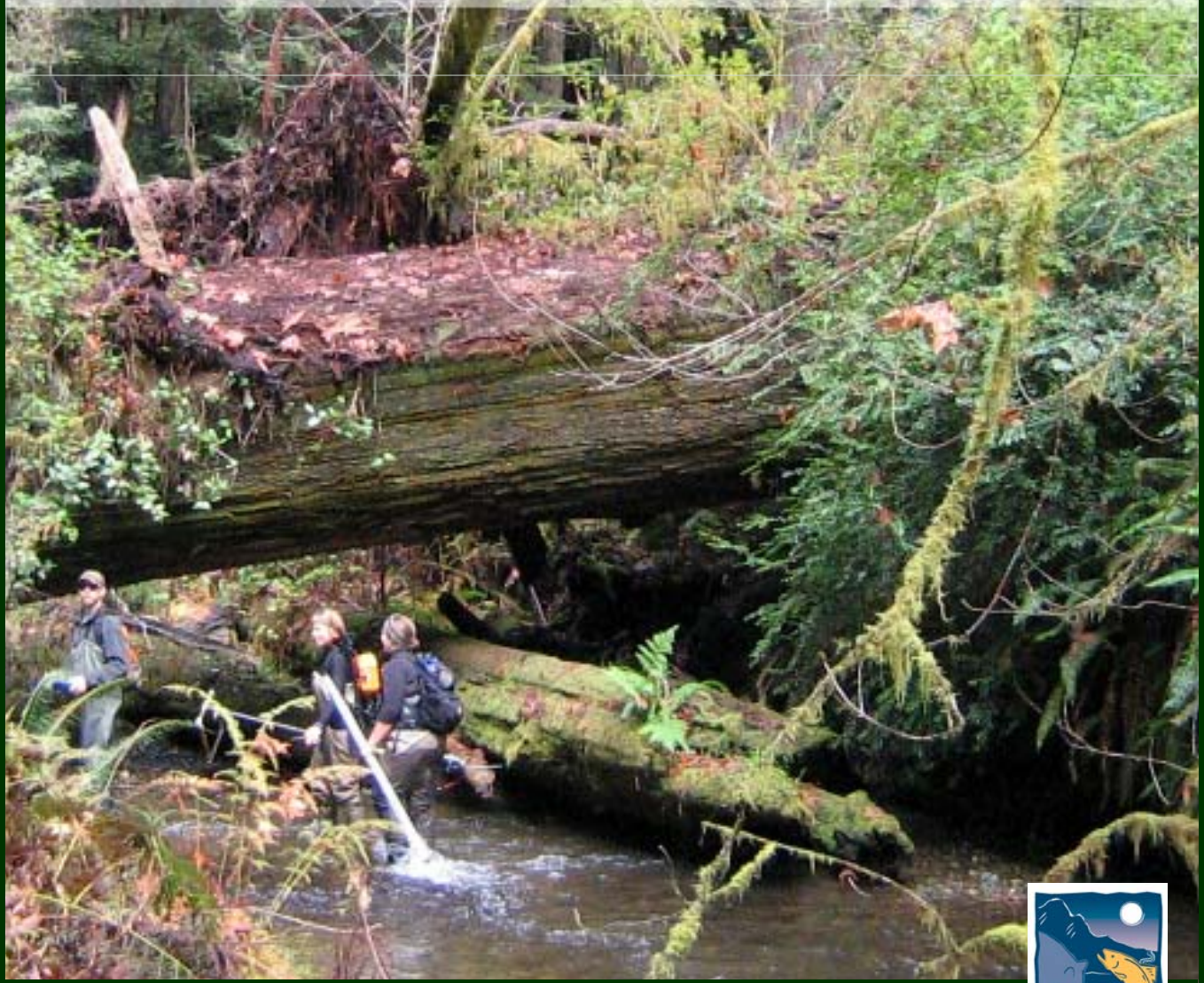
California Cooperative Fish Research Unit



2007 Annual Report

CA CO-OP FISH RESEARCH UNIT

California Cooperative Fish Research Unit

2007 Annual Report

October 2006 - September 2007

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

California Cooperative Fish Research Unit
Humboldt State University
1 Harpst Street – Wildlife & Fisheries Bldg. Room 212
Arcata, California 95521

Phone: 707-826-3268 FAX: 707-826-3269
Email: cuca@humboldt.edu Web: www.humboldt.edu/~cuca

TABLE OF CONTENTS

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 seventeen research projects, of which fourteen 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.

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

MISSION STATEMENT

The California Cooperative Fish Research Unit is a cooperative venture among Humboldt State University, the California Department of Fish and Game, and United States Department of the Interior, Geological Survey. 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.

COOPERATORS AND PERSONNEL

COOPERATING AGENCIES

United States Geological Survey
Cooperative Research Units
12201 Sunrise Valley Drive
Reston, VA 20192

Byron K. Williams, Chief
Bernard Shanks, Unit Supervisor

California Department of Fish and Game
1416 Ninth Street
Sacramento, CA 95814

Donald Koch, Director
Neil Manji, Chief, Fisheries Programs Branch

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

James H. Howard, Dean
Timothy Mulligan, Chair, Department of Fisheries Biology (August 2006 - July 2007)
David G. Hankin, Chair, Department of Fisheries Biology (August 2007 – present)

UNIT STAFF

Dr. Walter G. Duffy, Unit Leader
Adjunct Professor, Department of Fisheries Biology
707-826-5644
wgd7001@humboldt.edu

Dr. Peggy A. Wilzbach, Assistant Unit Leader
Adjunct Professor, Department of Fisheries Biology
707-826-5645
paw7002@humboldt.edu

Dr. Kenneth W. Cummins, Senior Advisory Scientist
Chair and Co-Director, Institute for River Ecosystems
Adjunct Professor, Department of Fisheries Biology
707-825-7350
kwc7002@humboldt.edu

Kay Brisby, Administrative Support Coordinator
707-826-3268
brisby@humboldt.edu

RESEARCH STAFF

Dr. Sharon Kahara, Post-Doctoral Research Associate (CCVA)
707-826-3208
snk6@humboldt.edu

HUMBOLDT STATE UNIVERSITY COOPERATING FACULTY

Department of Fisheries Biology
Eric Bjorkstedt, Adjunct Professor
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
Jeff Black, Professor and Chair
Richard G. Botzler, Professor
Rick N. Brown, Lecturer
Mark A. Colwell, Professor
Ned H. Euliss, Adjunct Professor
T. Luke George, Professor
Richard Golightly, Professor
Matthew Johnson, Professor
David W. Kitchen, Professor
Micaela Szykman Gunther, Asst. 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, Geology
Mary Ann Madej, Adjunct Professor, Geology
Sharyn B. Marks, Associate Professor, Biology
Michael Mesler, Professor, Biology

