

CALIFORNIA COOPERATIVE FISH RESEARCH UNIT



2004 Annual Report





Front Cover: The Lost Coast—King Range National Conservation Area. Photo by Don Baldwin (graduate student).

California Cooperative Fish Research Unit

2004 Annual Report

October 2003 - September 2004

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 nineteen research projects, of which twelve 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, Green Diamond Resource Company, Ducks Unlimited Inc., and the National Council for Air and Stream Improvement.

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
Lynn Haines, Mid-Continent
Supervisor (retired Sept. 2004)
Bernard Shanks, Unit Supervisor
(effective October 2004)

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
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1 Harpst Street
Arcata, CA 95521

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

UNIT STAFF

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Dr. Kenneth W. Cummins, Senior
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for River Ecosystems
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COOPERATORS AND PERSONNEL



RESEARCH COOPERATORS

RESEARCH STAFF

Kasey Bliesner, Project Biologist
Erika Caceres, Freshwater Shrimp Research Assistant
Scott Demers, SF Bay Salt Ponds Research Assistant
James M. Haley, Validation Monitoring Research Assistant
Isa Woo, North SF Bay Project Leader

HUMBOLDT STATE UNIVERSITY COOPERATING FACULTY

Department of Fisheries Biology

Kristine Brenneman, Assistant 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
T. Luke George, Associate 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
Hobart C. Perry, Assistant Professor, Forestry & Watershed Mgmt.
George Robison, Assistant Professor, Forestry & Watershed Mgmt.

UNIT STUDENTS

<u>Student</u>	<u>Major Advisor</u>	<u>Graduation</u>
Sarah Beesley	Walt Duffy	
Kasey Bliesner	Walt Duffy	May 2005
Philip Colombano	Walt Duffy	
Chad de Young	Peggy Wilzbach	
Kristin Engel	Peggy Wilzbach	
Rodney Engle	Walt Duffy	
Jennifer Feola	Walt Duffy	
Sharon Frazey	Peggy Wilzbach	May 2005
Eric Gonzales	Walt Duffy	
Stephen Gough	Walt Duffy	
Samantha Hadden	Peggy Wilzbach	
Stacy Johnson	Walt Duffy	
Casey Justice	Walt Duffy	
John Matousek	Peggy Wilzbach	
McLaughlin, Katherine	Walt Duffy	
Benjamin Ransom	Peggy Wilzbach	
Bethany Reisberger	Walt Duffy	
Seth Ricker	Walt Duffy	
Michael Sparkman	Walt Duffy	May 2004
Michele Wheeler	Walt Duffy	
Wendall Willey	Walt Duffy	May 2004

UNIT-AFFILIATED GRADUATE STUDENTS

<u>Student</u>	<u>Major Advisor</u>	
Donald Baldwin	George Robison	M.S., Watershed
Colleen Ellis	Mary Ann Madej	M.S., Geology
Oswaldo Hernandez	Richard Merritt	PhD., Entomology at Michigan State Univ.

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

STUDENT ASSISTANTS AND RESEARCH TECHNICIANS

Andrew Antonetti
 Aaron Bliesner
 Casey Campos
 Ryan DeKnikker
 Julia Everta
 Jang-Won Lee
 David Malakauskas
 Melissa Mata
 Jeremy Mull
 Laurel Osborn
 Brian Poxon
 Kimberly Rich
 Mariah Talbott

GRADUATE EDUCATION



The jolly field crew after a hard day's work.

CURRENT RESEARCH

PROJECT NARRATIVES

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 homogenously 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
Mary Langsner, Student Assistant

Funding

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

Duration

September 2003-September 2005

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 as revised Dec. 2004:

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.

Investigators

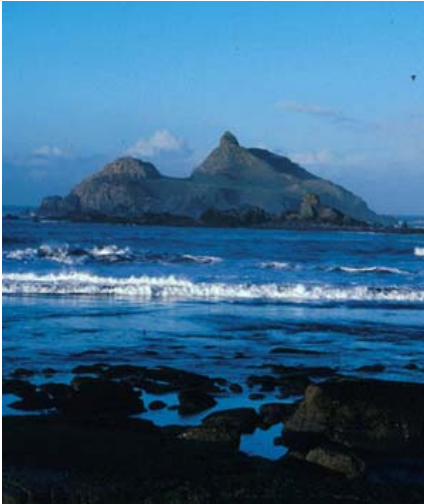
Dr. Richard T. Golightly, HSU
Richard Young, MS Student

