species occurrence data from a variety of sources, such as Idaho Department of Fish and Game. We attributed each polygon across the state with values from each modeling covariate and understory plant species information. We used that information to create predictive plant species distribution models for a variety of understory plant species that are preferred forage for mule deer (*Odocoileus hemionus*) and elk (*Cervus canadensis*). The models predict plant species presence and provide insight into species-environment relationships that can inform habitat management strategies to improve nutritional quality.

### Funding

Idaho Department of Fish and Game

### Principal Investigators

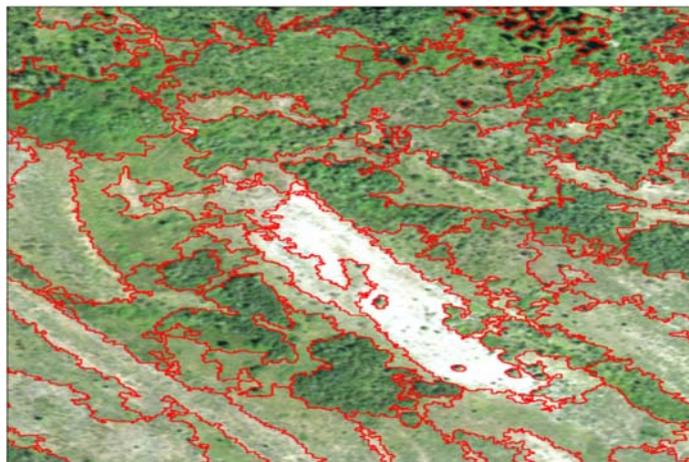
Eva Strand, Jocelyn Aycrigg, Ryan Long

### Graduate Student

Tara Ball

### Project Period

2015—2017



## Using GAP Data to Explain Elevational Patterns of Avian Species Richness in the U.S.

Many studies predict that species' distributions will shift upward in elevation in response to climate change, and indeed this movement has already been observed in some species. Such shifts may result in extirpations and changes in biodiversity along an elevational gradient. To predict how species richness may shift in response to future climate change, we first need to understand how species richness varies along an elevational gradient, and how that variation in species richness corresponds to variation in temperature, precipitation, vegetation phenology, land use, and land area. Understanding current patterns of elevational variation in avian species richness will provide a baseline from which we can quantify the speed and extent of change in the future. Additionally, this information will allow us to prioritize land for conservation based on knowledge of why different elevations are likely to support differing levels of biodiversity. We are examining variation in avian species richness along 86 elevational gradients in six major mountain ranges across the U.S., as well as the potential causes of that variation. We have a draft manuscript that is undergoing USGS review.

### Funding

U.S. Geological Survey Gap Analysis Program

### Principal Investigator

Courtney J. Conway

### Research Scientist

Kristen G. Dillon

### Project Period

2015—2018



## Examining the Taxonomy and Genetic Distinctiveness of the Red Wolf

The red wolf has been recognized as a species, *Canis rufus*, by the United States Fish and Wildlife Service (USFWS) since its protection under the Endangered Species Act (ESA) in 1973. Since then molecular analyses of red wolf DNA have resulted in competing hypotheses of red wolf taxonomy some which support the original ESA listing and others that do not support listing the red wolf as a species. This funded project seeks to provide additional information regarding the taxonomic status of the red wolf by including DNA from the last wild-captured individuals who founded the captive colony, generating data across the red wolf genome at single nucleotide polymorphism (SNP) markers via Restriction site-associated DNA sequencing (RADseq) and employing new analytical methods of hypothesis testing on single and multiple marker datasets. Hypothesis testing has begun on a dataset comprised of nuclear and Y chromosome microsatellite loci and mitochondrial DNA sequence markers. Samples for the SNP marker genotyping by RADseq have been screened via DNA quantification. RADseq library preparations will begin in February 2018.

