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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 40 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 fourteen research projects, of which ten were conducted by Unit scientists as principal or co-principal investigator and four 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.


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

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Bernard Shanks, Unit Supervisor

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Larry Week, Chief, Native Anadromous Fish and Watershed Restoration Branch (retired October 2006)
Neil Manji, Chief, Fisheries Programs Branch (effective October 2006)

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College of Natural Resources and Sciences
1 Harpst Street
Arcata, CA  95521
James H. Howard, Dean
David G. Hankin, Chair, Department of Fisheries Biology (through July 2006)
Timothy Mulligan, Chair, Department of Fisheries Biology (effective August 2006)

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Kasey Bliesner, Project Biologist
Mark Yost, Klamath Polychaetes 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

Department of Wildlife Management
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Rick N. Brown, Lecturer
Mark A. Colwell, Professor
Ned H. Euliss, Adjunct Professor
T. Luke George, Professor and Chair
Richard Golightly, Professor
Matthew Johnson, Professor
David W. Kitchen, Professor
Micaela Szykman Gunther, Asst. Professor

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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. Lamberston, 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
## UNIT STUDENTS

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<td>Mark Ashenfelter</td>
<td>Peggy Wilzbach</td>
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<td>Sarah Beesley</td>
<td>Walt Duffy</td>
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<td>Kasey Bliesner</td>
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<td>Philip Colombano</td>
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<td>Kristin (Engel) Mull</td>
<td>Peggy Wilzbach</td>
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<td>Rodney Engle</td>
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<td>Jennifer Feola</td>
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<td>Eric Gonzales</td>
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<td>Stephen Gough</td>
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<td>Samantha Hadden</td>
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<td>Casey Justice</td>
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<td>John Matousek</td>
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<td>May 2007</td>
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<td>Seth Naman</td>
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<td>Benjamin Ransom</td>
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<td>Michele Wheeler</td>
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<td>Katrina Wright</td>
<td>Walt Duffy</td>
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## UNIT-AFFILIATED GRADUATE STUDENTS

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<tr>
<th>Student</th>
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<tr>
<td>Caleb Balas</td>
<td>T. Luke George</td>
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<tr>
<td>Donald Baldwin</td>
<td>George Robison</td>
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<tr>
<td>Oswaldo Hernandez</td>
<td>Richard Merritt</td>
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<tr>
<td>Marlene Meaders</td>
<td>Gary Hendrickson</td>
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Students are pursuing M.S., Fisheries at Humboldt State University unless otherwise noted.

## STUDENT ASSISTANTS AND RESEARCH TECHNICIANS

- Aaron Bliesner
- Emily Campbell
- Florence Consolati
- Ryan DeKnikker
- Anna Deyle
- David Malakaukas
- Francine Mejia
- Daniel Menten
- Matthew Metheny
- Oliver Miano
- Barry Miller
- Laurel Osborn
- Brian Poxon
- April Shackelford
- Sarah Willson

A few of the crew: Florie Consolati, Katrina Wright, April Shackelford, Emily Campbell (above) and Philip Colombano, Barry Miller, Mark Ashenfelter and Matt Metheny (left).
Coho Fisheries Data Compilation and Report Writing Services. (CDFG Agreement)

The National Marine Fisheries Service (NMFS) listed coho salmon as a threatened species in the Central California Coast (CCC) Evolutionarily Significant Unit (ESU) on October 13, 1996, and in the Southern Oregon - Northern California Coast (SONCC) ESU on May 6, 1997. Both listings were based primarily on historical presence/absence data reported in Brown and Moyle (1991). On April 5, 2001, the California Fish and Game Commission accepted the petition and coho salmon north of San Francisco Bay were officially designated as a candidate species in the California Regulatory Notice Register on April 27, 2001. In August 2002, the Commission determined that coho salmon warranted threatened status in the California portion of the NMFS SONCC ESU and endangered status south to San Francisco Bay; coho salmon are considered a candidate recovery species. Coho salmon, south of San Francisco Bay, were state-listed as Endangered on December 31, 1995.

In order to assess the status of coho salmon in California, basic questions such as life history patterns, habitat needs, and their past and current distribution (commonly referred to as presence/absence) and abundance must be answered. Descriptions of life history patterns and habitat needs can be used to identify limiting factors. Presence/absence data can then be used to: i) determine if population size is stable, decreasing, or increasing; whether population fragmentation has occurred, and if so, to what degree; ii) identify and prioritize coho salmon streams that require restoration or rehabilitation; iii) assess effectiveness of restoration efforts.

