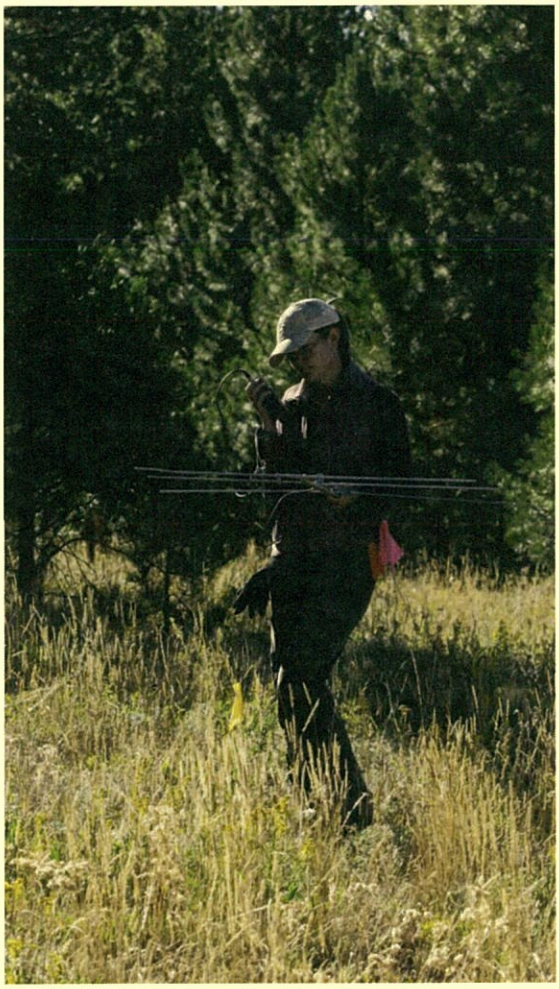
IDAHO COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT



ANNUAL REPORT TO COOPERATORS

1 JANUARY 2015 TO 31 DECEMBER 2015

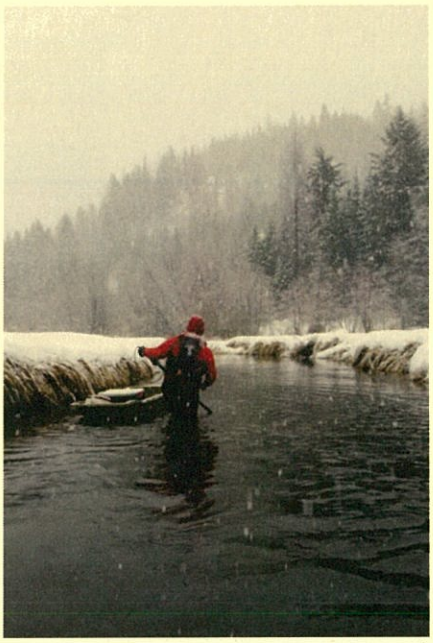
USGS
science for a changing world

IDAHO FISH & GAME

WILDLIFE MANAGEMENT INSTITUTE · WASHINGTON, D.C. ·

U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

University of Idaho



M.S. student, Zach Beard, using a mobile PIT tag antenna to search for juvenile Burbot in January

Zebra and quagga mussels collected from Lake Ontario

Burrowing owl recovered with geolocator in Mountain Home, ID

Cover photos:
Top: Phil Branigan, M.S. student, collecting fish sampled from the Kootenai River, Idaho
Bottom: Sage-grouse fitted with a radio-collar
Right: Senior research technician, Jennifer Smith, using telemetry to locate northern Idaho ground squirrel hibernaculum

REPORT TO COOPERATORS
1 January 2015 — 31 December 2015

Cooperators Meeting: 22 March 2016

IDAHO COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT

6TH AND LINE STREETS
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U.S. GEOLOGICAL SURVEY
IDAHO DEPARTMENT OF FISH AND GAME
UNIVERSITY OF IDAHO
U.S. FISH AND WILDLIFE SERVICE
WILDLIFE MANAGEMENT INSTITUTE

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Fishing paired hoop nets for Burbot on the Green River of Wyoming

Introduction

Idaho Cooperative Fish and Wildlife Research Unit
A cooperative research and educational program of
U.S. GEOLOGICAL SURVEY
IDAHO DEPARTMENT OF FISH AND GAME
UNIVERSITY OF IDAHO
U.S. FISH AND WILDLIFE SERVICE
WILDLIFE MANAGEMENT INSTITUTE

HISTORY OF COOPERATIVE RESEARCH UNITS

The Cooperative Fish and Wildlife Research Unit Program was established in 1935 in the U.S. Fish and Wildlife Service 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 renewable natural resource questions; participate in the education of graduate students destined to become managers and scientists in natural resources; provide technical assistance and consultation to parties who have interests in natural resource issues; and provide various forms of continuing education for natural resource professionals.

The Idaho Cooperative Wildlife Research Unit was established at the University of Idaho 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.

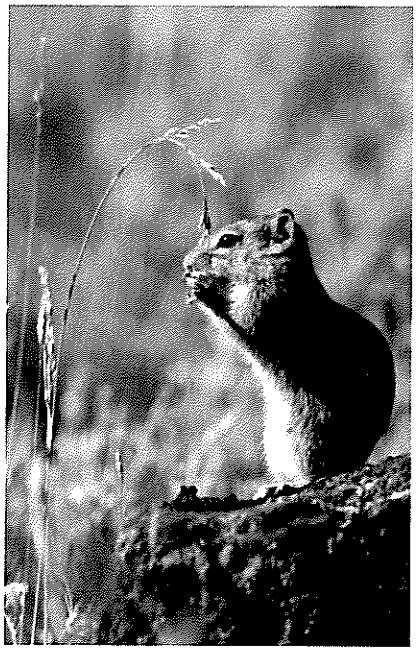
The Unit emphasizes research to help find solutions to problems affecting the fish and wildlife resources of Idaho, the Pacific Northwest, and the U.S. Special areas of focus include: studies of anadromous fish passage and ecology in the Snake River basin; evaluation of methods to enhance fish health of hatchery-reared fish; 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.

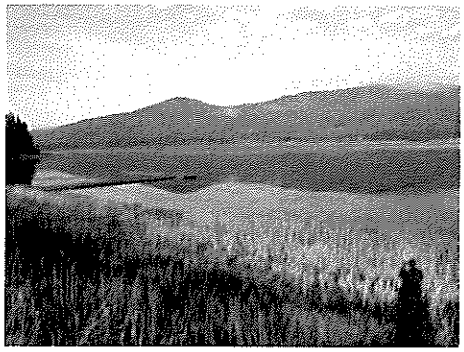
IDAHO UNIT FEDERAL SCIENTISTS, RESEARCH, EXPERTISE, AND INTERESTS

Unit personnel maintain close working and professional relationships with the University of Idaho faculty, Idaho Department of Fish and Game, and U.S. Fish and Wildlife Service personnel. Research studies are conducted with a focus on Idaho, in the Pacific Northwest, and Intermountain West, but include studies throughout North America and at various geographic scales.

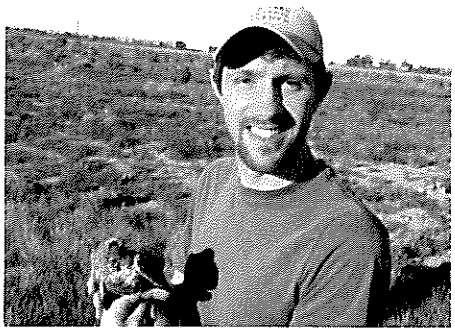
The Unit is directly supported through funding from Idaho Department of Fish and Game, the University of Idaho, and the U.S. Geological Survey. Contract funds support research from federal, state, tribal, and private entities including the Idaho Department of Fish and Game, U.S. Geological Survey, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, U.S. Forest Service, U.S. Department of Defense, 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.



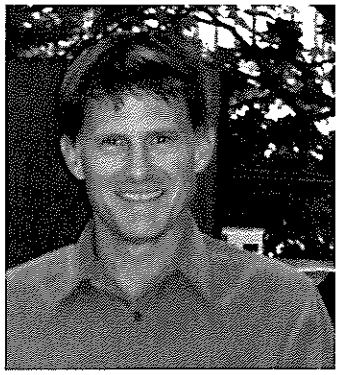
Northern Idaho ground squirrel



McArthur Lake, south of Bonners Ferry, ID



Wes Glisson with a burrowing owl



Courtney J. Conway – 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.

Christine M. Moffitt – Assistant Unit Leader and Professor of Fishery Resources. Recent research activities include studies of control measures for invasive species, steelhead physiology and migrations; interactions between cultured and wild fish; tools for evaluating the sustainability and risks of aquaculture systems; and fisheries history.

Michael C. Quist – 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; and developing and evaluating techniques that allow managers to more effectively and efficiently evaluate fish populations.

Elyse Bean - Program Specialist for the Idaho Cooperative Fish and Wildlife Research Unit. Elyse provides support for research and cooperative agreements for federal and state contracts. Elyse started her position on 18 May 2015.

Federally Funded Scientists and University Administrative Staff Contact Information

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Terry Rabot, Deputy Regional Director
Stephen Zylstra, Assistant Regional Director Science Applications
Dennis Mackey, Acting Supervisor Idaho State Office

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Wildlife Management Institute
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Fish and Wildlife Departmental Administrative Staff

Kim Stout, Administrative Assistant

Department of Fish and Wildlife Faculty with Unit Projects in 2015

Ken Cain, Professor
Brian Kennedy, Associate Professor
Eva Strand, Assistant Professor

Students and Research Staff Who Worked on Unit Projects in 2015

Postdoctoral Research Associates and Research Scientists
Jocelyn Aycrigg
Holly Goyert
Jack Connelly
Wesley Glisson
Anthony Locatelli
Kristen Dillon
David Johnson

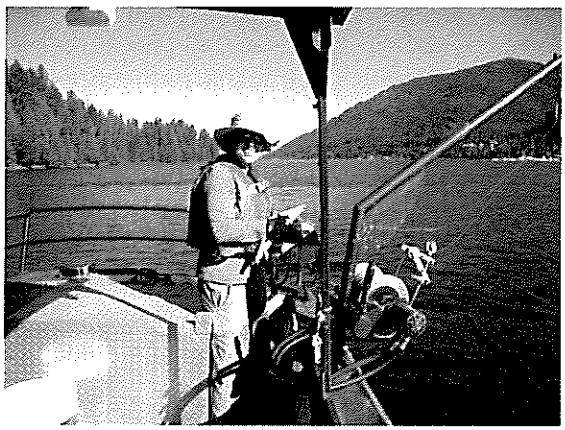
Senior Research Technicians
Lisa Cross
Jennifer Smith
Jill Wussow
Rhianna Hohbein

Undergraduate Assistants, Interns, and IH Technicians

Erica Jo Albertson
Austin Allison
Kolby Aerhart
Evan Appod
Nicole Benson
Graham Briley
Keala Bush
Stephanie Cunningham
Nicole Dotson
Caylee Falvo
Johnathan Farlye
Alyssa Gomez
Kayla Griffin
Emily Hays
Dylan Hopkins
Elizabeth (Lizzy) Jossie
Nathan Lester
Nick Maag
Kathryn McBaine
Randall McBride
Anna Miera
Matthew Modlin
Kyle Nellis
Joseph Noonan
Viviana Nunez
Vincent Oliveras
Brendan Popp
Jennifer Proescholdt
Arturo Rosales
Rebecca Schartau
Landon Schofield
Luke Teraberry
Mike Thomas
Grace Vaziri
Alyssa Winkler
Arthur Yenson
Tyler Zumwalt

