



CALIFORNIA  
COOPERATIVE  
FISH  
RESEARCH  
UNIT

2005 Annual Report



# California Cooperative Fish Research Unit

2005 Annual Report

October 2004 - September 2005

## Cooperators

U. S. Geological Survey  
California Department of Fish and Game  
Humboldt State University

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# INTRODUCTION

The California Cooperative Fishery Research Unit is pleased to provide this summary of our activities during the past year. The California Unit is one of 39 similar units established at universities throughout the United States. The Cooperative Unit Program began in 1935. Cooperators include the US Geological Survey, State Fish and Wildlife Agencies, Universities, and in some instances, other conservation agencies. The units conduct research of benefit to cooperators, train graduate students and provide research information to agencies and the public. Cooperative Units professional staff members are federal employees of the US Geological Survey and serve as faculty at their host university.

The California Cooperative Fishery Research Unit, established in 1966, is located in Arcata, California on the northern California coast at Humboldt Bay. The Unit is affiliated with the Department of Fisheries Biology in the College of Natural Resources and Sciences, Humboldt State University. Present staff includes Unit Leader Dr. Walter G. Duffy, Assistant Leader Dr. Peggy Wilzbach and Senior Advisory Scientist Dr. Kenneth W. Cummins.

During the past year, we have conducted or facilitated seventeen research projects, of which eleven were conducted by Unit scientists as principal or co-principal investigator and seven by cooperating faculty at Humboldt State University. We are proud of the role the California Unit serves in facilitating research at Humboldt State University and value the collaboration of our university colleagues, as well as that of our colleagues at cooperating agencies.

Base funding for the California Unit is provided by the U. S. Geological Survey and the California Department of Fish and Game. Humboldt State University provides facilities and administrative support services. Research sponsors include the U.S. Fish and Wildlife Service, N.O.A.A. Fisheries, U.S. Bureau of Land Management, U.S. Bureau of Reclamation, National Park Service, U.S. Forest Service, U.S. Geological Survey, California Department of Fish and Game, California Department of Forestry and Fire Protection, Yurok Tribe, and Green Diamond Resource Company.

# MISSION STATEMENT

The California Cooperative Fish Research Unit is a cooperative venture among Humboldt State University, the California Department of Fish and Game, and United States Department of the Interior. This venture allows cooperators to pool both human and financial resources to carry out the mission of the California Cooperative Fish Research Unit. The mission of the California Cooperative Fish Research Unit is to:

- 1) conduct scientific research that benefits fish, wildlife, their habitats, and ecosystems upon which they depend;
- 2) through mentoring and teaching graduate level courses, train graduate fisheries and wildlife management students to become competent fisheries and wildlife scientists; and
- 3) provide technical assistance to the fisheries and wildlife profession by sponsoring training workshops, reviewing and writing manuscripts for publication, and coordinating research activities with others.

## COOPERATING AGENCIES

### **United States Geological Survey**

Cooperative Research Units  
12201 Sunrise Valley Drive  
Reston, VA 20192

Byron K. Williams, Chief  
Bernard Shanks, Unit Supervisor

### **California Department of Fish and Game**

1416 Ninth Street  
Sacramento, CA 95814

Ryan Brodrick, Director  
Larry Week, Chief, Native  
Anadromous Fish and Watershed  
Restoration Branch

### **Humboldt State University**

College of Natural Resources and  
Sciences  
1 Harpst Street  
Arcata, CA 95521

James H. Howard, Dean  
David G. Hankin, Chair,  
Department of Fisheries Biology

## UNIT STAFF

Dr. Walter G. Duffy, Unit Leader  
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## COOPERATORS AND PERSONNEL

# RESEARCH COOPERATORS

## RESEARCH STAFF

Kasey Bliesner, Project Biologist

## HUMBOLDT STATE UNIVERSITY COOPERATING FACULTY

### Department of Fisheries Biology

Kristine Brenneman, Associate Professor

Ronald A. Fritzsche, Emeritus Professor

David Hankin, Professor and Chair

Bret C. Harvey, Adjunct Professor

Gary L. Hendrickson, Professor

Andrew Kinziger, Assistant Professor

Eric Loudenslager, Adjunct Professor & Fish Hatchery Manager

Helen Mulligan, Lecturer

Timothy Mulligan, Professor

Terry Roelofs, Professor

### Wildlife Department

Richard G. Botzler, Professor

Mark A. Colwell, Professor

Ned H. Euliss, Adjunct Professor

T. Luke George, Professor and Chair

Richard Golightly, Professor

### Other Departments

Steven A. Carlson, Professor Nat. Res. Planning & Interpretation

Gregory B. Crawford, Associate Professor Oceanography

Brad A. Finney, Professor Environmental Resources Engineering

Harvey M. Kelsey, Research Assistant, Geology

Roland H. Lamberson, Professor, Mathematics

Margaret Lang, Assistant Professor, Environmental Resources Engineering

Carol Lasko, Associate Professor, Chemistry

Tom Lisle, Adjunct Professor of Geology

Mary Ann Madej, Adjunct Professor, Geology

Sharyn B. Marks, Associate Professor, Biology

George Robison, Assistant Professor, Forestry & Watershed Mgmt.

## UNIT STUDENTS

<u>Student</u>	<u>Major Advisor</u>	<u>Graduation</u>
Mark Ashenfelter	Peggy Wilzbach	
Sarah Beesley	Walt Duffy	
Kasey Bliesner	Walt Duffy	December 2005
Philip Colombano	Walt Duffy	
Chad de Young	Peggy Wilzbach	
Kristin (Engel) Mull	Peggy Wilzbach	December 2005
Rodney Engle	Walt Duffy	December 2005
Jennifer Feola	Walt Duffy	
Sharon Frazey	Peggy Wilzbach	March 2005
Eric Gonzales	Walt Duffy	
Stephen Gough	Walt Duffy	
Samantha Hadden	Peggy Wilzbach	
Casey Justice	Walt Duffy	
Jang-Won Lee	Walt Duffy	
John Matousek	Peggy Wilzbach	
Katherine McLaughlin	Walt Duffy	
Seth Naman	Peggy Wilzbach	
Benjamin Ransom	Peggy Wilzbach	
Bethany Reisberger	Walt Duffy	
Seth Ricker	Walt Duffy	
Michele Wheeler	Walt Duffy	
Katrina Wright	Walt Duffy	

## UNIT-AFFILIATED GRADUATE STUDENTS

<u>Student</u>	<u>Major Advisor</u>	
Caleb Balas	T. Luke George	M.S., Wildlife
Donald Baldwin	George Robison	M.S., Watershed
Oswaldo Hernandez	Richard Merritt	PhD., Entomology at Michigan State Univ.
Marlene Meaders	Gary Hendrickson	M.S., Fisheries

Students are pursuing M.S., Fisheries at Humboldt State University unless otherwise noted.

