

IDAHO COOPERATIVE FISH AND WILDLIFE RESEARCH UNIT



**ANNUAL REPORT TO COOPERATORS
1 JANUARY 2014 TO 31 DECEMBER 2014**



Idaho Department of Fish and Game and University of Idaho personnel snorkeling the South Fork Clearwater River

University of Idaho



M.S. student Zach Klein (right) and Wyoming Game and Fish Department biologist Darren Rhea (left) sampling Burbot on the Green River



M.S. student Elizabeth Braker on Lake Pend Oreille

Cover photos:

- Left: Doris Duke Conservation Scholars and UI undergraduate students Katey Huggler, Elyce Gosselin, and Emily Brown banding nestling Burrowing Owls in northeastern Oregon
- Right: M.S. student David Gotsch with male Greater Sage-Grouse
- Center: Jordan Rutland, REU intern with other students and Chinook Salmon at the adult fish trap, Lower Granite Dam on the Snake River

REPORT TO COOPERATORS
1 January 2014 — 31 December 2014

Cooperators Meeting: 7 April 2015

IDAHO COOPERATIVE
FISH AND WILDLIFE RESEARCH UNIT

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Unit Cooperators

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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Ph.D. student Amanda Goldberg with a juvenile Northern Idaho Ground Squirrel.

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.



M.S. student Elizabeth Ng with a Lake Trout on Priest Lake



M.S. student Zach Klein with a Burbot



Courtney J. Conway – Unit Leader and Associate Professor of Wildlife Resources. Recent research has focused on: effects of cattle grazing on Sage-grouse demographic traits; effects of 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 steelhead physiology and migrations; assessing risks of aquatic invasive species; interactions between cultured and wild fish; 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.



Candy Ihm - Program Specialist for the Idaho Cooperative Fish and Wildlife Research Unit. Candy provided administrative support for research and cooperative agreements for federal and state contracts. Candy moved to Hawaii and resigned her position in February 2015.

Federally Funded Scientists and University Administrative Staff Contact Information

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Fish and Wildlife Departmental Administrative Staff

Linda Kisha, Administrative Assistant (retired)
Kim Stout, Administrative Assistant

Department of Fish and Wildlife Faculty with Unit Projects in 2014

Kerry Reese, Professor and Department Head (retired)
Brian Kennedy, Associate Professor
Kerri Vierling, Associate Professor
Frank Wilhelm, Associate Professor

Students and Research Staff Who Worked on Unit Projects in 2014

Postdoctoral Research Associates and Research Scientists

Joceyln Aycrigg
Lynnette Dornak
Wesley Glisson
David Johnson
Anthony Locatelli

Senior Research Technicians

Lisa Cross
Jennifer Smith

Undergraduate Assistants, Interns, and IH Technicians

Andrew J. Barao	Danielle Munzing
Tucker Brauer	Jaime Neill
Emily Brown	Joseph Noonan
Joe Caprio	Juan Ortiz-Perez
Turner Cotton	Nick Porter
Stephanie Cunningham	Emily Rankin
Elyce Gosselin	Jethro Runco
Kayla Griffin	Jordan Rutland
Bethany Guzman	Martin Sluk
Emily Hays	Ryan Starr
Rhianna Hohbein	Claire Tahon
Katey Huggler	Grace Vaziri
Kelsey Jarvis	Aaron Vincent
Jeffrey Johnson	Alyssa Winkler
Colin Luther	Jennifer Presler
Jenna McCullough	George Brady
Genevieve Maassen	Eric Gutierrez
Jeff McFarland	Haley Boyle
Bethany Lynn McGregor	Betsy Wagner
Kylie Meyer	Jennifer Symons
Matt Modlin	

Graduate Students on Coop Unit Projects 2014

* completed

Student	Discipline	Advisor
Amber Barenberg	M.S. Fishery Resources	C. M. Moffitt
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
Kristen G. Dillon	Ph.D Wildlife Resources	C. Conway
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
*Gifford Gillette	Ph.D. Wildlife Resources	K. P. Reese
Amanda Goldberg	Ph.D. Wildlife Resources	C. Conway
David Gotsch	M.S. Wildlife Resources	C. Conway
Joseph Holbrook	Ph.D. Wildlife Resources	K. Vierling
Zach Klein	M.S. Fishery Resources	M. Quist
*Carl Lundblad	M.S. Wildlife (Univ. Arizona)	C. Conway
Carl Lundblad	Ph.D. Wildlife Resources	C. Conway
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
Zach Swearingen	M.S. Wildlife Resources	C. Conway
*Carson Watkins	M.S. Fishery Resources	M. Quist



Hoop net sets on the Green River,
Wyoming

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 2015



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:

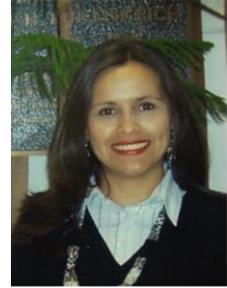
The Boise National Forest Land and Resource Management Plan of 2010 identified Bull Trout *Salvelinus confluentus* as a management indicator species (MIS). MIS are defined as “Representative species whose habitat conditions or population changes are used to assess the impacts of management activities 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.

Bull Trout, U.S. Fish and Wildlife Service



LIFE CYCLE ASSESSMENT AND ECOSYSTEM SERVICES FRAMEWORK FOR SUSTAINABLE AQUACULTURE PRODUCTION

Major Professor: Christine M. Moffitt
Student Investigator: Lubia Cajas Cano
Funding Agency: University of Idaho International Programs Office
Completion Date: 30 August 2015



Objectives:

- Create a Life Cycle Assessment (LCA) model to evaluate relevant environmental and socioeconomic factors involved in a life cycle of marine mussel production, and assign and obtain data using the model in an existing marine mussel production farm.
- Evaluate suitable candidate species for rearing within selected finfish and mollusk aquaculture settings, and simulate the potential of integrating these species into the systems.

Progress:

Aquaculture production has increased worldwide, and many scientists and regulators have articulated concerns about the effects on water quality and quantity of increased aquaculture production from open water or flow through systems. In contrast to deterioration of water quality, some aquaculture systems may enhance overall water quality. Mussels filter phosphorus, nitrogen, and other nutrients from content source water; they also provide socioeconomic resources, including a nutritious end product. Our LCA model estimated water, energy, and carbon footprints of production, and relevant socioeconomic inputs and outputs associated with the production system. A draft model has been developed, and will be reviewed with industry during the spring of 2015. Because the mussels filter water, they consume minimal amounts of water and energy during the production phase, and most resource use is attributed to the harvest and processing stage. Our estimates provide a value for the natural ecosystem services harvested from marine mussel production. We illustrate additional opportunities to utilize these systems and LCA tools in integrated systems to present a more environmentally friendly aquaculture system. In addition we are exploring the potential for Integrated Multi-Trophic Aquaculture systems (IMTA). The use of an IMTA may increase environmental sustainability because secondary species can use wastes and nutrients released from the production of the target product. Marine and freshwater mussels are capable of filtering phosphorus, nitrogen, and other nutrients from content source water. Proper placement of mussel aquaculture systems close or within aquaculture systems can result in reduced nutrient loading, and increase community diversity through recycled nutrients.



Mussels at aquaculture facility

AQUATIC INVASIVE SPECIES CONTROL – NEW ZEALAND MUD SNAILS, AND OTHER MOLLUSKS

Principal Investigator: Christine M. Moffitt
Graduate Student: Amber Barenberg
Undergraduate Summer Intern: Jordan Rutland
Funding Agency: Utah Division of Wildlife Resources
Completion Date: 31 May 2015



Objective:

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

Progress:

This project is focused on improving and refining appropriate tools to control invasive mollusk species, especially at fish hatcheries. We are providing information from our research to Utah in advance of publication to increase the management benefit. The Utah Division of Wildlife staff are also sharing results of their trials for use in data summaries by Moffitt as control measures are developed. Our research will provide additional laboratory analysis of promising chemical control measures. This past summer we provided an opportunity for our summer undergraduate intern Jordan Rutland (NSF-funded Research Experience for Undergraduates) to explore the genetic differences in populations of Asian clams from the Snake River, just downstream of Lower Granite Dam, with populations from the Snake River near Bliss, Idaho. She determined that there were two different genetic populations, and the morphs likely express that in shell color, with a purple shell more common at Lower Granite Dam site. Both populations were examined for reproductive potential and spawning behavior. We plan to explore further tests of the efficacy of KCl as a toxicant on NZMS and quagga mussels later this spring. These trials will be conducted at the USFWS's Willow Beach National Fish Hatchery, in Arizona.