Graduate Students on Coop Unit Projects 2015 (* indicates completed)

Student	Discipline	Advisor
Neil Ashton	Ph.D. Fishery Resources	K. Cain
*Amber Barenberg	M.S. Fishery Resources	C. M. Moffitt
Tara Ball	M.S. Forest, Range & Fire	E. Strand
Zach Beard	M.S. Fishery Resources	M. Quist
Elizabeth Braker	M.S. Environmental Science	C. M. Moffitt
Philip Branigan	M.S. Fishery Resources	M. Quist
Lubia Cajas Cano	Ph.D. Environmental Science	C. M. Moffitt
*Marika Dobos	M.S. Fishery Resources	M. Quist
*Maria Gerene Garcia	M.S. Wildlife (Univ. Arizona)	C. Conway
Trisha Giambra	M.S. Environmental Science	C. M. Moffitt
Amanda Goldberg	Ph.D. Wildlife Resources	C. Conway
David Gotsch	M.S. Wildlife Resources	C. Conway
*Joseph Holbrook	Ph.D. Wildlife Resources	K. Vierling
Janessa Julson	M.S. Range Science	K. Launchbaugh & C. Conway
*Zach Klein	M.S. Fishery Resources	M. Quist
Zach Klein	Ph.D. Fishery Resources	M. Quist
Trea LaCroix	M.S. Fishery Resources	F. Wilhelm
Carl Lundblad	Ph.D. Wildlife Resources	C. Conway
Maria (Masi) Mejia	Ph.D. Wildlife Resources	C. Conway & K.Vierling
*Elizabeth Ng	M.S. Fishery Resources	M. Quist
*Bryce Oldemeyer	M.S. Fishery Resources	B. Kennedy
Brittany Oleson	M.S. Wildlife (Univ. Arizona)	C. Conway
Ian Riley	M.S. Wildlife Resources	C. Conway
*Zach Swearingen	M.S. Wildlife Resources	C. Conway



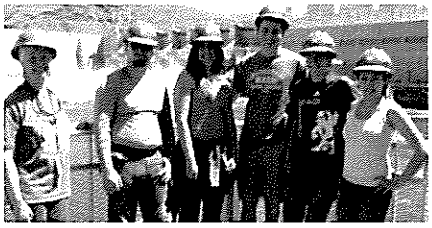
M.S. student Elizabeth Braker collecting data on Lake Pend Orielle

Zach Beard, M.S. student, using PIT mobile antenna to search for Burbot

Current Projects-Mentoring in Aquatic and Terrestrial Resources

EFFECTS OF CHANGES IN DISTURBANCE REGIMES ON ANIMAL COMMUNITIES

Principal Investigators:	Courtney Conway, Christine Moffitt Michael Quist, Kerri Vierling
Graduate Students:	Maria (Masi) Mejia, Elizabeth Braker
Doris Duke Interns:	Keala Bush, Michael Briggs. Viviana Baeza-Nunez Anna Miera, Aron Oliveras, Emily Brown, Elyce Gosselin, Katey Huggler, Emily Rankin, Bethany Guzman
Funding Agency:	USGS, RWO 160
Completion Date:	December 2019



Objectives:

- Select prototype communities or populations of study
- Define limiting factors in the prototype system
- Identify the suite of disturbance regimes that have changed within the system
- Examine the effects of altered disturbance regimes
- Evaluate potential mitigation /restoration strategies

Progress:

Anthropogenic changes have caused alterations to the natural disturbance regimes in many ecosystems. Human induced changes to the range, frequency, scale or type of disturbance can potentially exceed the tolerance to disturbance of native species in a community. The first cohort worked in internships with agencies during the summer in aquatic and terrestrial based projects and prepared for presentations at the Ecological Society of America's annual meeting in Baltimore, MD. The project's second year addressed different habitats throughout Idaho.

This project examined disturbance regimes in the sagebrush steppe of southern Idaho, during the past year provided opportunities for aquatic experiences in the McCall and Riggins region, and also in the Kootenai drainage of Northern Idaho.

Current Projects – Fisheries and Aquatic Resources

Analysis of Trends in Boise National Forest Bull Trout Management Indicator Species Data

Major Professor: Christine M. Moffitt
Graduate Student: Trisha Giambra, Environmental Sciences
Funding Agency: U.S. Forest Service
Completion Date: Spring 2016

Objectives:

- Review the data on bull trout collected as a Management Indicator Species by the Forest Service.
- Determine if there are measurable effects from management actions such as culvert replacements.

Progress:

The Boise National Forest Land and Resource Management Plan of 2010 identified Bull Trout *Salvelinus confluentus* as a management indicator species (MIS). MIS are defined as "Representative species whose habitat conditions or population changes are used to assess the impacts of management activities on similar species in a particular area. MIS are generally presumed to be sensitive to habitat changes". The Code of Federal Regulations (36 CFR 219.19) requires monitoring of MIS. On the Boise National Forest, population monitoring has occurred since 2004 and has been summarized in several reports. However, there is a need for a more detailed analysis of the data to consider invasive species and risks with connectivity. How do invasive species affect Bull Trout populations? Can we draw conclusions about trends for MIS on the Forest? A thorough evaluation of these parameters would provide the Forest with a basis and rationale for focusing and prioritizing future watershed and fisheries restoration projects. This would also provide an analysis to comply with Forest Plan and CFR monitoring requirements.

FROM TROUT TO MOLLUSKS: LIFE CYCLE ATTRIBUTES, SOCIO-ECONOMIC ATTRIBUTES AND ECOSYSTEM SERVICES SURROUNDING SUSTAINABLE AQUACULTURE

Major Professor:	Christine M. Moffitt
Student Investigator:	Lubia Cajas Cano
Funding Agency:	University of Idaho International Programs Office
Completion Date:	30 August 2016

Objectives:

- Use Life Cycle Assessment (LCA) models, Environmental Footprint tools, Input-Output Analysis of Economic Contributions, and Socio-Economic Assessments of two domestic aquaculture production systems: one freshwater, and one marine system
- Highlight the value of the ecosystem services that support both systems, and provide an assessment of the costs and benefits of increased domestic production.

Progress:

Aquaculture production of food and fiber has increased worldwide, and scientists, regulators, and citizens need accurate information to evaluate opportunities for the potential for growth of our domestic production of fish and shellfish. Much of the seafood consumed domestically is imported product, and a high percentage is from aquaculture. Regulators and the public have voiced concern regarding the safety of imports, and more recently people have become concerned about the negative socio-economic factors of foreign-based operations, including use of slave labor. Animal and plant protein production has costs and benefits that can be measured or estimated for each system with a variety of tools. We estimated water, energy, and carbon footprints of two aquaculture production systems, one in freshwater and one in the marine environment. The iconic Idaho Rainbow Trout industry was evaluated with an LCA and Environmental Footprint models. This industry provides a high value product, but is likely limited in its capacity to increase production unless additional aggressive re-use infrastructure is employed. A marine-based *Mytilus* mussel farm in Washington State was chosen for the second study. In this assessment, in addition to water and carbon footprints we included relevant socioeconomic inputs and outputs. Unlike finfish, aquaculture of marine and estuarine reared bivalves require few inputs except a high quality natural and productive ecosystem, their meat is high in protein and omega 3 fatty acids. Unlike the trout farms, the mussel farms have significant industrial growth potential within the framework of the new NOAA fisheries offshore leasing opportunities. Our analysis showed that each dollar of final demand at the farm gate from mussels within Washington generated $1.33 in direct and indirect economic contribution. If these systems were expanded domestically, the US, mussel farms could contribute $1.58 per dollar of mussel aquaculture output. Output included purchases from the farm within industrial sectors, excluding employee compensation, taxes and revenues. We have drafted three manuscripts from the results of our research that are near completion.

AQUATIC INVASIVE SPECIES CONTROL – QUAGGA MUSSELS AND OTHER MOLLUSKS OF CONCERN

Principal Investigator:	Christine M. Moffitt
Undergraduate student	Emily Hays
Collaborator	Kelly Stockton
Funding Agency:	Utah Division of Wildlife Resources and Pacific States Marine Fisheries Commission
Completion Date:	31 May 2016

Objective:

- Refine testing variables, and provide support for research studies that will increase the information on control measures for quagga mussels *Dreissena bugensis*, Asian clams *Cobicula fluminea*, New Zealand mud snails *Potamopyrgus antipodarum* (NZMS), and other invasive mollusk species of concern to the Western region especially Utah and the Columbia River Basin.

Progress:

Our project goal was to improve and refine appropriate tools to control invasive mollusk species at fish hatcheries, on vessels and vehicles, and in confined areas of reservoirs and lakes. Natural resource managers are seeking appropriate chemical eradication and control protocols for infestations of zebra mussels, *Dreissena polymorpha*, and quagga mussels. *D. rostiformis bugensis* that have limited effect on non-target species. Applications of low concentrations of potassium salt (as potash) have shown promise for use where the infestation and treatment can be contained or isolated. We conducted studies of the acute and chronic toxicity of potassium chloride to dreissenid mussels in four different sources of water sources from infested and non-infested locations (ground water from northern Idaho, surface water from the Snake River, ID, surface water from Lake Ontario, Ontario, Canada, and surface water from the Colorado River, AZ). We found short term exposure of veligers (< 24 h) to concentrations of 960 mg/L KCl produced rapid mortality in water from three locations, but veligers tested in Colorado River water were resistant. We used probit models to compare the mortality responses, predicted median lethal times and 95% confidence intervals. In separate tests, we explored the sensitivity of byssal stage mussels in chronic exposures (>29 d) at concentrations of 100 and 200 mg/L KCl. Significant and rapid mortality occurred within 10 d of exposure to concentrations of 200 mg/L KCl, regardless of water source. Kaplan-Meier estimates of mean survival of byssal mussels in 100 mg/L KCl prepared in surface water from Idaho and Lake Ontario were 4.9 or 6.9 d, respectively; however mean survival of mussels tested in the Colorado River water was > 23 d. The sodium content of the Colorado River water was nearly three times that measured in waters from the other locations, and we hypothesized sodium concentrations may affect mussel survival. To test our hypothesis, we supplemented Snake River and Lake Ontario water with NaCl to equivalent conductivity as the Colorado River, and found mussel survival increased to levels observed in tests of veliger and byssal mussels in Colorado River water. We recommend KCl disinfection and eradication protocols must be developed to carefully consider the water quality characteristics of treatment locations. We have submitted a manuscript summarizing these findings and are presenting the results of our studies at numerous workshops and meeting.

EFFECTIVENESS OF BENTHIC BARRIERS ON ERADICATION OF ASIAN CLAMS IN LAKE PEND OREILLE

Principal Investigator:	Christine M. Moffitt
Co-Principal Investigator:	Frank Wilhelm
Graduate Student:	Elizabeth Braker
USFWS Project Officer	Bob Kibbler
Funding Agency:	USGS/USFW SSP RWO 162
Collaborating Agency	Tom Woolf, Idaho Department of Agriculture
Completion Date:	30 June 2016

Objectives:

- Collect baseline information regarding pre-treatment invertebrate species composition and population densities of benthic organisms including Asian clams *Corbicula fluminea* in the Ellisport Bay area of Lake Pend Oreille.
- Determine the effectiveness of a 4-6 month application of impermeable benthic barriers for the eradication of Asian clams from Ellisport Bay.
- Determine the efficacy of impermeable benthic barriers on non-target organisms and rate of recovery post barrier removal.
- Compare risks, costs, and effectiveness of impermeable benthic barriers with either no action or use of more toxic reagents.