## STUDENT ASSISTANTS AND RESEARCH TECHNICIANS

Aaron Bliesner  
Ryan DeKnikker  
Melissa Mata  
Matthew Metheny  
Jeremy Mull  
Laurel Osborn  
Heather Perry  
Brian Poxon  
Kimberly Rich  
April Shackelford  
Mark Yost

## GRADUATE EDUCATION

# CURRENT RESEARCH

## PROJECT NARRATIVES



Katrina Wright, Student Investigator



A weir was installed near the mouth of Prairie Creek. Photos by M. Sparkman.

### Validation Monitoring: Testing Protocols in Prairie Creek. (CDFG Agreement)

Under this agreement we will test validation monitoring protocols, following methods developed under California Department of Fish and Game Grant # P0210565 (Duffy et al, 2005), to test their sensitivity to natural variation and identify their efficiency. Sampling will be conducted in Prairie Creek, tributary to Redwood Creek, Humboldt County. Specific tasks are described below.

**Juvenile Population Size** - The population size of juvenile coho salmon, cutthroat trout and steelhead in upper Prairie Creek will be measured during late summer (September) 2005, 2006, and 2007. A two step procedure will be used, consisting of habitat typing followed by electrofishing of a systematic random sample of each habitat type.

**Juvenile Condition** - The condition of coho salmon and steelhead will be determined from a sample of fish captured during juvenile population monitoring each year. After capture, fish will be anesthetized and measurements of length to the nearest 1.0 mm

and weight to the nearest 0.01 g will be taken.

**Smolt Production** - The number of salmon and steelhead migrating from Prairie Creek toward the ocean will be estimated from traps operated from March through May 2005,

2006, and 2007. Two fence type smolt traps, separated by 100-200 meters, will be installed near the mouth of Prairie Creek. A constant fraction of fish caught each day in the upstream trap will be marked to test the efficiency of the downstream trap. One or two underwater video cameras will be installed at the mouth of the downstream trap to document behavior of fish approaching the trap, the proportion avoiding entrainment into the trap, and the proportion entering and later escaping the trap.

**Adult Escapement** - Estimates of the number of adult salmon and steelhead returning to Prairie Creek to spawn will be made from surveys conducted from December through March/April 2005/06, 2006/07 and 2007/08. Traditional spawner survey methods consisting of live fish and carcass counts and carcass mark/recapture studies will be used to estimate population size. These estimates will in turn be compared to total fish counts made at a weir installed near the mouth of Prairie Creek to calculate the efficiency of these traditional escapement methods and estimate how variable this efficiency is.

### Investigators

Dr. Walter Duffy, CACFRU  
Katrina Wright, MS Student  
Katherine McLaughlin, MS Student

### Funding

California Department of Fish and Game (\$211,167)

### Duration

June 2005-May 2008



## **Upper Redwood Creek Juvenile Salmonid Abundance Project. (CDFG Agreement)**

This project will describe juvenile salmonid out-migration and estimate out-migrant smolt population sizes for wild 0+ Chinook salmon, 1+ steelhead trout, 2+ steelhead trout, cutthroat trout, and 1+ coho salmon using stratified mark/recapture methods. The long-term goal of the project is to determine the status and trends of juvenile salmonid smolt populations out-migrating from upper Redwood Creek. The data generated will contribute to data needed for Viable Salmonid Population (VSP) analysis, which is the basis for Federal ESA listing decisions. The information should also be useful in assessing watershed restoration needs in the basin. The field surveys and time frame are described below.

**Monitoring Goals-** conduct field sampling and data processing that will describe emigration timing, presence/absence, natural variability in wild smolt populations, smolt population estimates, smolt sizes and weights, and juvenile salmonid life histories.

**Field Procedures-** a 5' E.G. Solutions rotary screw trap (RST) will be installed in upper Redwood Creek. The RST will be operated daily (24hrs/day, 7 days/week) through juvenile emigration, ending early August. Fish in the livebox are removed, observed and enumerated. Population estimates will be determined using multiple trap-efficiency trials using peer reviewed methods. A sample of the catch will be marked and released upstream of the trap. Data from the subsequent recapture of the marked as well

as unmarked fish will be input into a model which determines population estimates on a weekly and seasonal basis. Quality control experiments will be performed to ensure that fish are handled in a safe and efficient manner. Fork lengths will be measured daily and weights will be measured every other day. Stream temperature will be recorded hourly using optic stowaway temperature probes. Stream temperature data may be used by appropriate agencies to investigate or document whether upper Redwood Creek is temperature impaired or not.

### **Investigators**

Dr. Walter Duffy, CACFRU  
Michael Sparkman, CDFG

### **Funding**

California Department of Fish and Game (\$57,296)

### **Duration**

April 2005-March 2006

## **Lower Redwood Creek Juvenile Salmonid Abundance Project. (CDFG Agreement)**

This project will describe juvenile salmonid out-migration and estimate out-migrant smolt population sizes for wild 0+ Chinook salmon, 1+ steelhead trout, 2+ steelhead trout, cutthroat trout, and 1+ coho salmon using stratified mark/recapture methods to determine the status and trends of juvenile salmonid smolt populations out-migrating from Lower Redwood Creek. The data generated will contribute to data needed for Viable Salmonid Population (VSP) analysis, which is the basis for Federal ESA listing decisions. The information should also be useful in assessing

watershed restoration needs in the basin. The field surveys and time frame are described below.