### Funding

U.S. Fish and Wildlife Service

### Principal Investigators

Jennifer Adams, Paul Hohenlohe, Lisette Waits

### Postdoc

Kimberly Andrews, Soraia Barbosa

### Project Period

2016—2018



## Wetland Restoration for Recovery of an Endangered Marsh Bird: Prioritizing Management Actions

Yuma Ridgway's rails (*Rallus obsoletus yumanensis*) are a federally endangered species endemic to emergent wetlands along the lower Colorado River. Historically, spring flooding reset succession and created new marshes across the floodplain of the lower Colorado River. River regulation has nearly eliminated the annual flood cycle of the Colorado River and without periodic floods, new emergent wetlands are not created and extant marshes senesce. Yuma Ridgway's rail populations are negatively impacted by wetland senescence. Land management agencies implement prescribed fire and mechanical treatments to mimic the restorative effects of periodic flooding and Yuma Ridgway's rails respond positively. However, these management efforts are difficult to implement efficiently at a large scale. We are evaluating the effectiveness of normalized difference vegetation index (NDVI) to identify marshes along the lower Colorado River where habitat restoration would be most effective for the recovery of Yuma Ridgway's rails. If successful, our approach will help spatially and temporally prioritize wetland management throughout the range of the Yuma Ridgway's rail, thereby facilitating the recovery of this species.

### Funding

U.S. Fish and Wildlife Service, Bureau of Land Management, National Park Service, National Fish and Wildlife Foundation

### Principal Investigator

Courtney J. Conway

### Graduate Student

Eamon Harrity

### Project Period

2016—2018



## Cause of Low Nesting Success and Recruitment of Western Grebes in Idaho

Western Grebes are currently experiencing population declines and low recruitment in Idaho. Western Grebes are colonial nesters that require large lakes or reservoirs to breed. The 3 largest breeding colonies of Western Grebes in Idaho are Deer Flat NWR, Minidoka NWR, and Cascade Reservoir. The proposed research will identify possible benefits of colonial nesting as well as help identify causes of population decline. We will test 2 hypotheses to explain how Western Grebes benefit from nesting colonially in Idaho: reduced nest predation, or reduced nest failure due to wave action. Grebe nests will be monitored by video cameras, by observers with binoculars and spotting scopes, and by Unmanned Aerial Vehicles. Similarly, water levels at and around nests will be monitored to quantify water level fluctuations. Also, eggs will be collected from nests for analysis of contaminant levels. The results will be useful for managers to form policies to help mitigate the current population decline.

### Funding

U.S. Geological Survey, U.S. Fish and Wildlife Service

### Principal Investigator

Courtney J. Conway

### Graduate Student

Deo Lachman

### Project Period

2016—2019





# Honors and Awards

## Unit Scientists

*Courtney J. Conway*

- Promoted to Full Professor in the College of Natural Resources, University of Idaho, March 2017.

*Christine M. Moffit*

- Athena Women of the Year Award (Faculty Category), University of Idaho, Academic Year 2016—2017.

## Graduate Students and Postdocs

*Shannon Blackburn*

- Ted Bjornn Scholarship, University of Idaho (2017)

*Amanda Goldberg*

- Curt Berklund Graduate Research Scholar Award, University of Idaho (2017)
- 2017 Kvale Scholarship, University of Idaho (2017)
- The J. Michael & Sharon L. Scott Graduate Student Scholarship (2017)

*Eamon Harrity*

- Alexander Bergstrom Memorial Research Award, Association of Field Ornithologists (2017)
- Gale Monson Research Award, Arizona Field Ornithologists (2017)

*John Heckel*

- Bill Alspach & Dave Engerbretson Memorial Scholarship, Clearwater Fly Casters (2017)

*Zachary Klein*

- John E. Skinner Memorial Award, American Fisheries Society (2017)
- Outstanding Graduate Student Award, Graduate and Professional Student Association, University of Idaho (2017)
- Idaho Chapter of the American Fisheries Society Graduate Student Scholarship (2017)

*Carl Lundblad*

- Ehrenreich Fellowship, University of Idaho (2017)
- Best Presentation Award, Utah Chapter of The Wildlife Society (2017)

*Conor McClure*

- Ted Bjornn Scholarship, University of Idaho (2017)

*Lindsey Sanders*

- Reed W. Fautin Memorial Scholarship, University of Wyoming (2017)
- Best Newsletter Article, Wyoming Chapter of The Wildlife Society (2017)

*Bryan Stevens*

- Best Student Presentation Award, Michigan Chapter of The Wildlife Society (2017)