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 2005

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

The King Range National Conservation Area (KRNCA) encompasses about 25,000 ha of Pacific coastal land in northern California. The area is recognized for its undeveloped nature and rugged topography. Twenty-five coastal streams drain the KRNCA, flowing directly to the Pacific Ocean. Many of these streams are considered to be potential spawning and juvenile rearing habitat for anadromous salmonids, particularly steelhead (*Oncorhynchus mykiss*). Six streams draining the northern half of the KRNCA were studied during 1999 and 2000. Steelhead trout were found in all six of these streams. Information on the status of fish communities inhabiting the remaining coastal streams of the KRNCA, as well as the condition of these streams, is needed to properly manage the area.

The objective of this research is to determine if steelhead occur in coastal streams in the southern KRNCA, evaluate the water quality of these streams, and determine if their distribution is correlated with habitat features. We will also determine the population density of all fish species inhabiting the study streams.

Principal Investigators

Dr. Walter Duffy, CACFRU
Donald Baldwin, MS Student

Funding

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

Duration

July 2002 to September 2005

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

This project continues studies that began in 1998. Coho salmon (*Oncorhynchus kisutch*) populations in the evolutionary significant units of central and northern California have been listed as “threatened” under the federal Endangered Species Act. This listing requires the National Marine Fisheries Service to quantitatively assess the effect of human activities upon the likelihood of extinction of coho salmon within these units. The assessment of human activities includes estimating survival rates throughout the life cycle of the species. This investigation is examining habitat conditions affecting coho salmon survival in northern California streams and comparing estimates of survival at various life stages, among seasons and years with similar estimates available for other regions. Measuring variability in seasonal supply of specific habitat types among and within streams will permit identification of habitats limiting coho salmon production.

Objectives:

1. Within the three streams, estimate abundance of a) adult coho salmon escaping, b) eggs produced, c) fry emerging from redds, d) juvenile coho salmon in July and September, and e) out-migrating smolts.
2. Within the three streams, estimate distribution of juvenile coho salmon and population age distribution.
3. Within Prairie Creek, characterize movement of juvenile coho salmon among habitat units and habitat types.

During the past year we tested the efficiency of remote PIT tag antenna in gathering data on movement of coho salmon smolts and examined the relationship between smolt movement and environmental conditions. Remote PIT tag antenna detected 99% (99 of 100) tagged coho salmon smolts passing the antenna. Movement of coho salmon smolts was best predicted with models incorporating water temperature and photoperiod.

This past year we also began developing models to estimate number of adult coho salmon and Chinook salmon from counts of redds, and to associate species with redds of unknown origin. This work will be completed during 2005.

Investigators

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

Funding

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

Duration

September 2003-September 2005



Downstream migrant trap in Prairie Creek. Photo by Aaron Bliesner.



Coho Spawning. Photo by Kristin Engel.

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 in recovering salmon and steelhead 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 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) assessing the seasonal lipid dynamics of juvenile steelhead to better describe seasonal fluctuation in condition.



The student investigators.

Investigators

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

Funding

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

Duration

May 2003 to December 2005



Kate McLaughlin assisting Casey Justice with large woody debris surveys in Mill Creek

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, as well as providing sport fishing opportunities. Juvenile salmon smolts enter and spend a variable amount of time in the Klamath River Estuary before migrating to the Pacific Ocean. The Klamath estuarine environment is influenced by water management in the upper river, often resulting in warm thermal regimes. Also, artificial propagation of salmon in upstream hatcheries results in the intermingling of hatchery and wild juvenile salmon in the estuary.

The Yurok Tribe needs to acquire information on the important food items in the diet of juvenile Chinook salmon residing in the Klamath River Estuary and slough habitats.

Objectives for this project are:

1. Identify sampled food items to Order and Family as specimen quality permits and determine volume by wet weight for each food item.
2. Analyze stomach contents samples to identify food items to Order and Family as the quality of the specimens permit and will determine volume by wet weight for each food item.

Investigators

Dr. Walter Duffy, CACFRU
Sarah Kleinschmidt, Technician
Mariah Talbott, Student Assistant

Funding

Yurok Tribe (\$28,800)

Duration

March 2002 to April 2005



The mouth of the Klamath River. Photo courtesy USFWS.