Progress:

The discovery of an infestation of Asian clams near the Ellisport Bay marina in Lake Pend Oreille, Idaho, triggered an effort by the Idaho State Department of Agriculture (IDA) and others to contain and (or) eradicate the infestation. Although Asian clams are known to occur in riverine and reservoir reaches of the Snake-Columbia River basin, no clams were known in Lake Pend Oreille Lake or in the Clark Fork drainage of Montana. Asian clams filter large quantities of nutrients from the water column that are released as pseudo feces on the lake bottom, creating enrichment of the benthos and promoting algal blooms. An infestation of Asian clams ignored for a time in Lake Tahoe resulted in trophic changes to the lake benthic environment and esthetics. In the winter, we used a planned lake-level drawdown to explore the option of using a non-permeable barrier and small quantities of NaOH placed beneath barriers to hasten mortality of clams. Following a pre-treatment assessment of density, we obtained necessary permits for a proposed experimental pesticide application from the EPA, and US Army Corps of Engineers. In November 2015, we removed a barrier that had been placed over infested substrate in the spring of 2015, and found all clams were dead. We sampled areas outside of the barrier to find live clams. We placed 6 additional small barriers on the substrate at that time for a shorter treatment, and in January 2016, we removed each of them and measured effectiveness. Unfortunately, the winds and wave disturbance disrupted the placement of the barriers, and the short term application was not effective. We are summarizing our results for publication. The use of sand bags and barriers at this location is compromised by fluctuating lake levels, and high winds. We plan to continue with additional research funded through the IDA. The scientists and collaborators engaged with the local citizens in extensive outreach and educational collaborations throughout the project, and still retain a website http://webpages.uidaho.edu/LPOAsianclams/ for updated information on our progress.

GUIDANCE DOCUMENTS TO IMPROVE OPERATIONS AT FISH HATCHERIES AND FIELD SITES TO REDUCE THE IMPACT OR PREVENT ESTABLISHMENT OF NEW ZEALAND MUDSNAILS AND OTHER INVASIVE MOLLUSK

Principal Investigator PI:	Christine M. Moffitt
Funding Agency:	U.S. Fish and Wildlife Service
Completion Date:	31 May 2016

Objectives:

- Draft and test a guidance document that uses a risk assessment based approach to assess prevent or control invasive mollusks at fish hatcheries and other locations.
- Provide the final document to the USFWS for their use as a resource.

Progress:

Fish hatcheries and aquaculture facilities are highly vulnerable to infestations of invasive mollusks because they have constant flows at constant temperatures with many nutrients available. They are also located near recreational areas, utilize open water sources, transport fish, and use other pathways that unwanted organisms utilize. It is very important for these scrutinized facilities to assess, manage, and communicate risk. All three components need to be part of a transparent process as risk analysis incorporates complex ecological, economic, legal, political, and social issues. Risk analysis is the most effective when there is open and continuous communications among risk assessors and affected stakeholders. New Zealand mudsnails (*Potamopyrgus antipodarum*, NZMS) are native to both fresh and brackish water of New Zealand and its surrounding islands but have invaded waters in Australia, Europe and the United States. In the latter, the first NZMS were found in benthic samples collected in the Nature Conservancy's Thousand Springs Preserve near Hagerman, Idaho. The NZMS are now found in every state in the Western U.S. with the exception of New Mexico, and populations are now in the Great Lakes, Wisconsin, and Minnesota. The working draft risk assessment and guidance document was presented to small work groups in 2014, and in June 2015, we collaborated with regional agencies to organize the 7th National New Zealand Mudsnails workshop in June 2015 in Seattle at the USGS Western Fisheries Research Center. We provided a summary of the approach and are working to complete this document in collaboration with Washington Department of Fisheries, and the US Fish and Wildlife Service for distribution to any interested parties. We are preparing a manuscript to provide an outline of the key aspects of the document.

MOVEMENT DYNAMICS, DISTRIBUTION, HABITAT USE, AND SPECIES ASSOCIATIONS OF JUVENILE BURBOT IN TRIBUTARIES OF THE KOOTENAI RIVER

Principal Investigator:	Michael C. Quist
Student Investigator:	Zachary Beard
Collaborating Investigators:	Ryan Hardy and TJ Ross, Idaho Department of Fish and Game
Funding Agency:	Idaho Department of Fish and Game
Completion Date:	31 December 2016

Objectives:

- Describe the fate and movement of stocked Burbot,
- Determine habitat use and species associations of Burbot in Deep Creek.

Progress:

Burbot *Lota lota* in the lower Kootenai River have been the focus of extensive conservation efforts, particularly the release of juvenile Burbot into small tributaries. In October of 2012, the Idaho Department of Fish and Game installed a fixed passive integrated transponder (PIT) tag antenna on Deep Creek, a small tributary of the Kootenai River, to evaluate movement of juvenile Burbot to the Kootenai River. Since 2012, approximately 12,000 juvenile Burbot have been released into Deep Creek, but few burbot have been detected at the antenna. This raises questions about the survival, movement, habitat associations, and species associations of juvenile Burbot in Deep Creek.

In 2014 and 2015, fishes and habitat were sampled from 58 reaches in Deep Creek. Eighteen species were sampled, including Burbot. Burbot were typically found in middle and upstream reaches within 1 km of a stocking location. Multiple logistic regression was used to evaluate fish species occurrences. Nonmetric multidimensional scaling was used to examine patterns in fish assemblage structure in Deep Creek. In addition to evaluating fish assemblage structure, five half-duplex PIT arrays were established in Deep Creek. Antenna detections indicate limited movement within Deep Creek. A full census of Deep Creek using mobile PIT tag antennas was completed in 2015. Two hundred and thirty individual tags were located, 15 belonged to fish that were alive, 13 had an unknown fate and 202 tags were either shed or from dead Burbot. Approximately 87% of tags were found within 1 km of a stocking location. In 2015, six stocking locations were established. Mobile PIT tag surveys were completed one week after stocking and two months after stocking. Results from these surveys suggest poor dispersal of juvenile Burbot after stocking. Another full census of Deep Creek will be completed in the summer of 2016.

EFFECTS OF HABITAT RESTORATION ACTIVITIES ON FISH ASSEMBLAGES AND POPULATIONS IN THE KOOTENAI RIVER, IDAHO

Principal Investigator:	Michael C. Quist
Student Investigator:	Philip Branigan
Collaborating Investigators:	Sue Ireland, Kootenai Tribe of Idaho; Brad Shepard, B.B. Shepard and Associates
Funding Agency:	Kootenai Tribe of Idaho
Completion Date:	31 December 2016

Objectives:

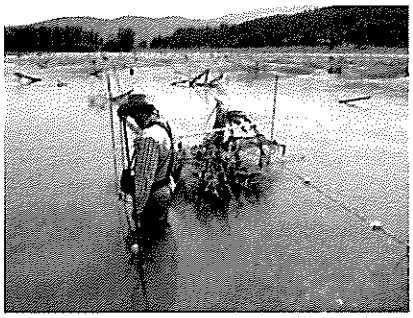
- Determine spatial and temporal variation in fish assemblage and population structure and function among side channels,
- Evaluate relations between habitat characteristics (e.g., instream cover, current velocities) in side channel habitats and fish assemblage and population structure and function, and
- Evaluate sampling designs for monitoring the effect of habitat restoration activities on fishes in side channels of the Kootenai River.

Progress:

The Kootenai River is one of Idaho's most unique resources, and supports a diversity of native species. Native fishes of high cultural and ecological importance include Burbot *Lota lota*, White Sturgeon *Acipenser transmontanus*, kokanee *Oncorhynchus nerka*, Redband Trout *O. mykiss gairdnerii*, Westslope Cutthroat Trout *O. clarki lewisi*, Bull Trout *Salvelinus confluentus*, and Mountain Whitefish *Prosopium williamsoni*. All of these species use the Idaho portion of the Kootenai River for all, or a significant portion of their life history. Like many other large rivers in North America, the Kootenai River has been degraded due to changes in land use and water development. The Kootenai Tribe of Idaho (KTOI) has been moving forward with ambitious plans to restore habitat and ecosystem function in the Kootenai River and its floodplain. On-going and planned restoration efforts provide a unique opportunity to evaluate the effects of habitat restoration on fish assemblages and populations.

Prepositioned electrofishers were used to sample fishes at 542 sites in 2014 and 2015. One-thousand-five-hundred-seventy-three individuals representing eight different species were sampled including Largescale Sucker *Catostomus macrocheilus*, Longnose Sucker *Catostomus catostomus*, Longnose Dace *Rhinichthys cataractae*, Torrent Sculpin *Cottus rhotheus*, Mountain Whitefish, Redside Shiner *Richardsonius balteatus*, Northern Pikeminnow *Ptychocheilus oregonensis*, and Redband Trout. Logistic regression was used to evaluate relationships between the occurrence of species and habitat characteristics. Mountain Whitefish and Largescale Suckers were most common in habitats with high bottom velocities. Longnose Dace occurrence was related to mean depth and the proportion of fine substrate. The occurrence of Torrent Sculpin was positively associated with large wood, fine substrate, and water depth. Future efforts include refinement of occurrence models and laboratory experimentation that will evaluate the effects of non-native Pumpkinseed *Lepomis gibbosus* on habitat use of Longnose Dace, Redside Shiner, and Redband Trout.

MANAGEMENT OF KOKANEE IN IDAHO LAKES: KOKANEE POPULATIONS DYNAMICS, *MYSIS*-KOKANEE INTERACTIONS, AND SAMPLING TECHNIQUES



Principal Investigator:	Michael C. Quist
Student Investigator:	Zachary B. Klein
Collaborating Investigators:	Andrew M. Dux and Matthew P. Corsi, Idaho Department of Fish and Game
Funding Agency:	Idaho Department of Fish and Game
Completion Date:	31 May 2019

Objectives:

- Evaluate the size selectivity of different sampling techniques for kokanee,
- Investigate the hypothesis that Mysis influence the growth, survival, and recruitment of kokanee, and
- Evaluate the performance of kokanee breeding groups (i.e., early-run, late-run) in Idaho.

Progress:

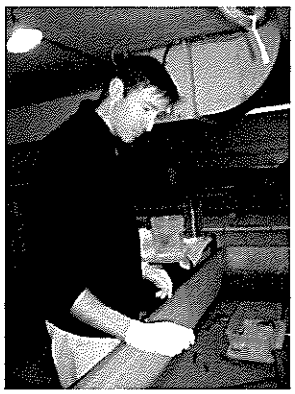
Kokanee *Oncorhynchus nerka* is arguably one of the most important fish in Idaho. Despite over 60 years of research a number of questions remain regarding the management and ecology of kokanee. This project seeks to address some of these knowledge gaps.

In 2015, Kokanee were sampled in Spirit, Hayden, and Pend Oreille (LPO) lakes using experimental curtain gill nets and mid-water trawls to assess the size-selectivity of mid-water trawls. Kokanee catch was highly variable across systems and gear. For instance, 257 kokanee were caught in Hayden Lake using gill nets; whereas, 5 fish were caught using mid-water trawls. Conversely, 108 kokanee were caught in LPO using gill nets, but 351 fish were sampled using mid-water trawls. In 2016 and 2017, kokanee will be sampled using gill nets and mid-water trawls in six additional water bodies throughout Idaho.

