

California Cooperative Fish & Wildlife Research Unit



"Plovers" from an original Serigraph 14"x 30", # 37, 2004.
John Wesa is a well-known Humboldt County artist who
has been collected both nationally and internationally.
www.wesaart.com

2014 Coordinating Meeting
June 11, 2014
Humboldt State University

Table of Contents

Agenda.....	3
2013 Coordinating Committee Meeting Minutes.....	5
Review of Projects Completed in 2013	
Monitoring the endangered Tidewater Goby (<i>Eucyclobius Newberry</i>) using eDNA in water samples: Assay development and field survey design (RWO 86).....	11
Redwood Creek juvenile salmonid (smolt) abundance projects 2009 – 2014.....	11
Estimating Salmon and Steelhead escapement to Redwood Creek using a DIDSON imaging system.....	13
Prairie Creek juvenile salmonid (smolt) abundance project YR 2013.....	13
Prairie Creek sub-basin life cycle abundance project.....	14
Habitat use, movement & survival of juvenile Coho Salmon in the Shasta River.....	15
Review of Current Research Projects	
Assessing the benefits of USDA conservation programs in the Upper Klamath River Basin & Central Valley of California on ecosystem services (RWO 84).....	17
Evaluating grassland and wetland ecosystems in the Northern Great Plains (RWO 85).....	18
Gene flow and hybridization of Coastal Cutthroat trout with Steelhead across sub-basins of the Smith River, California.....	20
Genetic Analysis of Tidewater Goby tissue samples by HSU COOP Unit (RWO 83).....	22
Distribution and relative abundance of juvenile Coho Salmon in the Redwood Creek basin, Humboldt County, California.....	22
Feeding and growth opportunities for juvenile Coho Salmon and Steelhead in Dry Creek, California.....	23
Habitat specific growth, movement and survival of juvenile Coho Salmon in five northern California streams.....	24
Lower and Upper Redwood Creek juvenile salmonid (smolt) abundance.....	26
Prairie Creek juvenile salmonid (smolt) abundance.....	27
Review of New Research Projects	
Redwood Creek life cycle monitoring (adult Steelhead escapement) – DIDSON 2013-15.....	29
Redwood Creek life cycle monitoring (adult Steelhead escapement) – DIDSON 2015-17.....	29
Prairie Creek Fisheries and Aquatic Ecosystem Synthesis.....	30
Phase II: Monitoring the endangered Tidewater Goby using environmental DNA in water samples: Field tests.....	31
Unit Program Review	
Program Direction.....	33
Service and Teaching.....	33
Other University Service.....	34
Theses of Unit Sponsored Graduate Students.....	34
Presentations.....	34
Technical Assistance.....	36
Scientific Publications.....	36
Unit Students and Staff.....	37

California Cooperative Fish & Wildlife Research Unit 2014 Coordinating Meeting

June 11, 2014

Humboldt State University, Behavioral & Social Sciences Building, room 508

AGENDA

Introductions and Welcome (Chair, Joe Margraf)	9:00
Additions to the Agenda	
Approval of 2013 Meeting Minutes	
Cooperator Reports and Research Needs	9:15
Each Cooperator is given the opportunity to speak about current issues and research needs within their organization as they relate to the mission and operation of the Cooperative Research Unit.	
Unit Research Summary	
Completed Projects Review (Wilzbach)	11:15
Lunch catered	11:45
Unit Research Summary (continued)	
Research Presentation (Sam Rizza)	1:00
Current Research Projects Review (Wilzbach)	1:45
New Research Projects (Wilzbach)	2:00
Unit Program Review	2:30
Cooperative Agreement and Program Direction	
University Service and Technical Assistance	
Accomplishments	
Facilities and Equipment	
Financial Status	
Adjourn	3:00

California Cooperative Fish & Wildlife Research Unit
2013 Coordinating Committee Meeting Minutes
Wednesday, May 14, 2013

The annual coordinating meeting was held at Humboldt State University, 1 Harpst Street, Arcata, California. The meeting began at 9:10 am and concluded at 3:15 pm.

In attendance:

Russ Bellmer, CDFW-Sacramento

Walt Duffy, Unit Leader, CA Cooperative Fish & Wildlife Research Unit

Leslie Farrar, CA Cooperative Fish & Wildlife Research Unit

David Hankin, HSU-Fisheries Department

Nick Hetrick, USFWS, Arcata

Matt Johnson, HSU - Wildlife Department

Joe Margraf, USGS Western Region

Tancy Moore, CA Cooperative Fish & Wildlife Research Unit

Steven Smith, HSU - CNRS

Nick Som, USFWS - Arcata

Peggy Wilzbach, Assistant Unit Leader, CA Cooperative Fish & Wildlife Research Unit

Rick Zechman, HSU - CNRS

Joe Margraf served as chair and opened the meeting. The agenda was reviewed and a change was requested to discuss membership funding and to add a cooperator's meeting immediately following the main meeting. Minutes of the 2012 meeting were reviewed and approved with no additions or changes.

COOPERATOR REPORTS

Report from Russ Bellmer, CDFW-Sacramento

- The department is investigating automating all salmonid monitoring, from data entry to report, with DIDSON's which are deployed in California.
- Official name of the department was changed to California Department of Fish and Wildlife as of January 1, 2013.
- Council on Ocean Affairs, Science and Technology (COAST) internship program (see: http://www.calstate.edu/coast/funding/internships/student_Intern_2013_rfa.shtml) had six positions located geographically from Los Angeles to Fort Bragg. One HSU student was placed for this summer. These internships are paid a stipend of \$1,500/month. Russ encourages HSU students to apply and has submitted paperwork to make CDFW more of a partner in the program which would increase the amount of funding awarded to \$4,000 – \$4,500 in the future. Program would like to expand beyond the summer, but it will depend upon more funding. The program is intended for undergraduate and graduate students in Wildlife and Fisheries. This year 4 undergraduate and 2 graduate internships were awarded. The program is advertised through the CSU system. The program has produced employees for CDFW resulting in hires of two scientific aides and two permanent employees.
- Fisheries Restoration Grant Program (FRGP) <http://www.dfg.ca.gov/fish/Administration/Grants/FRGP/> opens February 1, 2014 for six weeks. Early submission of proposals is advised due to anticipated high demand.
- Contract is in place for the Coop Unit with funding sources coming from three different programs: Coho, Trout and Wildlife.
- Research needs: a copy of "California Coho Salmon Recovery Research Needs" was shared with group. National Marine Fisheries is pushing to include fish above barriers in listings. Another need is for wide ranging watershed/habitat/ecological monitoring to assess population benefit to large watershed changes; department wants to invest \$ for largest return. Fish restoration project benefits have included the introduction of beavers. Department is having difficulty keeping match with use of federal funds. Joe Margraf explained that the difference between the overhead the SPF charges the Coop Unit and the federally negotiated rate can be claimed as match.
- Scientific permitting fees have been increased to bring program into self-sufficiency resulting in separate application and permit fees. Changes have been implemented regarding native resources and handling fish which is likely to affect consulting firms more than academic research.

Report from Steve Smith, HSU-CNRS

- Budget: The passage of Prop 30 helped the budget so that cuts will not have to be made this year. Strong student interest continues in the natural resources programs; this challenges our ability to provide enough seats to meet students demand. Fisheries

program is showing decline in students majoring in the program. This is not following the national trend. Graduation rates are going to be tied to funding for the CSU; four year graduation rates need to be increased by 10% by 2016-17. HSU requires 120 units to graduate with many of our students having many more than that when they graduate.

- Distance education: OSU has complete majors available in wildlife and fisheries on-line. Concerns regarding training and practical experience in these majors was discussed. The new chancellor is a proponent of on-line education.
- Enrollment growth in majors in CNRS is up over 35% in the past 5 years and is increasing faster than enrollment in the other two colleges. Measures are underway to manage increased enrollment in 2014, especially in Wildlife, Engineering and Biology programs, including setting a target for students that declare one of these as a major, resulting in a more competitive process being developed in upper division transfer students.

Report from Dave Hankin, HSU-Fisheries Department

- Not certain why the Fisheries program is slowing down but thinks that it may be a recruitment problem. In the past up to 70% were transfer students. The department has plans to work with the CNRS recruiter.
- There have been two retirements in the department as faculty and at the fish hatchery. Three faculty are in the faculty early retirement program (FERP). A search for a replacement for a faculty member failed and a new search will be initiated in the fall for a combined aquaculture/fish biology background. A new hatchery manager has been hired. A search for a marine lab director is currently in process.
- Marine Life Protection Area (MLPA) proposals are underway. The funding amounts to \$4 million for the North Coast region for monitoring; proposals are due mid-August.