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

A graduate student will evaluate a collection of about 600 historical fish scale samples collected during research on anadromous fish habitat conditions in Prairie Creek.

This project will contribute to understanding the ecology of fish in Prairie Creek and support other projects in Redwood National Park.

Work to be accomplished under this contract:

1. Access objects for retention in park natural history collection.
2. Re-house specimens in appropriate media provided by the park.
3. Apply catalog number to paper envelopes of remaining fish scales once applied to glass slides.
4. Prepare final summary report, at a minimum identifying staff utilized for the project, the protocol for determining the specimens' disposition, and any observations, recommendations, or conclusions relevant to the future study and curation of these materials.

Investigators

Dr. Walter G. Duffy, CACFRU
Graduate Student Assistant

Funding

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

Duration

August 2001 to December 2004

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 propose:

1. To locate marbled murrelet nests, describe nest habitat, and measure reproductive success at these nests in Redwood National Park and adjacent areas.
2. To measure behavioral responses of marbled murrelet adults and chicks at the nest to low-level forms of human disturbance, especially human presence and talking.
3. Ancillary objective: Describe at-sea movements of radio-marked birds relative to the availability of nesting habitat.

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)

Duration

March 2001 to April 2005

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

We are continuing an ongoing study of the impact of climate on the physics, hydrology, and biogeochemistry of Crater Lake, Oregon. This research addresses a number of the initial components of a broader USGS sponsored research program. It includes an assessment of predicted lake response to global climate change and an examination of the impact of annual variations in vertical mixing on biogeochemical cycling in the lake. This research will directly contribute to the resource management needs of Crater Lake National Park.

The objectives for 1999 - 2000:

1. Run the one-dimensional mixing model under contemporary and climate change (2xCO₂) scenarios, using forcing conditions from a regional climate model (provided by S. Hostetler, USGS/WR), with altitude corrections to humidity (and evaporation);
2. Estimate annual deep water exchange rates of temperature, salinity, dissolved oxygen and nitrate for Crater Lake, based on available deep lake profile data;
3. Revise draft manuscript on the Crater Lake heat budget and surface fluxes, in conjunction with Dr. R. Collier (Oregon State University) and Dr. K. Redmond (Desert Research Institute), for submission to a refereed journal.

Additional work objectives for 2000 - 2001:

1. Using the available multi-year historical data set, test the hypothesis that the extent of annual deep mixing in the lake is correlated statistically with the length of time the lake surface temperature is between 3°C and 4°C and the wind strength;

2. Assess the feasibility of using data from the Canadian Climate Centre's global climate data (under contemporary and future climate conditions) and long-term meteorological measurements from Crater Lake to develop good meteorological time series for assessing climate change impacts on Crater Lake;

3. Research available three-dimensional lake and ocean models and make recommendations for future development of a three-dimensional model for Crater Lake.

In summer 2004 the project was extended to allow additional time for analysis and report preparation.

Principal Investigator

Dr. Gregory Crawford, HSU
Micheal Higgins, MS Student

Funding

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

Duration

June 1999 to December 2004

COMPLETED RESEARCH

PROJECT NARRATIVES

Channel response to sediment pulses in steep, gravel-bed rivers: a flume study. (RWO 72)

Fluvial geomorphology field studies provide useful information on rates and processes of channel formation and evolution; however, they are typically confounded by a myriad of variables. In contrast, flume studies can control variables to provide a stricter experimental design, but the scale of water and sediment must be adapted to laboratory conditions. This study compared field measurements of channel response following sediment pulses in Redwood Creek, California, to those measured in a flume experiment.

Channel response to increased sediment loads followed a similar trajectory of change that had been documented in field studies of Redwood Creek. Initially the channel responded to increases in sediment load by textural changes in the channel bed. In addition to changes in bed armor, changes in the spatial distribution of the facies were analyzed with the geostatistical software program Fragstats. The complete data sets were submitted to the USGS Redwood Field Station.