MS Student Amber Barenberg collecting quagga mussel veligers at Willow Beach National Fish Hatchery

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
Undergraduate Interns: Emily Rankin and Bethany Guzman
Funding Agency: USGS/USFW SSP RWO 162
Collaborating Agency: Tom Woolf, Idaho Department of Agriculture
Completion Date: 30 June 2015



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 a response effort by the Idaho State Department of Agriculture (IDA) 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 can 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. We evaluated the extent of the existing distribution in Ellisport Bay with shoreline surveys and ponar samples. In the winter, we used a lake-level drawdown to further explore the option of using a non-permeable barrier and small quantities of NaOH placed beneath it to increase mortality of clams through elevated pH. Following a pre treatment assessment of density we focused on obtaining the necessary permits for a proposed experimental pesticide application from the EPA, and US Army Corps of Engineers. The project will be completed with evaluation of treatment options for control or eradication, and a proposal for follow up research. The scientists and collaborators engaged with the local citizens in extensive outreach and educational collaborations. We have provided 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 December 2015

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 snail has been observed in brackish waters on the Pacific coast. This guidance document was first drafted in 2013 by Moffitt and M.S. student K. Stockton as an information tool for fish hatchery managers. We expand the document to include additional information. The working draft risk assessment and guidance document was presented to small work groups in 2014 with Washington Department of Fish and Wildlife staff, biologists from the Colville Tribe, and with several biologists associated with public utilities. We are collaborating with agencies to organize the 7th National New Zealand Mudsnails workshop in June 2015 in Seattle at the USGS Western Fisheries Research Center. At this meeting we will provide a thorough assessment of the tool with participants, followed by field tests. The final risk assessment and management tool will be provided to 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.

EFFECTS OF CHANGES IN DISTURBANCE REGIMES ON ANIMAL COMMUNITIES

Principal Investigators: Courtney Conway and
Christine Moffitt
Co-Investigator: Kerri Vierling
Graduate Students: Elizabeth Braker; Joe
Holbrook, Amber
Barenberg
Doris Duke Interns: Emily Rankin, Bethany
Guzman, Emily Brown,
Elyce Gosselin, Katey Huggler
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. This project examined disturbance regimes in the sagebrush steppe of southern Idaho, and defined the extent of an infestation of Asian clams *Corbicula fluminea* in Lake Pend Oreille, Idaho.

Environmental Science M.S. student Elizabeth Braker served as the lead mentor for the five Doris Duke Undergraduate Scholars. Braker accompanied them to the leadership training at the National Conservation Training Center, and facilitated tours of Washington, DC. She also accompanied the students to their research sites, and spent most time with two of the scholars at Lake Pend Oreille, housed at the Idaho Department of Fish and Game's Sandpoint Hatchery.

Braker's project is "Developing effective communication and outreach tools to understand ecological and socioeconomic costs of invasive species". Fisheries M.S. student Amber Barenberg provided leadership for the 2014 summer research experience for two of the Doris Duke Scholars. Barenberg's thesis research was collaboration with USGS and the National Park Service and titled "The use of elevated pH to reduce the risk of release of select invasive mollusk species from vessel ballast and bilge". Wildlife Ph.D. student Joe Holbrook provided leadership for the 2014 summer research experience for three of the Doris Duke Scholars in southern Idaho. Holbrook's dissertation research is: "Influence of biotic and abiotic factors on distribution and abundance of burrowing animals on ecosystem functions in sagebrush-steppe ecosystems".

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 Investigators: Matthew P. Corsi and Daniel Schill, 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.
- Describe seasonal habitat use of and possible limiting factors affecting Westslope Cutthroat Trout populations.

Progress:

Although many Westslope Cutthroat Trout *Oncorhynchus clarki lewisi* populations in Idaho are robust and stable, population densities in some systems remain below management objectives. In many of those systems, such as in the South Fork Clearwater River (SFCR) system, environmental conditions (e.g., summer temperatures) are hypothesized to limit populations of Westslope Cutthroat Trout. Radiotelemetry and snorkeling methods were used to describe seasonal movement patterns, distribution, and habitat use of Westslope Cutthroat Trout in the SFCR during the summers of 2013 and 2014. Sixty-six tags were surgically implanted into Westslope Cutthroat Trout (170–405 mm) from 30 May–25 June, 2013 and 20 June–6 July, 2014. Of the radio-tagged fish, 26 shed tags, died, or were not relocated during the summer. Two distinct patterns of movement by Westslope Cutthroat Trout were observed in the SFCR. Twenty fish moved from the mainstem SFCR into tributaries as stream temperatures increased. Twenty-six fish persisted in the mainstem SFCR during the summer despite high daily maximum temperatures in 2013 (mean \pm SE = $22.3 \pm 0.15^\circ\text{C}$) and 2014 ($21.5 \pm 0.20^\circ\text{C}$). Snorkeling was conducted in August of 2014 to better describe the distribution and habitat use of Westslope Cutthroat Trout in the mainstem SFCR. Twenty-seven Westslope Cutthroat Trout were observed in 13 sites and found at low density (0.0003 ± 0.0001 fish/m²). Fish were not observed in sites where the maximum diel temperature exceeded 21.7°C ($20.9 \pm 0.14^\circ\text{C}$). Large boulders were also associated with Westslope Cutthroat Trout densities. Both radio-tagged fish that persisted in the SFCR during the summer and Westslope Cutthroat Trout observed during snorkeling.

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.
- 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 piscivorous fish species is concerning because the Green River supports a socially and economically important trout fishery. In addition, the Green River supports three species of conservation concern (i.e., Bluehead Sucker *Catostomus discobolus*, Flannelmouth Sucker *Catostomus latipinnis*, Roundtail Chub *Gila robusta*) which are likely negatively influenced by the introduction of Burbot. Thus, the suppression of Burbot is of primary interest to managers of the Green River. Unfortunately, little information is available on effective sampling techniques for Burbot. Research focused on the relationship between habitat characteristics and the occurrence of Burbot is also warranted to direct efficient sampling effort.

In total, 230 Burbot varying from 125 – 716 mm were sampled during the summer and fall of 2013 using night electrofishing, 6.4-mm bar measure mesh hoop nets, and 19-mm bar measure 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 measure mesh hoop nets produced the highest estimated detection probability (0.46 ± 0.07) during the fall. During both seasons, 19-mm bar measure 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 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.
- 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. Precipitous declines in popular kokanee *Oncorhynchus nerka*, Westslope Cutthroat Trout *O. clarki lewisi*, and Bull Trout *S. confluentus* fisheries in the following decades were attributed to increased Lake Trout abundance post mysid introduction. By the 1990s, Lake Trout dominated the recreational fishery in Priest Lake. However, recent surveys by the Idaho Department of Fish and Game (IDFG) indicate that nearly half of anglers at Priest Lake would prefer a more diverse fishery, which could potentially be achieved through Lake Trout suppression. Despite the prominence of Lake Trout in Priest Lake, little is known about the population and thus the feasibility or possible outcomes of such a removal effort.

A high-intensity tagging effort was conducted in spring 2013 with the assistance of a commercial fishing crew to address basic questions about the Lake Trout population. Gill nets and large trap nets were used to tag and release 2,977 Lake Trout. An initial Schnabel estimate indicated that abundance was likely between 40,667 – 58,763 individuals (95% C.I.). Population demographic data suggest that Lake Trout grow fast during the first few years of life, likely due to abundant Mysid prey. Growth rates decline around age 6 or 7 when fish begin to mature. Interestingly, we found that a low proportion (~50%) of the females spawn in a given year. Although the mechanism for this pattern is unknown, it is likely due to low prey availability for large lake trout. An age-structured population model was developed and used to evaluate a variety of management actions. Results of the modeling exercise will provide natural resource managers with options for managing Lake Trout. In addition to investigations on Lake Trout demographics and population modeling, we also investigate the trophic structure of fishes and invertebrates in Priest Lake using stable isotope analysis. Results of the research are forthcoming and will be used to provide insight on management options in the system.

EFFECTS OF HABITAT RESTORATION ACTIVITIES ON FISH ASSEMBLAGES AND POPULATIONS IN SIDE CHANNELS OF THE KOOTENAI RIVER

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 May 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*, Kootenai River 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 217 sites in 2014. Three-hundred-and-eighty-three individuals representing seven different species were sampled including Largescale Sucker *Catostomus macrocheilus*, 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 will include additional sampling in 2015 and refinement of occurrence models.