Report from Matt Johnson, HSU - Wildlife Department

- Wildlife majors are up 65% in enrollment over the past five years with 440 - 450 majors. This is about twice the size of UC Davis Fisheries and Wildlife combined. There are only two BS programs in Wildlife in the state. Program will be implementing measures to manage the growth over time. The Wildlife Society holds a meeting annually which hosts a quiz bowl in which HSU students have won the competition 9 out of the last 12 years at the national level. Wildlife graduates have solid job placement from the program; about half of these are with state and federal agencies. About 100 students graduate from the program annually. There are two tracks within the program, one geared more towards graduate school and the other for more traditional wildlife management careers.
- Wildlife has seven tenure track positions in the department and had two retirements which were replaced with a quantitative population modeler and a GIS species distribution modeler. The department will be revising curriculum to include some GIS training for their students.

- On-line education is something the department is keenly aware of and has been working to articulate a firmer stance to include the changes in higher education. There is interest in pursuing on-line education while retaining strengths in educating students in the field. Engagement is important and the department would like to extend the engagement piece including offering courses for high school students to get them interested in the program, which could be important recruitment/education tool. There is interest in expanding the model to support students to meet the state and nation's need, with attention in expanding into herpetology/conservation biology and sea bird ecology. Graduate program is usually 35 - 50 graduate students at a time, but is currently a little lower than this with recent faculty retirements. Course offerings appear well complemented to meet student's needs.

Report from Nick Hetrick, USFWS-Arcata

- Nancy Finley, Arcata office supervisor, took another position out of state. The Arcata office is one of four in the Klamath Basin: Yreka, which deals primarily with endangered species and wildlife habitat restoration; Klamath Falls, an ecological services office that deals with sucker issues and the National Wildlife Refuge. The Arcata office is tied to Trinity River restoration jointly with BLM, with roots deep in fisheries and having close ties to HSU. There have been a series of acting field supervisors and some retirements of staff that have moved to other agencies. The federal hiring freeze that is part of sequestration has required using a waiver system to hire a new field supervisor.
- The draft budget is in place for FY 2013. Fisheries took 14% cut and ecological services 21% cut which resulted in no refill of positions or contracts, purchases, travel. Next year is projected to have another budget cut. Cuts are usually at the regional and national levels, but funding has been cut to pay salaries so that furloughs can be avoided.
- Most research projects involve partnering with the tribes of Klamath Basin with a few exceptions. The USFWS provides technical support, equipment, training and report writing. The office is working on redd and carcass surveys to estimate escapement and distribution of wild Salmon stocks in the Trinity River and to evaluate restoration activities. Studies of juvenile Salmon out-migrants are also underway on the Trinity, Klamath, and the Mattole rivers. The office is helping to write investigation plans and reviewing some of their work. The dataset includes 17 years of estimates of juvenile out-migrant abundance, from the Trinity, and 7 - 8 years of estimates from the Klamath. The office did not have the ability to generate the estimates until new software was obtained. They are working on a collaborative model development of Stream Salmonid Simulator (S3) and will use the model to help make decisions managing flows, in-stream flows and predicting the effects of disease.
- A large Salmon escapement to the Klamath is expected this year, and low flows this year could lead to another potential adult fish die off as happened in 2002. Declines in available habitat, coupled with increasing water temperatures suggest a strong potential for juvenile die-off as well. They are expecting additional flow releases from the Trinity to augment the lower Klamath River to avert another fish kill and are on alert for juvenile die-off potential.

- Disease monitoring of both juvenile and adult Salmon is a big focus of the office. They are involved in habitat flow studies primarily on the Trinity but also on the Klamath, and are collaborating with OSU on polychaete studies. Flows are planned to be set at 1,150 cfs for the foreseeable future; this sets the stage for benthic monoculture. Hatchery review will be left to entities who run the hatcheries to implement recommendations given. Current in-stream flow studies on Shasta and Scott rivers will receive media attention in the coming months.
- Future research needs include evaluation of environmental effects from marijuana grows in all of the basins, particularly with respect to water issues and impacts on fish and wildlife. USFWS is interested in the potential HSU faculty hire regarding the aquaculture aspect especially if the position includes a disease component. They currently work with OSU, but would prefer to diversify perspectives.
- Scientific permit process has improved through CDFW; an entity collection permit may simplify process. A risk is that one individual could cause a problem for the entire group and result in a revoked permit.

Report from Nick Som, USFWS - Arcata

- Currently working on habitat suitability for redds and juvenile habitat use in the Trinity. They are collecting data using new techniques that allow the ability to refine the density part of juvenile fish use; their work is associated with the fish production modeling.

Report from Joe Margraf, USGS

- Chris Smith from the Wildlife Management Institute is unable to attend this year but plans on attending next year's meeting. WMI has had retirements over the past few years, but have rehired and have a full complement of staff. They are a good resource for lobbying as a NGO.
- Federal budget: The USGS is operating under a hiring freeze and there are several vacant Coop positions that are affected by this. There is hope that next year with a new fiscal year that this will be resolved although this is the third year of continuing resolutions and could well be the case for next year. Suzette Kimball is the acting director of the USGS. The new Secretary of the Interior, Sally Jewell, has a background in energy financing. Marsha McNutt left as director of USGS and no replacement for that position has been announced yet. Cooperative Research Unit scientists should expect furlough notices any time now. Restrictions have been put into place for travel (mission critical only), for research and meeting with partners only. All travel was suspended in April and May and forward from May will be under an approval process with an expected approval rate of about 50%.
- Ken Williams has retired and has taken a position with the Wildlife Society where he will continue to support the Cooperative Research Units. Kevin Whalen is acting as chief for 120 days. The position has not yet been advertised due to sequestration and it is uncertain what will happen after the 120 day period. Joe has been elected to VP of American Fisheries Society which requires five years of service. Walt has announced his retirement for February 2013. There may be many more retirements from the

cooperative units coming soon. The priority is to replace unit leader positions first. Peggy will likely be acting leader if a unit leader is not hired when Walt retires.

- Coop Units are maintaining their three general areas of initiatives: 1. Fostering trans-boundary research; 2. Structured decision making/adaptive resource management initiative; and 3. Affirmative action programs.

Review of current, completed projects and review of new projects

Walt Duffy and Peggy Wilzbach reviewed the current projects completed in the last year as well as ongoing projects, and introduced five new research projects to be approved:

New project review:

1. Distribution and relative abundance of juvenile Coho Salmon in the Redwood Creek basin, Humboldt County, California
2. Feeding and growth opportunities for juvenile Coho Salmon and Steelhead in Dry Creek, California
3. Functional assessment of riparian/wetland communities in the Whiskeytown National Recreational Area
4. Habitat specific growth, movement and survival of juvenile Coho Salmon in five northern California streams
5. Lower and Upper Redwood Creek juvenile salmonid (smolt) abundance
6. Monitoring endangered Tidewater Goby using water samples (RWO 86)
7. Prairie Creek juvenile salmonid (smolt) abundance
8. Water sustainability and climate in the upper Klamath River basin

Joe Margraf nominated to approve the projects unanimously as described. All approved.

UNIT RESEARCH SUMMARY

Tancy Moore, Fisheries Biology master's student, presented on "Overwinter survival and redistribution of juvenile Coho Salmon in Prairie Creek, California" a portion of her research in preparation for her master's thesis project.

2014 ANNUAL COORDINATING MEETING

Next year's meeting was set for Tuesday, May 13, 2014 via email after the meeting.

CLOSING

Joe Margraf motioned for the meeting to be adjourned. Russ Bellmer seconded. The meeting was adjourned at 3:15 pm.

REVIEW OF PROJECTS COMPLETED IN 2013

MONITORING ENDANGERED TIDEWATER GOBY USING ENVIRONMENTAL DNA IN WATER SAMPLES (RWO 86)

Investigators: Dr. Andrew P. Kinziger
Molly Schmelze, MS Student
Duration: December 2012 to December 2013
Funding: U.S. Fish & Wildlife Service (\$23,550)



Tidewater Goby (Eucyclogobius newberryi)

The recovery plan for the endangered Tidewater Goby calls for the development of standardized survey methods for monitoring the presence/absence of isolated populations throughout the geographic distribution of the species. The objective of this proposal was to assess the potential of using environmental DNA (eDNA) in water samples as a tool for determining the presence/absence of the endangered Tidewater Goby in lagoon and bay

habitats in northern California. eDNA is a noninvasive technique that has been successfully applied to a broad range of taxonomic groups, including fishes, and is sometimes less expensive than traditional field monitoring approaches. Studies have shown environmental DNA can closely track presence/absence even when species occur at low levels of abundance and can be useful for monitoring species that cannot be detected using conventional field approaches. However, insufficient testing has been conducted to determine the suitability of eDNA approaches for monitoring Tidewater Goby. In this report we deliver: (1) laboratory assays that can be used for determining presence or absence of Tidewater Goby eDNA in water samples, and (2) a field survey design for instituting a monitoring program for tracking presence/absence within isolated habitat units in northern California that was designed to specifically account for imperfect detection. Thus we are now poised to employ eDNA approaches to monitoring Tidewater Goby presence/absence at field sites in Del Norte, Humboldt, and Mendocino counties.