Investigators

Dr. Harvey Kelsey, HSU
Scott Carroll, Bryanna David and
Mauria Pappagallo, HSU Student
Assistants

Funding

USGS/BRD Western Ecological
Research Center (\$16,435)

Completed

September 2004

At-sea distribution of seabirds and marine mammals in the Southern California Bight. (RWO 59)

The Southern California Bight (SCB) is a critical breeding, migration and wintering area for seabirds and marine mammals along the west coast of North America. This area also has a high density of oil platforms and shipping lanes, and large regions are used for military operations. Effects of oil spills and disturbance from military operations may have severe consequences for seabirds and marine mammals in the SCB. Seabirds are especially sensitive to disturbance that may cause them to abandon breeding or to alter their foraging patterns.

During 1999 - 2003 we surveyed the at-sea distribution of seabirds and marine mammals in the SBC; examined diet, breeding biology, at-sea feeding areas, and at-sea foraging patterns of Cassin's Auklets and Brandt's Cormorants; and determined breeding populations of seabirds in the SBC and examined movement patterns of Brandt's Cormorants, and Brown Pelicans. The summary report is available at

http://www.werc.usgs.gov/sfbe/pdfs/USGS_Summary_Seabird_Report_2004.pdf.

Investigators

Dr. Richard Golightly, HSU
Dr. Harry Carter, HSU
William McIver, MS Candidate
Christine Hamilton, MS Candidate
John Mason, Research Assistant
Phil Capitolo, Research Assistant

Funding

USGS/BRD Western Ecological
Research Center (\$856,306)

Completed

September 2004

Science support for wetland restoration in the Napa-Sonoma salt ponds, San Francisco Bay Estuary. (RWO 58)

Trophic structure in salt ponds was documented along a salinity gradient to determine how biological processes vary with differing physical regimes and to predict outcomes and consequences of wetland restoration efforts. Biological studies included primary productivity and nutrient concentrations, variations in diversity of invertebrates, fishes, and birds, dietary preferences of fishes and birds, movement of birds, and the interrelationship of these components.

Investigators

Dr. Walter G. Duffy, CACFRU
Scott Demers, Research Assistant
Sarah Kleinschmidt, Research Assistant

Funding

USGS/BRD Western Ecological Research Center (\$348,610)

Completed

September 2004

Predicting prey availability for stream/river salmonids. (NCASI Contract)

Research was conducted to evaluate the prediction that the ratio of behavioral to accidental drifters (the Behavioral Drift Index) can serve as a tool to assess prey availability for stream salmonids. Samples from the benthos, drift, and salmonid stomachs were compared to test hypotheses that the diets of stream salmonids are more similar to the drift than to the benthos, and that the portion of behavioral drift in

salmonid diets corresponds with the proportion of behavioral drift in drift samples. The relationship between fish condition and the Behavioral Drift Index from drift or benthic samples was compared among a suite of stream sites differing in productivity. Studies were conducted in twelve reaches of six streams in the Smith and Klamath River Basins in northern California, which have been experimentally manipulated in a split-plot design by introduction of salmon carcasses (whole-plot factor) and removal of the riparian alder canopy (sub-plot factor) to increase light to the reach.

Investigators

Dr. Peggy Wilzbach, CACFRU
Dr. Kenneth Cummins, HSU
John Matousek, MS Student

Funding

National Council for Air and Stream Improvement, Inc. (\$64,297)

Completed

August 2004



John Matousek sampling benthic invertebrates at a Smith River study site.

The influence of increased light and alternate nutrient sources on growth of juvenile salmonids and their supporting food webs. (RWO 68)

A field experiment was conducted to provide information relevant to developing a successful adaptive management program for salmonid maintenance, recovery, or enhancement, through an evaluation of manipulations intended to increase juvenile salmonid growth. Through an approach combining field and laboratory experiments, we evaluated the relative effects of increased light, nutrient enhancement from salmon carcasses, and nutrient enhancement from conifer and red alder litter on: a) growth of juvenile salmonids; and b) structure of the food web pathways that support salmonid production.

Results suggested a greater relative effect of canopy opening than of carcass introductions on periphyton growth, and on abundance and growth of resident cutthroat trout and rainbow trout.

Investigators

Dr. Peggy Wilzbach, CACFRU
 Heather Ambrose, MS Student
 Osvaldo Hernandez, PhD candidate, Michigan State Univ.

Funding

USGS Cooperative Research Units (\$42,242)
 CA Department of Fish and Game (\$10,000 base funds)

Completed
 August 2004



Tarup Creek canopy manipulation.



Feeding efficiency and growth of salmonids increases with riparian canopy opening.

