33rd Annual Salmonid Restoration Conference

March 11-14, 2015 ~ Santa Rosa, CA

Fisheries Restoration: Planning for Resilience

Conference Co-sponsors

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Welcome to the 33rd Annual Salmonid Restoration Conference

Fisheries Restoration: Planning for Resilience

The theme of this year's Annual Salmonid Restoration Conference is Fisheries Restoration: Planning for Resilience and the conference agenda highlights innovative mechanisms and techniques to restore and recover salmonids. We will explore key recovery actions and implementation priorities in Pacific Northwest salmon recovery plans and efforts to plan for resilience in California's landscape. Salmonid Restoration Federation (SRF) and a team of coordinators crafted an agenda that addresses pressing issues affecting fisheries recovery. These pressing issues include climate change and drought as well as evolving strategies to preserve instream flows and leverage limited resources.

This year, workshops include an urban creek workshop highlighting efforts to interface with communities, the 4th Annual California Coastal Monitoring Program workshop focused on monitoring central coast coho salmon populations, a watershed approach fish passage and protection workshop, a captive broodstock symposium & Warm Springs hatchery tour, an "Innovative Trans-Boundary Approaches to Coho Salmon Recovery" workshop, and a combined workshop and tour focused on preserving instream flows. Field tours include: Bioengineering and Floodplain Restoration on the Russian and Napa Rivers, Large Wood and Off-Channel Habitat Projects in Western Sonoma, Lagunitas Creek Watershed: Stem to Stern Salmon Enhancement, Redwood Creek and Muir Beach Restoration Projects, and a Dry Creek Habitat Enhancement Project Tour.

Concurrent sessions include a recovery and implementation trilogy and a climate, drought, and flow changes track. A physical and environmental track will explore instream wood loading projects, floodplain processes, habitat, and importance to salmonids. Additional sessions focus on validating effectiveness monitoring of habitat restoration, strategically planning for salmon restoration, working in altered landscapes, and building diverse partnerships while advancing the restoration continuum towards conservation and recovery.

Dana Stolzman,
SRF Executive Director
and Conference Agenda Coordinator

The Plenary session will feature a keynote address by Congressman Jared Huffman, Ann Riley author of *Restored Urban Streams* will talk about how successful restoration projects happen, and Brian Spence of NOAA Fisheries will give a presentation on the *Historical Context for Interpreting Early Accounts of Pacific Salmon in California's Coastal Watersheds*. Lynn Ingram, author of *The West Without Water*, will discuss California's paleoclimate record and what we can learn from the past and apply towards future planning.

This Annual Salmonid Restoration Conference serves as a venue to share newly adopted protocols, learn about pioneering restoration techniques, and engage in constructive discourse about fisheries recovery strategies.

The production and coordination of the Annual Salmonid Restoration Conference is a collaborative process that engages SRF's Board of Directors, co-sponsors, and colleagues. I sincerely thank all of the field tour, workshop, and session coordinators who have done an outstanding job of creating a dynamic agenda as well as all of the dedicated presenters who are sharing their knowledge and expertise.

SRF appreciates all of our co-sponsors who generously contribute their ideas, time, and resources to the production of the Annual Salmonid Restoration Conference. I would like to specifically thank our long-time co-sponsor, the California Department of Fish and Wildlife, for their continued support of this Annual Salmonid Restoration Conference and the fisheries restoration field.

Thanks to all the conference participants who migrate tirelessly to participate in the largest salmon restoration conference in California and for joining us in our efforts to enhance the art and science of restoration and ultimately recover wild salmonid populations.

SRF Board touring the Wells Fargo Center for the Arts

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Friday Afternoon Concurrent Session 2

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Instream Wood Loading Projects in Northern California: Status and Challenges

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Conference Events

Special Thanks to Our Exhibitors

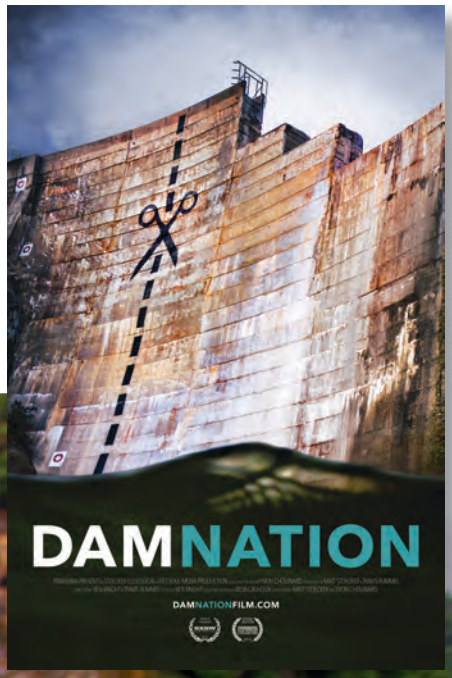
CONTECH ENGINEERED SOLUTIONS

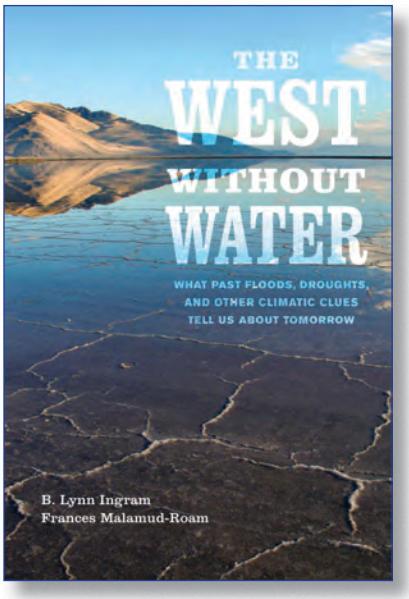
WORTHINGTON waterway barriers

Thursday, March 11

SRF Annual Membership Meeting 5:30 to 6:30pm
SRF Membership and Supporter Dinner 6:30pm
Screening of DamNation 8pm

LAGUNITAS BREWING COMPANY PETALUMA CALIF.

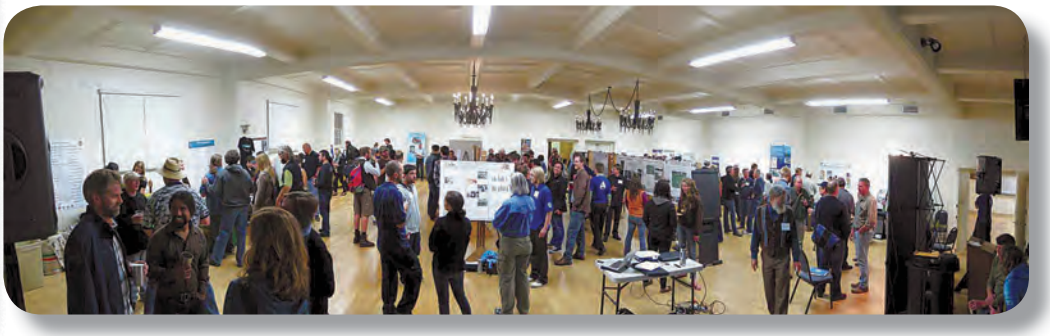




Friday, March 13

Book Signing with Author B. Lynn Ingram,
The West Without Water

Poster Session and Reception at 7pm in the Atrium

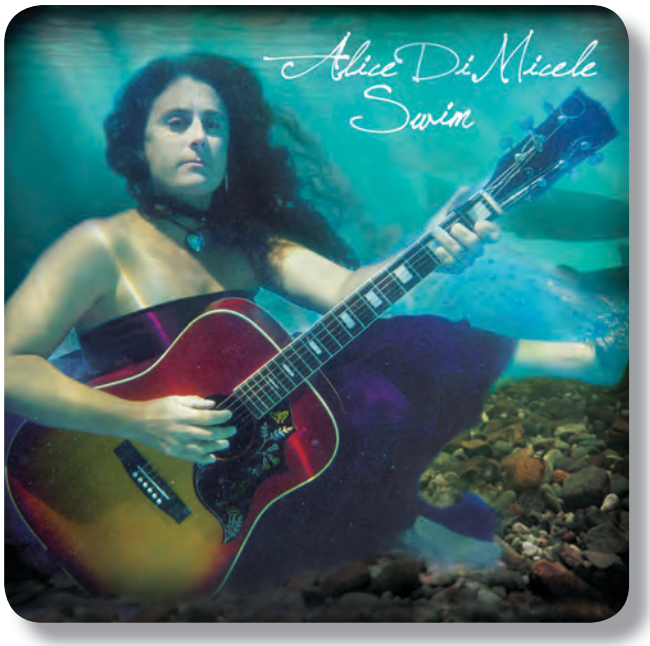


Saturday, March 14

Banquet, Awards Ceremony, and Dance!

SIERRA NEVADA

Some previous award recipients (Meredith Hardy, Steph Wald (current), Dave Highland, and Philip LaFollette)



River troubadour, Alice di Micele and her band, will play at the Saturday evening banquet.

Urban Creek Restoration: Interfacing with the Community Workshop and Tour

Wednesday, March 11

Workshop Coordinator*: Ann Riley, San Francisco Bay Regional Water Quality Control Board*

This workshop will span the breadth of topics with which anyone involved in urban stream restoration must stay current. Presentations at the workshop will include the use of regional curves as a design tool, new funding opportunities and legislation affecting them, case studies in restoration, citizen involvement strategies, and a panel on how to resolve some of the common issues that confront practitioners in urban settings. The workshop will culminate with a City of Santa Rosa trolley tour of Prince Memorial Greenway restoration on Santa Rosa Creek and Lower Colgan Creek.

A "Living River" Runs Through It, The Napa Creek Flood Management Project

Leslie Ferguson, *Water Resource Engineer and Fish Biologist, San Francisco Bay RWQCB*

The City of Napa endured numerous devastating floods, and yet prior to 1998, the local community continuously vetoed Army Corps of Engineers (Corps) flood control projects because they were environmentally destructive to the River. In response, Napa County created a community coalition process to develop a " Living River" flood management project. The flood management project concept and many critical design features were designed through this community coalition process. The community coalition process involved the Friends of the Napa River, local citizens and businesses, design consulting professionals (Phil Williams and Assoc., Trihey and Assoc., and Ann Riley), and environmental agency staff in conjunction with the Corps, City of Napa, and Napa County Flood Control District. The resulting Napa River/Napa Creek Flood Management Project (called the Living River Project) implemented by the Napa County Flood Control and Water District, The City of Napa, and the Corps, is a nationally award winning project for environmental design and flood management.

The project includes flood management elements on both the Napa River and Napa Creek. This presentation focuses specifically on the design and implementation of the Creek project completed in 2011. The Napa Creek project, .6 mile of creek through the heart of downtown Napa and residential areas, was challenging because the creek was deeply incised and confined by homes, business buildings, streets and bridges in every reach. Rip-rap, sacrete, concrete and rubble were common throughout the degraded habitat. The resulting 3000 foot project, starting at its confluence with the Napa River, includes: extensive biotechnical bank stability with LWD and vegetated soil lifts with willows (FREFs) and willow mattresses; constructed riffles, removal of three vehicle bridges; removal of seven homes and creation of a floodplain terrace. The two bypass culverts constructed underneath an alley and parking lot flowing only above bankful flows are compromise elements intended to convey high flows without excessive widening of the creek and associated mature tree loss. Plantings include large numbers of cottonwood, alder, willow, big leaf maple, and valley and live oaks, with a native understory. The short-term impacts of project construction to the non-native tree species and resultant loss of shade are significant, but the fast growing cottonwood, alder and willow are beginning to produce shade and improve riparian zone function. The project experienced a 10-year flood shortly after the construction was complete, and before the vegetation had become fully established. However, the majority of the project biotechnical features functioned with no or minor damage. This project illustrates that biotechnical solutions can be effective in urban, very constrained environments.

Leslie Ferguson has been involved with the Project since 1995 and was the co-chair of the Community Coalition "Water quality, habitat, and geomorphic work group" and is co-author of the "Living River Guidelines". She currently chairs the interagency environmental agency work group that continues to oversee the project.

Monitoring the Value of Fish Habitat Improvements along the Restricted Napa River Corridor: Lessons for Urban and Rural Environments

Jonathan Koehler, *Senior Biologist, Napa County Resource Conservation District*

Implementation of the Napa River Rutherford Restoration Project was completed in 2014, capping an unprecedented five-year restoration effort covering 4.5 river miles in the heart of the Napa Valley. Initiated in 2002, this private-public partnership aimed to restore geomorphic and biological functions to the Napa River, which has been highly confined over the past century by agricultural and rural residential land uses. Prior to restoration, the channel in this reach of the River was characterized by deep incision with frequent bank erosion, an overall lack of bed complexity, and a relatively narrow riparian corridor due to the lack of a functional floodplain. Key restoration elements of the project included channel widening, floodplain restoration, and installation of large wood and boulder features intended to provide aquatic habitat.

A long term channel monitoring and maintenance program was developed for this project by the Napa County Flood Control and Water Conservation District in collaboration with the Napa County Resource Conservation District (RCD), resource agency staff, various consultants, and riverfront landowners. The monitoring program involves making observations and taking water depth and velocity measurements during winter storm events when newly-graded floodplain areas are inundated, as well as during spring low-flow conditions when young salmonids would be expected to occupy the installed wood and rock habitat structures. The Napa County RCD also conducts annual snorkel and spawner surveys to assess fish abundance and distribution in the reach. These assessments are intended to evaluate whether the Rutherford Project is attaining one of its primary intended goals: to improve steelhead and salmon habitat quality and quantity under a broad range of flow conditions.

Monitoring results from the past four years show that all of the newly constructed floodplain benches are functioning as designed to provide areas of slow- and slack-water habitat where fish can escape from high flows. Under spring flow conditions, most (~70%) of the structures designed to provide hydraulic constrictions (creating feeding opportunities for juvenile salmonids) were meeting the project's velocity and depth target criteria. We also found that most (~75%) of the structures that were intended to provide summer cover for young fish were performing this function. Only about 30% of the structures installed specifically to induce pool scour were performing this function; however, bed scour is particularly irregular in terms of timing and magnitude and should be reassessed on a longer time-scale.

This monitoring program has broad applications to other restricted channels, both rural and urban, and can be used as a model to assess whether biological and geomorphic goals of stream restoration projects are being achieved. For a full report of our findings, please visit *www.naparcd.org*.

The Regional Curve Project, Creating a Restoration Design Tool While Benefiting the Community

Roger Leventhal, P.E., Marin County Flood Control District

This talk will present the results of a multi-year project, funded by the Environmental Protection Agency, to collect field data and prepare updated regional curves of hydraulic geometry for Marin and Sonoma Counties. The concept of regional curves and hydraulic geometry was originally developed by Luna Leopold in the 1950s - 1970s. Approximately 58 data points were collected and analyzed under this project scope. These curves include the traditional plots of stable bankfull characteristics (width, depth, and area) as a function of drainage area. However, additional data was collected for this project and analyzed to further segregate the results by stream geomorphic characteristics and to evaluate additional controls on stream morphology. The new dataset now includes both steeper creeks and creeks with smaller drainage areas than the original dataset and shows significant deviations from the original Leopold regional curve published in Water in Environmental Planning (1978) for these stream types, both of which represent streams that are commonly the focus of restoration efforts. This talk will provide an introduction on both the background and history of regional curves and present the new datasets along with specific examples of their use in creek restoration design projects. A similar project collecting regional curve data from the Wildcat Creek, San Francisquito Creek, and Pescadero Creek watersheds is now underway, and community college students are being integrated into some of the field work and learning the science as college projects. They are receiving training in basic field work methods such as surveying and receiving stipends to help with educational expenses.