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 May 2016



Objectives:

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

Progress:

In Idaho, Burbot *Lota lota* are only found in the Kootenai River. Similar to the majority of North American rivers, the Kootenai River has been highly altered following European settlement. Anthropogenic alterations began late in the nineteenth century with the construction of levees on the lower portion of the river. Libby Dam, constructed in the early 1970s near Libby, Montana, has altered thermal, hydrologic, and nutrient regimes of the Kootenai River. Restoration efforts for Burbot have primarily focused on conservation aquaculture. Although a variety of stocking strategies have been and will likely be employed in the future, one strategy of particular interest is the release of fish into small tributary streams in the Kootenai River basin. Over the last several years, the Idaho Department of Fish and Game (IDFG) has implemented a project on Deep Creek (a major tributary to the Kootenai River) to evaluate movement of stocked Burbot to the Kootenai River. Their data suggest that some fish survive, rear in the Deep Creek system, and then outmigrate to the Kootenai River. Key questions include whether or not remaining fish are alive, and characteristics of fish that died. Other important questions include those focused on the spatial distribution of survivors, their habitat use and selection, interactions with other fishes, growth rates, and outmigration patterns and characteristics.

In 2014, fishes and habitat were sampled from 25 reaches in Deep Creek. Sixteen species were sampled, including Burbot. Lower reaches of deep creek were dominated by Bluegill *Lepomis macrochirus*, Northern Pikeminnow *Ptychocheilus oregonensis*, and Largemouth Bass *Micropterus salmoides*. Middle reaches had high gradients and were dominated by Mountain Whitefish *Prosopium williamsoni* and Torrent Sculpin *Cottus rhotheus*. Uppermost reaches had fish assemblages dominated by Brook Trout *Salvelinus fontinalis* and Tench *Tinca tinca*. Burbot were typically found in middle and upstream reaches. In addition to evaluating fish assemblage structure, five half-duplex PIT arrays were established in Deep Creek. Movement of Burbot is currently being monitored. Additional sampling focused on recapturing Burbot will commence in 2015.

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 September 2015



Objectives:

- Compare multiple mark-recapture analyses to decipher which approach produces the most accurate juvenile salmonid abundance estimates for rotary screw traps (RST).
- Investigate variables effecting juvenile Chinook Salmon over winter location in Big Creek, Idaho.
- 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.

Progress:

Significant declines in native Chinook Salmon and Steelhead trout populations in the Snake River Basin has both species classified as “threatened” under the Endangered Species Act. These species are under extensive monitoring and research to try and evaluate population status and guide restoration plans. In the Columbia River Basin there are upwards of 100 rotary screw traps (RSTs) operated by various federal, state, and tribal agencies with the overall objective of capturing and tagging emigrating salmonids in order to quantify population abundance and size structure. The mark-recapture analyses implemented to estimate juvenile abundances often require sufficient amounts of recaptured individuals to calculate accurate abundances estimates. This is problematic, particularly during spring flows, when it may be difficult to operate RSTs or when they suffer from prohibitively low capture efficiencies as juvenile salmonids are outmigrating. The primary goal of this project is to improve Steelhead Trout and Chinook Salmon smolt population estimates at RSTs and develop statistical models and software needed to replicate the analysis. We are currently constructing a series of hierarchical Bayesian models that incorporate multiple years of data and influential covariates that potentially affect migration timing and recapture probabilities and are comparing these estimates to traditional abundance model estimates. Incorporating multiple years of data into the hierarchical framework will allow for information to be shared between years, making it possible to get more accurate estimates during long periods of missing data, while the inclusion of additional covariates that affect migration timing will help increase accuracy and precision of estimates by having the covariates help explain yearly variability. A second analysis is being conducted on the effects that juvenile Chinook overwinter location has on size, growth rate, and timing during spring smoltification at Big Creek, Idaho. We found that individuals 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. We are investigating the mechanisms that affect an individual’s overwinter location in this Wilderness watershed in order to generally improve our predictions about how future climatic and hydrologic shifts may influence juvenile Chinook life history decisions and survival.

Completed Projects – Fisheries and Aquatic Resources

EFFECTS OF HABITAT RESTORATION ACTIVITIES ON FISH ASSEMBLAGES AND POPULATIONS IN SIDE CHANNELS OF THE KOOTENAI RIVER

Principal Investigator: Michael C. Quist
Student Investigator: Carson J. Watkins
Collaborating Investigator: Sue Ireland, Kootenai Tribe of Idaho
Funding Agency: Kootenai Tribe of Idaho
Completion Date: 31 May 2014



Objectives:

- Evaluate spatial variation in fish assemblage and population structure in Kootenai River side channels.
- Evaluate patterns of habitat use and identify habitat variable influencing occurrence and relative abundances of individual species.
- Develop sampling designs to effectively monitor fish assemblages in the Kootenai River.

Progress:

The Kootenai River has been extensively modified by land-use and water-development activities throughout the past century where habitat loss has resulted in the decline of native fishes. Fish assemblage structure was compared among seven sites within main- and side-channel habitats during the summers of 2012 and 2013 in the lower Kootenai River, Idaho. Fishes and habitat characteristics were sampled using standard methods at each site on a biweekly schedule to evaluate the association of fish assemblages and populations with environmental variables. Fish assemblage relationships were evaluated using information on occurrence and relative abundance. Species-specific habitat associations were modeled to identify variables that were important in explaining variability in occurrence and relative abundance. Side-channel habitats were characterized by a high proportion of fine substrate, low current velocities, shallow depths, and abundant wood relative to main-channel habitats. Species composition was dominated by Largescale Sucker *Catostomus macrocheilus* and Mountain Whitefish *Prosopium williamsoni* at all sites. Side-channel habitats tended to have higher species richness than main-channel habitats, and native fishes had high reach similarity. Newly-rehabilitated sites had high catch rates of non-native fishes. Habitat use was directly related to each species' ecology and important habitat variables associated with occurrence and relative abundance of a given species were different. Results of this study suggest that non-native fishes were associated with rehabilitated side-channel habitats at the downstream extent of our study area. In addition, biotic interactions between native and non-native fishes may reflect the lack of reach similarity observed in our study. Overall, this study provides information on large river fish assemblages and patterns of habitat use in a large river system.

Current 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:

- Evaluate the effects of management actions relative to the Craig Mountain Wildlife Management Areas (CMWMA) mitigation goals.
- Evaluate changes in bird communities on CMWMA.
- Develop spatial models to investigate the effects of management actions on wildlife habitat within the 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, two major 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 data to evaluate management actions relative to CMWMA management goals. We began by gathering and evaluating 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 new results suggest that density of Pileated Woodpeckers has remained stable over the past 20 years. Density of the other two focal bird species has also remained relatively constant over the past 20 years. We are currently building predictive habitat models to assess how management actions have changed the quality and quantity of habitat on CMWMA (for each of the three focal bird species) over the past 25 years.

CONSERVATION OF THE NORTHERN IDAHO GROUND SQUIRREL

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



Objectives:

- Evaluate the effectiveness of two forest restoration treatments on survival rates of Northern Idaho Ground Squirrels.
- Determine whether plague caused by the bacterium *Yersinia pestis* is reducing survival of Northern Idaho Ground Squirrels and sympatric species.
- Identify causes for low overwinter survival.

Progress:

Northern Idaho Ground Squirrels (*Urocitellus brunneus*) were listed as threatened under the federal Endangered Species Act in 2000 and as Critically Endangered by the International Union for Conservation of Nature. 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). This project will compare demographic traits between two forest restoration treatments: thinning followed by a fall-season prescribed burn, and control. We will also measure vegetation structure, and body mass, relative abundance, and colony size at our study sites to examine whether these variables are affected by forest restoration treatments. We also have implemented 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 insecticides that control fleas. We have completed our first season of insecticide treatments and the treatments effectively reduced flea loads in Columbian Ground Squirrel (*Urocitellus columbianus*), Northern Idaho Ground Squirrel, and Deer Mouse (*Peromyscus maniculatus*). We will be able to compare annual survival of NIDGS and other rodents between treated and control sites this spring (2015). We have identified flea species collected from ground squirrels and Yellow-Pine Chipmunks (*Tamias amoenus*), from two of our study sites. The most common flea species on Northern Idaho Ground Squirrels and Columbian Ground Squirrels was *Thrassis pandorae*. We documented that the same flea species are shared among Yellow-Pine Chipmunks, Columbian Ground Squirrels, and Northern Idaho Ground Squirrels in our system (and hence fleas can potentially move plague among these species). We are also attaching radio collars on NIDGS to locate their hibernacula so that we can identify the 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 using LIDAR and point-count survey data to model the distribution and relative 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 are currently not available. We plan to create 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 Investigator:

Dave Gotsch

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 different levels of cattle grazing intensity on density and diversity of insects within Sage-Grouse breeding habitat
- Document the effects of different levels 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. We are currently putting radio collars on Sage-Grouse hens at four sites in southern Idaho. We are locating nests of radio-marked hens, at which we are measuring vegetation characteristics and sampling insects, and measuring demographic traits and grazing intensity for 2-3 years. After 2-3 years, we will alter spatial patterns of grazing intensity in some pastures that have Sage-Grouse nests.