Ecological monitoring and research on tidal wetlands in North San Francisco Bay. (DU Contract)

San Francisco Bay and the delta support two-thirds of remaining salt marsh ecosystems and tidal flat habitats on the Pacific Coast. However, 95% of wetlands have been lost to habitat modifications such as urban development and agriculture. The estuary remains a major resource for migratory birds and many rare endemic species. The implementation of broad-based, ecological monitoring program is essential to the success of large-scale tidal wetland restoration projects.

We compared monitoring data of physical and biological parameters over time, from pre-breach surveys in 1998 to post-breach surveys at regular intervals from December 1998 to 2003.

Invertebrate surveys examined the mutualistic interaction of the amphipod detritivore with the dominant cover plant pickleweed.

The acquired basic information about the processes behind tidal wetland restoration and ecological monitoring will facilitate an adaptive approach to the management of tidal restoration projects.

Investigators

Dr. Fritz Reid, Ducks Unlimited
 Isa Woo, Project Leader
 Dr. Walter G. Duffy, CACFRU

Funding

Ducks Unlimited, Inc. (\$141,000)

Completed
 March 2004

**Composition of suspended load as a measure of stream health.
(CDF Contract)**

The research objective was to establish the relative importance of size-specific, inorganic vs. organic components of the suspended load in influencing stream health, as reflected in the efficiency of growth of juvenile salmonids and their invertebrate food base.

Important results include:

1. Contribution of organic particles to the total suspended load is significant, especially during rising and falling limbs of a hydrograph, and during early season flows.
2. Organic particles in the suspended load contribute measurably to turbidities in the low-moderate ranges of NTU's.
3. The nutritional value of suspended sediment particles as a food resource for invertebrate consumers increases with an increase in the concentration of organic particles in the suspended load.
4. Both field and lab studies support that the efficiency of salmonid feeding is affected by turbidities, but that some feeding goes on even at high turbidities.

Investigators

Dr. Peggy Wilzbach, CACFRU
Dr. Mary Ann Madej, USGS / HSU
Samantha Hadden, MS Student
Colleen Ellis, MS Student

Funding

California Department of Forestry (\$79,656)

Completed

December 2003

**Influence of discharge on chinook salmon redds and spawning habitat in the Trinity River, California.
(RWO 69)**

Flows in the Trinity River have been controlled for nearly forty years since the construction of Lewiston and Trinity Dams. The channel morphology has been altered dramatically due to the reduced flows in the Trinity River following dam construction and diversion of most water out of the Trinity Basin. Occasionally large volumes of water are released during winter high flow periods.

To increase the understanding of the effect of these flows on chinook redds we mapped meso-habitat types based on literature, biological knowledge, and field verification. We documented redd building activity at selected locations and determined the average depth of egg deposition at channel rehabilitation sites and unaltered areas using freeze core samples of redd pockets. We contributed to efforts to determine the depth of scour at spawning areas and redd constructions sites and to determine egg mortality as a function of depth of scour at channel rehabilitation sites and unaltered areas.

Investigators

Dr. Walter G. Duffy, CACFRU
Danielle Evenson, MS Student
Christina Castelanelli, MS Student

Funding

USGS Cooperative Research Units (\$20,000)
USDI Fish and Wildlife Service (\$20,000)

Completed

December 2003

**Wetland management and avian botulism at Klamath National Wildlife Refuge.
(RWO 66)**

This study evaluated the effect of current wetland management practices at the Klamath Basin National Wildlife Refuge on the risk of avian botulism outbreaks and determined the potential impacts of water reduction on botulism at KBNWR. Specifically, we evaluated how the botulism history, the length of time (number of years) a wetland has been flooded (or has remained dry) affects the risk of botulism, and how current water management practices (flooding time, water level maintenance) influence the risk of botulism outbreaks.