Urban Creek Restoration:

Landscape Scale Urban Creek Restoration in Marin County, California

Greg Kamman, Principal Hydrologist, and Rachel Z. Kamman, Principal Engineer, Kamman Hydrology and Engineering, Inc.

Preservation and rehabilitation of steelhead in urban streams requires landscape-scale restoration planning and aggressive protection and acquisition of natural resources. Examples of urban stream restoration projects occurring at this scale in Marin County will be described. Climate change, which is expected to drive increases in drought intensity, storm magnitude, and storm frequency, can be anticipated to further reduce the availability of steelhead habitat in urban streams with limited adaptive capacity. Three Marin County watersheds, currently the focus of landscape scale restoration efforts, are used to illustrate the anticipated impacts of climate change on available habitat in local urban corridors and the value of resource protection and acquisition. Evaluated impacts include loss of headwater supply, sea level rise-induced shifts in salinity structure, geomorphic adjustment in both the cross-section and the longitudinal profile of the stream corridor, and engineered flood hazard abatement. The potential benefits of landscape scale restoration for both habitat and infrastructure management are also illustrated, using examples from proposed and implemented restoration efforts within these and other small coastal watersheds.

The Funding Conundrum: Problem – Vision – Solution

Mike Carlson, *Assistant Chief Engineer, Contra Costa County Flood Control and Water Conservation District*

Aging flood protection infrastructure is requiring flood control districts to rebuild their facilities. Many concrete channels and drop structures, the bane of fish restoration, were built over 50 years ago and currently exceed their design life. This provides an opportunity to creek restoration advocates to replace these single-purpose facilities with multi-objective infrastructure projects that provide fish habitat and natural stream function. Achieving this will require two things: (1) an organizational-scale/watershed-scale/community-scale vision for converting traditional flood protection infrastructure into natural stream systems as part of a capital replacement program; and (2) a reliable and adequate funding stream to pay for this environmentally sensitive replacement and maintenance program.

This presentation will describe how flood protection systems were funded and built, the impacts of Proposition 13 and Proposition 218, requirements from the Federal Clean Water Act, and the need for a capital replacement program. The presenter will then discuss the opportunity that replacing this infrastructure represents for the stream restoration community and the effort under way in Sacramento to provide a reliable source of funding to truly restore our concrete flood control channels.

Whose Watershed Is This?
Community Engagement in Urban Watershed/Creek Restoration

Joshua Bradt, Bay Area Steering Committee Chair, California Urban Streams Partnership

Community support and participation is critical to the success of urban creek restoration and watershed planning. Nonprofit citizen groups have a history of raising funds, planning, designing, and constructing stream restoration projects, and emphasizing community benefits such as the training of conservation corps youth, co-sponsoring youth training and employment, and involving schools, teachers, and neighborhoods in projects. Examples of projects integrating restoration, training, and youth group programs will be described. These projects can also provide employment for small businesses who do contract labor. A return to the design-build model and involving longer term local government financial support for organizations to remain stewards for the projects could assure better long-term benefits from the projects and continue community ties with the sites. On this latter point, capital funding for project design and construction has been much more easily available than resources for operations and maintenance. The lack of ongoing funding available to cover these costs has been the rationale for many local public agencies to forego restoration grant opportunities. Over the years, local nonprofit organizations have successfully designed and built numerous projects, only to see them become over-run with weeds and/or indiscriminately mowed or inadvertently damaged by local maintenance crews.

This presentation will address the following topics:

- Can we return greater use of the design-build approach to restoration?
- Can nonprofits skilled in ecosystem management be a long-term supplement to public agency maintenance?
- Does a better public understanding of project goals and natural processes translate into wider support and appreciation of restoration?
- How can we best continue to integrate community into the restoration projects?

This presentation will share lessons learned from over 20 years of both successful and unsuccessful community outreach and education in urban settings.

Marsh Creek Flood Control Channel Restoration: A Model for Community Partnerships for Contra Costa's 50-Year Plan for Converting Channels to Creeks

***Rich Walkling, MLA**, Planning Director/Business Manager, Restoration Design Group*

Marsh Creek is a salmon-bearing stream that flows from Mount Diablo through the cities of Oakley and Brentwood into the western Delta between Big Break and Dutch Slough. The final seven miles of Marsh Creek flow through a trapezoidal channel owned and operated by the Contra Costa County Water Conservation and Flood Control District (CCCFCD). In its 50-year plan, CCCFCD acknowledges the public's desire for "a healthy and natural looking eco-system in their drainage channels and creeks."

In 2012, the City of Oakley led a floodplain restoration project along the Marsh Creek flood control channel. The project created two acres of riparian floodplain along 800 linear feet of flood control channel. Designed to serve as a habitat node between the Delta and natural stream channels upstream of the flood control channel, the project has already attracted beavers to the site.

The project is one of the first "50-year" partnerships between the CCCFCD, a local municipality (City of Oakley), a community group (Friends of Marsh Creek Watershed), NGOs (American Rivers and the Natural Heritage Institute) and a design firm (Restoration Design Group) to modify the flood control channel for ecological benefit. Project conception to construction took approximately seven years, and a million dollar grant from the State of California. The project is now serving as a model, both physically and institutionally, for additional flood control channel restorations in Contra Costa County.

This talk will examine the many phases of project planning, design, and implementation, and will discuss how the community partnership evolved with different parties assuming the lead during different phases according to their strengths. The talk will distill the experience into a model that can be applied to other watersheds in Northern California.

Colgan Creek Urban Stream Restoration and Watershed Education Interactive Web Mapping

Brian Hines, *Colgan Creek Watershed Education Project Manager and Program Coordinator, Trout Unlimited; and* ***Ashlee Llewellyn,*** *Edd Clark and Associates, Inc.*

The Colgan Creek project includes restoration of the Colgan Creek Flood Control channel into a healthy riparian ecosystem while increasing the channel's capacity to convey floodwaters. The Redwood Empire Chapter of Trout Unlimited (RETU) was awarded a $75,000 watershed education grant through the Department of Water Resources Urban Streams Restoration Grant Program in partnership with the City of Santa Rosa. There are three elementary schools and three high schools in the watershed, with which RETU is working to make the restoration project a living laboratory. The grant funded a number of innovative ways the project can interface with students and the watershed community.

The grant also facilitated expansion of RETU's 25-year old award-winning "Steelhead in the Classroom" program to all schools in the watershed. The program includes the following:

- An interactive website and map of the watershed, where students can post water quality test data and pictures they take of the watershed and the restoration process
- Water quality test equipment for measurement of temperature, pH, dissolved oxygen, conductivity, sediment, phosphorus and nitrogen
- Full-size replicas of steelhead, coho, and Chinook
- Lesson plans, classroom visits, and field trips
- An online Creek Care Guide written specifically for Colgan Creek including its human and natural history, which includes information on raising native riparian trees for community restoration projects
- Interpretive signage, including the ethno-biology of riparian plants and Pomo basket-making

The interactive website will be demonstrated at the conference and an innovative flyover video of the project for monitoring its progress will be presented.

For more information, please visit *colgancreek.org*

A Case of Beaver-Assisted Restoration in an Urban Stream

Heidi Perryman, PhD, *President and Founder, Worth A Dam*

Beaver-assisted restoration has been recognized by the National Marine Fisheries Service, the United States Forest Service, and the United States Fish and Wildlife Service as a valuable tool in stream recovery. However, its potential application in urban settings is often overlooked. Serious concerns regarding infrastructure, street surfaces, and landscaping often prevent cities from considering this valuable, free, and tireless resource for improving creeks. Beaver mudwork augments invertebrate communities, benefitting salmonids. Beaver damming has been shown to aid repair of incised streams and restore aggregate sedimentation. Furthermore, streams with beaver have shown to have nine times more water than equivalent areas without beaver. As California faces increasing drought periods, it is more important than ever to consider beavers' water-saving capabilities.

Since the use of flow devices to control beaver activity has substantially advanced in the last decade, it is now easy for cities to safely control beaver effects in most situations, while enjoying the many benefits of beaver-assisted restoration. In 2007, the city of Martinez allowed beavers to remain in Alhambra Creek through installation of a flow device. This has controlled water height successfully for seven years, while letting the beavers remain. In addition to their damming and mudwork, they have used their naturally territorial behaviors to keep other families away, eliminating the need for trapping. To date twenty beavers have been born in the creek, but since beavers disperse at age two, the population remains at six. The subsequent wetlands created have drawn at least 15 new species to date and prevented an ephemeral stream from drying up during a summer where very little water remained.

Martinez is examined as a case study to explore the effects of beaver-assisted creek restoration in an urban setting.

Meeting the Needs of an Active Community While Restoring the Habitat of Salmonids on Incline and Third Creeks in the Lake Tahoe Basin

Charley Miller, P.E., (Presenter) and Chris Hogle, Cardno, and Brad Johnson, P.E., Incline Village General Improvement District

Located on the border of California and Nevada, Lake Tahoe is known for its scenic beauty, outstanding lake clarity, recreational opportunities, and indigenous Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*). The clarity of Lake Tahoe has been declining since the mid-1960s because of the deposition of fine particles and nutrients from erosion and urban runoff. This problem spurred efforts to restore the clarity of Lake Tahoe through stream restoration and drainage infrastructure improvement. The Third and Incline Creek Restoration Projects were initiated to improve water quality, reduce stream bank erosion, provide improved fish passage though culverts, and enhance aquatic and riparian habitat - all while integrating seamlessly with adjacent urban lands and recreational infrastructure. The large and diverse array of community interests and site users made community outreach critical to the planning and design process.

Combining the goals and objectives of restoring vital habitat of Third and Incline creeks with the needs of an active community creates critical communication efforts to the public and partners to understand the limitations and expectations that can coexist. A key result of the project was to eliminate redundant trails and consolidate human impact, while integrating the recreational features with the restored stream. This led to several integrated features that promoted salmonid habitat and allowed users to enjoy the riparian corridor without impacting this vital natural resource.

These projects incorporated multiple innovative methods and restoration techniques. V-log grade control structures were placed to raise and stabilize the bed elevation and center flow during high flow events. Coir logs were procured prior to construction and planted with two types of wetland plugs allowing vegetation to grow and become established prior to installation. 500 feet of the vegetated coir log was then placed on inside beds of the channel, along with wetland sod in the floodplain. Large wood LUNKERS (Little Underwater Keepers Encompassing Rheotactic Salmonids) were placed at three locations, constructed of large timber to create habitat for aquatics and stabilize the stream bank. On the downstream end of the project, boulder baffles were secured in a large culvert providing fish passage and saving hundreds of thousands of dollars by eliminating the need to replace the culvert. Finally, five pedestrian bridges were installed to increase human use while reducing human impact

The benefits of these improvements are diverse and address the multiple restoration and recreation objectives. Restored fish passage and improved substrate conditions on the lower portions of Third and Incline Creeks are beneficial to both the current non-native trout fisheries and the ongoing re-introduction of native Lahontan cutthroat trout. Improved geomorphic stability has reduced the potential for fine sediment to enter Lake Tahoe. The restoration of the riparian corridor has enhanced the aesthetic appeal of the site and the connection of locals and visitors with the riparian ecosystem.

Workshop Coordinators*: Stephen Swales, Fisheries Branch, California Department of Fish and Wildlife, and* **Charlotte Ambrose,** *NOAA Fisheries*

California Coho Salmon: A Species 'at the Edge': an Assessment of Current Recovery Status

Stephen Swales, *Fisheries Branch, California Department of Fish and Wildlife*

In California, coho salmon populations can be considered to be 'at the edge' from two perspectives: (1) they are situated at the southernmost limit of the global geographic range of the species, and (2) recent population declines in many of California's coastal watersheds has resulted in the species being listed, under both the state and federal Endangered Species Acts, as either threatened or endangered, and many populations may be at the edge of local extinction. As a result of these listings, state and federal agencies recently produced separate coho salmon recovery plans. In 2004, the California Department of Fish and Game produced the Recovery Strategy for California Coho Salmon, while more recently, in 2012, the National Marine Fisheries Service produced the Final Recovery Plan for Coho Salmon in the Central California Coast Evolutionarily Significant Unit (ESU). In 2014, the National Marine Fisheries Service also released the Final Recovery Plan for Coho Salmon in the Southern Oregon/Northern California Coast ESU. However, coho salmon populations in many of California's coastal watersheds continue to decline, some to the point of extirpation. The plight of the species is further compounded by ongoing severe drought conditions across most of California, which leads to reduced stream flows and increased water temperatures, potentially increasing fish mortality across the range of distribution. The situation of California coho salmon at the southernmost edge of the natural range of the species may also make fish more susceptible to any adverse effects of climate change. This presentation will review the current status of coho salmon recovery in California's coastal watersheds, including habitat restoration, inter-agency collaborations, captive rearing programs, and other recovery efforts.

Are California Coho Salmon Doomed? How to Improve Their Prognosis by Applying Lessons Learned from Studies on Canadian Coho Salmon

J.R. Irvine, *Pacific Biological Station, Fisheries and Oceans Canada*

Coho salmon in the Central California Coast Evolutionarily Significant Unit (CCC ESU) are listed as endangered. A recent draft Recovery Strategy listed hundreds of range-wide and watershed restoration recommendations to aid in their recovery. Yet, even though approximately $100 million has been spent since 2004 on these efforts, numbers of adult coho salmon returning to most monitored California systems continue to decline. Approximately 1,500 kilometers to the north, coho salmon returning to the Interior Fraser River watershed in British Columbia, listed as endangered by the Committee on the Status of Endangered Wildlife in Canada in 2002, show recent evidence of recovery. We argue that applying important lessons learned from studying Canadian coho salmon can reduce the likelihood of extirpation of central California coho salmon. Fishing, habitat perturbations, and climate change were identified as primary threats to the recovery of Interior Fraser Coho Salmon. Significant declines in spawning escapements and total returns during the 1990s were largely the result of declining smolt-adult survivals exacerbated by overfishing. An abrupt decrease in productivity (recruits per spawner) coincided approximately with the 1989-1990 shift in marine conditions in the North Pacific Ocean. Smolt survival remains low, and recent variability in adult returns, including the minor increases seen for some populations, were the result of variable survivals in fresh water. The putative recovery of Interior Fraser Coho Salmon required the following:

- Long-term commitment to reduced fishery exploitation
- Understanding the relative role of changes to survival in freshwater versus the ocean
- Determining the geographic extent of reproductively isolated populations called Conservation Units
- Investigating the pros and cons of enhancement
- Identifying abundance-based benchmarks that enable the determination of biological status

It is hard to be optimistic of the fate of California's coho salmon at the southern extent of their distribution during a period of climate warming. In order for coho salmon from the CCC ESU to return to levels of sustained viability or to achieve harvestable populations, studies that investigate the relevant items listed above are required. In addition, a properly designed approach to evaluate the effectiveness of restoration efforts in California is crucial (e.g. *www.monitoringadvisor.org*).

Use of System Dynamic Modeling as a Tool for Coho Recovery in Olema Creek, Point Reyes National Seashore

Michael Reichmuth, *Fisheries Biologist, National Park Service*

Olema Creek is a primary tributary to Lagunitas Creek, which is considered a coho salmon stronghold within the Central California Coast Evolutionarily Significant Unit. With over eight years of existing data, the United States Geological Service collaborated with the National Park Service to develop a dynamic model to investigate potential factors limiting survival and production, identify data gaps, and improve monitoring and restoration prescriptions. A key component of the model was the use of both coho monitoring data and physical parameter data such as water quality and stream flow. In addition to existing data, surrogate data from outside sources, commonly reported in peer-reviewed literature, and professional judgment were utilized when existing data was not available. This model was completed in 2014, giving park managers a new assessment method for evaluating the freshwater survival of coho salmon in Olema Creek. For example, summer juvenile coho estimates plotted against spring coho smolt estimates suggest a smolt production threshold. Using the Olema Creek model it was determined that a data gap exists for winter habitat on Olema Creek which may be a significant driver on overwintering coho survival. Models such as this one developed for Olema Creek are becoming a valuable management tool in the face of climate change and limited funds for salmonid restoration and monitoring.