REDWOOD CREEK JUVENILE SALMONID (SMOLT) ABUNDANCE PROJECTS 2009-2014

Investigators: Dr. Walter Duffy, CACFWRU
Michael Sparkman, CDFW
Lower RC Funding: California Department of Fish and Wildlife/FRGP (\$261,577)
Duration: June 2009 to March 2014
Upper RC Funding: California Department of Fish and Wildlife/FRGP (\$166,835)
Duration: June 2009 to March 2014

The Fisheries Restoration Grant Program funded these two projects to continue gathering long-term status and trends data on Salmon and Steelhead smolt production from upper and lower Redwood Creek. Baseline and status/trends of anadromous Salmonid populations (smolts) migrating through Lower Redwood Creek and Upper Redwood Creek were monitored each year in relation to physical conditions in Redwood Creek. Smolt population abundances for juveniles emigrating from upper-middle Redwood Creek for estimated for the 8th, 9th, and 10th consecutive year, and these data were added to the existing database. We used a rotary screw trap to capture downstream migrating smolts, and mark/recapture techniques to determine population abundances for: 0+ Chinook Salmon, 1+ and 2+ Steelhead Trout, and aged-1 and older Cutthroat Trout. Modified rotary screw traps were deployed in April and operated continuously until mid-August each year. Population estimates (weekly and seasonal) were determined using multiple trap efficiency trials.

Results are detailed in the following reports:

Lower Redwood Creek:

Sparkman, MD. 2014. Lower Redwood Creek juvenile salmonid (smolt) abundance project, study year 2013: a report to the Fisheries Restoration Grants Program (Project. No. 0810509) . CDFW AFRAMP, 2a5: 85 p. 50 Ericson Court, Arcata, CA. 95521.

Sparkman, MD. 2013. Lower Redwood Creek juvenile salmonid (smolt) abundance project, study year 2012: a report to the Fisheries Restoration Grants Program (Project. No. 0810509) . CDFW AFRAMP, 2a5: 78 p. 50 Ericson Court, Arcata, CA. 95521.

Sparkman, MD. 2012. Lower Redwood Creek juvenile salmonid (smolt) abundance project, study year 2011: a report to the Fisheries Restoration Grants Program (Project. No. 0810509) . CDFW AFRAMP, 2a5: 81 p. 50 Ericson Court, Arcata, CA. 95521.

Upper Redwood Creek:

Sparkman, MD. 2014. Upper Redwood Creek juvenile salmonid (smolt) abundance project, study year 2013: a report to the Fisheries Restoration Grants Program (Project. No. 0910529_01) . CDFW AFRAMP, 2a5: 74 p. 50 Ericson Court, Arcata, CA. 95521.

Sparkman, MD. 2013. Upper Redwood Creek juvenile salmonid (smolt) abundance project, study year 2012: a report to the Fisheries Restoration Grants Program (Project. No. 0910529_01) . CDFW AFRAMP, 2a5: 66 p. 50 Ericson Court, Arcata, CA. 95521.

Sparkman, MD. 2012. Upper Redwood Creek juvenile salmonid (smolt) abundance project, study year 2011: a report to the Fisheries Restoration Grants Program (Project. No. 0910529_01) . CDFW AFRAMP, 2a5: 63 p. 50 Ericson Court, Arcata, CA. 95521.

ESTIMATING SALMON AND STEELHEAD ESCAPEMENT TO REDWOOD CREEK USING A DUAL FREQUENCY IDENTIFICATION SONAR (DIDSON) IMAGING SYSTEM

Investigators: Dr. Walter Duffy, CACFWRU
Matthew Metheny, MS Student
Duration: April 2011 to March 2013
Funding: California Department of Fish and Wildlife/FRGP (\$60,197)

Dual frequency identification SONAR (DIDSON) was used to estimate an escapement of 5,479 (+/- 637) adult salmonids entering Redwood Creek to spawn between October 22, 2012 and March 18, 2013. Observations from California Department of Fish and Wildlife spawning surveys in the basin as well as snorkel surveys were used to model species apportionment of

the DIDSON counts. Of the 5,479 fish passing the DIDSON, 747 were estimated as Coho Salmon, 3,401 as Chinook Salmon, and 1,331 as Steelhead.



Matt Metheny standing by DIDSON unit

Results are described in: Duffy, W. and M. Metheny. 2013. Sonar estimation of adult Salmonid abundance in Redwood creek, Humboldt County, California 2009 - 2013: a report to the Fisheries Restoration Grants Program (Project P1010301). Matt gave an oral presentation on DIDSON use in Redwood Creek at the Annual Conference of the California-Nevada Chapter of the American Fisheries Society in Sacramento, California in March 2014.

PRAIRIE CREEK JUVENILE SALMONID (SMOLT) ABUNDANCE PROJECT YR 2013

Investigators: Drs. Margaret Wilzbach and Walter Duffy, CACFWRU
Tancy Moore, MS Student
Duration: March 2013 to March 2014
Funding: California Department of Fish and Wildlife/FRGP (\$14,548)

This project provided personnel support for the collection of baseline and short term data on monitoring of Steelhead, Coho Salmon, and Chinook Salmon smolts in Prairie Creek during the period March 26, 2013 – March 31, 2014. During the project period, student and non-student technicians employed under the contract periodically replaced batteries powering 2 PIT tag antennae arrays in the creek through fall of 2013, and contributed to monitoring downstream migration of juvenile salmon in Prairie Creek through August 13, 2013. The trap and associated equipment were then removed, and data were entered and edited. Seining was conducted in the Prairie Creek basin in two sampling efforts during fall 2013 to collect and tag young-of-the-year Coho Salmon to allow estimation of overwinter survival and tagging mortality of the fish during the winter of 2013 - 2014.

Project data were incorporated into the summarization of juvenile salmonid monitoring in Prairie Creek for the 2011 – 2013 sampling years, and are presented in: Wilzbach, M. and W. Duffy. 2014. Prairie Creek Juvenile salmonid (Smolt) Abundance Project YR 2013. Report to the Fisheries Restoration Grants Program (Project P1281015).

PRAIRIE CREEK SUB-BASIN LIFE CYCLE MONITORING PROJECT

Investigators: Dr. Walter Duffy, CACFWRU
Tancy Moore, MS Student
Duration: April 2011 to March 2014
Funding: California Department of Fish and Wildlife/FRGP (\$194,221)

Objectives of this project were to: 1) examine the importance of the unmonitored lower reaches of Prairie Creek to overwintering juvenile Coho Salmon; 2) compare overwinter growth rates, survival, and outmigration timing of juvenile Coho Salmon that overwinter in



Juvenile Coho Salmon (Onchorynchus kisutch)

Upper and Lower Prairie Creek; 3) monitor movement of juvenile Coho Salmon between Upper and Lower Prairie Creek throughout the winter and spring months; and 4) compare the age structure of juvenile Coho Salmon in Upper and Lower Prairie Creek.

During the summer of 2012, juvenile Coho Salmon (*Oncorhynchus kisutch*) in mainstem Prairie Creek and its tributaries were marked using PIT tags to monitor winter redistribution and estimate overwinter growth and survival. Since a substantial number of juvenile Coho Salmon in the Prairie Creek watershed may rear in freshwater for two years, a scale sample analysis was also conducted to determine what proportion of the 2012 population was exhibiting a two year freshwater residency. The Cormack-Jolly-Seber model and Program MARK were used to examine how rearing location, size at tagging, habitat unit depth, and volume of large woody debris affected overwinter survival. Nearly all juveniles in 2012 were found to be age 0, and apparent overwinter survival was 39.4%. On average, juveniles experienced a 0.13% increase in length per day and 0.35% increase in weight per day, with the smallest fish experiencing the highest growth rates. Fish that were larger in fall and tagged closer to the confluence of Prairie Creek had higher apparent overwinter survival, but habitat depth and quantity of large woody debris did not appear to impact survival probability. Large juveniles appeared to have low survival near the confluence of Prairie Creek; however, the model could not distinguish deaths from emigration, meaning the high mortality rate for large juveniles near the mouth may actually reflect a pattern of early emigration from the study area. Since juveniles that migrate to sea prior to spring trapping are typically treated as mortalities, these results have important implications for the way in which managers estimate freshwater survival for Coho Salmon.

Tancy Moore successfully defended her M.S. thesis in April 2014. Her finalized thesis will be available in pdf format on the Coop Unit website, and through the Humboldt State University Library. Project results are reported in Sparkman, M.D., W.G. Duffy and T.R. Moore. 2014. Prairie Creek Monitoring Project, 2011 - 2013 Seasons: a report to the Fisheries Restoration Grants Program (Project No. P01010302).