ECOLOGICAL DRIVERS OF GEOGRAPHIC VARIATION IN DEMOGRAPHIC TRAITS, REPRODUCTIVE EFFORT, AND LIFE HISTORIES OF BURROWING OWLS

Principal Investigator: Courtney J. Conway
Student Investigator: Carl Lundblad
Funding Agencies: U.S. Department of Defense,
USGS
Completion Date: 15 December 2017



Objectives:

- Examine geographic variation in key demographic and life history traits of Burrowing Owls along a latitudinal gradient spanning from the western U.S. from the Mexican to Canadian borders.
- Gain understanding into how geographic variation in demographic rates drive meta-population dynamics.
- Test multiple hypotheses that have been proposed to explain why Burrowing Owl clutch size is correlated with latitude.

Progress:

Burrowing Owls (*Athene cunicularia*) have declined throughout most of their range over the past 40 years, but the causes for these declines are not known. Our ability to understand range-wide population dynamics would be enhanced by understanding how Burrowing Owl reproductive and demographic parameters vary geographically. Genetic and stable isotope analyses indicate a high degree of dispersal and intermixing of different populations. Therefore, poor reproduction or survival in a portion of the species range may have negatively affect populations throughout their range. Furthermore, Burrowing Owls are declining most steeply in the northern portions of their range despite laying larger clutches in those areas. Explaining this paradox will reveal what aspects of Burrowing Owl fitness drive population trajectories and allow us to develop management strategies to reverse the species' decline. We are examining the comparative demography of burrowing owls at sites in California, Utah, Idaho, Oregon, and working to expand our studies to Nevada and Washington. We have installed 40 new artificial Burrowing Owl nest boxes on Mountain Home AFB in Idaho and are placing infrared video cameras inside owl burrows in each state to monitor reproductive attempts while minimizing disturbance to the owls. We are monitoring nests and uniquely-marking owls to measure differences in return rates and apparent survival.

IDENTIFYING MIGRATORY ROUTES AND WINTERING GROUNDS OF BURROWING OWLS THROUGHOUT WESTERN NORTH AMERICA

Principal Investigator: Courtney J. Conway
Research Scientist: David Johnson, University of Idaho
Student Investigator: Carl Lundblad
Funding Agency: U.S. Department of Defense
Completion Date: 31 May 2016



Objectives:

- Identify wintering areas of migratory Burrowing Owls throughout North America
- Identify migratory timing and migratory routes of Burrowing Owls throughout North America

Progress:

Many migratory populations of Burrowing Owls (*Athene cunicularia*) have declined over the past 40 years, but populations vary widely in their population trajectory over that time span. The causes for these declines, and for the spatial variation in population trend, are not known. Our ability to understand possible causes for these declines would be enhanced if we knew where populations spent their winter months and the migratory routes they followed. We are putting geolocators (light sensors) and satellite transmitters on breeding Burrowing Owls throughout their migratory range in the western U.S. and Canada. We are partnering with colleagues in Canada and in states throughout the western U.S. Along with our partners, we have put geolocators and satellite transmitters on >200 Burrowing Owls in the U.S. and Canada over the past 4 years. We have documented that Burrowing Owls that breed in Oregon, Washington, and British Columbia spend the winter months in Washington, Oregon, Nevada, and California. Owls that breed east of Oregon, Washington, and British Columbia winter in locations throughout central and northern Mexico. When the project is complete, we will produce a map that shows the migratory behavior of Burrowing Owls throughout their entire life cycle in locations throughout their distribution. These data will help determine whether the steepest population declines are associated with owls that winter in certain locations of North America.

DEVELOPMENT OF RANGE-WIDE HABITAT MODELS FOR PREDICTING MARSH BIRD OCCUPANCY IN NORTH AMERICA

Principal Investigator: Courtney J. Conway
Research Scientist: Wes Glisson
Funding Agencies: DoD, USFWS, USGS, Nebraska
Game & Parks Commission
Project Duration: 1 December 2018



Objective:

- Develop models to predict relative habitat suitability for North American marsh birds that allows agencies to identify priority wetlands for management and conservation efforts.

Progress:

Populations of many species of marsh birds have declined in North America. Several species of marsh birds (Virginia Rails, *Rallus limicola*; Sora, *Porzana carolina*; King Rails, *Rallus elegans*; Clapper Rails, *Rallus longirostris*) are game birds in many states and management agencies need estimates of population trends to set harvest limits. Despite the population declines and game bird status, wetlands with emergent marsh vegetation that these birds depend on continues to decline in the U.S. We are using the National Wetland Inventory database and other spatial data layers to generate predictive models of marsh bird habitat suitability throughout the U.S. These models will help land management and resource agencies set priorities for land acquisition and prioritize management actions.



Completed Projects-Wildlife and Terrestrial Resources

EFFECTIVENESS OF PROTECTED AREAS FOR CONSERVING BIODIVERSITY

Principal Investigators: Courtney J. Conway, Jocelyn Aycrigg
Postdoctoral Investigator: L. Lynnette Dornak
Funding Agency: U.S. Geological Survey
Completion Date: 1 April 2014



Objectives:

- Assess whether extent of restrictions on land use is associated with population trends and persistence of breeding bird populations within the continental U.S.
- Identify priority areas of conservation for species of “greatest concern” using spatially-explicit models

Progress:

More than 250 species of birds in the continental U.S. are classified as “species of conservation concern” by one or more organizations. The primary cause of population declines in most species of concern is considered habitat loss. One approach for preventing declines is the establishment of protected areas. But how effective is this approach? We examined whether areas managed specifically for biodiversity do, in fact, benefit the species they were designated to protect. We used population trends from Breeding Bird Survey data overlaid onto maps of protected areas in the U.S. (identified by GAP Protected Areas Database) to evaluate whether protected areas provide buffers against species’ population declines. We have submitted a manuscript based on the results of this analysis.

HABITAT PATCH SIZE AND DETECTION PROBABILITY OF YUMA CLAPPER RAILS

Principal Investigators: Courtney J. Conway
Staff Biologist: Meaghan Conway
Funding Agency: USFWS
Completion Date: August 2014



Objectives:

- Determine the relationship between patch size of emergent marsh vegetation and probability of occupancy by Yuma Clapper Rails.
- Estimate detection probability of Yuma Clapper Rails during the annual range-wide surveys.

Progress:

Yuma Clapper Rails (*Rallus longirostris yumanensis*) have been listed as federally endangered since the advent of the Endangered Species Act. The recovery plan for the Yuma Clapper Rail is currently being revised and the draft revision includes explicit recovery tasks. One of these recovery tasks is the acquisition of information on suitable sizes of habitat patches for clapper rails and the average density of rails in habitat patches of various sizes. Recovery also requires actual estimates of the number of Yuma Clapper Rails present each year, and so we need estimates of detection probability that are based on the survey methods currently used during the annual interagency survey effort. We estimated detection probability by conducting surveys near 11 radio-marked Yuma Clapper Rails. We digitized the size of all patches of emergent marshes throughout the lower Colorado River Valley and examined the influence of patch size on occupancy of clapper rails. We produced a draft final report and have received feedback from our partners on that draft report that we will incorporate.

DEVELOPMENT AND FIELD-TESTING OF SURVEY METHODS FOR A CONTINENTAL MARSH BIRD MONITORING PROGRAM IN NORTH AMERICA

Principal Investigator: Courtney J. Conway
Staff Biologist: Meaghan Conway
Funding Agencies: USFWS, USGS
Completion Date: December 2014



Objective:

- Develop methods, provide support materials and advise, and manage data for a continental survey effort for North American marsh birds that allows agencies to conduct marsh bird surveys in a standard manner that maximizes detection probability so that data can be pooled and compared across socio-political boundaries.

Progress:

Populations of many species of marsh birds are thought to be declining in North America. Several species of marsh birds (Virginia Rails, *Rallus limicola*; Soras, *Porzana carolina*; King Rails, *Rallus elegans*; Clapper Rails, *Rallus longirostris*) are game birds in many states and management agencies need estimates of population trends to set harvest limits. Despite the perceived population declines and game bird status, we currently lack effective monitoring programs to adequately estimate population size or trends (or effects of harvest) of these birds. Developing an effective monitoring protocol and sharing the resultant data among partners is essential to provide rigorous estimates of population change. We developed a monitoring protocol for marsh birds that is suitable for use throughout North America. The development of this survey protocol has led to a dramatic increase in survey data for marsh birds; >200,000 marsh bird point-count surveys have been conducted at hundreds of management areas across North America with data entered into a shared and publicly available database. We have used these data to address a variety of questions regarding optimal survey methodology and effects of management actions. We have also created a website that provides guidance and advice to partners, and have worked closely with USFWS Migratory Bird Office and the USGS Patuxent Wildlife Research Center to produce an online data entry and data retrieval module on the internet that can be used by agencies and organizations across North America.