Creating Rearing Habitat for ESA-Listed Coho Salmon with Multiple Life History Strategies

Michael Wallace, *California Department of Fish and Wildlife*

There has been a growing appreciation of the importance of the Stream-Estuary Ecotone (SEE) to juvenile coho salmon (*Oncorhynchus kisutch*) which has resulted in numerous habitat restoration projects being planned and completed in this habitat throughout northern and central California. This talk will present examples of various SEE restoration projects to improve habitat and restore access to Humboldt Bay tributaries. These projects occur throughout the entire continuum of the SEE, from brackish water through tidal freshwater to low gradient stream habitat in the lower portion of broad valley floors. The California Department of Fish and Wildlife (DFW) is sampling many of these projects to assess their performance and working with the restoration community to help design and improve future restoration projects. Initial results show that juvenile salmonids, especially coho salmon, moved into the newly restored sites as soon as they were accessible and water quality conditions allowed. The completed restoration projects in the lower portion of the SEE provided mostly over winter rearing habitat from December to June and individual juvenile coho reared at these sites for up to six months. DFW also found that juvenile coho captured in the SEE are larger than their cohorts rearing upstream in stream habitat and that restoring SEE habitat can benefit coho from the entire basin. This talk will show results of various SEE restoration techniques such as tide gate removal/modification, levee removal, and constructing or reconnecting off channel habitat. Providing access to and improving connections between small tributaries entering the SEE and creating off channel habitat appear to benefit juvenile salmonids.

Investigation of the Relationship between Physical Habitat and Salmonid Abundance in Two Coastal Northern California Streams

Sean Gallagher, *California Department of Fish and Wildlife*

Effective design and implementation of effective freshwater habitat restorations that improve conditions for coho salmon and other anadromous salmonids requires clear understanding of the relationships between fish abundance and stream habitat variables. In this study, we investigated the relationships between the variables of summer coho salmon and steelhead parr abundance and physical stream habitat in Caspar and Pudding Creeks in Mendocino County. The relationship between summer habitat and juvenile abundance were investigated using a stratified random experimental design. Our null hypothesis was that one or more of the habitat unit types and variables examined would be associated with salmonid abundance. We also examined habitat differences between the streams and tested our hypotheses regarding habitat variables and salmonid abundance, using two-way ANOVA (Analysis of Variance), factor analysis, and negative binomial regression modeling. The abundance of juvenile coho salmon and steelhead was positively associated with slow water, volume, and dry large wood abundance, and negatively associated with fast water habitat variables. Larger steelhead were also associated with cover habitat formed by wet and dry wood. We discuss our findings relative to the use of large wood in anadromous salmonid habitat recovery programs in California coastal watersheds.

The Effectiveness of Artificial Upstream Migration Flows for Coho Salmon

Eric Ettlinger, Marin Municipal Water District

The Marin Municipal Water District releases extra water into Lagunitas Creek to provide fall and winter "upstream migration flows" when rain does not provide adequate runoff to facilitate adult salmon migration. Assessing the effectiveness of these cold water releases is particularly important during critically dry years when water supplies are stretched. We analyzed 18 years of stream flow and spawner data, including time-lapse video monitoring, to assess the effectiveness of these water releases. With very few exceptions, these releases failed to trigger upstream migration or increase spawning. Even very small runoff events elicited stronger migration responses, indicating that water depth is not the most important factor for encouraging salmon to migrate in Lagunitas Creek. Opportunities to improve stream flow management and obstacles to change will be discussed.

Coho Salmon in a Spring Creek: Life History Tactics of Coho Salmon in the Shasta River and a Method for Quantifying Survival to Evaluate and Prioritize Restoration Efforts

Chris Adams, *California Department of Fish and Wildlife*

The Shasta River was historically among the top producers of coho salmon in the Klamath system. Its unique spring-dominated hydrology promotes rapid growth rates and provides consistent inter- and intra-annual flow. However, surface water diversions degrade the river and its salmonid habitat. A network of approximately 20 Passive Integrated Transponder tag detection stations have been in operation at key locations throughout the watershed for several years, providing detailed information on habitat use by tagged juvenile coho salmon. During periods of juvenile coho redistribution in early summer, we have documented extensive upstream movements to headwater springs, as well as extensive downstream movements to thermal refugial areas in the mid-Klamath. Some age-0 coho salmon grew to over 100 milimeters by June, when they appear to undergo smoltification and leave the Shasta River. A multi-state mark-recapture modeling framework has been established to estimate seasonal survival and movement parameters in different areas. These analyses have indicated that survival is lowest in summer and as high as 100% in winter. This data has been used to prioritize and evaluate restoration efforts including conservation of cold springs, tailwater reduction, riparian fencing, and coordination among diverters to reduce impacts on coho salmon habitat.

Juvenile Coho Salmon Exhibit Compensatory Mechanisms in a Large Volcanic Spring-fed River

Robert Lusardi, *UC Davis Center for Watershed Sciences*

Coho salmon in the Southern Oregon/Northern California Coast Evolutionarily Significant Unit (SONCC ESU) are currently listed as threatened under both the federal Endangered Species Act (ESA) and the California Endangered Species Act (CESA). Populations are depressed throughout the SONCC ESU, and in many watersheds all three brood-year lineages may have too few individuals to be self-sustaining. Consequently, there is an urgent need to identify and understand the habitats and ecological processes that can assist recovery planning and enhance viability. Recent thermal restoration on the Shasta River, a spring-fed tributary to the Lower Klamath River, has extended downstream rearing habitat for juvenile coho salmon. The longitudinal influence of cold water spring sources, rich in naturally-occurring nutrients, and their effects on the growth and prey availability of coho salmon were studied. Specifically, we quantified the growth and production of juvenile coho in five stream segments that differed in their spatial proximity to cold water spring sources on the Shasta River. We found strong differences in mean weekly maximum temperatures (MWMTs), invertebrate prey availability, and the growth and condition factor of juvenile coho salmon. Coho salmon reared in close proximity to springs experienced MWMTs ranging from 14.8°C to 16°C, that exhibited an apparent growth rate of 0.13 millimeters per day, and a 26% increase in mass, over the nine week study period. Conversely, individuals reared six kilometers downstream from cold water spring sources experienced MWMTs ranging from 17.6°C to 21°C, exhibited a growth rate of 0.27 millimeters per day, and a 161% increase in mass during the same period. Downstream individuals subjected to warmer water temperatures exhibited an 18% increase in fork length and two-fold increase in mass when compared with upstream individuals in closer proximity to spring sources. Our results indicate that juvenile coho salmon may have the ability to metabolically compensate for elevated water temperatures when food resources are near saturation. Moreover, our results suggest that volcanic spring-fed rivers may be areas of extraordinary intrinsic potential for the recovery of federally threatened coho salmon and should continue to be the focus of thermal restoration efforts.

Population Spatial Structure is an Essential Metric for Defining and Prioritizing Coho Salmon Restoration Projects

Justin Garwood, California Department of Fish and Wildlife

The spatial arrangement of resources across a landscape can have profound effects on species distribution. Resources are not randomly distributed, but reflect geological and geomorphic processes dictating physical and biological characteristics of fish habitat. For coho salmon, juvenile life stages are the most widely distributed across the riverscape, with patchy habitats being spatially and temporally dynamic. The spatial structure of a population refers both to the spatial distribution of individuals in the population and to the processes that generate that distribution. Winter and summer seasons represent distinctive time periods during which there is a high likelihood of contrasting stream habitat availability for juvenile coho salmon.

Understanding seasonal habitat patch size, utilization, connectivity, and colonization, and also the extinction processes affecting a population, will help managers define source patches, while also identifying isolated patches that are much more vulnerable to extinction. This information is critical to defining restoration goals that are based on current population distributions. Restoration of areas currently being used by coho salmon, or areas in close proximity to population centers, will likely have a rapid positive effect on productivity.

I developed an affordable snorkel survey protocol to sample juvenile coho salmon throughout a population space during the summer, using a randomly selected set of reaches with pools defined as the primary sampling unit. I applied multi-scaled occupancy models (i.e., Nichols et al. 2008) to estimate the probability of coho salmon occupancy simultaneously at two spatial scales, while accounting for detection probabilities. The larger scale corresponds to the probability of occupancy at the sample reach (ψ), whereas the smaller scale corresponds to the probability of occupancy at the sample pool (θ), given the species was present in the sample reach. Detection probability (p) is modeled at the smaller pool scale based on individual snorkel passes in each sampling unit. The advantage to modeling occupancy at two spatial scales in both landscape and local spatial distributions of a given species can be calculated while accounting for individual survey detection probabilities in a single framework. By tracking occupancy at both scales, the overall proportion of area occupied (PAO) can be determined for the population. Results from each year can be directly compared to assess the relative change in annual spatial structure. I will report on the first three years of spatial structure monitoring across four coho salmon populations in northern California and provide examples of prioritized restoration opportunities. I will also report on the recent development and application of annual PAO metrics in coastal plain and estuarine habitats employed during the winter.

What You Do Matters: The Latticework of Federal Listing Factors

Charlotte Ambrose, *California Programs Coordinator, NOAA Fisheries*

Section 4(a)(1) of the Federal Endangered Species Act requires Federal agencies to determine whether a species is endangered or threatened based on the threats associated with one or more of the following five factors: (1) The present or threatened destruction, modification, or curtailment of its habitat or range; (2) overutilization for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) the inadequacy of existing regulatory mechanisms; or (5) other natural or manmade factors affecting its continued existence. Section 4(b) also requires the determination be made on the basis of the best scientific and commercial data available after taking into account those efforts, if any, being made by any State or foreign nation, to protect such species.

In 2015, NOAA Fisheries will be conducting a five-year status review for all listed salmon and steelhead in the Pacific Northwest. This review will assess the accuracy of the listing classifications and determine if conditions have changed to warrant a delisting or status reclassification. To ensure that the five-year reviews are complete and based on the best available information, we are soliciting new information from the public, concerned governmental agencies, Tribes, the scientific community, industry, environmental entities, and any other interested parties concerning the status of salmon and steelhead and conservation efforts conducted to improve the threats associated with the five listing factors.

Specifically, we will be requesting new information that has become available since the respective species' previous status review on: (1) population abundance; (2) population productivity; (3) changes in species distribution or population spatial structure; (4) genetics or other diversity measures; (5) changes in habitat conditions; (6) conservation measures that have been implemented that benefit the species, including monitoring data demonstrating the effectiveness of such measures in addressing identified limiting factors or threats; (7) data concerning the status and trends of identified limiting factors or threats; (8) for Pacific salmon and steelhead, information on changes to hatchery programs that may affect their ESU or DPS membership; and (9) other new information, data, or corrections including, but not limited to, taxonomic or nomenclatural changes, identification of erroneous information in the previous listing determination, and improved analytical methods.

This presentation will provide an overview of the five-year status review process, how NOAA Fisheries reviews threats associated with the five listing factors, and how the innovative approaches of what you do (or not do) is evaluated against the Federal listing status of Pacific Northwest salmon and steelhead.

Bioengineering and Floodplain Restoration Projects on the Russian and Napa Rivers

Wednesday, March 11

Field Tour Coordinators*: Evan Engber, Bioengineering Associates, and Jorgen Blomberg, ESA PWA*

Bioengineering Associates will provide an overview of bioengineering techniques and a tour of two bioengineering restoration projects on the Russian River: the Asti winery and the Odd Fellows Recreation Club, which won the American Fisheries Society Western Division 2014 Award of Excellence in Riparian Management. These two sites feature a large number of bioengineering techniques used to rebuild large, damaged riparian areas.

In the afternoon, ESA PWA will lead a tour of the Napa River Restoration Rutherford Reach project which was designed to protect and enhance fish and wildlife habitat, reduce bank erosion, enhance flood management, and reduce Pierce's disease pressure on vineyards. This project is one of the most ambitious agricultural landowner-initiated ecosystem restoration projects to date in California which enhances 4.5 miles of habitat for endangered Chinook salmon and steelhead trout, using a combination of selective grading to create inset floodplain benches, instream structures (unanchored large woody debris), berm setbacks, and invasive plant removal and native species revegetation.

Lagunitas Creek Watershed: Stem to Stern Salmon Enhancement

Wednesday, March 11

Field Tour Coordinators: ***Ross Taylor,*** *Ross Taylor and Associates;*
and ***Greg Andrew,*** *Fisheries Program Manager, Marin Municipal Water District*

Lagunitas Creek in western Marin County is a coastal watershed with a drainage area of approximately 100 square miles. Lagunitas Creek supports the largest and most stable population of endangered coho salmon in central California, as well as a robust population of threatened steelhead trout. Numerous habitat restoration efforts and monitoring studies are ongoing which are consistent with the California Department of Fish and Wildlife's Recovery Strategy for California Coho Salmon and the federal Recovery Plan for Central California Coastal Coho Salmon.

This field tour will travel from the estuary to the headwaters and will highlight the following types of restoration activities:

- Estuary/Wetlands: we will visit the recently restored Giacomini wetlands project within the tidally-influenced estuary of lower Lagunitas Creek and Tomales Bay. These areas are important nursery areas for juvenile salmonids making the transition from the freshwater environment to the ocean environment.
- Erosion Control: we will examine completed road drainage improvement and bank stabilization projects that were implemented to reduce the introduction of fine sediments to important spawning reaches.
- Fish Passage: we will stop at two locations where migration barriers at road crossings were treated to improve the upstream passage of adult and juvenile salmonids. These sites will offer the contrasting treatments of full replacement and retrofit of existing infrastructure.
- In-Channel Habitat: we will examine in-channel large woody debris structures placed to improve pool habitat for summer rearing juvenile coho salmon.
- Off-Channel Habitat: we will a stop at a location where off-channel alcove habitat was created. These areas provide over-wintering juvenile salmonids with important refuge from high flow events and are recognized as features that address a limiting factor for coho salmon in many coastal California watersheds.

