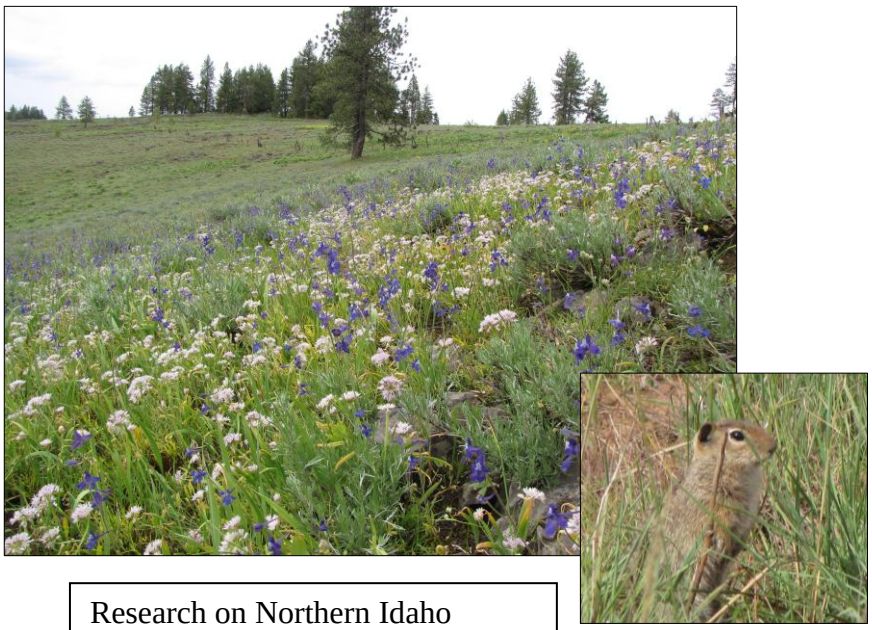
Report to Cooperators

Idaho Cooperative Fish and Wildlife Research Unit

1 January 2012 to 31 December 2012

Juan Ortiz-Perez, Tasha Britton and Charlie Withers-Haley processing Asian clam samples in CNR wetlab.



Research on Northern Idaho Ground Squirrels near New Meadows is designed to test effectiveness of forest restoration treatments.

University of Idaho

Cover Photos: Carson Watkins (left) and Steve Whitlock (right) with a white sturgeon sampled on the Kootenai River, Idaho.
Pair of Burrowing Owls nesting in eastern Washington are part of DoD funded study on migration.

REPORT TO COOPERATORS
1 January 2012 — 31 December 2012

IDAHO COOPERATIVE
FISH AND WILDLIFE RESEARCH UNIT

6TH AND LINE STREETS
DEPARTMENT OF FISH AND WILDLIFE SCIENCES
875 PERIMETER DRIVE MS 1141
COLLEGE OF NATURAL RESOURCES
UNIVERSITY OF IDAHO
MOSCOW, ID 83844-1141
208-885-6336
208-885-9080 (FAX)
idahocoop@uidaho.edu
http://www.uidaho.edu/cnr/research/researchprograms/coop
http://www.coopunits.org/Idaho/

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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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. Resent 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

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

Candy Ihm
Program Specialist
(208) 885-6336
cihm@uidaho.edu

Christine M. Moffitt
Assistant Unit Leader
(208) 885-7047
cmoffitt@uidaho.edu

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

Unit Cooperators

UNIVERSITY OF IDAHO
Kurt Pregitzer, Dean
College of Natural Resources

Kerry P. Reese, Head
Department of Fish and Wildlife Sciences
875 Perimeter Drive MS 1141
Moscow, ID 83844-1141

IDAHO DEPARTMENT OF FISH AND GAME
Virgil Moore, Director
Jim Unsworth, Deputy Director
Jeff Gould, Wildlife Bureau Chief
Ed Schriever, Fisheries Bureau Chief
600 South Walnut
P.O. Box 25
Boise, ID 83707

U.S. GEOLOGICAL SURVEY
Suzette Kimball, Acting Director
12201 Sunrise Valley Drive, MS 303
Reston, VA 20192

COOPERATIVE RESEARCH UNITS
Kevin Whalen, Acting Chief
Joseph Margraf, Regional Supervisor
12201 Sunrise Valley Drive, MS 303
Reston, VA 20192

U.S. FISH AND WILDLIFE SERVICE
Brian T. Kelly, Supervisor
Idaho State Office
Stephen Zylstra, Acting 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, Emeriti, and other Faculty Cooperators with Unit Projects in 2012

Christopher Caudill, Research Assistant Professor
Kathleen (Katy) Kavanagh, Professor
Brian Kennedy, Associate Professor
Beth Newingham, Assistant Professor
Janet Rachlow, Associate Professor
Kerry Reese, Professor and Department Head
Kerri Vierling, Associate Professor
Lisette Waits, Professor
Frank Wilhelm, Associate Professor

Graduate Students on Coop Unit Projects 2012

* indicates completed

Student	Discipline	Adviser
*Jennifer Adams	Ph.D. Wildlife Resources	L. Waits
Amber Barenberg	M.S. Fishery Resources	C. M. Moffitt
Samuel Bourret	M.S. Fishery Resources	B. Kennedy, C. Caudill
Lubia Cajas Cano	Ph. D. Environmental Science	C. M. Moffitt
*Timothy Caldwell	M.S. Fisheries Resources	F. Wilhelm
Marika Dobos	M.S. Fishery Resources	M. Quist
Trisha Giambra	M.S. Environmental Sciences	C. M. Moffitt
Gifford Gillette	Ph.D. Wildlife Resources	K. P. Reese
Amanda Goldberg	Ph.D. Wildlife Resources	C. Conway
*Richard Hartman	M.S. Fishery Resources	B. Kennedy
Benjamin Ho	M.S. Fishery Resources	C. Caudill
*Bryan Jones	M.S. Fishery Resources	C. M. Moffitt
Zach Klein	M.S. Fishery Resources	M. Quist
Amber Lankford	M.S. Wildlife Resources	K. Reese, K.Vierling
*Josh McCormick	M.S. Fishery Resources	M. Quist
Marius Myrvold	Ph.D. Water Resources	B. Kennedy, C. Caudill
Elizabeth Ng	M.S. Fishery Resources	M. Quist
Christopher Noyes	M.S. Fishery Resources	C. Caudill
Zachary Penney	Ph.D. Natural Resources	C. M. Moffitt
*John Plumb	Ph.D. Natural Resources	C. M. Moffitt
*Maggie Picard	M.S. Environmental Science	C. M. Moffitt
Elliott Reams	Ph.D. Fishery Resources	F. Wilhelm
*Adrienne Roumasset	M.S. Fishery Resources	C. Caudill
Chris Smith	M.S. Fishery Resources	M. Quist
*Carisa Stansbury	M.S. Environmental Science	L. Waits
*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
*Bonnie Woods	M.S. Wildlife Resources	J. Rachlow

Current 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) U.S. Army Corps of Engineers Portland District
Funding Agency:	USGS – RWO 144
Completion Date:	31 May 2013

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 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 $^{87}Sr/^{86}Sr$ 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.

We found that a substantial portion of sampled juvenile Chinook salmon rear in project reservoirs and emigrate from freshwater 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. 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.

Qualitative observations suggest that survival to adulthood is relatively high for reservoir-reared juveniles but that out-migration survival may be lower. Characterizing life history types and developing monitoring methods is a necessary first step to quantifying juvenile habitat use, emigration ecology, and the relative fitness of life history types. In particular, determining the relative fitness of rearing types will assist in estimating the potential benefits of alternative management options such as improved downstream dam passage for juvenile salmon vs. head-of-reservoir collection and transport around dams.

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:	Summer 2013

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.

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
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.

Progress:

Within their native distribution, steelhead trout are iteroparous and the proportion of fish observed repeat spawning varies from ~ 50% to < 1%. In the Snake and Columbia river systems, fish passage facilities at hydroelectric dams were not designed or constructed to accommodate downstream-migrating, post spawning steelhead adults (kelts). Our research focus is to understand and pose a model of the physiology and sequence of changes in pre - and post-reproductive steelhead trout in the Snake River system that tests factors affecting stock iteroparity. Inland maturing steelhead have a protracted fasting period in freshwater before spawning, and there is little known of the physiology during this long fast. Student Zachary Penney has concentrated on examining in detail the energetics of this process. We have prepared a manuscript describing the changes in proximate composition through pre to post spawning. Another manuscript was prepared a result of participating in a symposium at the AFS meeting in St. Paul that brought scientists together to compare Atlantic to Pacific salmon.

This manuscript will be submitted for a special issue in *Reviews in Fish Biology and Fisheries* entitled "Histological comparison of tissues in reproductive and post reproductive steelhead to understand the capacity for iteroparity". Our analyses found that tissues such as the spleen and liver maintain their cellular integrity throughout the long fasting period and the stomach of many kelts begins to show readiness to resume feeding. Ovaries examined in kelts show a proportion of early maturing oocytes indicating the capacity to spawn again.

Graduate student Bryan Jones defended his master's thesis in the fall (2012) and has completed final thesis submission. His focus was to compare demographics, migration patterns, and physiological metrics of steelhead kelts early in their downstream migration after spawning, with kelts tagged at the uppermost dam on the Snake River, Lower Granite Dam, Washington. We found kelts in good external condition had higher blood plasma nutritional metrics, lower tissue damage factors, and higher electrolytes than kelts in fair or poor condition. From our data base, we identified 8 kelts that we tagged had returned as spawners. However, none of those fish were detected migrating through juvenile fish bypass systems after they were released as kelts, suggesting that their successful downstream migration was likely spillway passage. To better understand preferred route of passage, we surgically implanted acoustic tags in kelts captured from free flowing and impounded sections of the Snake and Columbia river basins. In 2011, kelts tagged with acoustic tags at tributary sites were detected successfully migrating through the free-flowing Clearwater River and most (88%) were detected reaching the Lower Granite Dam forebay. However, only 9% were detected migrating in the Lower Columbia River below Bonneville Dam, suggesting mortality of the majority of the kelts in the impounded portion of river between Lower Granite and Bonneville dams.

Bryan Jones continues to track steelhead kelt in the Snake River as he was hired in April 2012 by the Pacific Northwest National Laboratory, in Richland, WA.

Zach Penney at Lower Granite Dam Kelt facility weighing sampled steelhead.

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

Principal Investigator:	Christine M. Moffitt
Collaborating Investigators:	Barnaby J. Watten, USGS
Field research site	Willow Beach NFH
Graduate Student:	Amber Barenberg
CRISSP NSF REU	Mindy P. Torres
HOIST intern	Marilena Gartiez
EPSCoR REU and Env. Science senior thesis	Justin Shearer
Undergraduate assistants:	Tasha Britton
	Charlie Withers-Haley
	Jenna Davis
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.

Progress:

The National Park Service (NPS) has identified a need for methods that can be used 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. These studies are part of a multidisciplinary team effort in the US Geological Survey (USGS) 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 are the direct 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 has tested quagga mussels, Asian clams, and New Zealand mudsnails in laboratory tests to determine killing rate at different temperatures. Our goal is to model the time to complete mortality of these selected resistant invertebrate species. We have conducted trials with quagga mussels at Willow Beach National Fish Hatchery, AZ. Other trials have been conducted in the CNR Fisheries wet laboratory. We anticipate testing our tools on board the Ranger III to establish efficacy in field applications of ballast tanks. If successful this application will provide an inexpensive and effective method for treating ballast systems to assure that no harmful species are released into the environment. We have prepared a draft manuscript for a book chapter on quagga mussel control.

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 2013

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.

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.

Progress:

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 has a goal of enhancing the opportunities for collaboration between tribal and selected state scientists to complete manuscripts comparing Snake River steelhead populations with those from other regions, especially Alaska. We plan to compete and submit for publication a manuscript comparing characteristics of migrating steelhead kelts from the Snake/Columbia River populations and those from the Situk River, AK.

In addition to the research and manuscript collaborations, this project provides support for graduate student Zach Penney to travel to Washington DC and other locations to interact with federal agency and others engaged in Native American natural resource policy. We plan for Penney to visit the office of Cooperative Research Units, and the Tribal Liason Monique Fordham in the USGS. We have already engaged with USFWS tribal liason, Pat Durham, who will also arrange for in person meetings with key DOI and other governmental and NGO professionals. Penney will present a seminar on some of his research and his educational background. The meetings will be scheduled during a time appropriate to have the opportunity of several meetings, and opportunities to shadow key program leaders and managers. The goals of these interactions are to explore post graduate opportunities for Native American scientists such as Penney in the executive branch and elsewhere.

POPULATION STRUCTURE, DYNAMICS, AND FOOD HABITS OF NORTHERN PIKE AND SMALLMOUTH BASS IN COEUR D'ALENE LAKE: POTENTIAL EFFECTS ON ADFLUVIAL CUTTHROAT TROUT AND MANAGEMENT ALTERNATIVES

Principal Investigator:	Michael C. Quist
Student Investigator:	John Walrath
Collaborating Investigator:	Jon 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.
- Evaluate alternatives for managing northern pike and smallmouth bass populations within the context of adfluvial westslope cutthroat trout conservation efforts.

Progress:

The Coeur d'Alene Tribe has recently documented poor survival of adfluvial westslope cutthroat trout *Oncorhynchus clarkii* originating from Lake and Benewah creeks (small tributaries to Coeur d'Alene Lake). Although a number of factors likely contribute to mortality of cutthroat trout in the system, low survival is thought to be primarily due to intensive predation by northern pike *Esox lucius* and smallmouth bass *Micropterus dolomieu* in Coeur d'Alene Lake. Research has shown that the introduction of northern pike and smallmouth bass in the western United States has had a detrimental effect on native fishes. To assess northern pike and smallmouth effects on cutthroat trout in Coeur d'Alene Lake, sampling was conducted at four locations during 2012: Cougar, Wolf Lodge, and Windy bays, and Benewah Lake. Fish were sampled using two techniques: gill nets and boat electrofishing. Bimonthly sampling occurred in Windy Bay and Benewah Lake when adfluvial westslope cutthroat trout were outmigrating; monthly sampling occurred when cutthroat trout were not outmigrating. Cougar and Wolf Lodge bays were sampled monthly. Consumption of cutthroat trout and other prey items will be evaluated using a bioenergetics model. Bioenergetics models will also be coupled with yield-per-recruit models to evaluate management strategies for northern pike and smallmouth bass populations.