GRADUATE EDUCATION

UNIT STUDENTS

Student	Major Advisor	Graduation
Mark Ashenfelter	Peggy Wilzbach	
Sarah Beesley	Walt Duffy	December 2006
Philip Colombano	Walt Duffy	
Chad de Young	Peggy Wilzbach	August 2007
Jennifer Feola	Walt Duffy	August 2007
Eric Gonzales	Walt Duffy	December 2006
Stephen Gough	Walt Duffy	
Samantha Hadden	Peggy Wilzbach	
Brian Hodge	Duffy & Wilzbach	
Casey Justice	Walt Duffy	August 2007
Jang-Won Lee	Walt Duffy	
John Matousek	Peggy Wilzbach	May 2007
Katherine McLaughlin	Walt Duffy	
Seth Naman	Peggy Wilzbach	
Roman Pittman	Peggy Wilzbach	
Brian Poxon	Walt Duffy	
Benjamin Ransom	Peggy Wilzbach	December 2007
Michele Wheeler	Walt Duffy	
Katrina Wright	Walt Duffy	

UNIT-AFFILIATED GRADUATE STUDENTS

Student	Major Advisor	Program
Caleb Balas	T. Luke George	M.S. Wildlife, HSU
Donald Baldwin	George Robison	M.S. Watershed, HSU
Oswaldo Hernandez	Richard Merritt	PhD. Entomology Michigan St. Univ.
Marlene Meaders	Gary Hendrickson	M.S. Fisheries, HSU

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

STUDENT ASSISTANTS AND RESEARCH TECHNICIANS

Brooke DeVault
Emily Campbell
Pam Loring
David Malakaukas
Daniel Menten
Matthew Metheny
Brian Poxon
April Shackelford
Sarah Willson
Mark Yost

CURRENT RESEARCH

AGE STRUCTURE OF STEELHEAD IN THE KLAMATH RIVER BASIN AND THE EFFECT OF THE HALF-POUNDER LIFE HISTORY ON POPULATIONS.

Investigators:	Dr. Walter Duffy, CACFRU
	Dr. Peggy Wilzbach, CACFRU
	Brian Hodge, MS Student
Duration:	March 2007 to July 2009
Funding:	California Department of Fish and Game/AFRAMP ($52,972)

The Klamath River and its tributaries support the greatest number of steelhead (*Oncorhynchus mykiss*) in California. The Klamath River also supports one of the most important steelhead fisheries in the state. Estimates of adult steelhead run size in the Klamath River basin range from 283,000 in the 1960's to 87,000 in the 1980's. These adult fish are comprised of three distinct stocks, separated by migration timing. Spring run (summer) steelhead enter the river during May-July as immature fish and migrate to cold water tributaries where they mature before spawning during December-February. Fall run steelhead enter the river during August-October and disperse throughout the basin, spawning during February-April. Winter run steelhead enter the river during November-February and spawn during January-April. In addition to these three stocks, a run of small (250-344 mm) immature steelhead commonly called half-pounders enters the river in the fall after spending two – four months in the estuary or coastal waters.

The "half pounder" life history was thought to be unique to a few rivers in northern California and southern Oregon. However, a "half-pounder" life history has recently been described from rivers in the western Kamchatka Peninsula in Russia and is suspected to occur in the Russian River, CA.

Adult steelhead in the Klamath River basin vary in their expression of the "half-pounder" life history. Most adult fish entering tributaries above the confluence of the Trinity River exhibit the "half-pounder" life history, while few in the lower river do. Furthermore, an intermediate proportion of fish in the Trinity River exhibit this life history.

The objectives of this project are:

1. To determine the current age structure of steelhead stocks throughout the Klamath River basin, and
2. To investigate the benefit of the "half-pounder" life history to steelhead populations in the Klamath River basin.

Data collection was initiated in fall 2007 and involved gathering steelhead to collect samples of scale and other biological data. Brian Hodge had collected 310 steelhead scale samples. Most of these samples were obtained from the Trinity River weir (Table 1).

Table 1. Number of scale and biological samples collected during October – December, 2008.

	Scale samples		
Collection method	Trinity	Klamath	Biological samples
Hook & line	30	13	
Guide reported	0	12	
Weir collection	255	--	
Biological data			
Weight-length			64
Fecundity			50
Total	285	25	114

Brian Hodge has met with and received training from Department of Fish and Game staff familiar with aging techniques for steelhead. He will begin aging samples collected in summer 2008. In 2008, we will attempt to increase sample size by employing beach seines in the lower Klamath River, and possibly at sites in the mid-Klamath River.

ASSESSING THE EFFECTS OF USDA CONSERVATION PRACTICES ON WETLAND ECOSYSTEM SERVICES IN CALIFORNIA'S CENTRAL VALLEY. (RWO 80)

Investigators:	Dr. Walter Duffy, CACFRU
	Dr. Sharon Kahara, HSU-SPF
Duration:	September 2006 to June 2010
Funding:	USDA, Natural Resources Conservation Service ($597,332)

California's Central Valley (CCV) encompasses an area of 55,100 km2, extending a distance of almost 7,000 km from Red Bluff in the north to around Bakersfield in the south. The CCV was historically an ecosystem consisting of grassland, prairie, and oak-grass savanna habitats. Interspersed within these primary habitats were riparian woodland, freshwater marsh, and vernal pool wetlands. These wetlands were integral in supporting the diverse flora and fauna of the historic CCV.

Most, if not all, these habitats in the CCV have been altered by human activity. Area of wetland habitats in the CCV prior to 1900 has been estimated to be 1.6-2.0 million ha . In the 1980's, wetland area in the CCV had been reduced to 153,000 ha. Human activities leading to wetland loss in the CCV are many and varied, but agricultural development and urbanization are chief among them.

The U. S. Department of Agriculture, Natural Resource Conservation Service (NRCS) administers a variety of programs intended to assist farmers and ranchers in addressing natural resource concerns on private lands. Among these programs is the Wetland Reserve Program (WRP), created as part of the 1990 Farm Bill. The WRP program focuses on restoring degraded wetlands or those that have been converted to agricultural production. In California, NRCS has focused their WRP activities on restoring a variety of wetlands, including seasonal wetlands, semi-permanent marshes, vernal pools, riparian and tidally-influenced wetlands.