In cooperation with the Department of Fish and Game the contractor will finish writing a report which will provide fishery managers with coho salmon distribution and how it changes through time. The data used in this report was generated from literature review and field surveys conducted between 2001 and 2005. The contractor will identify historic coho salmon streams throughout the state of California, present a presence by brood year table for brood years 1979 through 2004, and provide a bibliography for all streams researched. The brood year table will be examined to determine shifts in spatial or temporal distribution. This information will be vital in establishing recovery targets, provides a baseline for trend analysis, and will define a coho salmon sampling universe. The project will maintain and organize the 12,000 document library, manage the library using EndNote bibliographic software, edit a 36,000 record Access database, assemble a presence by brood year table for brood years 1979 through 2004, create and maintain ArcView GIS files for analysis, determine the degree of spatial and maternal brood year lineage fragmentation, and summarize findings in a written report.

Investigators
Dr. Walter Duffy, CACFRU

Funding
California Department of Fish and Game ($24,583)

Duration
April 2006-December 2006
**Manayunkia speciosa:** Life history, rearing, and associated development of *Ceratomyxa shasta*. (USFWS Agreement)

Studies have indicated that a high percentage of out-migrant Chinook salmon smolts in the Klamath River succumb to disease. Foott et al. (2002) and others have suggested that ceratomyxosis caused by *Ceratomyxa shasta* appears to be the leading cause of mortalities. This project will investigate the life cycle of the intermediate host of *C. shasta* and effects of *C. shasta* on this intermediate host. The ultimate goal is to gather information applicable to managing anadromous salmonids in the presence of *C. shasta* and perhaps applicable to controlling the intermediate host.

Specimens of *M. speciosa* will be collected and reared in the laboratory in order to determine its life history requirements, particularly in regards to food habits and reproduction. This will require specific tasks as follows:

1. **Manayunkia speciosa** specimens will be collected from the lower Klamath River.
2. Specimens will be transported to Humboldt State University.
3. Specimens will be reared in artificial stream system.
4. Early feeding stages will be reared in the laboratory in order to study growth rates and food habits.

The development of *C. shasta* in *Manayunkia speciosa* will be described from those specimens maintained in the laboratory.

1. **Manayunkia speciosa** specimens will be examined for *C. shasta* infections using polymerase chain reaction (PCR) techniques.
2. Both positive and negative specimens will be examined histologically.
3. Histopathology associated with *C. shasta* infections in *M. speciosa* will be described.

**Investigators**

Dr. Gary Hendrickson, HSU Fisheries
Dr. Kenneth Cummins, HSU IRE
Dr. Peggy Wilzbach, CACFRU
Marlene Meaders, MS Student

**Funding**

US Fish and Wildlife Service ($55,000)

**Duration**

January 2006-June 2007
Growth and movement of resident rainbow trout transplanted below barriers to anadromy. (CDFG Agreement)

In common with several other salmonid species, rainbow trout *Oncorhynchus mykiss* is a polytypic species characterized by populations of resident, ad-fluvial, and fluvial rainbow trout and anadromous steelhead (Behnke 1992). The genetic vs. environmental basis underlying the migratory polymorphism is poorly understood. The migratory polymorphism may result from phenotypic plasticity within a single gene pool or from fixed differences between sympatric but reproductively isolated populations. Reproductive isolation between life history morphs has been identified in some locations for sockeye salmon and kokanee (Wood et al 1999) and Atlantic salmon (Vespoor and Cole 1989). However, Nordeng (1983) demonstrated, through rearing experiments of controlled pairings of anadromous and resident parents, that resident and migratory Arctic char were from the same gene pool and that migration was environmentally controlled.

Whether resident and anadromous forms constitute a single randomly mating gene pool or exhibit reproductive isolation between life history forms has significant implications for the study and management of steelhead populations in California, which have undergone precipitous decline in recent years. We propose a simple transplantation experiment in Freshwater Creek to determine if resident rainbows isolated above long-standing barriers will exhibit migratory behavior when relocated to downstream reaches. Such an experiment can provide valuable information on whether populations above barriers should be included in ESU’s and whether these populations offer potential for recovery of below-barrier populations.

The need to determine whether anadromous progeny can arise from resident parents and the importance of this behavioral plasticity to the persistence of steelhead was specifically targeted for recommended future research in the Steelhead Restoration and Management Plan for California (State of California, The Resources Agency Department of Fish and Game 1996).

The objective of the project is to determine if resident rainbow trout isolated above a long-standing barrier in Freshwater Creek will exhibit migratory behavior when transplanted below the barriers, and to compare growth rates between transplanted individuals and above-barrier residents.

