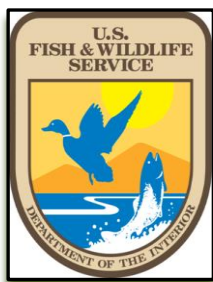


# **Report to Cooperators**

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



**1 January 2013 to 31 December 2013**



University of Idaho



Preparing for ballast trials at Houghton MI, on the Ranger III



Marika Dobos with cutthroat trout, South Fork Clearwater River

Cover Photos: Left: Kelly Stockton Presenting at Western Division AFS meeting April 2013  
Right: Zach Klein with burbot, trapped in Wyoming.

**REPORT TO COOPERATORS**  
**1 January 2013 — 31 December 2013**

**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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# Introduction

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## **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 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.





**Courtney J. Conway** – Unit Leader and Associate Professor of Wildlife Resources. Recent research has focused on: 1) the ecology, habitat requirements, and survey methods for marsh birds; 2) the causes of migratory behavior of burrowing owls throughout North America; 3) 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 Assistant 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 provides administrative support for research and cooperative agreements for federal and state contracts. Candy formerly worked in the budget office in CNR and assists with budgets, proposals, and billing for contracts that run through the Unit's cooperative agreement.



## **Federally Funded Scientists and University Administrative Staff Contact Information**

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Robyn Thorson, Regional Director  
Richard Hannan, Deputy Regional Director  
Stephen Zylstra, Assistant Regional  
Director, Science Applications  
Pacific Region

#### **WILDLIFE MANAGEMENT INSTITUTE**

Chris Smith  
Western Field Representative  
Wildlife Management Institute  
5450 Tumbleweed Dr.  
Helena, MT 59602

## **Fish and Wildlife Departmental Administrative Staff**

Linda Kisha, Administrative Assistant II

## **Department of Fish and Wildlife Faculty, and other Faculty Cooperators with Unit Projects in 2013**

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Christopher Caudill, Research Assistant Professor

Brian Kennedy, Associate Professor

Beth Newingham, Assistant Professor

Kerry Reese, Professor and Department Head

Kerri Vierling, Associate Professor

Frank Wilhelm, Associate Professor



## Graduate Students on Coop Unit Projects 2013

\* indicates completed

| Student             | Discipline                   | Adviser                |
|---------------------|------------------------------|------------------------|
| Amber Barenberg     | M.S. Fishery Resources       | C. M. Moffitt          |
| Elizabeth Braker    | M.S. Environmental Science   | C. M. Moffitt          |
| *Samuel Bourret     | M.S. Fishery Resources       | B. Kennedy, C. Caudill |
| 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 Resources      | C. Conway              |
| Trisha Giambra      | M.S. Environmental Science   | C. M. Moffitt          |
| Gifford Gillette    | Ph.D. Natural Resources      | K. P. Reese            |
| Amanda Goldberg     | Ph.D. Natural Resources      | C. Conway              |
| David Gotsch        | M.S. Wildlife Resources      | C. Conway              |
| Joseph Holbrook     | Ph.D. Natural Resources      | K. Vierling            |
| Zach Klein          | M.S. Fishery Resources       | M. Quist               |
| Amber Lankford      | M.S. Wildlife Resources      | K. Reese, K. Vierling  |
| Carl Lundblad       | Ph.D. Natural Resources      | C. Conway              |
| Elizabeth Ng        | M.S. Fishery Resources       | M. Quist               |
| Bryce Oldemeyer     | M.S. Fishery Resources       | M. Quist               |
| Brittany Oleson     | M.S. Wildlife Resources      | C. Conway              |
| *Zachary Penney     | Ph.D. Natural Resources      | C. M. Moffitt          |
| Elliott Reams       | Ph.D. Fishery Resources      | F. Wilhelm             |
| *Chris Smith        | M.S. Fishery Resources       | M. Quist               |
| *Elise Suronen      | M.S. Restoration Ecology     | B. Newingham           |
| Zach Swearingen     | M.S. Wildlife Resources      | C. Conway              |
| *John Walrath       | M.S. Fishery Resources       | M. Quist               |
| Carson Watkins      | M.S. Fishery Resources       | M. Quist               |
| *Steven Whitlock    | M.S. Fishery Resources       | M. Quist               |



MS Student John Walrath receives AFS Scholarship at Western Division meeting Boise 2013.

## **Current Projects-Fisheries and Aquatic Resources**

### **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: 31 March 2015



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#### **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 of juvenile Chinook Salmon in Big Creek, Idaho
- Quantify the effect that over winter location has on juvenile Chinook Salmon size during spring migration and survival through the hydroelectric system.

#### **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 RST operated by various federal, state, and tribal agencies targeted at capturing emigrating salmonid in order to obtain abundance estimates. 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 RSTs aren’t able to operate or have low recapture efficiencies and juvenile salmonid are migrating. The goal of this project is to compare various analytical mark-recapture techniques to explore which analysis produces the most accurate juvenile abundance estimates, particularly during periods of low recapture efficiencies. The project will compare smolt estimates calculated from Bailey’s modified Lincoln-Peterson models with various time stratifications against a hierarchical Bayesian model and a hierarchical Bayesian model with p-splines. Once new juvenile chinook population estimates have been calculated, an additional analysis will be performed looking at the effects that juvenile Chinook density has on Chinook migration timing, over-winter location, and growth rates in Big Creek, ID.

## 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 2014

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### 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 some reports. However, there is a need for a more detailed analysis on the data that has been collected. Specifically, there is a need to compare the MIS data to management actions that may have influenced bull trout populations across the Forest. In the last several years, culvert replacements have been a primary focus of the Forest and several culvert replacements/removals have occurred. Evaluating the MIS data in relation to culvert migration barriers and replacements/removals, water temperature and invasive species, particularly brook trout, would provide the Forest with an overall picture of the current fisheries situation. Some questions that are important to fisheries managers are: Have culvert replacements/removals affected bull trout populations? Are there adequate water temperatures to provide bull trout habitat across the Forest? How do invasive species affect bull trout populations? Can we make any conclusions about trend 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.

## **LIFE CYCLE ASSESSMENT AND ECOSYSTEM SERVICES FRAMEWORK FOR SUSTAINABLE AQUACULTURE PRODUCTION**

Major Professor: Christine M. Moffitt  
Student Investigator: Lubia Cajas Cano  
Funding Agency: U of Idaho Multicultural  
Scholarship  
and International Programs Office  
Completion Date: 30 August 2014

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### **Objectives:**

- Create a Life Cycle Assessment 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 a 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, and provide socioeconomic resources including a nutritious end product. We are evaluating environmental and socioeconomic factors involved in marine mussel production systems in Washington State with a life cycle assessment (LCA). Our LCA model estimated water, energy, and carbon footprints of the production, and relevant socioeconomic inputs and outputs associated with the production system. 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 input-output model evaluated economic contributions of mussel production into other industries within the US (such as agriculture, transportation, manufacturing, mining, utilities, etc). Our results illustrate for regulators and policymakers the benefits of using LCA models with both environmental and socioeconomic factors in evaluations of resource sustainability. 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 as secondary species can use wastes and nutrients released from the target product production. 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. The Life Cycle Assessment (LCA) model framework evaluates water, energy, and socioeconomic inputs and outputs associated with the production system. These tools can illustrate to regulators and policymakers the benefits of including LCA models and basic factors from socioeconomic and environmental factors to better understand and evaluate production systems for sustainability.



## HELPING AGENCIES WITH AQUATIC INVASIVE SPECIES CONTROL - NZMS

Principal Investigator: Christine M. Moffitt  
Graduate Student: Amber Barenberg  
Funding Agency: Utah Division of Wildlife Resources  
Completion Date: 31 May 2014

---



### Objective:

- Increase communication and provide support to students and research studies at the University of Idaho that will increase the information on control measures that can be used for NZMS and other invasive mollusk species of concern to Utah and the region.

### Progress:

The Utah Division of Wildlife Resources provided support for the research in our laboratory to increase the interaction of their staff with the Moffitt laboratory to allow for identification of tools to improve in the control of invasive species, especially at fish hatcheries. Since this contract was provided Utah Division of Wildlife promoted former Moffitt MS student Jordan Nielson to lead the agency efforts on aquatic invasive species. We are providing information from all our research tools to Utah in advance of publication for increased benefit. They are also sharing results of their trials for use in data summaries by Moffitt as we develop control measures.

## 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  
Graduate Student: Amber Barenberg  
Undergraduate Student: Colin Heath  
Funding Agency: US Fish and Wildlife Service  
Completion Date: 31 December 2014

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### 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 FWS for their use as a resource.

### Progress:

This contract began in the fall of 2013 to provide Moffitt additional resources to improve a draft document prepared in collaboration with MS student K. Stockton. The working draft has been tested in workshops held recently in Washington State with Tribal, agency and PUD biologists. We plan further evaluation of the tool at Idaho hatcheries and elsewhere. The final product will assist the US Fish and Wildlife Service and others with conservation hatchery production in assessing risks and preventing the spread of NZMS and other invasive mollusks.



## **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:          | Amber Barenberg                            |
| USFWS Project Officer      | Bob Kibbler                                |
| Undergraduate Students:    | Colin Heath<br>Daniel Olsen                |
| Funding Agency:            | USGS/USFW SSP project 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 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 impact of application of impermeable benthic barriers on non-target organisms and rate of recovery post barrier removal.
- Compare risks, costs, and effectiveness of impermeable benthic barriers compared to 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 eradicate these organisms. Although Asian clams are known to occur in riverine and reservoir reaches of the Snake/Columbia River basin, none are known in Lake Pend Oreille Lake or anywhere in Montana. The clams have the ability to filter large quantities of water, removing nutrients that are released as pseudo feces on the lake bottom. These feces effectively fertilize the benthos and promote algal blooms that can affect invertebrate benthic diversity. An infestation of Asian clams that was ignored for a time in Lake Tahoe has resulted in impacts to the lake benthic environment and esthetics, resulting in an expensive control program that employs non-permeable benthic barriers to suffocate the beds of clams. The opportunity for a more rapid control or eradication effort in Idaho would result in cost savings, and secure the ecosystem from alterations from such infestations. The Lake Tahoe Regional Planning Agency recommended that Idaho consider the use of benthic barriers to control or eradicate the Lake Pend Oreille infestation. The SSP project will provide the opportunity to test these measures in Idaho, and report on the efficacy and considerations of this tool to control infestations. Due to Federal sequestration and delays in funding, this project began the late fall of 2013. Using shoreline surveys, we evaluated several locations around boat launches for evidence of Asian clams. Efforts conducted so far have supported that the infestation appears localized in the area of Ellisport Bay. Samples of benthos were collected in November, and clams enumerated and measured. From the size of organisms, the infestation appears to have been established for at least 3 years. A more extensive survey is planned for April 2014, and then the team will

develop plans for application of barriers and evaluation of benthic organisms and characteristics.