We also seek to understand how trophic interaction between *Mysis* and kokanee influence the population dynamics of kokanee. Specifically, we are interested in understanding how resource competition between the two species influences the recruitment success of kokanee. We are currently collecting data and have sampled 272 sites to evaluate the distribution and species composition of zooplankton and *Mysis* in LPO. In addition, approximately 1,400 kokanee varying from 19 – 282 mm (TL) were sampled in LPO using mid-water trawls. Data on *Mysis* and zooplankton will be related to kokanee population dynamics to understand the influence that *Mysis* have on the recruitment success of kokanee.

Finally, we are planning two laboratory experiments that will address performance differences between early- and late-run kokanee. The first experiment will focus on understanding inherent performance differences between the two breeding groups. The second experiment will focus on understanding how different breeding groups respond to periods of low prey abundance (winter). Information gained from both experiments will help to identify the mechanism(s) influencing post-release mortality of kokanee. Furthermore, if differences between breeding groups are observed, future management actions can focus on rearing and stocking the better performing breeding group.

TEMPERATURE EFFECTS ON EARLY LIFE STAGES OF BURBOT



Principal Investigator:	Kenneth Cain
Student Investigator:	Neil Ashton
Collaborators:	Mike Faler, USFWS; Ryan Hardy, Idaho Fish & Game; Shawn Young, Kootenai Tribe of Idaho; Sarah Stephenson, Canadian Ministry of FLNRO
Funding Agencies:	USFWS
Completion Date:	31 May 2018

Objectives:

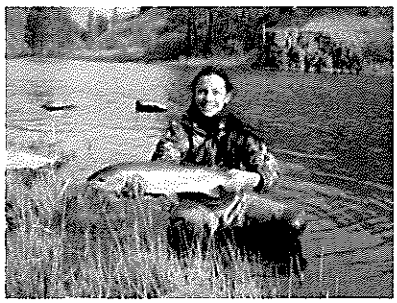
- Determine optimal and tolerable temperatures for spawning, embryo development, and larval growth and survival of the North American Burbot (*Lota lota maculosa*).
- Compare results from temperature effect studies with historic and current thermal regimes in the lower Kootenai River downstream of Libby Dam.
- Use results to assess the Tribal conservation aquaculture program, feasibility of reestablishing natural production, and options for modifying dam operations to support recruitment of early life stages.

Progress:

Regional agencies and tribes have been working together on burbot restoration in the Kootenai basin in the U.S. and Canada for the past several decades. By building consensus, actions have been identified that guide rehabilitation of the Kootenai River burbot population and their habitat, while maintaining a strong level of community support. The funded project is an opportunity to further collaborate with the USFWS and to refine our understanding of restoration options for native burbot in Idaho and the Pacific Northwest. In the first year of funding, a pilot-study at the University of Idaho found that thermal regimes similar to Kootenai River conditions downstream from Libby Dam caused higher deformity in embryos and larvae. A graduate student was selected to investigate thermal tolerances at spawning, embryo and larvae development, and metamorphosis to juvenile stage. Intensive laboratory studies will test for thermal effects on physiology and survival at these critical life stages. Field studies in the Kootenai River will include temperature monitoring, surveys of spawning activity from stocked hatchery burbot, sampling for natural larvae recruitment, and identification of potential spawning and nursery habitats.

Completed Projects – Fisheries and Aquatic Resources

HABITAT USE AND MOVEMENT PATTERNS OF WESTSLOPE CUTTHROAT TROUT IN THE SOUTH FORK CLEARWATER RIVER BASIN



Principal Investigator:	Michael C. Quist
Student Investigator:	Marika E. Dobos
Collaborating Investigator:	Matthew P. Corsi, Idaho Department of Fish and Game
Funding Agency:	Idaho Department of Fish and Game
Completion Date:	31 May 2015

Objectives:

- Characterize seasonal movement patterns and distribution of Westslope Cutthroat Trout in the South Fork Clearwater River basin, and
- Describe seasonal habitat use of and possible limiting factors affecting Westslope Cutthroat Trout populations.

Progress:

Despite the wide distribution of Westslope Cutthroat Trout (WCT) *Oncorhynchus clarki lewisi* across Idaho, populations in some systems remain depressed. Snorkel surveys conducted on the South Fork Clearwater River (SFCR) basin suggested that densities of WCT were low and length structure was poor. Overexploitation and harsh environmental factors (e.g., high summer temperature) were hypothesized to have influenced populations of WCT in the SFCR system. Radio-telemetry was used to describe seasonal movement patterns and habitat use of WCT in 2013 and 2014. Additionally, snorkeling was conducted along the main stem SFCR in the summer of 2014 to examine the spatial distribution and habitat use of WCT. Water temperature loggers were also deployed along the main stem SFCR and in the major tributaries to examine the influence of water temperatures on the distribution of WCT. Although movement patterns among individuals varied, WCT generally exhibited either mobile or sedentary tendencies during the summer. Fish in the upper region of the SFCR moved upstream into smaller tributaries while fish in the middle region remained in the main stem rivers despite warm water temperatures. Results from snorkeling also indicated that there was a higher density of WCT in the middle region of the SFCR, whereas few were observed in the upper region. Densities of WCT in the SFCR were still considerably lower than neighboring systems (e.g., Lochsa River, Selway River). During this study, WCT were not observed in the lower region of the main stem SFCR. Water temperature data indicated that the lower region was too warm for WCT to persist. The upper region of the SFCR also had warm temperature conditions during the summer that likely limited the distribution of WCT. This study provides a glimpse of the complex life history of WCT and informs management and restoration actions by providing information on important seasonal habitat for WCT in the SFCR basin.

POPULATION ECOLOGY OF BURBOT IN THE GREEN RIVER OF WYOMING

Principal Investigator:	Michael C. Quist
Student Investigator:	Zachary B. Klein
Collaborating Investigators:	Darren T. Rhea and Anna C. Senecal, Wyoming Game and Fish Department
Funding Agency:	Wyoming Game and Fish Department
Completion Date:	31 May 2015

Objectives:

- Evaluate sampling techniques for juvenile and adult Burbot,
- Investigate the relationship between Burbot occurrence and habitat characteristics, and
- Describe age and growth of Burbot from the Green River of Wyoming.

Progress:

Burbot *Lota lota* were illegally introduced to the Green River drainage in the 1990s. Since their introduction, Burbot have been sampled from the New Fork River to the Colorado-Utah Border at Dinosaur National Monument. The introduction and proliferation of a picivorous fish is concerning because the Green River supports a socially and economically important trout fishery. Furthermore, the Green River supports three species of conservation concern (i.e., Bluehead Sucker *Catosomus discobolus*, Flannelmouth Sucker *C. latipinnis*, Roundtail Chub *Gila robusta*) which are potentially negatively influenced by the introduction of Burbot. Thus, the suppression of Burbot is of primary interest to managers of the Green River drainage. Unfortunately, little information is available on effective sampling gears for Burbot. In addition, relatively little is known about the habitat use of Burbot which is critical information for directing the efficient removal of Burbot from the Green River drainage.

In total, 568 Burbot varying from 52 – 719 mm were sampled during the summer and fall of 2013 using night electrofishing, 6.4-mm bar mesh hoop nets, and 19-mm bar mesh hoop nets. Occupancy modeling was used to estimate the detection probability (p) of each gear while also investigating the relationship between detectability and habitat characteristics. During the summer, night electrofishing had the highest detectability ($p \pm$ SE; 0.30 ± 0.06); however, 6.4-mm bar mesh hoop nets produced the highest estimated detection probability (0.46 ± 0.07) during the fall. During both seasons, 19-mm bar mesh hoop nets had the lowest detection probability of all gears. Mean current velocity and proximity to downstream reservoir were inversely related to detection probability during the fall. Using a hurdle modeling approach, the occurrence and abundance of Burbot was inversely related to current velocity and positively associated with large substrate. Demographic data were also used to develop an age-structured population model. Results of the model suggest that relatively high levels of annual fishing mortality (>50%) would be required to suppress Burbot in the Green River. Future research should focus on identifying the presence of spawning aggregations that might provide managers with an opportunity to impose high mortality in a relatively short period of time.

POPULATION DYNAMICS AND TROPHIC ECOLOGY OF NON-NATIVE LAKE TROUT IN PRIEST LAKE, IDAHO

Principal Investigator:	Michael C. Quist
Student Investigator:	Elizabeth L. Ng
Collaborating Investigator:	Jim Fredericks, Idaho Department of Fish and Game
Funding Agency:	Idaho Department of Fish and Game
Completion Date:	31 May 2015

Objectives:

- Provide fishery-independent estimates of Lake Trout abundance and population demographic parameters, and
- Evaluate potential management strategies using population models.
- Characterize the trophic ecology of Lake Trout.

Progress:

Lake Trout *Salvelinus namaycush* were introduced to Priest Lake, Idaho, during the 1920s, but remained at low abundance until the introduction of *Mysis diluviana* in the 1960s. Popular fisheries for kokanee *Oncorhynchus nerka*, Westslope Cutthroat Trout *O. clarki lewisi*, and Bull Trout *S. confluentus* declined in the following decades, potentially due to increased Lake Trout abundance post-mysid introduction. Lake Trout currently dominate the recreational fishery in Priest Lake, but recent surveys indicate that nearly half of anglers would prefer a more diverse fishery. A high-intensity tagging effort was conducted in spring 2013 to address basic questions about the Lake Trout population. Gill nets and large trap nets were used to tag and release nearly 3,000 Lake Trout. The estimated population size was 43,210 (95% CI: 31,569-59,451) or 4.6 fish/ha (3.3-6.3 fish/ha), and exploitation was 13.6%. Although young Lake Trout were characterized by fast growth and young age at maturity, growth rates were lower for adults. High rates of skipped spawning (>50%) were also observed. Projections from an age-structured population model indicated that the population was growing ($\lambda = 1.03$). Eradication could be achieved by increasing annual mortality to 32%, approximately twice the current rate. A protected slot-length limit (660-813 mm) could increase population length-structure, but few fish grew fast enough to exit the slot. In contrast, a juvenile removal scenario targeting age-2 to age-5 Lake Trout maintained short-term harvest of trophy-length individuals while reducing overall population abundance. Finally, stable isotope ($\delta^{13}C$ and $\delta^{15}N$) analysis was used to explore the relationship between Lake Trout growth and diet, and to evaluate the food web structure of Priest Lake. Lake Trout exhibited low variability in isotopic signatures, potentially indicating dependence on *M. diluviana* across lengths with only opportunistic foraging on prey fishes. The food web in Priest Lake was disjoint, with one group of species using primarily pelagic-origin carbon sources, and another using primarily littoral-origin carbon sources. Information about the demography and trophic ecology of Lake Trout in Priest Lake will help managers understand the outcomes of management actions. Overall, this work also contributes to a broader understanding of Lake Trout outside their native distribution.

DEVELOPMENT OF AN ANALYTICAL APPROACH FOR IMPROVING ESTIMATES OF JUVENILE SALMON AND STEELHEAD ABUNDANCES AT ROTARY SCREW TRAPS

Principal Investigator:	Brian Kennedy
Graduate Student Researcher:	Bryce Oldemeyer
Funding Agency:	Idaho Department of Fish and Game
Completion Date:	20 November 2015

Objectives:

- Find an effective approach to estimate juvenile salmonid abundances from sparse and missing mark-recapture data.
- Quantify the effects that rearing location has on growth rates, size during spring migration, and migration timing of juvenile Chinook salmon in Big Creek, Idaho.
- Investigate variables effecting juvenile Chinook salmon overwinter location in Big Creek, Idaho.