**Transplantation Experiment:**

Juvenile rainbow /steelhead will be captured by electrofishing above the two barriers to upstream. All age 1+ rainbow will be weighed and marked with individually numbered Passive Integrated Transponder (PIT) tags directly into the body cavity. A small sample of untagged individuals will be sacrificed to obtain otolith samples for analysis of strontium (SR) to calcium (CA) ratios in the otolith primordia. This analysis allows determination of resident vs. anadromous parentage in that egg yolk formed in the marine environment exhibits an enriched SR/CA relative to yolk formed in freshwater. Half of the tagged individuals will be relocated below the barrier, leaving an equal number of tagged fish above the barrier. Fish remaining above the barriers will be re-sampled seasonally to allow estimation of growth rates. Attempts to locate and recapture transplanted individuals will take

![Climbing upper Freshwater Creek. (Photo by M. Metheny)](image-url)
advantage of a variety of sampling methodologies and installations currently in place within the basin. Once detected and captured, transplanted individuals will be weighed, status determined (parr, pre-smolt, smolt, or adult), and released. Data will be analyzed to determine the direction and extent of movement by transplanted individuals, and to compare growth rates between tagged individuals above and below barriers.

**Investigators**
Dr. Peggy Wilzbach, CACFRU
Mark Ashenfelter, MS Student

**Funding**
California Department of Fish and Game ($64,088)

**Duration**
September 2005-December 2007

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**Effects of conservation programs on amphibian communities in seasonal wetlands of the Prairie Pothole Region’s glaciated plains. (RWO 78)**

Historically, the Glaciated Plains supported a rich flora and fauna and was the most important area in North America for waterfowl production. The rich soils that originally supported native flora also have proven a boon to agricultural production. Consequently, the current landscape consists of myriad land uses varying from relatively pristine sites to areas converted to high production agriculture. Anthropogenic disturbances associated with these changes include hydrologic alteration (e.g. drained wetlands), addition of agricultural chemicals, and use of conventional tillage practices. Concerns over the loss of natural habitat and the sustainability of agricultural production in the area led to the implementation of various programs to facilitate land-use changes designed to improve the overall ecological health of the area and promote sustainable agriculture.

To better understand the nature of these influences on amphibians, we will explore potential methods of assessing the impacts of federal conservation programs on amphibian communities in the prairie pothole region (PPR) of the United States. This research will evaluate amphibian communities along a land-use disturbance gradient (native grassland/wetland, restored grassland/wetland from conservation programs, and intensive agricultural production areas) and along the natural climate/biological gradient of the PPR to provide an initial assessment regarding the impact of conservation programs on amphibians of the Glaciated Plains. This two-year effort will provide information to evaluate a methodology that can be applied at a regional scale to evaluate amphibian communities in relation to land-use change and climate driven ecological processes. These data eventually will be used in a broader DOI-USDA partnership to quantify and assess the impacts of conservation programs on ecological services.

**Objectives:**
1. Determine amphibian species composition of farmed, conservation program, and natural seasonal wetlands from sampling points near Devils Lake, ND; Morris, MN; and Spirit Lake, IA.
2. Compare amphibian communities of farmed, conservation program, and natural seasonal wetlands using multivariate statistical techniques.
3. Develop logistic regression models that identify best fitting and most parsimonious models describing relationships between amphibian species presence/absence and explanatory environmental variables.

**Investigators**
Dr. T. Luke George, HSU Wildlife
Dr. Walter Duffy, CACFRU
Caleb Balas, MS Student

**Funding**
USGS, Northern Prairie Wildlife Research Center ($102,666)

**Duration**
August 2005-December 2007
Development of a research plan for quantifying the abundance of the invertebrate host of salmonid parasites in the Lower Klamath River. (RWO 77)

In Phase I of the project, 55 samples from a variety of microhabitat types differing in substrate, depth, and velocity characteristics were collected in fall 2005 from 30 stations ranging from below Iron Gate Dam to Klamath Glen, near the mouth of the Klamath River estuary. These preliminary data are being analyzed to determine if presence of the polychaete varies along the longitudinal profile of the river and to evaluate general habitat associations of the polychaete. The goal of this effort is to develop a statistically-based research plan to quantify the distribution and abundance of the polychaete as a necessary precursor to designing a polychaete control strategy. Potential control strategies may include: 1) target-specific chemical control; 2) enhancement of biological control, i.e. natural predation on the polychaete; 3) alteration of existing water quality conditions; and/or 4) changes in the magnitude, duration, and timing of water releases from Iron Gate Dam.