Investigators

Dr. Rick Botzler, HSU
Yvette Hernandez, MS Student

Funding

USDI Fish and Wildlife Service (\$20,000)

Completed

December 2003

UNIVERSITY SERVICE AND TEACHING

WALT DUFFY

Courses Taught

Fish 575 Fish Bioenergetics Spring 2004 3 units

Guest Lectures

Bioenergetics of Fish, April 2004

High Tech Fish Tagging Methods, March 2004

Salmonid Physiology During Smolt Transformation, April 2004

Graduate Committee Service

Academic and Research Advisor

Sarah Beesley - MS Fisheries Biology, Humboldt State University

Kasey Bliesner - MS Fisheries Biology, Humboldt State University

Philip Colombano - MS Fisheries Biology, Humboldt State University

Rodney Engle - MS Fisheries Biology, Humboldt State University

Jennifer Feola - MS Fisheries Biology, Humboldt State University

Eric Gonzales - MS Fisheries Biology, Humboldt State University

Stephen Gough - MS Fisheries Biology, Humboldt State University

Stacy Johnson - MS Fisheries Biology, Humboldt State University

Casey Justice - MS Fisheries Biology, Humboldt State University

Katherine McLaughlin- MS Fisheries Biology, Humboldt State University

Bethany Reisberger - MS Fisheries Biology, Humboldt State University

Seth Ricker - MS Fisheries Biology, Humboldt State University

Michael Sparkman - MS Fisheries Biology, Humboldt State University

Wendall Willey - MS Fisheries Biology, Humboldt State University

Michele Wheeler- MS Fisheries Biology, Humboldt State University

Committee Member

Donald Baldwin - MS Fisheries Biology, Humboldt State University

Jang-Won Lee - MS Fisheries Biology, Humboldt State University

Craig Milewski - Ph.D. Fisheries, South Dakota State University

Stan Glowacki - MS Fisheries Biology, Humboldt 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

PEGGY WILZBACH

Courses Taught

Fish 580 Salmonid Behavior Spring 2004 3 units

Graduate Committee Service

Academic and Research Advisor

Chad de Young - MS Fisheries Biology, Humboldt State University
Kristin Engel - MS Fisheries Biology, Humboldt State University
Sharon Frazey - MS Fisheries Biology, Humboldt State University
Samantha Hadden - MS Fisheries Biology, Humboldt State University
John Matousek - MS Fisheries Biology, Humboldt State University
Benjamin Ransom - MS Fisheries Biology, Humboldt State University

Committee Member

Eric Gonzales - MS Fisheries Biology, Humboldt State University
Oswaldo Hernandez - PhD Entomology, Michigan State University
Debra Parthree - MS Fisheries Biology, Humboldt State University
Bethany Reisberger - MS Fisheries Biology, Humboldt State University
Seth Ricker - MS Fisheries Biology, Humboldt State University
Kasey Sirkin - MS Fisheries Biology, Humboldt State University
Susan Corum - MS Fisheries Biology, Humboldt State University

University Committees and Workgroups

Member, Graduate Advisory Council, College of Natural Resources and Sciences, HSU
Chair, Graduate Student Fee Waiver Committee, College Natural Resources & Sciences, HSU

KEN CUMMINS

Graduate Committee Service

Committee Member

Heather Ambrose - MS Fisheries Biology, Humboldt State University
Sarah Beesley - MS Fisheries Biology, Humboldt State University
Samantha Hadden - MS Fisheries Biology, Humboldt State University
Oswaldo Hernandez - PhD Entomology, Michigan State University
Kasey Sirkin - MS Fisheries Biology, Humboldt State University

UNIVERSITY SERVICE AND TEACHING

PROFESSIONAL SERVICE AND INVOLVEMENT

INVITED SEMINARS

Duffy, W. G. 2004. A general weight equation for juvenile coho salmon? Klamath River Basin Task Force. Arcata, California. February 2004. [Invited]

Duffy, W. G., D. Schultz and M. Brown. Development of a general weight equation for juvenile coho salmon: does condition reflect habitat quality? Salmonid Restoration Federation. Davis, California. March 2004. [Invited]

Duffy, W. G. and M. A. Wilzbach. 2004. Restoration of salmon in California. Given at University of California - Davis. April 2004, Davis, CA [Invited]

Duffy, W. G. Historical and current fish communities of the Lower Klamath River. Conference on Science of the Lower Klamath River, U.S. Department of the Interior, Arcata, CA, June 2004. [Invited]

Duffy, W. G. Summary and research needs in the Lower Klamath River. Conference on Science of the Lower Klamath River, U.S. Department of the Interior, Arcata, CA, June 2004. [Invited]

Wilzbach, M. A. 2003. Riparian canopy opening overrides carcass addition in affecting growth and abundance of stream salmonids. Smith River Colloquium, presented by the Smith River Advisory Council. November 2003, Crescent City, CA [Invited]