This research project will assess the effects of conservation practices on wetland ecosystem services in the CCV. This CEAP-Wetlands assessment will produce estimates of wetland ecosystem services, quantify the effects of agriculture on wetlands, with and without implementation of USDA conservation practices, and develop predictive wetland functional condition indicator models.

Objectives of the research are to:

1. Organize and conduct a regional workshop for the purpose of identifying ecosystem functions and services most important in CCV wetlands.
2. Evaluate ecosystem services provided by USDA-NRCS restoration of palustrine emergent wetlands in the CCV.
3. Evaluate ecosystem services provided by USDA-NRCS restoration of different types of wetlands.

Progress:
In 2007, we completed objective #1. The workshop was held in Davis, CA, and was attended by 35 wetland scientists and managers. The workshop produced a consensus, among those attending, on the most fruitful wetland response variables to measure.

Also in 2007, Dr. Sharon Kahara was selected to lead this project. Dr. Kahara arrived in August and quickly became involved in all aspects of the project.

Since her arrival, Dr. Kahara has organized a digital database for the project that includes wetland size and distribution, as well as land use and management actions relevant to specific wetlands. More than 190 individual wetlands have been reviewed for their suitability in meeting experimental design criteria. Among those, a group of 100-150 has been selected for sampling in 2008 or 2009.

Field sampling was started in February 2008. Sampling will gather data on three potential ecosystem services, biological diversity, flood water storage and nutrient storage (see below).

- Biological diversity
    - Bee diversity
    - Amphibian diversity
    - Shorebird diversity
    - Waterfowl use of WRP restored wetlands
- Flood water storage
    - Carbon, nitrogen and phosphorus storage
    - In soils
    - In plants

The sampling design will include gradients of wetland age and management intensity. Results from field sampling across these gradients will be used to construct models describing ecosystem service response to each.

CONSERVATION GENETICS OF THE FEDERALLY ENDANGERED TIDEWATER GOBY (EUCYCLOBIUS NEWBERRYI) IN NORTHERN CALIFORNIA. (RWO 79)

Investigators:	Dr. Andrew Kinziger, HSU, Fisheries Biology
	William T. McCraney, MS Student
Duration:	September 2006 to June 2009
Funding:	US Fish & Wildlife Service ($140,905)

The tidewater goby (*Eucyclogobius newberryi*) is a federally endangered fish species (U.S. Fish and Wildlife Service, 1992; 1994) ranging from the Smith River in northern California to Agua Hedionda Lagoon in southern California (Swift, 1989). The tidewater goby inhabits brackish/freshwater lagoons and estuaries that are positioned linearly along the California coast. Lagoons and estuaries inhabited by tidewater goby are separated from one another by 1-20 km (Swift, 1989). Tidewater gobies have no explicit marine stage and ocean habitats between these estuaries and lagoons are not inhabited by stable populations of goby; however, rare periodic migrants occur in ocean habitats (Swift, 1989; Lafferty, 1999; Swenson, 1999). There is only one known record of tidewater goby from coastal oceanic waters (California Academy of Science (CAS) Ichthyological Collection, CAS 31769). Many coastal lagoons inhabited by tidewater gobies are physically isolated from the ocean by sand bars that rarely open to the ocean (~0-5 openings annually) making dispersal into and out of the lagoons contingent upon lagoon openings. Given the fragmented nature of tidewater goby geographic distribution it is convenient to view this species as composed of metapopulations experiencing periodic local extirpation with subsequent recolonization from regional source populations (Lafferty et al., 2001).

An understanding of how the fragmented distribution of tidewater goby influences population structure (e.g., migration rates, among population genetic divergence and within population genetic diversity) is critical for proper management and conservation of this endangered species. Previous studies of population structure of tidewater gobies employing a "broad brush" approach wherein variation in the mitochondrial genome was assessed in relatively few individuals from throughout the species entire geographic range revealed evidence for low levels of among population migration and high levels of genetic differentiation among tidewater goby populations (Dawson et al., 2001). Studies using a more "fine scale" approach wherein a large number of individuals were sampled from a few populations revealed similar trends. For example, Mendoca et al. (2001) assessed microsatellite variation in 50 individuals from each of three central California populations and revealed evidence for low migration, high amount of among population genetic differentiation and evidence for a population bottleneck. Using a similar sampling regime and allozyme data Crabtree (1985) found nearly identical patterns for southern California populations. The number of localities studied and the sample sizes examined to date however are insufficient to resolve the patterns of migration and genetic differentiation to the extent that would be required to make appropriate management decisions. Moreover, tidewater goby populations from northern California have NEVER been studied using a "fine scale" approach.

The objective of this study is to investigate the population structure of northern California tidewater goby at two spatial scales: (a) "Phylogeographic Scale" — among populations from Point Arena to Smith River (Cape phylogeographic region (see Dawson et al, 2001)), and (b) "Estuary Scale"— among populations in Humboldt Bay. Testing for population structure in tidewater gobies at the "Estuary Scale" has not been previously undertaken. Twelve populations of tidewater goby (eight from coastal areas in the Cape Phylogeographic region and four from Humboldt Bay) will be examined. A total of 50 individuals will be assayed per location to provide sample sizes large enough for rigorous statistical tests. Thus a total of 600 individuals will be genetically assayed for this study (12 populations * 50 individuals/population).

Each individual will be genotyped at six microsatellite loci. Microsatellites are the marker of choice for "fine scale" population genetic studies for two reasons: (a) genetic tissue samples can be obtained using non-lethal methods by taking a small fin clip in the field and preserving it in 95% ethanol thus minimizing impacts on existing populations, and (b) microsatellites exhibit high mutation rates, high number of alleles and high levels of polymorphism providing excellent resolution for studies of "fine scale" population structure (Hillis et al., 1996; Estoup et al., 1998). A drawback of using microsatellite markers is that they must be designed specifically for a species or a group of closely related species. Fortunately, four microsatellite loci have been specifically developed for tidewater goby (Mendonca et al., 2001) and it is hoped that two others can be identified by screening microsatellite loci developed for closely related species in the family gobiidae (e.g., Jones et al., 2001; Ohara et al., 2004). All microsatellite assays will be conducted at Humboldt State University Fish Genetics Laboratory using the Beckman-Coulter CEQ 8000 genetic analysis system.