## Courses and Workshops Taught

*Courtney J. Conway*

- NR 511— Writing Scientific Manuscripts - Directed Study (Spring 2017)
- WLF 504—Research Presentations, 2 credits (Spring 2017)
- WLF 502—Analysis of Upland Game Bird Data - Directed Study (Fall 2017)
- Field Tour: Sage-grouse and Livestock Grazing. Idaho Rangeland Center Fall Forum Field Tour, October 2017

*Michael C. Quist*

- FISH 501—Fish & Wildlife Seminar, 1 credit (Spring 2017)
- FISH 510—Advanced Fisheries Techniques, 3 credits (Spring 2017)
- Workshop: Age and Growth of Fishes. Utah Division of Wildlife Resources, December 2017



## Publications

- Barenberg, A. and C. M. Moffitt. 2017. Toxicity of aqueous alkaline solutions to New Zealand mudsnails, Asian clams, and quagga mussels. *Journal of Fish and Wildlife Management*. On line early: <http://fwspubs.org/doi/pdf/10.3996/022017-JFWM-013>
- Beard†, Z. S., M. C. Quist, R. S. Hardy, and T. J. Ross. 2017. Habitat associations of juvenile Burbot in a tributary of the Kootenai River. *Transactions of the American Fisheries Society* 146:1008-1015.
- Beard†, Z. S., M. C. Quist, R. S. Hardy, and T. J. Ross. 2017. Survival, movement, and distribution of juvenile Burbot in a tributary of the Kootenai River. *North American Journal of Fisheries Management* 37:1274-1288.
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- Klein†, Z. B., T. F. Bonvechio, B. R. Bowen, and M. C. Quist. 2017. Precision and accuracy of age estimates obtained from anal fin spines, dorsal fin spines, and sagittal otoliths for known-age largemouth bass. *South-eastern Naturalist* 26:225-234.
- McCullough†, J. M., and C. J. Conway. 2017. Breeding behavior of northern saw-whet owls in Oregon. *North-west Science* 91:222-227.
- Ng†, E. L., J. P. Fredericks, M. C. Quist. 2017. Stable isotope evaluation of population- and individual-level diet variability in a large, oligotrophic lake with nonnative lake trout. *Ecology of Freshwater Fish* 26:271-279.
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- Roth†, C. J., D. J. Schill, and M. C. Quist. 2018. Fight and air exposure times of caught and released salmonids from the South Fork Snake River. *Fisheries Research* 201:38-43.
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# Presentations

- Beard†, Z. S., M. C. Quist, R. S. Hardy, and T. J. Ross. 2017. Habitat and species associations of juvenile burbot and other fishes in a tributary of the Kootenai River. Annual Meeting of the Idaho Chapter of the American Fisheries Society. Boise, ID. 3 Mar 2017.
- Beard†, Z. S., M. C. Quist, R. S. Hardy, and T. J. Ross. 2017. Survival, movement, and distribution of juvenile Burbot in a tributary of the Kootenai River. Annual Meeting of the Idaho Chapter of the American Fisheries Society. Boise, ID. 3 Mar 2017.
- Blackburn†, S. E., M. L. Gingras, J. DuBois, Z. J. Jackson, and M. C. Quist. 2017. Population dynamics and management of White Sturgeon in the Sacramento-San Joaquin River system, California. 147th Annual Meeting of the American Fisheries Society. Tampa, FL. 24 Aug 2017.
- Bonvechio, T. F., Z. B. Klein†, B. R. Bowen, and M. C. Quist. 2017. Precision and accuracy of age estimates obtained from anal fin spines, dorsal fin spines, and sagittal otoliths for known-age Largemouth Bass. 25th Annual Meeting of the Georgia Chapter of the American Fisheries Society. Statesboro, GE. 25 Jan 2017.
- Branigan†, P. B., M. C. Quist, B. B. Shepard, and S. C. Ireland. 2017. Microhabitat associations of native fishes in rehabilitated reaches of the Kootenai River, Idaho. Annual Meeting of the Idaho Chapter of the American Fisheries Society. Boise, ID. 3 Mar 2017.
- Branigan†, P. B., M. C. Quist, B. B. Shepard, and S. C. Ireland. 2017. Resource selection and species interactions of select native and nonnative fishes of the Kootenai River, Idaho. Annual Meeting of the Idaho Chapter of the American Fisheries Society. Boise, ID. 3 Mar 2017.
- Brauer†, T. B., M. C. Quist, and D. T. Rhea. 2017. Population characteristics of invasive burbot in Fontenelle Reservoir, Wyoming. Annual Meeting of the Idaho Chapter of the American Fisheries Society. Boise, ID. 3 Mar 2017.
- Conway, C. J., K. Launchbaugh, A. Meyers, D. Musil, P. Makela, and S. Roberts. 2017. Effects of Cattle Grazing on Greater Sage-grouse and Other Sagebrush-steppe Birds. Special Symposium at the Annual Meeting of the American Ornithological Society. East Lansing, MI. 5 Aug 2017. INVITED.
- Conway, C. J., K. Launchbaugh, A. Meyers, D. Musil, P. Makela, and S. Roberts. 2017. Effects of grazing on sage-grouse and other shrub-steppe birds: a collaborative project to inform management of sage-steppe rangelands. Great Basin Landscape Conservation Cooperative Webinar Series. 13 Sep 2017. INVITED.
- Conway, C. J., K. Launchbaugh, A. Meyers, D. Musil, P. Makela, and S. Roberts. 2017. The Grouse & Grazing Project. Public Forum. Burley, ID. 27 Oct 2017.
- Conway, C. J., K. Launchbaugh, D. Musil, P. Makela, and S. Roberts. 2017. Effects of Livestock Grazing Intensity on Nesting Success and Brood Movements in Greater Sage-Grouse. Annual Meeting of the Idaho Chapter of The Wildlife Society. Boise, ID. 2 Mar 2017.
- Conway, C. J., K. Launchbaugh, D. Musil, P. Makela, and S. Roberts. 2017. The Idaho Grouse & Grazing Project: a collaborative, landscape-scale experiment to assess the effects of cattle grazing. Annual Meeting of the Idaho Bird Conservation Partnership. Boise, ID. 27 Feb 2017. INVITED.
- Conway, C.J. 2017. Relationships between livestock grazing and wildlife populations. Rangeland Center Fall Forum. Boise, ID. 6 Oct 2017. INVITED.