HABITAT USE, MOVEMENT, AND SURVIVAL OF JUVENILE COHO SALMON IN THE SHASTA RIVER

Investigators: Dr. Margaret Wilzbach, CACFWRU
Chris Adams, MS Student
Duration: September 2010 to July 30, 2013
Funding: California Trout, INC. (\$20,000)

Movement and survival of juvenile Coho Salmon (*Oncorhynchus kisutch*) were assessed at a watershed scale using PIT tags and a network of instream antennas in the Shasta River, a highly productive tributary of the Klamath River in interior northern California. Chris Adams developed and used a multi-state mark-recapture model to estimate apparent survival, movement, and detection probabilities of tagged juvenile Coho Salmon during the summer (May-October) and winter (November - March) periods in four segments of the upper Shasta River watershed in 2011 - 2012. Both upstream and downstream movements of age-0 Coho Salmon tagged in the upper Shasta River occurred in early summer. These included movements to rearing areas up to nine kilometers upstream, as well as outmigration from the Shasta River. Apparent survival estimates over the summer ranged from 0.40 (95%CI 0.22-0.61) to 0.74 (95%CI 0.54-0.88). Substantial redistribution among upper Shasta River rearing areas occurred in late fall. Apparent survival estimates over the winter ranged from 0.48 (95%CI 0.38-0.58) to 1.0. Reach-specific estimates of apparent survival were made for outmigrating age-1 smolts from the upper Shasta River to the Klamath River in the spring of 2012 using a Cormack-



Pit tag antennae in the upper Shasta River

Jolly-Seber mark-recapture model. Apparent survival of outmigrating smolts from Shasta River kilometer 46 to the Klamath River was 0.88 (95%CI 0.76-0.95). Juvenile Coho Salmon in the upper Shasta River displayed rapid growth rates, with young of the year reaching 100 mm fork length by their first June.

Research constituted the master's thesis research of Chris Adams, who defended his thesis in March 2013. Chris's thesis is available at: <http://humboldt-dspace.calstate.edu/xmlui/handle/2148/1641>.

REVIEW OF CURRENT RESEARCH PROJECTS

ASSESSING THE BENEFITS OF USDA CONSERVATION PROGRAMS IN THE UPPER KLAMATH RIVER BASIN & CENTRAL VALLEY OF CALIFORNIA ON ECOSYSTEM SERVICES (RWO 84)

Investigator: Dr. Walter Duffy, CACFWRU
Dr. Sharon Kahara, HSU Wildlife Dept.
PhD student, Rosemary Records, CSU
Duration: September 2011 to June 2015
Funding: USDA, Natural Resources Conservation Service (\$212,264)

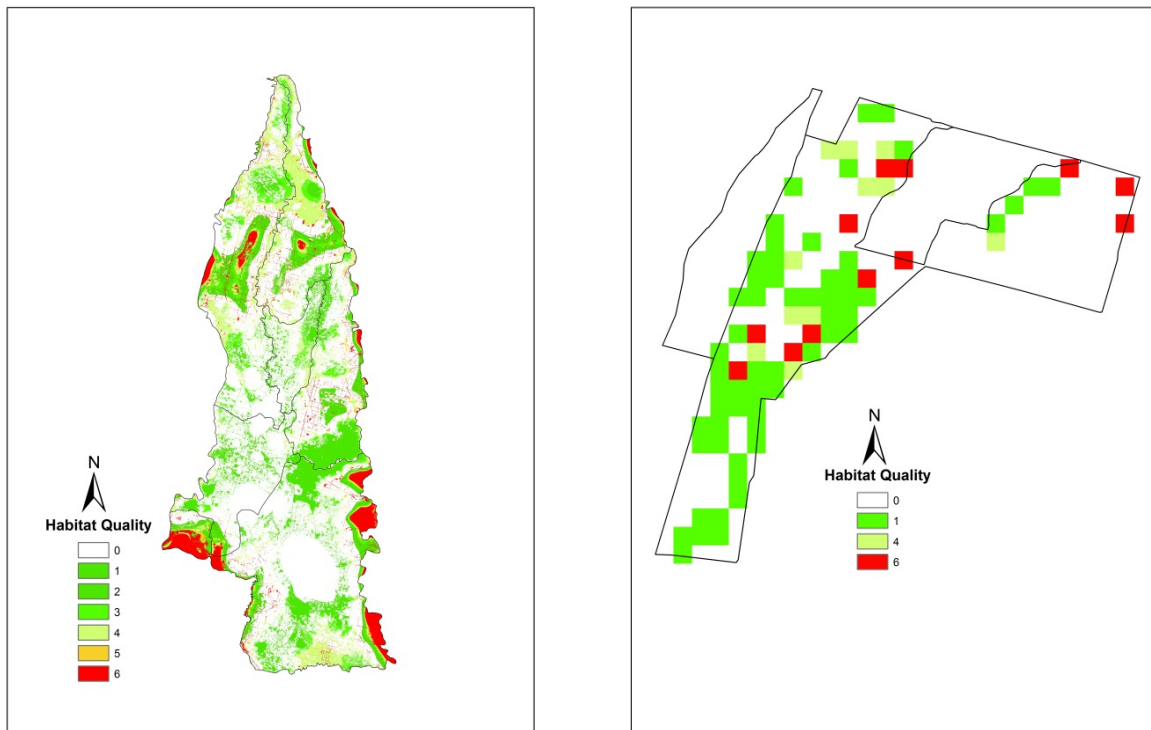
This research is part of the U.S. Geological Survey's Science Initiative, Integrated Landscape Monitoring (ILM) Initiative. This is an initiative to develop monitoring and modeling tools to evaluate the influence of U.S. Departments of Agriculture (USDA) and Interior conservation programs on diverse ecosystem services.

Objectives in this research are to: 1) prepare the necessary geospatial data layers (land use, land cover, soil type, precipitation, air temperature) needed for applying geospatial models in the Upper Klamath Basin and the Central Valley; 2) develop algorithms relating ecosystem services (amphibian habitat, waterfowl habitat, pollinator habitat, water storage) to geospatial data layers; and 3) evaluate the water quality benefit of USDA conservation programs in the Upper Klamath Basin and Central Valley.

Progress: In the past year, we calibrated and validated a SWAT (Soil and Water Assessment Tool) model of the Sprague River Basin and its three main tributaries (the North and South Forks of the Sprague River, and the Sycan River). We used the calibrated model to evaluate water quality benefits provided by wetlands in the Sprague River Basin under present conditions and six future climate scenarios for the 2040s. Additionally, we assessed potential effects of climate change alone on stream flow and water quality in the Sprague River, and the effects of climate in combination with hypothetical wetland losses. The scenarios show a range of warming and uncertainty in the sign of precipitation, which could change flows little or result in substantial winter increases. Wetland loss scenarios suggest that conservation of present-day wetlands is an important strategy for managing diffuse loads of total nitrogen and total phosphorus from the Sprague River to Upper Klamath Lake. The latter results were part of Rosemary Records' MS thesis, which was successfully defended in October 2013. The research has resulted in a manuscript accepted for discussion in Hydrology and Earth System Sciences (April 2014), as well as poster presentations at Colorado State University's annual Hydrology Days (March 2014) and the American Geophysical Union fall meetings (December 2013).

During the past year, we completed habitat quality models for waterfowl, upland birds and shorebirds in California's Central Valley. The models allow us to quantify available habitat to specified bird guilds (Figure 1). We are also in the process of preparing a manuscript for review based on field surveys conducted in 2008 - 2009. In the manuscript, we investigated

management intensity relative to climate and age of restored wetland habitats in California's Central Valley.



Habitat quality maps for waterfowl in A) the Sacramento sub-basin and B) one Wetland Reserve Program easement in California's Central Valley.

EVALUATING GRASSLAND AND WETLAND ECOSYSTEMS IN THE NORTHERN GREAT PLAINS (RWO 85)

Investigators: Dr. Walt Duffy, CACFWRU
Dr. Matt Johnson, Wildlife Department
Dr. Ned Euliss, Wildlife Department/USGS
Russ Bryant, MS Student

Duration: September 2011 – September 2015

Funding: U.S. Geological Survey (\$195,000)

The U.S. Geological Survey (USGS), Northern Prairie Wildlife Research Center (NPWRC) is engaged in an on-going research effort to better understand grassland, wetland, and riverine ecosystems and their associated biotic communities in the northern Great Plains (NGP). NPWRC's research programs specifically focus on identifying and understanding threats to NGP ecosystems and developing and evaluating conservation measures that abate those threats. The first phase of this research investigates native bee pollinators, land use and agricultural pesticides.