Project Status:

Collection of multilocus microsatellite genotypes for this project have been completed. The finalized data set contains 672 tidewater goby from 13 different populations: Lake Earl, Stone Lagoon, Big Lagoon, McDaniel Slough, Gannon Slough, Gannon Pond, Jacoby Creek, Wood Creek, Elk River, Humboldt Bay National Wildlife Refuge, Eel River, Virgin Creek and Pudding Creek. Each individual was genotyped at 9 microsatellite loci. Data analyses and report preparation are underway with anticipated completion date of December 2008.

Preliminary results indicate levels of genetic differentiation among populations included in this study are very large, even for populations that are only separated by a few kilometers. For example, there is marked divergence between populations in north versus south Humboldt Bay. Estimates of genetic diversity (heterozygosity and allelic richness) are highly variable among populations suggestive of bottlenecks and founder effects. Data is most consistent with genetic drift as the causative agent in divergence among populations. Preliminary results were presented at Humboldt Bay Symposium (April 2008), Eureka, California.

MANAYUNKIA SPECIOSA: LIFE HISTORY, REARING, AND ASSOCIATED DEVELOPMENT OF CERATOMYXA SHASTA. (USFWS AGREEMENT)

Investigators:	Dr. Gary Hendrickson, HSU Fisheries Dr. Kenneth Cummins, HSU IRE Dr. Peggy Wilzbach, CACFRU Marlene Meaders, MS Student
Duration:	January 2006 - June 2008
Funding:	US Fish and Wildlife Service ($55,000)

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. The objective of this project is to 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.

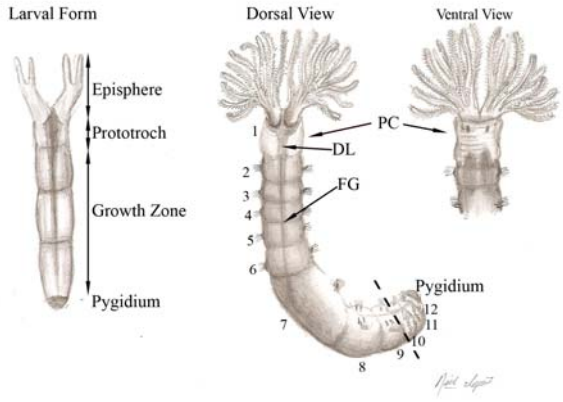


Fig. 1. Zones of polychaete growth and development. Diagram illustrates major external features of adult *Manayunkia speciosa* and how each zone of growth develops from the polychaete larvae. Entire animal is shown in ventral view and anterior end is shown in dorsal view. Each segment is numbered; dashed line indicates thorax-abdomen junction. Drawings by Nick Ingram. DL, dorsal lip; FG, fecal groove; PE, peristomial collar.

Specimens of *M. speciosa* were collected and reared in the laboratory in order to determine its life history requirements, particularly in regards to food habits and reproduction. Specific tasks included:

1) Collection of *Manayunkia speciosa* from the lower Klamath River.
2) Transport of specimens to Humboldt State University.
3) Rearing of specimens in artificial stream system.
4) Rearing of early feeding stages in the laboratory in order to study growth rates and food habits.

The development of *C. shasta* in *Manayunkia speciosa* was described from those specimens maintained in the laboratory. *Manayunkia speciosa* specimens were examined for *C. shasta* infections using polymerase chain reaction (PCR) techniques. Both positive and negative specimens were examined histologically. Histopathology associated with *C. shasta* infections in *M. speciosa* is described in a master's thesis to be defended by Marlene Meaders in June 2008.

GROWTH AND MOVEMENT OF RESIDENT RAINBOW TROUT TRANSPLANTED BELOW BARRIERS TO ANADROMY. (CDFG AGREEMENT)

Investigators:	Dr. Peggy Wilzbach, CACFRU
	Mark Ashenfelter, MS Student
Duration:	September 2005-June 2008
Funding:	California Department of Fish and Game ($64,088)

In common with several other salmonid species, rainbow trout Oncorhynchus mykiss is a polytypic species characterized by populations of resident, adfluvial, 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. 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 (Department of Fish and Game 1996).

We conducted a transplantation experiment to determine if resident rainbow trout (O. mykiss) isolated above a barrier to anadromy would exhibit migratory behavior when relocated below the barrier. A total sample of 150 trout (>100 mm FL) upstream of a 5 m high waterfall in Freshwater Creek was captured during fall 2005 and summer 2006 and individually marked with PIT tags. At each sampling event, half of the sample was transplanted below the waterfall, approximately 10 km from tidewater, and an equal number of tagged individuals were released above the barrier. Tagged individuals in above- and below- barrier reaches were subsequently relocated and/or recaptured to compare growth rates and movement. Movement varied considerably among individuals. The majority of transplanted individuals displayed little movement or moved in an upstream direction only; 20% moved more than 5 km downstream, and of these, half moved into tidewater and displayed morphological changes associated with smolting. Six percent of tagged, above-barrier individuals were found in below-barrier reaches, presumably washing over the falls. The smoltification of at least some transplanted individuals, coupled with above-barrier 'leakage' of fish downstream, suggests the potential for resident trout to exhibit migratory behavior and to enter breeding populations of steelhead.

The final report describing our results is in preparation, and Mark Ashenfelter has submitted a first draft of his master's thesis.

EFFECTS OF CONSERVATION PROGRAMS ON AMPHIBIAN COMMUNITIES IN SEASONAL WETLANDS OF THE PRAIRIE POTHOLE REGION'S GLACIATED PLAINS. (RWO 78)

Investigators:	Dr. T. Luke George, HSU Wildlife Dr. Walter Duffy, CACFRU Caleb Balas, MS Student
Duration:	August 2005-June 2008
Funding:	USGS, Northern Prairie Wildlife Research Center ($102,666)

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 assessed the impacts of federal conservation programs on amphibian communities in the prairie pothole region (PPR) of the United States. This research evaluated 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 research provided information to evaluate a methodology that may be applied at a regional scale to evaluate amphibian communities in relation to land-use change and climate driven ecological processes.

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.

Caleb Balas, the graduate student on this project, produced a thesis in which all three objectives were addressed. He found that amphibian diversity and species composition varied with human influence on wetlands, as well as along the geographic/climate gradient.

DEVELOPMENT OF A RESEARCH PLAN FOR QUANTIFYING THE ABUNDANCE OF THE INVERTEBRATE HOST OF SALMONID PARASITES IN THE LOWER KLAMATH RIVER. (RWO 77)

Investigators:	Dr. Peggy Wilzbach, CACFRU Dr. Kenneth Cummins, HSU-IRE Mark Yost, Biologist Sarah Willson, Technician
Duration:	August 2005-May 2008
Funding:	US Fish and Wildlife Service ($148,113)

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 IIA 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 (NO_3^{2-}), 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 macro-invertebrates co-occurring with the polychaete.