ECOLOGY AND MANAGEMENT OF COLUMBIAN SHARP-TAILED GROUSE IN IDAHO

Principal Investigator: Kerry P. Reese
Student Investigator: Gifford Gillette
Funding Agency: Idaho Department of Fish and Game
Completion Date: December 2014



Objectives:

- 1) Evaluate aerial infrared (AIR) for conducting Columbian Sharp-tailed Grouse lek counts
- 2) Improve population monitoring of Columbian Sharp-tailed Grouse by conducting a statistical population reconstruction of Rockland and Curlew Valley populations.
- 3) Compare demographic information of Columbian Sharp-tailed Grouse occupying Conservation Reserve Program lands and sagebrush rangelands.
- 4) Obtain unambiguous identification of Columbian Sharp-tailed Grouse nest predators.
- 5) Test the olfactory concealment theory by evaluating wind characteristics using 3-axis sonic anemometers at nest sites of Columbian Sharp-tailed Grouse.

Progress:

The dissertation on ecology and management of Columbian Sharp-tailed Grouse (CSTG; *Tympanuchus phasianellus columbianus*) in southern Idaho was completed by Gifford Gillette during December 2014 and the following conclusions for each objective were made. We compared two count methods: aerial infrared (AIR) counts of CSTG on leks and ground-based lek counts. We did not detect a difference in counts between sampling methods because confidence intervals overlapped zero (-0.14 to 2.14). The cost to conduct AIR counts was twice that of ground counts (on a per lek basis), but AIR allowed us to survey more leks in less time. Hence, we believe AIR has potential as a standard lek count method for CSTG. We used statistical population reconstruction (SPR) to estimate the hunted Idaho population of CSTG during 2000–2013. The estimated abundance for Idaho was stable around 37,000 adults ($\pm 6,400$). Thus, harvest rates of 0.05–0.16 appear appropriate for maintaining populations. SPR is a flexible framework for estimating abundance, but is seldom used by wildlife managers. Workshops, software, or guide books are needed to help managers with model development and mechanics of SPR. We measured CSTG demographic rates in Conservation Reserve Program (CRP) lands from 2011 to 2013 in Idaho. CSTG successfully bred, nested, and reared young in CRP albeit at comparatively lower rates ($\lambda = 0.77 \pm 0.284$) than grouse occupying shrub-steppe ($\lambda = 1.08 \pm 0.316$). CRP aids CSTG conservation in Idaho but population growth in CRP habitats is unlikely. We used videography of CSTG nests to describe nest predators and measured wind characteristics with anemometers at nests to test the olfactory concealment theory. American Badgers (*Taxidea taxus*) and Coyotes (*Canis latrans*) caused 75% of nest failures. Wind characteristics at CSTG nest sites did not support predictions of the olfactory concealment theory.

Awards, Publications, and Service of Unit Scientists and Students 1 January 2014 – 31 December 2014

HONORS AND AWARDS

Marika Dobos

Idaho State Council of Trout Unlimited Graduate Scholarship, 2014
Ted Bjornn Idaho AFS Scholarship, University of Idaho, 2014

Zachary Klein

Best Student Poster Award, Annual Meeting of the Idaho Chapter of the American Fisheries Society, 2014
AFS Sea-Grant Best Student Paper Symposium, Finalist, 144th Annual Meeting of the American Fisheries Society, 2014
Ted Bjornn Idaho AFS Scholarship, University of Idaho, 2014

Carl Lundblad

American Ornithologists' Union 2014 Travel Award
Student Research Award – 2014 Idaho Chapter of The Wildlife Society: Management, Conservation, and Education Grant
University of Arizona 2014 Tuition Scholarship

Elizabeth Ng

Best Student Paper Award, Honorable Mention, Annual Meeting of the American Fisheries Society, 2014
Susan B. Martin Scholarship, Idaho Chapter of the American Fisheries Society (2014)

Michael Quist

Excellence in Science Award, Cooperative Research Units, U.S. Geological Survey, 2014
Outstanding Mentor Award, Idaho Chapter of the American Fisheries Society, 2014

Carson Watkins

Best Student Poster Award, Annual Meeting of the Colorado-Wyoming Chapter of the American Fisheries Society, 2014
Best Student Paper Award, Annual Meeting of the Idaho Chapter of the American Fisheries Society, 2014
Idaho Chapter of the American Fisheries Society Graduate Student Scholarship, 2014

Steven Whitlock

Best Student Paper Award, Honorable Mention, Annual Meeting of the Oregon Chapter of the American Fisheries Society, 2014

PEER-REVIEWED PUBLICATIONS FROM COOP UNIT RESEARCH ACTIVITIES

- Borgmann, K. L., and C. J. Conway. *In press*. Does foliage density near a bird's nest reduce the risk of nest predation? New insights from a comparative analysis. *Wilson Journal of Ornithology*.
- Buelow, J., and C. M. Moffitt. 2015. Physiological indices of seawater readiness in postspawning steelhead kelts. *Ecology of Freshwater Fish* 24:112-122.
- 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. *In press*. Elevational gradient in clutch size of red-faced warblers. *Journal of Field Ornithology*.
- Fischer, J. R., and M. C. Quist. 2014. Gear and seasonal bias associated with abundance and size structure estimates for lentic freshwater fishes. *Journal of Fish and Wildlife Management* 5:394-412.
- Fischer, J. R., and M. C. Quist. 2014. Characterizing lentic freshwater fish assemblages using multiple sampling methods. *Environmental Monitoring and Assessment* 186:4461-4474.
- Glisson, W. J., C. J. Conway, C. P. Nadeau, K. L. Borgmann, and T. A. Laxson. *In press*. Range-wide Wetland Associations of the King Rail: A Multi-scale Approach. *Wetlands*.
- Klein, Z. B., M. C. Quist, D. T. Rhea, and A. C. Senecal. *In press*. Habitat use of non-native burbot in a western river. *Hydrobiologia*.
- Klein, Z. B., M. C. Quist, D. T. Rhea, and A. C. Senecal. *In press*. Sampling techniques for burbot in the Green River, Wyoming. *Fisheries Management and Ecology*.
- Klein, Z. B., M. M. Terrazas, and M. C. Quist. *In press*. Age estimation of burbot using pectoral fin rays, branchiostegal rays, and otoliths. *Intermountain Journal of Science*.
- Lankford, A.J., L.K. Svancara, J.J. Lawler, and K. Vierling. 2014. Comparison of climate change vulnerability assessments for wildlife. *Wildlife Society Bulletin* 38:386-394.
- 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.
- 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. *In press*. Field trials to test the efficacy of elevated pH with NaOH followed by carbonization for ballast treatment. *Management of Biological Invasions*.

- Moffitt, C. M., and L. Cajas-Cano. 2014. Blue Growth: the 2014 FAO State of the World Fisheries and Aquaculture. *Fisheries* 39:552-553.
- Nadeau, C. P., and C. J. Conway. *In press*. Optimizing water depth for wetland-dependent wildlife could increase wetland restoration success, water efficiency, and water security. *Restoration Ecology*.
- Parks, T. P., M. C. Quist, and C. L. Pierce. *In press*. Anthropogenic disturbance and environmental associations with fish assemblages in two nonwadeable rivers. *River Research and Applications*.
- Parks, T. P., M. C. Quist, and C. L. Pierce. 2014. Historic changes in fish assemblage structure in midwestern nonwadeable rivers. *American Midland Naturalist* 171:27-53.
- Penney, Z. L., and C. M. Moffitt. 2014. Fatty acid consumption in white muscle and liver tissue of stream maturing steelhead during early migration and kelt emigration. *Journal of Fish Biology* 86: 105-120
- Penney, Z. L., and C. M. Moffitt. 2014. Proximate composition and energy density of stream maturing adult steelhead during upstream migration, sexual maturity, and kelt emigration. *Transactions of the American Fisheries Society* 143:399-413
- Penney, Z. L., and C. M. Moffitt. 2014. Histological assessment of organs in sexually mature and post-spawning steelhead trout and insights into iteroparity. *Reviews in Fish Biology and Fisheries* 24:781-801.
- Plumb, J. M., and C. M. Moffitt. *In press*. Re-estimating temperature-dependent consumption parameters in bioenergetics models for juvenile Chinook salmon. *Transactions of the American Fisheries Society*.
- Porter, N. J., T. F. Bonvechio, J. L. McCormick, and M. C. Quist. 2014. Population dynamics of bowfin in a south Georgia reservoir: latitudinal comparisons of population structure, growth, and mortality. *Journal of the Southeastern Association of Fish and Wildlife Agencies* 1:103-109.
- Quist, M. C., and R. D. Schultz. 2014. Effects of management legacies on stream fish and benthic aquatic macroinvertebrate assemblages. *Environmental Management* 54:449-464.
- Smith, C. D., J. R. Fischer, and M. C. Quist. 2014. Historical changes in Nebraska's lotic fish assemblages: a spatiotemporal assessment. *American Midland Naturalist* 172:160-184.
- 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*.
- Sullivan, B. L., J. L. Aycrigg, J. H. Barry, R. E. Bonney, N. Bruns, C. B. Cooper, T. Damoulas, A. A. Dhondt, T. Dietterich, A. Farnsworth, D. Fink, J. W. Fitzpatrick, T. Fredericks, J. Gerbracht, C. Gomes, W. M. Hochachka, M. J. Iliff, C. Lagoze, F. A. La Sort, M. Merrifield, W. Morris, T. B. Phillips, M. Reynolds, A. D. Rodewald, K. V. Rosenberg, N. M. Trautmann, A. Wiggins, D. W. Winkler, W. Wong, C. L. Wood, J. Yu, and S. Kelling. 2014. The eBird enterprise: an integrated approach to development and application of citizen science. *Biological Conservation* 169:31-40.
- Trushenski, J. L. Blankenship, J. Bowker, T. Flagg, J. Hesse, K. Leber, K. Lorenzen, D. MacKinlay, D. Maynard, C. Moffitt, V. Mudrak, K. Scribner, S. Stuewe, J. Sweka, G. Whelan & C. Young-Dubovsky. 2014. AFS completes assessment, issues new guidance regarding hatchery operation and the use of hatchery-origin fish. *Fisheries* 39:543-547.