The study on Coeur d'Alene Lake began with intensive sampling in late March of 2012. Sampling occurred on 113 days, and 10,639 individual fishes representing 23 species were captured. Electrofishing effort totaled 46.3 hours and 471 gill nets were fished for 835.9 hours. We captured 481 northern pike, in which 382 were marked and 59 were recaptured. We also sampled 1,032 smallmouth bass, of which we marked 505 and recaptured 15. To date, seasonal catch rates, length-frequency distributions, proportional size distributions, and relative weights have been calculated for northern pike and smallmouth bass. Stomach samples were removed from 477 northern pike and 810 smallmouth bass, but have not been processed. Hard structures were also collected from 420 northern pike and 841 smallmouth bass and are currently being processed for age and growth analysis. Field work will resume in mid-March and continue through the end of May.

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:

- Describe the population dynamics and spawning characteristics of segregated kokanee breeding groups in Lake Pend Oreille.
- Evaluate the procedure for the estimation of lakeshore spawning kokanee egg-to-fry survival.
- Directly measure relationship between kokanee incubation success and spawning habitat characteristics.

Progress:

In the 1950s, Lake Pend Oreille (LPO) produced an average annual kokanee *Oncorhynchus nerka* harvest of over a million fish, while also providing a trophy bull trout *Salvelinus confluentus* and rainbow trout *O. mykiss* fisheries. Kokanee, which function as both a prey and sport fish species, declined precipitously beginning in the late 1960s following several biological and hydrological alterations to the lake. The most significant alteration is thought to be the initiation of winter lake level drawdowns associated with power production at Albeni Falls Dam. 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 primarily exist above the minimum winter lake elevation. Since 1996, the Idaho Department of Fish and Game has evaluated a lake level management strategy to determine if raising winter lake levels increase kokanee recruitment. The method for evaluating the lake 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 lake level management has been ongoing for more than 15 years, there are still three important gaps in information pertaining to the strategy and kokanee spawning ecology in general. First, the lake water level management strategy is intended to benefit shore-spawning kokanee, yet little is known about this ecotype's life history and how it compares to tributary spawners. Second, the properties of EF survival estimate, used to evaluate the effect of lake level, are untested and the estimate has no measure of variability with which to compare the recruitment response between the two lake level regimes. Lastly, the lake level management strategy assumes that winter lake elevation dictates the quality of substrate available for spawning, when the relationship between substrate composition and shoreline EF survival has not been adequately described. The goal of this project is to inform kokanee recovery efforts in

LPO by describing kokanee spawning ecology and examining the premise and recruitment metric underlying the lake level management strategy. The objectives for accomplishing this goal are to (1) describe population dynamics and spawning characteristics of spatially- and temporally-segregated kokanee spawning groups, to (2) evaluate the procedure for estimating lakeshore spawning kokanee EF survival, and to (3) use laboratory and *in situ* incubation experiments to directly measure the relationship between kokanee EF survival and spawning habitat characteristics.

Substantial progress was made in 2012 towards completing the first two objectives of this project. Segregated spawning groups of kokanee were sampled in fall 2011 and their life history (e.g., size-at-maturity) and spawning characteristics (e.g. egg size, fecundity) were compared. Segregated kokanee spawning groups differed significantly in size, sex ratio, and fecundity. Kokanee spawning in Scenic Bay were greater in length and had higher fecundity than spawners in tributaries, while shoreline spawners in other locations were the smallest in body size. The second objective of evaluating the EF survival estimation procedure was completed using piecewise sensitivity analysis and nonparametric bootstrapping. Both analyses revealed instability in the properties of the EF survival estimate and high interannual variability, which precludes the use of traditional parametric methods for testing the effect of lake elevation on kokanee recruitment using this estimate. Alternative methods, such as population modeling, are currently being explored as a means of retrospectively measuring the influence of lake level on kokanee recruitment.

A laboratory experiment and an *in situ* study were performed over the winter of 2011-2012 to measure how intragravel survival of kokanee is affected by habitat characteristics, particularly substrate composition. Substrate composition did not affect survival in laboratory experiment, although kokanee fry condition was poorest in the treatment with the highest proportion of fine sediment (< 0.83 mm). An *in situ* experiment was performed in three major shoreline spawning sites. The water level of LPO was maintained at 625.1 m in winter 2011-2012, so the effect of gravel made available by water level management could not be evaluated. Instead, a suite of habitat characteristics were measured at each egg box. Egg survival was not related to the depth of boxes and substrate composition alone was a poor predictor of egg survival. At several sites, dissolved oxygen and egg survival appeared to be enhanced by the presence of downwelling groundwater. These results suggest that spawning habitat on the shoreline of LPO may not be as limited as previously thought and that groundwater may play a role in spawning site selection. A second *in situ* study was initiated in November, 2012 that was composed of 60 randomly-selected sites, each containing six egg boxes (360 total boxes). Sites were allocated between current, historic, and unused spawning areas. Each site consists of three pairs of incubation boxes: with one positioned above and the other below the low water level (625.1 m). The probabilistic sampling method used in the second *in situ* study will allow conclusions about substrate composition and water level influence to be generalized across all spawning areas of LPO and the influence of lake level management on substrate character and EF survival to be measured directly, without relying on a tenuous population-level recruitment estimate.

ASSESSMENT OF SAMPLING TECHNIQUES FOR JUVENILE BURBOT IN THE KOOTENAI RIVER, IDAHO

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:

- Evaluate gear efficacies targeting juvenile burbot using several sampling techniques (e.g., hoop nets, benthic trawls, boat-mounted electrofishing).
- Determine the influence of habitat characteristics (e.g., temperature, depth, substrate type) on gear efficiency and juvenile burbot detectability.
- Describe juvenile burbot habitat use in large riverine systems.

Progress:

The lower Kootenai River burbot *Lota lota* population (i.e., downstream of Libby Dam, Montana) has declined in abundance over the past sixty years. Due to declines, a multiagency coalition was created and has initiated restoration efforts (e.g., habitat restoration, conservation aquaculture) to evaluate and (or) recover the burbot population. Increased effort has also been invested in monitoring the wild population. The focus of this project is to evaluate different sampling techniques for the capture of juvenile burbot in the Kootenai River, Idaho.

Although the focus of the project is on the Kootenai River, the Green River of Wyoming was selected as a secondary sampling location. The Green River was selected based on high burbot densities and habitat similarities (e.g., flow velocities, substrate size) with the Kootenai River. Field sampling occurred at reaches in the Kootenai (n = 15) and Green (n =11) rivers during the summer (June, July, August) and fall (September, October) of 2012. This enabled a temporal comparison of gear efficacy and allowed for the estimation of detectability and occupancy rates. All reaches were resampled at least once in the same season. Each reach was sampled with three sampling techniques (i.e., boat-mounted electrofishing, hoop nets, benthic trawl). In addition to collecting data on fishes (e.g., length, weight), habitat characteristics (e.g., substrate, channel morphometry) were also measured to help explain variability in burbot catch, detectability, and occupancy.

Forty-two burbot were collected during 86 sampling events in the Kootenai and Green rivers. Total sampling effort included 345 hoop net net-nights, 19.5 hours of electrofishing, and 345 trawl hauls. All burbot were sampled with hoop nets (n = 29) or electrofishing (n = 13). Preliminary work with occupancy models indicates that hoop nets had the highest detection rate among sampling techniques. Detection rates varied by river system and appear to be influenced by depth and temperature. Future work will include completing the final field season (summer of 2013) and further investigate the role habitat has on occupancy and detectability.

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 and Shawn Young, Kootenai Tribe of Idaho
Funding Agency:	Kootenai Tribe of Idaho
Completion Date:	31 August 2014

Objectives:

- Determine spatial and temporal variation in fish assemblage and population structure in Kootenai River side channels.
- Evaluate relationships between habitat types within side channels and structure of fish communities.
- Evaluate sampling designs to monitor responses to side channel restoration on the Kootenai River.

Progress:

The Kootenai River is one of Idaho's most unique and important resources, and supports a diversity of native species. Native fishes of high cultural and ecological importance include burbot *Lota lota*, Kootenai River white sturgeon *Acipenser transmontanus*, kokanee *Oncorhynchus nerka*, redband trout *O. mykiss gairdnerii*, westslope cutthroat trout *O. clarki lewisi*, bull trout *Salvelinus confluentus*, and mountain whitefish *Prosopium williamsoni*. All of these species use the Idaho portion of the Kootenai River for all, or a significant portion of their life history. Like many other large rivers in North America, the Kootenai River has been degraded due to changes in land use (e.g., logging, mining) and water development (i.e., Libby Dam). These disturbances have had deleterious effects on ecosystem function of the Kootenai River. The Kootenai Tribe of Idaho has been active in the past and is moving forward with ambitious plans to restore habitat and ecosystem function in the Kootenai River and its floodplain. On-going and planned restoration efforts provide a unique opportunity to evaluate the effects of habitat restoration on fish assemblages and populations. In particular, restoration activities on side channels are likely to elicit large positive responses due to their importance to fishes and other organisms in the system. The purpose of this project is to provide information on the effects of habitat restoration activities on fish assemblage structure and function in side channels of the Kootenai River. A major benefit of this project is that it will provide an understanding of the distribution and abundance of fishes, by species and life history stage, in side-channel habitats of the Kootenai River. This information is critical for evaluating the effect of management actions (e.g., habitat restoration) on fish assemblages and populations. 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 began on a bi-weekly schedule in late July 2012, with the exception of one sampling event that occurred in June 2012. We conducted 12 sampling events during this time where 117 individual 100-m reaches were sampled during each event. Fish sampling continued through October 1, 2012 at which point the schedule switched to bi-

monthly sampling events. Mountain whitefish, largescale sucker *Catostomus macrocheilus*, and redband trout were designated as focal species targeted for population-level analysis. Focal species were chosen based on their abundance in the braided reach of the Kootenai River and their response to recent nutrient addition projects. As such, individuals from these three species were measured, and an aging structure was removed prior to release. The leading fin ray on the left pectoral fin was removed from 10 individuals per centimeter length group for each of the focal species. Otoliths were also removed from 100 individuals of rainbow trout and mountain whitefish to corroborate ages obtained from fin rays.

Thus far, 2,527 individual fish have been sampled representing 19 different species. Fishes were sampled using two gears—boat-mounted electrofishing and a mini-Missouri benthic trawl. We sampled 1,625 individuals from side channels and 902 individuals from main-channel sites. Two burbot were captured during sampling in September. Focal species accounted for 80% of the total catch (mountain whitefish = 49%; largescale sucker = 28%; rainbow trout = 3%). Catch rates for all species were higher in side channels than in the main channel, and included a greater number of species. More fish (total number and species) were sampled with electrofishing (n = 2,428) than with the benthic trawl (n = 99) and only one species (black crappie *Pomoxis nigromaculatus*) was unique to the benthic trawl. The benthic trawl was effective at capturing mountain whitefish which represented 60% of the trawling catch. Approximately 1,600 calcified structures (i.e., otoliths and pectoral fin rays) were collected from focal species. Aging structures are currently being processed for age and growth analysis in the coming months. Fish sampling will continue until December of 2013.

AN EXAMINATION OF THE SPATIAL AND TEMPORAL DISTRIBUTION AND DENSITY OF *MYSIS* 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 2013

Objectives

- Determine spatial and temporal distribution of zooplankton and *Mysis* in Lake Pend Oreille.
- Modify the IDFG zooplankton production and quality index (ZPI/ZQI) for kokanee.
- Collect and analyze historic climate date for immediate 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:

Since the turn of the 20th century, the Lake Pend Oreille (LPO) ecosystem has undergone large changes resulting from the construction of dams, the continued introduction of various fish species, the addition of nutrients from upstream and nearshore areas, and the introduction of

Mysis diluviana (a freshwater shrimp) as prey for fish. The introduction of mysids to lakes throughout the Pacific Northwest and LPO has been particularly disruptive of entire ecosystems because mysids are present year-round and compete with fish fry for small zooplankton food. Harvest is one approach to reduce the abundance of mysids and is used Okanagan Lake, B.C. However, this requires an understanding of the spatial and temporal distribution of mysids. Anecdotal evidence from LPO suggests that mysids move to shallow nearshore areas over winter which may afford their capture and removal. Also, it has been well-established that the thermal stratification of LPO affords zooplankton a thermal refuge from predation by mysids and that zooplankton production as well as survival of kokanee is higher in some areas, especially bays. The survival of hatchery-reared fry may benefit from timing of, and location of their stocking in LPO if released in areas favorable to their survival.

To establish general whole-lake zooplankton and mysid distributions of LPO monthly surveys of 36 sites have been completed since June 2012. To process the large number of zooplankton samples we have modified the zooplankton Quality index (ZQI used by some regions of IDFG for kokanee on LPO. This has allowed us to spatially identify areas of LPO where zooplankton size and abundance are optimal for kokanee. Once data are available for a complete year, we should be able to identify zooplankton 'hotspots' or indicate if there is a temporal pattern that could be used to locate optimal areas in which to stock hatchery-reared fry.

To determine if a model to predict the optimal date of stocking of hatchery-reared fry could be predicted from climatic data, we analyzed historic climatic records for LPO and the surrounding watershed. Examination of this data (temp 1950s to current) showed that the surface water of LPO is warming, however, the duration of stratification is decreasing. The onset of stratification is slightly (but not significantly) later in spring now than in the 1950s. However, the date of destratification has decreased significantly by 40 to 60 days overall in the south and north parts of the lake, respectively. This was a puzzling finding and has prompted further investigation which is ongoing. We are examining lake level drawdown, and rate of change in the thermal mass of the epilimnetic water in late September and October of each year. Research in 2013 will include completion of the above objectives.

Completed Projects – Fisheries and Aquatic Resources

IMPACTS OF HYDROLOGIC ALTERATION ON JUVENILE STEELHEAD (*ONCORHYNCHUS MYKISS*) HABITAT, GROWTH, SURVIVAL AND MOVEMENTS

Principal Investigator: Brian Kennedy
Laboratory Technician: Richard Hartson
Graduate Student Researcher: Marius Myrvold

Funding Agency: Bureau of Reclamation
Completion Date: 31 March 2012

Objectives:

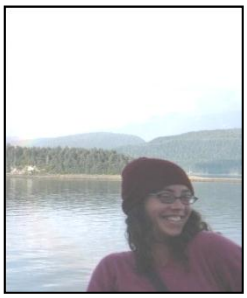
- Quantify temperature and primary stream channel habitat features relative to flow levels in Lapwai, Mission, Webb, and Sweetwater creeks.
- Quantify spatial variation in stream productivity (macroinvertebrate abundance, community composition and diversity) relative to stream flow and temperature in Lapwai, Mission, Webb, and Sweetwater creeks.
- Quantify demographics and bioenergetics of juvenile steelhead (*Oncorhynchus mykiss*) populations and the relative impacts of hydrologic alteration.
- Quantify the effects of intraspecific competition and interspecific interactions on juvenile steelhead demographics (growth, survival and emigration).
- Evaluate juvenile and adult movement and migration behavior in Lapwai, Mission, Webb, and Sweetwater creeks relative to flow operations.