In Phase IIB 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.

VALIDATION MONITORING: TESTING PROTOCOLS IN PRAIRIE CREEK. (CDFG AGREEMENT)

Investigators:	Dr. Walter Duffy, CACFRU
	Katrina Wright, MS Student
	Katherine McLaughlin, MS Student
Duration:	June 2005-May 2008
Funding:	California Department of Fish and Game ($211,167)

This research assessed protocols for validation monitoring of watershed restoration. Assessment included evaluating the sensitivity of protocols to natural variation.

Sampling was conducted in Prairie Creek, tributary to Redwood Creek, Humboldt County and included the following:

Juvenile Population Size – The population size of juvenile coho salmon, cutthroat trout and steelhead in upper Prairie Creek was estimated during late summer (September) 2005, 2006, and 2007. A two step procedure was 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 was determined from a sample of fish captured during juvenile population monitoring each year.

Smolt Production – The number of salmon and steelhead migrating from Prairie Creek toward the ocean was estimated from traps operated from March through May 2005, 2006, and 2007.

Adult Escapement – Estimates of the number of adult salmon and steelhead returning to Prairie Creek to spawn were made from surveys conducted from November through March/April 2005/06, 2006/07 and 2007/08. Traditional survey methods consisting of live fish and carcass counts and carcass mark/recapture studies were used to estimate population size. These estimates were compared to total fish counts made at a weir installed near the mouth of Prairie Creek.

Data have been compiled and analyzed, and a final report has been prepared.

UPPER REDWOOD CREEK JUVENILE SALMONID ABUNDANCE PROJECT. (CDFG AGREEMENT)

Investigators:	Dr. Walter Duffy, CACFRU
	Michael Sparkman, CDFG
Duration:	May 2007-April 2008
Funding:	California Department of Fish and Game ($48,355)

This project estimated the population size of salmonid juveniles and smolts migrating from upper Redwood Creek. Stratified mark/recapture methods were used to identify trap efficiency and expand catch records to population size. This involved marking a sample of the catch and releasing upstream of the trap each week. Data from the subsequent recapture of the marked as well as unmarked fish were then input into a model which determines population estimates on a weekly and seasonal basis. The long-term goal of the project is to determine the status and trends of juvenile salmonid smolt populations migrating downstream from upper Redwood Creek.

Population estimates for the three species sampled at this trap include 68,283 age 0+ coho salmon, 34,431 age 1+ steelhead and 2,861 age 2+ steelhead. The data collected have been analyzed and a report written.

LOWER REDWOOD CREEK JUVENILE SALMONID ABUNDANCE PROJECT. (CDFG AGREEMENT)

Investigators:	Dr. Walter Duffy, CACFRU
	Michael Sparkman, CDFG
Duration:	May 2007-April 2008
Funding:	California Department of Fish and Game ($57,631)

This project estimated the population size of salmonid juveniles and smolts migrating from lower Redwood Creek. Stratified mark/recapture methods were used to identify trap efficiency and expand catch records to population size. This involved marking a sample of the catch and releasing upstream of the trap each week. Data from the subsequent recapture of the marked as well as unmarked fish were then input into a model which determines population estimates on a weekly and seasonal basis. The long-term goal of the project is to determine the status and trends of juvenile salmonid smolt populations migrating downstream from upper Redwood Creek.

Population estimates for the three species sampled at this trap include 33,380 age 0+ coho salmon, 4,753 age 1+ steelhead and 869 age 2+ steelhead. The data collected have been analyzed and a report written.

RESPONSE OF STEELHEAD POPULATIONS TO FIRE DISTURBANCE IN THE KINGS RANGE NATIONAL CONSERVATION AREA. (NOAA AGREEMENTS)

Investigators:	Dr. Walter Duffy, CACFRU
	Philip Colombano, MS Student
Duration:	September 2004-December 2008
Funding:	NOAA Fisheries ($31,624)
	NOAA Fisheries ($8,376)

These agreements provide additional funding for RWO 75 (see next page). Specific tasks included in this agreement are:

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 scale samples and 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)

Investigators:	Dr. Walter Duffy, CACFRU
	Philip Colombano, MS Student
Duration:	August 2004-September 2007
Funding:	US Bureau of Land Management ($30,189)

This research assessed steelhead populations, other aquatic biota, aquatic habitat, and water quality associated with streams along the west slope of the King Range recently affected by fire. Data collected included estimates of steelhead population size, steelhead growth, aquatic invertebrate composition, large woody debris distribution and volume, habitat type and distribution and water quality. The experimental design included three streams. One treatment stream had burned hot (Big Creek), one burned with less severity (Kinsey Creek) and one that did not burn served as a control (Spanish Creek).

Objectives:

1. Determine if fire influences the population size and growth of steelhead.
2. Determine if fire accelerates large woody debris recruitment to KRNRA streams.
3. Determine if fire alters fish habitat volume.
4. Determine if fire alters the distribution of water quality and aquatic invertebrates within streams.

Habitat and large wood were surveyed in July 2004 and 2005. Fish sampling was completed in September and October of 2004, 2005 and 2006. Preliminary analyses suggest that fire had little or no affect on steelhead population size (see below).

Estimated size of juvenile steelhead populations in three streams in the Kings Range Wilderness Area, California.

Year	Spanish Cr. (Control)	Kinsey Cr. (Burned)	Big Flat Cr. (Burned Hot)
2004	3223	1099	3436
2005	1349	473	6109
2006	2646	1932	12157

The graduate student, Philip Colombano, continues to work on the remaining data and we expect a thesis during 2008.

EVALUATION AND MONITORING OF BURROW-NESTING SEABIRDS AT CASTLE ROCK NATIONAL WILDLIFE REFUGE. (RWO 74)

Investigators:	Dr. Richard T. Golightly, HSU Richard Young, MS Student
Duration:	September 2003 to July 2008
Funding:	USGS – SSP Appropriated Funds ($46,875)

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.

For current project information, and to view live video, please visit this web page.
http://www.humboldt.edu/~rtg1/research/castle_rock.html

COMPLETED RESEARCH

MERCURY IN BIRDS OF THE SAN FRANCISCO BAY-DELTA: TROPHIC PATHWAYS, BIOACCUMULATION AND ECO-TOXICOLOGICAL RISK TO AVIAN REPRODUCTION. (RWO 76)

Investigators:	Dr. Mark Colwell, HSU
Completed:	September 2007
Funding:	USGS/BRD Western Fisheries Research Center ($146,136)

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. We used an integrated field and laboratory approach to evaluate the risks of Hg exposure to birds. Specifically we integrated 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 approach enhances the evaluation of the relative hazard of Hg to aquatic birds within the estuary on a taxonomic, food web and geographic basis.