Wilzbach, M. A. 2004. Relative effects of salmon carcass addition and light enhancement on salmonid biomass and growth. Given at Oregon State University. May 2004, Corvallis, 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 Recovery Team - southern Oregon/northern California E.S.U. coho salmon
- Member, NOAA Recovery Team - Oregon Coast E.S.U. coho salmon
- Member, CA Dept. of Fish and Game Coho Salmon Recovery Team
- Chair, Watershed Restoration Proposal Peer Review Committee
- Member, Redwood Creek Pulse Group
- Member, Watershed Ecology Team

Wilzbach

Member, Redwood Creek Pulse Group
Member, Watershed Ecology Team

HONORS AND AWARDS

Engel, Kristin - McCrone Promising Graduate Fellowship Award given by Humboldt State University, Research and Graduate Studies, May 2004

Engel, Kristin - HSU Fisheries Department Scholarship for scholastic achievements, spring 2004

Engel, Kristin - Woolford Rotary Fellowship given by Eureka Rotary Club, spring 2004

Hadden, Samantha - HSU Fisheries Department Scholarship for scholastic achievements, spring 2004

Matousek, John - HSU Fisheries Department Scholarship for scholastic achievements, spring 2004

COMMUNITY OUTREACH

Duffy/Bliesner

Freshwater Elementary School job shadow program

Wilzbach

County Science Fair judge
Jacoby Creek Elementary School salmon presentation

PAPERS AND PROPOSALS REVIEWED

Duffy

Peer reviewer for articles submitted to the journal Fisheries (3), North American Journal of Fisheries Management (1), Journal of the North American Benthological Society (1), Wetlands (1), and for a book chapter.

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, North American Journal of Fisheries Management, Fisheries Bulletin, Ecological Applications, Conservation Biology, American Midland Naturalist.

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, Ecological Society of America
Member, North American Benthological Society

Wilzbach

Member, American Fisheries Society
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.

TRAINING PROVIDED

Duffy

Use of validation monitoring protocols developed for use in assessing watershed restoration, 2-day workshop, Fort Bragg, CA, November 2003.

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 California Unit collaborated with the U.S.G.S. - Western Fisheries Research Center, U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation and N.O.A.A. Fisheries to organize a conference on science in the Lower Klamath River. The conference was held on the HSU campus in June 2004.

The purpose of the Conference was to initiate a dialogue between resource management and scientific communities, including tribal authorities, academia, and other stakeholders about present and future information needs and their priority in the Basin. The physical connections and ecological linkages between upper and lower basins, including the Trinity River, were key themes. Conference goals focused on anadromous fishes and instream flow needs.

PUBLICATIONS AND PRESENTATIONS

SCIENTIFIC PUBLICATIONS

Ambrose, H. E., M. A. Wilzbach and K. W. Cummins. Periphyton response to increased light and salmon carcass introduction in northern California streams. 2004. *Journal of the North American Benthological Society* 23(4):701-712.

Gleason, R. A., N. H. Euliss Jr., D. E. Hubbard and W. G. Duffy. The invertebrate egg banks of restored, natural, and drained wetlands in the Prairie Pothole Region of the United States. *Wetlands* (in review).

Gleason, R. A., N. H. Euliss Jr., D. E. Hubbard and W. G. Duffy. 2003. Effects of sediment load on emergence of aquatic invertebrates and plants from wetland soil egg and seed banks. *Wetlands* 23:26-34.

Hebert, P. N., H. R. Carter, R. T. Golightly, and D. L. Orthmeyer. 2003. Radio-telemetry evidence of re-nesting in the same season by the marbled murrelet. *Waterbirds* 26:261-265.

Madej, M. A., M. A. Wilzbach, K.W. Cummins, C. C. Ellis, and S.J. Hadden. 2004. The significance of suspended organic sediments to turbidity, sediment flux, and fish feeding behavior. *Proceedings, Redwood Region Forest Science Symposium, Mar 2004, University of California-Berkeley. In press.*

Puckett, C. 2003. Radios lead scientists to marbled murrelets nests. *Birdscapes: News from International Habitat Conservation Partnerships.* Published by U.S. Fish and Wildlife Service, Winter 2003.