It is widely known but often ignored that pollinators are critical to sustain healthy ecosystems and prosperous human populations. However, a report on the Status of Pollinators in North America, combined with intense media coverage of honey bee colony collapses beginning in 2006, sparked a renewed and widespread interest in the role of honey and native bees in the pollination of agricultural crops, maintaining functioning ecosystems and enhancing biodiversity. Additionally, a recent report demonstrates that the need for pollination is on the increase at the same time that pollinator numbers and insect pollinated plants are declining. Agricultural practices, urban development, and fallow land-use practices have disrupted habitat for bees, both in terms of essential nutrition provided by forage and nesting sites,



Mite observed on a native bee

especially for native bees. Pesticides are a concomitant problem that can have detrimental effects on bees when they forage on contaminated flowers, and disease among bees can spread from external parasites. Healthy pollinator populations depend on landscapes that provide ample and nutritious sources of non-contaminated pollen and nectar-yielding flowers. However, no field studies have quantified the availability of specific flowers or cover types across the landscape or the influence these factors have on the health of thousands of native pollinators.

Objectives for this first phase of research are to:

1. evaluate and compare abundance and diversity of native pollinators within native prairie U.S. Fish & Wildlife Service (FWS) lands and Conservation Reserve Program (CRP) lands;
2. document foraging behavior, vegetation visited, and the pollen diet of native pollinator species;
3. document the seasonal changes in the vegetation community and pollinator populations; and
4. evaluate risk from agrichemical contamination of pollen on native prairie FWS lands and CRP lands.

Russ has completed the data collection and is beginning the data analysis. He has given oral presentations on his findings at the Western Section of the Wildlife Society 2014 Annual Meeting in Reno, Nevada, and at the 2014 Natural Capital Project Annual Meeting in Palo Alto, California.

GENE FLOW AND HYBRIDIZATION OF COASTAL CUTTHROAT TROUT WITH STEELHEAD ACROSS SUB-BASINS OF THE SMITH RIVER, CALIFORNIA

Investigators: Dr. Margaret Wilzbach, CACFWRU
Sam Rizza, MS Student
Duration: Jan 2013 to May 2015
Funding: California Department of Fish and Wildlife/Heritage and Wild Trout

Cutthroat Trout (*Oncorhynchus clarki*) and Rainbow Trout (*Oncorhynchus mykiss*) are believed to have diverged from a common ancestor nearly two million years ago, at the beginning of the Pleistocene. While most other subspecies of Cutthroat Trout dispersed further inland and subsequently evolved in isolation from Rainbow Trout, the Coastal Cutthroat (*O. clarki clarki*) coevolved with the coastal subspecies of Rainbow Trout, (*O. mykiss irideus*), or Steelhead, throughout its range from northern California to southern Alaska. While hybrids between Coastal Cutthroat Trout and Steelhead are fully fertile, reproductive isolation between them has been largely maintained over geologic time because of evolved differences in selection of spawning locations. Natural hybridization has been documented mostly in settings where habitat is limited and run-times overlap. Stocking of non-native hatchery Rainbow Trout and habitat disturbance, however, has increased the potential for hybridization.



Coastal cutthroat trout (*Oncorhynchus clarki clarki*)

Conservation of Coastal Cutthroat populations requires a reliable means of identifying the fish in the field when they co-occur with Steelhead or hybridized individuals, as fisheries management decisions are usually based on abundance estimates that rely heavily on visual identifications. Classification of morphologic characteristics paired with computer-aided morphologic analyses that compare body type with habitat preference have proven useful in differentiating species among assemblages of juvenile Coastal Cutthroat Trout, Steelhead, and their hybrids. Statistical classification models have primarily been used on juveniles, a life stage where phenotypic traits are most similar among the fishes. This study will focus on adult stages and attempt to define hybrid phenotypic characteristics from adult Cutthroat Trout and Steelhead to improve field identification.

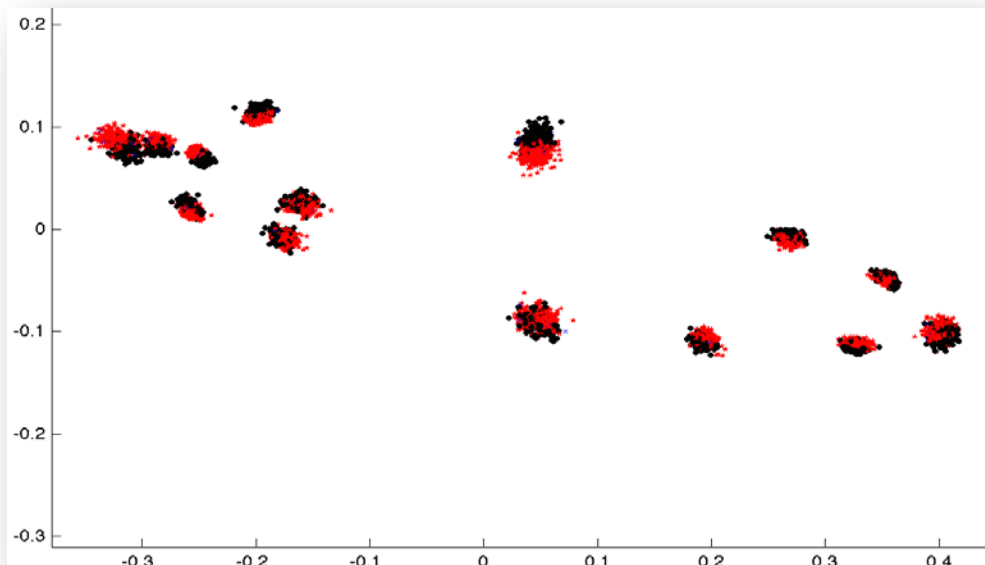
Objectives of this study are to:

1. determine incidence of hybridization between Coastal Cutthroat Trout and Steelhead in the Smith River, and assess Cutthroat Trout gene flow among its 7 sub-basins. Fish will be captured by hook and line, measured and photographed, and tissue and scale samples will be collected. Genetic analyses of tissue samples will be conducted in the NOAA Southwest Fisheries Science Center in Santa Cruz;

2. create a classification model to estimate species identity in the sub-basins from phenotypic characteristics following methods of Rohlf (2001);
3. establish the field identification error rate of adult Cutthroat Trout, Steelhead, and their hybrids from genetic analysis and the classification model.

During the summer of 2013, 888 putative Coastal Cutthroat Trout, Steelhead, and their hybrids were sampled in each of the seven sub-basins. Tissue samples were collected from all individuals and sent to the NOAA genetics lab in Santa Cruz. PCR (polymerase chain reaction) extractions have been made and SNP (single nucleotide polymorphism) genotyping is scheduled for May 2014.

Photographs from 580 individuals were included in the morphometric analysis. Photographs were dropped from the analysis if they were blurry, taken from angle other than directly above, or the fish was not positioned correctly. The software tpsDIG2 was used to place 14 landmarks on each photo. Based on multiple morphometric software programs and packages (MorphoJ, IMP8, and R: geomorph) morphological differences were found between putative Coastal Cutthroat Trout and Steelhead. Once genotypes are assigned and if a sufficient number of individuals are determined to be hybrids, we will attempt to define a hybrid morphology, which is key in classification models and cluster analysis. Scale samples of Coastal Cutthroat Trout over 285 mm have been checked for discernable anadromous life history events; none have shown distinct marine growth annuli.



Procrustes superimposition removes size, position, and orientation differences that obscure shapes of putative Coastal Cutthroat Trout, Steelhead and their hybrids (n=580 individuals). Black dots denote Steelhead, red dots denote Coastal Cutthroat Trout, and blue dots denote hybrids.

GENETIC ANALYSIS OF TIDEWATER GOBY TISSUE SAMPLES BY HSU COOPERATIVE UNIT (RWO 83)

Investigator: Dr. Andrew P. Kinziger
Conrad Newell, MS Student
Duration: May 2011 to May 2014
Funding: U.S. Fish & Wildlife Service (\$73,004)



The endangered Tidewater Goby (*Eucyclogobius newberryi*) is a small fish (maximum total length 60 mm) restricted to discrete brackish water lagoons and bay habitats along the California coast. Site occupancy histories recorded on a time series suggest that southern California Tidewater Goby populations experience periodic extinctions and colonizations consistent with the metapopulation model.

Tidewater Goby (Eucyclogobius newberryi)

We generated Tidewater Goby presence/absence histories for 99 sites across the northern extent of the species range in Curry County, Oregon, and Del Norte, Humboldt and Mendocino counties, California. Site occupancy histories of Tidewater Goby was tabulated on an annual basis between 1897 and 2013 using our own field surveys, published papers, museum vouchers, and unpublished reports. Analysis shown that detection probabilities for Tidewater Goby are about 0.50 and that extinction and colonization rates are very low for northern California populations of Tidewater Goby. Similarly, comparison genetic diversity metrics, allele frequencies, and individual assignments across temporal collections indicated stability through time in all sites we examined consistent with the absence of extinction and colonization dynamics. Our findings indicate that northern California populations do not conform to a metapopulation model of population dynamics and instead is composed of series of highly isolated populations occurring linearly along the California coast.