Progress:

Mark-recapture data collected at rotary screw traps (RSTs) are used to estimate abundance of migrating anadromous juvenile salmonids exiting natal rearing habitat. Abundance estimates obtained from RST data are used to determine demographic information central for monitoring salmonid populations and informing conservation actions. Frequently, environmental conditions and mechanical failures alter rotary screw trap efficiencies, or completely cease rotary screw trap operations, potentially leading to biased abundance estimates. We increased the precision and accuracy of abundance estimates by structuring a time stratified hierarchical Bayesian model that incorporated annually recurring juvenile salmonid migratory characteristics into the model. An all-inclusive package that will format data, run identical analysis used for the manuscript, and produce both text and graphical summary output will be publicly available through Program R by June, 2016. A second analysis was conducted on the effects that juvenile Chinook salmon overwinter location has on size, growth rate, and timing during spring smoltification at Big Creek, Idaho. Individual fish that move out of Big Creek natal reach rearing areas prior to their first winter were on average 23 mm larger during spring migration, have nearly double the winter growth rate, and enter the hydroelectric system an average of 9 days earlier during spring migration than natal reach rearing individuals. Out of the environmental and biological variables hypothesized to effect overwinter rearing location, total cohort abundance was the best predictor of natal reach rearing to downstream rearing ratios for cohorts. The results from this study have strong implications about the effects juvenile Chinook life-history expressions may have on survival and reproductive success for Chinook salmon populations in Idaho.

This cooperative project was concluded upon the successful defense by Bryce Oldemeyer on November 19, 2015, and his completion of the academic requirements necessary to receive his master's degree in December 2015.

Current Projects – Wildlife and Terrestrial Resources

Dispersal Patterns of Yuma Ridgway's Rail: Implications for Mortality Caused By Solar Power Farms

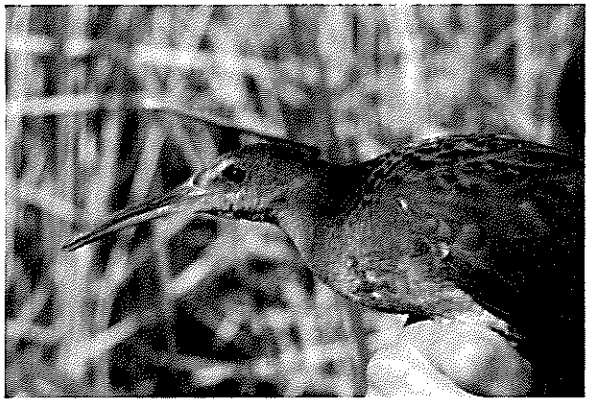
Principal Investigator:	Courtney J. Conway
Student Investigator:	TBD
Funding Agency:	USFWS, BLM, NPS, NFWF
Completion Date:	31 December 2018

Objectives:

- Document the seasonal timing of natal dispersal of endangered Yuma Ridgway's Rails.
- Document direction and distance of natal dispersal movements of endangered Yuma Ridgway's Rails.

Progress:

Carcasses of Yuma Ridgway's Rails (*Rallus obsoletus yumanensis*) and other rails have been found below solar panels of recently constructed solar energy farms in the Mohave deserts of southeastern California. These birds are dependent on fresh water marshes and never stray from marshes. These mortalities have concerned federal agency partners because they may indicate a 'lake effect' whereby dispersing/migrating rails may confuse the solar panels for lakes. Moreover, federal construction permits for future solar farms may need to include the possibility of take of these endangered birds as required under the Endangered Species Act. We will catch rails and deploy satellite transmitters to document their dispersal behavior.



Yuma Ridgway's rail

EFFECTIVENESS OF POTENTIAL RECOVERY MEASURES FOR THE NORTHERN IDAHO GROUND SQUIRREL

Principal Investigator:	Courtney Conway
Student Investigator:	Amanda R. Goldberg
Collaborators:	Diane Evans-Mack, Idaho Department of Fish & Game; Ana Egnew, USDA Forest Service; Greg Burak, USFWS
Funding Agencies:	US Forest Service, USGS, USFWS
Completion Date:	31 May 2017

Objectives:

- Evaluate the effectiveness of burning and forest thinning treatments on survival of northern Idaho ground squirrels (NIDGS).
- Determine whether plague caused by the bacterium *Yersinia pestis* is reducing survival of northern Idaho ground squirrels and sympatric species.
- Document the effects of snow depth on overwinter survival of NIDGS.
- Identify factors that influence selection of hibernacula by NIDGS.
- Document seasonal changes in the diet of the northern Idaho ground squirrel.

Progress:

Northern Idaho Ground Squirrels (*Urocitellus brunneus*) were listed as federally threatened in 2000 and as Critically Endangered by the IUCN. An inter-agency Technical Working Group was formed to recommend conservation actions to reverse declines and recover the species. The Technical Working Group has advocated the use of thinning and prescribed fire to improve habitat quality for Northern Idaho Ground Squirrels (NIDGS). We are comparing demographic traits among three forest restoration treatments: thinning followed by a fall-season prescribed burn, burning only, and control. We also have implement field experiments to examine whether sylvatic plague is depressing survival of NIDGS. Plague, a disease caused by the bacterium *Yersinia pestis*, was introduced from Asia to North America in ~1900. Even a low incidence of plague can decrease annual survival of rodents. Plague has been documented in both Adams and Valley counties where all NIDGS habitat is located. To evaluate the effects of plague, we are treating a subset of colonies with an insecticide that controls fleas. We have completed two field season of insecticide treatments and the treatments effectively reduced flea loads in NIDGS, Columbian Ground Squirrels (*Urocitellus columbianus*), Yellow-Pine Chipmunks (*Tamias amoenus*), and Deer Mice (*Peromyscus maniculatus*). NIDGS survival was 1.1 (F) and 1.4 (M) times greater on flea removal sites compared to control sites. Chipmunk survival was 5.0 (F) and 4.6 (M) times greater on flea removal sites than control sites. We documented that the same flea species are shared among Yellow-Pine Chipmunks, Columbian Ground Squirrels, and NIDGS in our system (and hence fleas can potentially move plague among these species). We have attached radio collars with light loggers on NIDGS to locate their hibernacula, document activity patterns prior to hibernation, document dates that squirrels enter in hibernation and emerge in the spring, and record skin temperature so that we can document other factors that affect overwinter survival.

Ecological Causes of Life History Variation and Habitat Selection in Red-Faced Warblers

Principal Investigator: Courtney J. Conway
Student Investigator: Kristen G. Dillon
Funding Agencies: NSF, Arizona Game and Fish Department
Completion Date: 31 May 2017

Objectives:

- Identify the causes of elevational variation in clutch size of Red-Faced Warblers.
- Document how other life history traits vary with elevation in Red-Faced Warblers.
- Determine the ecological factors driving Red-Faced Warbler habitat selection.
- Use LIDAR and point count data to create habitat-association and predictive distribution models for Red-Faced Warblers breeding in Arizona.

Progress:

Clutch size declines with breeding elevation in Red-Faced Warblers (Cardellina rubrifrons) in southeastern Arizona; birds lay 20% fewer eggs/clutch at higher elevations compared to birds breeding at lower elevations. This same pattern has been observed in other species. We are testing multiple hypotheses to explain the cause of the negative relationship between elevation and avian clutch size. We are also documenting whether reproductive investment and survival vary along an elevational gradient, and studying the ecological processes driving habitat selection in Red-Faced Warblers. Breeding densities of Red-Faced Warblers are highest at mid-elevations within their elevational breeding range where they nest in the bottom portions of montane canyons. We are used LIDAR and point-count survey data to model the distribution and relative of abundance of Red-Faced Warblers throughout Arizona. The Red-Faced Warbler is listed as a state Partners-in-Flight species of concern and a species of greatest conservation need by Arizona Game and Fish Department. The species has a highly restricted breeding range, limited in the United States to high-elevation riparian coniferous woodlands in Arizona and southwestern New Mexico. However, detailed projections of the breeding distribution or abundance of Red-Faced Warblers were not previously available. We created the first spatially explicit models of the species' breeding distribution and abundance in Arizona.

GROUSE & GRAZING: EFFECTS OF CATTLE GRAZING ON GREATER SAGE-GROUSE

Principal Investigators:	Courtney J. Conway, Karen Launchbaugh, Eva Strand, Dave Musil, Don Kemner
Research Scientist:	Anthony Locatelli
Student Investigators:	Dave Gotsch, Ian Riley, Janessa Julson
Funding Agencies:	IDFG, BLM, OSC, Little Endowment, Idaho Cattle Association
Completion Date:	1 January 2024

Objectives:

- Determine the effects of spring cattle grazing on demographic traits of greater sage-grouse
- Document the effects of cattle grazing intensity on density and diversity of insects within Sage-Grouse breeding habitat
- Document the effects of cattle grazing intensity on vegetation features that contribute to Sage-Grouse habitat suitability

Progress:

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 and habitat characteristics. 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 spring grazing intensities on demographic traits and habitat characteristics of Sage-Grouse. The results will help guide management actions (and inform policy and litigation decisions) in Sage-Grouse habitat throughout southern Idaho and throughout the species' range. For the past 2 years, we have attached radio transmitters to 237 Sage-Grouse hens at four sites in southern Idaho. We have located 161 nests of radio-marked hens, at which we measured vegetation characteristics and sampled insects, and measured demographic traits and grazing intensity. After 2 years of pre-treatment sampling, we will experimentally alter spatial patterns of grazing intensity in some pastures that have Sage-Grouse nests. This is a 10-year study and the results will help inform grazing policy within sage-grouse nesting habitat.

M.S. student, Dave Gotsch, holding a sage-grouse

Completed Projects-Wildlife and Terrestrial Resources

Evaluating Mitigation Measures on the Craig Mountain Wildlife Management Area

Principal Investigator: Courtney J. Conway
Student Investigator: Zach Swearingen
Funding Agency: Idaho Department of Fish and Game
Completion Date: 31 December 2015

Objectives:

- Estimate the extent to which the density of 3 target bird species has changed since private lands on Craig Mountain were converted to a Wildlife Management Area.
- Determine if densities of Pileated Woodpeckers vary among different types of timber harvest on CMWMA.

Progress:

Idaho Department of Fish and Game (IDFG) identified the Yellow Warbler (*Dendroica petechia*), Black-Capped Chickadee (*Poecile atricapillus*), Pileated Woodpecker (*Hylatomus pileatus*), White-tailed Deer (*Odocoileus virginianus*), Rocky Mountain Elk (*Cervus canadensis*), and North American River Otter (*Lontra canadensis*) as 'target species' toward which land management on CMWMA would be directed. Management actions and recreational use has changed considerably since 60,000 mitigation acres were acquired and added to CMWMA in 1992. These changes are a result of noxious weeds, increased recreational activities, road closures, wildfires, a Mountain Pine Beetle (*Dendroctonus ponderosae*) infestation, and commercial timber harvest. We compared data from baseline surveys conducted soon after the mitigation acres were acquired by IDFG to contemporary survey data to evaluate whether management actions were compatible with CMWMA management goals. We gathered data from all prior bird and vegetation surveys conducted on the CMWMA over the past 25 years. Initial analyses suggested that numbers of one of the target bird species (Pileated Woodpeckers) had declined since 1992, but data that we collected in 2013 and 2014 allowed us to control for annual variation in detection probability and our new results now show definitively that density of Pileated Woodpeckers has remained stable over the past 20 years. We estimated the extent to which breeding density of the 3 target bird species had changed during the past 20 years of management. In addition, we used both correlative and quasi-experimental approaches to examine the effects of 3 timber harvest prescriptions (partial removal cuts, regeneration cuts, and fuel reduction cuts) on breeding density of Pileated Woodpeckers. Results suggest that the management actions and land uses implemented within the management area have not led to declines in density for the 3 target bird species. However, breeding density of Pileated Woodpeckers was negatively correlated with timber harvest intensity; breeding density of Pileated Woodpeckers was 81% lower in areas that had received fuel reduction cuts compared to areas with no recent harvest, and breeding density of Pileated Woodpeckers declined 86% following regeneration cuts.