Abstract:
The Bureau of Reclamation owns a series of water storage reservoirs, diversion dams and canals that provide irrigation water to the Lewiston Orchards area of Lewiston, Idaho. The Lewiston Orchards Project (LOP) is operated by the Lewiston Orchards Irrigation District (LOID), which distributes the water to agricultural, urban and suburban users. Lapwai watershed provides spawning and rearing habitat for a distinct population segment (DPS) of a federally endangered salmonid, *Oncorhynchus mykiss*, or steelhead, of the Snake River Basin. The LOP withdraws water from these creeks that are designated as critical habitat for this species. Importantly, the major temporal impact that water withdrawals have are during the summer months when juvenile fish are trying to gain mass before smolting (migrating to the ocean) and diversion operations can potentially leave the streams dry. Decreased flows during spring may also impact spawning of adult A-run *O. mykiss* in the basin (NMFS 2006).

Understanding the effects of hydrologic changes on fish populations requires an integrative approach that addresses 1) how the growth potential of individual fish is affected, 2) how changes in growth and growth potential influence survival of individuals and, ultimately, how processes for the individual scale up to population level dynamics, and 3) how population dynamics are influenced by altered connections among subpopulations. These changes can be a direct result of hydrologic change (Lopes et al. 2004) or an indirect effect through altered temperatures, productivity or trophic relationships. Our study is addressing how flow

alterations in the Lapwai system influence growth and survival of juvenile *O. mykiss*. We are developing integrated models for flow-foraging relationships, bioenergetics (i.e., energy gains and losses), productivity relationships, and fish movements, which collectively are designed to identify mechanistic relationships between fish performance and habitat.

CONDITION AND SPAWNING SUCCESS OF ADULT SPRING CHINOOK IN THE WILLAMETTE RIVER



Principal Investigator:	Christopher Caudill
Student Investigator	Adrienne Roumasset
Collaborators:	Carl Schreck (USGS/OSU)
	and Michael Kent (OSU)
	U.S. Army Corps of Engineers
Funding Agency:	USGS - RWO 147
Completion Date:	31 May 2012

Objectives:

- Evaluate upstream migration behavior, distribution and fate of upper Willamette River (UWR) spring Chinook salmon in the Willamette River and tributaries.
- Determine the factors affecting fate and spawning success in UWR spring Chinook salmon specifically focusing on prespawning mortality (PSM).
- Determine relationships between PSM temperature history, collection and holding regime, and interactions among factors, e.g., disease development at high temperatures.
- Determine the relationships between PSM and watershed-scale factors among 11 spawning populations within the Willamette Basin.

Abstract:

From 2 May through 8 July 2011, we intragastrically radio-tagged 150 Chinook salmon at Willamette Falls Dam and released them back into the fishway upstream from the trap. Almost all (97%) radio-tagged salmon also received an archival temperature logger. An additional 100 salmon were tagged with archival temperature loggers only. Run timing of the run-at-large and the radio-tagged sample was relatively late in 2011 compared to the ten year average and the late timing was associated with high flow and cool temperatures in 2011. Approximately 25% (38/150) of the radio-tagged salmon had intact adipose fins (i.e., presumed wild origin) and ~75% (112/150) had clipped adipose fins (i.e., were of certain hatchery origin). Radio-tagged salmon received one of two handling treatments. Thirteen percent (19/150; unclipped only) received an experimental, eugenol-based anesthetic, AQUI-S®E. The remaining ~87% were tagged without anesthesia and with the use of a fish restraint device.

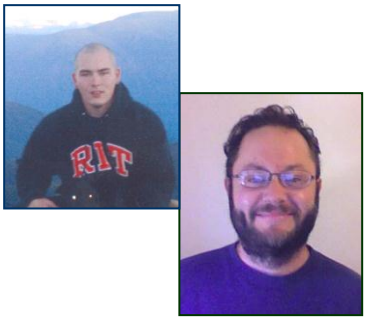
Data from the system-wide migration study will be integrated with results from spring Chinook salmon studies in Fall Creek and the North Fork Middle Fork Willamette River to evaluate the potential contribution of main stem versus tributary factors to prespawn mortality. The data will also provide valuable baseline information on the relationship between upstream migration, Willamette Valley Project operations, and environmental conditions as they pertain

to the implementation of the WVP Biological Opinion. During 2011 we continued monitoring prespawn mortality in two tributaries because in recent years high percentages (80-90%) of adult Chinook salmon transported above dams in some Willamette River tributaries have died prior to spawning. In 2011, we surveyed the energetic status and survival rates of two populations of Willamette River spring Chinook salmon, monitored river environmental conditions, and investigated the relationships among prespawn mortality and a suite of potential causative factors including disease assessment.

Results from our on-going Willamette River Chinook salmon studies suggest that prespawn mortality is caused by an interaction of environmental factors (particularly water temperature), disease, fish condition, and energetic status. Multi-year sampling of adult energetic status, disease and parasite prevalence, and other condition metrics will: 1) provide insights into the factors causing prespawn morality; 2) determine how mean salmon condition varies from year to year in response to environmental factors such as main stem and ocean conditions; and 3) will assist in the development of effective management strategies to reduce prespawn mortality in Willamette River spawning tributaries including regulation of flow and/or temperature, and holding of adults under pathogen free conditions prior to outplanting.

Prespawn mortality (PSM) rates in UWR spring Chinook salmon vary considerably both between sub-basins within a year and between years in the same sub-basin. Annual rates ranged from 1% in the Upper McKenzie River in 2008 to 95% in the Middle Fork Willamette River in 2007. We hypothesized that environmental conditions during the holding period and population differences associated with fish density and origin, fish handling practices, and other factors can partially explain variability in PSM rates. We analyzed a dataset of PSM rates from 11 index reaches in the Willamette River and the adjacent Sandy River basin with observations from 2001-2010 using mixed model regression and Akaike Information Criterion (AIC) scores. The best model for PSM included both environmental factors that vary from year-to-year (e.g., stream temperature, spawner density) and relatively static watershed-scale features (e.g., % basin agriculture). Exploratory analyses revealed a complex and hierarchical set of relationships between PSM and predictor variables and among the predictor variables themselves (i.e., many predictors were inter-correlated). Nonetheless, consistent positive and significant associations were found between annual PSM rate and 7 day average maximum temperature (7-DAM) and fish density (D), as well as a significant negative association with percent wild (W). The associations between PSM and 7-DAM are consistent with other observations of increased PSM rates at higher stream temperatures. Additional analyses revealed 7-DAM may be largely controlled by differences among sub-basins in underlying geology and land-use. Percent wild (W) and spawner density (D) were strongly inter-correlated. Reaches with high densities were those with high numbers of hatchery fish (and hence low W) and were also in areas below dams, potentially with marginal quality spawning habitat. Thus, density dependent mechanisms may have acted to produce a negative ecological hatchery effect below dams. Further investigation of these relationships are needed to test hypotheses about underlying mechanisms and will assist with the prioritization of management action within and among sub-basins.

IMPROVING ADULT PACIFIC LAMPREY PASSAGE AND SURVIVAL AT LOWER COLUMBIA RIVER DAMS, 2011



Principal Investigator: Christopher Caudill
Student Investigators: Benjamin Ho
Christopher Noyes
Collaborator: Mary Moser, NOAA-Fisheries
US Army Corps of Engineers
Portland District
Funding Agency: USGS – RWO 151
Completion Date: 30 June 2012

Objective:

- Evaluate passage and survival of adult Pacific lamprey (*Lampetra tridentata*) at lower Columbia River dams during the 2011 adult lamprey migration.

Abstract:
We tagged adult Pacific lamprey (*Entosphenus tridentatus*) collected at Bonneville Dam with half duplex (HD) passive integrated transponder (PIT) tags and monitored their passage and migration behaviors at Bonneville, The Dalles, John Day, McNary, Ice Harbor, Lower Monumental, Lower Granite, and Priest Rapids dams. Our objectives were to calculate lamprey passage times, to estimate escapement past the monitored sites, and to evaluate potential physiological and environmental correlates with lamprey migration through the study area. In total, we HD-PIT tagged 929 lampreys in 2011: 800 were released downstream from Bonneville Dam near Hamilton Island, 109 were released upstream from Bonneville Dam near Stevenson, WA, and 20 were released directly into the Cascades Island lamprey passage structure (LPS). An additional 85 lampreys were double-tagged with HD-PIT tags and acoustic transmitters (JSATS).

The 2011 escapement estimate from release below Bonneville Dam past the dam was 56%, higher than estimates in the 2005-2009 HD-PIT studies (41-53%). Escapement from the top of Bonneville Dam to the top The Dalles Dam (52%) and from the top of The Dalles Dam to the top of John Day Dam (80%) was also higher than or similar to previous estimates. Large lampreys in the downstream release group were significantly more likely than small lampreys to pass through most dam-to-dam reaches. As in previous years, lampreys last detected at upriver sites were significantly larger than those last recorded closer to the release site, indicating that size-dependent effects on migration distance and final distribution were likely. Lamprey migration times were highly variable. The median passage time for the downstream-released fish was 10.2 days (< 1 km/d) from release to the top of Bonneville Dam. Median times between top-of-ladder antennas were 4.3 days (17 km/d) between Bonneville and The Dalles dams, 3.4 days (11 km/d) between The Dalles and John Day dams, and 9.1 days (14 km/d) between John Day and McNary dams. Each of the reaches upstream from Bonneville Dam included one reservoir and one dam. Median migration rates ranged from 5-18 km/d in reservoir-plus-dam reaches upstream from McNary Dam that included portions of the Snake and upper Columbia rivers, including the unimpounded Hanford Reach. Lampreys generally migrated faster later in the summer through most reaches, coincident with increasing river temperatures and decreasing river discharge.

The combined basin-wide results in 2011 indicated improved passage efficiency at Bonneville Dam and through some upstream reaches, despite river discharge that was well above average (typically associated with lower escapement). Recent modifications made to fishway operations and structures potentially improved lamprey passage at dams (especially Bonneville Dam). In 2011, we continued our evaluation of the Juvenile Salmon Acoustic Telemetry System (JSATS) for monitoring the migration and final fates of adult Pacific lampreys in Bonneville Reservoir and the Bonneville Dam tailrace, two areas with high unaccounted loss in past telemetry studies.

Distributions and final fates of tagged fish through early spring were similar to those seen in previous years. The majority (84%) of fish that entered or were released into Bonneville Reservoir passed through the majority of the reservoir and were detected at the Lyle, WA receiver gate, 16 km from The Dalles Dam. This suggests that migration conditions and factors during summer and fall such as predation are not strongly contributing to the overall unaccounted losses in the Bonneville Reservoir and that fish are not overwintering in the downstream two-thirds of Bonneville Reservoir.

The relationship between lamprey swimming behavior and passage success in fishways remains unclear, though previous telemetry studies have indicated poor passage at several locations including fishway entrances and transition pools. In the summer of 2011, we completed a Dual-Frequency Identification Sonar (DIDSON) pilot study at Bonneville Dam to evaluate potential applications of this technology for passively observing Pacific lamprey (*Entosphenus tridentatus*) behavior and passage at fine scales (1-5 m). A secondary objective was to determine whether DIDSON monitoring could provide quantitative estimates for common passage metrics (e.g., entrance efficency). Images were also collected in portrait mode to identify lamprey depth distributions. We also summarized the presence or absence of white sturgeon (*Acipenser transmontanus*), a lamprey predator.

This pilot study demonstrated that DIDSON technology can provide useful assessments of behavior and distribution of adult lamprey movements near fishway entrances and inside fishways within the sampling range (6-7 m) of the instrument. We observed many lamprey swimming throughout the sampled portion of the water column, including in mid-channel locations at fishway entrances. In situ swimming depths within our sample volume did not indicate a consistent depth preference during the day or night. However, it was not possible to sample the bottom strata near fishway floors at most sites because I-beams available for DIDSON mounting did not reach the bottom. We observed very few lampreys that attached to substrate or walls at the sampled depths but we did observe entrance events by adults. When white sturgeon were present we generally observed fewer lamprey events and lamprey were more likely to move downstream. These results suggest a reduction in activity or avoidance by adult Pacific lamprey in the presence of sturgeon. Overall, we found that the DIDSON was an effective monitoring tool for detailed observation of adult lamprey behavior at the fine- to meso-scale (i.e., < 10 m). These data provide important and complementary results to PIT, radio and acoustic telemetry studies.

EVALUATION OF THE ECOSYSTEM SERVICES OF NATIVE FRESHWATER MUSSELS IN THE PACIFIC NORTHWEST

Major Professor:	Christine M. Moffitt
Student Investigator:	Maggie Picard
Funding Agency:	Bonneville Power Administration Office of Tribal Affairs Environmental Science Program
Completion Date:	30 May 2012

Objectives:

- Interact with professionals with the Confederate Tribes of the Umatilla Indian Reservation (CTUIR) conducting restoration efforts of native freshwater mussels.
- Estimate the ecosystem services obtained through their restoration program.

Abstract:
Freshwater mussels in North America are useful indicator species for assessing the health of freshwater environments. Each mussel is capable of exchanging as much as 30 L of water per day. In aquatic ecosystems, freshwater mussels aid in the recycling of nutrients, specifically nitrogen and phosphorus, decrease turbidity, increase diversity, and positively affect the food web. Ecosystem services have been defined as ‘‘conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life’’. Freshwater mussels have a long American history, they served as a dietary staple for Native Americans and their shells were utilized as buttons and regalia. Freshwater mussels increase water quality and present residual nutrients in a usable form to macroinvertebrates and other organisms in the river/lake beds and hyporheic zone. In a natural setting, freshwater mussels supply ecosystem services to the freshwater environment that improves the sustainability and improves aquatic habitat restoration and conservation. Through interactions, and use of the literature, we quantified and described the benefits of ecological services resulting from the restoration efforts underway on the Umatilla reservation. Our research highlights the synergistic effect of native mussels with other functional invertebrate and vertebrates in the stream ecosystems.

Freshwater Anodonta Mussel

GUIDANCE DOCUMENT TO PREVENT, REDUCE, ELIMINATE OR CONTAIN NEW ZEALAND MUDSNAIL INFESTATIONS AT FISH PROPAGATION FACILITIES

Principal Investigator: Christine M. Moffitt
Collaborating Investigators: Barnaby J. Watten USGS
Bryan Kenworthy, USFWS
Larry Peltz, USFWS
Graduate Students: Kelly Stockton
Amber Barenberg
Funding Agency: U.S. Fish and Wildlife Service
Completion Date: 30 June 2012

Objectives:

- Summarize and synthesize the state of knowledge on control measures.
- Evaluate completeness of data on control measures and determine areas of needed additional data.
- Provide a tool for hatchery biologists and managers that summarizes the state of the science, provides details on prevention and control measures and an outline of decision tools for a rapid response to new or potential infestations.