- Conway, C. J., and A. R. Goldberg. 2017. Effects of forest restoration treatments on the northern Idaho ground squirrel. Northern Idaho Ground Squirrel Technical Team Meeting. Boise, ID. 13 Nov 2017. INVITED.
- Conway, C. J., D. H. Johnson, C.G. Lundblad, and J.L. Conley. 2017. Migratory Behavior and Breeding Dispersal of Burrowing Owls in the western United States. World Owl Conference. Evora, Portugal. 30 Sep 2017.
- Conway, C. J., D. H. Johnson, C.G. Lundblad, and J.L. Conley. 2017. Migratory behavior and dispersal of burrowing owls throughout North America. Annual Meeting of The Wildlife Society. Albuquerque, NM. 25 Sep 2017.
- Conway, C. J., K. L. Launchbaugh, D. Musil, P. Makela, and S. Roberts. 2017. Effects of Livestock Grazing Intensity on Greater Sage-grouse. BLM Idaho Leadership Team meeting, Boise, ID. 11 Apr 2017. INVITED.
- Feekent†, S. F., M. C. Quist, B. J. Bowersox, and M. E. Dobos. 2017. Distribution and movement of wild steelhead, hatchery steelhead, and anglers in the Clearwater River, Idaho. Annual Meeting of the Idaho Chapter of the American Fisheries Society. Boise, ID. 3 March 2017.
- Goldberg†, A.R., C. J. Conway, D. Evans Mack, G. Burak, and D. E. Biggins. 2017. Effects of sylvatic plague on northern Idaho ground squirrels. Annual Meeting of the American Society of Mammalogists. Moscow, ID. 22 Jun 2017.
- Goldberg†, A. R., C. J. Conway, D. Evans Mack, G. Burak, and D. E. Biggins. 2017. Effects of sylvatic plague on northern Idaho ground squirrels. Annual Meeting of The Wildlife Society. Albuquerque, NM. 26 Sep 2017.
- Goldberg†, A. R., C. J. Conway, D. Evans-Mack, and G. Burak. 2017. Effects of microclimate change on Northern Idaho Ground Squirrel hibernation. Annual Meeting of the Idaho Chapter of The Wildlife Society. Boise, ID. 2 Mar 2017.
- Gotsch†, D., C. J. Conway, and D. Musil. 2017. Prey availability for sage-grouse chicks: effects of cattle grazing and vegetative structure. Annual Meeting of the Idaho Chapter of The Wildlife Society, Boise, ID. 2 Mar 2017.
- Gotsch†, D., C. J. Conway, D. Musil, and S. Roberts. 2017. Prey for sage-grouse: Impacts of livestock grazing. Annual Meeting of The Wildlife Society. Albuquerque, NM. 27 Sep 2017.
- Goyert, H. F., E. O. Garton, B. A. Drummond, and H.M. Renner. 2017. Density-dependence and changes in the carrying capacity in Alaskan seabird populations. PSG: Tacoma, WA; 25 Feb
- Goyert, H. F., E. O. Garton, B. A. Drummond, and H.M. Renner. 2017. Density-dependence and changes in the carrying capacity of Tufted Puffin populations in Alaska. Tufted Puffin Technical Committee Meeting: Tacoma, WA; 22 Feb
- Goyert, H. F. 2017. Prey availability, habitat, and foraging behavior in terns. Sand Lance stakeholders workshop, Parker River National Wildlife Refuge; 8 May. INVITED.
- Harrity, E. and C. J. Conway, C.J. 2017. Fire as a tool for improving habitat quality of wetland-dependent birds in the southwestern U.S. Annual Meeting of the Association of Fire Ecology. Orlando, FL. 30 Nov 2017. INVITED.
- Heckel†, J. W., IV, M. C. Quist, S. A. Carleton, C. J. Watkins, and A. M. Dux. 2017. Using otolith microchemistry to describe the isotopic landscape of the Coeur d'Alene Lake basin. Annual Meeting of the Idaho Chapter of the American Fisheries Society, Boise, ID, March 3.
- Heckel†, J. W., IV, M. C. Quist, S. A. Carleton, C. J. Watkins, and A. M. Dux. 2017. Using otolith microchemistry to describe the isotopic landscape of the Coeur d'Alene Lake basin. Wild Trout XII, West Yellowstone, MT, September 28.
- Helmstetter†, N., C. J. Conway, and A. R. Goldberg. 2017. Using Morphometrics to Estimate Age of Northern Idaho Ground Squirrels (*Uroditellus brunneus*). Idaho Conference on Undergraduate Research. Boise, ID. 26 Jul 2017.