In Phase II A of the project, we will address additional information needed to fully develop a research plan for quantifying polychaete abundance and distribution, and to promote the design of an effective control strategy. Specifically, we propose: 1) to evaluate the effect of seasonality on the distribution and habitat associations of the polychaete; 2) to establish water quality parameters associated with polychaete presence; and 3) to describe the diversity and abundance of non-target macroinvertebrates co-occurring with the polychaete. Objective one will be met by collecting and analyzing an additional set of samples in spring/summer 2006 from the same suite of locations and habitat associations that were collected in fall 2005. Based on initial findings that suggest the absence of the polychaete from the lower sections of the river (below the Trinity River) but presence in the middle and upper river sections, additional samples will be collected within the transition zone to more precisely demarcate locations of presence and absence. Substrate-preference experiments will be conducted in laboratory channels to establish substrate preference and to suggest a standardized-sampling methodology employing artificial substrates. Objective two will be met by collecting and analyzing water quality samples from all invertebrate samples collected in spring/summer 2006. Grab samples will be collected from the water column with a horizontal water sampler, and analyzed for concentrations of alkalinity, nitrate (NO₃⁻), total nitrogen, soluble-reactive phosphorus (SRP), and total phosphorus (TP). Objective three will be met by analyzing samples collected during fall 2005 and spring/summer 2006 to quantify the abundance and taxonomic identity of predators and other non-target macroinvertebrates co-occurring with the polychaete.

In Phase II B of the project, we propose to collect, establish and maintain populations of Manayunkia speciosa in experimental stream channels to elucidate three major information needs that are relevant to testing the effects of the above mentioned control strategies: a) food sources (particle size and origin) of the polychaete; b) natural predators of the polychaete, such as odonates and naucorids; and c) pattern and determinants of the life history of the polychaete. Flow, temperature, food, and natural predators will be manipulated in controlled experiments.

**Investigators**

Dr. Peggy Wilzbach, CACFRU
Dr. Kenneth Cummins, HSU-IRE
Mark Yost, Biologist
Sarah Willson, Technician

**Funding**

US Fish and Wildlife Service ($148,113)

**Duration**

August 2005-May 2008
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 November 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. 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 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 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
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.
Response of steelhead populations to fire disturbance in the Kings Range National Conservation Area. (RWO 75)

1. 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 the Bureau of Land Management 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 large woody debris 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 in 2005.

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

1. 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.

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

3. 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 ($146,136)

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 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

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
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.

Results and Discussion:

Objective 1 - Population size and productivity. We observed terns for 14 weeks for a total of 14.5 hours. We observed a maximum of 43 terns on 15 June 2005. The lack of observed breeding behaviors suggests that terns did not breed on Sand Island in 2005. This was confirmed by the lack of adult terns, nests and juveniles in August 2005.

Objective 2 - Potential constraints to colony size. On 24 April 2005 one bald eagle was observed near the island. For three consecutive weeks there were three “scarecrow” structures placed on the island by an unknown person. Nesting habitat appears to be somewhat limited due to a large population of cormorants that periodically roosted on the island in 2004 and 2005 and which nested on the island in previous years. With hundreds of cormorants sometimes roosting on the island, there is the possibility of crowding out tern nests and/or preventing nesting attempts by terns.

Even absent cormorants, the amount of suitable nesting habitat available to terns on Sand Island is somewhat limited. The unvegetated habitats of the island may not be sufficient to support more than a few hundred nesting pairs, especially considering that spring high tides of the summer solstice predictably inundate much of the island. For those terns currently nesting on Sand Island, however, there are numerous beneficial habitat characteristics including: availability and close proximity of food, lack of frequent disturbance by humans or predators, and minimal vegetation (Shuford and Craig 2002). Furthermore, a decrease in vegetation height and coverage from 1 January 2001 to the 2003 breeding season has been observed during kayak surveys around the island (Colwell, pers. obs.). For this reason, we recommend that the area be protected from increased human activity in the area such as fishing and oyster farming, as well as recreation such as jet skiing and motor boating. These activities could potentially cause abandonment of the site due to their consistency, noise level, and speed. This area has been an important colony in the past and may increase in importance in the future.

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

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

Completed
October 2006
Restoration Validation Monitoring and Protocol Development Project. (CDFG Agreement)

This agreement continued 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:

1. Completed 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 tested proposed protocols evaluating their utility for the California Coastal Salmonid Restoration Monitoring and Evaluation Program.

3. Conducted a pilot study for the implementation of DFG’s California Coastal Salmonid Restoration Monitoring and Evaluation Program. Conducted baseline, pre-project monitoring for restoration projects scheduled for implementation within the next three years.