**Monitoring Goals-** field sampling and data processing will describe emigration timing, presence/absence, natural variability in wild smolt populations, smolt population estimates, smolt sizes and weights, and juvenile salmonid life histories.

**Field Procedures-** a 5' E.G. Solutions rotary screw trap (RST) will be installed in Lower Redwood Creek. The RST will be operated daily (24hrs/day, 7 days/week) through juvenile emigration, ending late July or early August. Population estimates will be determined using multiple trap-efficiency trials using peer reviewed methods. A sample of the catch will be marked and released upstream of the trap. Data from the subsequent recapture of the marked as well as unmarked fish will be input into a model which determines population estimates on a weekly and seasonal basis. Quality control experiments will be performed to ensure that fish are handled in a safe and efficient manner. Fork lengths will be measured daily and weights will be measured every other day. Stream temperature will be recorded hourly using optic stowaway temperature probes. Stream temperature data may be used by appropriate agencies to investigate or document whether lower Redwood Creek is temperature impaired or not.

### **Investigators**

Dr. Walter Duffy, CACFRU  
Michael Sparkman, CDFG

### **Funding**

California Department of Fish and Game (\$57,631)

### **Duration**

April 2005 - March 2006

**Response of steelhead populations to fire disturbance in the Kings Range National Conservation Area. (NOAA Agreements)**

Agreement 1. Conduct biological surveys to quantify: (a) taxonomic composition of the fish community, (b) density of each species, and (c) age/size structure of each species. Use statistically rigorous, two-phase sampling protocol and follow appropriate protocols to minimize impacts on captured organisms. Develop an age-length key for use in estimating average growth for each age class over the course of the study. Collect scales from older juvenile steelhead in each of the three creeks to assess past growth. Sample benthic macroinvertebrates in each of the three creeks to quantify biological condition of streams according to established protocols and biotic indices.

Process (a) scale samples and (b) benthic macroinvertebrate samples. Process and analyze data collected above in context of physical data collected.

Agreement 2. Process and analyze data on the abundance and distribution of steelhead and the physical and ecological characteristics of steelhead habitat in small watersheds of the Lost Coast in California collected during two field seasons (October 2004 - May 2006). Analysis will integrate data collected prior to fire disturbance to examine the effects of fire and fire-related disturbance. Student to produce a draft MS thesis, and, in collaboration with principal investigators, a draft manuscript suitable for publication in a peer-reviewed journal.

**Investigators**  
Dr. Walter Duffy, CACFRU  
Philip Colombano, MS Student

**Funding**  
NOAA  
Fisheries (\$31,624)  
NOAA  
Fisheries (\$8,376)

**Duration**  
September 2004-December 2006



**Response of steelhead populations to fire disturbance in the Kings Range National Conservation Area. (RWO 75)**

The objective of this work is to collect, analyze, and report information about the aquatic biota, aquatic habitat, and water quality associated with streams along the west slope of the King Range which were recently effected by fire. As a comparison, similar information will be collected on streams not affected by the recent fire. This information will help BLM to develop post-fire management actions which may be necessary for protection and management of aquatic resources. This research will assess the response of streams and steelhead to the 2003 fire in streams within the King Range National Recreation Area. Six streams have been chosen for study over a two year period. We propose to address these questions:

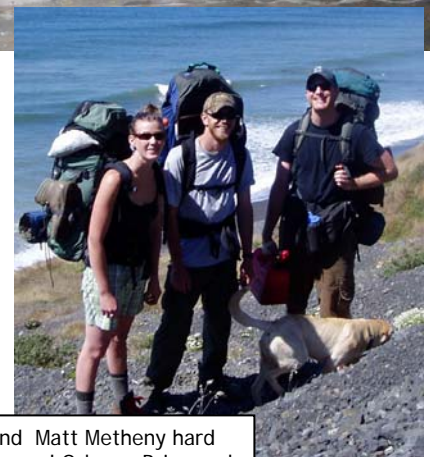
1. Does fire accelerate LWD recruitment to KRNRA streams?
2. Does fire alter fish habitat volume?
3. Does fire alter the distribution of water quality and aquatic invertebrates within streams?

The experimental design will include one treatment stream that burned hot (Big Creek), one where the severity of the burn was less (Kinsey Creek) and one control (Spanish Creek). Habitat and large wood surveys will be conducted beginning in July 2004 and 2005.

**Investigators**  
Dr. Walter Duffy, CACFRU  
Philip Colombano, MS Student

**Funding**  
US Bureau of Land Management (\$30,189)

**Duration**  
August 2004-September 2007



Top: Brian Poxon and Matt Metheny hard at work. Bottom: Laurel Osborn, Brian and Casey Justice on the long trek to sites.

**Mercury in birds of the San Francisco Bay-Delta: Trophic pathways, bioaccumulation and ecotoxicological risk to avian reproduction. (RWO 76)**

The San Francisco Bay-Delta watershed has a legacy of mercury (Hg) contamination from both Hg mining and gold extraction. Hg contamination is significant enough to threaten both human health and ecosystem function. Hg bioavailability within subregions of the watershed and even the watershed as a whole ultimately may be increased by certain restoration approaches. Reduction of Hg within the watershed needs to be guided by appropriate human and ecotoxicological endpoints as well as an understanding of the factors affecting Hg bioaccumulation. Reproductive success in birds is believed to be more sensitive to methyl-Hg than adult or juvenile survival and consequently should be a focus for any biological work done in the ecosystem.

Our goal is to use an integrated field and laboratory approach to evaluate the risks of Hg exposure to birds. Specifically we propose to integrate a field assessment of MeHg exposure and response in three feeding guilds within the estuary with a laboratory assessment of the variation in sensitivity of avian embryos to methyl-Hg. The proposed approach will enhance the evaluation of the relative hazard of Hg to aquatic birds within the estuary on a taxonomic, food web and geographic basis.