## **EFFECTS OF CHANGES IN DISTURBANCE REGIMES ON ANIMAL COMMUNITIES**

|                           |                                   |
|---------------------------|-----------------------------------|
| Principle Investigators:  | Courtney Conway and C. M. Moffitt |
| Co-Investigator:          | Kerri Vierling                    |
| Funding Agency:           | USGS, RWO 160                     |
| Completion:               | December 2019                     |
| Graduate Students:        | Elizabeth Braker; Joe Holbrook    |
| Undergraduate assistants: | To be chosen                      |



---

### **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 areas. 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. Such changes can include increasing of the frequency of fire, draught or hydrological extremes. The introduction of non-native species into an ecosystem can alter the dynamics of energy transfer and organization of food webs. These changes can adversely affect native species via disease, competition, or other resource limitations. Our ability to conserve species and to maintain species diversity is limited by our understanding of the effects of altered disturbance regimes. Moreover we have little information on the effectiveness of potential mitigation strategies to help animals or communities withstand the altered environmental conditions following disturbance. This project will support graduate students to address one or more of the objectives. The focus for 2014 is in the sagebrush steppe of the birds of prey area in Idaho, and Lake Pend Oreille, and other northern Idaho lake systems. The graduate students on this project will be assisted by undergraduate students that are part of the Doris Duke Conservation Scholars program during the summer.

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

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

---



### **Objectives:**

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

### **Progress:**

Despite the widespread distribution of Westslope Cutthroat Trout (WCT) *Oncorhynchus clarki lewisi* across Idaho, populations in some systems remain depressed. Snorkel surveys conducted on the South Fork Clearwater River (SFCR) basin suggest that densities of WCT are low and length structure is poor. Overexploitation and harsh environmental factors (e.g., high summer temperature) are hypothesized to influence populations of WCT in the SFCR system. Radio-telemetry was used to describe seasonal movement patterns and habitat use of WCT during the summer of 2013. Fish were sampled in three tributaries using rotary screw traps and with angling in the mainstem river. Radio tags were surgically implanted into 35 WCT (170–365 mm) from 30 May through 25 June, 2013. Of the 35 fish that were tagged and released, 20 survived through the summer. Fish exhibited two distinct movement patterns in the SFCR system. Nine of the tagged fish had a large summer home range and moved up into tributaries once stream temperatures increased in early July. Eleven of the tagged fish had a smaller home range and stayed in the mainstem river for the duration of the summer despite extremely warm water temperatures. During the 2014 field season, radio tags with temperature sensors will be used to identify if small areas of coldwater refugia are being used by WCT. Snorkel surveys and large-scale habitat measurements will also be conducted to provide additional information on habitat use, density, and distribution of WCT in the SFCR system.

## POPULATION ECOLOGY OF BURBOT IN THE GREEN RIVER OF WYOMING

Principal Investigator: Michael C. Quist  
Student Investigators: 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 December 2014



### Objectives:

- Evaluate sampling techniques for juvenile and adult Burbot.
- Investigate the relationship between Burbot occurrence and habitat characteristics.
- Describe diet, 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 was 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 ( $p \pm SE$ ;  $0.30 \pm 0.06$ ); however, 6.4-mm bar measure mesh hoop nets produced the highest estimated detection probability ( $0.46 \pm 0.07$ ) 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.

The relationship between Burbot occurrence and habitat characteristics will be investigated to further direct suppression efforts in the Green River. Additionally, otoliths collected from Burbot will be evaluated to estimate age and growth and will provide baseline information for evaluations of management actions. Finally, the diet of Burbot will be examined to investigate their role in the food web of the Green River.

## 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.). Angler exploitation will be estimated from tagged fish reported through the IDFG hotline. To date, 168 fish have been reported. Structures for ageing and ovaries were collected during this and a supplementary autumn sampling event. These data will be used to estimate demographic parameters and build an age-structured population model. These models will be used to estimate intrinsic population growth rates under a variety of management strategies.

Future work will also include stable isotope analysis of tissue from Lake Trout and other important species in the lake. This analysis should provide a better understanding of trophic structure in Priest Lake. Integrating the Lake Trout population assessment with improved knowledge of diet will help managers make prudent decisions about the future of Priest Lake. This work also contributes to a broader understanding of Lake Trout outside their native distribution.



## 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 August 2014



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### 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:

Like many other large rivers in North America, the lower Kootenai River has been degraded by changes in land use and water development (e.g., Libby Dam). These disturbances have had deleterious effects on ecosystem function of the Kootenai River. As such, the Kootenai Tribe of Idaho has been actively rehabilitating habitat in the Kootenai River and portions of its floodplain in a section of the river known as the braided reach. The purpose of this project is to provide information on the effects of habitat rehabilitation activities on fish assemblage structure and function in side channels of the Kootenai River. A major benefit of this research is that it will provide an understanding of the distribution and abundance of fishes throughout the braided reach of the Kootenai River. The information gleaned from this project is critical for evaluating the effect of habitat restoration on fish assemblages and populations. Furthermore, information on side channels will also provide insight that can be used to develop more effective and efficient sampling designs.

Fish sampling in the Kootenai River occurred bi-weekly during the summers of 2012 and 2013. During this time, 8,338 fishes were sampled representing 20 species and 7 families. Four-hundred-and-seven pectoral fin rays from largescale suckers *Catostomus macrocheilus* were collected in 2012 and used to evaluate age structure and growth rates. In general, species richness tended to be higher in side channel compared to main channel sites. Fish assemblage structure was different in treatment sites compared to reference sites and we observed an increasing pattern in the relative abundance of all species after rehabilitation of treatment sites. Native fishes tended to be found in close association with one another, while non-native fishes were rarely sampled in the same reaches as native fishes. We modeled growth of largescale suckers and found that nutrient enhancement (another management tool being used to mitigate water development activities) explained the most variability in growth. We found little support for models incorporating temperature and discharge on both growth and recruitment. Future work will focus on evaluating species-specific habitat use and defining the sampling effort required to detect differing levels of species richness and changes in catch rates.

## **AN EXAMINATION OF THE SPATIAL AND TEMPORAL DISTRIBUTION AND DENSITY OF *MYISIS* AND ZOOPLANKTON AND IMPLICATIONS FOR THE SURVIVAL OF KOKANEE FRY IN LAKE PEND OREILLE**

Principal Investigator: Frank M. Wilhelm  
Student Investigator: Elliott Reams  
Funding Agency: Idaho Department of Fish and Game  
Completion Date: 28 February 2014



### **Objectives:**

- Determine spatial and temporal distribution of zooplankton and *Mysis* in Lake Pend Oreille.
- Collate and analyze historic climate data for LPO watershed to determine potential to predict the date of stratification to allow managers to optimize the timing of the release of hatchery-reared kokanee.

### **Progress:**

Lake Pend Oreille (LPO) in northern Idaho has experienced extensive anthropogenic-mediated alterations in its hydrology and biological community during the last century with the construction of dams to regulate lake level and the introduction of fish and invertebrates. We focus on the role of non-native mysids in the LPO food web. Because mysids preferentially prey on large zooplankton, they directly compete with kokanee fry for food resources. This competition is reduced after stratification provides a warm thermal refuge for zooplankton from mysid predation. Fisheries managers of LPO desire to maximize the survival of hatchery-reared kokanee fry by optimizing the date and area of release. This requires the ability to predict the date of stratification and knowledge of the spatial and temporal distribution of zooplankton and mysids.

We identified the onset, end, and duration of stratification in LPO by analyzing temperature profiles starting in 1951 using normalized least square regressions. The onset of stratification was constant ( $176.5 \text{ DOY} \pm 3 \text{ days SE}\bar{x}$ ), while the end and duration of stratification have decreased significantly. The invariant onset of stratification allows managers to predict when to stock kokanee fry. However, the significant decrease in the duration of stratification means that the thermal refuge and thus ability of fry to consume zooplankton prey without competition from mysids is greatly reduced.

The inexplicable decline of mysid densities in 2012-2013 to a mean of  $0.046 \text{ individuals/m}^2$  is puzzling and unprecedented in lakes across North America. As a result, our data to map spatial and temporal patterns of mysids are weak and should be repeated if, and when, mysid densities increase. The spatial and temporal distribution of zooplankton were determined from field-collected samples using a modified zooplankton quality index relevant to kokanee. Results showed that optimal zooplankton biomass suitable for kokanee was clustered around Windy Point and the confluence of Idlewild and Scenic Bays suggesting these as ideal areas in which to stock fry.



## **Completed Projects – Fisheries and Aquatic Resources**

### **COMPARATIVE SURVIVAL OF RESERVOIR-REARED AND RESERVOIR-BYPASSED SPRING CHINOOK SALMON IN THE WILLAMETTE RIVER BASIN**

Principal Investigators: Christopher Caudill  
and Brian Kennedy.  
Student Investigator: Sam Bourret  
Collaborators: Lisa Borgerson (ODFW)  
Ben Clemens (ODFW)  
& U.S. Army Corps of Engineers  
Portland District  
Funding Agency: USGS – RWO 144  
Completion Date: 31 May 2013

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#### **Objectives:**

- Determine the degree of life history variability in three Willamette River subbasins (McKenzie, Santiam, and Middle Fork Willamette basins) by surveying juvenile growth patterns and otolith isotopic ratios from individuals collected from stream and reservoir rearing habitats.
- Evaluate the ability of scale and otolith analyses to resolve the natal stream, juvenile rearing habitat, and ocean entry timing for adult salmon of unknown source.

#### **Progress:**

Understanding the distribution, abundance and relative performance of life history types is an important element of the Willamette Valley Biological Opinion for Upper Willamette River Chinook Salmon listed under the Endangered Species Act and is critical for development of effective management strategies for juvenile Chinook salmon in the Willamette Valley Basin (WVB). Recent analyses of screw trap data suggest that juvenile Chinook salmon life history strategies are variable within and among WVB populations, including traits that resemble both an ocean-type life history with subyearling emigration in summer or fall as well as a stream-type life history with yearling emigration the following spring. We reconstructed the juvenile rearing and migratory patterns of a sample of natural-origin adult Chinook salmon that returned to the Middle Fork Willamette Basin. Scale morphometric patterns and otolith isotope ratios of  $^{87}\text{Sr}/^{86}\text{Sr}$  were used to characterize juvenile life histories and estimate juvenile size at freshwater emigration. We also used alkaline earth elements Sr, Ba, Mn, Mg, and Ca in otoliths and water, combined with otolith morphometric attributes, to discern movement and rearing of natural-origin juvenile Chinook salmon in natal rearing (adult outplant) tributaries and downstream project reservoirs.