Large Wood Placement Methodologies Field Tour

Wednesday, March 11

Field Tour Coordinators: ***John Green,*** *Lead Scientist, Gold Ridge Resource Conservation District;* ***Lauren Hammack****, Principal and Fluvial Geomorphologist, Prunuske Chatham, Inc.; and* ***Chris Blencowe,*** *Blencowe Watershed Management*

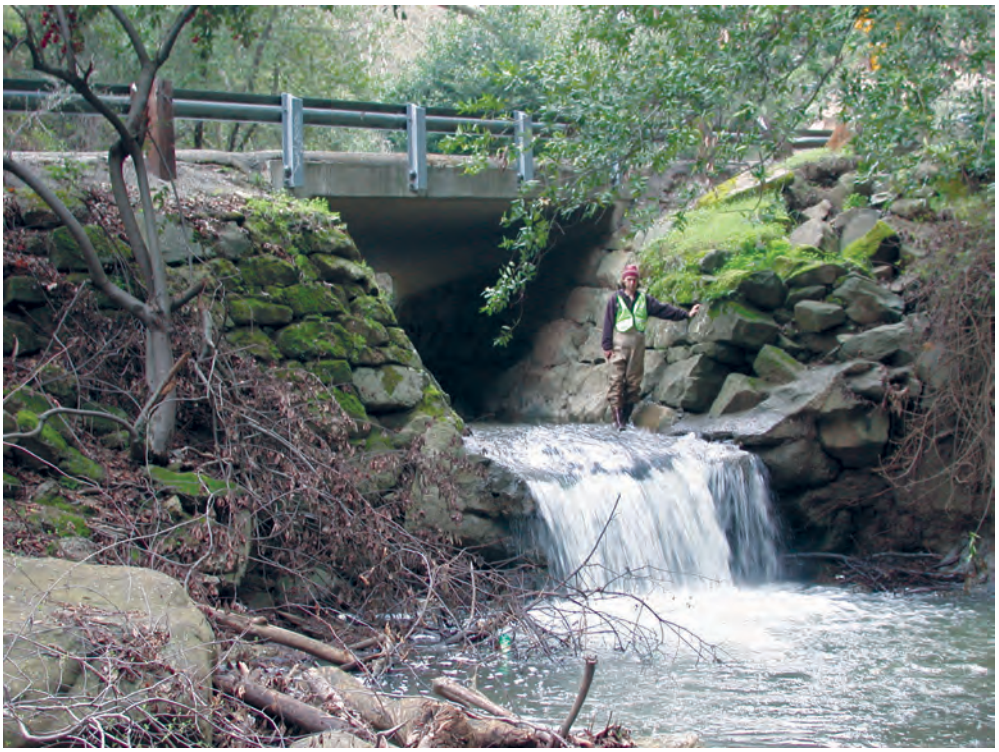
The absence of naturally recruited wood in stream channels has resulted in simplified stream channels and degraded habitat in salmonid watersheds throughout the Pacific region. Wood has historically been removed from streams because of fear of bank erosion and flooding, or through "stream cleaning," riparian forest clearing, and other management practices. Over the past couple of decades, the placement of large wood in stream channels has been widely used to provide for channel and habitat complexity until natural wood recruitment occurs. Large wood placement in different settings requires a variety of approaches, ranging from unanchored logs and trees to engineered wood structures with substantial anchoring. On this tour, we will visit project sites in western Sonoma County where different methods have been used to return large wood to stream channels, and discuss the effectiveness, feasibility, advantages, and disadvantages of each method, as well as their relative cost in various settings.

Fish Passage and Protection Using a Watershed-Scale Perspective

Thursday, March 12

Workshop Coordinator*: Michael Love,* *Michael Love and Associates*

In many watersheds, historical land use and water resources management activities created conditions that impede anadromous salmonid migrations, prevent full utilization of spawning and rearing habitat, and endanger offspring survival. Impediments can be the stereotypical dam or culvert, unscreened water intakes, or inadequate in-stream flows that lead to insufficient depth and delays to spawning migrations. Recovery of anadromous salmonid populations within a watershed often requires addressing multiple impediments in a coordinated effort involving multiple stakeholders. The workshop will focus on collaborative efforts to address fish passage and protection on a watershed basis. Case histories will be used to demonstrate how successful planning among multiple stakeholders concerning fish passage, screening, operations, and in-stream flows has led to substantial on-the-ground improvements for fish. Presenters will also highlight some of the institutional challenges still impeding these efforts, and propose solutions to them. Presenters will also describe some of the technical analysis and solutions used to restore fish populations, including operational changes to existing dams, modifications of natural barriers, fish routing and energetics, and innovative fishways to accommodate more complex water management strategies.



Watershed Scale Passage: Exploring Missing or Weak Links—What Has and Has Not Worked?

Marcin Whitman, California Department of Fish and Wildlife

This talk will provide an overview of sites where a watershed approach has been taken, or should have been taken, in the past, and what we can learn from this. We will examine such issues as the following:

- How approaches differ, depending on the size, number, and characters of landowners in a watershed
- The role of non-governmental organizations, Resource Conservation Districts, and others in serving as expediters, trusted brokers, foundations of continuity, and repositories of knowledge
- Examples of where watershed and regional planning has served effectively and where it has mis-stepped
- Uses and limitations of the Passage Assessment Database
- What tools in the toolbox (including ones from outside California) are not being used, why not, and whether such tools should be reconsidered

Fish Passage Forum: Identifying Physical Barriers to Fish Passage and Social Barriers to Remediation

Michael Bowen (Presenter), *Coastal Conservancy;* ***Kevin Shaffer,*** *California Department of Fish and Wildlife;* ***Bob Pagliuco****, NOAA Fisheries; and* ***Lisa DeBruyckere,*** *Fish Passage Forum*

Remediating barriers to fish passage is widely accepted as a successful means to restore fragmented aquatic habitat and recover listed anadromous salmonids. State and federal recovery plans underscore the need to provide fish passage at high priority barriers, and millions of dollars of public funds have been spent in pursuit of this goal. However, achieving this goal has been challenging for technical, biological, and social reasons. Moreover, the prioritization of barriers has been hampered by issues ranging from a lack of available data to a lack of a general agreement on the criteria for setting priorities.

The mission of the California Fish Passage Forum is to protect and restore listed anadromous salmonid species and other aquatic organisms in California by promoting collaboration among public and private sectors for fish passage improvement projects and programs. The goal of the Forum is to restore connectivity of freshwater habitats throughout the historic range of anadromous fish.

The Forum coordinates among agency programs and private sector activities to target high priority projects and to improve the timeliness and cost-effectiveness of fish passage. Overall, the Forum seeks to expedite the removal of barriers to fish passage by achieving consensus on technical, biological, and social priorities for barrier remediation.

Forum efforts have included the collaborative development of the Passage Assessment Database, extensive discussion regarding procedural hurdles to barrier remediation, development of protocols to monitor the efficacy of projects, and cooperative efforts to prioritize barrier removal projects. More recently, the Forum has also disbursed small grants to support fish passage improvement projects. In addition, the Forum plays an important convening role, bringing together partners, landowners, and others to discuss project-specific challenges and consensus-building solutions.

Juvenile Coho Salmon and Steelhead Leap Test

David White (Presenter), NOAA Fisheries; Benjamin C. White, United States Army Corps of Engineers, Warm Springs Hatchery; and Chelle L. Gentemann, Remote Sensing Systems

Recent literature documents that juvenile salmonids are mobile within watersheds in order to utilize different habitats, access better water quality, forage, disperse from competitors and predators, and seek refuge from high water velocities during storm events. In many cases, adult and juvenile salmonids face waterfalls of various heights while attempting to migrate upstream. These waterfalls are often caused by man-made structures (e.g., dams and road culverts) or other anthropogenic effects. While the leaping abilities of adult salmonids have been extensively documented, little information exists on the leaping abilities of juveniles. This gap in our knowledge has resulted in inconsistent state and federal guidelines for juvenile salmonids regarding appropriate design jump heights at fish passage facilities. Additionally, not understanding the leaping abilities of juveniles may either result in costly over-engineered fish passage facilities or inadvertent blockages of appropriate spawning habitat. To directly document the leaping abilities of juvenile salmonids, we tested groups of 100 juvenile coho salmon and steelhead at the Warm Springs Hatchery in Geyserville, California. Success was measured by the number of fish upstream of the jump at the end of the test period. We found that juveniles were able to ascend heights never documented before. We found that similar numbers of fish ascended the six inch and 12 inch jump heights, that steelhead were generally more successful leapers than coho salmon of a similar size, and that success for both species was related to fish length and weight. We also recorded leaping attempts above water and underwater on video to study leaping behavior. The results of this study have implications regarding the appropriate design of fish passage facilities, especially for juvenile salmonids.

Achieving Comprehensive Fish Passage in a Sub-Basin of the Eel River

Ross Taylor, Ross Taylor and Associates

Fish passage through stream crossings (especially culverts) and over dams is an important factor in the recovery of depleted salmonid populations throughout the Pacific Northwest. Although most fish-bearing streams with culverts at stream crossings tend to be relatively small in size with only a couple of miles or less of upstream habitat, thousands of these exist and the cumulative effect of blocked habitat is probably quite significant. One of the challenges in opening up significant reaches of blocked habitat is that many streams are crossed by multiple roads with culverts, often managed by a variety of entities. Thus, prioritization and coordination are vital to achieving comprehensive fish passage in any given watershed.

Ryan Creek is a 2.5 square mile tributary to Outlet Creek (a tributary to the Eel River) located in Mendocino County just north of Willits. Ryan Creek has approximately 2.8 miles of anadromous salmonid habitat within two main forks and the following fish species have been documented in the creek: coho salmon, Chinook salmon, steelhead, Pacific lamprey, and sculpin. According to the United States Geological Survey topographic map, nine stream crossings are shown within the potential fish-bearing stream reaches. Crossing ownership includes: Northwestern Pacific Railroad, Mendocino County Department of Transportation, the California Department of Transportation, and various private property owners.

Fish passage assessments in the early 2000s identified the County-maintained crossing on Ryan Creek Road and the Highway 101 culvert on the north fork of Ryan Creek as the highest priority passage impediments. Additionally, a private culvert on the south fork above Highway 101 was qualitatively identified as a potential migration barrier.

Besides coordination with multiple road owners, other challenges in implementing fish passage projects on Ryan Creek included the following:

- Recognizing the proximity of the crossings to each other and the potential for channel head-cutting or aggradation in adjacent channel reaches
- Integrating instream habitat structures into an impacted channel reach between Ryan Creek Road and Highway 101
- Obtaining landowner access to conduct post-project biological sampling

Manastash Creek Restoration Program: Dams, Diversions, and Instream Flow

Michael Garello, P.E., Senior Water Resources and Fisheries Engineer, HDR Engineering, Inc.

An ideal tool for implementing watershed based approaches to restoration is to foster a process where consensus among all project stakeholders and a balance between the environment and private land use can occur. The process of obtaining consensus can often take decades, a great deal of patience, and a genuine commitment from all involved. The results can sometimes be gratifying as landowners, irrigators, special districts, resource agencies, and non-governmental organizations walk away at the end of the day as partners, all with a tally in the win column. However, beyond the rose-colored glasses, decision periods can be lengthy, project budgets can run dry, and patience can often wear thin, causing periods of distrust and stagnation. The Manastash Creek Restoration Program in Ellensburg, Washington is a strong example of how project adversaries have learned to work together and implement important projects that benefit the recovery of sensitive-endangered fish species such as bull trout and steelhead trout.

The objective of the Manastash Creek Restoration Program is to restore upstream and downstream fish passage along Manastash Creek and increase instream flow by upgrading and/or consolidating six 80-year old stream diversions to meet current National Marine Fisheries Service (NMFS) and Washington Department of Fish and Wildlife (WDFW) standards, removing five partial and total fish passage barriers, implementing several irrigation and water conveyance efficiency projects, enacting trust-water purchase opportunities, and developing in-stream habitat that was once lost over years of degradation. After project implementation, endangered bull trout and steelhead trout will have access to 30 miles of high quality spawning and rearing habitat that has been inaccessible for over 100 years. The area, however, is a hotbed of political agendas, water shortages, degraded fishery resources, tribal law, and traditional agricultural values. The project would not have moved forward without the formation of a system that allowed stakeholders to work out their differences while bringing the right balance of technical problem solving and money to the table.

The Manastash Restoration Steering Committee was formed in 2001 to facilitate the implementation of the Manastash Creek Restoration Program using the term "consensus" as their primary ground rule. This Steering Committee consisted of representatives of seven irrigation distribution systems, the Washington Department of Ecology, WDFW, Washington Environmental Council, Kittitas Reclamation District, US Bureau of Reclamation, NMFS, and the Yakama Nation. Not a single step forward was taken until each member of the Steering Committee Board agreed on the proposed plan of action. Throughout the course of plan development and project implementation, members honored their commitment to exhibit patience, learn to trust one another, and respect the viewpoints of one another. After years of facilitation by the Kittitas County Conservation District and collaboration among the Steering Committee, five major project components of this program have been implemented. A project that began as a class action lawsuit between three members of the Steering Committee is emerging as a potential success story.

NMFS-Sponsored Studies for Anadromous Fish Reintroduction in the Upper Yuba River Watershed, 2010-2014

Rick Wantuck, NOAA Fisheries

A presentation on the comprehensive set of Yuba River studies completed between 2010 and 2014, sponsored by the National Marine Fisheries Service (NMFS) and its contract consultants, including topics such as Anadromous Fish Passage, Dam Removal or Modification, Habitat Productivity, Salmonid Life Cycle Models, and Reintroduction Plans.

Following is a list of the subject studies sponsored by NMFS:

- Yuba River Fish Passage: Conceptual Engineering Project Options (Montgomery-Watson-Harza, 2010)
- Modeling Habitat Capacity and Population Productivity for Spring-run Chinook Salmon and Steelhead in the Upper Yuba River Watershed, (Stillwater Sciences, 2012 and 2013)
- Modeling Sediment Transport Dynamics and Evaluating Flood Risks in the Yuba and Feather Rivers, California, Following Modifications of Englebright and Daguerre Point Dams, Technical Report (Stillwater Sciences, June 2013)
- Yuba River Fish Passage Improvement Investigation,
- (Gathard Engineering Consulting, May 2014)
- Upper Yuba River Anadromous Salmonid Reintroduction Plan,
- (R2 Resources, Stillwater Sciences, QEDA Consulting, NMFS February 2014)

NMFS sponsored six contract studies between 2010 and 2014 to enable the construction of a reintroduction plan for spring-run Chinook salmon and steelhead in the upper Yuba River watershed. Six consulting firms worked collaboratively with NMFS and other knowledgeable stakeholders to develop various conceptual plans for fish passage, habitat assessment models, a salmonid life-cycle model, and an adaptive management framework for a phased anadromous salmonid reintroduction plan. This presentation will touch on key highlights of the studies, with particular focus on the life-cycle modeling approach and the recommendations of the resultant *Upper Yuba River Reintroduction Plan.*

Upper Yuba River Anadromous Salmonid Reintroduction Plan

Noble Hendrix (Presenter), *QEDA Consulting;* ***Phil Hilgert,*** *R2 Resource Consultants, Inc.; and* ***A.J. Keith,*** *Stillwater Sciences, Inc.*

The successful reintroduction of spring-run Chinook salmon to the Upper Yuba River was evaluated using information on the distribution and quality of existing habitat, connectivity between upstream and downstream sub-basins, and life-cycle modeling to assess the opportunity to establish self-sustaining runs. In addition to the intrinsic production potential and survival prospects for early life stages, survival rates during the outmigration and estuarine/ocean phases of the life-cycle will also determine the viability of self-sustaining runs. The life-cycle model evaluated two passage scenarios: (1) an upstream and downstream collection and transport program to the North Yuba, and (2) construction of a fish ladder and juvenile downstream passage facilities at Englebright Dam and upstream and downstream passage facilities at Our House on the Middle Yuba. Life-cycle model results indicated that providing successful fish passage (via collection and transport methods) to the North Yuba could support self-sustaining populations of spring-run Chinook salmon under dry, wet, and average flow conditions. Passage at Englebright Dam would require improved hydrologic flows and habitat enhancements to support self-sustaining populations. An initial pilot experimentation phase (first 2-3 years) is recommended to conduct studies to validate assumptions and identify critical uncertainties that affect the likelihood of successful reintroductions. A short-term reintroduction phase (9-12 years) should focus on evaluating population dynamics (survival, reproduction, migration) and fish passage facility performance. Finally, a long-term reintroduction phase should focus on improving performance of the fish passage system and understanding the likelihood of long-term viability of the reintroduced population. A successful reintroduction will require iterative experimentation and refinement and an adaptive management framework to structure the information obtained from monitoring and experiments at each phase of the reintroduction.