DISTRIBUTION AND RELATIVE ABUNDANCE OF JUVENILE COHO SALMON IN THE REDWOOD CREEK BASIN, HUMBOLDT COUNTY, CALIFORNIA

Investigators: Dr. Margaret Wilzbach, CACFWRU
Teri Moore, CDFW
Duration: June 2013 to March 2016
Funding: California Department of Fish and Wildlife/FRGP (\$48,866)

The objective of this study is to evaluate the spatial distribution and relative abundance of juvenile Coho Salmon in the Redwood Creek basin.

From July 1 through September 24, 2013, we conducted snorkel surveys in a spatially balanced set of 26 stream sections (reaches) randomly selected from a defined sample frame which



Snorkeling in Redwood Creek

includes all potential spawning habitat accessible to anadromous Salmonids in the Redwood Creek basin. Each survey reach was systematically sub-sampled based on specific habitat criteria. For streams averaging less than ($<$) three meters (m) wetted width, potential sampling units included all pools with surface area greater than ($>$) three m^2 and depths $>$ than 0.3m. For streams averaging $>$ three m wetted width, potential sampling units included all pools with surface area $>$ than six m^2 and depths $>$ than 0.3 m.

To collect biological data, we sampled every second qualifying pool with two independent dive passes along the entire length of each survey reach. For each sampling unit (pool), the primary and secondary diver recorded all salmonids observed by species, stage, and age class. Other species were noted and counted if possible. Divers maintained a distance of one pool apart to ensure independent counts and

allow pools to equilibrate after the first pass. After completing his/her dive pass, the secondary diver collected the physical habitat information for each pool, including: habitat type (main channel pool, lateral scour pool, backwater pool or flatwater), total length (m), average width (m), maximum depth (cm), large woody debris count, estimated cover quality (1=none, 2=poor, 3=average, 4=good, 5=excellent), estimated instream shelter (estimated as the area of the unit surface area in square meters containing shelter), and standardized GPS coordinates (UTM: NAD83 Zone 10N).

To date, we have conducted snorkel surveys in 26 of the 47 reaches included in the Redwood Creek sampling frame. After surveys are completed for the entire frame (by October 1, 2014), we will use models to estimate occupancy rates for juvenile Coho Salmon in the Redwood Creek basin at two spatial scales: the sample reach (i.e., the proportion of reaches occupied within the sample frame) and sub-basin. Ultimately, the information obtained during this survey will be used to evaluate trends in Coho Salmon spatial structure, and identify habitat characteristics that influence distribution patterns.

FEEDING AND GROWTH OPPORTUNITIES FOR JUVENILE COHO SALMON AND STEELHEAD IN DRY CREEK, CALIFORNIA

Investigators:	Dr. Margaret Wilzbach, CACFWRU Andrea Dockham, MS Student
Duration:	January 2013 – December 2015
Funding:	Sonoma County Water Agency (student stipend)

The National Marine Fisheries Service determined that operation of the Warm Springs Dam on Dry Creek, a 22-km tributary of the Russian River in Sonoma County, California, threatens survival of juvenile Coho Salmon and Steelhead; the agency issued a Biological Opinion requiring improvements to salmonid habitat. Cold water released from the dam provides ideal temperatures for the salmon, but the high velocity of water released from the dam is problematic. The Biological Opinion mandated the creation of pools, backwaters and side channels to provide rearing habitat for young fish, and the Water Agency and US Army Corps are investing \$40 - 50 million in habitat enhancement over the next 10 years. While specific enhancements are being constructed to provide flow refuges, the extent to which the enhancements will contribute to meeting the food needs of the fish is unknown. This study will provide a baseline of macroinvertebrate data to help evaluate the habitat enhancements, and examine how feeding and growth opportunities for juvenile Steelhead and Coho Salmon vary along the length of Dry Creek.

The Sonoma County Water Agency is supporting the thesis research of master's student Andrea Dockham through a stipend to Andrea, and it is providing her with logistical support.

Project objectives are to:

1. characterize and compare the structure of benthic invertebrate communities in contiguous reaches of Dry Creek;
2. evaluate reach-specific prey selection by young of year Steelhead; and
3. evaluate reach-specific correspondence between availability and diet composition with condition of juvenile salmonids.

Field sampling was completed in fall 2013, and lab processing of invertebrate samples is underway. Identification of half of the invertebrate samples has been completed.

HABITAT SPECIFIC GROWTH, MOVEMENT, AND SURVIVAL OF JUVENILE COHO SALMON IN FIVE NORTHERN CALIFORNIA STREAMS

Investigators:	Dr. Margaret Wilzbach, CACFWRU John Dieber-Hanson, MS student
Duration:	January 2013 - March 2015
Funding:	California Department of Fish and Wildlife/Coop Unit Support (\$135,000)

State Fisheries biologists and the California Cooperative Fish and Wildlife Research Unit (CACFWRU) have been independently conducting Coho Salmon and Steelhead life cycle monitoring in five streams in northern California (Prairie, Freshwater, Mill, Caspar, and Pudding creeks) for a series of years. However, no attempt has been made to coordinate monitoring components, or integrate experimental design to provide inference into the commonality of limiting factors or the value of specific restoration treatments.



Northern California stream

A goal of salmon life cycle monitoring is developing an understanding of the relationships between habitat and salmonid survival to help interpret regional trends and direct effective restoration actions. Evaluation of life cycle monitoring data to date suggests that factors affecting abundance of freshwater life stages are often density-dependent, and that over-winter survival and low summer growth are major factors limiting Coho Salmon production in at least some northern California streams. With recent evidence that that juvenile Coho Salmon are dependent on multiple freshwater habitats, even within a single watershed, a hierarchical approach to evaluating habitat use and survival must be employed.

CACFWRU and CDFW biologists (including Ricker: Freshwater Creek, Garwood: Mill Creek, Gallagher: Pudding and Caspar Creeks) have agreed to standardize

sampling protocols and coordinate research efforts to enable assembly of a region-wide database on habitat limitations to guide stream restoration.

Objectives of this collaborative project are to:

1. determine habitat specific abundance, growth, survival, and movement of juvenile Coho Salmon in five creeks each year during summer, fall, and winter;
2. PIT tag juvenile Coho Salmon in specific habitats throughout Caspar, Freshwater, Mill, Prairie, and Pudding creeks in summer, fall, and winter and record their length and weight;
3. install remote PIT tag antenna arrays in the middle- and outlet of each watershed to monitor redistribution within each watershed, as well as smolt migration;
4. use smolt traps and PIT tag antenna detections to document migration timing, abundance, and survival tied to habitat units and habitat data;
5. estimate habitat specific over summer and overwinter growth rates, survival, and migration timing of juveniles and smolts in each stream; and
6. investigate relationships between survival, growth, habitat types & habitat complexity.

Master's student John Diebner-Hanson has developed a proposal to evaluate, among reach and basins of the five streams, the relationship between overwinter survival, emigration, and growth of juvenile Coho Salmon with the volume of large woody debris, low-velocity rearing areas, and off-channel habitat units. He will begin field work in summer 2014.

LOWER AND UPPER REDWOOD CREEK JUVENILE SALMONID (SMOLT) ABUNDANCE

Investigators: Dr. Margaret Wilzbach, CACFWRU
Michael Sparkman, CDFW
Duration: June 2013 to March 2017
Funding: California Department of Fish and Wildlife/FRGP (\$224,818)



Students seining in Prairie Creek

This project will continue a long-term study on the abundance of Coho Salmon, Chinook Salmon, Steelhead Trout, and Cutthroat Trout smolts emigrating from the Redwood Creek watershed. Rotary screw traps will be located river mile 4 and 33 that will allow for estimation of smolt population abundances from the upper and lower basin, as well as travel times between traps. Estimates of smolt abundances will represent production from 37 miles (upper) and 93 miles anadromous habitat. The study is planned to continue for more than 20 years to fully encompass biological and environmental variability within the watershed, and to detect any changes attributable to climate change. This study will include determining baseline and status/trend population information for Coho Salmon, Chinook Salmon, Steelhead Trout, and Cutthroat Trout smolts that may

be used to identify factors limiting species recovery and to identify restoration needs in the basin. Abundance and size of yearling Coho Salmon smolts emigrating from Prairie Creek may be used as the benchmark for other streams since Prairie Creek is in near pristine condition. Protocols used in this study are in compliance with the California Coastal Salmonid Population Monitoring (CDFW Fish Bulletin 180), supported by the SONCC Coho Salmon draft recovery plan (NMFS 2012), and have been peer reviewed by CDFW Biometrician (Phil Law).