- Walrath, J. D., M. C. Quist, and J. A. Firehammer. *In press*. Population structure and dynamics of northern pike and smallmouth bass in Coeur d'Alene Lake, Idaho. *Northwest Science*.
- Walrath, J. D., M. C. Quist, and J. A. Firehammer. 2015. Trophic ecology of nonnative northern pike and their effect on conservation of naïve westslope cutthroat trout. *North American Journal of Fisheries Management* 35:158-177.
- Watkins, C. J., Z. B. Klein, M. M. Terrazas, and M. C. Quist. *In press*. Influence of sectioning location on age estimates from common carp dorsal spines. *North American Journal of Fisheries Management*.
- Watkins, C. J., T. J. Ross, R. S. Hardy, and M. C. Quist. *In press*. Precision of hard structures used to estimate age of mountain whitefish. *Western North American Naturalist*.
- Whitlock, S. L., M. C. Quist, and A. M. Dux. *In press*. Incubation success and habitat selection of shore-spawning kokanee *Oncorhynchus nerka*: effects of water level regulation and habitat characteristics. *Ecology of Freshwater Fish*.
- Whitlock, S. L., M. C. Quist, and A. M. Dux. 2014. Influence of habitat characteristics on shore-spawning kokanee. *Transactions of the American Fisheries Society* 143:1404-1418.

BOOKS AND BOOK CHAPTERS

- Borgmann, K. L., and C. J. Conway. *In press*. Wildlife habitat restoration. Pages xx-xx in *Wildlife habitat conservation: concepts, challenges, and solutions*. (M. L. Morrison and H. A. Mathewson, eds.). John Hopkins University Press, Baltimore, Maryland.
- 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., Z. L. Penney, and L. Cajas Cano. 2014. Reconnecting people to their natural environment. Pages 185-192 in W. Taylor and A. Lynch, editors. *The future of fisheries: perspectives for the next generation of professionals*. American Fisheries Society. Bethesda, MD.
- Moffitt, C. M., A. Barenberg, K. A. Stockton, and B. J. Watten. *In press*. Efficacy of two approaches for disinfecting surfaces and water infested with quagga mussel veligers. Chapter 20 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

- Dillon, K.G., and C.J. Conway. 2014. Using LiDAR to map the distribution and abundance of the Red-faced Warbler. Arizona Game and Fish Department Report.
- North American Bird Conservation Initiative, U.S. Committee, 2014. The state of the birds 2014. U.S. Department of Interior: Washington, D.C. 16 pages. (J. Aycrigg was a member of Science Team that wrote this report).

THESES AND DISSERTATIONS

- Garcia, M. G. 2014. Why is the Burrowing Owl breeding range contracting? M.S. Thesis, University of Arizona.
- Gillette, G. 2014. Ecology and management of Columbian Sharp-tailed Grouse in southern Idaho: evaluating infrared technology, the Conservation Reserve Program, statistical population reconstruction, and the olfactory concealment theory. Ph.D. Dissertation, University of Idaho.
- Lundblad, C. G. 2014. Altitudinal migration in birds: tests of four mechanistic hypotheses in Yellow-eyed Juncos (*Junco phaeonotus*). M.S. Thesis, University of Arizona.
- Watkins, C. J. 2014. Effects of habitat rehabilitation activities on fish assemblages and populations in the Kootenai River, Idaho. 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. 2014. Symposium at the Cornell Lab of Ornithology on Meeting Big Data Challenges in Biodiversity Research: Data collection, processing, analysis, and application. "Exploring GIS applications in biodiversity research", Ithaca, NY.
- Aycrigg, J. L. 2014. Palouse Audubon Society. "Assessing the value of private lands and waters to U.S. birds: The State of the Birds Report 2013", Moscow, Idaho.
- Aycrigg, J. L. 2014. Overview of the State of the Birds Reports 2009-2014. Symposium on: 'Conservation in the big picture.' International Association of Landscape Ecology, Anchorage, AK.
- Cajas Cano, L. 2014. Lead planner for Central American Youth Ambassador Program (CAYA) funded through Center for Intercultural Education and Development, Georgetown University, International Programs Office, University of Idaho. Workshops held at the University of Idaho March, and October.
- Conway, C. J. 2014. Continental Patterns in Demography and Migration of Burrowing Owls in North America. University of Idaho's Student Chapter of The Wildlife Society, Moscow, ID. 26 Feb 2014. INVITED.
- Conway, C.J. 2014. Invited Panelist for special symposium titled Working Together: Understanding and Leveraging Gender Differences in the Wildlife Profession. Joint Annual Meeting of the Idaho Chapter of The Wildlife Society and the Northwest Section of The Wildlife Society, Boise, ID. 6 March 2014. INVITED. Panel Speaker.
- Conway, C.J. 2014. Latitudinal Gradients in Population Trends and Demographic Traits of Burrowing Owls: Causes and Consequences. 4th International Burrowing Owl Symposium, Pasco, WA. 4 Feb 2014. INVITED.
- Conway, C.J., and A. Macías-Duarte. 2014. Continental Patterns in Migration and Dispersal of Burrowing Owls based on Genetics and Stable Isotopes. 4th International Burrowing Owl Symposium, Pasco, WA. 4 Feb 2014. INVITED.
- Conway, C. J. Invited Panelist for Early Professionals Symposium, organized by the Early Professionals Committee of the AOU. AOU/COS/SCO-SOC Joint Annual Meeting, Estes Park, CO. 24 September 2014. INVITED.

- Conway, C. J., W. Glisson, K. Borgmann, J. Aycrigg, and T. Laxson. 2014. Using GAP data to predict range-wide habitat suitability and assess threats to the long-term persistence of marsh birds. USGS GAP Partnership Projects webinar. 18 Dec 2014. INVITED.
- Conway, C. J., and K. Launchbaugh. 2014. How does spring livestock grazing influence sage-grouse populations? Idaho Sage-grouse Advisory Committee Meeting, Boise, ID. 28 May 2014. INVITED.
- Davidson, A., T. Laxson, J. Aycrigg, L. Duarte, and L. Dunn. 2014. The ecological and social characteristics of the National Wilderness Preservation Systems (NWPS). ESRI User's conference, San Diego, CA.
- Dillon, K., and C. J. Conway. 2014. Why elevation matters: Intraspecific variation in life history strategies. Special Symposium on Alpine Ornithology: ecological adaptations and challenges for birds breeding in mountain ecosystems. AOU/COS/SCO-SOC Joint Annual Meeting, Estes Park, CO. 24 September 2014. INVITED.
- Dobos, M. E., M. C. Quist, and M. P. Corsi. 2014. Movement patterns and habitat use of westslope cutthroat trout in the South Fork Clearwater River basin. Wild Trout XI Symposium, West Yellowstone, Montana, September 24. POSTER
- Dobos, M. E., M. C. Quist, and M. P. Corsi. 2014. Movement patterns 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, Idaho Falls, Idaho, February 12. PLATFORM
- Dornak, L.L., C. J. Conway, and J. Aycrigg. 2014. Are protected areas in the U.S. enough to conserve biodiversity? Special Symposium titled Conservation in the big picture: data and analysis to inform the future. Annual Conference of the International Association of Landscape Ecology. Anchorage, AK. 20 May 2014. INVITED.
- Garcia, M.G., and C. J. Conway. 2014. Why have Burrowing Owls Disappeared from Portions of their Former Breeding Range? 4th International Burrowing Owl Symposium, Pasco, WA. 4 Feb 2014.
- Gillette, G.L., K.P. Reese, J.W. Connelly, and J.M. Knetter. Estimated abundance of the hunted population of Columbian sharp-tailed grouse in Idaho derived from population reconstruction. 29th Western Agencies Sage and Columbian Sharp-tailed Grouse Workshop, June 17-19, 2014, Elko, Nevada, USA.
- Gillette, G.L. Using aerial infrared to conduct prairie grouse lek counts. University of Idaho Innovation Showcase, April 16, 2014, Moscow, Idaho, USA.
- Gillette, G.L., K.P. Reese, J.W. Connelly, and J.M. Knetter. The effects of landscape characteristics on the population dynamics of Columbian sharp-tailed grouse. Idaho Chapter of the Wildlife Society, March 5, 2014, Boise, Idaho, USA.
- Goldberg, A. R., C. J. Conway, and D. Evans Mack. 2014. Why are Northern Idaho Ground Squirrels so Rare? Joint Annual Meeting of the Idaho Chapter of The Wildlife Society and the Northwest Section of The Wildlife Society, Boise, ID. 4 March 2014.
- Gotthardt, T., J. Lonneker, A. Davidson, S. Pyare, F. Huettmann, and J. L. Aycrigg. 2014. Identifying conservation priorities in Alaska. Symposium on: 'Conservation in the big picture.' International Association of Landscape Ecology, Anchorage, AK.
- Hilty, J., C. Groves, J. M. Scott, and J. L. Aycrigg. 2014. The United States needs a comprehensive vision for conserving its natural heritage. North American Congress for Conservation Biology, Missoula, MT.