A first objective was to evaluate otolith traits and growth patterns for juveniles rearing in tributaries feeding project reservoirs compared to juveniles rearing in reservoirs. We found that a substantial portion of sampled juvenile Chinook salmon rear in project reservoirs and emigrate to the sea at large sizes, which may provide a survival advantage to adulthood. We found a high correlation between otolith and scale freshwater age in adult samples, indicating

that estimating life history composition from scales provides an accurate and cost-effective monitoring tool. Elemental water samples from the North Fork Middle Fork Willamette and Lookout Point reservoir were variable, and similar patterns were found in otoliths from juveniles captured in each habitat. Preliminary results from analysis of otolith microstructure suggest increased growth in project reservoirs relative to natal rearing streams. Many life history traits inferred from scales were substantiated by otolith analyses.

A second major objective was to reconstruct the juvenile life history of returning adults, including rearing habitat (spawning tributary or reservoir). Results suggest that 90% (n = 18) of sampled non-hatchery adults returning to the Middle Fork Willamette River reared in a reservoir and 10% (n = 2) reared in natal tributary habitat upstream from the reservoir. The results demonstrate the utility of otolith microchemistry and microstructure to distinguish among rearing habitats, including habitats in highly altered systems, and that altered habitats (reservoirs) may contribute substantially to the production of adults.

## **DEVELOPING STRATEGIES TO IMPROVE SURVIVAL AND RETURN RECRUITMENT OF STEELHEAD KELTS FROM SNAKE RIVER STOCKS**

Principal Investigator:

Christine M. Moffitt

Student Investigators:

Bryan Jones

Zach Penney

Jessica Buelow

EPSCoR-NSF Intern:

Heath Hewett

Scientific Staff:

Boling Sun

Collaborators:

Doug Hatch, CRITFC

Brett Bowersox and Tim Copeland

IDFG

Brian Marston, Alaska Fish and Game

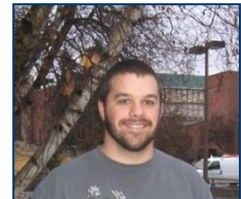
Funding Agency:

Columbia River Inter-tribal Fisheries

Commission

Completion Date:

30 August 2013



### **Objectives:**

- Obtain and synthesize physiological metrics into models that describe changes observed in hatchery - and natural-origin steelhead trout stocks from fall upriver migration through spawning and early kelt migration.
- Obtain a complete profile of the condition and physiology of downstream migrating natural origin stocks captured at Lower Granite Dam bypass facility, and compare and contrast these profiles with fish examined at upriver sites.
- Evaluate the survival and migration behavior of natural origin steelhead kelts collected from the bypass facility at Lower Granite Dam, tagged with acoustic tags and transported via barge or truck to locations below Bonneville Dam.
- Evaluate the emigration of natural origin steelhead kelts PIT tagged and released below Lower Granite Dam to migrate through the Snake and Columbia River hydro system.

**Abstract:**

Our research was directed to improve understanding of the physiological ecology of pre - and post-reproductive steelhead trout in the Snake River system. Inland maturing steelhead have a protracted fasting period in freshwater before spawning, and little is known of their physiology during this long fast. The project supported three graduate students, PhD Zachary Penney, and MS students Bryan Jones and Jessica Buelow.

Many studies of steelhead trout address the migration, genetics, and population dynamics of steelhead using a variety of tools and modeling approaches. Management goals to improve the recovery of steelhead stocks at risk of extinction in the Columbia/Snake River systems include objectives of increasing the proportion of post spawning fish that survive and spawn again. Although a plethora of physiological studies conducted on juvenile and smolts steelhead provide profiles of biochemical and hormonal indices that have been useful in evaluating factors affecting juvenile survival and migration success, few studies have been conducted on post spawning steelhead (kelts). We conducted a comprehensive evaluation of mature and kelt steelhead trout from an ESA-listed population in the Snake/Columbia River system to assist in understanding physiological factors affecting their capacity for repeat spawning. To be successful, post-spawning steelhead migrating downstream to the ocean must prepare physiologically and physically for a seawater transition. We used histological analysis to assess the cellular architecture in the pyloric stomach, ovary, liver, and spleen in sexually mature and kelt steelhead trout. We observed 38% of emigrating kelts contained food or fecal material in the gastrointestinal tract and that evidence of feeding was more likely in good condition kelts. We found a significant renewal of villi in the pyloric stomachs of kelts was associated with feeding. No vitellogenic oocytes were observed in sections of kelt ovaries, but perinucleolar and early/late stage cortical alveolus oocytes were present suggesting iteroparity was possible. We documented a negative correlation between the quantity of perinucleolar oocytes in ovarian tissues and fork length of kelts suggesting that larger steelhead trout may invest more into a single spawning event. Liver and spleen tissues of both mature and kelt steelhead trout had minimal cellular necrosis. Our findings indicate that the physiological processes causing rapid senescence and death in semelparous salmon are not evident in steelhead trout, and recovery begins in fresh water. We sampled blood, gill filaments, and evaluated the external condition of migrating kelts from an ESA-listed population in the Snake/Columbia River system to evaluate their physiological readiness for transition to seawater. We chose attributes often considered as measures of preparation for seawater in juveniles, including gill Na<sup>+</sup>K<sup>+</sup> ATPase activity, plasma electrolytes, and hormones to consider factors related to external condition, size and sex. We found kelts in good external condition had plasma profiles similar to downstream migrating smolts. In addition, we evaluated proximate constituents of steelhead sampled at selected intervals during upstream migration in the Snake/Columbia River system, overwintering in Idaho tributaries, and kelt migration downstream at Lower Granite Dam to determine the rate of depletion of energy stores in the muscle tissues. At a basin-wide scale, we estimated that between early freshwater entry and post-spawning (kelt) emigration, the lipid content of white muscle was reduced by 94% to levels less than 1% of wet tissue weight. Lipid was depleted more rapidly than protein during the reproductive cycle, and afterward provided the only remaining somatic energy source for post spawning migration. We found that protein content was consistently higher in sexually mature male steelhead compared to females

suggesting variations in energy allocation prior to reproduction between sexes. In kelts, lipids, protein, and energy densities of white muscle were significantly higher in good condition kelts over levels measured in poor condition fish. Fork length was positively correlated with both protein and energy density suggesting that larger steelhead may have higher somatic energy over smaller kelts. We found no evidence of significant inter-annual variation in lipid, protein, and energy density of sexually mature and kelt steelhead. Post-spawning survival of steelhead is likely limited by the low energy density of kelts, and our data lend support to observations of low rates of iteroparity in this and other populations of inland stream-maturing steelhead. We compared selected physiological attributes of Snake/Columbia River kelts with those of the Situk River, Alaska, a coastal steelhead system with higher proportion of repeat spawning. We observed that plasma cholesterol and triglycerides were significantly higher in coastal kelts suggesting that somatic lipid stores after spawning were higher than in inland kelts. Plasma protein content was below detection limits in a large number of inland kelts (27–68%), whereas plasma protein levels were above detection limits in nearly all (92%) coastal kelts. We found that lipid, protein and energy density of white muscle tissues from natural kelt mortalities were similar between coastal and inland steelhead. Based on selected nutritional metrics measured with plasma biochemistry we suggest that although many Snake River kelts are preparing for seawater reentry and recovery, they may be energetically limited. Compounded with these factors, the additional distance and impoundments encountered by Snake River kelts during their downstream migration make them less likely to immigrate to the ocean and recover to repeat spawn.



Zach Penney sampling steelhead  
in the Situk River, Alaska



## HIGH RISK BALLAST WATER: TESTING OF EFFICACY OF HYDRATED LIME AND SODIUM HYDROXIDE BIOCIDAL TREATMENTS ON SELECTED TARGET INVERTEBRATES

Principal Investigator: Christine M. Moffitt  
Collaborating Investigators: Barnaby J. Watten, USGS  
  
Field research site: Willow Beach NFH Houghton, MI  
  
Graduate Student: Amber Barenberg  
CRISSP NSF REU Mindy P. Torres  
Mary Babrowiez  
Marilena Gartiez  
  
HOIST intern: Justin Shearer  
Env. Science senior thesis: Colin Heath  
Daniel Olsen  
  
Undergraduate assistants: Tasha Britton  
Kate Wilcox  
Charlie Withers-Haley  
Jenna Davis  
Brandon Snow  
Taylar McClue  
  
Funding Agency: U.S. Geological Survey  
Completion Date: 31 December 2013



### Objectives:

- Develop laboratory tests to determine appropriate protocols of dosage, and exposure time to achieve complete mortality of selected more resistant invertebrate species
- Test and refine protocols for testing in laboratory trials
- Design appropriate procedures and experimental designs for scaled up for trials on board the ships to establish efficacy in field applications of ballast tanks.

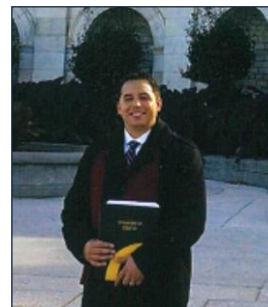
### Abstract:

The National Park Service (NPS) identified a need for improved methods to protect the integrity of natural systems from invasive species. Of particular concern is the release of organisms in residues and within the ballast of shipping tanks in the Great Lakes, and other large lakes. Our studies were part of a multidisciplinary team effort in the US Geological Survey (USGS) and the NPS to test the efficacy and safety of using high pH treatments as a rapid and easily reversible treatment to kill invertebrates and other target organisms. Our studies were the result of a successful bench scale testing of a treatment proposed by Dr. Barnaby Watten and colleagues at the US Geological Survey's Leetown Science Center. The Great Lakes Initiative (GSI) conducted bench-scale tests of the efficacy of elevated pH in sodium hydroxide treated water and concluded pH levels of 11.5 to 12.5 were effective in killing rotifers, Daphnia, and copepods within 4 hours of exposure. Our project tested quagga mussels, Asian clams, and New Zealand mudsnails in laboratory tests to determine killing rates at different temperatures. We modeled time to mortality of adults and juvenile life stage. Tests were conducted with quagga mussels at Willow Beach National Fish Hatchery, AZ. Other

laboratory trials were conducted in the CNR Fisheries wet laboratory. In September 2013, we conducted a field trial onboard the Ranger III in Houghton, Michigan, and traveled into Lake Superior on the ship. We found that pH of 11.6 with NaOH produced 100% mortality of all plankton in two replicate ballast treatments. The trials also included successful neutralization of the elevated pH using the CO<sub>2</sub> from shipboard diesel engines. The project supported numerous undergraduate interns as well as MS graduate student Barenberg. She is currently working to complete her MS thesis. We have one book chapter completed in press from these results, and two manuscripts in preparation.