- Jones, C., and C. J. Conway. 2017. Full life-cycle monitoring of burrowing owls (*Athene cunicularia*) in southeastern Colorado. Annual Meeting of the Colorado Chapter of The Wildlife Society, Ft. Collins, CO. 16 Feb 2017.
- Julson†, J., K. Launchbaugh, and C. J. Conway. 2017. How to Estimate Utilization of Grasses: Ocular Estimation or Height-Weight Method? Society for Range Management Annual Conference. St. George, UT. 29 Jan 2017.
- Julson†, J., K. Launchbaugh, E. Strand, C. J. Conway, and A. Locatelli. 2017. Relationships among spring livestock grazing, sage-grouse nest fate, and climate in sagebrush-steppe communities. Society for Range Management Annual Conference. St. George, UT. 29 Jan 2017.
- Klein†, Z. B., M. C. Quist, A. M. Dux, and M. P. Corsi. 2017. Evaluating the size selectivity of mid-water trawls for sampling kokanee. 147th Annual Meeting of the American Fisheries Society, Tampa, FL, August 24.
- Klein†, Z. B., M. C. Quist, A. M. Dux, and M. P. Corsi. 2017. Evaluating the size selectivity of mid-water trawls for sampling kokanee. Annual Meeting of the Idaho Chapter of the American Fisheries Society, Boise, ID, March 3.
- Klein†, Z. B., M. C. Quist, A. M. Dux, and M. P. Corsi. 2017. Evaluating the size selectivity of mid-water trawls for sampling kokanee. Annual Meeting of the Western Division of the American Fisheries Society, Missoula, MT, May 24.
- Klein†, Z. B., M. J. Breen, and M. C. Quist. 2017. Population characteristics and the influence of discharge on Bluehead Sucker and Flannelmouth Sucker. Annual Meeting of the Western Division of the American Fisheries Society, Missoula, Montana, May 22.
- Klein†, Z. B., M. J. Breen, and M. C. Quist. 2017. Population characteristics and the influence of discharge on Bluehead Sucker and Flannelmouth Sucker. 147th Annual Meeting of the American Fisheries Society. Tampa, FL, 24 August 2017.
- Klein†, Z. B., M. J. Breen, and M. C. Quist. 2017. Population characteristics and the influence of discharge on Bluehead Sucker and Flannelmouth Sucker. Annual Meeting of the Idaho Chapter of the American Fisheries Society. Boise, ID. 3 Mar 2017.
- Launchbaugh, K. L., and C. J. Conway. 2017. Grouse & grazing: how does spring livestock grazing influence sage-grouse populations? Public Lands Endowment Board of Directors Annual Meeting. Flagstaff, AZ. 21 Sep 2017. INVITED.
- Launchbaugh, K. L. 2018. Grouse & grazing study: effects of spring grazing on sage-grouse populations. Idaho Range Livestock Symposium. Marsing, ID. 9 Jan 2018. INVITED.
- Lundblad†, C. G., and C. J. Conway. 2017. Thermal constraints affect reproductive success of burrowing owls breeding along a latitudinal gradient. Annual Meeting of the Idaho Chapter of The Wildlife Society. Boise, ID. 2 Mar 2017.
- Lundblad†, C. G., and C. J. Conway. 2017. Thermal ecology, reproductive success, and climate adaptability of Burrowing Owls. Utah Chapter of The Wildlife Society. Bryce Canyon, UT. 23 March 2017.
- Lundblad†, C.G., and C. J. Conway. 2017. Effects of nest microclimate on reproductive success of Burrowing Owls along a latitudinal gradient. Annual Meeting of The Wildlife Society. Albuquerque, NM. 25 Sep 2017.
- Manning†, S. E., B. S. Stevens, and D. M. Williams. Evaluating fall harvests with practicable wild turkey management models: incorporating observation uncertainty and regulation cycle. Annual Meeting of the Michigan Chapter of The Wildlife Society, Grayling, MI, 17 March 2017.
- Manning†, S. E., B. S. Stevens, and D. M. Williams. Evaluating fall harvests with practicable wild turkey management models: incorporating observation uncertainty and regulation cycle. Midwest Fish and Wildlife Conference, Lincoln, NE, 7 Feb 2017.