**OBJECTIVES**

Determine recurvirostrid (both American avocet, *Recurvirostra americana*, and black-necked stilt, *Himantopus mexicanus*) dietary exposure to mercury with radio telemetry in the San Francisco Bay estuary.

Determine Forster's tern (*Sterna forsteri*) dietary exposure to mercury using radio telemetry in the San Francisco Bay estuary.

Assist in monitoring recurvirostrid (both American avocet, *Recurvirostra americana*, and black-necked stilt, *Himantopus mexicanus*) and tern (both Forster's tern, *Sterna forsteri*, and Caspian tern, *Sterna caspia*) reproductive success in the San Francisco Bay estuary.

**Investigators**

Dr. Mark Colwell, HSU

**Funding**

USGS/BRD Western Fisheries Research Center (\$128,636)

**Duration**

August 2004-September 2007

**Habitat requirements of the endangered California freshwater shrimp (*Syncaris pacifica*) in streams on the Point Reyes National Seashore and Golden Gate National Recreation Area. (USGS Agreement)**

The California freshwater shrimp (*Syncaris pacifica*) is a federally listed endangered species whose distribution is seemingly restricted to low elevation perennial streams in Marin, Sonoma, and Napa counties north of San Francisco Bay, California. Little is known about the habitat requirements of this shrimp. The purpose of this study is to develop a better understanding of the habitat requirements of California freshwater shrimp populations inhabiting Lagunitas and Olema creeks. The results will be used to identify management actions that will benefit the shrimp population in Olema Creek and elsewhere.

Specific objectives are:

1. To determine if shrimp are homogeneously distributed throughout these streams or if their distribution is concentrated in certain localities;
2. To determine if shrimp distribution is associated with selected habitat characteristics (e.g., stream morphometry, water quality, types and amounts of underwater cover, cohabiting fish species).

**Investigators**

Dr. Walter Duffy, CACFRU

**Funding**

USGS/BRD Western Fisheries Research Center (\$31,295)

**Duration**

September 2003-September 2008

## Evaluation and monitoring of burrow-nesting seabirds at Castle Rock National Wildlife Refuge. (RWO 74)

We are investigating seabird use of Castle Rock located in Del Norte County, California. Recently, the populations of Aleutian Canada Geese and Double-crested Cormorants have increased dramatically. It is suspected that the geese and cormorants are having detrimental effects on the six species of crevice/burrow nesting seabirds known to nest on Castle Rock. The status of these seabirds has never been well understood due to the presence of many surface nesting birds, frail soils, the difficulty in monitoring the concealed nest sites, and the logistical challenges of working on an island.

Study objectives:

1. Estimate the current nesting population and examine productivity of burrow-nesting seabirds on Castle Rock;
2. Assess techniques for long-term monitoring of soil depth, vegetation, and burrows;
3. Examine possible impacts of Aleutian Canada Geese and Double-crested Cormorants on seabird burrows;
4. Provide recommendations for monitoring burrowing seabirds on Castle Rock.

<http://www.humboldt.edu/~rtg1/research/castlerock.html>

### Investigators

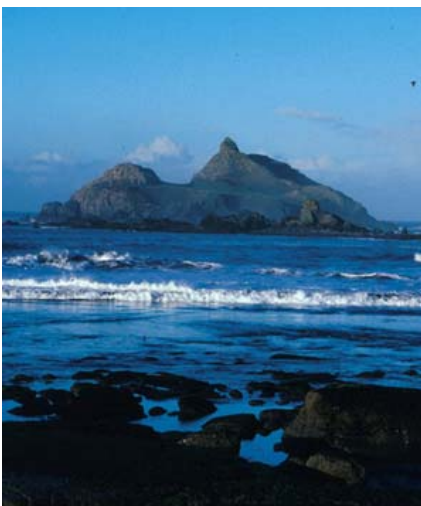
Dr. Richard T. Golightly, HSU  
Richard Young, MS Student

### Funding

USGS - SSP Appropriated Funds  
(\$46,875)

### Duration

September 2003 to March 2007



Castle Rock - National Wildlife Refuge.  
Photo courtesy USFWS.



Caspian Tern. Photo courtesy USFWS.

## Monitoring Caspian Terns (*Sterna caspia*) on Sand Island, Arcata Bay, California. (RWO 73)

The Caspian Tern is widely distributed throughout the world. The estimated world population of approximately 100,000 pairs breeds at a limited number of colonies where most populations are declining. In the Pacific Northwest, tern populations have been growing, with perceived impacts on federally listed salmonids. Efforts to mitigate negative impacts of terns on salmonids have included hazing of breeding terns from colonies where birds forage largely on salmonids. Other efforts under consideration include the restoration of habitat at locations where terns have nested in the past. In 2002 adults and nearly fledged young terns were observed on Sand Island, suggesting terns were re-establishing themselves at this historical breeding colony.

The objectives are to determine:

1. The number of Caspian Terns breeding on Sand Island;
2. Potential constraints to colony size (e.g., habitat, predation, natural or human disturbance);
3. Diet composition from observational data on bill loads;
4. Hatching and fledging success, if possible.

### Investigators

Dr. Mark Colwell, HSU  
Nancy Fox-Fernandez, MS Student  
Jennifer Roth, MS Student

### Funding

USDI Fish and Wildlife Service  
(\$7,932)

### Duration

June 2003 to May 2006



## Restoration Validation Monitoring and Protocol Development Project. (CDFG Contract)

This agreement continues the work that began in 2001 to develop and validate standardized sampling and assessment protocols suitable for a comprehensive, long-term program to systematically monitor and validate the effectiveness of watershed restoration projects for salmon and steelhead in coastal California. The purpose of validation monitoring is to establish relationships between implementation of watershed restoration and conservation actions and the subsequent responses by salmon and steelhead. In this phase we will:

1. Complete the development of standardized sampling protocols to monitor, assess, and document the biological responses to various instream, riparian, and upslope restoration and enhancement projects intended to improve salmonid habitat.
2. Field test proposed protocols evaluating their utility for the California Coastal Salmonid Restoration Monitoring and Evaluation Program.
3. Provide two training sessions to DFG staff and other parties, selected by DFG in the use of proposed monitoring protocols.
4. Conduct a pilot study for the implementation of DFG's California Coastal Salmonid Restoration Monitoring and Evaluation Program. Conduct baseline, pre-project monitoring for restoration projects scheduled for implementation within the next three years. The location and number of projects to monitor will be selected in collaboration with the DFG

Fisheries Restoration Grants Program staff.