## TRIBAL STUDENT EDUCATIONAL ENHANCEMENT

|                         |                                |
|-------------------------|--------------------------------|
| Principal Investigator: | Christine M. Moffitt           |
| Graduate Student:       | Zachary L. Penney              |
| Funding Agency:         | U.S. Geological Survey RWO 155 |
| Completion Date:        | 31 December 2013               |



### Objectives:

- Support interactions with agency and tribal biologists to complete manuscripts and collaborations to characterize the physiology of Snake/Columbia River populations of steelhead trout
- Meet and interact with managers and scientists engaged with Native American and Indigenous peoples natural resources at several other federal agencies inside and outside of the Department of Interior, housed in the greater Washington DC area.

### Abstract:

The natural resource agencies are in need of qualified Tribal scientists and managers that can assist with co-management and tribal trust interpretations and discussions. Fish and wildlife resources are important to the cultural heritage and to human subsistence of native tribes. This project goal was to enhance the opportunities for Ph.D. student Zach Penney to collaborate between tribal with other professionals to complete manuscripts on Snake River steelhead populations and compare them with results from other regions, especially Alaska. After a series of successful applications, and competitive interviews working through Oregon Sea Grant, Penney was admitted to the John A Knauss Marine Policy Fellowship program with NOAA. The Sea Grant Knauss Fellowship provides a unique educational experience to graduate students with an interest in ocean, coastal and Great Lakes resources and national policy affecting those resources. Each successful intern is matched with "hosts" in the legislative and executive branch of government located in the Washington, D.C. area, for a one year paid fellowship. In November, Penney traveled to Washington DC for placement interviews, and determined that he would be placed in the office of California Representative Jared Huffman. Penney is busy working on the Magnuson Re-authorization, the Klamath River resources, marine protected areas, as well as Tribal government relationships. The internship will continue through December 2014, and visitors to Washington DC are urged to connect with him if possible. In addition to the successful internship, Moffitt and Penney have published three manuscripts from his dissertation research and are preparing two additional this year.

## ASSESSMENT OF SAMPLING TECHNIQUES AND FISH ASSEMBLAGE STRUCTURE IN LARGE WESTERN RIVER SYSTEMS

Principal Investigator: Michael C. Quist  
Student Investigator: Christopher D. Smith  
Collaborating Investigator: Ryan Hardy, Idaho  
Department of Fish & Game  
Funding Agency: Idaho Department of Fish & Game  
Completion Date: 31 December 2013



### Objectives:

- Compare the efficacy of three sampling techniques for fish assemblages
- Determine the influence of habitat characteristics on detectability of fishes in large western rivers.
- Describe fish assemblage and population-level relationships with habitat characteristics

### Progress:

Large rivers have been modified on a global scale with deleterious effects to fishes. An improved ability to sample fishes and evaluate species-specific habitat use would help improve management of these complex systems. The focus of this project was to evaluate sampling techniques for fish assemblages in large rivers and to investigate population and fish assemblage-level relationships with habitat characteristics.

This study was conducted in the Green and Kootenai rivers, two large river systems in western North America. Field sampling occurred at 500-m long reaches ( $n = 73$ ) during the summers (June, July, August) of 2012 and 2013 and fall (September, October) of 2012. All reaches sampled in a season were resampled at least once and many (74%) were resampled three or four times in a single season. Each reach was sampled with three techniques (i.e., boat-mounted electrofishing, hoop nets, benthic trawl). In addition to collecting data on fishes (e.g., count, length, weight), habitat characteristics (e.g., substrate, channel morphometry) were also measured to investigate species-specific habitat use and detectability relationships.

A total of 11,676 individuals consisting of 30 species and nine families was sampled. Electrofishing and hoop nets had the highest detection probabilities for most species, whereas detectability of most fishes was low with benthic trawls. Gear and habitat effects on detectability were common for most fishes. In addition to evaluating sampling techniques, an investigation of longitudinal transitions in habitat and fish assemblage structure was conducted in the Kootenai River. Habitat gradients and fish assemblage structure varied among river sections (braided, canyon, meander) in the Kootenai River. Population-level relationships with habitat characteristics varied by species and provided information regarding species ecology and habitat use. Results of this work improve our understanding of gear efficacy for fish assemblages and habitat associations of fishes in large western rivers. Such information will be important for managing river systems across western North America.



## **POPULATION DYNAMICS AND TROPHIC ECOLOGY OF NORTHERN PIKE AND SMALLMOUTH BASS IN COEUR D'ALENE LAKE: IMPLICATIONS FOR THE CONSERVATION OF WESTSLOPE CUTTHROAT TROUT**

|                             |  |
|-----------------------------|--|
| Principal Investigator:     | Michael C. Quist                       |
| Student Investigator:       | John D. Walrath                        |
| Collaborating Investigator: | Jon A. Firehammer, Coeur d'Alene Tribe |
| Funding Agency:             | Coeur d'Alene Tribe                    |
| Completion Date:            | 31 December 2013                       |



### **Objectives:**

- Describe the population structure and dynamics of northern pike and smallmouth bass.
- Determine seasonal food habits of northern pike and smallmouth bass and model consumption of cutthroat trout.

### **Progress:**

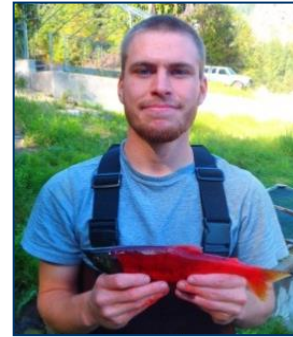
The Coeur d'Alene Tribe has recently documented poor survival of adfluvial Westslope Cutthroat Trout *Oncorhynchus clarkii lewisi* originating from Lake and Benewah creeks (small tributaries to Coeur d'Alene Lake). Although a number of factors likely contribute to mortality of Westslope Cutthroat Trout in the system, low survival is thought to be a function of predation by Northern Pike *Esox lucius* and Smallmouth Bass *Micropterus dolomieu* in Coeur d'Alene Lake. Sampling was conducted at four locations during 2012 and the spring of 2013: Cougar Bay, Wolf Lodge Bay, Windy Bay, and Benewah Lake. Fish were sampled using two techniques: gill nets and boat electrofishing. Consumption of Westslope Cutthroat Trout and other prey items was evaluated using modified Costello plots and bioenergetics models.

Sampling occurred on 138 days and 15,645 individual fishes, representing 24 species, were captured. We captured 736 Northern Pike and 1,418 Smallmouth Bass. Northern Pike in Coeur d'Alene Lake exhibited fast growth and a large size structure, likely due to high mortality and low density. Alternatively, low availability of invertebrate prey and high intraspecific competition resulted in poor size structure and slow growth of Smallmouth Bass.

Total length of Westslope Cutthroat Trout consumed by Northern Pike varied from 87 to 437 mm and averaged 250 mm. Westslope Cutthroat Trout occurred in 1% of Smallmouth Bass stomachs while contributing 7% of the total energy in the spring of 2012. Alternatively, in the spring of 2012, Westslope Cutthroat Trout occurred in approximately 25% of Northern Pike stomachs and contributed roughly 75% of the total energy intake. During the summer and fall, percent occurrence and energy contribution of Westslope Cutthroat Trout decreased by about 50%. During the spring of 2013, the occurrence and energy contribution of Westslope Cutthroat Trout in Northern Pike diets were similar to the spring of 2012. The total biomass estimate of Westslope Cutthroat Trout consumed by Northern Pike (i.e., 2008-2011 year classes) in the four study bays was 1,231 kg (95% confidence intervals; 723-2,396 kg) and the total number was 5,641 (3,311-10,979). Fortunately, intense seasonal predation suggests that predation on Westslope Cutthroat Trout might be alleviated by reducing Northern Pike densities near tributaries used by Westslope Cutthroat Trout for spawning.

## KOKANEE SPAWNING ECOLOGY AND RECRUITMENT RESPONSE TO WATER LEVEL MANAGEMENT IN LAKE PEND OREILLE, IDAHO

Principal Investigator: Michael C. Quist  
Student Investigators: Steven L. Whitlock  
Collaborating Investigators: Andrew M. Dux, Idaho  
Department of Fish and Game  
Funding Agency: Idaho Department of Fish and Game  
Completion Date: 31 December 2013



### Objectives:

- Use a laboratory experiment and a fine scale *in situ* incubation study to directly measure the relationship between kokanee EF survival and spawning habitat characteristics.
- Test whether survival is enhanced in the habitat provided by a high water year.
- Use existing data to evaluate the EF survival estimator used by the Idaho Department of Fish and Game and develop alternative methods for measuring the effect of the water-level management strategy on recruitment.

### Progress:

Kokanee *Oncorhynchus nerka* were the centerpiece of a productive commercial and recreational fishery in Lake Pend Oreille, Idaho for decades, before declining in the late 1960s. The decline has been attributed to poor recruitment caused by a reduction in quality shoreline spawning habitat, which was linked to a hydropower-related shift to a lower minimum water level. Kokanee predominantly spawn over-winter on the shoreline of LPO. Drawdowns are thought to decrease recruitment by reducing the availability of suitable spawning gravels, which are thought to exist above the minimum winter lake elevation. Since 1996, the Idaho Department of Fish and Game has evaluated a water level management strategy to determine if raising winter water levels increase kokanee recruitment. The method for evaluating the water level hypothesis is to fluctuate between years of the preexisting low lake elevation (625.1 m) and years with an experimentally raised lake elevation (626.4 m). Kokanee recruitment response to habitat changes is measured using a back-calculated egg-to-fry (EF) survival estimate.

Though water level management has been ongoing for more than 15 years, several issues have recently come to the attention of managers. One issue is that the EF survival estimator has produced unrealistic estimates in recent years. Another issue is that observations of spawning kokanee appear to undermine some of the premises of the water level hypothesis. These observations include recurrent spawning in apparently unsuitable habitat and the recent discovery of large spawning aggregations deep (>10 m) within the lake. To address these concerns, several investigations were undertaken to inform management of kokanee in LPO. The goal of this research was to improve kokanee recovery efforts in LPO by thoroughly describing kokanee spawning ecology and testing the water-level management hypothesis. The objectives set for accomplishing this goal were to (1) use a laboratory experiment and a fine scale *in situ* incubation study to directly measure the relationship between kokanee EF survival and spawning habitat characteristics, (2) test whether survival is enhanced in the habitat

provided by a high water year, and (3) use existing data to evaluate the EF survival estimator and develop alternative methods for measuring the effect of the water-level management strategy on recruitment.