- McClure†, B. C., M. C. Quist, J. R. Kozfkay, and M. P. Peterson. 2017. Population dynamics and movement of Smallmouth Bass in the Snake River. Western Warmwater Fisheries Meeting. Spokane, WA, 11 July 2017. INVITED.
- McClure†, B. C., M. C. Quist, J. R. Kozfkay, and M. P. Peterson. 2017. Population dynamics and movement of Smallmouth Bass in the Snake River. Annual Meeting of the Idaho Chapter of the American Fisheries Society. Boise, ID. 3 Mar 2017.
- Meyers, A.R., C.J. Conway, D.D. Musil, K. Launchbaugh, and S. Roberts. 2017. Effects of Spring Cattle Grazing on Nest Survival of Greater Sage-grouse in Southern Idaho. Annual Meeting of The Wildlife Society. Albuquerque, NM. 27 Sep 2017.
- Moffitt, C. M. 2017. Aquatic invasive species: management and risks. Environmental Science Seminar Series. October 2017.
- Moffitt, C. M. 2017. Connecting diversity efforts in AFS. In session “Harnessing the Power of Diversity and Inclusion”. 2017. Annual Meeting, American Fisheries Society. Tampa, FL. August 2017
- Moffitt, C. M. and K. Stockton-Fiti. 2017. Controlling the spread of invasive zebra and quagga mussels with KCL. Annual Meeting, American Fisheries Society, Tampa, FL. August 2017
- Moffitt, C. M. 2017. Connecting Efforts to Achieve Cultural Diversity in AFS Program at Multiple Scales. Oregon Chapter American Fisheries Society Annual Meeting. Bend, OR. Mar. 2017
- Roth†, C. J., D. J. Schill, and M. C. Quist. 2017. Let’s get real: air exposure times of wild trout in a catch and release fishery. World Recreational Fishing Conference. Victoria, Canada, 17 July 2017.
- Roth†, C. J., D. J. Schill, M. C. Quist, and B. High. 2017. Air exposure times of caught and released trout on the South Fork Snake River. Annual Meeting of the Idaho Chapter of the American Fisheries Society. Boise, ID. 3 Mar 2017.
- Roth†, C. J., D. J. Schill, M. C. Quist, and B. High. 2017. Air exposure times of caught and released trout on the South Fork Snake River. Annual Meeting of the Washington-British Columbia Chapter of the American Fisheries Society. Boise, ID. 12 April 2017.
- Roth†, C. J., D. J. Schill, M. C. Quist, and B. High. 2017. Let’s get real: air exposure times of wild trout in a catch and release fishery. Wild Trout XII. West Yellowstone, MT. 28 September 2017.
- Roth†, C. J., D. J. Schill, M. C. Quist, and B. High. 2017. Survival of Yellowstone Cutthroat Trout exposed to air during mid-summer angling events. Annual Meeting of the Idaho Chapter of the American Fisheries Society. Boise, ID. 3 Mar 2017.
- Roth†, C. J., D. J. Schill, M. C. Quist, and B. High. 2017. Survival of Yellowstone Cutthroat Trout exposed to air during mid-summer angling events. Annual Meeting of the Washington-British Columbia Chapter of the American Fisheries Society. Boise, ID. 12 April 2017.
- Roth†, C. J., D. J. Schill, M. C. Quist, and B. High. 2017. Survival of Yellowstone Cutthroat Trout exposed to air during mid-summer angling events. Wild Trout XII. West Yellowstone, MT. 28 September 2017.
- Roth†, C. J., D. J. Schill, M. C. Quist, and B. High. 2017. Evaluating the effects of air exposure from mid-summer angling events on the survival of Yellowstone Cutthroat Trout. World Recreational Fishing Conference. Victoria, Canada. 18 July 2017.
- Roth†, C. J., D. J. Schill, M. C. Quist, B. High, M. R. Campbell, and N. Vu. 2017. Effects of air exposure on survival and fitness of Yellowstone Cutthroat Trout. Annual Meeting of the Idaho Chapter of the American Fisheries Society. Boise, ID. 3 Mar 2017.
- Roth†, C. J., D. J. Schill, M. C. Quist, B. High, M. R. Campbell, and N. Vu. 2017. Effects of air exposure on survival and fitness of Yellowstone Cutthroat Trout. Annual Meeting of the Washington-British Columbia Chapter of the American Fisheries Society. Boise, ID. 12 April 2017.