5. The CACFRU will enter data it collects during field testing trials and baseline, pre-project monitoring surveys into the DFG's Restoration Monitoring Database.

Six sampling protocols were identified and are being refined for inclusion in a chapter in the Department of Fish and Game restoration manual. Field testing was initiated and a pilot study started in the Hollow Tree Creek watershed, in cooperation with Mendocino Redwood Company.

During the past year we completed descriptions of validation monitoring protocols. These protocols will be included in a California Department of Fish and Game restoration manual. We also continued field testing of these monitoring protocols. Efforts have been directed toward: 1) evaluating the influence of large wood on growth and survival of juvenile salmonids, 2) gathering data on condition of steelhead from Alaska through California with which to develop a general weight equation for steelhead, and 3) evaluating physical and biological factors used in site selection by spawning coho salmon.

### Investigators

Dr. Walter G. Duffy, CACFRU  
Dr. Peggy Wilzbach, CACFRU  
Kristin (Engel) Mull, MS Student  
Casey Justice, MS Student  
Katherine McLaughlin, MS Student

### Funding

California Department of Fish and Game (\$285,585)

### Duration

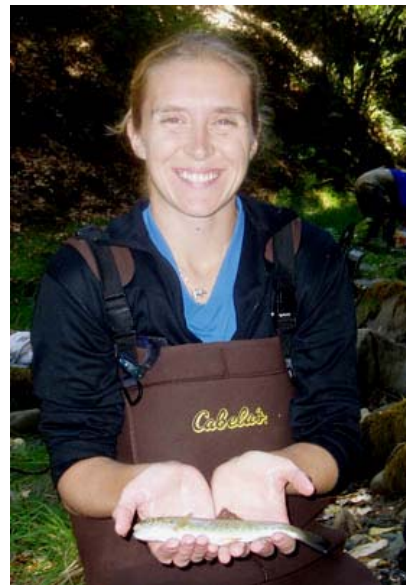
May 2003 to December 2005



Kristen Mull



Casey Justice



Kate McLaughlin



# COMPLETED RESEARCH

## PROJECT NARRATIVES

### The effect of habitat quality on coho salmon survival rates in northern California coastal streams. (NOAA-Fisheries Contract)

During the period of this contract we gathered two years of additional data on the response of coho salmon to habitat. These data included delineating the amount and type of habitat available to fish, and estimates of 1) adult escapement, 2) smolt production and 3) juvenile abundance.

Two theses initiated during this project are now in preparation. Steve Gough's thesis addresses estimating adult escapement. Steve used estimates of adult escapement to the three streams over a five year period to: 1) compare methods of estimating escapement, 2) assign species to redds of unknown origin and 3) examine relationships between adult escapement and juvenile abundance.

This work suggested that both area-under-the-curve data from live adult fish observations and counts of redds both produced reliable estimates of adult escapement. Steve modeled the probability of redds of unknown origin belonging to either coho salmon or Chinook salmon and found that time of redd construction explained more than 90% of the variability in the data set. Last, Steve found strong relationships between adult escapement and juvenile abundance for both coho salmon and Chinook salmon.

Jen Feola's thesis addresses smolt production from the three streams. She also used a five year data set to examine environmental factors that may help forecast the timing of smolt catch in traps. In addition, she investigated the potential of deploying remote PIT tag antennas to measure smolt

movement. Jen found that water temperature and photoperiod were the best predictors of coho salmon smolt catch in traps. Remote PIT tag antennas detected 95-98% of the tagged fish passing the trap and most of those fish moved between 8:00 P.M. and noon.

#### Investigators

Dr. Walter G. Duffy, CACFRU  
Dr. Peggy Wilzbach, CACFRU  
Dr. Terry Roelofs, HSU  
Jennifer Feola, MS candidate  
Stephen Gough, MS candidate  
Kasey Bliesner, Biologist

#### Funding

NOAA National Marine Fisheries Service (\$162,000)

#### Completed

September 2005



Kasey Bliesner and crew working downstream migrant trap.

## Biological assessment of streams in the southern portion of the King Range National Conservation Area, California. (RWO 71)

Three streams were sampled as part of the assessment of the southern portion of the King Range, including Horse Mountain Creek, Gitchell Creek and Buck Creek. One additional stream, Telegraph Creek, was sampled to determine if steelhead were present.

The three streams sampled are all second order streams in steep terrain (gradient 8 - 12%), with watershed areas ranging from 3.1 - 8.5 km<sup>2</sup>. Number of habitat units found in the three streams ranged from 189 in Buck Creek to 347 in Horse Mountain Creek. In each stream, riffle and run habitats predominated in lower reaches, while cascade and pool habitats became more common in upper reaches. We recorded the amount and distribution of large wood (LWD) in each stream, measured basic water quality parameters (temperature, specific conductance, and pH), and collected samples of macroinvertebrates.

We randomly selected ~ 20% of the total habitat units in each stream to sample the abundance and distribution of fish. Steelhead, coast range sculpin and three-spined stickleback were found in each of the three streams. Scales were collected and size recorded from a subsample of the steelhead captured.

A final report has been prepared for the Bureau of Land Management.

### Investigators

Dr. Walter Duffy, CACFRU  
Donald Baldwin, MS Student

### Funding

USDI Bureau of Land Management  
(\$40,000)

### Completed

July 2002 to September 2005



Don Baldwin sampling invertebrates.