The rotary screw traps will be set each year in March and operated continuously until August, dependent upon trap catches and the migration periods. Population estimates (by week and season) will be determined using marking-recapture techniques 2 - 5 times per week to account for changes in stream flow and subsequent changes in trapping efficiencies. Marked fish are taken upstream and released at night, and most are recaptured sometime before the trap is checked at 0900. Genetic samples will be taken from each species at age category weekly. Age composition of each species will be determined using length frequency data and from periodic aging using scales. Stream water temperature will be recorded every half hour using data loggers.

PRAIRIE CREEK JUVENILE SALMONID (SMOLT) ABUNDANCE PROJECT

Investigators: Dr. Margaret Wilzbach, CACFWRU
Peter Drobny, MS Student
Duration: June 2013 – March 2017
Funding: California Department of Fish and Wildlife/FRGP (\$268,236) and
Coop Unit Fund

This project will continue the long-term monitoring of juvenile salmonid populations in Prairie Creek that has been in place since 1998. The Prairie Creek sub-basin of Redwood Creek is a stronghold for Coho Salmon production within the basin, and serves as an important reservoir for recovery of salmonids within Redwood Creek. The Prairie Creek sub-basin is a life cycle monitoring station as described in the CDFW's California Coastal Salmonid Monitoring Plan, as it combines monitoring of juveniles and smolts with estimates of returning adults from redd counts.

Objectives of this project are two-fold:

1. to estimate over-winter growth and survival of juvenile Coho Salmon within reaches of Prairie Creek; and
2. to estimate smolt population abundances for Coho Salmon, Chinook Salmon, Steelhead Trout and Cutthroat Trout in Prairie Creek.

The project is conducted in cooperation with CDFW biologist Michael Sparkman, who is running the smolt trap operation. Smolt trapping data from Prairie Creek will be combined with similar data from Redwood Creek upstream of the confluence with Prairie Creek to get a basin wide estimate of smolt production from Redwood Creek. We are estimating overwinter survival by PIT- tagging juveniles in the fall, and subsequently detecting the tagged fish with remote antennae and direct capture with the smolt trap. MS student Peter Drobny is developing a thesis proposal to evaluate the relationship between overwinter survival of juvenile Coho Salmon with intra- and interspecific salmonid densities in late-summer. He will begin his thesis research in late summer 2014.

NEW RESEARCH PROJECTS REVIEW

REDWOOD CREEK LIFE CYCLE MONITORING (ADULT STEELHEAD ESCAPEMENT) - DIDSON 2013 - 2015

Investigators: Dr. Walt Duffy, CACFWRU
Matthew Metheny, Research Associate
Duration: June 2013 – March 2015
Funding: California Department of Fish and Wildlife (\$24,569)

The main goal of this project is to count the anadromous fish migrating through Redwood Creek during the 2013 – 2014 spawning season. Another goal of the project is to use this data to estimate survival in both freshwater and estuary/marine environments. These goals will be achieved through the use of a standard model DIDSON unit to record data and images of migrating fish 24 hours per day from December 1, 2013 through June 15, 2014. The data collected by the unit will be processed and analyzed to estimate the numbers of fish and sizes of fish. Lastly, data will be presented in a detailed assessment and monitoring report providing estimates of escapement for adult Steelhead and estimates of adult to smolt, smolt to adult, and post spawning survival. Run timing and relations to environmental variables will be determined.

REDWOOD CREEK LIFE CYCLE MONITORING (ADULT STEELHEAD ESCAPEMENT) DIDSON 2015 - 2017

Investigators: Dr. Margaret Wilzbach, CACFWRU
Matthew Metheny, Research Associate
Duration: July 2015 – March 2017
Funding: California Department of Fish and Wildlife/FRGP (\$27,342)

This project will use DIDSON to estimate the number of adult Steelhead migrating into and out of Redwood Creek providing status and trend information. A DIDSON has been deployed on Redwood Creek since 2009 as part of a pilot study to test its potential for monitoring adult escapement. Review of the DIDSON video collected has demonstrated that the images can be used effectively to count migrating salmonids over a wide range of conditions. The project will provide adult data, which will be combined with existing smolt monitoring data (CDFW AFRAMP) so that Redwood Creek becomes a life cycle monitoring station for Steelhead, where smolt to adult and adult to smolt survival will be calculated. The project will determine migration timing of Steelhead in Redwood Creek and any relation to environmental conditions (streamflow, temperature, tides) using standard statistical techniques.



DIDSON deployed in Redwood Creek

PRAIRIE CREEK FISHERIES AND AQUATIC ECOSYSTEM SYNTHESIS

Investigators: Dr. Margaret Wilzbach, CAFWRU
Matthew Metheny, Research Associate
Duration: June 2014 - June 2015
Funding: Redwood National Park (\$10,283)

The 104 km² Prairie Creek watershed is almost entirely situated within the Redwood National and State Parks, which is a World Heritage Site and part of the California Coast Range Biosphere Reserve. Although the lower half of the watershed has been impacted by highway construction, timber harvest, and other land use, the creek in the upper watershed flows through undisturbed forest of late seral coast redwood and provides outstanding habitat for fisheries and aquatic resources. The upper watershed often serves as a reference site in studies evaluating land use impacts on aquatic resources. Prairie Creek and its tributaries support populations of Chinook Salmon, Coho Salmon, Steelhead, Coastal Cutthroat Trout and other valued fishes and aquatic vertebrates.

Many studies of watershed conditions, stream habitat and aquatic resources have been conducted in the Prairie Creek watershed over the last 50 or more years, by diverse groups including university researchers, federal and state agency scientists, and others. However, many of the data from these studies remains buried in files and reports which are not publicly available. The overall objective of this project is to identify and locate existing datasets, and to synthesize information on fisheries and aquatic resources into a “State of the Knowledge” report. The information will be used to evaluate fisheries health and function of sub-watersheds and guide restoration opportunities/alternatives in lower Prairie Creek.

Specific objectives are to:

- a) identify and locate historic and current datasets, reports, theses, and publications on fisheries and aquatic resources in Prairie Creek, including maps and GIS data;
- b) compile available electronic data in its native format, and compile digital copies of bibliographic references;
- c) develop an annotated bibliography on fisheries and aquatic ecosystems in Prairie Creek which includes study reach location, study dates, focus of study and type of data collected (e.g. fish habitat, water quality, species- and life stage-specific), and key findings of the study;
- d) synthesize the fisheries and aquatic information into a “State of the Knowledge” report for the Prairie Creek watershed. The report will identify:
 - a) factors believed to limit fish and aquatic production, with a focus on salmonid species; and
 - b) information gaps, spatially within the watershed and life-stage and species-specific.

The report will also provide a prioritized list of information needs and suggest studies to fill data gaps.

PHASE II: MONITORING THE ENDANGERED TIDEWATER GOBY (*EUCYCLOBIUS NEWBERRYI*) USING ENVIRONMENTAL DNA IN WATER SAMPLES: FIELD TESTS

Investigator: Andrew Kinziger, HSU Fisheries Department
Margaret Wilzbach, CACFWFRU
Duration: January 2015 to January 2016
Funding: USFW (\$15,000)

This project proposes to assess the potential of using environmental DNA in water samples as a tool for monitoring the endangered tidewater goby in lagoon and bay habitats. Environmental DNA is a cost-effective and noninvasive technique that has been successfully applied to a broad range of taxonomic groups, including fishes. Studies show that environmental DNA can closely track presence/absence and can be useful for monitoring species that cannot be detected using conventional field approaches. Despite apparent promise, insufficient testing has been conducted to determine the suitability of environmental DNA (eDNA) approaches for monitoring tidewater goby. This project has two major phases: (1) develop and test eDNA techniques, and (2) apply eDNA techniques for presence/absence detection in natural settings. This proposal is for the second phase. During this second phase, HSU and the USFWS will collaborate to survey 15 water bodies in northern California to 1) employ traditional field surveys techniques for tidewater goby, 2) collect 1-5 water samples from each site and test water samples for tidewater presence/absence of tidewater goby DNA, and 3) evaluate suitability of QPCR for determining the presence/absence and/or relative abundance of tidewater goby. The ultimate goal is to develop cost-effective molecular assays that could be combined with robust presence/absence survey designs so that tidewater goby could be efficiently and economically monitored in the northcoast ESU.

UNIT PROGRAM REVIEW

PROGRAM DIRECTION

Duffy retired in February 2014, and is no longer supervising active graduate students. He plans to continue his involvement in a few on-going research projects, and has transferred project responsibilities for other projects to Wilzbach. Wilzbach is serving as Unit Leader until the vacant Unit Leader position can be filled, and is quickly trying to come up to speed with new administrative responsibilities. Authorization to initiate the search for a new Unit Leader is unlikely to occur before Congress passes a FY-15 budget (if then). Attrition of Unit scientists from 2 to 1 will challenge Unit capabilities. Nonetheless the Unit is resolved to stay the course and continue our 47-year history of producing cost-effective, high quality science and services that address Cooperator needs. It has been five years since the cooperators agreed to the terms of the Cooperator Agreement and we are planning to review the agreement during this meeting.