All three incubation studies found that substrate size composition was a poor predictor of survival. The *in situ* studies found that kokanee eggs deposited at depths >10 m were viable and intragravel survival appeared to be enhanced by downwelling in habitat that was ostensibly poor. The existing method for assessing the water-level strategy was evaluated using sensitivity analysis and a simulation and shown to be unreliable, so an alternative assessment method was developed and applied using a bootstrap-based generalized Ricker model. No recruitment response to water-level management was detected with the alternative method. The incubation studies and stock assessment model together suggested that water-level management is not an effective strategy for increasing the recruitment of shore-spawning kokanee.

## Current Projects – Wildlife and Terrestrial Resources

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### EVALUATING MITIGATION MEASURES ON THE CRAIG MOUNTAIN WILDLIFE MANAGEMENT AREA

|                         |                                   |
|-------------------------|-----------------------------------|
| Principal Investigator: | Courtney J. Conway                |
| Student Investigator:   | Zach Swearingen                   |
| Completion Date:        | 31 December 2014                  |
| Funding Agency:         | Idaho Department of Fish and Game |

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#### 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 identified the yellow warbler, black-capped chickadee, pileated woodpecker, white-tailed deer, Rocky Mountain elk, and river otter as ‘focus species’ toward which land management on CMWMA would be directed. Management actions and recreational use has changed considerably since CMWMA was acquired by IDFG in 1992. These changes are a result of noxious weeds, increased recreational activities, road closures, two major wildfires, a mountain pine beetle infestation, and commercial timber harvest. This project will take advantage of baseline surveys conducted soon after the property was acquired by IDFG and contemporary data to quantitatively 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 focal bird species (pileated woodpeckers) had declined since 1992, but data that we collected in 2013 allowed us to control for annual variation in detection probability and new results suggest the exact opposite – that numbers of pileated woodpeckers have increased over the past 20 years. We will conduct another season of data collection and will build predictive habitat models to assess how management actions have changed the quality and quantity of habitat on CMWMA (for each of the 3 focal bird species) over the past 25 years.

## CONSERVATION OF THE NORTHERN IDAHO GROUND SQUIRREL

Principal Investigator: Courtney Conway  
Student Investigator: Amanda R. Goldberg  
Collaborating Investigator: Diane Evans-Mack, Idaho  
Department of Fish and Game  
Ana Egniew, USDA Forest  
Service  
Funding Agency: US Forest Service  
Completion Date: 31 May 2017

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### 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 (U.S. Fish and Wildlife Service 2000) and as Critically Endangered by the International Union for Conservation of Nature (Hafner 1998). 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 2 treatments: (1) thinning followed by a fall-season prescribed burn, and (2) control. We will also measure vegetation structure, and body mass, relative abundance, and colony size at all sites to examine whether these variables are affected by forest treatment. We also plan to examine whether plague is depressing survival in NIDGS. Plague, a disease caused by the bacterium *Yersinia pestis*, was introduced from Asia to North America in ~1900 (Barnes 1993). Even a low incidence of plague can have adverse effects on some species. Plague has been documented in both Adams and Valley counties where all NIDGS habitat is located (Abbott and Rocke 2012). We will treat a subset of colonies with pesticides that control fleas and then compare survival between treated and control sites. We will attach radio collars to NIDGS to locate their hibernacula and evaluate the 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          |
| Completion Date:        | 31 May 2017                |
| Funding Agency:         | NSF, Arizona Game and Fish |
| Department              |                            |



### Objectives:

- Identify the causes of elevational variation in clutch size of 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 ( $n=400$ ; Dillon and Conway, in revision). 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 studying the ecological processes driving habitat selection in red-faced warblers. Breeding densities of red-faced warblers indicate a distinct mid-elevation and nest in the highest densities in the bottom portions of montane canyons. We are using LIDAR and point-count survey data to model the distribution and relative of abundance of red-faced warblers throughout Arizona. The red-faced warbler is listed as an AZ Partners in Flight species of concern. 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  
Student Investigator: Dave Gotsch  
Funding Agency: IDFG, BLM, OSC, Little  
Endowment  
Completion Date: 1 January 2024



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### **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 sage-grouse 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 will implement 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 3 sites in southern Idaho. We will locate nests of radio-marked hens and measure demographic traits and grazing intensity for 2 years and then alter spatial patterns of grazing intensity in areas that have nests.



## 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 February 2014



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### Objectives:

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

### Progress:

More than 250 species of birds in the continental US 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 will examine 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.

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

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



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### 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 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 many colleagues in Canada and in states throughout the western U.S. Along with our partners, we have put geolocators and satellite transmitters on >150 burrowing owls in the U.S. and Canada over the past 2 years. We have documented that burrowing owls that breed in Oregon and Washington spend the winter months in WA, OR, NV, and CA. Owls that breed in Alberta have wintered in locations throughout central and northern Mexico. In 2014, we plan to put satellite transmitters and geolocators on owls in ID, UT, CO, SD, and MT. 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.

### **HABITAT PATCH SIZE AND DETECTION PROBABILITY OF YUMA CLAPPER RAILS**

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|--------------------------|--------------------|
| Principal Investigators: | Courtney J. Conway |
| Staff Biologist:         | Meaghan Conway     |
| Funding Agency:          | USFWS              |
| Project Duration:        | 2008 - 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.

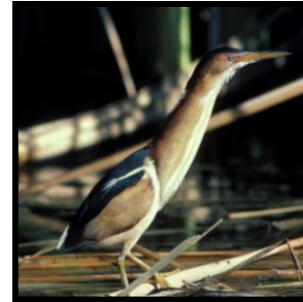


#### **Progress:**

Yuma clapper rails (*Rallus longirostris yumanensis*) have been listed as federally endangered since the advent of the Endangered Species Act (U.S. Department of the Interior 1989, Conway and Eddleman 2000). The recovery plan for the Yuma clapper rail (U.S. Fish and Wildlife Service 1983) 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        |
| Project Duration:       | ongoing            |



### **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 rail, sora, clapper rail, king rail) 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.



**EVALUATING DEMOGRAPHIC RATES AND HABITAT OF COLUMBIAN SHARP-TAILED GROUSE (*TYMPANUCHUS PHASIANELLUS COLUMBIANUS*) IN THE ROCKLAND AND CURLEW VALLEYS**

Principal Investigator: Kerry P. Reese  
Student Investigator: Gifford Gillette  
Funding Agency: Idaho Department of Fish and Game  
Completion Date: 30 June 2014

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**Objectives:**

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

**Progress:**

To assess the impacts of recent land use changes including the Conservation Reserve Program (CRP) on Columbian sharp-tailed grouse (hereafter CSTG) demographic rates and to assess the quality of CRP, we trapped and monitored CSTG in the Rockland and Curlew Valleys of southeastern Idaho where multiple cover types are available for use. We monitored 135 female CSTG fitted with radio-transmitters during the 2011-2013 breeding seasons. CSTG occupying CRP lands successfully hatched young and reared broods in fields dominated by a nonnative Eurasian grass. CSTG using CRP lands experienced lower survival (68%, n=80), nest success (28%; n=72), and brood success (38%, n=24) compared with CSTG occupying shrub-steppe rangelands (80% survival, n=60; 37% nest success, n=63; 55% brood success, n=22). Videography of 68 nests during 2011-2013 revealed 33 failed nests caused by: badgers (17), coyotes (9), ravens (4), long-tailed weasel (1), beef cow (1), and striped skunk (1). To complete objective 5 we conducted simultaneous ground and aerial infrared (AIR) lek counts during 2012 on April 11<sup>th</sup> and 12<sup>th</sup> at 25 leks. Identical lek counts using ground-based and AIR methods were obtained at 4 of 25 (16%) leks. We did not detect significant differences between ground-based (12.9 mean  $\pm$  1.8 SEM) and AIR methods (11.8 mean  $\pm$  1.5 SEM, Z = -1.3099, p = 0.196). The average difference between paired counts was 1  $\pm$  1.3. The average absolute difference in simultaneous counts between AIR and ground was 4.7  $\pm$  0.9. An NRCS Conservation Innovation Grant (CIG) allowed us to conduct four mornings of AIR lek counts (n=88) that were also counted using ground-based methods during spring 2013. Counting 88 leks one time using AIR methods was approximately twice the cost (\$177/lek) of ground-based methods (\$83/lek) but AIR required fewer IDFG resources than ground-based methods.



## **Completed Projects-Wildlife and Terrestrial Resources**

### **DEVELOPMENT OF A HABITAT SUITABILITY INDEX MODEL FOR THE ENDANGERED MASKED BOBWHITE**

Principal Investigators: Courtney J. Conway  
Student Investigator: Dominic LaRoche  
Funding Agency: USFWS  
Project Duration: 2011 - 2013

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#### **Objective:**

- Develop a model for identifying habitat conditions of masked bobwhite.

#### **Abstract:**

Masked bobwhite are federally endangered in the U.S. and Mexico and appear to be effectively extinct in the wild. We worked with 9 species experts to develop a suite of habitat models based on expert opinion. The models could be used to help identify sites for reintroduction or identify sites to conduct surveys to search for extant populations. We have produced a draft final report and are awaiting comments back from our partners.

### **EFFECTS OF PRESCRIBED FIRE ON NORTHERN IDAHO GROUND SQUIRREL HABITAT AND USE**

Principal Investigator: Beth Newingham  
Student Investigator: Elise Suronen (MS)  
Christina Sullivan (UG thesis)  
Collaborators: Diane Evans-Mack (IDFG)  
Eric Yensen (College of S. Idaho)  
Funding Agency: Idaho Department of Fish and Game  
Closing Date: 30 September 2013

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#### **Objectives**

- Characterize *Urocyonellus brunneus brunneus* occupied habitat.
- Determine the effects of thinning and prescribed fire on potential but currently unoccupied *U. b. brunneus* habitat.

#### **Abstract:**

*Habitat Characterization* – Sites occupied by NIDGS had tree canopy cover of 10 to 15%, tree densities of 64 to 118 trees/ha, and understory height was 20 to 25 cm. Understory vegetation of occupied habitat consisted of 20 to 30 species, while across site richness was 153. We also identified 15 understory species with the highest constancy and cover across the 7 sites. Litter depth was 0.7 to 0.9 cm deep, and the soil texture was clay loam.