The Importance of Alameda Creek within NMFS' Recovery Planning Framework and Ongoing Efforts to Return Steelhead Trout to the Watershed

Joshua Fuller and Amanda Morrison (Co-presenters), NOAA Fisheries, West Coast Region

The Alameda Creek watershed is approximately 700 square miles, making it the largest drainage area within the San Francisco Bay Area outside the Sacramento-San Joaquin system. Historically, Alameda Creek supported viable returns of steelhead trout, however, due to major landscape alterations and significant fish passage barriers, steelhead have not had volitional access to the watershed since 1972. In 1997, Central California Coastal steelhead were listed under the Federal Endangered Species Act as threatened, and starting in 1999, major efforts to restore steelhead to Alameda Creek began. Over the past 15 years, extensive efforts by non-governmental organizations, resource agencies, and private and public utilities have greatly enhanced our understanding of the watershed and the challenges that exist. Though some priority barriers have been removed or remedied in the watershed, a few of the highest priority fish barriers remain. In 2011, the National Marine Fisheries Service and California Department of Fish and Wildlife issued their respective regulatory documents on the San Francisco Public Utilities Commission's Calaveras Dam Rebuild Project, which prescribe significant actions that support the recovery of steelhead to Alameda Creek. This milestone signifies a major step towards rehabilitating the watershed in light of steelhead recovery and ensures implementation of key fish passage facilities and the associated flow prescriptions. Additionally, the highest priority barrier, the BART Weir, has 100% completed designs, and the issuance of the necessary regulatory documents for this project is underway. The approach to these fish passage projects and recovery of steelhead in Alameda Creek are extremely complicated when balancing the constraints of a highly modified and engineered system with the watershed needs of anadromous steelhead trout.

Applying the Ecosystem and Diagnosis and Treatment Method in Alameda Creek: A Moving-Window Habitat Analysis to Explore Population Impacts of Passage Barriers and Their Removal

Grant Novak, ICF International

Prioritization of fish passage barrier removal and repair is an increasingly important topic in the recovery of fish populations. Fish recovery plans often include barrier removal as a strategy to improve population success by making additional habitat available, but they rarely provide a method for prioritizing barrier repair and removal. Determining which barrier removal projects would have the greatest benefit to fish populations is a complex challenge. While some barriers are complete, and obvious candidates for removal, it is often the case that barriers are partially passable based on seasonal flows, swimming abilities of various life stages, direction of migration, etc. The Ecosystem Diagnosis and Treatment (EDT) method gives fisheries biologists and restoration planners the ability to incorporate their understanding of fish movement and timing, flows (both measured and modeled), passage requirements of various life stages, and habitat requirements of various life stages into a science based approach to make conclusions about population and/or watershed level effects of barriers to fish populations. The EDT method was applied in Alameda Creek to aid the San Francisco Public Utilities Commission in the development of their Alameda Watershed Habitat Conservation Plan.

Would repair of a structure that is a partial barrier to upstream migrating steelhead during summer low flows benefit the population? What if the barrier was a partial barrier during high flows? How would its repair impact the population relative to the repair of another partial barrier?

By applying the most recent knowledge of fish movement and timing, the EDT method delivers results that allow managers to quantify benefits due to barrier removal at the watershed and fish population level. Because the EDT method is a modeled framework, it easily allows the end-user to apply a variety of hypothetical scenarios including modeled flows, various barrier removal designs or modification, and proposed habitat quality and quantity improvements in order to account for potential effects, not just at the local reach level but, most importantly, at the watershed and population scale.

Addressing Fish Passage Improvements in Lower Alameda Creek

Steven Allen (Co-presenter) and Travis James, GHD; and Shane O'Nesky and Therese Wooding (Co-presenters), Alameda County Water District

The Alameda County Water District (ACWD) and the Alameda County Flood Control and Water Conservation District are working together to provide fish passage improvements in the Alameda County Flood Control Channel located in the lower portion of Alameda Creek. These projects are part of a basin-wide effort to restore native steelhead runs to Alameda Creek.

ACWD has several facilities in and around lower Alameda Creek to help provide groundwater recharge and ultimately provide potable water to the adjacent cities of Fremont, Newark, and Union City. ACWD has been actively involved in improving fish passage conditions around their facilities for well over a decade. Several projects have been completed and several more projects are in progress to improve fish passage conditions. The improvements are all intended to allow steelhead trout and other threatened or endangered fish species to more easily and safely migrate upstream and downstream through lower Alameda Creek.

Previously completed fish passage projects include the Alameda Creek Pipeline No. 1 Fish Screen, Bunting Pond Fish Screen, the Rubber Dam No. 2 Decommissioning and Foundation Modification Project, and the Kaiser Pond Fish Screen. Current fish passage projects include the Rubber Dam No. 1 and Flood Control Drop Structure Fish Ladder, the Rubber Dam No. 3 Fish Ladder, and the Shinn Pond Fish Screen.

This presentation will focus on the current fish passage improvement projects being developed at Rubber Dam No. 1 and Rubber Dam No. 3. Both proposed facilities are similar in nature in part due to their shared goal of providing for fish passage past channel spanning inflatable rubber dams when fully inflated. Passage must be provided not only when the dams are fully inflated, but also during the transition during inflation and deflation, which presents certain challenges. The new facilities need to improve both upstream and downstream passage conditions during operation of the rubber dams.

The general operations of the facilities in lower Alameda Creek are fairly straightforward. The reality of operating these facilities year-round during different flow conditions becomes more complex. ACWD will provide an overview of their operations to share the challenges they face delivering water to local municipalities and the actions they are taking to improve fish passage conditions.

GHD will provide an overview of the technical solutions the design team has developed to improve fish passage conditions at these two sites. The design team includes GHD, Michael Love and Associates, Kozmo Bates, and Kleinfelder. Improvements at both sites include a vertical slot fishway, multiple fishway exits at multiple elevations, a downstream juvenile spillway, and plunge pools directly downstream of the rubber dams. Improvements at Rubber Dam No. 1 also had to address an additional vertical drop over a concrete drop structure. Additional project elements at this location included a transition pool, transition channel, and an additional fishway to help fish migrate past the downstream concrete apron and energy dissipaters.

The presentation will include pictures of the existing facilities, plan views of the proposed facilities, details about certain components, and a three-dimensional tour of the proposed facilities at Rubber Dam No. 1.

Restoring Access to Alameda Creek's Lowest Steelhead Tributary

Leslie Koenig (Co-Presenter), Alameda Resource Conservation District;
Michael Love (Co-Presenter), Rachel Shea, Michael Love and Associates;
and Katie Bergmann, Natural Resources Conservation Service

Stonybrook Creek drains a 6.7 square mile watershed and drains into the Niles Canyon reach of Alameda Creek, which flows into San Francisco. The lower 2.25 miles of Stonybrook Creek flows through a steep, boulder and bedrock dominated canyon and is crisscrossed numerous times by a county road. Planning was initiated in 1999 to recover anadromous steelhead in the Alameda Creek watershed, including removing the keystone barrier located in the downstream flood control channel. Once addressed, Stonybrook Creek is the first potential spawning tributary migrating steelhead will encounter in the system.

Stonybrook Creek was one of the first Alameda Creek tributaries assessed for habitat and migration barriers. Assessments found suitable spawning and year-round rearing habitat within Stonybrook Canyon. However, a 2001 fish passage assessment found the lower 2.25 miles of channel contains one California Department of Transportation, five county, and three private culvert crossings, with most of the county crossings being considered total barriers. In 1999, a pair of radio -tagged adult steelhead released in Niles Canyon migrated into Stonybrook Creek and spawned immediately downstream of the first encountered severe culvert barrier, demonstrating the need to improve passage conditions as part of overall recovery efforts.

Through coordinated efforts by the stakeholder lead Alameda Creek Fisheries Working Group, a strategic plan for addressing the Stonybrook Creek barriers was developed in 2010. This document summarized the multiple barrier assessments that occurred throughout the watershed between 2001 and 2005, considered how location and severity of each barrier may inhibit potential steelhead life history tactics, and then prioritized stream crossing replacements and retrofits. It also developed planning level cost estimates for addressing the top eight crossings, with consideration of cost escalation for construction through 2020.

Beginning in 2012, the County and the Alameda RCD secured funding from multiple sources to address the two highest priorities for restoring fish passage in Stonybrook Creek. Due to limited funds, one of the culverts will be retrofitted with fish baffles while the other will be replaced with a channel spanning bridge. Both crossings will require restoring the channel profile, which includes using salvaged boulders to reconstruct the steps, pools, and cascades found throughout the upstream reference reach. Design plans have been finalized and permitting is underway. Permitting challenges have included concerns about predation of red legged frogs by reintroduction of steelhead, purchase of permanent easements for monitoring and maintenance, establishment of an inspection and maintenance plan, and the on-going responsibilities that it designates.

Through careful planning and persistence, it is expected that the lower 1.84 miles of Stonybrook Creek will be accessible to adult steelhead when the keystone barrier on Alameda Creek is eliminated in 2016.

A Watershed Approach to Fish Passage Feasibility (Calaveras Dam Case Study)

Jon Stead (Presenter), AECOM, and Steve Leach, URS Corporation; and Craig Freeman, San Francisco Public Utilities Commission

The Calaveras Dam Replacement Project involves design and construction of an embankment replacing the 220 foot-high Calaveras Dam that impounds Calaveras Reservoir. This is the largest drinking water storage reservoir in the San Francisco Bay Area, for the San Francisco Public Utility Commission (SFPUC) Hetch Hetchy Regional Water System. The dam is located in a region containing sensitive habitats and special-status species, including Central California Coast steelhead. Regulatory requirements for construction of the replacement dam prompted SFPUC to evaluate dam operations and aquatic habitat conditions in the watershed. In pursuit of project approval, the project team evaluated fish passage issues (both man-made and natural) downstream, at, and upstream of the replacement dam in order to identify feasible measures that SFPUC could implement as part of the project and balance with water supply requirements. One complicated alternative (a fish ladder over the replacement dam) was examined, demonstrated to be infeasible, removed from consideration by regulatory agencies, and dropped as a proposal by members of the concerned public. Other fish passage options at alternate locations were examined and determined to be feasible and consistent with the operation of the replacement Calaveras Dam, leading to acquisition of required resource agency permits for construction and operation of the project, as well as gaining support of the project by members of the concerned public. Early initiation of the studies conducted at other locations in the watershed was critical to provision of information in a timely manner that allowed completion of the environmental and permitting processes without delays to the overall project schedule.

Arroyo Mocho Stanley Reach Pilot Project: Floods, Fish, and Finance

Elke Rank (Presenter) and Carol Mahoney, Zone 7 Water Agency;
and Phil Stevens, Executive Director, Urban Creeks Council

Arroyo Mocho has been mined for aggregate, widened, moved, and straightened throughout the last century to accommodate urbanization. Fish passage barriers and channels choked with non-native grasses are common and offer little aesthetic, habitat, or water quality benefits. The financing of restoration projects can be challenging for flood control agencies. Even more challenging is retrofitting decades-old engineered channels to function as natural fluvial and ecological environments without giving up critical flood protection, sediment management, or water supply functions.

This Project is intended to demonstrate the feasibility of transforming an earthen trapezoidal channel into a vegetated stream exhibiting natural fluvial and ecological function, while also maintaining its functionality for flood protection, sediment management, and groundwater recharge. It also explores the use of mitigation funds to facilitate construction and maintenance.

In 2013, the Project replaced concrete and grouted structures in a nearly one-mile stretch of Arroyo Mocho with rock and vegetative structures to allow potential fish passage and dampen stream velocities. Planting 12 acres of streamside vegetation, currently underway, will further stabilize banks, reduce velocities, and increase habitat value. Through a newly formed partnership, "Living Arroyos," trained apprentices and community volunteers will carry out much of the planting and the vegetation maintenance as a way to increase community knowledge and "ownership" of local streams. Zone 7 collaborated with the Resources Agencies to find suitable mitigation dollars from other offsite projects and agencies.

Construction was completed in 2013. Given the very dry drought conditions since construction, exacerbated by an interruption in otherwise normal summer flow releases to Arroyo Mocho, a true test of the fluvial function of this project has not yet occurred. Planting of the channel and banks was completed in 2014, and the final step of seeding with native grasses is expected to occur in early 2015. The drought conditions have taken a toll on the plants, and an arduous program of hand watering, using local recycled water, was carried out over the summer months to ensure their survival.

As of Fall 2014, we have secured mitigation dollars from one local agency to support the cost of this project; with consent from the Regional Water Quality Control Board, this agency made a payment to Zone 7 and in return was granted mitigation credit for an unrelated project in the Valley.

This project is the first of its kind for Zone 7. It would not have happened without a "champion" at the agency to gently nudge the status quo. While only time will tell the true success of the design, it does seem clear (given the number of inquiries from outside parties) that there is a real need for projects like this that offer mitigation opportunities.

In light of the non-traditional approach to design, funding, and construction methods (e.g., use of community volunteers), the Project will encourage Zone 7 to expand beyond its conventional methods and experiment with new ways of carrying out its mission.

Overcoming Challenges with the Strawberry Creek Watershed-Scale Habitat Restoration

Rachel Shea (Presenter), *Engineering Geomorphologist, and* ***Michael Love****, Michael Love and Associates;* ***Darci Short,*** *Redwood National Park; and* ***Mitch Farro,*** *Pacific Coast Fish, Wildlife, and Wetlands Restoration Association*

This presentation will discuss how multiple project challenges were overcome while planning and implementing a multi-step, multi-organization restoration effort for 9,000 feet of Strawberry Creek that encompasses both public and private lands. Implementation has been ongoing since 2007. Project planning and implementation has focused on identifying and addressing the physical and vegetative constraints resulting from historical land use practices that compromise fisheries habitat and geomorphic function of the stream. These constraints included undersized and perched channel crossings, excessive sedimentation in the stream, decreased riparian area, grazing impacts, and the spread of invasive *glyceria* and reed canary grass (*Phalaris arundinacea*), which physically block fish passage, degrade water quality, and prevent native riparian growth. The undersized crossings and the presence of the invasive grasses in the channel also cause chronic out-of-bank flooding of adjacent ranchlands, limiting productivity and threatening livestock safety.

Strawberry Creek is located within the northwestern portion of Humboldt County and is a tributary to the Redwood Creek estuary. The Redwood Creek basin, including Strawberry Creek, is identified as a specific hydrologic unit in both the California Department of Fish and Wildlife and National Marine Fisheries Service Coho Recovery Plans because it constitutes a unique and important component in the Southern Oregon-Northern California Coast Evolutionarily Significant Unit of coho salmon. Strawberry Creek is relatively small, with a drainage area of 2.1 square miles, but it historically supported coho, steelhead, and a large sea-run cutthroat trout population. Strawberry Creek has the potential to play a significant role in recovering salmonid populations within the larger Redwood Creek basin. Due to flood control levees, Strawberry Creek is the only remaining tributary to the Redwood Creek estuary with opportunities to expand rearing habitat.

Initial project planning entailed a reconnaissance level evaluation of limiting factors throughout the entire 9,000-foot reach of stream that flows from the base of the hillslope across the valley bottom. This reach flows through three private landownerships and lands managed by Humboldt County, California Department of Transportation, and Redwood National Park. Prioritization of restoration sites was based generally on first implementing work that would improve channel capacity and reduce water levels sufficiently to reestablish riparian areas that will ultimately out-compete the invasive grasses. These included physical removal of invasive grasses, riparian area reestablishment, and stream crossing upgrades. To be most effective, implementation was recommended in a downstream to upstream sequence. Other improvements recommended included livestock exclusion fencing, upslope sediment reduction, and channel and wetland restoration.

The actual sequence of implementation was affected by numerous challenges. These included obtaining landowner trust and cooperation regarding restoration on their properties, obtaining funding for implementation and maintenance, infrastructure conflicts, and obtaining environmental compliance in an area containing numerous threatened and endangered species. Additional challenges were encountered during project implementation associated with working in a ponded wetland, timing constraints imposed by song bird presence, unexpected beaver impacts, and ongoing removal and control of invasive grasses with limited funding.