Bluso, J. D., M. A. Colwell, J. Y. Takekawa, J. T. Ackerman. Sex-specific Space Use by Forster's Terns Breeding in South San Francisco Bay. Submitted to Waterbirds, in review 2008.

Abstract - Parental care behaviors often differ in dimorphic seabirds, leading to sex-specific differences in foraging behaviors. However, few studies have examined sex-specific foraging behaviors in monomorphic seabirds. Using radio-telemetry, we studied Forster's Terns (*Sterna forsteri*) – a monomorphic and socially monogamous seabird – breeding in the South San Francisco Bay, California. Space use did not differ between males and females. Instead, space use varied by breeding stage and colony affiliation. Forster's Terns were located farthest from the nest during pre-breeding and post-breeding time periods, and closest to the nest during incubation and chick-rearing. Home-range size and core-use areas decreased as the breeding season progressed and were most concentrated in the post-breeding stage. The results of this and other studies indicate that terns, unlike other monomorphic seabirds studied, do not exhibit sex-specific differences in space use.

COHO FISHERIES DATA COMPILATION AND REPORT WRITING SERVICES. (CDFG AGREEMENT)

Investigators:	Dr. Walter Duffy, CACFRU
Duration:	April 2006 to June 2007
Funding:	California Department of Fish and Game ($24,583)

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.

This project was to write a report providing fishery managers with information on the distribution of coho salmon in California and how distribution has changed over time. The data used in this report were generated from a literature review and field surveys conducted between 2001 and 2005. Historic coho salmon streams throughout California were identified, a table compiling presence by brood year for years 1979 through 2004 was produced, and a bibliography for all streams researched was compiled. Analyses included evaluating data for shifts in spatial or temporal distribution.

The project compiled and organized a 12,000 document library, managed using EndNote bibliographic software. An Access data base containing 36,000 records was edited. ArcView GIS files to assess coho salmon distribution were created.

SALMONID MOVEMENT IN PRAIRIE CREEK SPAWNING GROUNDS. (CDFG AGREEMENT)

Investigators:	Dr. Walter Duffy, CACFRU Katrina Wright, MS Student
Completed:	May 2007
Funding:	Pacific States Marine Fisheries Commission ($10,632)

This project supplemented an ongoing project titled: Validation Monitoring: Testing Protocols in Prairie Creek. Item #5 in exhibit A of this project contract states that the number of adult salmonids passing a weir will be compared with escapement estimates obtained by traditional methods (AUC, mark-recapture studies). The objective of this item is to test the accuracy and efficiency of traditional methods of estimating escapement so that recommendations can be made to guide monitoring throughout California.

During the winter of 2005/2006 we operated the weir and collaborated with CDFG biologist Michael Sparkman who placed radio tags on 15 female adult coho salmon. These fish disbursed widely, with six or seven ascending five different tributaries to Prairie Creek. The wide dispersal of adult salmon into tributary streams compromises the accuracy of traditional methods of estimating escapement for two reasons. First, the number of adults using the main stem of Prairie Creek where escapement is estimated is unknown. Second, it is not possible to conduct escapement surveys of all tributaries due to the number of stream miles.

The solution we identified was to PIT tag adult salmonids at the weir and detect any that move into tributaries using remote antenna. Subtracting these fish from observations at the weir would permit comparison of the two methods.

This project provided funding for five remote PIT tag antenna. Antenna were installed and tested in 2007. In 2008, antenna were installed and operated all winter.

HYDROLOGIC ALTERATION IN THE KLAMATH RIVER BASIN.

Investigators:	Dr. Peggy Wilzbach, CACFRU
	Seth Naman, MS Student
Completed:	January 2007
Funding:	Idaho State University ($4,802)

This project provided funding for graduate student Seth W. Naman to conduct research in association with Professor Rob Van Kirk of Idaho State University during the fall semester of 2006.

The analysis addressed the immediate need for a comprehensive analysis of the hydrologic regime and its change over time on the Scott River, an important coho salmon rearing tributary in the Klamath Basin. Given the difficulty in obtaining accurate diversion records and the complexity of the effects of groundwater withdrawals on surface flow, the Scott River analysis utilized a comparative approach (Stewart-Oaten et al. 1986, 1992) in which hydrologic regime in the Scott River was compared to those in other regional streams that have experienced similar climatic and land use changes over the past few decades but not necessarily the same water management changes. Such an approach was successful in identifying changes in irrigation practices as the cause of changes in surface flow in the Salt River, Wyoming (Venn et al. 2004). Analysis of the hydrologic regime on the Scott River is relevant to hydrologic regimes in other important Klamath River tributaries, including the Shasta, Salmon and upper Trinity Rivers and Indian Creek.

We analyzed 5 streams and 16 snow courses to identify causes of decreased base flow in the Scott River. April 1 snow water equivalent (SWE) decreased significantly at most snow courses lower than 1800m in elevation and increased slightly at higher elevations. Correspondingly, base flow decreased significantly in the two streams with the lowest latitude-adjusted elevation and increased slightly in two higher-elevation streams. Base-flow decline in the Scott River was larger than that in all other streams and larger than predicted by elevation and latitude. Irrigation withdrawal in the Scott watershed has doubled since the 1950s, and the amount of ground water withdrawn has increased from 1 to 50 Mm3/yr. Water use changes have been minimal in the other watersheds. We estimate that half of the observed 10 Mm3 (8000 acre- feet) decline in July 1-22 October discharge in the Scott River is due to changes in irrigation use. Returning to pre-1970 irrigation patterns in the Scott Valley could potentially increase streamflow by an average of 0.5 m3/s (17cfs) over the July 1-October 22 period.

A manuscript describing this work has been submitted for publication.