## Heat exchange and climate modeling in Crater Lake, Oregon. (RWO 63)

We examined observations of key limnological properties (primarily temperature, salinity, and dissolved oxygen), measured over a 14 year period in Crater Lake, Oregon. During some years (e.g., 1994-1995), higher-than-average wintertime deep convection and ventilation led to the removal of significant amounts of heat and salt from the hypolimnion, while dissolved oxygen concentrations increased. In other years, such as the winter of 1996-1997, heat and salt concentrations increased through the year and dissolved oxygen levels dropped; indicating conditions were dominated by the background geothermal inputs and dissolved oxygen consumption by bacteria (i.e., minimal deep convection). Over the entire 14 year period, no statistically significant trend was observed in the annual hypolimnetic heat and salt content.

Measurements from several thermistors moored in the hypolimnion provided new insight into the time and space scales of the deep convection events. For some events, cool water intrusions were observed sequentially, from shallower depths to deeper depths, suggesting vertical mixing or advection from above. For other events, the cooling was observed first at the deepest sensors, suggesting a thin, cold water pulse that flowed along the bottom and mixes more slowly upwards into the basin. In both cases, the source waters must have originated from the epilimnion.

Conditions during a strong ventilation year (1994-1995) and a weak ventilation year (1996-1997) were compared. The results suggested the major

difference between these two years was the evolution of the stratification in the epilimnion during the first few weeks of reverse stratification. As a consequence, thermobaric instabilities were likely easier to form during 1995 than 1997. Thus, the details of surface cooling and wind-driven mixing during the early stages of reverse stratification may determine the net amount of ventilation possible during a particular year.

**Principal Investigator**  
Dr. Gregory Crawford, HSU  
Micheal Higgins, MS Student

**Funding**  
USGS/BRD Forest and Rangeland  
Ecosystem Science Center  
(\$39,600)

**Completed**  
August 2005

## Seasonal food availability and diet analysis for juvenile Chinook salmon utilizing the Klamath River Estuary. (Yurok Contract)

The Klamath River supports runs of spawning salmon that are the basis of a Native American subsistence fishery, and provide sport fishing opportunities. Juvenile salmon spend a variable amount of time in the estuary before migrating to the ocean. The Klamath estuarine environment is influenced by water management in the upper river, often resulting in warm thermal regimes. Artificial propagation of salmon in upstream hatcheries results in the intermingling of hatchery and wild juvenile salmon in the estuary.

Size of 478 juvenile Chinook salmon was recorded, 163 in 2001 and 315 in 2002. Fork length of juvenile Chinook salmon collected in 2002 was greater (mean 93.96 mm) than fish collected in 2001 (mean FL 89.43 mm). A total of 436 juvenile Chinook salmon stomachs were examined, 161 in 2001 and 275 in 2002. Twenty-seven prey taxa were found in stomachs, but most were rare or uncommon. The most commonly occurring prey during both years was the marine amphipod *Corophium* spp. Over both years, *Corophium* spp. contributed more to the total mass consumed than any other taxa. Chironidae larvae and the marine isopod *Gnorimosphaeroma* spp. were also common during both years. Stomach fullness and prey consumed varied with season and time of day.

**Investigators**  
Dr. Walter Duffy, CACFRU  
Sarah Kleinschmidt, Technician

**Funding** Yurok Tribe (\$28,800)

**Completed**  
April 2005

## Evaluation of human-caused disturbance of breeding Marbled Murrelets in Redwood National and State Parks, California. (RWO 70)

Marbled murrelets are an extremely secretive avian species for which basic life history information is lacking. The ESA status of this species, combined with lack of life history information, hampers Redwood National Park management of visitor use. In response to management information needs we located marbled murrelet nests, described nest habitat, and measured reproductive success at these nests in Redwood National Park and adjacent areas.

Behavioral responses of marbled murrelet adults and chicks at the nest to low-level forms of human disturbance, especially human presence and talking were measured.

At-sea movements of radio-marked birds relative to the availability of nesting habitat were described.

<http://www.humboldt.edu/~rtg1/research/mmurr.html>

This work is documented as a chapter within a comprehensive report completed in Spring 2006.

### Investigators

Dr. Richard Golightly, HSU  
Brian Acord, MS Candidate  
Dr. P. Hebert, Field Coordinator  
S. B. Cluit, K. Max, P. Capiolo, G. Wengert, J. Hall, Research Assistants

### Funding

USGS/BRD Western Ecological Research Center (\$150,000)

### Completed

April 2005



Marbled Murrelet.  
Photo from Wikipedia.org

## REDW Fish Scale and Associated Data Cataloging Project. (NPS Contract)

This project involved assigning ages to fish scales collected by Redwood National Park staff. Approximately 600 scales, most from salmon, were aged. One graduate student assigned ages to 100% of the scales and a second graduate student corroborated the age assignment for about 30% of the total number. The latter corroboration process was not required as part of the contract, but we considered it important to provide a measure of variation associated with age assignments.

All scales receiving an age assignment were catalogued using Redwood National Park protocols and entered in a database that was provided to the park. A final report was prepared and submitted in 2005.

### Investigators

Dr. Walter G. Duffy, CACFRU  
Graduate Student Assistants

### Funding

NPS, Redwood National Park  
(\$2,400)

### Completed

January 2005

# UNIVERSITY SERVICE AND TEACHING

## WALT DUFFY

### Courses Taught

Fish 575	Fish Bioenergetics	Spring 2005	3 units
Fish 580	Restoration Ecology of Riverine Fish	Fall 2005	3 units

### Guest Lectures

Bioenergetics of Fish, November 2005  
High Tech Fish Tagging Methods, September 2005

### Graduate Committee Service

#### *Academic and Research Advisor*

Sarah Beesley - MS Fisheries, Humboldt State University  
Kasey Bliesner - MS Fisheries, Humboldt State University  
Philip Colombano - MS Fisheries, Humboldt State University  
Rodney Engle - MS Fisheries, Humboldt State University  
Jennifer Feola - MS Fisheries, Humboldt State University  
Eric Gonzales - MS Fisheries, Humboldt State University  
Stephen Gough - MS Fisheries, Humboldt State University  
Casey Justice - MS Fisheries, Humboldt State University  
Jang-Won Lee - MS Fisheries, Humboldt State University  
Katherine McLaughlin- MS Fisheries, Humboldt State University  
Bethany Reisberger - MS Fisheries, Humboldt State University  
Seth Ricker - MS Fisheries, Humboldt State University  
Michele Wheeler- MS Fisheries, Humboldt State University  
Katrina Wright - MS Fisheries, Humboldt State University