4. Data collected during field testing trials and baseline, pre-project monitoring surveys were entered into the DFG’s Restoration Monitoring Database.

A methods manual consisting of six chapters was written, peer reviewed and accepted by the California Department of Fish and Game (CDFG). The manual is now being used by CDFG and contractors are required to use methods contained in the manual.

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)

Completed
December 2005
WALT DUFFY

Courses Taught
Fish 580 Restoration Ecology of Riverine Fish Fall 2005 3 units

Guest Lectures
Bioenergetics of Fish, November 2006
High Tech Fish Tagging Methods, September 2006
Smoltification in Salmon, March 2006
Ecology of Freshwater Bivalves, April 2007

Graduate Committee Service
Academic and Research Advisor
Sarah Beesley - 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
Michele Wheeler- MS Fisheries, Humboldt State University
Katrina Wright - MS Fisheries, Humboldt State University

Committee Member
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Brooke DeVault - MS Fisheries, Humboldt State University
Benjamin Ransom - MS Fisheries, Humboldt State University
Stephanie Souza - MS Mathematics, Humboldt State University
Steve Tussing - MS Fisheries, 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, Humboldt State University
John Matousek - MS Fisheries, Humboldt State University
Oswaldo Hernandez - PhD Entomology, Michigan State University
Marlene Meaders - MS Fisheries, Humboldt State University
John Walsh - MS Biology, Humboldt State University
Courses Taught
Fish 580  Salmonid Behavior  Spring 2006  3 units
Fish 585  Ecology of Running Waters  Fall 2006  3 units

Guest Lectures
Food Supply Considerations in Salmonid Restoration, November 2006
Perspectives on Pursuing a Career in Fisheries, April 2007
Stream Invertebrate Drift, April 2007

Graduate Committee Service
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Mark Ashenfelter - MS Fisheries, Humboldt State University
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Seth Naman - MS Fisheries, Humboldt State University
Benjamin Ransom - MS Fisheries, Humboldt State University

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Erin Hannelly - MS Biology, Humboldt State University
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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
Susan Corum - MS Fisheries, Humboldt State University
Heidi Vogel - MS Fisheries, Humboldt State University
Katrina Wright - MS Fisheries, Humboldt State University

University Committees and Workgroups
Member, Graduate Advisory Council, College of Natural Resources and Sciences, HSU
Chair, Tuition Waiver Committee, College of Natural Resources and Sciences, HSU
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
- Member, U. S. Geological Survey, Klamath Science Committee

Wilzbach
Member, Redwood Creek Pulse Group
Member, Watershed Ecology Team
Member, Steering Committee, Klamath River Fish Health

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.
COMMUNITY OUTREACH

Duffy/Wright

Guided Arcata High School students in sampling fish on Jolly Giant Creek for an AP Biology class project.

Duffy

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), Ecology of Freshwater Fish (1) and Southwestern Naturalist (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).

Peer reviewer for proposal to Arctic-Yukon-Kuskokwim Sustainable Salmon Initiative.

Wilzbach


Reviewer for proposal submitted to the National Science Foundation.

Book review for the American Fisheries Society.
PROFESSIONAL
SERVICE AND INVOLVEMENT

PROFESSIONAL SOCIETY INVOLVEMENT

Duffy
Member, American Fisheries Society
Member, Annual Meeting Arrangements Committee
Member, External Affairs Committee
Member, Salmonid Restoration Federation
Member, Society of Wetland Scientists

Wilzbach
Member, American Fisheries Society
Member, Program Committee, AFS 2007 Annual Meeting
Member, AFS Maughn Scholarship Committee
Member, AFS Publication Award Committee
Member, Coastal Cutthroat Trout Symposium and Western Division
AFS Scholarship Committee
Member, Ecological Society of America
Member, North American Benthological Society
Member, International Limnological Society

TECHNICAL ASSISTANCE

Duffy
Provided assistance to the Karuk Tribe and California Department of Fish and Game in negotiating changes to State Fish and Game codes regarding gold mining in streams.

Provided expert witness testimony for an administrative law hearing on providing access for anadromous fish above dams on the Klamath River.

Wilzbach
External reviewer on faculty promotion committee for Utah State University.

Provided guidance to Plum Creek Timber Company, Oregon, in developing an aquatic monitoring program.
PUBLICATIONS AND PRESENTATIONS

SCIENTIFIC PUBLICATIONS


TECHNICAL PAPERS


PAPERS PRESENTED


\textbf{THESES}