Implementation of a Multifaceted Fish Passage Improvement Project on the Russian River

Jonathon Mann (Co-Presenter) HDR,
and Steve Koldis (Co-Presenter), Sonoma County Water Agency

The study and design for the Mirabel Fish Screen and Fish Ladder Replacement project in Sonoma County has been underway since 1999, with the last three years in final engineering. Along the way, many challenges of the project site have been investigated and designs put into place for remediation. Ground improvements construction to address geotechnical concerns at the site is now complete as site challenges continue to evolve during current construction of the fish passage improvements. The evolution of the ground and fish passage improvements designs, along with the many facets of the project site and challenges of managing the project through implementation, will be presented. The project includes a new contemporary fish screen system at the intake for the 11 foot high bladder dam, increased bypass flow control and capacity, and a bypass fishway in the form of a vertical slot fish ladder for significantly improved fish migration past the dam. The fish ladder also includes a large public viewing gallery with windows to the ladder for enhanced public education and a more intimate experience with fish. The expected fish passage performance and challenges of public access design will be highlighted. The project is currently in construction with completion expected in the summer of 2015.

Captive Broodstock Symposium and Warm Springs Hatchery Tour

Thursday, March 12

Workshop Coordinators: *Erik Sturm, NOAA Fisheries, and Benjamin White, U.S. Army Corps of Engineers*

This workshop will explore the purpose, regulations, genetic implications, and other key issues commonly associated with captive broodstock programs, regardless of species. Talks will address the use of captive broodstock programs to aid species recovery, genetic issues inherent in captive rearing, experimental use captive broodstock to inform conservation and recovery, and spawning issues that arise in captive broodstock programs. Moreover, panel discussions after each series of talks will allow audience members the opportunity to interact and ask in-depth questions from the presenters. Finally, the workshop will conclude with a field trip to Warm Springs Hatchery on Lake Sonoma. This tour will highlight the coho salmon captive broodstock program run by the United States Army Corps of Engineers and the efforts needed to keep this species from going extinct in the Russian River drainage.

A Closer Look at the Release Strategies of a Captive Broodstock Program

Benjamin White and Rory Taylor (Co-Presenters), Warm Springs Hatchery, U.S. Army Corps of Engineers; and Mariska Obedzinski, UC Cooperative Extension, California Sea Grant

As part of a multi-agency recovery effort, the Russian River Coho Salmon Captive Broodstock Program began releasing juvenile coho into multiple tributaries of the Russian River in 2004. Since then, over one million juvenile coho have been released throughout the Russian River watershed using a variety of different release strategies aimed at promoting the re-establishment of self-sustaining runs of coho salmon into native habitat. Coho are released at various life-stages with the goal that they will imprint on their designated release stream, and ultimately return to that same stream as spawning adults two years later. Early on in the program, the primary release strategy was to hike the fish into the streams using water-filled backpacks during the spring and fall of their first year (as fingerlings and advanced fingerlings). This allows the fish to spend between six and nine months in their designated release stream prior to out-migration to the ocean. Benefits of this strategy include natural imprinting and selection processes and reduced time in the hatchery environment to help avoid domestication effects. With the continual threat of drought-like conditions in the Russian River basin, drawbacks of this strategy include potentially low freshwater survival rates which result in fewer out-migrating smolts and in turn fewer returning adults. To help counter this, the program has added new release strategies that include smolt and pre-smolt releases. For the smolt releases, streamside imprinting tanks and flash-board dam pond sites have been used in an attempt to acclimate the fish to their new release stream prior to outmigration. With any new release strategies, though, there are trade-offs that need to be evaluated. With an extensive monitoring component that includes snorkel surveys, downstream migrant trapping, Passive Integrated Transponder tag antenna arrays, video monitoring, and spawner surveys, the program has been evaluating the pros and cons of the different release strategies. In this talk, we will present an overview of the different techniques used and obstacles encountered when implementing the different release strategies, as well as a comparison of growth, survival, and adult return rates observed among the different release groups.

Putting the Red Back in Redfish Lake: Twenty Years of Captive Broodstock Progress towards Saving the Pacific Northwest's Most Endangered Population of Salmon

Thomas Flagg (Presenter), *Supervisory Fisheries Research Biologist, Manchester Research Station, NOAA Fisheries, Northwest Fisheries Science Center; and* ***Paul A. Kline,*** *Assistant Chief of Fisheries, Idaho Department of Fish and Game*

In November 1991, Snake River sockeye salmon were listed as endangered under the United States Endangered Species Act (ESA). These fish are one of the most depleted populations of salmonids in the world, with the last known remnants returning to Redfish Lake in the Sawtooth Valley in central Idaho. Only 16 adult fish total (11 males and 5 females) returned to Redfish Lake during the decade after ESA listing; all were taken into captivity for broodstock. The culture program for Redfish Lake sockeye salmon has resulted in the production of over 10,000 adult captive descendants from these 16 wild fish. The genetic focus of the program and adherence to various central tenets of conservation aquaculture has enabled program managers to retain approximately 95% of the original founding genetic variability. Overall, the Redfish Lake sockeye salmon captive broodstock effort has experienced great production success. Survival to the eyed-stage of development usually exceeds 80%, while fry-to-maturation survival is also in the 80% range. Over 1.5 million captive-reared fish have been released as pre-smolts, 1.5 million as smolts, 1.0 million planted as eyed-eggs, and 5,500 released as pre-spawning adults to Sawtooth Valley lakes and tributary streams. Since the first program-produced adult fish started returning from the ocean in 1999, over 6,500 adults have returned to collection sites in the Sawtooth Valley. Average smolt-to-adult return from the ocean for anadromous sockeye salmon produced from juveniles released as smolts were almost 3.5 orders of magniture greater than average rates for adults produced from pre-smolt releases (0.63% vs 0.18%). Average smolt-to-adult return for fish produced from natural spawning events were over two-fold higher than average rates for adults produced from smolt releases (1.56% vs 0.63%) and over eight-fold higher than rates for fish released as pre-smolts. Over 85% of returning adults originated from full-term smolt releases, while the pre-smolt release option accounted for a relatively small proportion (approximately 3%) of all returning adults. Importantly, the relatively small outmigration of naturally-produced smolts from in-lake spawning events produced over 11% of the adult returns and did so at a smolt-to-adult return rate that we estimate is near to the required minimum for population self-sustainability. This outcome is critically important as it demonstrates the potential for the population to become self-sustaining and effectively address draft recovery objectives. A new hatchery (Springfield) has been constructed in Idaho to produce one million smolts that should result in an average of 5,000 adults returning from the ocean annually. Models have been developed to transition the program from the captive broodstock phase through re-colonization and local adaption phases. This planning balances the amount of natural-origin spawners taken into the broodstock with the proportion released to the habitat for natural spawning and provides specific biological trigger points that should lead to phasing out both the captive broodstock and, ultimately, all hatchery intervention components. It seems certain that the use of captive broodstock technology and the steps described above have put the population on the road to recovery.

Using a Captive Broodstock Program to Assist in the Recovery of Coho Salmon South of the Golden Gate

Erick Sturm, *NOAA Fisheries, Southwest Fisheries Science Center*

In 2002, a coho salmon captive broodstock program was begun between the National Marine Fisheries Service, Southwest Fisheries Science Center, Fisheries Ecology Laboratory (FED) and the Monterey Bay Salmon and Trout Project, (MBSTP) a local non-profit group dedicated to the recovery of native salmonids in Monterey Bay. At the time this program was started one of its primary goals was to prevent the extinction of the Scott Creek run of coho salmon, the southernmost run of coho salmon in North America and the last sustaining run of coho salmon south of the Golden Gate. A second goal of this program was to assist the recovery of coho salmon runs south of the Golden Gate. The captive broodstock program would be the cornerstone of this program and its goals.

To date, this program has attained its primary goal of preventing the extinction of coho salmon south of the Golden Gate. However, the second goal of assisting in the recovery of coho salmon runs in other watersheds south of the Golden Gate has proven more difficult than anticipated for multiple reasons, including poor ocean conditions, wild fire that almost destroyed the MBSTP hatchery, disease at the FED lab and MBSTP hatchery, and drought. These problems, in conjunction with a lack of habitat restoration, have made recovery of coho salmon south of the Golden Gate an ongoing effort.

In 2010, after a program review, the focus of this program has been to rebuild just the Scott Creek coho salmon runs. At this same time, the program almost doubled its rearing capacity of captive broodstock fish with the addition of more rearing tanks at the Warm Springs Hatchery. The focus on Scott Creek and increase in captive broodstock numbers has seen a dramatic increase in numbers of smolts released into Scott Creek and hopefully an increase in the numbers of adult returns. The 2015 spawning season will be the first spawning season that came from the increased smolt releases.

A Regional Approach to Captive Rearing in Support of Recovery Objectives in the Northern Central California Coast Coho Salmon ESU

Robert Coey (Co-Presenter), *NOAA Fisheries;* ***Manfred Kittel (Co-Presenter),*** *California Department of Fish and Wildlife; and* ***Peter LaCivita,*** *U.S. Army Corps of Engineers*

Although captive breeding and habitat restoration are sometimes portrayed as competing approaches to recovery of threatened or endangered species, they are more accurately complementary techniques to address different sets of problems faced by many endangered species. To be viable, the Central California Coast coho salmon Evolutionary Significant Unit (CCC ESU) must contain sufficient fully functional high-quality freshwater habitat for coho populations to complete the freshwater phase of the life cycle. However, improvements in habitat quality to remediate limiting factors may yield few results if a population has declined to an abundance that is too low to respond to habitat improvements. In this scenario, captive rearing efforts may be required to preserve genotypes and rebuild remnant coho populations to levels that can maximize habitat potential. In the case of coho salmon in central California, where many historical populations have experienced, or are close to, local extirpation, both habitat restoration and captive rearing programs are of critical importance in the recovery of coho salmon.

Populations that have fallen below their depensation threshold are at a high risk of extirpation due to their low abundance alone, regardless of habitat availability. To the extent that the preservation of locally adapted genotypes is critical to the recovery of the CCC ESU, strategically placed captive rearing programs have the potential of preventing further extirpation, maintaining genetic diversity, and redirecting the species' trajectory towards recovery. Hatchery Genetic Management Plans (HGMP) are required under the ESA, and are intended to provide the plans for strategic management while safeguarding against the negative effects of artificial propagation, both in hatchery and wild populations. The Russian River Coho Salmon Captive Broodstock Program, which is jointly managed by the United States Army Corps of Engineers, California Department of Fish and Wildlife, and National Marine Fisheries Service (NMFS), has been in operation since 2001, and while the focus has been in the Russian River, the program has utilized its resources to strategically support recovery in nearby independent and dependent populations in the ESU. An updated HGMP has been presented to NMFS, which formalizes a strategic plan to regionally support coho recovery in the northern CCC ESU and will be outlined in the presentation.

Presenters will discuss the overall regional concept, the status of each population within each diversity strata, the different strategic elements of various programs which are catered to support the individual needs of each population, and the challenges of working across diverse communities.

Evaluating Effects of Release Timing on Subsequent Movement and Marine Survival of Coho Salmon Smolts from the Big Creek Captive Rearing Program

Brian Spence (Presenter), Joseph Kiernan, *and* ***Erick Sturm,*** *NOAA Fisheries, Southwest Fisheries Science Center, Fisheries Ecology Division*

Coho salmon populations in watersheds south of the Golden Gate have declined precipitously in the last several decades, with almost no natural production occurring in the Santa Cruz Mountains over the last nine years. Perpetuation of these endangered stocks now hinges on a small hatchery/captive brood program operated cooperatively by the National Marine Fisheries Service (NMFS) and the Monterey Bay Salmon and Trout Project (MBSTP) in the Scott Creek watershed. The NMFS Southwest Fisheries Science Center is currently engaged in several research projects intended to support and inform adaptive management of this program. One focal area of research is evaluating the influence of release timing of smolts on subsequent behavior and survival. Traditionally, smolts reared at the hatchery have been released on a single date annually, typically in the early part of spring. Initial evidence from out-migrant trapping operations suggested that most hatchery fish were migrating downstream shortly after release, suggesting that they are entering the ocean in late March to early April, perhaps a month or more earlier than the peak migration period for naturally produced fish in the region. This suggests that a possible mismatch between the timing of outmigration of hatchery smolts and timing of favorable conditions in the marine environment may be partly responsible for poor return rates of adult fish back to the watershed. In spring of both 2013 and 2014, NMFS scientists have release batches of coded wire and Passive Integrated Transponder (PIT) tagged fish, at weekly intervals over a period spanning eight weeks during the spring, to help determine optimal release strategies for coho salmon smolts produced by this program. Infrastructure associated with the Scott Creek life cycle monitoring station, including multiple PIT tag antennas, downstream migrant traps, and an adult fish weir, enable tracking of movement of individual fish after release as well as estimation of survival rates of different release groups. Returns of two-year-old jacks to Scott Creek and neighboring watersheds during the winter of 2013-2014 hint at possible differences in marine survival among release groups; preliminary results based on returns of three-year-old adult coho from the 2013 release groups in winter of 2014-2015 will be presented. Other projects examining success of juvenile (pre-smolt) releases, release of maturing captive brood adults, and response of planted hatchery coho to large wood enhancements will also be discussed.

Genetic Broodstock Management of Endangered Coho Salmon: A Tale of Two Conservation Hatchery Programs

Elizabeth A. Gilbert-Horvath (Presenter), and John Carlos Garza, PhD, NOAA Fisheries, Southwest Fisheries Science Center, and University of California Santa Cruz

Steep declines in abundance and the widespread extirpation of local populations of coho salmon from streams in California have led to protection of the species under the Endangered Species Act. Small population sizes and low encounter rates between naturally spawning adults mean that the risk of extinction remains high. As a consequence, two conservation hatchery broodstock programs were established to reintroduce the species into vacant streams and to supplement remnant natural populations within the Central California Coast Coho Salmon Evolutionarily Significant Unit. These two programs are located at Warm Springs Hatchery in the Russian River watershed and Kingfisher Flat Hatchery in the Scott Creek watershed. More than ten years ago, both hatchery programs adopted genetic broodstock management practices to minimize inbreeding among coho salmon broodstock and to conserve genetic resources. All broodstock individuals, including natural- and hatchery-origin, captive and ocean returning, are genotyped with a set of polymorphic nuclear DNA markers. Genotype data is analyzed to produce a matrix of pairwise relatedness estimates. This "spawning matrix" ranks all potential mates by their inbreeding risk and is used dynamically in season by hatchery personnel to optimize the selection of spawn pairs. Genetic data is also used to guide experimental outbreeding programs, to select fish for inclusion in the captive broodstock, and to inform the release of maturing adults during spawning season. Following more than a decade of genetic broodstock management, it is now possible to analyze several generations of each of the three brood cycles of coho salmon and to evaluate temporal trends in genetic composition, patterns of parentage and sibling structure, successes and pitfalls, and the results of experimental outbreeding.

Managing Precocious Maturation in Chinook Salmon Captive Broodstock for the San Joaquin River Restoration Program

Paul Adelizi, *California Department of Fish and Wildlife*

The San Joaquin River Restoration Program is tasked with restoring spring-run Chinook salmon in the San Joaquin River, as mandated by the legal settlement, *Natural Resources Defense Council v. Rodgers*. The Program will use Central Valley spring-run Chinook salmon as a donor stock to restore a self-sustaining San Joaquin River Spring-run population. Because the Central Valley populations are threatened, only limited transfers can occur. Therefore, the program will depend on artificial propagation using captive broodstock to attain sufficient numbers for reintroduction.