Awards, Publications, and Service of Unit Scientists and Students

1 January 2015 – 31 December 2015

HONORS AND AWARDS

Unit scientists:

Courtney Conway

Elected as Fellow of the American Ornithologists' Union (AOU), 2015

Christine Moffitt

Elected as Fellow of the American Fisheries Society, 2015

Idaho Chapter American Fisheries Society Excellence in Aquaculture, 2015

Michael Quist

Best Professional Paper Award, Annual Meeting of the Colorado-Wyoming Chapter of the American Fisheries Society, 2015

Graduate students:

Zachary Beard

Ted Bjornn Idaho AFS Scholarship, University of Idaho, 2015

Philip Branigan

Best Student Paper Award, Annual Meeting of the Idaho Chapter of the American Fisheries Society, 2015

Marika Dobos

AFS Sea-Grant Best Student Paper Symposium, Finalist, 145th Annual Meeting of the American Fisheries Society, 2015

Zachary Klein

Outstanding Masters Research and Creativity Award, University of Idaho, 2015

Best Student Poster Award, Annual Meeting of the Colorado-Wyoming Chapter of the American Fisheries Society, 2015

Carl Lundblad

Outstanding Thesis Award, School of Natural Resources and the Environment, University of Arizona, 2015

Idaho Chapter of The Wildlife Society: Management, Conservation, and Education Award, 2015

Elizabeth Ng

Best Student Presentation, 145th Annual Meeting of the American Fisheries Society, 2015
Eugene Maughan Graduate Student Scholarship, 2015
John E. Skinner Memorial Award, American Fisheries Society, 2015
Best Student Poster Award (M.S.), Department of Fish and Wildlife Sciences, University of Idaho, 2015
Outstanding Graduate Student—Fisheries, Department of Fish and Wildlife Sciences, University of Idaho, 2014-2015

Zach Swearingen

Best Student Presentation Award, Annual Conference of the Idaho Chapter of The Wildlife Society, 2015

PEER-REVIEWED PUBLICATIONS FROM COOP UNIT RESEARCH ACTIVITIES

Aycrigg, J. L. G. Beauvais, T. Gotthardt, F. Huettmann, S. Pyare, M. Andersen, D. Keinath, J. Lonneker, M. Spathelf, and K. Walton. *In Press.* Novel approaches to modeling and mapping terrestrial vertebrate occurrence in the Northwest and Alaska: an evaluation. *Northwest Science.*

Aycrigg, J. L. T. R. Belote, M. S. Dietz, G. H. Aplet, and R. A. Fischer. 2015. Bombing for biodiversity in the United States: response to Zentelis and Lindenmayer 2015. *Conservation Letters* 8:306-307.

Bakevich, B. D., C. L. Pierce, and M. C. Quist. 2015. Status of the Topeka shiner in west-central Iowa. *American Midland Naturalist* 174:350-358.

Borgmann, K. L., and C. J. Conway. 2015. The nest-concealment hypothesis: new insights from a comparative analysis. *Wilson Journal of Ornithology* 127:646-660.

Buelow, J., and C. M. Moffitt. 2015. Physiological indices of seawater readiness in postspawning steelhead kelts. *Ecology of Freshwater Fish* 24:112-122.

Carter-Lynn, K. P., M. C. Quist, and M. Liter. 2015. Population dynamics of channel catfish near the northern edge of their distribution: implications for management. *Fisheries Management and Ecology* 22:530-538.

Dietz, M. S., R. T. Belote, G. H. Aplet, and J. L. Aycrigg. 2015. The world's largest wilderness preservation system after 50 years: how well are ecosystems represented? *Biological Conservation* 184:431-438.

Dillon, K. G., and C. J. Conway. 2015. Elevational gradient in clutch size of red-faced warblers. *Journal of Field Ornithology* 86:163–172.

Dobos, M. E., M. P. Corsi, D. J. Schill, J. M. DuPont, and M. C. Quist. *In press.* Influences of summer water temperatures on the movement, distribution, and resource use of fluvial westslope cutthroat trout in the South Fork Clearwater River basin. *North American Journal of Fisheries Management.*

Fremier, A. K., M. Kiparsky, S. Gmur, J. Aycrigg, R. K. Craig, L. K. Svancara, D. D. Goble, B. Cosens, F. W. Davis, and J. M. Scott. 2015. A riparian conservation network for ecological resilience. Biological Conservation 191:29-37.

Glisson, W. J., C. J. Conway, C. P. Nadeau, K. L. Borgmann, and T. A. Laxson. 2015. Range-wide wetland associations of the King Rail: A multi-scale approach. *Wetlands* 35:577-587.

Glisson, W.J., S.K. Jacobi, R.S. Brady, A.T. Paulios, and D.J. Larkin. 2015. Sensitivity of secretive marsh birds to vegetation condition in natural and restored wetlands in Wisconsin. *Journal of Wildlife Management* 79:1101-1116.

Klein, Z. B., M. C. Quist, D. T. Rhea, and A. C. Senecal. 2015. Habitat use of non-native burbot in a western river. *Hydrobiologia* 757:61-71.

Klein, Z. B., M. C. Quist, D. T. Rhea, and A. C. Senecal. 2015. Sampling techniques for burbot in a western non-wadeable river. *Fisheries Management and Ecology* 22:213-223.

La Sorte, F. A., D. Fink, W. M. Hochachka, J. L. Aycrigg, K. V. Rosenberg, A. D. Rodewald, N. E. Bruns, A. Farnsworth, B. L. Sullivan, C. Wood, and S. Kelling. 2015. Documenting stewardship responsibilities across the annual cycle for birds on U.S. public lands. *Ecological Applications* 25:39-51.

Lorenz, T. J., K. T. Vierling, J. Vogeler, J. Lonneker, and J. Aycrigg. 2015. Incorporating shrub and snag specific LiDAR data into GAP wildlife models. Journal of Fish and Wildlife Management 6:437-447.

Macías-Duarte, A., and C. J. Conway. 2015. Distributional changes in the Western Burrowing Owl (*Athene cunicularia hypugaea*) in North America from 1967 to 2008. *Journal of Raptor Research* 49:75-83.

Macías-Duarte, A., and C. J. Conway. 2015. Spatial patterns in hydrogen isotope ratios in feathers of burrowing owls from western North America. *The Auk: Ornithological Advances* 132:25-36.

McCormick, J. L., M. C. Quist, and D. J. Schill. 2015. Evaluation of angler reporting accuracy in an off-site survey to estimate statewide steelhead harvest. *Fisheries Management and Ecology* 22:134-142.

Moffitt, C. M., B. J. Watten, A. Barenberg, and J. Henquinet. 2015. Hydroxide stabilization as a new tool for ballast disinfection: efficacy of treatment on zooplankton. *Management of Biological Invasions* 6:263-275.

Nadeau, C. P., and C. J. Conway. 2015. Optimizing water depth for wetland-dependent wildlife could increase wetland restoration success, water efficiency, and water security. *Restoration Ecology* 23:292-300.

Nadeau, C. P., C. J. Conway, and N. Rathbun. 2015. Depth of burrowing owl nest boxes affects thermal suitability and occupancy. *Journal of Field Ornithology* 86:288-297.

Ng, E. L., J. P. Fredericks, and M. C. Quist. 2015. Effects of gill-net trauma, barotrauma, and deep release on postrelease mortality of lake trout. *Journal of Fish and Wildlife Management* 6:265-277.

Ng, E. L., J. P. Fredericks, M. C. Quist. *In press.* Population dynamics and evaluation of alternative management goals for nonnative lake trout in a large western lake. *North American Journal of Fisheries Management.*

Ng, E. L., J. P. Fredericks, M. C. Quist. *In press.* Stable isotope evaluation of population- and individual-level diet variability in a large, oligotrophic lake with nonnative lake trout. *Ecology of Freshwater Fish.*

Parks, T. P., M. C. Quist, and C. L. Pierce. 2016. Anthropogenic disturbance and environmental associations with fish assemblages in two nonwadeable rivers. *River Research and Applications* 35:66-84.

Penney, Z. L., C. M. Moffitt, B. Jones, and B. Marston. *In press.* Physiological comparisons of plasma and tissue metrics of selected inland and coastal steelhead kelts. *Environmental Biology of Fishes.*

Plumb, J. M., and C. M. Moffitt. 2015. Re-estimating temperature-dependent consumption parameters in bioenergetics models for juvenile Chinook salmon. *Transactions of the American Fisheries Society* 144:323–330.

Smith, C. D., M. C. Quist, and R. S. Hardy. 2015. Detection probabilities of electrofishing, hoop nets, and benthic trawls for fishes in two western North American rivers. *Journal of Fish and Wildlife Management* 6:371-391.

Smith, C. D., M. C. Quist, and R. S. Hardy. *In press.* Fish assemblage structure and habitat associations in a large western river system. *River Research and Applications.*

Trushenski, J. T., H. L. Blankenship, J. D. Bowker, T. A. Flagg, J. A. Hesse, K. M. Leber, D. D. MacKinlay, D. J. Maynard, C. M. Moffitt, V. A. Mudrak, K.T. Scribner, S. F. Stuewe, J. A. Sweka, G. E. Whelan, and C. Young-Dubovsky. 2015. Introduction to a special section: Hatcheries and management of aquatic resources (HaMAR)—Considerations for use of hatcheries and hatchery-origin fish. *North American Journal of Aquaculture* 77:327-342.

Walrath, J. D., M. C. Quist, and J. A. Firehammer. 2015. Population structure and dynamics of northern pike and smallmouth bass in Coeur d'Alene Lake, Idaho. *Northwest Science* 89:280-296.

Walrath, J. D., M. C. Quist, and J. A. Firehammer. 2015. Trophic ecology of nonnative northern pike and their effect on conservation of native westslope cutthroat trout. *North American Journal of Fisheries Management* 35:158-177.

Watkins, C. J., B. S. Stevens, M. C. Quist, B. B. Shepard, and S. C. Ireland. 2015. Patterns of fish assemblage structure and habitat use among main- and side-channel environments in the lower Kootenai River, Idaho. *Transactions of the American Fisheries Society* 144:1340-1355.

Watkins, C. J., T. J. Ross, R. S. Hardy, and M. C. Quist. 2015. Precision of hard structures used to estimate age of mountain whitefish. *Western North American Naturalist* 75:1-7.

Watkins, C. J., Z. B. Klein, M. M. Terrazas, and M. C. Quist. 2015. Influence of sectioning location on age estimates from common carp dorsal spines. *North American Journal of Fisheries Management* 35:690-697.

Whitlock, S. L., M. C. Quist, and A. M. Dux. 2015. Incubation success and habitat selection of shore-spawning kokanee Oncorhynchus nerka: effects of water level regulation and habitat characteristics. *Ecology of Freshwater Fish* 24:412-423.

Books and Book Chapters

Borgmann, K. L., and C. J. Conway. 2015. Wildlife Habitat Restoration. Pages 157-167 in Wildlife Habitat Conservation: Concepts, Challenges, and Solutions. (M. L. Morrison and H. A. Mathewson, eds.). John Hopkins University Press, Baltimore, Maryland. INVITED.