- Johnson, D. H., C. J. Conway, T. I. Wellicome, M. Gregg, and J. L. Conley. 2014. Use of Solar-powered Satellite Transmitters in Assessing Migration Patterns of Burrowing Owls in Western North America. International User Conference on ARGOS Wildlife Applications. Baltimore, MD. 19 Nov 2014.
- Johnson, D.H., T.I. Wellicome, C. J. Conway, J. Rebolz, M. Livingston, H. Newsome, and J. Fox. 2014. Use of Geolocators in Assessing Migration Patterns of Western Burrowing Owls in Oregon, Washington, and Saskatchewan. 4th International Burrowing Owl Symposium, Pasco, WA. 4 Feb 2014.
- Klein, Z. B., M. C. Quist, D. T. Rhea, and A. C. Senecal. 2014. Sampling techniques for burbot *Lota lota* in the Green River, Wyoming. 144th Annual Meeting of the American Fisheries Society, Québec City, Québec, August 19. PLATFORM
- Klein, Z. B., M. C. Quist, D. T. Rhea, and A. C. Senecal. 2014. Population characteristics of non-native burbot in the Green River, Wyoming. 144th Annual Meeting of the American Fisheries Society, Québec City, Québec, August 19. POSTER
- Klein, Z. B., M. C. Quist, D. T. Rhea, and A. C. Senecal. 2014. Sampling techniques for burbot *Lota lota* in the Green River, Wyoming. Annual Meeting of the Colorado-Wyoming Chapter of the American Fisheries Society, Laramie, Wyoming, March 4. PLATFORM
- Klein, Z. B., M. C. Quist, D. T. Rhea, and A. C. Senecal. 2014. Sampling techniques for burbot *Lota lota* in the Green River, Wyoming. Annual Meeting of the Idaho Chapter of the American Fisheries Society, Idaho Falls, Idaho, February 12. PLATFORM
- Kreitler, J., T. Wilson, J. Aycrigg, T. Laxson, and B. Sleeter. 2014. Coupled climate and land-use change effects on GAP modeled species: A draft framework for national cumulative impacts and case study of the Pacific Northwest. Symposium on: 'Conservation in the big picture.' International Association of Landscape Ecology, Anchorage, AK.
- Lonneker, J, T. Laxson, T. D. Rich, and J. L. Aycrigg. 2014. Assessing representation of bird species and ecological systems within the National Wildlife Refuge System. Symposium on: 'Conservation in the big picture.' International Association of Landscape Ecology, Anchorage, AK.
- Lundblad, C. G., and C. J. Conway. 2014. Why do some but not all birds migrate? Tests of mechanistic hypotheses in yellow-eyed juncos. AOU/COS/SCO-SOC Joint Annual Meeting, Estes Park, CO. 24 September 2014.
- Lundblad, C. G., and C.J. Conway. 2014. Why do Life Histories Vary Geographically? Novel Approaches to Unresolved Questions. Fish and Wildlife Sciences Departmental seminar, University of Idaho. 12 Nov 2014.
- Mackey, A., T. Prather, J. Wallace, G. Shewmaker, and C. J. Conway. 2014. Developing an integrated pest management strategy for controlling *Ventenata* (*Ventenata dubia*) in Conservation Reserve Program lands in the Palouse. Joint Annual Meeting of the Idaho Chapter of The Wildlife Society and the Northwest Section of The Wildlife Society, Boise, ID. 5 March 2014.
- Mackey, A., T. Prather, C. J. Conway, J. Wallace, G. Shewmaker, and J. Johnson. 2014. Effects of *Ventenata* (*Ventenata dubia*) infestation on nesting success of tree swallows (*Tachycineta bicolor*) within CRP fields of the Palouse. Joint Annual Meeting of the Idaho Chapter of The Wildlife Society and the Northwest Section of The Wildlife Society, Boise, ID. 4 March 2014.

- McKerrow, A., A. Davidson, and T. Earnhardt. 2014. Integrating Recent Land Cover Mapping Efforts to Update the National Gap Analysis Program's Species Habitat Map. PECORA 19, Denver, CO.
- Moffitt, C. M., B. Watten, A. Barenberg, and J. Henquinet. 2014. Hydroxide stabilization as a new tool for ballast disinfection: efficacy of treatment on zooplankton. Columbia River Basin Team, 100th Meridian. Heathman Lodge, Vancouver, Washington. 1-2 October, 2014 (invited)
- Moffitt, C. M. 2014. Reconnecting People to Their Natural Environment. American Fisheries Society Annual Meeting, Quebec City, Québec, August. (invited)
- Moffitt, C. M. 2014. Plenary and Business Award Ceremonies for Annual Meeting of the American Fisheries Society. Quebec City, Québec, August. (invited)
- Moffitt, C. M., B. Watten, A. Barenberg, and J. Henquinet. 2014. Hydroxide stabilization as a new tool for ballast disinfection: efficacy of treatment on zooplankton. Upper Midwest Invasive Species conference, Duluth MN. 20-22 October (contributed poster).
- Moffitt, C. M. 2014. Elevated pH: An effective, economical and safe tool to control release of invasive species. American Fisheries Society Annual Meeting, Quebec City, Québec. August.
- Moffitt, C. M., Z. L. Penney, J. Buelow, B. Jones, and B. Marston. 2014. Energetics and physiology of Columbia/Snake Steelhead. Pacific Coast Steelhead Management Meeting, Skamania Lodge, Washington. March (Invited).
- Ng, E. L., M. C. Quist, and J. P. Fredericks. 2014. Estimation of gill-net selectivity for lake trout and application to demographic parameter estimates. 144th Annual Meeting of the American Fisheries Society, Québec City, Québec, August 18. PLATFORM
- Ng, E. L., M. C. Quist, and J. P. Fredericks. 2014. Population dynamics of lake trout in Priest Lake, Idaho. 144th Annual Meeting of the American Fisheries Society, Québec City, Québec, August 19. POSTER
- Ng, E. L., M. C. Quist, and J. Fredericks. 2014. Estimation of gear selectivity for lake trout in Priest Lake, Idaho. Annual Meeting of the Idaho Chapter of the American Fisheries Society, Idaho Falls, Idaho, February 12. PLATFORM
- Rankin, E., B. Guzman, A. Barenberg, E. Braker, and C. M. Moffitt. Population Density and Management of Invasive Asian Clams in Lake Pend Oreille. Mc Call Outdoor Science Center, upward bound workshop, July.
- Smith, C. D., M. C. Quist, and R. S. Hardy. 2014. Fish assemblage and population relationships with habitat in the Kootenai River, Idaho. Annual Meeting of the Idaho Chapter of the American Fisheries Society, Idaho Falls, Idaho, February 12. PLATFORM
- Smith, C. D., M. C. Quist, and R. S. Hardy. 2014. Comparison of sampling techniques for fish assemblages in western rivers. Annual Meeting of the Idaho Chapter of the American Fisheries Society, Idaho Falls, Idaho, February 12. PLATFORM
- Swearingen, Z., C. J. Conway, and P. Zager. 2014. Are Target Species Benefiting from Management Actions on Craig Mountain Wildlife Management Area? 2014 In-Service Training School meeting, Boise State University, Boise, ID. 21 May 2014.
- Swearingen, Z., C. J. Conway, and P. Zager. 2014. Are Target Species Benefiting from Management Actions on Craig Mountain Wildlife Management Area? Annual Meeting for the Coordination of the Craig Mountain Area, Lewiston, ID. 25 March 2014.