Abstract:
Our guidance document is designed for hatchery personnel or others to 1) assess pathways of invasion, 2) evaluate the likelihood of infestations, and 3) use tools to reduce the risks of invasion by the New Zealand mudsnail, *Potamopyrgus antipodarium* (NZMS). Fish hatcheries and aquaculture facilities are at risk of harboring and transporting invasive species because of the features and practices that occur at these facilities. Constant water flows, use of groundwater or springs with characteristically minimal temperature variability, increased nutrients from fish production and waste from fish feed, movement of fish and equipment between locations, public visitation and fishing access near or on facilities are all features of many aquaculture facilities. The NZMS has become established in many locations throughout Western North America and areas of the Great Lakes and Midwest. This snail is a successful invader due to its small size, tolerance of a wide range of water quality, reproduction via live offspring via clonal reproduction, and strong operculum that increases its ability to survive for long periods out of water. Once established, the NZMS is very difficult to eradicate. This guidance document provides a summary of information that can assist in preventing infestations, and has information summarized about disinfection and monitoring. Using guides in this document, the manager can summarize all features of the facility to achieve a final ranking of risk of infestation as low, medium or high. After ranking, a manager should consider next step scenarios for when and how to monitor so that the options for rapid response can be pursued. Information on monitoring and decontamination can be provided through supplemental documents. The guide uses a decision analysis approach to understanding and ranking risks. It provides the most up to date tools for monitoring, collection of samples and analysis. Details on sample labeling and retention are provided, as well as quality assurance recommendations. We have one manuscript in press and two additional manuscripts are in preparation and early review.

RESEARCH, MONITORING AND EVALUATION OF EMERGING ISSUES AND MEASURES TO RECOVER THE SNAKE RIVER FALL CHINOOK SALMON ESU

Principal Investigator:	Christine M. Moffitt
Student Investigators:	John Plumb
Collaborating Investigators:	William P. Connor, USFWS
	Ken Tiffan, USGS
Funding Agency:	Bonneville Power Administration
Completion Date:	31 August 2012

Objectives:

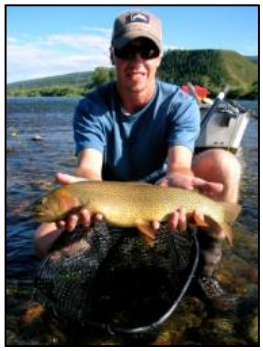
- Determine if the wild fall Chinook salmon life history is changing over time due to biological or physical alterations in the environment.
- Analyze the fork length, weight and morphology of PIT-tagged wild fall Chinook salmon subyearlings, and determine densities in fish rearing areas.
- Determine if the joint probability of active migration and survival to the tailrace of Lower Granite Dam is affected by biological or physical alterations in the free following river environment or spill operations.

Abstract:

Snake River fall Chinook salmon (*Oncorhynchus tshawytscha*) were among the first Pacific salmon stocks to be petitioned for federal listing under the Endangered Species Act, and in 1992 were given threatened status. An integral part of population recovery was to increase the numbers of hatchery-reared juveniles (from native brood-stock) released into the river, with the intent to offset the reproductive loss of wild salmon. In 1995, ~ 16,400 hatchery-reared juvenile fish were released into the lower Snake river, yet by 2008 over 4 million fish were released upstream of Lower Granite Dam. In years since the supplementation (since ~ 1999), the naturally-produced subyearling fall Chinook salmon have been smaller and may emigrate at earlier dates than observed during 1990's. To understand this we used existing data from a variety of sources to pose and test various models regarding these changes. Mark-recapture models were used to measure fish collection and detection, to potentially improve daily fish abundance estimates at Lower Granite Dam – the first dam encountered during seaward migration from the Snake River. We produced a multistate (multinomial) approach that enabled us to assess the effect of dam operations on fish detection, and in turn, correct abundance estimation at a dam. We used recapture data from previous studies of radio-tagged subyearlings upstream, in, and downstream of the dam during annual passage studies at Lower Granite Dam. When coupled with relatively fine-scale information from telemetry studies, multistate models provided information on key demographic parameters for juvenile salmon populations. This modeling approach enabled fish abundance estimates (and the uncertainty) to be obtained from daily information on fish sampling and dam operations, and in turn, relate abundance estimates to the migration behavior, growth, consumption, and size-at-outmigration for the naturally-produced subyearlings in free-flowing and reservoir reaches of the lower Snake River as they traveled to Lower Granite Dam. We also used the Wisconsin bioenergetics model as a tool to understand growth of subyearling Chinook salmon. We used data obtained from four different laboratory studies that evaluated growth under different temperature regimes, and with high

energy diets. We then compared these growth rates to model predicted growth rates. We found that the fall Chinook salmon may have a higher tolerance to higher water temperatures than assumed in the Wisconsin model. Finally, we used the bioenergetics model and the capture probability data to create an advection-diffusion model to assess fish travel times to the dam. Abundance estimates were used with the projected bioenergetics estimates of fish weight at the dam in a multiple regression framework to quantify the relation between observed and predicted fish weight, and determine whether fish abundance may explain variation in fish weight over and above that expected by fish bioenergetics.

ASSESSMENT OF ANGLER SURVEY METHODS FOR MANAGING IDAHO'S ANADROMOUS FISHERIES: ANGLER SURVEY DESIGN AND THE ROLE OF SOCIAL DESIRABILITY BIAS



Principal Investigator:	Michael C. Quist
Student Investigator:	Joshua L. McCormick
Collaborating Investigator:	Daniel J. Schill, Idaho Department of Fish and Game
Funding Agency:	Idaho Department of Fish and Game
Completion Date:	31 December 2012

Objectives:

- Assess bias and precision of creel survey sampling designs to estimate Chinook salmon harvest in Idaho.
- Quantify self-reporting bias in Chinook salmon and steelhead creel surveys in Idaho.
- Develop sampling designs to collect Chinook salmon and steelhead parentage based genetic tagging samples throughout fisheries in Idaho.

Progress:

Chinook salmon *Oncorhynchus tshawytscha* and steelhead *O. mykiss* populations have declined significantly since the early 1900s in the Snake River basin of Idaho. As a result, hatchery production was adopted to supplement wild, Endangered Species Act-listed populations, and provide consumptive sport fisheries. Sport fisheries are managed to maximize angling opportunity and harvest of hatchery-produced salmon and steelhead while minimizing incidental catch-and-release mortality of wild populations. Progress towards management goals is assessed through the use of several angler survey methods. To meet management goals, precise, unbiased data are needed. Therefore, the objective of this research was to evaluate angler survey methods which are used to collect information used to manage anadromous fisheries in Idaho.

To evaluate creel survey designs, censuses of angling activity were conducted in localized areas of multiple Chinook salmon fisheries throughout Idaho. It was assumed that the observed sections were representative of the entire fishery, and served as theoretical populations which were re-sampled using Monte Carlo simulations. Various sampling designs, survey methods, and catch rate estimators were assessed. The resulting sampling distributions derived through Monte Carlo simulations were evaluated based on expected bias and precision. Anger-reported

data were also evaluated for reporting accuracy. Additionally, sampling designs to collect parentage-based genetic samples to estimate hatchery-specific steelhead harvest were evaluated using historic coded-wire tag data.

Overall, the ratio-of-means catch rate estimator provided the most accurate and precise estimates of mean catch rate and total catch of three estimators in roving-roving and roving-access surveys. Root mean square error of simulated total catch estimates using roving-roving surveys was 1.42 times greater and relative bias was 160.13 times greater on average than for roving-access surveys. Length-of-stay bias and non-stationary catch rates in roving-roving surveys both appeared to have an effect on estimates of catch rate and total catch. Roving-access surveys were more accurate than roving-roving surveys for Chinook salmon fisheries in Idaho.

All sampling designs to estimate effort and total catch in roving surveys evaluated were relatively unbiased. Systematic random sampling resulted in the most precise estimates. Systematic and simple random sampling designs had mean square error (MSE) estimates that were generally half of those observed with cluster sampling designs which only sampled a portion of the day. Increasing the number of clusters available for sampling within a day decreased MSE of estimates of daily angling effort, but MSE of total catch estimates was variable depending on the fishery. The results of our simulations provide guidelines on the relative influence of sample sizes and sampling designs on parameters of interest in short-duration Chinook salmon fisheries.

A total of 164 angler trips was observed and anglers were interviewed to quantify self-reporting bias in Chinook salmon creel surveys. Anglers fished for 541 hours and caught 74 Chinook salmon. Anglers reported fishing for 604 h, an overestimate of 63 h; anglers reported catching 66 fish, eight less than observed. Underreporting of catch and over-reporting of time fished by anglers presents challenges when managing Chinook salmon sport fisheries. However, confidence intervals were near target levels, and using more liberal definitions of angling when estimating effort in creel surveys may decrease sensitivity to bias in angler-reported data.

Evaluation of steelhead sampling designs showed that variance of hatchery-specific estimates of steelhead harvest was similar when the number of spatial and temporal strata was reduced compared to the current stratified sampling design. Bias was several orders of magnitude higher with the reduced stratification scheme. Neyman, proportional, and equal allocation resulted in similar bias. The observed bias was a result of unevenly dispersed harvest of hatchery cohorts throughout the fishery both spatially and temporally. Potential bias and precision should be balanced against the costs and complexity of planning and implementing parentage-based genetic tagging (PBT) surveys for estimating hatchery-specific harvest of steelhead.

PIT tagging operation in Snake River.

John Walrath with a northern pike from Lake Coeur d'Alene, Idaho.

Largescale sucker from the Kootenai River, Idaho.

Current Projects – Wildlife and Terrestrial Resources

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
Funding Agency:	U.S. Department of Defense
Completion Date:	31 May 2016

Objectives:

- Identify wintering areas of migratory burrowing owls throughout North America
- Identify migratory timing and migratory routes of burrowing owls throughout North America

Progress:

Many migratory populations of burrowing owls 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 the winter months. We are putting geolocators (light sensors) and satellite transmitters on breeding burrowing owls throughout their migratory range in the western U.S. and Canada. We are partnering with colleagues in Canada and in states throughout the western U.S. Along with our partners, we have put geolocators and satellite transmitters on owls that breed in Oregon and Alberta over the past 2 years. Owls in Oregon have wintered in WA, OR, CA, and NV. Owls in Alberta have wintered in locations throughout central and northern Mexico. In 2013, we plan to put transmitters on owls in ID, UT, CO, and SD. When the project is complete, we will produce a map that shows the migratory behavior of burrowing owls throughout their entire life cycle in locations throughout their distribution. These data will help determine whether the steepest population declines are associated with owls that winter in certain locations of North America.

DEVELOPMENT 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:	2001 - 2014

Objective:

- Implement 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 hunted 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 is essential for collection of long-term data designed to provide rigorous estimates of population change. We developed a monitoring protocol for marsh birds that is suitable for use throughout North America and field-tested the new protocol at a subset of National Wildlife Refuges and other protected areas across the country. The protocol includes everything from survey route selection and point placement to field methods and data forms, and the data are entered into a pooled database. 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 locations across North America with data entered into the shared database. We have used these data to address a variety of questions regarding optimal survey methodology and effects of management actions (Conway and Nadeau 2006). We have also created a comprehensive website for the project and have worked closely with USFWS Migratory Bird Office and the USGS Patuxent Wildlife Research Center to produce an online data entry and retrieval module on the internet that can be used by agencies across North America. We are currently helping to move management of this shared database from Patuxent WRC to the Avian Knowledge Network at Point Reyes Bird Observatory.

IDENTIFYING IMPORTANT AREAS FOR MARSH BIRD MANAGEMENT IN THE UNITED STATES: USING GIS TO MODEL PRESENCE AND ABUNDANCE OF MARSH BIRDS

Principal Investigator:	Courtney J. Conway
Postdoctoral Investigator:	Kathi Borgmann
Funding Agencies:	USFWS, USGS, DoD
Project Duration:	2007 - 2014

Objective:

- Identify the National Wildlife Refuges that provide the best habitat for each of 13 species of secretive marsh birds in the U.S.

Progress:

To assure the proper management and long-term persistence of marsh birds in the United States, we must identify: (1) the specific types of wetlands that are used most by each species of marsh bird, and (2) which federal lands have large amounts of these preferred wetlands types. We have developed preliminary habitat models based on National Wetland Inventory data that are effective at identifying optimal habitat for 13 species of rails, bitterns, and grebes. We will use more marsh bird survey data and a model selection approach to improve upon preliminary models to produce and validate a set of final models (one for each of the 13 species). We will then use the models to estimate the amount of optimal habitat for each of the 13 species on each parcel of federal land in the U.S. Ultimately, we will provide our federal partners with a list of areas that likely provide optimal habitat for secretive marsh birds so that this information can be incorporated into their long-term management plans.

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

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:

"The mission of the Craig Mountain Wildlife Management Area is to protect and enhance wildlife populations and wildlife habitat, to mitigate for the habitat losses associated with the construction and inundation of Dworshak Reservoir, and to provide for compatible uses of

these wildlife resources by the public."
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. The habitat for these species has changed considerably since CMWMA was acquired in 1992. These changes are a result of noxious weeds, increased recreational activities, 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 and contemporary data to quantitatively evaluate management direction relative to CMWMA management goals. The first semester of this project was spent gathering and evaluating data from baseline bird and vegetation surveys conducted on the CMWMA. In addition to gathering data from baseline surveys which were conducted in 1993-1994, data were also gathered from surveys completed in 1997 and 2002. The 2013 field season will focus on adding to this long-term data set.

HABITAT PATCH SIZE AND DETECTION PROBABILITY OF YUMA CLAPPER RAILS

Principal Investigators: Courtney J. Conway
Staff Biologist: Meaghan Conway
Funding Agency: USFWS
Project Duration: 2008 - 2013

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 are currently conducting analyses in preparation of the final report.

DEVELOPING OPTIMAL SURVEY TECHNIQUES FOR MONITORING POPULATION STATUS OF RAILS, SNIPE, COOTS AND GALLINULES

Principal Investigator:	Courtney J. Conway
Collaborating Investigator:	Mark Woodrey, Mississippi State University
Staff Biologists:	Christopher Nadeau and Meaghan Conway
Funding Agency:	USFWS
Project Duration:	2008 - 2013

Objective:

- Improve survey methods for secretive marsh birds in North America

Progress:

A need for more accurate information on population status and trends of marsh birds has been identified as a top research need for 15 years (Tacha and Braun 1994). Efforts have been underway for the past decade to develop continental survey protocols and a sampling frame for conducting marsh bird surveys throughout North America (Ribic et al. 1999, Conway and Gibbs 2001, Conway and Timmermans 2005, Conway and Droege 2006). However, numerous methodological questions related to optimal survey methods were raised at a recent marsh bird symposium. We evaluated: 1) the optimal timing for conducting surveys in each region of the country, 2) the optimal tide stage for conducting surveys in both freshwater and saltwater tidal systems, and 3) the effect of broadcasting non-local dialects on detection probability. We are preparing data to facilitate analyses.