Cooke, S. J., V. M. Nguyen, J. M. Dettmers, R. Arlinghaus, M. C. Quist, D. Tweddle, O. L. F. Weyl, R. Raghavan, M. Portocarrero-Aya, E. A. Cordoba, and I. G. Cowx. *In press.* Sustainable inland fisheries—perspectives from the recreational, commercial, and subsistence sectors from around the globe. Pages xx-xx *in* G. Cross, J. Olden, and M. Krosek, editors. *Conservation of freshwater fish.* Cambridge University Press, United Kingdom.

Moffitt, C. M., A. Barenberg, K. A. Stockton, and B. J. Watten. 2015. Efficacy of two approaches for disinfecting surfaces and water infested with quagga mussel veligers. Pp 467-477, Chapter 30 *in* W. H. Wong and S. Gerstenberger, editors. Biology and management of invasive quagga and zebra mussels in the Western United States. CRC Press.

Technical and Semi-Technical Reports

Braker, E., C. M. Moffitt, F. M. Wilhelm, J. Noonan, B. Kibler, and T. Woolf. 2015. Asian clam invasion. Idaho Naturalist News 7(4):8 - 9.

Dillon, K.G., and C.J. Conway. 2015. Using LiDAR to Map the Distribution and Abundance of the Red-faced Warbler. Arizona Game and Fish Department Report.

Goldberg, A. R., A. Z. Allison, and C. J. Conway. 2015. Effects of Forest Restoration and Sylvatic Plague Treatments on Demography of Northern Idaho Ground Squirrels. Annual Progress Report 2015. Wildlife Research Report #2015-03. Idaho Cooperative Fish and Wildlife Research Unit, Moscow, Idaho.

Goldberg, A. R. and C. J. Conway. 2015. Effectiveness of Forest Restoration on Demography of a Federally Listed Ground Squirrel. Summer Progress Report 2015. Wildlife Research Report #2015-01. Idaho Cooperative Fish and Wildlife Research Unit, Moscow, Idaho.

Goldberg, A. R. and C. J. Conway. 2015. Effects of Forest Restoration on Demography of Northern Idaho Ground Squirrel and Plague Study. Fall Progress Report 2015. Wildlife Research Report #2015-02. Idaho Cooperative Fish and Wildlife Research Unit, Moscow, Idaho.

Goldberg, A.G., J. Smith, and C.J. Conway. 2015. Effectiveness of forest restoration and plague treatments on demography of a federally listed ground squirrel. Unpublished report to the U.S. Fish and Wildlife Service, threatened and endangered species project TE-94776A-0. 3 February 2015.

Johnson, D., C. J. Conway, T. E. Wellicome, R. Fisher, and J. L. Conley. 2015. Further advances on burrowing owl migration. *Tracker News Magazine* 16(2):4.

Locatelli, A, C. Conway, D. Musil, K. Launchbaugh, and S. Roberts. Grazing effects on greater sage-grouse: Annual report 2016. University of Idaho, Moscow, ID, USA.

Mejia, M.F. 2015. Recruiting natural resource professionals and students in Texas. *Texas Wildlife Association Magazine* 31:28-29.

Moffitt, C. M. 2016. Actions and dialog to change perceptions and increase engagement of underrepresented minorities in fisheries and aquatic sciences. *Fisheries* 41:66-67.

THESES AND DISSERTATIONS

Barenberg, A. 2015. The use of elevated pH to reduce the risk of release of select invasive mollusk species from vessel ballast and bilge water. M.S. Thesis, University of Idaho.

Dobos, M. E. 2015. Movement, distribution, and resource use of Westslope Cutthroat Trout in the South Fork Clearwater River basin. M.S. Thesis, University of Idaho.

Klein, Z. B. 2015. Population ecology and the suppression of Burbot in the Green River, Wyoming. M.S. Thesis, University of Idaho.

Ng, E. L., 2015. Population dynamics and trophic ecology of nonnative Lake Trout in Priest Lake, Idaho. M.S. Thesis, University of Idaho.

Swearingen, Z. J. 2015. Effectiveness of management actions intended to benefit wildlife populations on the Craig Mountain Wildlife Management Area. M.S. Thesis, University of Idaho.

POSTERS AND PAPERS PRESENTED AT MEETINGS, WORKSHOPS AND CONFERENCES BY STUDENTS, STAFF AND FACULTY SUPPORTED THROUGH THE COOPERATIVE RESEARCH UNIT

Aycrigg, J. L., J. R. Tricker, R. T. Belote, M. S. Dietz, L. Duarte, and G. H. Aplet. 2015. The next 50 years: opportunities for diversifying the ecological representation of the National Wilderness Preservation System. Ecological Society of American, Baltimore, Maryland.

Beard, Z. S., M. C. Quist, R. S. Hardy, and T. J. Ross. 2015. Distribution and habitat use of juvenile burbot and other fishes in a tributary of the Kootenai River. 145th Annual Meeting of the American Fisheries Society, Portland, Oregon, August 17. PLATFORM

Beard, Z. S., M. C. Quist, R. S. Hardy, and T. J. Ross. 2015. Distribution of juvenile burbot and other fishes in a tributary of the Kootenai River, Idaho. Annual Meeting of the Idaho Chapter of the American Fisheries Society, Boise, Idaho, March 5. PLATFORM

Braker, E., C. M. Moffitt, K, Vierling, C. Conway, and M. Quist. 2015. (poster).Investment in mentoring: training to promote diversity in conservation professions. Idaho Chapter American Fisheries Society, 5 March. Boise ID.

Branigan, P. B., M. C. Quist, B. B. Shepard, and S. C. Ireland. 2015. Microhabitat use and species associations of native fishes in rehabilitated reaches of the Kootenai River, Idaho. 145th Annual Meeting of the American Fisheries Society, Portland, Oregon, August 17. PLATFORM

Branigan, P. R., M. C. Quist, B. B. Shepard, and S. C. Ireland. 2015. Microhabitat use by native and nonnative fishes in the Kootenai River, Idaho. Annual Meeting of the Idaho Chapter of the American Fisheries Society, Boise, Idaho, March 5. PLATFORM

Conway, C. J., K. Launchbaugh, A. Locatelli, D. Musil, P. Makela, and S. Roberts. 2015. Large-scale field experiments to assess the effects of cattle grazing on Greater Sage-Grouse. Tri-state coordination meeting for sage-grouse grazing research. Helena, MT. 4 Nov 2015. INVITED.

Conway, C. J., and W. Glisson. 2015. Validation of GAP's deductive distribution models for marsh birds in the U.S. GAP Analysis Program's Partnership Projects - Status Update Meeting. Webinar. 27 Oct 2015. INVITED.

Conway, C. J., K. Launchbaugh, A. Locatelli, W. Pratt, P. Makela, D. Kemner, D. Musil, S. Roberts. 2015. Experimental study to assess effects of spring cattle grazing on Sage-Grouse. Annual Meeting of the Association of Fish and Wildlife Agencies, Tucson, AZ. 15 Sep 2015. INVITED.

Conway, C. J., J. W. Connelly, K. Launchbaugh, D. Gotsch, W. Pratt, P. Makela, D. Kemner, D. Musil, E. Strand, J. Robison, and J. Whiting. 2015. Effects of spring cattle grazing on Sage-Grouse: a project update. Annual Meeting of the Idaho Chapter of The Wildlife Society, Pocatello, ID. 11 Mar 2015.

Dillon, K.G., and C. J. Conway. 2015. Using GAP data to explain elevational patterns of avian species richness in the US. GAP Partnership Projects - Status Update Meeting. Webinar. 27 Oct 2015. INVITED.

Dobos, M. E., M. C. Quist, M. P. Corsi, and J. M. DuPont. 2015. Influence of summer water temperatures on the movement, distribution, and habitat use of fluvial westslope cutthroat trout in the South Fork Clearwater River basin. 145th Annual Meeting of the American Fisheries Society, Portland, Oregon, August 17. PLATFORM

Dobos, M. E., M. C. Quist, M. P. Corsi, and J. M. DuPont. 2015. Movement, distribution, and habitat use of westslope cutthroat trout in the South Fork Clearwater River basin. Annual Meeting of the Idaho Chapter of the American Fisheries Society, Boise, Idaho, March 5. PLATFORM

Ellison, K. S., C. J. Conway, D. H. Johnson, S. J. Dinsmore, P. Skrade, R. J. Fisher, T. I. Wellicome, G. W. Page, T. L. Tibbitts, N. Warnock, J. Watson, E. Bayne, S. Olimb, and D. Jorgensen. 2015. Migratory grassland birds of the Great Plains: A comparison of migrations of five species and the implications for conservation. America's Grasslands Conference. Ft. Collins, CO. 29 Sep 2015.

Glisson, W., and C. J. Conway. 2015. Validation of GAP's deductive distribution models for marsh birds in the U.S. FY15 GAP Partnership Projects. USGS GAP program Webinar. 7 Apr 2015.

Glisson, W., and C. J. Conway. 2015. Influence of wetland features and anthropogenic threats on the breeding distribution of American Bitterns in the United States. Annual Meeting of the Idaho Chapter of The Wildlife Society, Pocatello, ID. 12 Mar 2015.

Goldberg, A. R., C. J. Conway, D. Evans Mack, and E. Yensen. 2015. Why have populations of Northern Idaho Ground Squirrels declined? Annual Meeting of the Idaho Chapter of The Wildlife Society, Pocatello, ID. 11 Mar 2015.

Griffin‡, K. M., Z. S. Beard, M. C. Quist, and J. M. Flinders. 2015. Age estimation of Utah chub in Henrys Lake, Idaho using otoliths, pectoral fin rays, and scales. 145th Annual Meeting of the American Fisheries Society, Portland, Oregon, August 17. POSTER

Guzman*, B., E. Rankin, E. Braker, C. M. Moffitt, and F. M. Wilhelm. 2015. (poster) Benthic survey of Ellisport Bay, Lake Pend Oreille, Idaho, for invasive Asian clams. Ecological Society of America, August. Baltimore, MD.

Hardy, R. S., C. Holderman, T. J. Ross, B. Shafii, and M. C. Quist. 2015. Ten years of nutrient additions in the Kootenai River, Idaho: what's the verdict for fisheries recovery efforts? 145th Annual Meeting of the American Fisheries Society, Portland, Oregon, August 17. PLATFORM

Klein, Z. B., M. C. Quist, D. T. Rhea, and A. C. Senecal. 2015. Habitat use of burbot in the Green River, Wyoming. Annual Meeting of the Idaho Chapter of the American Fisheries Society, Boise, Idaho, March 5. PLATFORM

Klein, Z. B., M. C. Quist, D. T. Rhea, and A. C. Senecal. 2015. Population characteristics and the suppression of burbot in the Green River, Wyoming. Annual Meeting of the Idaho Chapter of the American Fisheries Society, Boise, Idaho, March 5. PLATFORM

Klein, Z. B., M. C. Quist, D. T. Rhea, and A. C. Senecal. 2015. Habitat use of nonnative burbot in a western nonwadeable river. Annual Meeting of the Colorado-Wyoming Chapter of the American Fisheries Society, Fort Collins, Colorado, February 26. PLATFORM

Klein, Z. B., M. C. Quist, D. T. Rhea, and A. C. Senecal. 2015. Population dynamics of burbot in the Green River of Wyoming. Annual Meeting of the Colorado-Wyoming Chapter of the American Fisheries Society, Fort Collins, Colorado, February 26. PLATFORM

Klein, Z. B., M. M. Terrazas, and M. C. Quist. 2015. Precision of hard structures for estimating the age of burbot. Annual Meeting of the Colorado-Wyoming Chapter of the American Fisheries Society, Fort Collins, Colorado, February 26. POSTER

Oldemeyer, B.N., Kennedy, B.P., and T.S. Copeland. 2015. The effects two pre-smoltification life history expressions have on juvenile Chinook Salmon growth, migration timing, and fork length in a wilderness environment. National American Fisheries Society Meeting, Portland, OR.