- Swearingen, Z., C. J. Conway, F. Cassirer, and P. Zager. 2014. Declines in counts of Pileated Woodpeckers on Craig Mountain WMA: declines in abundance or detection probability? Joint Annual Meeting of the Idaho Chapter of The Wildlife Society and the Northwest Section of The Wildlife Society, Boise, ID. 4 March 2014.
- Terrazas, M. M., Z. B. Klein, and M. C. Quist. 2014. Precision of hard structure for estimating the age of burbot. 144th Annual Meeting of the American Fisheries Society, Québec City, Québec, August 19. POSTER
- Walrath, J. D., M. C. Quist, and J. A. Firehammer. 2014. Trophic ecology of northern pike and their effect on conservation of westslope cutthroat trout. Annual Meeting of the Idaho Chapter of the American Fisheries Society, Idaho Falls, Idaho, February 12. PLATFORM
- Watkins, C. J., M. C. Quist, and R. S. Hardy. 2014. Population dynamics of largescale suckers in the Kootenai River, Idaho: effects of nutrient enhancement on growth. 144th Annual Meeting of the American Fisheries Society, Québec City, Québec, August 20. PLATFORM
- Watkins, C. J., Z. B. Klein, M. M. Terrazas, and M. C. Quist. 2014. Standardized removal and sectioning locations for common carp dorsal spines. Annual Meeting of the Colorado-Wyoming Chapter of the American Fisheries Society, Laramie, Wyoming, March 4. POSTER
- Watkins, C. J., Z. B. Klein, M. M. Terrazas, and M. C. Quist. 2014. Standardized removal and sectioning locations for common carp dorsal spines. Annual Meeting of the Idaho Chapter of the American Fisheries Society, Idaho Falls, Idaho, February 12. POSTER
- Watkins, C. J., M. C. Quist, B. B. Shepard, and S. C. Ireland. 2014. Modeling fish assemblage structure and habitat use to guide rehabilitation activities in the Kootenai River, Idaho. Annual Meeting of the Idaho Chapter of the American Fisheries Society, Idaho Falls, Idaho, February 12. PLATFORM
- Watkins, C. J., M. C. Quist, and R. S. Hardy. 2014. Population dynamics of largescale suckers in the Kootenai River, Idaho: effects of discharge and nutrient enhancement on growth and recruitment. Annual Meeting of the Idaho Chapter of the American Fisheries Society, Idaho Falls, Idaho, February 12. PLATFORM
- Watkins, C. J., M. C. Quist., B. S. Shepard, and S. Ireland. 2014. Patterns of fish assemblage structure and habitat use among main-and off-channel habitats in the lower Kootenai River, Idaho. International Kootenai River Ecosystem Restoration Meeting, Bonners Ferry, Idaho, May 9. PLATFORM
- Watkins, C. J., M. C. Quist, T. J. Ross, and R. S. Hardy. 2014. Effects of nutrient enrichment, discharge, and temperature on growth and recruitment of largescale suckers in the Kootenai River, Idaho, May 9. PLATFORM
- Whitlock, S. L., M. C. Quist, and A. M. Dux. 2014. Measuring the effects of water level management on kokanee in Lake Pen Oreille, Idaho using a bootstrap stock-recruitment model. Annual Meeting of the Oregon Chapter of the American Fisheries Society, Eugene, Oregon, February 23. PLATFORM
- Whitlock, S. L., M. C. Quist, and A. M. Dux. 2014. Effects of water level regulation and habitat characteristics on shore-spawning kokanee incubation success and habitat selection. Annual Meeting of the Idaho Chapter of the American Fisheries Society, Idaho Falls, Idaho, February 12. PLATFORM

TECHNICAL ASSISTANCE, OUTREACH, AND SERVICE

Courtney J. Conway

- Associate Editor, *Wetlands*. 2011-2014.
- 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.
- Masked Bobwhite Recovery Team, 2008-2014.
- Evaluator for student presentations at the 2014 annual conference of The Wildlife Society.
- Mentor for the Student-Professional Mixer at the 2014 joint annual conference of the American Ornithologists' Union and the Cooper Ornithological Society, Estes Park, CO.
- Mentor for the Early Professionals Symposium at the 2014 joint annual conference of the American Ornithologists' Union and the Cooper Ornithological Society, Estes Park, CO.
- Judge for student presentation awards at the 2014 joint annual conference of the American Ornithologists' Union and the Cooper Ornithological Society, Estes Park, CO.
- Chair of Search Committee, Population Ecologist, Department of Fish and Wildlife Sciences, University of Idaho. 2013-2014.
- Taught *Conceptual Foundations in Ecology* (WLF 504), 3 cr., Spring 2014.
- Taught *Fish and Wildlife Graduate Seminar* (WLF 501), 1 cr., Fall 2014.
- Culture and Climate Committee, Department of Fish and Wildlife Sciences. 2014-present.
- CNR college representative on University of Idaho Graduate Council, 2013-present.

Christine M. Moffitt

- Associate Editor, *Transactions of the American Fisheries Society*. 2005 – present.
- Chair, American Fisheries Society Award of Excellence Committee. 2013-2014.
- Advisor, Palouse Unit of Idaho Chapter, American Fisheries Society.
- Member, AFS Steering Committee for Symposium on Use of Hatchery Fish in Aquaculture, Representing Fish Health Section. 2011-2014
- Reviewer for Department of Agriculture CREES, Small Business Investment in Research (SBIR) Phase I grants – Aquaculture. 2014.
- Bi-national Agricultural Research and Development Fund proposals. 2011-2014.
- Member at large, the Western Regional Panel on Aquatic Nuisance Species. 2014-2016.
- Member, 100th Meridian Initiative - Columbia River Basin Team Participant
- Idaho Invasive Species Council, Aquatic Invasive Species
- Peer reviewer following journals: *Aquaculture*; *Environmental Toxicology and Chemistry*, *Northwest Science*; *Aquatic Invasions*; *North American Journal of Aquaculture*; *Environmental Management*. *Fisheries*, *Aquaculture*, *Environmental Science and Pollution Research*.
- UI Committee for design & engineering of Aquaculture Research relocation. 2014
- CNR Promotion Committee. September - December 2014

UI Search Committee, Fish Physiology. July - present

UI Laboratory Support Committee. July - present

Taught *Fish Physiology* (FISH 501), 2 cr., Fall 2014.

Mentored Undergraduate Research Interns:

CRISSP, REU student. Jordan Rutland, Paine College, Augusta, GA.

Doris Duke Conservation Scholars, Bethany Guzman and Emily Rankin

Developed training with guidance document for fish hatcheries to assess risk, and prevent, control or eradicate infestations of the New Zealand mudsnails and other invasive mollusks. Workshop presented for Washington Public Utility District biologists, Wenatchee, WA. 5 March.

Training with guidance document for fish hatcheries to assess risk, and prevent, control or eradicate infestations of the New Zealand mudsnails and other invasive mollusks. Workshop presented for Washington Department of Fish and Wildlife, Colville Tribe, Okanagan Nation Biologists, Okanagan County Invasive Species Specialists, Washington Public Utility District Biologists, Oroville, WA. 4 March.

Training with guidance document for fish hatcheries to assess risk, and prevent, control or eradicate infestations of the New Zealand mudsnails and other invasive mollusks. Workshop presented for Washington Public Utility District biologists, Wenatchee, WA. 5 March.

Interactive workshop with Universidad Católica de Temuco, Chile. Presentation of program, tours of facilities and collaborative opportunities. July 2014.

Asian clam infestation in Lake Pend Oreille and Lake Tahoe. Special citizens meeting, Panida Theater, Sandpoint, ID. June.

Michael C. Quist

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

Education Section of the American Fisheries Society, Immediate Past-President. 2012-present

Search Committee, Department Head, Department of Fish and Wildlife Sciences, University of Idaho. 2013-2014

Taught *Fish and Wildlife Seminar* (FISH 501)

Taught *Advanced Fisheries Techniques*

Undergraduate research mentor for two students:

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

Jeffrey Johnson. 2013-2014. Food habits and prey selection of juvenile burbot.

Delivered workshop on "Age and growth of fishes" to Idaho Department of Fish and Game, Biologist Training, Boise, Idaho. 2014

Kootenai River Technical Advisory Committee. 2012-present