*Effects of Prescribed Burning on Habitat* – Before the prescribed burn, burn units had higher tree densities and canopy cover than control units; however, the prescribed fall burn did not reduce tree density or canopy cover one year later. Understory height in the BURN unit



decreased slightly post-burn, approaching control conditions. Majority of understory characteristics were similar between control and burn units before, one, and two years after the burn, but understory community structure remained strongly dissimilar. Key habitat attributes associated with NIDGS presence include tree canopy cover, understory height and community structure, and litter depth.

### **ASSESSING THE VULNERABILITY OF IDAHO SPECIES OF GREATEST CONSERVATION NEED TO CLIMATE CHANGE**

Principal Investigators: Kerry Reese and Kerri Vierling  
Student Investigator: Amber Lankford  
Funding Agency: USGS  
Anticipated Completion Date: 31 December 2013



#### **Objectives:**

- To determine the vulnerability of Idaho's Species of Greatest Conservation Need (SGCN) to projected changes in climate
- To determine the spatial distribution of vulnerable SGCN species across Idaho
- To communicate with agency personnel and others concerning: 1) vulnerability database development and 2) findings associated with the vulnerability assessment

#### **Abstract:**

The present and future management of wildlife species depends upon understanding the degree of vulnerability that they face in dynamic ecosystems. The Intergovernmental Panel on Climate Change (IPCC) defines vulnerability as "the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes." Vulnerability can be broken down into three contributing factors: exposure, sensitivity, and adaptive capacity.

The growing threat of the direct and indirect effects of climate change makes vulnerability assessment a key to effective future wildlife management. Our project had two major objectives. The first was to assess the outputs of current vulnerability and sensitivity assessments to determine whether these assessments were comparable. We presented a poster at the Idaho Chapter of the Wildlife Society Annual Meeting in 2013 on the results of this comparison, developed this concept into a manuscript, and submitted this manuscript for publication to the Wildlife Society Bulletin. This manuscript has been accepted for publication, and should be published in 2014.

Our second objective was to develop a spatially explicit framework to determine species vulnerability. Climate exposure was represented by the magnitude of deviation between future climate projections and present day climate models. Projections were provided by the USGS at approximately 1 km resolution. Sensitivity of each species was calculated by modifying the score received from the Climate Change Sensitivity Database. This database was developed by our collaborators at the University of Washington. Most of the sensitivity scores have been completed for species with adequate information, however many species still lack sensitivity scores. Adaptive capacity was measured as a spatial model of landscape permeability across

current landscape cover models. Exposure, sensitivity, and adaptive capacity variables were combined into the vulnerability map framework, and vulnerability scores were generated on a pixel-by-pixel basis to create spatially explicit maps of vulnerability. We finalized this methodology in spring 2013, and have applied this framework to 5 Idaho species thus far. We are currently finalizing a manuscript detailing this framework, and we will submit a manuscript for publication in the spring of 2014.

## **Awards, Publications, Service and Other Activities of Unit and Unit Collaborating Scientists and Students 1 January 2013 – 31 December 2013**

### **HONORS AND AWARDS**

*Courtney Conway*

Nominated for Fellow of the American Ornithologists' Union, 5 May 2013.

*Brittany Oleson*

2013 Best Student Presentation Award for her talk at the Annual Conference of the Arizona and New Mexico Chapters of The Wildlife Society, Albuquerque, NM

*Kristen Dillon*

NSF Graduate Research Fellowship Award

2013 Student Research Grant from The Explorers Club Exploration Fund, New York City.

*Carl Lundblad*

NSF Graduate Research Fellowship Award.

Research Award from the Western Bird Banding Association.

*Christine Moffitt*

American Fisheries Society Equal Opportunity Section and Student Subsection

Influential Career Contributions 2013. "Ladies Night," AFS annual meeting, Little Rock, AR. September

American Fisheries Society Distinguished Service Award, 2013. For team leadership to select a new Society Executive Director. May 2013.

*Zachary L. Penney*

University of Idaho Outstanding Graduate Student - Fisheries, and Outstanding College of Natural Resources Graduate Student, 2013-2014

American Fisheries Society, Outstanding student oral presentation. American Fisheries Society, Annual Meeting Little Rock Arkansas, September.

*Mike Quist*

2014 Outstanding Mentor Award, Idaho Chapter of the American Fisheries Society

2014 Best Student Poster Award, Annual Meeting of the Colorado-Wyoming Chapter of the American Fisheries Society (co-author with graduate students, C.J. Watkins and Z.B. Klein)

2014 Best Student Paper Award, Honorable Mention, Annual Meeting of the Oregon Chapter of the American Fisheries Society (co-author with graduate student, S.L. Whitlock)

2014 Best Student Paper Award, Annual Meeting of the Idaho Chapter of the American

## Awards, Publications and Outreach

- Fisheries Society (co-author with graduate student, C. J. Watkins)  
2014 Best Student Poster Award, Annual Meeting of the Idaho Chapter of the American Fisheries Society (co-author with graduate students, C. J. Watkins and Z. B. Klein)  
2013 Outstanding Research Award, College of Natural Resources (awarded to graduate student, J. L. McCormick)

### *Elliott Reams and Frank Wilhelm*

Selected as project mentor for (NSF) C.R.I.S.S.P R.E.U (Center for Research on Invasive Species and Small Populations, Research Experience for Undergraduates) student Garret Kratina. June 2013 - August 2013.

## PEER REVIEWED PUBLICATIONS FROM COOP RESEARCH ACTIVITIES

- Bakevich, B. D., C. L. Pierce, and M. C. Quist. 2013. Status, distribution, and habitat associations of Topeka shiners in west-central Iowa. *North American Journal of Fisheries Management* 33:1258-1268.
- Borgmann, K. L., C. J. Conway, and M. L. Morrison. 2013. Breeding phenology of birds: mechanisms underlying seasonal declines in the risk of nest predation. *PLoS ONE* 8(6): e65909. doi:10.1371/journal.pone.0065909.
- Bourret, S.L., B.P. Kennedy, C.C. Caudill, and P.M. Chittaro. Assessing the Feasibility of Geochemical Signatures to Distinguish Early Freshwater Movement, Habitat Use, and Life History of Chinook Salmon (*Oncorhynchus tshawytscha*). *Journal of Fish Biology*. *In revision*.
- Buelow, J., and C. M. Moffitt. 2014. Physiological indices of seawater readiness in postspawning steelhead kelts. *Ecology of Freshwater Fish*. published online: 25 February 2014, doi: 10.1111/eff.12130
- Connor, W. P., K. F. Tiffan, J. M Plumb, and C. M. Moffitt. 2013. Evidence for density-dependent growth opportunity as a factor for changes in downstream movement timing and body size of subyearling Chinook salmon. *Transactions of the American Fisheries Society* 142:1453-1468.
- 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 x-x in G. Cross, J. Olden, and M. Krosek, editors. *Conservation of freshwater fish*. Cambridge University Press, United Kingdom.
- Dzul, M. C., M. C. Quist, S. J. Dinsmore, D. B. Gaines, and M. R. Bower. 2013. Coarse-scale movement patterns of a small-bodied fish inhabiting a desert stream. *Journal of Freshwater Ecology* 28:27-38.
- Dzul, M. C., P. M. Dixon, M. C. Quist, S. J. Dinsmore, M. R. Bower, K. P. Wilson, and D. B. Gaines. 2013. Using variance components to estimate power in a hierarchically nested sampling design: improving monitoring of larval Devils Hole pupfish. *Environmental Monitoring and Assessment* 185:405-414.

- Dzul, M. C., S. J. Dinsmore, M. C. Quist, D. B. Gaines, K. P. Wilson, M. R. Bower, and P. M. Dixon. 2013. A simulation model of the Devils Hole pupfish population using monthly length frequency distributions. *Population Ecology* 55:325-341.
- Fischer, J. R., and M. C. Quist. *In press*. Characterizing lentic freshwater fish assemblages using multiple sampling methods. *Environmental Monitoring and Assessment*.
- Fischer, J. R., R. M. Krogman, and M. C. Quist. 2013. Influences of native and non-native benthivorous fishes on aquatic ecosystems degradation. *Hydrobiologia* 711:187-199.
- Gillette, G.L., K. P. Reese, P. S. Coates, J. M. Knetter, J. P. Romero, C. J. Colt, and S. Peterson. 2013 The efficacy of aerial infrared videography for conducting prairie grouse lek counts. The Wildlife Society Annual Meeting, Milwaukee, WI, October.
- Kratina, G., Reams, E., Wilhelm, F.M. Length discrimination of zooplankton in five mesh sizes while filtering preserved samples. *in prep*.
- Lankford, A.J., L.K. Svancara, J.J. Lawler, and K. Vierling. 2014. Comparison of climate change vulnerability assessments for wildlife. *Wildlife Society Bulletin (in press)*.
- Macías-Duarte, A., and C. J. Conway. Patterns in deuterium ratios of burrowing owl feathers: implications for tracking raptor movements in western North America. *Auk*, acceptable pending revision.
- McCormick, J. L., M. C. Quist, and D. J. Schill. 2013. Creel survey designs for short-duration Chinook salmon fisheries. *North American Journal of Fisheries Management* 33:977-993.
- McCormick, J. L., M. C. Quist, and D. J. Schill. 2013. Self-reporting bias in Chinook salmon sport fisheries in Idaho: implications for roving creel surveys. *North American Journal of Fisheries Management* 33:723-731.
- Moffitt, C. M. 2013. Cooperative Research Unit Corner: Collaborations to Prevent the Spread of Aquatic Invasive Species Outdoor News Bulletin August 2013. Wildlife Management Institute.
- 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. Pp XX in W. H. Wong and S. Gerstenberger, editors. *Biology and management of invasive quagga and zebra mussels in the Western United States*. CRC press.
- Nadeau, C. P., C. J. Conway, L. Piest, and B. Burger. 2013. Multi-species call-broadcast improved detection of endangered Yuma clapper rail compared to single-species call-broadcast. *Wetlands* 33:699-706. DOI: 10.1007/s13157-013-0425-x.
- 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. 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. 2013. Histological assessment of organs in sexually mature and post-spawning steelhead trout and insights into iteroparity. *Reviews in Fish Biology and Fisheries*. DOI 10.1007/s11160-013-9338-2.
- Porter, N. J., T. F. Bonvechio, J. L. McCormick, and M. C. Quist. *In press*. 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*.
- Smith, C. D., J. R. Fischer, and M. C. Quist. *In press*. Historical changes in Nebraska's lotic fish assemblages: a case study and review of endemic species' conservation statuses for the Great Plains. *American Midland Naturalist*.
- Steidl, R. J., C. J. Conway, and A. Litt. 2013. Power to detect trends in abundance of secretive marsh birds: effects of species traits and sampling effort. *Journal of Wildlife Management* 77:445-453.
- Stockton, K. and C. M. Moffitt. 2013. Disinfection of three wading boot surfaces infested with New Zealand mudsnails. *North American Journal of Fisheries Management* 33:529-538.
- Suronen, E.F. and B.A. Newingham. 2013. A starting point: An ecosystem of reference for habitat restoration of the northern Idaho ground squirrel, *Urocitellus brunneus*. *Northwestern Naturalist*. 94:110-125.
- Suronen, E.F. and B.A. Newingham. 2013. Restoring habitat for the northern Idaho ground squirrel (*Urocitellus brunneus*): Effects of prescribed burning on dwindling habitat. *Forest Ecology and Management*. 304:224-232.
- White, G., J. Claussen, C. Moffitt, B. Norcross, and D. Parrish. 2013. Dr. J. Frances Allen: pioneer of women in fisheries. *Fisheries* 38:103-111.
- Wilhelm, F. M, Reams, E., Rohrbacher, M., and Dux, A. Use of ethanol or formaldehyde preservative does not affect estimates of a zooplankton quality index. Submitted to *Inland Waters*.