UNIVERSITY SERVICE AND TEACHING

WALT DUFFY

Courses Taught

Fish 575	Fish Bioenergetics	Spring 2007	3 units
Fish 580	Restoration Ecology of Riverine Fish	Fall 2007	3 units

Guest Lectures

High Tech Fish Tagging Methods, October 2007
Coastal Cutthroat Trout Demographics, November 2007

Graduate Committee Service

Academic and Research Advisor
Sarah Beesley – MS Fisheries, Humboldt State University
Philip Colombano – MS Fisheries, Humboldt State University
Jennifer Feola – MS Fisheries, Humboldt State University
Stephen Gough – MS Fisheries, Humboldt State University
Brian Hodge – 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
Brian Poxon – MS Fisheries, Humboldt State University
Michele Wheeler– MS Fisheries, Humboldt State University
Katrina Wright – MS Fisheries, Humboldt State University

Committee Member
Donald Baldwin – MS Watershed, Humboldt State University
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

PEGGY WILZBACH

Courses Taught

Fish 585	Ecology of Running Waters	Fall 2006	3 units
Fish 585	Ecology of Running Waters	Fall 2007	3 units

Guest Lectures

Food Supply Considerations in Salmonid Restoration, November 2006
Perspectives on Pursuing a Career in Fisheries, April 2007
Opportunities and Challenges to Women Pursuing Careers in Fisheries, May 2007
Stream Invertebrate Drift, April 2007

Graduate Committee Service

Academic and Research Advisor

Mark Ashenfelter – MS Fisheries, Humboldt State University
Chad de Young – MS Fisheries, Humboldt State University
Samantha Hadden – MS Fisheries, Humboldt State University
Brian Hodge – MS Fisheries, Humboldt State University
John Matousek – MS Fisheries, Humboldt State University
Seth Naman – MS Fisheries, Humboldt State University
Roman Pittman – MS Fisheries, Humboldt State University
Benjamin Ransom – MS Fisheries, Humboldt State University

Committee Member

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

PROFESSIONAL SERVICE AND INVOLVEMENT

NON-SOCIETY MEMBERSHIPS

Cummins

- Member, Technical Advisory Committee for the California Board of Forestry
- Member, Evaluation Panel for the California Central Valley Program Implementation Act (CVPIA)

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
- Member, Redwood Creek Watershed Committee

Wilzbach

- Member, Steering Committee, Klamath River Fish Health
- Member, Watershed Ecology Team
- Member, Redwood Creek Pulse Group
- Member, Smith River Advisory Council

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
- Guided Arcata High School students in sampling fish on Jolly Giant Creek for an AP Biology class project.
- Advisor to Watershed Stewards Program

Wilzbach
- Judged Humboldt County Science Fair
- Jacoby Creek Elementary School salmon presentation
- Evaluation of Salmonid Curriculum Project of CDFG/HSU

TECHNICAL ASSISTANCE

Duffy
- Continued to provide assistance to the Karuk Tribe regarding gold mining in streams.
- Provided assistance to the Department of Fish and Game in estimating mortality of juvenile salmon in downstream migrant traps and how mortality may be ameliorated.
- Provided assistance to the U. S. Congress in the form of a telephone interview about the status of salmon in the Klamath River and the restoration of salmon.
- Provided MOCC training for DOI staff and HSU students.

Wilzbach
- Continued to provide guidance to Plum Creek Timber Company, Oregon, in developing an aquatic monitoring program.
- Provided assistance to USFS in predicting impacts of Iron Gate Dam removal on habitat for polychaetes (intermediate hosts for salmon pathogens)

PAPERS AND PROPOSALS REVIEWED

Duffy
- Peer reviewer for articles submitted to the journal Fisheries (3) and North American Journal of Fisheries Management (1), and River Research and Applications (1).
- 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.
- Peer reviewer for Bureau of Reclamation aquatic research program.

Wilzbach
- Peer reviewer for articles submitted to the journals Transactions of the American Fisheries Society (1), North American Journal of Fisheries Management (1).
- Peer review prior to submission for USGS (1) and USFS (1).
- Proposal review for the National Sea Grant College Program (1).

PROFESSIONAL SOCIETY INVOLVEMENT

Duffy

- Member, American Fisheries Society
  - Member, Annual Meeting Arrangements Committee
  - Member, External Affairs Committee and Science for the General Public sub-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 Robert Kendall Award for Best Paper Selection Committee
- Member, Coastal Cutthroat Trout Symposium and WD Scholarship Committee
- Member, Ecological Society of America
- Member, North American Benthological Society
- Member, International Limnological Society

PUBLICATIONS AND PRESENTATIONS

SCIENTIFIC PUBLICATIONS

Bell, E., and W.G. Duffy. 2007. Previously undocumented two-year freshwater residency of juvenile coho salmon in Prairie Creek, California. Transactions of the American Fisheries Society. 136:966-970.

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

Duffy, W.G., and E.P. Bjorkstedt. Demographics of coastal cutthroat trout, *Oncorhynchus clarki clarki*, in Prairie Creek, California. Pages __ - __ In: P.J. Connolly, T.H. Williams and R.E. Greswell editors. Coastal cutthroat trout symposium: biology, status, management and conservation. Proceedings of a symposium, Fort Worden State Park, Washington, 29 September – 1 October 2005. In Press.

Duffy, W.G. and S. N. Kahara. Response of freshwater wetland ecosystems to USDA farm conservation practices in California's Central Valley. Ecological Applications, In Press.

Euliss, N.H., Jr., L.M. Smith, S. Liu, W.G. Duffy, S.P. Faulkner, R.A. Gleason and S.D. Eckles. Integrating estimates of ecosystem services from conservation programs and practices into models for decision makers: The vision for CEAP Wetlands. Ecological Applications, In Press.

Frazey, S. L. and M. A. Wilzbach. 2007. The relationship between productivities of salmonids and forest stands in northern California watersheds. Western Journal of Applied Forestry 22 (2) 2007:73-80.

Mull, K. E. and M. A. Wilzbach. 2007. Selection of spawning sites by coho salmon in a northern California stream. North American Journal of Fisheries Management 27:1343-1354.

Williams, T. H., B. C. Spence, W.G. Duffy, D. Hillemeier, G. Kautsky, T. Lisle, M. McCain, T. Nickelson, G. Garman, E. Mora, and T. Pearson. Framework for assessing viability of threatened coho salmon in the Southern Oregon/Northern California Coast Evolutionarily Significant Unit. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-SWFSC, In Press.

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

PAPERS PRESENTED

Ashenfelter, M. J. and M. A. Wilzbach. 2007. Movement of resident trout transplanted below a barrier to anadromy. Annual Meeting of the American Fisheries Society, San Francisco, CA, September 2007.