Currently, a small-scale interim facility is being operated to provide the program with practical experience rearing Chinook salmon in captivity to adulthood and to allow early phased reintroductions while a full-scale conservation facility is under development. The interim facility was initiated in 2010 and is rearing spring-run Chinook broodstock from brood years 2012 and 2013. Research at the facility has focused on preventing excessive early maturation in the broodstock, particularly in males. Hatchery-reared Chinook salmon broodstock have the proclivity for early sexual maturation. These "precocious" fish are often not utilized in breeding programs to avoid over-representing the trait in offspring. Several factors may trigger early maturation in Chinook, including genetics, emergence timing, energy stores, and size and/or growth rate at specific times of year. The physiological decision to initiate maturation occurs 8 to 12 months prior to spawning and for yearlings, the decision occurs shortly after emergence.

In an experimental group of 2010 brood year (BY) fall-run Chinook salmon, early maturation occurred in 15% of the yearling males and 84% of the remaining males at age two. In addition, early maturation occurred in 10% of the two-year-old females. Growth modulation is reported to be effective in reducing male precocity by providing a reduced feed ration and/or reduced temperatures to restrict growth rates during the maturation decision window. Because of the high levels of precocity that we observed, the program began to initiate a growth modulation strategy. In spite of early attempts, precocity occurred in 34% of the 2012 BY yearling males. In response, a more aggressive feed reduction schedule was implemented, particularly between the months of September and January. The percentage of two-year-old precocious males in the 2012 BY males reduced to 26%. In addition, precocity was reduced to just 7% in the 2013 BY males, which was nearly one-fifth of the precocious yearlings observed the previous year. The reduced maturation rate appears to be due to an aggressive reduction in growth rates achieved through a reduced feed ration and low rearing temperatures during incubation and early rearing.

Monitoring Coho Salmon in the Russian River as Part of the Russian River Coho Salmon Captive Broodstock Program

Nick Bauer (Presenter), Mariska Obedzinski, Sarah Nossaman-Pierce, Andrew Bartshire, and Paul Olin, UC Cooperative Extension, and California Sea Grant

The Russian River Coho Salmon Captive Broodstock Program (RRCSCBP), a collaborative partnership that includes the United States Army Corps of Engineers, National Marine Fisheries Service, the California Department of Fish and Wildlife, the Sonoma County Water Agency, California Sea Grant, and University of California Cooperative Extension (UC), is working to reestablish a self-sustaining population of native Russian River coho. Since 2001, program partners have been breeding coho salmon from local genetic stock at Warm Springs Hatchery and releasing them as juveniles into historic coho streams in the Russian River watershed. UC's primary role in the program is to monitor wild and hatchery coho salmon in the stream environment to evaluate the efficacy of the broodstock program and to work with partners to apply advances in scientific knowledge to its management. This presentation will explore two aspects of recent monitoring outcomes: (1) variation in out-migrant timing in relation to release season and stream, and (2) annual variation in the proportion of two-year-old male coho (jacks) returning to Russian River tributaries to spawn.

California Coastal Monitoring Program Workshop: Monitoring Central Coast Coho Salmon Populations Today and Beyond

Thursday, March 12

Workshop Coordinator*: Kevin Shaffer, California Department of Fish and Wildlife*

Introduction to the Workshop: The Significance of Central California Coast Coho Salmon for the Progress of Population Monitoring and Recovery in California

Kevin Shaffer, *California Department of Fish and Wildlife*

This year's conference is being held in the center of the central-northern California eco-region and the federal North Central Domain. The Central California Coast coho salmon Evolutionary Significant Unit (CCC ESU) is one of only two population groups of coastal salmon listed under both the state and federal Endangered Species Acts and is only one of two population groups listed as endangered. This ESU also encompasses the Mendocino Coast, where population monitoring in coastal California was first expanded into a scientifically robust and comprehensive project to evaluate the status and trend of coastal populations of a species of salmon in California.

The 4th annual workshop will focus on significant monitoring projects that constitute the state's efforts to build a comprehensive monitoring program for coastal populations of coho and Chinook salmon and steelhead. Presenters will highlight their techniques, data collection, analyses, and future priorities in this ESU's most significant watersheds. The morning will be dedicated to the geographic range of the projects, from south of San Francisco Bay, to the Marin Coast, the Russian River Basin, and the Mendocino Coast.

The afternoon will highlight unique monitoring projects in this ESU, as exemplified by the coho salmon broodstock monitoring program associated with Warm Springs Hatchery. We will also feature broad applications that include CCC examples (such as the use of dual sonar) to expansion of the program (such as habitat monitoring coupled with fish population monitoring—the pilot program in the Mendocino Coast).

The workshop will demonstrate the continued collaboration of the state and federal government, water agencies, private entities, and landowners in this ESU to gather important data on coho salmon. This collaboration is the foundation of ongoing efforts and the future of the California Monitoring Program for Coastal Salmon and Steelhead.

Scott Creek Life Cycle Monitoring Station: Informing the Recovery of Southern Coho Salmon.

Joseph Kiernan (Presenter), Ann-Marie Osterback, Nicolas Retford, Jeff Perez, Emerson Kanawi, Brian Spence, and Erick Sturm, NOAA Fisheries, Southwest Fisheries Science Center, Fisheries Ecology Division

The Central California Coast Evolutionarily Significant Unit represents the southernmost extent of coho salmon in North America. Populations are particularly imperiled south of San Francisco Bay (Santa Cruz Mountains Diversity Stratum), where coho salmon have been functionally extirpated from most watersheds and all brood-year lineages have too few individuals to be self-sustaining. Since 2003, the National Marine Fisheries Service Southwest Fisheries Science Center (SWFSC) has operated a life cycle monitoring station in Scott Creek (Santa Cruz County) which supports the last extant population of coho salmon in the region. Our research and monitoring activities have produced a 12+ year time-series of key viable salmonid population parameters, including estimates of marine and freshwater survival. Severe population declines since 2006 have necessitated a reliance on artificial production (coho captive broodstock program) for population persistence and recovery. We will discuss the status and trends of the Scott Creek coho salmon population and highlight reintroduction and recovery efforts currently underway. In particular, we will discuss the effects of drought on coho life history patterns and large-scale experiments to quantify how release timing affects the marine survival of hatchery smolts. We will also present preliminary research to quantify rates of straying from Scott Creek (coho salmon source population) to adjacent watersheds in the region.

Overcoming the Complexities of CMP Implementation in the Russian River

Aaron Johnson (Presenter) and Gregg Horton, Sonoma County Water Agency;
Mariska Obedzinski and Andrew Bartshire, University of California Cooperative Extension, California Sea Grant

At more than 3,800 square kilometers, the Russian River Watershed is by far the largest watershed in the Central California Coast coho salmon Evolutionarily Significant Unit (CCC ESU). The Russian River drains more than one-third of the watershed area encompassed by the entire CCC ESU. The large size, varied climate along the coastal to inland gradient (which leads to a restricted coho distribution), and the vast amount of privately-owned land result in complexities for California Coastal Monitoring Program (CMP) implementation. We are attempting to overcome these challenges by working closely with the statewide CMP team to adapt monitoring strategies outlined in Fish Bulletin 180. Examples include incorporating digital video monitoring along with a DIDSON system to monitor adults and Passive Integrated Transponder tag monitoring to augment smolt estimates. The substantial experience and monitoring infrastructure already in place as a result of efforts by the Sonoma County Water Agency and University of California Cooperative Extension/ California Sea Grant afford synergy by extending CCC ESU coho status and trend monitoring into a watershed of central importance to CCC coho recovery while providing a framework from which to identify specific, local impediments to recovery.

Russian River Salmonid Population Monitoring: Addressing Multiple Monitoring Objectives within the Framework of the Coastal Monitoring Plan

Mariska Obedzinski (Presenter), Nick Bauer, Sarah Nossaman, Andrew Bartshire, Desiree DelaVega and Paul Olin, UC Cooperative Extension, and California Sea Grant; and Greg Horton and Aaron Johnson, Sonoma County Water Agency

California Sea Grant and UC Cooperative Extension's Coho Monitoring Program began in 2004 with the first release of juvenile coho into Russian River tributaries as part of the Russian River Coho Salmon Captive Broodstock Program (RRCSCBP). As the RRCSCBP has grown over the last ten years, UC's monitoring efforts have expanded, and, in combination with the Sonoma County Water Agency's (SCWA) salmonid monitoring efforts, have provided a foundation for implementation of the California Coastal Salmonid Monitoring Plan (CMP) in the Russian River. With funding support from the California Department of Fish and Wildlife, UC and SCWA began implementation of the CMP in 2013. In this talk, we describe how we have adapted our monitoring program to efficiently address the objectives of the RRCSCBP and the CMP, as well as to evaluate specific coho recovery questions related to habitat enhancement projects, fish passage barriers, and summer survival in relation to stream flow.

Update on the Lagunitas Creek Life-Cycle Monitoring Station: Applying the CMP to a Small Coastal Watershed

Gregory Andrew, *Fishery Program Manager, Marin Municipal Water District*

This presentation will discuss the findings through the first two and a half years of California Coastal Monitoring Program (CMP) life-cycle monitoring on Lagunitas Creek, which supports one of the best populations of coho salmon in Central California and the State. Lagunitas Creek was established as a CMP life-cycle monitoring station in 2012. All aspects of the CMP are being conducted, including the following:

- Adult monitoring: salmon spawner surveys and DIDSON camera monitoring;
- Spatial structure monitoring: juvenile salmonid surveys;
- Diversity monitoring: carcass tissue sample collections; and
- Life-cycle monitoring: adult counting station (DISDON), outmigrant juvenile trapping (smolt surveys), and survival indices (juvenile, over winter, and marine survival estimates).

This is being implemented as a collaborative effort between the California Department of Fish and Wildlife, the Marin Municipal Water District, the National Park Service, and the Salmon Protection and Watershed Network.

We will discuss the successes and challenges associated with implementing the CMP in Lagunitas Creek. It is a relatively small watershed and the CMP was developed to allow for cost effective data collection and statistically valid analyses from much larger drainages. In addition, salmonid monitoring surveys in Lagunitas Creek extend back to the 1970s, with annual juvenile and spawner surveys since 1994 and annual smolt surveys since 2006. The CMP approach has added to the data set and the coho population trends for Lagunitas Creek. The CMP has introduced the Generalized Random Tessellation Stratified (GRTS) ample selection scheme to our juvenile and spawner surveys. The DIDSON camera and Passive Integrated Transponder tagging have added new technologies to the adult abundance and survival estimates. As a result, the coho population estimates from the prior data set and from the CMP approach have been in variance, although the population trend is valid. This points to the importance of implementing the CMP in order to track a comparable, statewide assessment of the coho population and evaluate the regional populations in relation to the coho recovery targets.

Dual Frequency Identification Sonar (DIDSON) Deployment and Preliminary Performance as Part of the California Coastal Salmonid Monitoring Plan

Kristine Atkinson (Presenter), Michael K. Lacy,
and ***Russell Bellmer,*** *California Department of Fish and Wildlife*

Anthropogenic alteration of landscapes has negativity altered riverine habitat and hydrologic processes, negatively affecting the viability of salmonid species which depend on healthy watershed processes for spawning, migration, rearing, growth, and survival. As societies increasingly demand more water and other natural resources, the ability of natural resource managers to conserve these resources will be based, in part, on their ability to maintain and restore watershed processes. California's salmon and steelhead populations have experienced drastic declines leading to both federal and state Endangered Species Act listings of many coastal stocks (Good et al. 2005, Williams et al. 2011, CDFG 2002). California has experienced pressure from the federal government, other states, fisheries organizations, and communities to improve status and trend monitoring of coastal salmon and steelhead. Of the four National Marine Fisheries Service's Viable Salmonid Population (VSP; McElhany et al. 2000) parameters (abundance, spatial distribution, productivity, and diversity), adult abundance is the most fundamental. Establishment of DIDSON counting stations under California's Coastal Salmonid Monitoring Plan (CMP) (Adams, et al., 2011) in key locations will enable the California Department of Fish and Wildlife to obtain vital adult return data to inform state, trans-state, and federal management and recovery decisions. Since 2006, DIDSON cameras have been installed in numerous California streams to enumerate adult salmon and steelhead during upstream migration. We report on the operational and biological results of initial deployments of DIDSON units across California for the primary purpose of counting returning anadromous salmonids, principally as part of CMP but also within several Central Valley watersheds. Additionally, we report on the laboratory experimental results at the University of California, Davis, and the sturgeon work performed in the Central Valley. This is the first comprehensive report of the use of DIDSON devices in California's watersheds.

Putting One Foot in Front of the Other: A Step By Step Discussion Among Partners For Implementing The California Coastal Salmonid Monitoring Plan

David Wright (Presenter), *Campbell Global, LLC;* ***Sean Gallagher,*** *California Department of Fish and Wildlife; and* ***David Dulrich,*** *Mendocino Redwood Company*

The need for scientifically reliable status and trend information resulting from endangered species listings of Chinook salmon, coho salmon, and steelhead in coastal California was the impetus for the California Coastal Salmonid Monitoring Plan (CMP). The CMP began with a series of meetings in the early part of the last decade and crested with the publication of Fish Bulletin 180 in 2011. During that time, our work evaluating many aspects of the CMP led to the first implementation of the plan in the State in 2009. The value of CMP as a scientifically design-based monitoring scheme with standardized field protocols, data management, and data summaries is now well-recognized and has resulted in developing monitoring programs throughout coastal California. A key part of implementing the CMP is developing and maintaining partnerships. In this workshop session, we work through examples of successes, failures, and progress in a stepwise fashion from our implementation of the monitoring plan. We discuss motivations, interests, and expectations for monitoring from the different perspectives of the varied institutions we represent. We hope to provide helpful insight to participants interested in implementing the CMP, increasing partnership opportunities, and improving information generated from this monitoring effort.

The Habitat Component of the California Coastal Salmonid Monitoring Plan

Sean Gallagher, California Department of Fish and Wildlife

The fish monitoring portions of the California Coastal Salmonid Monitoring Plan (CMP) are rather well-developed and are being implemented all along the coast of California. However, the habitat monitoring component, while actively represented and acknowledged, has trailed. In fact, Bulletin 180 left it to the future. Given that recovery plans require both fish and habitat status and trend information, I think the future of habitat monitoring within the CMP is now. Since 2008, I have been working in several arenas to help develop habitat monitoring for the CMP, starting with modifications of the California Department of Fish and Game's Habitat Restoration Manual's habitat typing methods and traveling through Columbia Habitat Monitoring Protocol. Habitat assessment within the CMP requires repeatable methods which fit within its spatially balanced sample design and produce metrics and information for assessment of status, trends, threats, and restoration. In this session, I hope to stimulate discussion on what is needed for CMP habitat monitoring and develop recommendations for bringing this important part of the monitoring program to life.

The Status of Coastal Salmonid Monitoring Efforts in Central California, Future Priorities, Needs, and Obstacles to Monitoring Anadromous Salmonids in the Central California Coast

George Neillands, *Senior Environmental Scientist, California Department of Fish and Wildlife*

Declining populations of salmon and steelhead within the central California coast have resulted in listing of central California coastal anadromous salmonids either under the California Endangered Species Act (CESA) or the Federal Endangered Species Act (ESA). California Department of Fish and Wildlife (CDFW) and the National Marine Fisheries Service (NMFS) are engaged in the development and implementation of the California Coastal Salmonid Monitoring Plan (CMP, Adams et al 2011), which is designed to measure the progress toward recovery of these populations. The CMP utilizes the Viable Salmonid Population (VSP; McElhaney et al 2000) concept as the framework for the plan development. The priority has been on developing protocols for monitoring status and trend of adult returns. However, habitat monitoring is equally important and protocols are currently being developed for inclusion into the monitoring plan.