Oldemeyer, B.N., Kennedy, B.P., and T.S. Copeland. 2015. The effects two pre-smoltification life history expressions have on juvenile Chinook Salmon growth, migration timing, and fork length in a wilderness environment. Advances in the Population Ecology of Stream Salmonids IV, Girona, Spain.

Moffitt, C. M., B Watten*, A. Barenberg, J. Henquinet. 2015. (poster) Hydroxide stabilization as a new tool for ballast disinfection: efficacy of treatment on zooplankton. International Association for Great Lakes Research, 58th Annual Conference. 25-29 May. Burlington VT.

Moffitt, C. M. 2015. Factors affecting the outcome of potential chemical control tools for dreissenids and other invasive mollusks. Annual Meeting of the Western Regional Panel on ANS, September 2-4, Lake Tahoe, CA.

Moffitt, C. M. 2015. Socio-economic and environmental factors influence the relevance of natural resources. Idaho Chapter American Fisheries Society, March. Boise ID.

Moffitt, C. M., F. Wilhelm, E. Braker, B. Kibler, J. Noonan, and T. Woolf. 2015. Asian clams can pose a significant threat to aquatic resources: updates on the Lake Pend Oreille infestation and management. Idaho Chapter American Fisheries Society, March. Boise ID.

Moffitt, C. M. 2015. Plenary and Business Award Ceremonies for 145th Annual Meeting of the American Fisheries Society. Portland, OR, August

Moffitt, C. M., 2015. Water and Energy, Dams, Ships, Fish, CO2 and other things. Guest lecture and discussion leader for Chemistry 400, Honor's Seminar. October 28. Instructor Tom Bitterwolf.

Moffitt, C. M. 2015. Summary of considerations regarding KCl treatments for quagga mussels. Dreissenid mussel research priorities workshop. Portland State University. 4-5 November.

Moffitt, C. M. and K. Stockton. 2015. Potential Chemical Control Tools for Dreissenids and other Invasive Mollusks. Columbia Basin, Columbia River Basin Team Meeting, Portland, 7-9 October 2015.

Moffitt, C. M. 2015. Risks and management of diseases to avoid unwanted outcomes in aquaculture. Ethics in Aquaculture and Fisheries Management, 145th Annual Meeting American Fisheries Society. Portland OR. 19 August.

Moffitt, C. M., and B. Kibler. 2015. Corbicula response in Lake Pend Oreille LPO, Idaho. Columbia River Basin Team Meeting, 12-13 May, Boise. ID.

Moffitt, C. M., and F. Wilhelm. 2015. Use of elevated pH under barriers at Lake Pend Oreille, ID. Idaho Invasive Species Council, 6 March. Boise, ID

Ng, E. L., M. C. Quist, and J. Fredericks. 2015. Effects of gill-net trauma, barotrauma, and deep release on post-release mortality of lake trout. 145th Annual Meeting of the American Fisheries Society, Portland, Oregon, August 17. POSTER

Ng, E. L., M. C. Quist, and J. Fredericks. 2015. Harvest and reproductive output regulate nonnative lake trout population growth: implications for management. 145th Annual Meeting of the American Fisheries Society, Portland, Oregon, August 17. PLATFORM

Ng, E. L., M. C. Quist, and J. Fredericks. 2015. Effects of gill-net trauma, barotrauma, and deep release on post-release mortality of lake trout. Annual Meeting of the Idaho Chapter of the American Fisheries Society, Boise, Idaho, March 5. POSTER

Ng, E. L., M. C. Quist, and J. Fredericks. 2015. Effects of harvest regulations on population dynamics of lake trout in Priest Lake. Annual Meeting of the Idaho Chapter of the American Fisheries Society, Boise, Idaho, March 5. PLATFORM

Ng, E. L., M. C. Quist, and J. Fredericks. 2015. Trophic structure of the Priest Lake fish assemblage. Annual Meeting of the Idaho Chapter of the American Fisheries Society, Boise, Idaho, March 5. PLATFORM

Quist, M. C., K. Carter-Lynn, and M. Liter. 2015. Population dynamics of channel catfish in northern Idaho lakes: implications for management. Annual Meeting of the Colorado-Wyoming Chapter of the American Fisheries Society, Fort Collins, Colorado, February 26. PLATFORM

Ross, T. J., S. A. Carleton, M. C. Quist, and R. S. Hardy. 2015. Stock assignment of fluvial rainbow trout *Oncorhynchus mykiss* in the Kootenai River, Idaho using otolith microchemistry: lessons learned and future directions. Annual Meeting of the Idaho Chapter of the American Fisheries Society, Boise, Idaho, March 5. PLATFORM

Ross, T. J., S. A. Carleton, M. C. Quist, J. Dunnigan, and R. S. Hardy. 2015. Application of otolith microchemistry to evaluate natal origins, maternal origins, and stock composition of rainbow trout *Oncorhynchus mykiss* in the Kootenai River, Idaho. 145th Annual Meeting of the American Fisheries Society, Portland, Oregon, August 17. PLATFORM

Swearingen, Z., C. J. Conway, F. Cassirer, and P. Zager. 2015. Evaluating twenty one years of management on Craig Mountain Wildlife Management Area: Are we meeting our objectives? Annual Meeting of the Idaho Chapter of The Wildlife Society, Pocatello, ID. 11 Mar 2015.

Swearingen, Z., C. J. Conway, and F. Cassirer. 2016. Effects of Three Timber Harvest Prescriptions on Breeding Density of Pileated Woodpeckers. Annual Meeting of the Idaho Chapter of The Wildlife Society, Coeur d' Alene, ID. 23 Feb 2016.

Smith, J., G. Vaziri, S. Cunningham, A.R. Goldberg, and C.J. Conway. 2015. Effects of cattle grazing on seed availability in northern Idaho ground squirrel colonies. Annual Meeting of the Idaho Chapter of The Wildlife Society, Pocatello, ID. 11 Mar 2015.

Terrazas, M. M., Z. B. Klein, and M. C. Quist. 2015. Precision of hard structures for estimating the age of burbot. Annual Meeting of the Idaho Chapter of the American Fisheries Society, Boise, Idaho, March 5. POSTER

Vierling, K., C. J. Conway, C. Moffitt, and E. Braker. 2015. Internship programs in the Fish and Wildlife Sciences Department at the University of Idaho: opportunities for expanding wildlife education. Idaho Chapter of The Wildlife Society Annual Meeting, 10 March 2015. Pocatello, ID

Wilhelm, F. C. Moffitt, E. Braker, B. Kibler, J. Noonan, and T. Woolf. 2015. Efforts to use elevated pH and benthic barriers to eradicate Asian clams (Corbicula) from Idaho's Great Lake, Lake Pend Oreille. North American Lake Management Society symposium. November 17 – 20, Sarasota Springs, N.Y.

Woodrey, M.S., and C.J. Conway. 2015. The Application of the Standardized North American Marsh Bird Monitoring Protocol. 2015 Southeast Partners in Flight Annual Meeting, 3 Nov 2015, Lafayette, LA. INVITED.

TECHNICAL ASSISTANCE, OUTREACH, AND SERVICE

Courtney J. Conway

Chair of the Scientific Program Committee for the 6th North American Ornithological Conference in Washington, DC. 2014-present.

USFWS steering committee on marsh bird management and research programs. 2011-present.

Chair of Search Committee, Wildlife Habitat Ecologist-Rangelands, Department of Fish and Wildlife Sciences, University of Idaho. 2015.

Taught *Fish and Wildlife Graduate Seminar* (WLF 501), 1 cr., Fall 2015.

Taught *Special Topics: Fish and Wildlife Speakers* (WLF 504), 1 cr., Fall 2015.

Taught *Preparing Scientific Manuscripts* (NR 511), 2 cr, Spring 2015.

Culture and Climate Committee, Department of Fish and Wildlife Sciences. 2014-present.

CNR college representative on University of Idaho Graduate Council, 2013-2015.

Christine M. Moffitt

Associate Editor, Transactions of the American Fisheries Society. 2005 – present.

Co-chair, American Fisheries Society Awards Committee. 2014- present.

Advisor, Palouse Unit of Idaho Chapter, American Fisheries Society.

Member at large, the Western Regional Panel on Aquatic Nuisance Species. 2014-present.

Member, 100th Meridian Initiative - Columbia River Basin Team Participant

Idaho Invasive Species Council, Aquatic Invasive Species

Member, Scientist Expert Panel for Delta Science Program- Review of feasibility of use of shore-based ballast water reception and treatment facilities in California. Delta Stewardship Council, and the California State Lands Commission. http://deltacouncil.ca.gov/feasibility-study-shore-based-ballast-water-reception-and-treatment-facilities-california-0

Invited participant to share information, and discuss Dreissenid mussel research priorities. Portland State University. Organized by Pacific States, USGS, and USFWS. 4-5 November.

Chair, Research Grade Evaluation Aquatic Scientists, 7 panel members, 19 scientist in review, USGS. January – May.

Outside reviewer for tenure and promotion, University of Michigan-Flint. August.

Reviewer, Great Lakes Fisheries Commission Science Board. Peer reviewer for 2 research proposals.

Peer Review of Asian Clam Risk Assessment, BC Ministry of Environment. May.

Member of organizing and planning team for Natural Resources Tribal Engagement Educational Summit September-October 2015. Panel moderator.

Co-organizer for two day workshop and presentations on multi-cultural inclusion with Dr. Carolyn Finney author of Black faces and White Spaces. 27-30 September. Panel moderator.

Organizer for special session "Actions and dialog to change perceptions and increase engagement of underrepresented minorities in fisheries and aquatic sciences". American Fisheries Society, Portland OR August 2015.

Doris Duke Conservation Scholars. Co-PI and Mentor. Five interns for summer experience. Fieldtrip and interactions regarding anadromous fish and invasive species.

Planning team for Western Region New Zealand mudsnail workshop. Seattle WA, June 16-17.

Climate change and the potential effects on salmonid rearing in the future- Dr. Christine Moffitt, University of Idaho "Inflow-Outflow, Responsible and Efficient Aquaculture" Idaho Chapter American Fisheries Society. 3 March.

Peer reviews for: Ecological Engineering; Water, Air and Soil Pollution; North American Journal of Fisheries Management, Freshwater Science, Ecology.

Member Culture and Climate Committee, Department of Fish and Wildlife Sciences.

Member, USGS Emerging diseases work group.

UI Laboratory Support Committee.

Michael C. Quist

Culture and Climate Committee, Department of Fish and Wildlife Sciences, University of Idaho, Chair.

Search Committee, Wildlife Ecology and Management, Department of Fish and Wildlife Sciences, University of Idaho, 2015.

Taught *Fish and Wildlife Seminar* (FISH 501), 1 cr., Spring 2015.

Taught *Fisheries Management* (FISH 418). 3 cr/. Fall 2015.

Undergraduate research mentor for two students:

Kayla Griffin. 2014-present. Precision of structures used to age Utah Chubs.

Katie McBaine. 2015-present. Trophic ecology of Burbot in the Green River basin of Wyoming.

Kootenai River Technical Advisory Committee. 2012-present