Funding from the national CRU program was reduced to \$0 this FY. This marks the second year in a row that funds have not been available for placement in our vehicle replacement fund. Our ability to manage the Unit's small vehicle fleet is uncertain.

The annual contribution of California Department of Fisheries and Wildlife for basic operational expenses of the Unit and graduate student support is greatly appreciated. The current contract through which funds are allocated will expire at the end of March 2015. We will seek a contract amendment to extend the project period, and to remove the indirect costs currently being charged to the contract. (The Cooperative Agreement stipulates that contributions from the Department for operational expenses will not be charged overhead by the University). A need for extension of the project period derives because of a delay in contract finalization and allocation of funds, and a shorter contract duration than we had understood to be the case.

Leslie continues to contribute to guidance of Unit and CNRS students in addition to providing administrative support to the Unit. She participated in Institute for Student Success events in August 2013 and January 2014; in the workshop Tribal Worldview and Context: The Native American Student; and in two campus book circles focused on understanding student needs.

Facilities and Equipment:

We appreciate the outstanding facilities provided by HSU. No major equipment was acquired during the past year. We anticipate moving our two small flumes, constructed for use in hydrological studies, from their current location in Environmental Engineering to the Fish Hatchery grounds in fall 2014, where they will be more available for course use.

UNIVERSITY SERVICE AND TEACHING

Courses Taught

Ecology of Running Waters (3 units)	Wilzbach	Fall 2013
-------------------------------------	----------	-----------

Graduate Student Major Advisor

Duffy	Stephen Zipper - MS Fisheries, Humboldt State University Tancy Moore - MS Fisheries, Humboldt State University
Wilzbach	John Deibner-Hanson - MS Fisheries, Humboldt State University Andrea Dockham-MS Fisheries, Humboldt State University Peter Drobny, MS Fisheries, Humboldt State University Sam Rizza - MS Fisheries, Humboldt State University Christopher "Olie" Smith - MS Fisheries, Humboldt State University

Graduate Committee Service (unit scientists serve as members, not major advisors)

Duffy	Rosemary Records - PhD Environmental Engineering, Colorado State University Sam Rizza - MS Fisheries, Humboldt State University Russ Bryant, MS Wildlife, Humboldt State University
Som	Tancy Moore - MS Fisheries, Humboldt State University John Deibner-Hanson - MS Fisheries, Humboldt State University
Wilzbach	Shari Anderson - MS Fisheries, Humboldt State University Scott Benson - MS Fisheries, Humboldt State University Emily Ferrell - MS Environmental Science & Mgmt, Humboldt State University Molly Gorman, MS Fisheries, Humboldt State University Jeffrey Hayes - MS Forestry, Humboldt State University Michelle Krall - MS Fisheries, Humboldt State University David Malakauskas, PhD Entomology, Michigan State University Meiling Roddam - MS Fisheries, Humboldt State University Steven Zipper - MS Fisheries, Humboldt State University

OTHER UNIVERSITY SERVICE

Duffy	Guest lecture, Principles of Restoration, Environmental Management & Protection fall 2013
Wilzbach	Member, IACUC
Farrar	Updated and maintained the Unit's University web page and USGS web page; Search committee for the Center for Academic Excellence in Science, Technology, Engineering and Mathematics.

THESES OF UNIT-SPONSORED GRADUATE STUDENTS

Malakauskas, D. 2013. Ecology of *Manayunkia speciosa*. PhD Dissertation, Michigan State University, East Lansing, MI.

- Moore, T. 2014. Overwinter survival and redistribution of juvenile Coho Salmon *Oncorhynchus kisutch*, in Prairie Creek, California. M.S. Thesis, Humboldt State University, Arcata, CA.
- Records, R. 2013. Water quality benefits of wetlands under historic and potential future climate in the Sprague River watershed, Oregon. M.S. Thesis, Colorado State University, Fort Collins, CO.
- Zipper, S. 2014. Use of riparian wetlands by larval Lost River, shortnose, and Klamath largescale suckers in the Sprague River, Oregon. M.S. Thesis, Humboldt State University, Arcata, CA.

PRESENTATIONS

- Bryant, Russ. North Dakota GIS Users Conference, Modeling Native Bumblebee Habitat in North Dakota, Grand Forks, North Dakota, September 11, 2013. Awarded first place in student paper category competing against PhD. Students.
- Bryant, Russ. Western Section of the Wildlife Society 2014 Annual Meeting, presented an oral presentation regarding research analyzing land cover as an indicator for native bees in North Dakota in the "Web and GIS Technologies for Wildlife Science and Conservation" section, Reno, Nevada, January 2014.
- Bryant, Russ. Natural Capital Project Annual Meeting and Training, Assessing the Effects of Land Cover on Native Bee Diversity in Eastern North Dakota, Stanford University, Palo Alto, California, March 2014.
- Metheny, Matt. Sonar assessment of adult salmonids in Redwood Creek, Humboldt County, California, American Fisheries Society Annual meeting, Sacramento, California, March 2014.
- Moore, Tancy. Overwinter survival, growth and movement of juvenile Coho Salmon in Prairie Creek, California, American Fisheries Society Western Division conference, Mazatlan, Mexico, April 2014.
- Records, Rosemary, et al.,. Implications for riparian vegetation of potential climate-induced changes to flow regime in a western stream, poster presentation, Hydrology Days, Colorado State University, Fort Collins, CO., March 2014. Also presented at American Geophysical Union Annual Meeting, San Francisco, CA., December 2013.

TECHNICAL ASSISTANCE

- Duffy Department of Fish and Wildlife, serves as Chair of the Fishery Restoration Grants Program, Peer Review Committee.
- Department of Fish and Wildlife, serves as a member of the California Advisory Committee on Salmon and Steelhead.
- Department of Fish and Wildlife, serves as the science representative on the Coho Salmon recovery team.
- U. S. Geological Survey, member of the Klamath Basin Leadership Team.
- US EPA, member of team assembled to review wet meadow wetland rapid assessment protocols.
- Organized a technical session on the use of DIDSON technology for assessing fish populations in California, American Fisheries Society, California-Nevada Chapter Annual Meeting, Davis, CA.
- Wilzbach Department of Fish and Wildlife, serves as an alternate member of the California Advisory Committee on Salmon and Steelhead.
- Department of Fish and Wildlife, serves as an alternate science representative on the Coho Salmon recovery team.
- Review of Oregon Department of Environmental Quality protocols for aquatic macroinvertebrate-based assessment of water quality impairment for Plum Creek Timber Company.

SCIENTIFIC PUBLICATIONS

- Danehy, R., M.A. Wilzbach, Young, M. et al. 2014. Regional specific interactions of forests and fish. Pp. x-x in Danehy, R. and A. Dolloff (eds.). Reflections on forest management: can fish and fiber coexist? American Fisheries Society, Bethesda. In review.
- Duffy, W.G., P. Garone and others. 2013. Wetlands. Pages xx – xx in E. Zavaleta and H. Mooney, editors, Ecosystems of California. University of California Press, Berkeley, California (in press).
- Hodge, B., M.A. Wilzbach, and W.G. Duffy. 2014. Potential fitness benefits of the half-pounder life history in Klamath River Steelhead. Transactions of the American Fisheries Society, in press.
- Malakauskas, D.M., S.J. Willson, M.A. Wilzbach, and N.A. Som. 2013. Flow variation and substrate type affect dislodgement of the freshwater polychaete, *Manayunkia speciosa*. Freshwater Science 32: 862-873.

Records, Rosemary, Duffy, W.G., et al. Climate change and wetland loss impacts on a Western river's water quality (in press).

UNIT STAFF

Walter Duffy, Unit leader
Margaret Wilzbach, Assistant Unit Leader
Leslie Farrar, Unit Administrative Support

Research Associates and Cooperators

Sharon Kahara
Nick Som, Affiliate Scientist
Sarah Willson
Matt Metheny

Graduate Student Assistants

Russ Bryant
John Deibner-Hanson
Andrea Dockham
Peter Drobny
David Malakauskas, PhD, MSU
Tancy Moore
Rosemary Records, PhD, CSU
Sam Rizza
Christopher Olie Smith
Stephen Zipper

Student Technicians

Charles Boone
Chris Fabian
Sage Gang-Halvorson
Mike Griffin
David Kissling
Ann Thompson
Emily Trejo-Sypolt

Technicians

Jaspir Amir
Seth Bowman
Nick Campise
Adam Canepa
Olivia Carter
Jason Cotter
Rebecca Dutra
Melissa Gordon
Steven Holt
Andrew Lillejord
Matt Metheny
Todd Newhouse
Laurel Osborn
Roderick Park
Gwendolyn Roy
Anthony Scheiff
Matthew Settelmayer
Benjamin Sheppard
Nicholas Van Vleet
Dominic Vitali