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Roth†, C. J., D. J. Schill, M. C. Quist, B. High, M. R. Campbell, and N. Vu. 2017. Effects of air exposure on survival and fitness of Yellowstone Cutthroat Trout. *World Recreational Fishing Conference*. Victoria, Canada. 18 July 2017.

Schill, D. J., C. J. Roth†, M. C. Quist, B. High, M. R. Campbell, and N. Vu. 2017. Effects of air exposure on survival and fitness of Yellowstone cutthroat trout. *147th Annual Meeting of the American Fisheries Society*. Tampa, FL, 24 August 2017.

Shea, C. P., B. D. Bakevich†, P. W. Bettoli, J. R. Fischer†, C. L. Pierce, and M. C. Quist. 2017. Combining dynamic occupancy models and trait-based approaches to assess the response of stream fish assemblages to hydrological and hydrothermal variability. *Annual Meeting of the Society for Freshwater Sciences*. Raleigh, NC. 6 June 2017.

Stevens, B.S., and C. J. Conway. 2018. Estimating abundance with removal models. *North Dakota Game and Fish Department*. Bismark, ND. 25 Jan 2018. INVITED.

Stevens, B.S., and C.J. Conway. 2017. Developing range-wide occupancy models for king rails: optimizing predictive capabilities across spatial scales. *Annual Meeting of The Wildlife Society*. Albuquerque, NM. 24 Sep 2017.

Stockton-Fiti, K.A.† and C. M. Moffitt. 2017. Investigation of the Edwards protocol on Dreissenid mussels. *29th International Conference on Aquatic Invasive Species*. Fort Lauderdale, FL. 22-26 Oct. 2017.

Watkins†, C. J., M. C. Quist, T. J. Ross, and R. S. Hardy. 2017. Response of fish population dynamics to mitigation activities in a large, regulated river. *147th Annual Meeting of the American Fisheries Society*. Tampa, FL. 24 August 2017.

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