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

Objective:

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

Progress:

Masked bobwhite are federally endangered in the U.S. and Mexico and appear to be effectively extinct in the wild. We are working with 9 species experts to develop a suite of habitat models to help identify sites for reintroduction. We have conducted extensive interviews with the 9 species experts and worked with them to develop quantitative habitat models based on their knowledge of the habitat requirements for this extremely rare bird.

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 Egnew, USDA Forest Service
Funding Agency:	US Forest Service
Completion Date:	31 May 2017

Objectives:

- Evaluate the effectiveness of two forest restoration treatments on survival rates of Northern Idaho Ground Squirrels.
- Determine the presence of plague caused by the bacterium *Yersinia pestis* on NIDGS and associated 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 conditions for northern Idaho ground squirrels (NIDGS). This project will compare demographic traits among 3 treatments: (1) thinning followed by a fall-season prescribed burn, (2) mechanical thinning of canopy (no burn), and (3) control. We will also measure foraging behavior, vegetation structure, and NIDGS body mass at all sites to examine whether the quality or quantity of forage plants preferred by NIDGS varies among treatments. We also plan to examine whether plague is present 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 examine the presence of plague in small mammals that are sympatric with NIDGS: yellow-pine chipmunks (*Tamias amoenus*), montane voles (*Microtus montanus*), deer mice (*Peromyscus maniculatus*), Columbian ground squirrels (*Urocitellus columbianus*), and red-backed voles. NIDGS recovery efforts would be enhanced if plague is present in the ecosystem and efforts to control plague are implemented sooner rather than later. Lastly, we hope to learn more about winter ecology of NIDGS. One population of NIDGS was found to have low overwinter survival. The causes for this low survival may reflect issues related to habitat, climate, burrow availability, food limitation, nutrient limitation, or disease. We will attach radio collars to NIDGS to locate their hibernacula and evaluate the effects of the following factors on overwinter survival: (1) snow duration and height, (2) NIDGS weight just before hibernation, (3) temperature in relationship to burrow depth, location within NIDGS habitat, and snow cover, and (4) flea density.

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:

Investigations into ecological constraints on life history traits have led to many advances in our understanding of resource allocation tradeoffs that mediate the evolution of life history strategies (Martin 1995). Yet, inferences from empirical studies are limited because these traits often vary over large geographic scales that make field experiments difficult. A useful approach that may improve our understanding of the causes of life history variation is to test predictions of hypotheses that might explain elevational patterns in traits such as clutch size, and to do so along a contiguous elevational transect that spans the entire elevational range of a species. However, such studies are rare. We have studied the breeding ecology of red-faced warblers (*Cardellina rubrifrons*) in southeastern Arizona since 2002. Clutch size declines with breeding elevation in our study system; 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 study systems, but not explained. We are testing multiple mechanistic hypotheses to explain the causes of the negative relationship between elevation and avian clutch size. We use a combination of manipulative experiments and correlational data to test predictions of hypotheses about food limitation, nest predation risk, female condition, and time constraints. Our results will provide insights into whether this observed pattern reflects an elevational shift from fast to slow life history strategies, and will help elucidate the ecological processes responsible for the diversity of avian life history strategies.

We are also studying the ecological processes driving habitat selection in red-faced warblers. Red-faced warblers in the Santa Catalina Mountains breed along a 1000m elevation gradient, and we observe a distinct mid-elevation peak in breeding densities. Furthermore, red-faced warblers in southeastern Arizona are primarily found breeding in montane canyons and they nest in the highest densities in the bottom of those canyons. Nesting density declines rapidly as one travels uphill, away from the base of the canyon, despite the existence of what appears to be contiguous potential breeding habitat. We are testing hypotheses about food abundance and predation risk to explain red-faced warbler habitat selection and nest-site preferences.

Finally, we are combining LIDAR and point count data to model the distribution and relative of abundance of red-faced warblers in Arizona. Light detection and ranging, commonly referred to as LIDAR, is a relatively new source of remote sensing data that uses a laser to directly measure the three-dimensional distribution of plant canopy and subcanopy topography. 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 are relating survey data collected in the field on relative abundance of red-faced warblers to the fine-scale three dimensional measurements of vegetation structure obtained from lidar to create spatially explicit models of the species' breeding distribution and abundance in Arizona.

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

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:

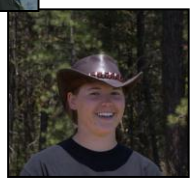
More than 250 species of birds in the continental US are classified as "species of conservation concern" by agencies and organizations such as IUCN, USFW, and PIF. These classifications range from critically endangered species (e.g., California Condor) to common birds in steep decline (e.g., Grasshopper Sparrow). The primary cause of population declines is considered habitat loss. The loss of unique ecological systems prompted the US to set aside lands with permanent protection from conversion and managed specifically for biodiversity.

We will examine whether areas managed specifically for biodiversity do, in fact, benefit the species they were designated to protect. We will use route-level Breeding Bird Survey data to develop route-specific population trends across species' breeding ranges within the US. Trends of routes that overlap protected areas (identified by GAP Protected Areas Database) will be compared to those trends that reflect no managed protection, both by species and by species richness. Trend data will also be analyzed within a spatial framework to determine which factors best predict species' population trends.

We will also use the species models and GAP analyses to identify areas where large gaps in protected areas are common across species, where additional protected areas would benefit the maximum number of species and ecological systems, and where additions to the protected areas network would have the least associated costs. We will evaluate connectivity of currently protected areas, as well as how adding new areas improves the broader, landscape mosaic.

These results will provide information regarding "best" locations for new protected areas as well as the agencies/organizations responsible for land holdings.

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

Objectives

- Characterize *Urocitellus brunneus brunneus* occupied habitat.
- Determine the effects of thinning and prescribed fire on potential but currently unoccupied *U. b. brunneus* habitat.
- Determine the effects of thinning and prescribed fire on the nutritional value of primary plants in the *U. b. brunneus* diet.
- Examine *U. b. brunneus* use in burned and unburned areas, as well as microhabitat use.

Progress:

Habitat Characterization –

Methods: We characterized habitat features of *U. b. brunneus* by sampling seven currently occupied sites for vegetation. We chose habitat attributes that are likely important to North Idaho Ground Squirrel (NIDGS), as well as attributes that are potentially altered by restoration treatments, which included overstory canopy cover, tree density, ground cover, litter depth, and soil texture. We also developed an extensive plant collection (~168 species) for all characterization sites that will be archived at the University of Idaho.

Results**:** 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 –

Methods: We quantified the effects of prescribed fire on NIDGS habitat by implementing prescribed fire in the fall of 2010 adjacent to three of the seven habitat characterization sites. The same vegetation and soil characteristics were collected before the burn and one and two years post-fire as listed in the habitat characterization objective.

Results**:** 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.

Effects of Prescribed Burning on Forage Nutritional Value –

Methods: To examine changes in nutritional value of forage plants, we collected leaves or seeds from 24 species. Due to low sample sizes, we only analyzed digestible nitrogen for six species, which is a nutritional index for NIDGS.

Results**:** We had limited availability of plant material for certain species. Additionally, mold contamination also reduced plant materials available for analysis. Samples were processed at the Washington State University nutritional lab. No significant patterns emerged in the nutritional analyses partially due to low sample sizes for statistics.

Effects of Prescribed Burning on U. b. brunneus Microhabitat Use

Methods: We determined *U. b. brunneus* use in unburned and burned areas at two sites by observing *U. b. brunneus* activity in the morning, afternoon and evening in June and July for 1.5 hours. The types of *U. b. brunneus* microhabitat sites included food acquisition, burrow, food consumption and lookout spots. Vegetation measurements (canopy cover and visual obstruction) were taken at each microhabitat site.

Results**:** There was no significant difference between squirrel use sightings in unburned and burned areas. Used microhabitat understory and overstory canopy cover averaged around 27% with a minimum value of 3% and a high value at 73% (high values largely influenced by ponderosa pine tree canopy). Understory vegetation height of used microhabitat had an average height of 8.99 cm (confidence interval of 7.98 to 10.02 cm).

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

Progress:

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. Exposure represents the availability of a system to the impacts of climate change and the magnitude and rate of change of those impacts. Sensitivity encompasses the tolerance of a system to change, and adaptive capacity is the ability of a system to cope with impacts of change. Vulnerability is therefore expressed as: Vulnerability = (exposure + sensitivity) – adaptive capacity.

The growing threat of habitat alterations resulting from climate change makes vulnerability assessment a key to effective future wildlife management. There are many potential approaches when developing a vulnerability assessment model, and we are using a spatially explicit map of species vulnerability approach. In this approach, we are utilizing the three variables necessary for a vulnerability assessment: exposure, sensitivity, and adaptive capacity. Climate exposure is represented by the degree of deviation between future climate projections and present day climate models. Projections of variables are provided by the USGS at approximately 1 km resolution. Sensitivity of each species is calculated by modifying the score they received from the Climate Change Sensitivity Database. This database includes variables that have also been assigned as factors of adaptive capacity. We will use only those factors that represent species sensitivity. 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 with poor information still lack sensitivity scores. Adaptive capacity will be measured through a spatially explicit index as well as a static score. The static component of adaptive capacity includes data on the age to reproductive maturity, number of reproductive events per year, and general trophic level. The spatial component of adaptive capacity is represented by a dispersal buffer around the species current GAP distribution model as well as a model of barriers to species dispersal. These two components are combined over each 1 km pixel to represent both the mobility and the generation time of each species. The exposure, sensitivity, and adaptive capacity variables will be combined into the vulnerability map framework, and vulnerability scores will be generated on a pixel-by-pixel basis to create a spatially explicit map of vulnerability.

We presented the preliminary framework for a vulnerability cube approach at the Idaho Chapter of the Wildlife Society Annual Meeting in 2012, and received feedback from agency personnel. In summer 2012, we developed the framework for the spatially explicit model of vulnerability described above. In autumn of 2013 we researched and wrote a paper concerning the comparability of currently existing vulnerability indices. This paper was submitted to the Wildlife Society Bulletin in late December 2012. Due to delays in climate data availability, we were not able to begin working on the vulnerability map until late February 2013. At present we are in the process of finishing running the mean and standard deviation calculations for current day and projected climate models. We still anticipate that the model will be completed by May of 2013.

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 2013

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 radar (IR) for conducting Columbian sharp-tailed grouse lek counts

Progress:

State wildlife biologists and researchers in Idaho have recently identified a need to improve population monitoring of Columbian sharp-tailed grouse (*Tympanuchus phasianellus columbianus*; hereafter CSTG) and assess the impacts of recent land use changes including the Conservation Reserve Program (CRP) on CSTG demographic rates. To assess the quality of CRP, we trap and monitor CSTG in the Rockland and Curlew Valleys of southeastern Idaho where multiple cover types are available for use. We trapped and banded 204 CSTG near 20 leks in the Rockland and Curlew Valleys during spring 2011 and 2012 using 2 trapping methods. Survival of birds occupying CRP lands during spring and summer was 64% (n = 14) during 2011 and 62% (n = 29) during 2012; for CSTG occupying sagebrush rangelands during spring and summer survival was 77% (n=22) during 2011 and 71% (n=17) during 2012. Nest success of CSTG occupying CRP lands was 38% (n = 8) during 2011 and 32% (n=25) during 2012; for CSTG occupying sagebrush rangelands nest success was 14% (n=14) during 2011 and 45% (n=22) during 2012. Videography of 38 nests during 2011 and 2012 revealed 18 failed nests caused by: badgers (10), coyotes (3), ravens (2), long-tailed weasel (1), beef cow (1) and striped skunk (1). We conducted simultaneous ground and aerial IR lek counts during 2012 on April 11th and 12th at 25 leks. Mean ground and aerial IR lek counts were similar for these counts (mean ground count = 13; mean aerial IR count = 12). An NRCS Conservation Innovation Grant (CIG) was awarded to this project in collaboration with Jeffrey M. Knetter at the Idaho Department of Fish and Game. The CIG award allows 4 mornings of flights and we anticipate conducting 100 aerial IR lek counts during April 15th-21st of 2013.

Completed Projects-Wildlife and Terrestrial Resources

EFFECTS OF SURFACE WATER ON ABUNDANCE AND REPRODUCTIVE SUCCESS OF BIRDS IN DESERT RIPARIAN WOODLANDS

Principal Investigator:	Courtney J. Conway
Collaborators:	Chris Kirkpatrick (Univ of Arizona) and Don Swann (NPS)
Staff Biologists:	Dominic LaRoche, Gabrielle Robinson
Project Partners:	AZGFD, NPS, DOD, USGS, BLM, TNC, USFWS
Project Duration:	January 2005 to December 2012

Objective:

- Quantify the effects of reduction in surface water (due to drought or groundwater withdrawal) on persistence of bird populations in desert riparian woodlands.

Progress:

Riparian woodlands in the desert southwest are an extremely important resource because they constitute <1% of the desert landscape, yet typically support >50% of the breeding birds. Ground water withdrawal (and subsequent loss of surface water) to support growing human populations in the desert southwest has the potential to degrade or eliminate riparian woodlands throughout the region. During the first 2 years of the study, we surveyed birds, sampled vegetation, and measured surface water at 23 study sites located in riparian woodlands throughout southeastern Arizona. We also sampled avian food resources (i.e., aerial arthropods) and monitored nests of riparian bird species at a subset of 10 and 6 of these study sites, respectively. We examined the role of surface water and vegetation health (proportion of live vegetation) on bird parameters while controlling for potentially confounding variables such as vegetation structure and composition. Results suggest that relative abundances of several species of birds of conservation concern were positively associated with the presence and extent of surface water in riparian woodlands. In addition, we found evidence of substantial declines in breeding populations of riparian-obligate bird species such as Bell's vireo and yellow warbler following a drought-induced die-off of riparian trees at 1 of our 23 study sites (Rincon Creek in Saguaro National Park). Ultimately, results from this project will allow Saguaro National Park to predict the effects of proposed groundwater withdrawal projects on the abundance and diversity of breeding birds within the park. This information will allow the park to predict the effects of applications for new groundwater wells (to support human population growth in the region) on bird populations within the park. Such predictions will support applications from various agencies (e.g., Saguaro National Park) to the state of Arizona to maintain instream flow rights. This research project is addressing an emerging issue that will only become more important as the expanding human population places more demands on ground water resources in the arid west.