Saiki, M. K., and B. A. Martin. 2001. Survey of fishes and environmental conditions in Abbotts Lagoon, Point Reyes National Seashore, California. *California Fish and Game* 87(4):123-138.

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 prep).

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 ter-restrial amphipod (*Traskochestia 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.

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

PAPERS PRESENTED

Bias, M. A., I. Woo, J. Y. Takekawa, S. Demers, and G. T. Downard. 2003. Effect of Tidal Marsh Restoration on Salt Marsh Harvest Mice: the Need for Indices of Habitat Quality. CALFED Bay Delta Science Conference, Sacramento, CA.

Downard, G. T. and F. Reid. 2003. Monitoring Fish Assemblages among Tidal Marsh Restoration Projects in San Pablo Bay. Poster Presentation. The 6th Biennial State of the Estuary Conference. Oakland, CA.

Hadden, S. J., M. A. Wilzbach, K. W. Cummins, and M. A. Madej. 2004. Effect of organic and inorganic suspended load concentration on the foraging efficiency of juvenile salmonids in the field and artificial stream channels. Oral presentation to the Annual Meeting of the Cal-Neva American Fisheries Society, Apr 2004, Redding, CA.

Madej, M. A., M. A. Wilzbach, K. W. Cummins, C. C. Ellis, and S. J. Hadden. 2004. The significance of suspended organic sediments to turbidity, sediment flux, and fish-feeding behavior. *Redwood Region Forest Science Symposium, University of California-Berkeley, Mar 2004.*

Woo, I., J. Y. Takekawa, M. A. Bias, S. Demers, and G. T. Downard. 2003. Transitional Habitats In Tidal Marsh Restoration: Avian Response to Mud Flat Formation on Tolay Creek, San Pablo Bay. CALFED Bay Delta Science Conference, Sacramento, CA.

TECHNICAL PAPERS

Duffy, W. G., M. A. Wilzbach, M. Wheeler and S. Frazey. 2003. Validation Monitoring of Watershed Restoration in California: Recommended Protocols. Final Report to the California Department of Fish and Game, Interagency Agreement No. P0010565 U.S. Geological Survey, California Cooperative Fish Research Unit, Humboldt State University, Arcata, California.

Golightly, R. T., P. N. Hebert, G. Wengert, W. Pinix, and B. O'Donnell. 2004. Marbled Murrelet feeding ecology in coastal waters of northern California. Unpubl. Report, Humboldt State University, Department of Wildlife, Arcata, CA.

Hebert, P. N. and R. T. Golightly. 2003. Breeding biology and human-caused disturbance to nesting of marbled murrelets (*Brachyramphus marmoratus*) in northern California. Unpubl. Progress Report, Humboldt State University, Department of Wildlife, Arcata, CA

Madej, M. A., M. A. Wilzbach, K. W. Cummins, S. J. Hadden, and C. C. Ellis. 2003. Composition of suspended load as a measure of stream health. Progress Report/Draft Final Report December 19, 2003.

Miles, A. K., J. Y. Takekawa, D.H. Schoelhamer, S. E. Spring, N. D. Athearn, G.G.Shellenbarger, and D. C. Tsao. 2004. San Francisco Bay Estuary Salt Ponds Progress Report 2001-2003, USGS Priority Ecosystem Science Program, USGS/USFWS (CNO) Science Support.

Takekawa, J. Y., D. H. Schoellhamer, A. K. Miles, G. G. Shellenbarger, N. D. Athearn, S. E. Spring, M. K. Saiki, C. A. Jannusch. 2004. Initial biophysical changes after breaching a salt pond levee: final report on the Napa-Sonoma Wildlife Area Pond 3 breach. Unpubl. Prog. Rep., U. S. Geological Survey, Vallejo, CA. 42 pp.

THESES

Sparkman, M. D. 2004. Negative influences of predacious egg-eating worms, *Haplotaxis ichthyophagous*, and fine sediments on coho salmon, *Oncorhynchus kisutch*, in natural and artificial redds. M.S. Thesis, Humboldt State University, Arcata, Calif.

Willey, W. S. 2004. Energetic response of juvenile coho salmon (*Oncorhynchus kisutch*) to varying water temperature regimes in northern California streams. M.S. Thesis, Humboldt State University, Arcata, Calif.



Night electro-fishing for the Validation Monitoring Project. Photo by Kasey Bliesner.