Bjorkstedt, E. P., B. C. Spence, T. H. Williams, W. G. Duffy, D. Fuller, J. C. Garza, D. Hankin, D. Hillemeier, W. Jones, G. Kautsky, T. Lisle, R. Macedo, M. McCain, M. Rode, J. Smith, R. G. Szerlong, R. Schick, T. Pearson, E. Mora, M. Goslin and A. Agrawal. 2007. Historical population structure of ESA-listed Pacific salmonids in the Southern Oregon/Northern California Coast and North-Central California Coast recovery domains. 137th Annual Meeting, American Fisheries Society, San Francisco, CA, September 2007.

Colombano, P. A. and W. G. Duffy. 2007. Response of coastal steelhead streams to fire disturbance. 28th Annual Meeting, Pacific Ecology and Evolution Conference, University of Washington Pack Experimental Forest, WA, March 2007.

Colombano, P. A. and W. G. Duffy. 2007. Response of coastal steelhead streams to fire disturbance. 137th Annual Meeting, American Fisheries Society, San Francisco, CA, September 2007.

DeYoung, C. J. and M. A. Wilzbach. 2007. Effects of turbidity on foraging efficiency and growth of salmonids in natural settings. Annual Meeting, Oregon Chapter, American Fisheries Society, Eugene, OR, February 2007.

Duffy, W. G. 2007. Fish in wetlands: the good, the bad and the ugly. Workshop on Wetland Assessment in California, USDA-NRCS, Davis, CA, March 2007.

Duffy, W.G. 2007. Influence of Wetlands Reserve Program on California. Annual Meeting, Society of Soil and Water Conservation, Tampa, FL, June 2007. [INVITED]

Duffy, W. G. 2007. Life history of anadromous fishes in California and their habitat requirements. Annual Meeting, Licensed California Foresters Association, Redding, CA, October 2007. [INVITED]

Duffy, W. G. 2008. Mortality of juvenile salmon associated with downstream migrant traps: a concern for monitoring. Annual Meeting, California/Nevada Chapter, American Fisheries Society, Lake Tahoe, CA, April 2008. [PRESENTED]

Duffy, W. G. 2008. Influence of freshwater habitat quality on coho salmon populations: evidence from nine years of investigations in Redwood National Park. Aquatic Resources in Redwood Creek. Redwood National Park, Orick, CA, April 2008. [INVITED]

Duffy, W.G. 2008. Response of wetlands in California's Central Valley to global change. Annual Meeting Society of Wetland Scientists, Washington, D.C., May 2008. [INVITED]

Euliss, N. H., L. M. Smith, W. G. Duffy and S. Faulkner. 2007. Beyond CEAP: Integrating delivery of concurrent goods and services attributable to conservation programs into models for decision makers to evaluate ecological change. Annual Meeting, Society of Soil and Water Conservation, Tampa, FL, June 2007.

Justice, C., and W. G. Duffy. 2007. Response of juvenile salmonids to placement of large woody debris in California coastal streams. 43rd Annual Meeting, Oregon Chapter, American Fisheries Society, Eugene, OR, February 2007.

Harvey, B. C. and M. A. Wilzbach. 2007. Carcass addition fails to affect abundance and growth of resident salmonids in northern California streams. Annual Meeting of the American Fisheries Society, San Francisco, CA, September 2007.

Kahara, S. K. and W. G. Duffy. 2008. Ecosystem services influence of USDA farm conservation practices on wetlands in California's Central Valley. Annual Meeting Society of Wetland Scientists, Washington, D.C., May 2008. [INVITED]

McLaughlin, K. D. and W.G. Duffy. 2007. Condition of juvenile steelhead in northern California streams. 137th Annual Meeting, American Fisheries Society, San Francisco, CA, September 2007.

Meaders, M. D. and G. L. Hendrickson. 2007. Manayunkia speciosa and Ceratomyxa shasta. Klamath River Fish Health Conference, Fortuna, CA, January 2007.

Mull, K. E. and M. A. Wilzbach. 2007. Selection of spawning sites by coho salmon in Freshwater Creek, California. Annual Meeting of the American Fisheries Society, San Francisco, CA, September 2007.

Naman, S. W. and M. A. Wilzbach. 2007. Predation by hatchery-reared steelhead on natural salmonid fry in the upper Trinity River, California. Annual Meeting of the American Fisheries Society, San Francisco, CA, September 2007.

Wilzbach, M. A. 2007. Should deep, dark, and dense riparian canopy coverage be the target for salmonid fishes? Symposium on Forestry and Anadromy in California, sponsored by the California Licensed Foresters Association, Redding, CA, October 2007.

Wilzbach, M. A., K. W. Cummins, S. Willson, M. Yost, and D. Malakauskas. 2007. Field and lab studies on the distribution and ecology of Manayunkia speciosa. Klamath River Fish Health Conference, Fortuna, CA. January 2007.

Wright, K. A. and W. G. Duffy. 2007. Monitoring Chinook and coho salmon escapement in Prairie Creek, California. 28th Annual Meeting, Pacific Ecology and Evolution Conference, University of Washington Pack Experimental Forest, WA. March 2007.

Wright, K.A., and W.G. Duffy. 2007. Escapement estimation of adult coho and Chinook salmon in Prairie Creek, California. 137th Annual Meeting, American Fisheries Society, San Francisco, CA, September 2007.

THESES

Beesley, S. B. 2006. Secondary production of *Paraleptophlebia* (Ephemeroptera) within three northern California coastal streams. M. S. Thesis, Humboldt State Univ., Arcata, CA. 59 pp.

DeYoung, C. 2007. Effects of turbidity on foraging efficiency and growth of salmonids in natural settings. M. S. Thesis, Humboldt State Univ., Arcata, CA. 58 pp.

Feola, J. E. 2007. Environmental variables influencing downstream migration of juvenile coho salmon (*Oncorhynchus kisutch*) in three northern California streams. M. S. Thesis, Humboldt State Univ., Arcata, CA. 82 pp.

Gonzales, E. J. 2006. Diet and prey consumption of juvenile coho salmon (*Oncorhynchus kisutch*) in three northern California streams. M. S. Thesis, Humboldt State Univ., Arcata, CA. 66 pp.

Justice, C. 2007. Response of juvenile salmonids to placement of large woody debris in California coastal streams. M. S. Thesis, Humboldt State Univ., Arcata, CA. 121 pp.

Matousek, J. 2007. Predicting prey availability for stream salmonids. M. S. Thesis, Humboldt State Univ., Arcata, CA. 44 pp.

Ransom, B. O. 2007. Extended freshwater rearing of juvenile coho salmonids (*Oncorhynchus kisutch*) in northern California streams. M. S. Thesis, Humboldt State Univ., Arcata, CA. 72 pp.