HABITAT ASSOCIATIONS OF BIRDS IN MONTANE RIPARIAN FORESTS OF THE SKY ISLAND MOUNTAIN RANGES

Principal Investigator:	Courtney Conway
Graduate Student:	Kristen Dillon, University of Arizona
Collaborator:	Chris Kirkpatrick
Project Partners:	USFWS, AZGFD, USGS, T&E Inc.
Project Duration:	2002 - 2012

Objective:

- Quantify the habitat associations of birds within montane forests of the southwestern U.S.

Progress:

The Madrean woodlands that cover the upper elevations of Sky Island Mountains in the southwestern U.S. and northwestern Mexico have been listed as a global biodiversity hotspot (Conservation International 2006); 1 of only 2 such hotspots in North America. These woodlands have high species diversity due to a high number of endemic species. Since 2002, we've monitored nests and documented habitat associations of 2 little-studied ground-nesting birds, the red-faced warbler and yellow-eyed junco, within 5 study sites in the Santa Catalina Mountains. We found that red-faced warblers and yellow-eyed juncos selected nest-sites close (≤30 m) to drainage bottoms in stands of montane riparian forest characterized by more ferns, forbs, brush, and small woody debris, more saplings and small trees (red-faced warblers), and more shrubs and less canopy cover (yellow-eyed juncos). Although both species nested in close proximity within montane riparian forest, environmental features at nest-sites differed, especially at finer spatial scales For example, most yellow-eyed juncos nested adjacent to grass, whereas red-faced warblers situated nests adjacent to a variety of plant species, including grass, big-tooth maple, white fir, and Douglas-fir. Both species avoided nesting in areas that were burned by a recent (2003) low-severity wildfire suggesting short-term negative effects of fire for breeding populations of red-faced warblers and yellow-eyed juncos. Our results show that montane riparian forests in the southwestern U.S. provide important breeding habitats for coexisting populations of red-faced warblers and yellow-eyed juncos. These forests are limited in their geographic extent and threatened with disturbance (e.g., catastrophic wildfire).

POPULATION TRENDS, RELATIVE ABUNDANCE AND EFFECTS OF MANAGEMENT ACTIONS FOR WEBLESS MIGRATORY GAME BIRDS

Principal Investigators:	Courtney J. Conway and Christopher Nadeau
Post-doctoral Investigator:	Leonard Santisteban
Staff Biologist:	Christopher Nadeau
Project Partners:	USFWS, USGS
Project Duration:	2008 - 2012

Objectives:

- Estimate population trends of secretive marsh birds (rails, bitterns, grebes) at national and regional scales.
- Estimate detection probability during surveys of marsh birds.
- Estimate breeding density of marsh birds.
- Evaluate the effects of some common wetland management actions on marsh birds.

Progress:

Populations of many species of webless migratory game birds that inhabit marshes are thought to be declining in North America. We used distance sampling and circular plot sampling to estimate breeding density and detection probability of 14 species from data gathered during marsh bird surveys conducted between 1999 and 2009. We also calculated density for both estuarine and palustrine marsh for species that were detected in both types of wetlands. We estimated population trends for all 14 species as well using both route-regression approach and loglinear Poisson regression. And we examined the effects of water depth, salinity, and pH on marsh bird abundance. Detection probability varied among species and was lowest for American bitterns (8%) and highest for yellow rails (55%). Estimates of breeding density also varied among species and was lowest for limpkins (0.002 birds/ha) and highest for clapper rails (0.64 birds/ha). Breeding density of individual species varied among FWS regions. Clapper rails had higher densities in estuarine marsh than in palustrine marsh, while all other species had higher densities in palustrine marsh. Prescribed fire led to increased numbers of clapper rails, Virginia rails, and black rails.

PYGMY RABBIT SURVEY

Principal Investigator:	Lisette Waits
Post doc:	Jennifer Adams
Funding Agency:	Idaho Department of Fish and Game
Completion Date:	30 September 2012

Objectives:

- Complete optimization of protocol to distinguish between pellets of all North American lagomorph species using a single PCR reaction.
- Work with IDFG to organize an effort to collect pygmy rabbit pellets from multiple locations in southern Idaho.
- Identify all collected pellets to species.

Progress:

We have completed development of the PCR-based method to distinguish all lagomorph species in the region. The test was developed and tested on at least 20 tissue samples of the following species: black-tailed jackrabbit (*Lepus californicus*), white-tailed jackrabbit (*Lepus townsendii*), mountain cottontail (*Sylvilagus nuttallii*), desert cottontail (*Sylvilagus audubonii*), eastern cottontail (*Sylvilagus floridanus*), and pygmy rabbit (*Brachylagus idahoensis*). We then optimized our methods for using this test on DNA extracted from fecal pellets so that managers have a non-invasive survey method for pygmy rabbits. Our species ID method was published in Molecular Ecology Resources (Adams et al 2011).

We have evaluated the success rates for our species ID test for pellet samples collected in the field during spring, summer and fall (n = 128) compared to samples collected on snow in the winter (n = 30). Success rates (94%) were considerably higher for samples collected in the winter. We analyzed 143 pellets collected by IDFG in the fall and early winter of 2009 - 2010. Success rate for species identification of these pellets was 73%. Pygmy rabbits were detected at 40 out of 55 plots sampled. We have been using this genetic test to analyze samples for other agency biologists in the region and have helped to identify the first record of pygmy rabbits in Colorado. We have also expanded the use of this approach to the WA pygmy rabbit population and developed methods for individual ID of pygmy rabbits using fecal pellets.

IDAHO GRAY WOLF MONITORING AND POPULATION ESTIMATION

Principal Investigator:	Lisette P. Waits
Student Investigator:	Carisa Stansbury
Collaborator:	Idaho Fish and Game
Funding Agency:	IDFG
Completion Date:	30 May 2012

From 2009 – 2010 we used a predictive habitat model to locate rendezvous sites and conducted noninvasive genetic sampling (NGS) of scat and hair at these sites in four study areas in Idaho,

USA. We evaluated species and individual identification success rates across study areas in different climate regimes and estimated population size using the single-session estimator, CAPWIRE. We applied three different recapture coding methods to our datasets and introduce a new method of coding capture data to optimize model performance. NGS population estimates were compared to telemetry-based estimates generated concurrently.

We collected 1999 samples and identified 193 unique individuals which were detected one to 30 times. Species identification success rates were consistently high (>92%) across areas and 82% of samples were identified as wolf. Individual identification success rates for fecal DNA samples were 78-80% in the drier study areas, but decreased 29% in the wettest study area. NGS population estimates were in general agreement with telemetry estimates in our four study areas, but estimates varied by recapture coding method. Our new coding method (PART) produced estimates that had the greatest agreement with telemetry estimates and produced 95% confidence intervals that overlapped telemetry estimates in three of five datasets. The estimates using PART were more precise and closer to telemetry relative to recapture between data types and rendezvous sites (CAP) and it was less conservative than using all of the data (ALL) and likely provided more reliable estimates when one or more packs was missed.

This study shows that predictive habitat modeling of rendezvous sites combined with NGS is successful at detecting gray wolf presence, identifying unique individuals, obtaining a minimum count of individuals and estimating abundance across study areas with different precipitation and temperature regimes.

We are continuing to analyze this dataset to estimate the number of packs and number of individuals per pack. Carisa Stansbury completed her MS work on this project in May 2012. We have published one paper, submitted one paper and have one in preparation.

Awards, Publications, Service and Other Activities of Unit and Unit Collaborating Scientists and Students 1 January 2012 – 31 December 2012

HONORS AND AWARDS

Kristen Dillon

2012 Alexander Bergstrom Memorial Research Award from the Association of Field Ornithologists.

2012 Graduate Research Fellowship from the National Science Foundation (2012-15).

Carl Lundblad

2012 Graduate Research Fellowship from the National Science Foundation (2012-15).

2012 Research Award from the Western Bird Banding Association.

Josh McCormick

Best Student Paper Award, Annual Meeting of the Idaho Chapter of the American Fisheries Society (co-author with Michael Quist)

Outstanding Graduate Student Award (2012), Department of Fish and Wildlife Sciences

Christine Moffitt

Columbia River Intertribal Fish Commission. 2012. Recognition of outstanding partnership and collaboration with tribal entities. Presented to the University of Idaho in recognition of the Moffitt laboratory collaborations.

Lifetime Achievement Award, Idaho Chapter of the American Fisheries Society. March 2012.

University of Idaho Alumni Award for Excellence as a Mentor –2012 for Zachary L. Penney, December

USGS Performance Award. 2012. For maintaining active research, teaching and outreach.

Zachary L. Penney

Equal Opportunities Travel Award presented by the Equal Opportunities Section of the American Fisheries Society for travel to the Annual American Fisheries Society Meeting in St. Paul, MN, August 2012

Outstanding Graduate Student Award by the Palouse Unit of the Idaho Chapter of the American Fisheries Society.

Steven Douglas Shawley Scholarship, February & August 2012

Kelly Creek Flycasters Scholarship, November 2012

University of Idaho Alumni Award for Excellence December 2012

Lisette Waits

2012 University of Idaho Mid-Career Award

PEER REVIEWED PUBLICATIONS FROM COOP RESEARCH ACTIVITIES

Conway, M., C. J. Conway, and C. P. Nadeau. 2012. Intraspecific variation in reproductive traits of burrowing owls. *Journal of Ethology* 30:395-402.

Cox, B. S., A. M. Dux, M. C. Quist, and C. S. Guy. 2012. Use of a seismic air gun to reduce survival of nonnative lake trout embryos: a tool for conservation? *North American Journal of Fisheries Management* 32:292-298.

Decker, K., C. J. Conway, and J. J. Fontaine. 2012. Nest predation, food, and female age explain seasonal declines in clutch size. *Evolutionary Ecology* 26:683-699.

Dzul, M. C., D. B. Gaines, J. R. Fischer, M. C. Quist, and S. J. Dinsmore. 2012. Evaluation of Salt Creek pupfish (*Cyprinodon salinus salinus*) otoliths for use in age and growth analyses. *Southwestern Naturalist* 57:412-416.

Dzul, M. C., M. C. Quist, S. J. Dinsmore, D. B. Gaines, and M. R. Bower. *In press*. Coarse-scale movement patterns of a small-bodied fish inhabiting a desert stream. *Journal of Freshwater Ecology*.

Dzul, M. C., M. C. Quist, S. J. Dinsmore, P. M. Dixon, and M. R. Bower. 2012. Identifying sources of error in surveys of Devils Hole pupfish. *Southwestern Naturalist* 57:44-50.

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. *In press*. A simulation model of the Devils Hole pupfish population using monthly length frequency distributions. *Population Ecology*.

Fischer, J. R., R. M. Krogman, and M. C. Quist. *In press*. Influence of native and non-native benthivorous fishes on aquatic ecosystems degradation. *Hydrobiologia*.

Fischer, J. R., T. E. Neebling, and M. C. Quist. 2012. Development and evaluation of a boat-mounted RFID antenna for monitoring freshwater mussels. *Freshwater Science* (formerly *Journal of the North American Benthological Society*) 31:148-153.

Keefer, M. L., G. A. Taylor, D. F. Garletts, C. Helms, G. A. Gauthier, T. M. Pierce, and C. C. Caudill. *In press.* High-head dams affect downstream fish passage timing and survival in the Middle Fork Willamette River. *River Research and Applications*.

Keefer, M. L., G. A. Taylor, D. F. Garletts, C. K. Helms, G. A. Gauthier, T. M. Pierce and C. C. Caudill. 2012. Reservoir entrapment and dam passage mortality of juvenile Chinook salmon in the Middle Fork Willamette River. *Ecology of Freshwater Fish* 21: 222-234.

McCormick, J. L., M. C. Quist, and D. J. Schill. 2012. Effect of survey design and catch rate estimation on total catch estimates in Chinook salmon fisheries. *North American Journal of Fisheries Management* 32:1090-1101.

Moffitt, C. M. 2012.Diversity in natural resource science professions: using feminine attributes to broaden diversity. *Fisheries* 37:376-377.

Moffitt, C. M. and C. A. James. 2012. Seasonal dynamics of Potamopyrgus antipodarum infestations in a heavily used recreational watershed in intermountain North America. *Aquatic Invasions* 7:193–202.

Moffitt, C. M., and C. A. James. 2012. Response of New Zealand mudsnails *Potamopyrgus antipodarum* to freezing and near freezing fluctuating water temperatures. *Freshwater Science* 31:1035-1041.

Nadeau, C. P., and C. J. Conway. 2012. A field evaluation of distance estimation error during wetland-dependent bird surveys. *Wildlife Research* 39:311-320.

Nadeau, C. P., C. J. Conway, L. Piest, and B. Burger. *In press*. Multi-species call-broadcast improved detection of endangered Yuma clapper rail compared to single-species call-broadcast. *Wetlands*.

Nielson, J., C. M. Moffitt, and B. J. Watten. 2012. Hydrocyclonic separation of invasive New Zealand mudsnails from an aquaculture water source. *Aquaculture* 326–329:156–162.

Nielson, R. J., C. M Moffitt, and B. J. Watten. 2012. Toxicity of elevated partial pressures of carbon dioxide to invasive New Zealand mudsnails. *Environmental Toxicology and Chemistry* 31:1838–1842.

Pennell, M.W., C.R. Stansbury, L.P. Waits, and C.R. Miller. *In press*. Capwire: a R package for estimating population census size from non-invasive genetic sampling. *Molecular Ecology Resources.*

Plumb, J. M., W. P. Connor, K. F. Tiffan, C. M. Moffitt, R. W. Perry, and N.S. Adams. 2012. Estimating and predicting collection probability of fish at dams using multistate modeling. *Transactions of the American Fisheries Society* 141:1364-1373.

Quist, M. C., and J. R. Spiegel. 2012. Population demographics of catostomids in large river ecosystems: effects of discharge and temperature on recruitment dynamics and growth. *River Research and Applications* 28:1567-1586.

Schultz, R. D., A. L. Fowler, J. M. Goeckler, and M. C. Quist. *In press*. Latitudinal comparisons of growth and development of a relative growth index for hybrid striped bass in North America. *North American Journal of Fisheries Management.*

Schultz, R. D., J. M. Goeckler, and M. C. Quist. *In press*. Size-based mortality caps as thresholds for managing hybrid striped bass in Kansas reservoirs. *North American Journal of Fisheries Management.*

Sindt, A. R., C. L. Pierce, and M. C. Quist. 2012. Fish species of greatest conservation need in wadeable Iowa streams: current status and effectiveness of aquatic GAP Program distribution models. *North American Journal of Fisheries Management* 32:135-146.

Sindt, A. R., M. C. Quist, and C. L. Pierce. 2012. Habitat associations of fish species of greatest conservation need at multiple spatial scales in wadeable Iowa streams. *North American Journal of Fisheries Management* 32:1046-1061.

Stockton, K. and C. M. Moffitt. *In press.* Disinfection of three wading boot surfaces infested with New Zealand mudsnails. *North American Journal of Fisheries Management*.