## BOOKS AND BOOK CHAPTERS

- Moffitt, C. M., Z. L. Penney, and L. Cajas Cano 2014. Reconnecting people to their natural environment. in W. Taylor and A. Lynch, editors. *The future of fisheries: perspectives for the next generation of professionals*. American Fisheries Society. Bethesda, MD.
- Schultz, R. D., A. L. Fowler, J. M. Goeckler, and M. C. Quist. 2013. Comparisons of growth for hybrid striped bass in North America. Pages 219-227 in J. S. Bulak, C. C. Coutant, and J. A. Rice, editors. *Biology and management of inland striped bass and hybrid striped bass*. American Fisheries Society, Symposium, Bethesda, Maryland.
- Schultz, R. D., J. M. Goeckler, and M. C. Quist. 2013. Size-based mortality caps as thresholds for managing hybrid striped bass in Kansas reservoirs. Pages 461-472 in J. S. Bulak, C. C. Coutant, and J. A. Rice, editors. *Biology and management of inland striped bass and hybrid striped bass*. American Fisheries Society, Symposium, Bethesda, Maryland.



## TECHNICAL AND SEMI-TECHNICAL REPORTS

- Bourret, S.L., C.C. Caudill, B.P. Kennedy, L. Borgerson, and B. Clemens. 2013. Comparative growth, survival, and life history of reservoir and tributary reared spring Chinook salmon in the Willamette River Basin: implications for otolith and scale methodologies. UI FERL report 2013-7-DRAFT for the US Army Corps of Engineers, Portland District.
- Dillon, K., and C. J. Conway. 2013. Ecological Causes of Elevational Gradients in Avian Clutch Size. Report to T&E, Inc. Wildlife Research Report #2013-01, U.S. Geological Survey, Arizona Cooperative Fish and Wildlife Research Unit, Tucson, AZ.

## THESES AND DISSERTATIONS

- Bourret, S. L. 2013. Salmon Life History in an altered landscape: reconstructing juvenile migration using chemical and structural analysis. Fish and Wildlife Sciences. MS Thesis.
- Colin Heath. 2013-2014. Measures to control aquatic invasive mollusks. Senior Thesis, Environmental Science.
- Dillon, K. 2013. Ecological Causes of Elevational Gradients in Avian Clutch Size. M.S. Thesis, School of Natural Resources and the Environment, University of Arizona, Tucson, AZ.
- Hewitt, Heath. 2013. Otolith aberrancy in hatchery Steelhead. Environmental Science Senior Thesis.
- Lankford, Amber J. 2013. Climate change vulnerability of terrestrial wildlife: An Idaho case study. M.S. Thesis, College of Natural Resources, University of Idaho.
- Olsen, Dani. 2013-2014. Survey of Asian clam infestations in Lake Pend Oreille, ID. Environmental Science Senior Thesis.
- Parks, Timothy. 2013. Fish assemblages in Iowa's nonwadeable rivers: distribution, relative abundance, and relations with instream habitat and barriers to movement. MS. Thesis.
- Penney, Z. L., 2013. Physiological and energetic constraints of iteroparity in steelhead trout (*Oncorhynchus mykiss*). PhD dissertation.
- Smith, Christopher. 2013 Assessment of sampling techniques and fish assemblage structure in large western river systems. M.S. thesis
- Suronen, E.F. 2012. Establishing references sites and evaluating thinning and burning as restoration tools for the northern Idaho ground squirrel (*Urocitellus brunneus*) MS. thesis.
- Walrath, John. 2013. Population dynamics and trophic ecology of northern pike and smallmouth bass in Coeur d'Alene Lake: implications for the conservation of westslope cutthroat trout. M.S. thesis
- Whitlock, Steven. 2013. Kokanee spawning ecology and recruitment response to water level management in Lake Pend Oreille. MS Thesis.

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

- Aycrigg, J. L., J. Sauer, D. Fink, D. Mehlman, K. V. Rosenberg, L. L. Dornak, and C. J. Conway. 2013. National survey and observational databases inform bird conservation efforts. The Wildlife Society, Milwaukee, WI. 8 October 2013.
- Barenberg\*, A., C. M. Moffitt and B. J. Watten. 2013 Elevated pH as a disinfection tool against three invasive mollusks of concern. Annual Meeting, American Fisheries Society. Little Rock AR. 8-12. September.
- Barenberg\*, A., C. M. Moffitt, and B. J. Watten. 2013 Washington State Lake Protection Association (WALPA) and Oregon Lake Management Association. Vancouver, WA. 16-18 October.
- Bourret, S.\*, B.P. Kennedy, C.C. Caudill, and L. Borgerson. 2013. Characterizing life history patterns in UWR Chinook salmon (*Oncorhynchus tshawytscha*) reared above WVP reservoirs. USACE Willamette Basin Fisheries Science Review, Corvallis, OR.
- Cajas Cano\*, L. and C. M. Moffitt. 2013 Life cycle assessment (LCA) of marine mussels production in Washington, US. Western Division American Fisheries Society, Boise, ID 17 April.
- Connelly, J.W., C. J. Conway, D. Kemner, K. Launchbaugh, W. Pratt, K. P. Reese, E. T. Rinkes, J. Robison, E. Strand, and J. Whiting. 2013. Grouse and Grazing in Idaho: a collaborative approach to answering difficult questions. Idaho Chapter of The Wildlife Society. Coeur d'Alene, Idaho. 13 March 2013.
- Conway, C. J. 2013. Critical thinking and the ethics of co-authorship. Behind the Scenes of Scientific Publication and Critical Review Workshop. The Wildlife Society, Milwaukee, WI. 5 October 2013. INVITED. Panel Speaker.
- Conway, C. J. 2013. Stakeholder reflections on collective challenges. Idaho Department of Fish and Wildlife Bureau of Wildlife Summer Meeting, Coeur d'Alene, Idaho. 11 Sep 2013. INVITED. Panel Speaker.
- 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.
- Dillon, K. G., and C. J. Conway. 2013. Does nest predation or food limitation explain the elevational gradient in clutch size in Red-faced Warblers? Joint Meeting of

- the American Ornithologists' Union and Cooper Ornithological Society, Chicago, IL. 15 Aug 2013.
- 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. L. Aycrigg. 2013. Does the protected areas network in the US adequately protect birds of conservation concern? Joint Meeting of the American Ornithologists' Union and Cooper Ornithological Society, Chicago, IL. 16 Aug 2013.
- Fischer, J. R., and M. C. Quist. 2013. Understanding fish assemblage structure in lentic ecosystems: relative effects of abiotic factors and management legacies. 143<sup>rd</sup> Annual Meeting of the American Fisheries Society, Little Rock, Arkansas, September 11. PLATFORM.
- Garcia, M. G., and C. J. Conway. 2013. Influence of temperature, precipitation and vegetation on burrowing owl occupancy and abundance. 46<sup>th</sup> Joint Annual Meeting of the Arizona/New Mexico Chapters of The Wildlife Society and American Fisheries Society. 8 Feb 2013.
- 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.
- Johnson, D.H., T.I. Wellicome, C. J. Conway, J. Rebholz, 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. 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.
- Lankford, A., L.K. Svancara, J.J. Lawler, and K. Vierling. 2013. Comparison of climate change vulnerability assessments for wildlife. 49<sup>th</sup> Annual Meeting of the Idaho Chapter of The Wildlife Society, Coeur d' Alene, Idaho. 11-14 March.
- Lankford, A., L. Svancara, and K. Vierling. 2013. Spatial climate change risk assessment for wildlife: An Idaho case study. 4th Pacific Northwest Climate Science Conference. Portland, Oregon. 5-6 September.
- Lundblad, C. G., and C. J. Conway. 2013. Access to food and not intolerance of cold drives altitudinal migration of Yellow-eyed Juncos. Joint Meeting of the American Ornithologists' Union and Cooper Ornithological Society, Chicago, IL. 16 Aug 2013.
- McCormick, J.L., M.C. Quist, and D.J. Schill. 2013. Self-reporting bias in Idaho Chinook salmon sport Fisheries: implications for roving creel surveys. Joint