#### *Committee Member*

Donald Baldwin - MS Watershed, Humboldt State University  
Sharon Frazey - MS Fisheries, Humboldt State University  
Craig Milewski - Ph.D. Fisheries, South Dakota State University  
Benjamin Ransom - MS Fisheries Biology, Humboldt State University  
Daniel Scarr - MS Mathematics, Humboldt State University  
Steve Tussing - MS Fisheries Biology, Humboldt State University

## KEN CUMMINS

### Graduate Committee Service

#### *Committee Member*

Sarah Beesley - MS Fisheries, Humboldt State University  
Michael Brady - MS Biology, Humboldt State University  
Samantha Hadden - MS Fisheries Biology, Humboldt State University  
Oswaldo Hernandez - PhD Entomology, Michigan State University  
John Walsh - MS Biology, Humboldt State University



## PEGGY WILZBACH

### Courses Taught

Fish 585	Ecology of Running Water	Fall 2004	3 units
Fish 580	Salmonid Behavior	Spring 2006	3 units

### Guest Lectures

Light and nutrients in stream ecosystems, November 2004  
Fish Behavior, February 2005  
Energy flow in freshwater ecosystems, April 2005  
Landscape perspective in fish ecology, April 2005  
Food supply considerations in salmonid restoration, November 2005

### Graduate Committee Service

#### *Academic and Research Advisor*

Mark Ashenfelter - MS Fisheries, Humboldt State University  
Chad de Young - MS Fisheries, Humboldt State University  
Kristin (Engel) Mull - MS Fisheries, Humboldt State University  
Sharon Frazey - MS Fisheries, Humboldt State University  
Samantha Hadden - MS Fisheries, Humboldt State University  
John Matousek - MS Fisheries, Humboldt State University  
Seth Naman - MS Fisheries, Humboldt State University  
Benjamin Ransom - MS Fisheries, Humboldt State University

#### *Committee Member*

Dawn Alvarez - MS Fisheries, Humboldt State University  
Colin Anderson - MS Fisheries, Humboldt State University  
Brooke DeVault - MS Fisheries, Humboldt State University  
Jon Goin - MS Fisheries, Humboldt State University  
Josh Fuller - MS Fisheries, Humboldt State University  
Eric Gonzales - MS Fisheries, Humboldt State University  
Erin Hannelly - MS Biology, Humboldt State University  
Oswaldo Hernandez - PhD Entomology, Michigan State University  
Jang-Won Lee - MS Fisheries, Humboldt State University  
Barbara McCoy - MS Fisheries, Humboldt State University  
Katherine McLaughlin - MS Fisheries, Humboldt State University  
Marlene Meaders - MS Fisheries, Humboldt State University  
Bethany Reisberger - MS Fisheries, Humboldt State University  
Seth Ricker - MS Fisheries, Humboldt State University  
Susan Corum - MS Fisheries, Humboldt State University  
Heidi Vogel - MS Fisheries, Humboldt State University

### University Committees and Workgroups

Member, Graduate Advisory Council, College of Natural Resources and Sciences, HSU

## UNIVERSITY SERVICE AND TEACHING

# PROFESSIONAL SERVICE AND INVOLVEMENT

## INVITED SEMINARS

Duffy, W. G. 2005. Status of salmon and steelhead in coastal rivers of California. Presented to California State Legislature Staff. June 2005, Sacramento, CA [Invited]

Wilzbach, M. A. 2005. Research partnerships with the forest products industry. Given at Humboldt State University Business Partners. March 2005, Arcata, CA [Invited]

Wilzbach, M. A. 2005. Riparian canopy opening and salmon carcass additions to increase salmonid growth. Given at Western Forestry Conference on the Science and Policy of Wildlife and Salmon. September 2005, Portland, OR [Invited]

Wilzbach, M. A. 2005. Riparian management and fish productivity. Given at National Council of Air and Stream Improvement, Portland, OR [Invited]

## NON-SOCIETY MEMBERSHIPS

### Cummins

- Co-Chair, Independent Science Board of the Ecosystem Restoration Program, CALFED
- Executive Committee, Science Advisory Board, Environmental Protection Agency, Washington, D.C.

### Duffy

- Member, California Citizens Advisory Committee on Salmon and Steelhead (Public Panel)
- Member, NOAA Technical Recovery Team for Coho Salmon, Southern Oregon/Northern California
- Member, NOAA Technical Recovery Team for Coho Salmon, Oregon Coast
- Member, CA Dept. of Fish and Game Recovery Team for Coho Salmon
- Member, Redwood Creek Pulse Group
- Member, Watershed Ecology Team

### Wilzbach

Member, Redwood Creek Pulse Group  
Member, Watershed Ecology Team

## COMMUNITY OUTREACH

### Duffy/Bliesner

Freshwater Elementary School job shadow program

### Duffy

Evaluation of Salmonid Curriculum Project of CDFG/HSU  
Advisor to Watershed Stewards Program

### Wilzbach

County Science Fair judge  
Jacoby Creek Elementary School salmon presentation  
Evaluation of Salmonid Curriculum Project of CDFG/HSU

## PAPERS AND PROPOSALS REVIEWED

### Duffy

Peer reviewer for articles submitted to the journal Fisheries (2) and North American Journal of Fisheries Management (1).

Reviewed 15 student proposals for funding through the Society of Wetland Scientists.

Proposal reviews for the Citizens Advisory Committee on Salmon and Steelhead Trout Restoration by the California Department of Fish and Game (60 proposals).