Steckler, S. E., and C. J. Conway. 2012. Frequent vocalizing is negatively associated with brood parasitism in a host of the Brown-headed Cowbird. *Condor* 114: 219-226.

Steidl, R. J., C. J. Conway, and A. Litt. *In press.* Power to detect trends in abundance of secretive marsh birds: effects of species traits and sampling effort. *Journal of Wildlife Management* 77:in press.

Stockton, K.A., C. M. Moffitt, D. L. Blew, and C. N. Farmer. 2012. Acute toxicity of sodium fluorescein to ashy pebblesnails *Fluminicola fuscus*. *Northwest Science* 86:190-197.

Suronen, E.F., and B.A. Newingham. *In press*. A starting point: An ecosystem of reference for habitat restoration of the northern Idaho ground squirrel, *Urocitellus brunneus*. *Northwestern Naturalist* 94:in press.

Torstrom, S.M., J.R. Adams, and L.P. Waits. *In press*. Detecting pygmy rabbits *(Brachylagus idahoensis)* using DNA extracted from fecal pellets of mixed species groups. *Wildlife Society Bulletin.*

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.

BOOKS AND BOOK CHAPTERS

Moffitt, C. M., Z. L. Penney, and L.Cajas Cano. *In final review*. Reconnecting human populations to their natural environment. Edited by Taylor et al. Future of fisheries: perspectives for the next generation of professionals, American Fisheries Society, Bethesda.

Quist, M. C., M. A. Pegg, and D. R. DeVries. 2012. Age and growth. Pages 677-731 i*n* A. Zale, D. Parrish, and T. Sutton, editors. *Fisheries techniques, third edition*. American Fisheries Society, Bethesda, Maryland.

TECHNICAL AND SEMI-TECHNICAL REPORTS

Conway, M., and C. J. Conway. 2012. Relative abundance of Yuma clapper rails within proposed improvement sites along the Union Pacific Railroad in Imperial Valley, California. Wildlife Research Report #2012-01.

Johnson, E.L., T.S. Clabough, M.L. Keefer, C.C. Caudill, P.N. Johnson, W.T. Nagy, and M.A. Jepson. 2012. Evaluation of dual frequency identification sonar (DIDSON) for monitoring Pacific lamprey passage behavior at fishways of Bonneville Dam, 2011. UI FERL Report 2012-5-DRAFT for the US Army Corps of Engineers, Portland District.

Keefer, M.L., C.C. Caudill, E.L. Johnson, T.S. Clabough, M.A. Jepson, C.T. Boggs, and M.L. Moser. 2012. Adult Pacific lamprey migration in the lower Columbia River: 2011 half-duplex PIT tag studies. UI FERL Report 2012-3-DRAFT for the US Army Corps of Engineers, Portland District.

Naughton, G.P., C.C. Caudill, T.S. Clabough, M.L. Keefer, M.J. Knoff, and M.A. Jepson. 2012. Migration behavior and spawning success of spring Chinook salmon in Fall Creek and the Middle Fork North Fork Willamette River:

relationships among fate, fish condition, and environmental factors, 2011. UI FERL Report 2012-2-DRAFT for the US Army Corps of Engineers, Portland District.

Noyes, C.J., C.C. Caudill, T.S. Clabough, D.C. Joosten, E.L. Johnson, M.L. Keefer, and G.P. Naughton. 2012. Adult Pacific lamprey migration behavior and escapement in the Bonneville Reservoir and lower Columbia River monitored using the Juvenile Salmonid Acoustic Telemetry System (JSATS), 2011. UI FERL Report 2012-4 for the US Army Corps of Engineers, Portland District.

THESES AND DISSERTATIONS

Hughes, Laura. 2012. Use of calcium hydroxide as an agent to kill invasive species in boat ballast. Senior Thesis, Environmental Sciences. May 2012.

Jones, Bryan. 2013. Migratory and physiological characteristics of steelhead kelts from the Clearwater River, Idaho, and Lower Granite Dam, Washington. M.S. Thesis, College of Natural Resources, University of Idaho.

Madsen, Rhett. 2012. Monitoring and mitigation of supersaturation of dissolved gasses in the release waters from Dworshak dam. Senior Thesis, Environmental Sciences. May 2012.

McCormick, J. L. 2012. Assessment of angler survey methods for managing Idaho's anadromous fisheries. M.S. Thesis, College of Natural Resources, University of Idaho.

Plumb, John. 2012. Evaluation of models and the factors affecting the migration and growth of naturally produced subyearling fall Chinook salmon (*Oncorhynchus tshawytscha*) in the Lower Snake River. PhD.Dissertation. College of Natural Resources, University of Idaho.

Roumasset, A.G. 2012. Pre-spawn mortality of upper Willamette River spring Chinook salmon: associations with stream temperature, watershed attributes, and environmental conditions on the spawning grounds. M.S. Thesis, Water Resources, University of Idaho.

Shearer, Justin. 2012. Control strategies for invasive Asian clams. Senior Thesis, Environmental Sciences December 2012.

Stansbury, C. 2012. Monitoring gray wolves (*Canis lupus*) using noninvasive genetics sampling at rendezvous sites. M.S. Thesis, Environmental Science, University of Idaho.

Sullivan, C.A. 2012. Microhabitat use by northern Idaho ground squirrels (*Urocitellus brunneus*) in response to prescribed fire. Undergraduate senior thesis for Ecology and Conservation Biology major. University of Idaho. College of Natural Resources.

Suronen, E.S. 2012. Establishing reference sites and evaluating thinning and burning as restoration tools for the northern Idaho ground squirrel (*Urocitellus brunneus*). M.S. Thesis, College of Natural Resources, University of Idaho.

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

Bakevich, B.D., C.L. Pierce and M.C. Quist. 2012. Distribution and habitat associations of Topeka shiners in west-central Iowa. 24th Annual Meeting of the North Central Division of the American Fisheries Society - Rivers and Streams Technical Committee, Milan, Illinois. 28 March.

Barenberg, A., C. M. Moffitt, and B. J. Watten. 2012. Elevated pH as a management tool to control invasive mollusks. Washington State Lake Protection Association (WALPA). Wenatchee, WA. 24-26 October.

Barenberg, A., C. M. Moffitt, and B. J. Watten. 2012. Use of hydrated lime and sodium hydroxide to reducing the risks of release of invasive species from ballast systems.143rd Annual Meeting, American Fisheries Society, St. Paul, MN. 19 – 13 August.

Borgmann, K. L., C. J. Conway, and M. L. Morrison. 2012. A new method to measure nest concealment. North American Ornithological Conference. Vancouver, BC, Canada. 15 Aug 2012.

Bourret, S., B.P. Kennedy, C.C. Caudill, and L. Borgerson. 2012. Characterizing juvenile Chinook salmon life history variability in the Willamette Valley using otoliths and scales. USACE 2011 Willamette Basin Fisheries Science Review, Corvallis, OR.

Cajas Cano, L. and C. M. Moffitt. 2012. Life cycle assessment integrating two or more species to improve sustainability in marine aquaculture. Idaho Chapter American Fisheries Society Annual Meeting. Coeur d Alene, ID. 6-9 March

Carter-Lynn, K., M. Liter, B. Hammond, and M. C. Quist. 2012. An evaluation of the channel catfish fishery in north Idaho lakes. Annual Meeting of the Idaho Chapter of the American Fisheries Society, Coeur d'Alene, ID. 8 March.

Caudill, C.C., G. Naughton, G.A. Taylor, M.L. Keefer, M.J. Knoff, A. Roumasset*, C.B. Schreck, and M. Kent. 2012. Migration behavior and spawning success in spring Chinook salmon in Fall Creek and the North Fork Middle Fork Willamette River: relationships among fate, fish condition, and environmental factors, 2008-2011. USACE 2011 Willamette Basin Fisheries Science Review, Corvallis, OR.

Caudill, C.C., M.A. Jepson, T.S. Clabough, S.R. Lee, G.P. Naughton, M.R. Morasch, M.J. Knoff, D.C. Joosten, T.L. Dick, and M.L. Keefer. 2012. Migration behavior, timing, and distribution of spring Chinook salmon radio-tagged at Willamette Falls Dam, 2011. USACE 2011 Willamette Basin Fisheries Science Review, Corvallis, OR.

Conway, C. J. 2012. Behind the Scenes of Scientific Publication and Critical Review. Workshop sponsored by the Student Professional Development and Early Career Professional Working Groups of The Wildlife Society. Annual Conference of The Wildlife Society, Portland, OR. 13 Oct 2012.

Conway, M., and C. J. Conway. 2012. Effects of a changing climate on breeding phenology, clutch size and reproductive success in burrowing owls. North American Ornithological Conference. Vancouver, BC, Canada, 15 Aug 2012.

Conway, M., and C. J. Conway. 2012. Climate effects on breeding phenology, clutch size, and reproductive success in burrowing owls. Natural Resources Graduate Student Forum, University of Arizona. Tucson, AZ. 9 Aug 2012.

Conway, C. J. 2012. Challenges for young male and female professionals returning to Central and Caribbean Countries. University of Idaho. Moscow, ID. 22 May 2012.

Conway, C. J. 2012. Comparative Demography of Burrowing Owl Populations in North America. Idaho TWS Conference, Boise, ID. 6 March 2012.

Conway, C. J. 2012. Comparative Demography of Burrowing Owl Populations in North America. Symposium on Society for Range Management Annual Conference, Spokane, WA. 30 January 2012.

DeMay, S.M., P.A. Becker, C.A. Eidson, J.L. Rachlow, T.R. Johnson, and L.P. Waits. 2012. Non-invasive genetic monitoring of the Columbia Basin pygmy rabbit: evaluation of fecal DNA degradation. The Wildlife Society 19th Annual Conference, Portland, OR.

Dillon, K. G., and C. J. Conway. 2012. Breeding Biology of Red-faced Warblers in the Santa Catalina Mountains. Arizona Field Ornithologists. Lake Havasu City, AZ. 27 Oct 2012.

Dillon, K. G., and C. J. Conway. 2012. Why do birds that breed at high elevation lay smaller clutches? A test of alternative hypotheses. 45th Joint Annual Meeting of the Arizona/New Mexico Chapters of The Wildlife Society and American Fisheries Society. Phoenix, AZ. 3 February 2012.

Dillon, K. G., and C. J. Conway. 2012. Effects of temperature and precipitation on annual variation in breeding phenology of Red-faced Warblers in the Santa Catalina Mountains. 3rd Conference on Biodiversity and Management of the Madrean Archipelago. Tucson, AZ. 1 May 2012.

Dillon, K. G., and C. J. Conway. 2012. Changes in breeding phenology and elevational gradients in clutch size of red-faced warblers: effects of climate, nest predation, and food. North American Ornithological Conference. Vancouver, BC, Canada. 17 Aug 2012.

Fischer, J. R., C. D. Smith, and M. C. Quist. 2012. Historical changes in Nebraska's stream fish assemblages. 24th Annual Meeting of the North Central Division of the American Fisheries Society - Rivers and Streams Technical Committee, Milan, Illinois. March 28.

Gillette, G. L., K. P. Reese, J. M. Knetter, and J. W. Connelly. 2012. Assessing the quality of CRP lands as habitat for Columbian sharp-tailed grouse and the accuracy of lek counts obtained with aerial infrared imagery. Western Agencies Grouse Workshop. June 22, 2012. Steamboat Springs, CO.

Hewett, H., C. M. Moffitt and Z. L. Penney. 2012. Prevalence of otolith aberrancy in hatchery-reared juvenile steelhead trout from the Snake River basin. Idaho Chapter American Fisheries Society Annual Meeting. Coeur d Alene, ID. 6-9 March

Hewett, H., Z. Penney, and C. M. Moffitt. 2012. Prevalence of otolith aberrancy in hatchery-reared juvenile steelhead trout from the Snake River basin. Idaho NSF EPSCoR and Idaho NASA EPSCoR annual meeting, Boise, ID. 2-3 October.

Hewett, H., Penney, Z., and Moffitt, C.M. 2012.Otolith Aberrancy in juvenile Snake River steelhead trout. Idaho NSF EPSCoR and Idaho NASA EPSCoR Annual Meeting, Boise, ID. October

Hewett, H., Penney, Z., and Moffitt, C.M. 2012. Otolith Aberrancy in juvenile Snake River steelhead trout. 49th Idaho Chapter of the American Fisheries Society Annual Meeting, Coeur d'alene, ID. March

Hughes, L., A. Barenberg, T Britton, C. Withers-Haley, C. M. Moffitt, B. J. Watten, and J. Davis. 2012. Use of hydrated lime to reducing the risks of release of invasive species from boats and ballast systems . Idaho Chapter American Fisheries Society Annual Meeting. Coeur d Alene. 6-9 March.

Jones, B., C. M. Moffitt, T. Copeland, B. Bowersox, D. Hatch, Z. Penney, and J. Buelow. 2012. Migration and physiology of Clearwater River steelhead kelts. Idaho Chapter American Fisheries Society Annual Meeting. Coeur d Alene. 6-9 March.

Kennedy, B.P. and R.B. Hartson. 2012. A watershed scale test of optimal foraging in a variable environment. Annual meeting for Idaho Chapter AFS, Boise, ID. March

Lankford, A., 2012 Climate change vulnerability assessment of terrestrial bird species, Idaho Chapter of the Wildlife Society Meeting. March

LaRoche, D. D., and C. J. Conway. 2012. Development of a habitat suitability model for Masked Bobwhite based on expert opinion. Masked Bobwhite Recovery Team Meeting, Tucson, AZ. 23 January 2012.

LaRoche, D.D., and C. J. Conway. 2012. Developing a habitat suitability index model for a critically endangered bird: understanding habitat suitability and uncertainty based on expert opinion. Graduate Interdisciplinary Program in Statistics Research Showcase, University of Arizona, Tucson, AZ. 12 Dec 2012.

LaRoche D. D., C. J. Conway, D. E. Swann, and C. Kirkpatrick. 2012. The future of southwestern birds in a changing climate: Changes in species composition due to declines in available water and riparian vegetation. North American Ornithological Conference. Vancouver, BC, Canada. 15 Aug 2012.

Limberger, A.J., C.A. Sullivan, E.S. Suronen, and B.A. Newingham. 2012. Small-scale habitat use by the north Idaho ground squirrel, *Urocitellus brunneus brunneus*. Idaho Chapter of the Wildlife Society. Boise, ID.

Lundblad, C. G., and C. J. Conway. 2012. What Makes a Migrant: Migratory Patterns and Their Causes within a Sky Island. Western Field Ornithologists. Petaluma, CA. 29 Sep 2012.

Lundblad, C. G., and C. J. Conway. 2012. Differential migration of yellow-eyed juncos along an elevational gradient. North American Ornithological Conference. Vancouver, BC, Canada. 17 Aug 2012.