## Awards, Publications and Outreach

- Meetings of the Idaho Chapter and Western Division of the American Fisheries Society, Boise, Idaho, April 17.
- Moffitt, C.M. and A. Barenberg. Asian clams infestations and Lake Pend Oreille. Invasive Aquatic Species Treatment Prevention and Education in the Northern Interior Columbia Basin. Dover City Hall, ID. 28 March 2013. (presented by Barenberg due to travel restrictions)
- Moffitt, C.M. Invasive mollusks: what are the risks and what can we do? (paper presented by K. Stockton due to sequester). Western Division, AFS, Boise, ID 15-18 April 2013.
- Moffitt, C. M. 2013. Initiating dialog needed to diversify natural resources management. American Fisheries Society 143rd annual meeting, Little Rock, AR. September.
- Moffitt, C. M. 2013 Dynamics of social values and fish culture. Hatcheries and management of aquatic resources special session at American Fisheries Society annual meeting, Little Rock, AR. 8-12 September.
- Moffitt, C.M. 2013 Plenary and business meeting Awards Ceremonies. Annual Meeting of the American Fisheries Society, Little Rock, AR, 8-12 September.
- Moffitt\*, C. M., Watten, B., and A. Barenberg. 2013 Elevated pH: an effective, economical and safe tool to control release of invasive species. American Water Resources Association. Annual Meeting. Portland, OR. 4-7 November.
- Moffitt, C. M. 2013 Tools to manage and prevent the spread of invasive invertebrate species in fish culture operations. Northwest Fish Culture Conference, Boise, ID. 3-5 December.
- Moffitt, C.M. 2013 Social values and their influence on fish culture. Northwest Fish Culture Conference, Boise, ID. 3-5 December.
- 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.
- Oleson, B. I., and C. J. Conway. 2013. Of Owls and Alfalfa: Why do Burrowing Owls Associate with Irrigated Agriculture in the Southwestern U.S.? 46<sup>th</sup> Joint Annual Meeting of the Arizona/New Mexico Chapters of The Wildlife Society and American Fisheries Society. 8 Feb 2013.
- Oleson, B. I., and C. J. Conway. 2013. Of Owls and Alfalfa: Why do Burrowing Owls Associate with Irrigated Agriculture in the Southwestern U.S.? Colorado River Terrestrial and Riparian (CRTR) Conference, Laughlin, NV, 30 Jan 2013.
- Parks, T. P., M. C. Quist, and C. L. Pierce. 2013. Historic shifts in fish assemblages in Iowa's nonwadeable rivers; new analyses for a new retrospective. 25<sup>th</sup> Annual Meeting of the North Central Division of the American Fisheries Society - Rivers and Streams Technical Committee, Rock Island, Illinois, March 27. PLATFORM.
- Penney\*, Z. L., and C. M. Moffitt. (oral). 2013 Finding death: the relationship between energy and iteroparity in steelhead trout. AFS/Sea Grant best student presentations. Annual Meeting, American Fisheries Society. Little Rock AR. 9 September.

- Penney, Z. and C. M. Moffitt. (oral). 2013 Histological assessment of selected tissues in maturing and post spawning Snake River steelhead. Western Division American Fisheries Society, Boise, ID 17 April.
- Quist, M. C., M. E. Mather, D. L. Parrish, S. R. Chipps, T. J. Kwak, and C. P. Paukert. 2013. The voices of reality: why effective fisheries education is challenging and practical ways to move forward. 143<sup>rd</sup> Annual Meeting of the American Fisheries Society, Little Rock, Arkansas, September 11. PLATFORM.
- Reams, Elliott, Frank Wilhelm & Andy Dux. 32nd International Symposium of the North American Lake Management Society. November 8th, 2012. Madison, WI. Influences of Climate Change on the Annual Thermal Stratification of a Large Oligotrophic Lake.
- Reams Elliott, Frank Wilhelm & Andy Dux. Eastern Washington / North Idaho Regional Lakes Conference, Spokane, WA. February 9th, 2013. Changes in the thermal stratification of Lake Pend Oreille.
- Reams, Elliott, Frank Wilhelm & Andy Dux. Western AFS 2013 annual meeting. Boise, Idaho. April 17th, 2013. Zooplankton size structure as an indicator of productive stocking sites.
- Reams, Elliott, Frank Wilhelm & Andy Dux. Pend Oreille Basin Commission, Dover, Idaho. April 22, 2013. Changes in the thermal stratification of Lake Pend Oreille.
- Reams, Elliott, Frank Wilhelm & Andy Dux. 33rd International Symposium of the North American Lake Management Society. November 31st, 2013. San Diego, CA Zooplankton size structure as an indicator of productive stocking sites.
- 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.
- 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. 2013. Comparison of techniques for sampling juvenile burbot in lotic systems. Joint Meetings of the Idaho Chapter and Western Division of the American Fisheries Society, Boise, Idaho, April 16. PLATFORM.
- Smith, C. D., M. C. Quist, and R. S. Hardy. 2013. Comparing sampling techniques for burbot in riverine systems: an occupancy modeling approach. 143<sup>rd</sup> Annual Meeting of the American Fisheries Society, Little Rock, Arkansas, September 11. PLATFORM.
- Walrath, J. D., M. C. Quist, and J. A. Firehammer. 2013. Population dynamics of northern pike and smallmouth bass in Coeur d'Alene Lake, Idaho. Joint Meetings of the Idaho Chapter and Western Division of the American Fisheries Society, Boise, Idaho, April 16. PLATFORM.
- Walrath, J. D., M. C. Quist, and J. A. Firehammer. 2013. Seasonal food habits of northern pike and smallmouth bass in Lake Coeur d'Alene, Idaho. Lake Roosevelt Forum Conference, Spokane, Washington, November 19. PLATFORM.



- Walrath, J. D., M. C. Quist, and J. A. Firehammer. 2013. Seasonal food habits of northern pike and smallmouth bass in Lake Coeur d'Alene. 143<sup>rd</sup> Annual Meeting of the American Fisheries Society, Little Rock, Arkansas, September 10. PLATFORM.
- 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., J. R. Yates†, and M. C. Quist. 2013. Precision of hard structures used to estimate age of common carp. 143<sup>rd</sup> Annual Meeting of the American Fisheries Society, Little Rock, Arkansas, September 10. POSTER.
- Watkins, C. J., M. C. Quist, and B. B. Shepard. 2013. Fish assemblage structure between side- and main-channel habitats of the Kootenai River, Idaho. Joint Meetings of the Idaho Chapter and Western Division of the American Fisheries Society, Boise, Idaho. April 17. POSTER.
- 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. 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, B. B. Shepard, and S. P. Young. 2013. Fish assemblages in the Kootenai River, Idaho: description of structure and implications for management. 143<sup>rd</sup> Annual Meeting of the American Fisheries Society, Little Rock, Arkansas, September 11. 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.
- Whitlock, S. L., M. C. Quist, and A. M. Dux. 2013. Habitat characteristics influencing shore-spawning kokanee incubation success in Lake Pend Oreille, Idaho. 32<sup>nd</sup> International Kokanee Workshop, Fort Collins, Colorado, February 13. PLATFORM.
- Whitlock, S. L., M. C. Quist, and A. M. Dux. 2013. An *in situ* egg box experiment to assess kokanee shore-spawning incubation success Lake Pend Oreille, Idaho. Joint Meetings of the Idaho Chapter and Western Division of the American Fisheries Society, Boise, Idaho, April 17. PLATFORM.
- Whitlock, S. L., M. C. Quist, and A. M. Dux. 2013. Evaluation of water level management as a tool for enhancing shore-spawning kokanee recruitment in



## Awards, Publications and Outreach

- Lake Pend Oreille, Idaho. 33<sup>rd</sup> International North American Lake Management Society Symposium, San Diego, California, October 30. PLATFORM.
- Whitlock, S. L., M. C. Quist, and A. M. Dux. 2013. Kokanee recruitment response to water level management in Lake Pend Oreille, Idaho. 143<sup>rd</sup> Annual Meeting of the American Fisheries Society, Little Rock, Arkansas, September 10. PLATFORM.
- Whitlock, S. L., M. C. Quist, and A. M. Dux. 2013. Optimizing Mysis shrimp sampling efforts in Lake Pend Oreille, Idaho. 143<sup>rd</sup> Annual Meeting of the American Fisheries Society, Little Rock, Arkansas, September 10. POSTER.
- 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.
- 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. 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.
- Yates, J. R., C. J. Watkins, and M. C. Quist. 2013. Evaluation of calcified structures for estimating ages of common carp. Joint Meetings of the Idaho Chapter and Western Division of the American Fisheries Society, Boise, Idaho, April 17. POSTER.

## TECHNICAL ASSISTANCE OUTREACH AND PROFESSIONAL SOCIETY ACTIVITIES

### *Outreach presentations and workshops*

- Moffitt, C. M. 2014 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.
- Moffitt, C. M. 2014 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, Wenatche, WA. 5 March.
- Cajas Cano, L. 2013 – 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.

*Editorial and Professional Society Boards, and other Activities*

*Courtney J. Conway*

Invited member of a USFWS steering committee on marsh bird management and research programs. 2011-present.  
Invited to serve as Associate Editor for the peer-reviewed journal *Wetlands*. 2011-present.  
Invited by USFWS Regional Director to serve on the Masked Bobwhite Recovery Team, 2008-present.

*Christine M. Moffitt*

Associate Editor, Transactions of the American Fisheries Society. 2005 - present  
Member, Search and Selection Committee for Executive Director, American Fisheries Society. 2012-2013.  
Chair, American Fisheries Society Award of Excellence Committee. 2013-2014.  
Advisor, Palouse Unit of Idaho Chapter, American Fisheries Society.  
Member, 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. 2013.  
Member, Fisheries Strategic Plan Steering Committee for USFWS, Sport Fishing and Boating Partnership. 2012 - 2013.  
Bi-national Agricultural Research and Development Fund proposals. 2011-2013.  
Participant, 100<sup>th</sup> Meridian Initiative - Columbia River Basin Team Participant  
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.  
University of Idaho Committee Assignments:  
Committee for design engineering Aquaculture Research relocation. 2014  
CNR Promotion Committee. September - December 2013  
Lead for wet laboratory safety and repairs projects April – June 2012

*Michael C. Quist*

Education Section of the American Fisheries Society, Immediate Past-President. 2012-present  
Education Section of the American Fisheries Society, President 2011-2013  
Search Committee, Department Head, Department of Fish and Wildlife Sciences, University of Idaho. 2013-2014  
Search Committee, Population Ecologist, Department of Fish and Wildlife Sciences, University of Idaho. 2012-2013  
Teaching Experience:  
2013: Fish and Wildlife Seminar (2 semesters), Ecological Thresholds, Advanced Fisheries Techniques

## Awards, Publications and Outreach

### Undergraduate Research Mentoring:

Jeffrey Johnson. 2013-present. Food habits and prey selection of juvenile burbot.  
Expected graduation: December 2014.

Jarrold Yates. 2012-2013. Precision of hard structures for aging common carp and the influence of sectioning location on age estimates. Initial employment: Fisheries Technician, Idaho Department of Fish and Game.

Nicholas Porter. 2010-2013. Age structure and growth of bowfin in Lake Lindsay Grace, Georgia. Initial employment: Fisheries Technician, University of Idaho.

### *Natural resource organization and agency service:*

“Age and growth of fishes” workshop, Idaho Department of Fish and Game, Biologist Training, Boise, Idaho. 2014

Kootenai River Technical Advisory Committee. 2012-present