### Wilzbach

Peer reviewer for articles submitted to the journals Transactions of the American Fisheries Society (2), North American Journal of Fisheries Management (1), Fisheries Bulletin (1), Ecological Applications (1), Conservation Biology (1), American Midland Naturality (1), Canadian Journal Fisheries and Aquatic Sciences (2).

Reviewer for proposal submitted to the National Science Foundation.

Book review for the American Fisheries Society.

## PROFESSIONAL SERVICE AND INVOLVEMENT

# PROFESSIONAL SERVICE AND INVOLVEMENT

## PROFESSIONAL SOCIETY INVOLVEMENT

### Duffy

Member, American Fisheries Society  
Member Salmonid Restoration Federation

### Wilzbach

Member, American Fisheries Society  
Member, AFS Maughn Scholarship Committee  
Member, Program Committee, AFS 2007 Annual Meeting  
Member, Ecological Society of America  
Member, North American Benthological Society  
Member, International Limnological Society

## TECHNICAL ASSISTANCE

### Duffy

Served on steering committee and participated in two workshops to develop a state fish monitoring program in California.

### Wilzbach

External reviewer on faculty promotion committee for Utah State University.

## TRAINING PROVIDED

### Duffy

Taught Department of Interior motor boat operator certification course for nine students representing USGS, Yurok Tribe and HSU.

## FACILITATING SCIENCE

The California Unit continued to promote the Watershed Ecology Team (W.E.T.) to foster collaboration among aquatic scientists in northern California. A specific goal of the team is to foster interdisciplinary communication and research. This team consists of about 200 scientists, agency staff and graduate students from the immediate area. Monthly meetings consist of informal discussions relating to watershed ecology and are usually attended by 50-80 members.

The Unit also serves as an advisor to Redwood National Park in developing an aquatic monitoring plan for the park.

# PUBLICATIONS AND PRESENTATIONS

## SCIENTIFIC PUBLICATIONS

Cummins, K. W. and M. A. Wilzbach. 2005. The inadequacy of the fish bearing criterion for stream management. *Aquat. Sci.* 67:486-491.

Cummins, K. W. and M. A. Wilzbach. Ecosystems: Streams and Rivers: Ecosystem dynamics and integrating paradigms. In Encyclopedia of Ecology. Elsevier Press (in review).

Frazey, S. L. and M. A. Wilzbach. 2006. The relationship between productivities of salmonids and forest stands in northern California watersheds. *Western Journal of Applied Forestry*. In press.

Gleason, R. A., N. H. Euliss Jr., D. E. Hubbard and W. G. Duffy. 2004. The invertebrate egg banks of restored, natural, and drained wetlands in the Prairie Pothole Region of the United States. *Wetlands* 24:562-572.

Mull, K.E. and M.A. Wilzbach. Selection of spawning sites by coho salmon in a northern California stream. *North American Journal of Fisheries Management* (in review).

Shellenbarger, G. G., K. Swanson, D. Schoellhamer, J. Takekawa, N. Athearn, A.K. Miles, S. Spring, and M. Saiki. Desalinization, Erosion, Tidal, and Biological Changes Following the Breach of a Salt Pond, San Francisco Bay, California. *Restoration Ecology* (in revision).

Takekawa, J. Y., A. K. Miles, D. H. Schoellhamer, N. D. Athearn, C. Jannusch, M. K. Saiki, W. D. Duffy, and S. Kleinschmidt. Trophic structure and avian communities across a salinity gradient in evaporation ponds of the San Francisco Bay estuary. *Hydrobiologia*. In press.

Takekawa, J. Y., G. T. Downard, S. Obrebski, T. Irwin, I. Woo, and M. A. Bias. Mutualistic interactions between pickleweed (*Salicornia virginica*) and a terrestrial amphipod (*Traskocheastia traskiana*) (in prep).

Wilzbach, M. A., B. C. Harvey, J. L. White, and R. J. Nakamoto. 2005. Riparian canopy opening overrides salmon carcass enhancement in affecting abundance and growth of resident salmonids. *Canadian Journal of Fisheries and Aquatic Sciences* 62:58-67.

Wilzbach, M. A. and K. W. Cummins. Ecosystems: Streams and Rivers: Physical setting and adapted biota. In Encyclopedia of Ecology. Elsevier Press. (in review).

Woo, I. and Takekawa, J. Y. Canopy response of a native halophyte, *Salicornia virginica*, to varying salinity and inundation. *Wetlands Ecology and Management* (in prep).

## TECHNICAL PAPERS

Wilzbach, M. A. 2005. Using riparian canopy opening and salmon carcass addition to increase salmonid growth. *Western Forester, Society of American Foresters* 50(2):6-7.

## PAPERS PRESENTED

Duffy, W.G. and E.P. Bjorkstedt. 2005. Demographics of coastal cutthroat trout in Prairie Creek, California. Coastal Cutthroat Trout Symposium, October 2005, Port Townsend, WA.

Wilzbach, M. A. and S. L. Frazey. 2005. Linking Forests and Fish: The Relationship Between Productivities of Salmonids and Forest Stands in Northern California.

Wilzbach, M. A. and S. L. Frazey. 2005. Linking Forests and Fish: The Relationship Between Productivities of Salmonids and Forest Stands in Northern California.

## THESES

Bliesner, K. L. 2005. Trophic ecology and bioenergetics modeling of Sacramento perch (*Archoplites interruptus*) in Abbotts Lagoon, Point Reyes National Seashore. M.S. Thesis, Humboldt State University, Arcata, Calif.

Engle, R. O. 2005. Distribution and summer survival of juvenile steelhead trout in two streams within the King Range National Conservation area, California. M.S. Thesis, Humboldt State University, Arcata, Calif.

Frazey, S. L. 2005. The relationship between productivities of salmonids and forest stands in northern California streams. M.S. Thesis, Humboldt State University, Arcata, Calif.

Mull, K. E. 2005. Selection of spawning sites by coho salmon (*Oncorhynchus kisutch*) in Freshwater Creek, California. M.S. Thesis, Humboldt State University, Arcata, Calif.





Front Cover: Kinsey Creek. Photo by Philip Colombano (graduate student).