Lundblad, C. G., and C. J. Conway. 2012. Migration dynamics and wintering strategies of Yellow-eyed Juncos in southeastern Arizona. Arizona Field Ornithologists. Lake Havasu City, AZ. 27 Oct 2012.

Madsen, R., C. M. Moffitt, J. Christiansen, and J. Olson. 2012. Monitoring and mitigation of saturated gasses at Dworshak National Fish Hatchery. Idaho Chapter American Fisheries Society Annual Meeting. Coeur d Alene. 6-9 March.

McCormick, J. L., M. C. Quist, and D. J. Schill. 2012. Effect of survey design and catch rate estimation on total catch estimates in Chinook salmon fisheries.

Annual Meeting of the Idaho Chapter of the American Fisheries Society, Coeur d'Alene, Idaho. March 8.

McCormick, J. L., M. C. Quist, and D. J. Schill. 2012. Stratification and allocation of sampling effort using parentage-based genetic tagging to estimate steelhead harvest. 142nd Annual Meeting of the American Fisheries Society, St. Paul, Minnesota. August 21.

Merchant, A.Z. E.R. Benson, J. Hegg and B.P. Kennedy. 2012. Determining the maternal origin of juvenile steelhead in Lapwai Basin, Idaho. Annual meeting for Idaho Chapter AFS, Boise, ID. March

Moffitt, C. M. 2012. Diversity and equality. Workshop and presentation to SEEDS group, 1 February and 15 February. University of Idaho.

Moffitt, C. M. 2012. Plenary and Business Meeting Awards Ceremonies for Annual Meeting of the American Fisheries Society, St. Paul, MN. August

Moffitt, C. M. 2012. Asian clams in Lake Pend Oreille. Presentation to Clark Fork Management Committee Meeting, Noxon, Montana. 19 September

Moffitt, C. M. 2012. Invasive species. Guest lecture for Wildlife 314 class. 27 January

Moffitt, C.M. and L. Cajas Cano. 2012. Conflicts for global aquatic resources: the need for tools to assess tradeoffs. 143nd Annual meeting of American Fisheries Society. St. Paul, MN. 19 – 23 August

Moulton, C. E., and C. J. Conway. 2012. Assessment of peak detection periods for surveying secretive marsh birds in Idaho. North American Ornithological Conference. Vancouver, BC, Canada. 15 Aug 2012.

Myrvold and Kennedy. 2012. A bioenergetic- and habitat-based examination of self-thinning relationships in juvenile steelhead across a stream network. Annual meeting for the American Fisheries Society, St. Paul, MN. August

Myrvold K.M. and Kennedy, B.P. 2012. Effects of body mass, water temperature and consumption rates on juvenile steelhead (*Oncorhynchus mykiss*) in a hydrologically altered watershed. Annual meeting for Idaho Chapter AFS, Boise, ID. March

Oleson, B. I., and C. J. Conway. 2012. Of owls and alfalfa: why are burrowing owls associated with agricultural fields in North America? Annual Cooperators Meeting, Arizona Cooperative Fish and Wildlife Research Unit, Tucson, AZ. 5 Sep 2012.

Parks, T. P., M. C. Quist, and C. L. Pierce. 2012. Historical changes in fish assemblages in non-wadeable rivers of Iowa. 142nd Annual Meeting of the American Fisheries Society, St. Paul, Minnesota. 23 August

Penney, Z. and C M. Moffitt. 2012. Factors affecting iteroparity in Snake River steelhead trout 2012. Idaho Cooperative Fish and Wildlife Research Unit Annual Cooperators Meeting Moscow, ID. April

Penney, Z. 2012. An introduction to salmon ecology and management in the Snake River Subbasin. Cultural Interpretations of the Regional Landscape at Washington State University, Pullman, WA. September

Penney, Z. 2012. Repeat spawning in Snake River steelhead or lack thereof. Kelly Creek Flycasters, Lewiston, ID. December

Penney, Z. 2012. Fish reproduction and recovery. Fish Physiology 511 University of Idaho, Moscow, ID. November

Penney, Z. 2012. Native American fishing and fishing rights in the Northwest: More than just a tradition. Senior Fisheries Seminar Fish 494, Moscow, ID. February

Penney, Z. L., C. M. Moffitt, B. Marston. J. Buelow, B. Jones. 2012. A comparison of the nutritional and energetic status of kelts from the Snake River and coastal Situk River, AK using blood plasma metrics. Idaho Chapter American Fisheries Society Annual Meeting. Coeur d Alene, ID. 6-9 March

Penney, Z. 2012. Threatened and endangered species. Mrs. Pinkham's 5th grade class, Lapwai, ID. May

Penney, Z., and C. M. Moffitt. 2012. No guts no glory: using histology to assess the capacity for post-reproductive recovery in Snake River steelhead kelts. 143rd Annual Meeting, American Fisheries Society, St. Paul, MN. 19 – 13 August

Penney, Z., C. M. Moffitt, B. Marston, C. Woods, B. Jones, and J. Buelow. 2012. Nutritional and energetic status of inland Snake River and coastal Situk River kelts using blood plasma chemistry. 13th Steelhead Management Meeting Pacific States Management Council, Fort Worden, WA.13-14 March

Penney, Z. and C.M. Moffitt. 2012. No guts, no glory: Assessing the capacity for post-reproductive recovery in Snake River steelhead kelts. 142nd Annual Meeting of the American Fisheries Society, St. Paul, MN.

Penney, Z., C.M. Moffitt, Marston, B., Woods, C., Jones, B., and Buelow, J. 2012. Nutritional and energetic status of kelts from the Snake River and Situk River, AK using blood chemistry. 49th Idaho Chapter of the American Fisheries Society Annual Meeting, Coeur d'alene, ID.

Penney, Z., Moffitt, C.M., Marston, B., Woods, C., Jones, B., and Buelow, J. 2012. Nutritional and energetic status of inland Snake River and coastal Situk River kelts using blood plasma chemistry. 13th Annual Steelhead Management Meeting Pacific States Management Council, Fort Worden, WA. March

Plumb, J. M., C. M. Moffitt, J. A. Yanke, W. P. Connor and K. F. Tiffan. 2012. Thermal shift in maximum consumption helps explain bioenergetics and growth by subyearling fall Chinook salmon. Idaho Chapter American Fisheries Society Annual Meeting, Coeur d Alene, ID. 6-9 March.

Porter, N., J. L. McCormick, M. C. Quist, and T. Bonvechio. 2012. Age structure and growth of bowfin in Lake Lindsay Grace, Georgia. Annual Meeting of the Idaho Chapter of the American Fisheries Society, Coeur d'Alene, ID. 8 March

Roumasset, A. and C.C. Caudill. 2012. Associations between Chinook salmon prespawn mortality rates, environmental factors, and watershed features in sub-basins of the Willamette River Valley. USACE 2011 Willamette Basin Fisheries Science Review, Corvallis, OR.

Scholten, G. M., M. D., Sundberg, J. R. Fischer, and M. C. Quist. 2012. Eradication of gizzard shad *Dorosoma cepedianum* with low-dose rotenone applications. 142nd Annual Meeting of the American Fisheries Society, St. Paul, MN. August 20

Schreck, C.B., M. Kent, S. Benda, J. Unrein, R. Chitwood, C.C. Caudill, and G. Naughton. 2012. Prespawn mortality in spring Chinook salmon in the upper Willamette River: potential causes. USACE 2011 Willamette Basin Fisheries Science Review, Corvallis, OR.

Schreck, C.B., M. Kent, S. Benda, J. Unrein, R. Chitwood, C.C. Caudill, and G. Naughton. 2012. Prespawn mortality in spring Chinook salmon in the upper

Willamette River: potential management options. USACE 2011 Willamette Basin Fisheries Science Review, Corvallis, OR.

Shearer, J., C. M. Moffitt, and A. Barenberg. 2012. NaOH toxicity to invasive quagga mussels and Asian clams: estimating lethal time of exposure to NaOH pH 12. Idaho NSF EPSCoR and Idaho NASA EPSCoR annual meeting, Boise, ID. 2-3 October

Smith, C. D., J. R. Fischer, and M. C. Quist. 2012. Historical changes in Nebraska's lotic fish assemblages: a spatiotemporal assessment. 142nd Annual Meeting of the American Fisheries Society, St. Paul, MN, August 20

Smith, C. D., J. R. Fischer, and M. C. Quist. 2012. Long-term changes in Nebraska's stream fish assemblages. Annual Meeting of the Idaho Chapter of the American Fisheries Society, Coeur d'Alene, ID. March 8

Sullivan, C.A., E.S. Suronen, and B.A. Newingham. 2012. Northern Idaho ground squirrel microhabitat preference in response to prescribed burns. Idaho Chapter of the Wildlife Society. Boise, ID.

Sullivan, C.A., E.S. Suronen, and B.A. Newingham. 2012. Microhabitat use by northern Idaho ground squirrels in response to prescribed fire. Society for Range Management Annual Meeting, Spokane, WA.

Sundberg, M. D., G. M. Scholten, J. R. Fischer, and M. C. Quist. 2012. Effects of low-dose rotenone toxicity on benthic invertebrates. 142nd Annual Meeting of the American Fisheries Society, St. Paul, MN. August 20

Suronen, E.F. and B.A. Newingham. 2012. Evaluating thinning and prescribed fire as habitat restoration for an endemic threatened species. Annual Meeting of the Ecological Society of America, Portland, OR.

Suronen, E.F. and B.A. Newingham. 2012. Northern Idaho ground squirrel habitat restoration: Insights into treatment effects. Idaho Chapter of the Wildlife Society. Boise, ID.

Suronen, E.F. and B.A. Newingham. 2012. Evaluating prescribed fire effects on wildlife habitat used as a restoration tool. Society for Range Management Annual Meeting, Spokane, WA.

Torstrom, S. and L.P. Waits. 2012. Detecting the presence of pygmy rabbits (*Brachylagus idahoensis*) using DNA extracted from fecal pellets of mixed species groups. McNair Undergraduate Research National Conference.

Waits, L. 2012 , Non-invasive genetic sampling contributions to wildlife ecology, conservation and management. Memorial University Newfoundland, Canada.

Waits, L. 2012. The use of non-invasive genetic sampling to monitor terrestrial carnivores in the Symposium Transformative Research and Management in Northwestern Large and Meso-Carnivores Wildlife Society, Portland, OR.

Waits, L. 2012. Conservation Genetic, landscape genetics and molecular ecology, Katmandu University, Nepal.

Waits, L. 2012. Conservation Genetics Workshop, Loja, Ecuador – 20 attendees

Waits, L. 2012, Contributions of genetics to the conservation and management of wildlife populations, Biotechnology symposium, Katmandu, Nepal.

Waits, L. 2012. Genetic Diversity and Fitness, Medical University, Katmandu, Nepal

Wheeler, T., Kavanagh, K and Noble Stuen, A. 2012. Marine Nutrient Subsidies in Inland riparian forests. Presentation given at the Ecological Society of America meeting in Portland, OR.

Wheeler, T., K . Kavanagh, and A. Noble Stuen. 2012. Modeling the effects of anadromous fish nitrogen on riparian forest carbon balance. Presentation given at the Ecological Society of America meeting in Portland, OR.

Whitlock, S. L., M. C. Quist, and A. M. Dux. 2012. Sensitivity analysis of kokanee egg-to-fry survival estimates in Lake Pend Oreille, Idaho. Annual Meeting of the Idaho Chapter of the American Fisheries Society, Coeur d'Alene, ID. March 8

Whitlock, S. L., M. C. Quist, and A. M. Dux. 2012. Comparison of kokanee breeding groups in Lake Pend Oreille, Idaho. 142nd Annual Meeting of the American Fisheries Society, St. Paul, MN. August 20

TECHNICAL ASSISTANCE OUTREACH AND PROFESSIONAL SOCIETY ACTIVITIES

Outreach presentations and workshops

Cajas Cano, L. 2012. Leadership, environmental and social entrepreneurship trainer. Central American Youth Ambassador Program (CAYA). US Department of State, Bureau of Education and Cultural Affairs in conjunction with Center for Intercultural Education and Development at Georgetown University. January

Cajas Cano, L. 2012. Workshop leader, social entrepreneurship. Scholarships for Education and Economic Development Program (USAID SEED Program), University of Idaho June 2011 – June 2012

Cajas Cano, L. 2012 – 2013. 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.

Conway, C. J. 2012. Invited member of a USFWS steering committee on marsh birds whose– goal is to develop the long-term business plan for how USFWS (and partner agencies) will invest in solving the most pressing issues for the conservation and management of marsh birds in North America. 2011-present.

Conway , C. J. 2012. Marsh Bird Training Workshop. I developed, organized, and delivered/coordinated three-day marsh bird training workshop in Yuma, Arizona.

Conway, C. J. 2012. Asked to speak to group of young male and female college students about challenges of returning home to their Central American and Caribbean countries after spending a year at Univ of Idaho. May 2012.

Editorial and Professional Society Boards, and other Activities

Courtney J. Conway

Associate Editor of *Wetlands.* 2010-2013

Scientific Program Committee for the 2012 North American Ornithological Conference in Vancouver, British Columbia. 2010-2012.

Member of the Masked Bobwhite Recovery Team. 2009 – 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. 2011-2012
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.2011-2013
Reviewer for Department of Agriculture CREES, Small Business Investment in Research (SBIR) Phase I grants – Aquaculture. 2012, 2013
Member, Fisheries Strategic Plan Steering Committee for USFWS, Sport Fishing and Boating Partnership. 2012 - 2013
Outside reviewer for Promotion, Department of Biology, Michigan Technology University. 2012
Reviewer for Department of Agriculture CREES, Small Business Investment in Research (SBIR) Phase II grants- Aquaculture. 2012
Reviewer Lake Tahoe Science Consortium Research Program. 2011 to present
Reviewer for Alaska Marine Ecosystem Grant Program. 2012
Reviewer, Oregon Sea Grant Research Proposals
Reviewer for Israel Bi-national Agricultural Research and Development Fund proposals. 2011-2012
Participant, 100th Meridian Initiative - Columbia River Basin Team Participant
Participant, Idaho Invasive Species Council, Aquatic Invasive Species
Fish and Wildlife Sciences promotion committee Sept – October 2012
Evaluation team for Morris K. Udall Scholarship applications February – March 2012
2012 Lead for wet laboratory safety and repairs projects April – June 2012

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.

Michael C. Quist

President, Education Section of the American Fisheries Society. 2011-2012

Laboratory and field sampling for invasive mollusks.
Left: Kate Wilcox, sorting NZMS,
Right: Amber Barenberg, collecting veligers.

Left: Steve Whitlock and Right: Chris Smith with a rainbow trout from the Kootenai River, Idaho.