Currently, a few organizations have implemented population-level monitoring programs outlined in the CMP for monitoring priority coho salmon populations. These organizations include CDFW, NMFS's Southwest Fishery Science Center, Sonoma County Water District, Marin Municipal Water District, Salmon Protection and Watershed Network, and the National Park Service. To track Chinook salmon and steelhead abundance trends we must expand upon our existing coho salmon monitoring efforts immediately throughout the region using the existing CMP framework. This presentation will include a summary of the current and planned CMP work conducted in the central California coast and will address the ongoing priorities, challenges, needs, and obstacles faced in implementing the CMP in this region for all listed anadromous salmonids.

Dry Creek Field Tour: Partnerships in Habitat Enhancement and Monitoring for Salmonid Recovery

Thursday, March 12

Tour Coordinators: *Justin Smith and Neil Lassettre, Sonoma County Water Agency, and Playalina Bojanowski, Sonoma Resource Conservation District*

This tour features salmonid habitat enhancement projects and monitoring programs in the Dry Creek basin. These projects range from physical enhancement to create hydraulic refuge and escape cover, to hydrologic enhancement to ensure flow reliability. An effectiveness and validation monitoring program is being implemented through an adaptive management plan with collaboratively-developed physical performance metrics and validation monitoring aimed at documenting shifts in habitat use at site-, reach-, and basin-scales. The tour visits multiple sites constructed on both private and public land through the collaboration of six public agencies, three non-governmental organizations, and multiple private landowners. Projects are located on tributaries to and the mainstem of Dry Creek and showcase physical enhancements including engineered log jams, off-channel and in-channel habitat enhancements, fish passage improvement projects, and hydrologic enhancements including off channel detention ponds and frost fans to restore stream flow.

Redwood Creek and Muir Beach Restoration Projects

Thursday, March 12

Tour Coordinators: ***Carolyn Shoulders,*** *Golden Gate National Recreation Area;*
Michael Reichmuth, *Point Reyes National Seashore; and* ***Mike Jensen,*** *Prunuske Chatham, Inc.*

A series of actions were implemented by the National Park Service on Redwood Creek over a five-year period to restore natural geomorphic function to the last half-mile of channel to the ocean. The natural channel processes, such as floodplain connectivity, off-channel features, and in-channel wood were designed to provide suitable habitat for the endangered coho salmon and threatened steelhead. Monitoring of salmonids within the restoration area is underway to evaluate whether the habitat has been effectively created and whether it is being used by coho. The lower Redwood Creek restoration provides an example of both the succession of restoration projects over time and the creation of complex habitat features in a dynamic system.

In fall of 2014, Green Gulch Farm and Prunuske Chatham, Inc. converted a straightened, concrete controlled reach of Green Gulch Creek, the lowest tributary to Redwood Creek, into a natural meandering stream with created floodplains. The intention of the project is to increase the resilience of the Redwood Creek system by creating additional salmonid rearing habitat, restoring 1.5 acres of wetland/riparian habitat, and integrating the creek into the daily experience of the organic farm. Vegetated floodplains and slow-water alcoves filled with large wood provide high-quality shelter habitat. To enhance habitat complexity and temporarily stabilize banks until the vegetation is established, rootwad structures, log vanes, and brush mattresses were installed on outside bends. Salvage wood was added for pool complexity and live wood was incorporated into the structures to jumpstart root establishment. Over 3,000 sedge and rush plugs, and woody and herbaceous plants will be installed to create a continuous upland, wetland, and riparian forest complex.

Improving Summer Streamflows Workshop and Tour

Thursday, March 12

Workshop Coordinator: *John Green, Lead Scientist, Gold Ridge Resource Conservation District*

In coastal California's Mediterranean climate, demand for water tends to be highest when water is most scarce, and water extraction from rivers and streams can lead to diminished streamflow and degraded water quality, imperiling juvenile salmonids. Under the exceptional drought conditions of the past two years, these impacts have become even more severe. In western Sonoma County, the Russian River Coho Partnership, Gold Ridge Resource Conservation District, Occidental Arts and Ecology Center WATER Institute, Prunuske Chatham, Inc., and our partners have employed several methods for reducing the impacts of water diversion on streamflows, including developing alternative water sources, constructing water storage, and changing the timing of water diversion to enhance summer flows. This will be a full-day combined workshop and tour. In the morning, we will discuss the background of flow improvement efforts in western Sonoma County, including the history of this multi-stakeholder effort, scientific foundation for these programs, potential legal issues in developing off-channel and rainwater catchment projects, and program effectiveness monitoring. During the afternoon tour, we will visit several project sites and discuss advantages and disadvantages of various methods, along with obstacles to be overcome in implementing these projects.

Taking Some of the Low Out of Flow: Coastal Instream Flow Projects and Water Rights

Mary Ann King, Trout Unlimited

A handful of groups across California are using cooperative approaches to address low streamflow in coastal streams, including the Russian River Coho Water Resources Partnership. Mary Ann will talk about the water rights permitting associated with in-stream flow projects, including the processes for dedicating water to in-stream flow and avenues for obtaining new water rights for storage and forbearance projects. She will provide an overview of some of the infrastructure and water management strategies (e.g., tank and pond storage and forbearance, frost protection alternatives, irrigation efficiency, rainwater harvesting, etc.) that have been employed to-date.

Hydrologic Foundations for Restoring Streamflow in Coastal California Watersheds

Matt Deitch, CEMAR

The steady recession of streamflow through the dry summer season represents one of the most substantial challenges to the survival of salmonids in coastal California. Water management practices can make streamflow conditions worse; land managers often divert water from streams and adjacent shallow aquifers to meet a wide range of water needs, causing the further depletion of flow. As these impacts have been recognized, there is growing interest in restoration actions to restore summer base flow through winter water storage or overall reduction in water use.

Streamflow data are essential for several steps in creating meaningful streamflow restoration projects. In early stages, they help to identify those reaches where impacts are greatest, with greatest opportunity to benefit from flow restoration projects. Data are also useful for evaluating whether there is sufficient water in winter to meet dry-season needs and for determining the methods that can be employed to store water appropriately. Finally, flow data are useful for predicting and ultimately evaluating the benefit of implemented projects on summer base flow. Without flow data, it is not possible to know whether flow restoration projects will have their intended benefit.

Conservation Hydrology, Pondering, Planning, and Implementation

Brock Dolman, *Occidental Arts & Ecology Center*

Historic and modern land uses all occur within someone's watershed somewhere. All land use modifications directly influence the hydrologic condition of the uplands and the stream network to which they drain. Until we adapt how we log, farm, and develop housing in ways that reflect and express watershed process consciousness of coastal California, unnaturally dry creeks in summer, muddy flashy creeks in winter, and salmonids on the brink of extinction will be the norm. These conditions are the direct result of our ecologically illiterate socio-settlement philosophy. To paraphrase an oft used saying: Form Follows Fluvial Function and by the same token Form Follows Drainage Dysfunction. It is a matter of practical understanding and applied hydro-literacy with salmonid decline being but one messenger.

Therefore, while there is much interest and critical need for rigor in technical design and construction, as well as funding, it is essential to have a community container centered on Basin of Relations integration. All landowners and managers, from ridgeline to rivermouth, need to be engaged in strategies to improve streamflow otherwise successful salmonid recovery will elude us. It's about people and relationships. Effective and participatory community-based organizing, education, demonstration and trust building are key to proactive participation in the retrofitting of watersheds for both people and fish. Rainwater harvesting starts with Brainwater Harvesting!

In this session we will explore not only what is happening to support instream flows for coho, but will also unpack some of the ego-system engineering efforts that were fundamental to the actualization of these successful models.

Swimming Upstream: Salmon Protection in a Tough Political Climate

Congressman Jared Huffman, U.S. Congress

Congressman Huffman, who represents the North Coast of California in Congress and serves as the senior Democrat on the Water, Power, and Oceans Subcommittee, will discuss the political challenges facing salmon restoration efforts from a federal perspective—from debates involving partisan, regional, and treaty/trust obligations, to scientific uncertainty, to other complicating social and political factors. In particular, Huffman will explore three of the leading threats to salmon restoration in California: drought, unregulated marijuana cultivation on public and private lands, and the U.S. Congress.

Representative Jared Huffman (D-San Rafael) was sworn in as a member of the 113th Congress on January 3, 2013 to represent California's second district. The district spans from the Golden Gate Bridge north to the Oregon border, covering six counties including all of Marin, Mendocino, Humboldt, Trinity, and Del Norte, and much of Sonoma Counties. Huffman is a member of the Committee on Natural Resources and the House Budget Committee.

Prior to his election to Congress in November of 2012, Huffman served six years in the California State Assembly where he authored more than 60 pieces of successful legislation and received numerous awards for his legislative leadership. Huffman chaired the Water, Parks, and Wildlife Committee, served on the Budget Committee and was co-chair of the Legislative Environmental Caucus.

In the Assembly, Huffman distinguished himself as a legislator who tackles complex public policy challenges, works tirelessly, and gets results – often by forging bipartisan consensus on difficult issues. He played a leading role in crafting and passing the historic package of water reforms in 2009. Other notable laws authored by Huffman include California's pioneering lighting efficiency standards (AB 1109) which were subsequently adopted into federal law; the nation's largest programs for solar hot water heating (AB 1470) and paint recycling (AB 1343); reforms that improve California's State Parks system (AB 1589) and Department of Fish and Wildlife (AB 2402); and creation of a new voluntary type of corporation, California Benefit Corporations, to promote corporate social responsibility (AB 361).

Prior to his election to public office, Huffman was a Senior Attorney for the Natural Resources Defense Council (NRDC). One of his proudest accomplishments at NRDC was helping forge an agreement to restore a 153-mile stretch of the San Joaquin River in California's Central Valley.

Before he joined NRDC, Huffman was a successful public interest attorney whose victories included several major jury verdicts in gender discrimination and race discrimination trials. He also served 12 years in local government as a Director of Marin County's largest special district, the Marin Municipal Water District (MMWD), from 1994 to 2006.

How Do Successful Restoration Projects Happen?

Ann Riley, PhD, Watershed and River Restoration Advisor, San Francisco Bay Regional Water Resources Control Board and author of Restored Urban Streams

We learn from case studies of urban stream restoration projects in the San Francisco Bay Area spanning 1982-2014 that achieving success with quality restoration project shares common factors. These factors include the following: community leaders and organized citizens; engagement of engineers and scientists with up to date knowledge on restoration objectives and methods; strong regulatory involvement; public outreach on project objectives and benefits; the support of at least one local or state agency, office, or staff; a consensus planning process involving any and all interested public and government stakeholders; project design with an interdisciplinary team; a team or organization which takes responsibility for project implementation and continuity between design and construction; and combining different schools of restoration and practices into project design and implementation. Missing any one of these factors can compromise a project with good ecological restoration potential or prevent the project from being realized.

Let's consider this last mentioned factor of needing to combine different schools of restoration into restoration design. Viewing restoration design practice over a 30-year period records an evolution in thinking about how to best define restoration. We also follow the development and use of various schools of restoration which evolve and at times go in and out of favor. These schools include: watershed processes and stream evolution models; the empirical school which includes analogy methods and hydraulic geometry; the analytical schools which emphasize hydraulic modeling; stream classification; native fish population abundance; fish biological diversity; landscape design based re-vegetation; large scale floodplain re-vegetation agricultural based strategies; soil bioengineering and ecological recovery of primary riparian plant species; bird habitat as the riparian restoration goal; and the use of passive restoration approaches including storm water management.

During this 30-year period, disagreements over the appropriateness of applying different schools to restoration have broken out. There are supporters and detractors involved in each school. In fact, each school and its concepts and practices has its inherent strengths and weaknesses, and the strongest restoration projects are often those which combine design concepts and methods. Rather than succumb to membership in a particular camp, let's celebrate and apply the diversity of schools and tools we have available to us.

Historical Context for Interpreting Early Accounts of Pacific Salmon in California

Brian Spence, NOAA Fisheries, Southwest Fisheries Science Center

Fishery scientists and managers charged with implementing the Endangered Species and Magnuson-Stevens Fishery Conservation and Management Reauthorization Acts are commonly called upon to define the historical ranges of various Pacific salmonid species. This is challenging, as many salmonid populations likely were extirpated from portions of their ranges many years ago, and records of their historical occurrence may be scarce or lacking. In seeking to resolve historical distribution questions, we often turn to the writings of pioneering ichthyologists from the late 19th century, most notably David Starr Jordan and his contemporaries, assuming that the early range descriptions they provided accurately reflect the distributions of these fishes prior to significant degradation of their freshwater habitats and loss of populations. When interpreting these early writings, however, it is important to understand the context in which these accounts are imbedded. First, through the late 1800s, the extent of scientific exploration of coastal watersheds of California was extremely limited; consequently, the range information published by Jordan and colleagues was based on sparse collection records or unpublished and unverifiable accounts. Further, prior to 1880, the taxonomy and nomenclature surrounding the Pacific salmonids was in a state of extreme confusion, with numerous putative species being described based on variations in size, age, and sex of individuals. Scientific names adopted by one scientist were sometimes incorrectly assigned to different species by other scientists based on use of non-definitive characteristics. Additionally, common names such as "dog salmon" and "salmon trout" were often applied to multiple species depending on the specific region. Moreover, understanding of the life histories and ecology of the various salmonid species was poor. Collectively, these uncertainties led to numerous instances of species being assigned to a particular geographic range based on incorrect identification of collected specimens. Further confounding interpretation of early writings is the fact that significant degradation of freshwater habitat in California had already occurred by the latter half of the 19th century due to logging, hydraulic mining, agricultural development, and other human activities. Consequently, even in those instances where early scientific surveys were conducted, such surveys may post-date the extirpation of local populations. And finally, early records of occurrence of certain species in some watersheds may have been the consequence of early hatchery and stocking activities, which began in earnest in California in the early 1870s. For all of these reasons, scientists and managers should seek to avoid the pitfall of over-interpreting individual accounts of species occurrences and instead look broadly across many lines of evidence. Even then, definitive answers about historical occurrence in various watersheds simply may not be attainable.

California's Climate in Perspective: Paleoclimate Records of Past Droughts and Floods

B. Lynn Ingram, PhD, *University of California, Berkeley, and author of* **The West Without Water**

In this talk, I will present evidence for the long-term history of climate change in California, including evidence for "megafloods" and "megadroughts" that recurred over the past several thousand years. These extreme events in California, mirrored by events throughout the West, were of much longer duration and severity than any experienced over the past century and are virtually unknown in the living memory of modern residents of the West. These severe climatic downturns recurred every 90-200 years in the past and are likely to recur in the coming century.

Professor B. Lynn Ingram researches the history of climate change in California using sediment cores from lakes and estuaries, including San Francisco Bay. Dr. Ingram is a Fellow of the California Academy of Science and is a Senior Fulbright recipient. She received her masters and PhD in Geology from the University of California, Los Angeles and Stanford University. She has been a Professor in the Departments of Earth and Planetary Science and Geography at University of California, Berkeley since 1995. She has written numerous research articles on past climate environmental change in the Pacific region and is the author of a new book on the history of climate and water resources in the western United Stated, entitled: *The West Without Water: What Past Floods, Droughts, and Other Climatic Clues Tell Us About Tomorrow.*

Session Coordinators: *Charlotte Ambrose, California Programs Coordinator, NOAA Fisheries, and Nora Berwick, Recovery Coordinator, NOAA Fisheries, West Coast Region*

Implementing Mechanisms for Coho Salmon, Chinook Salmon, and Steelhead Recovery Across NOAA's West Coast Region

Charlotte Ambrose, California Programs Coordinator, NOAA Fisheries

The Endangered Species Act requires the National Marine Fisheries Service (NMFS) to develop and implement recovery plans for salmon and steelhead listed under the Federal Endangered Species Act. Recovery plans identify actions needed to restore these species so they are once again self-sustaining elements of our ecosystem and no longer need protection. Although recovery plans are guidance, not regulatory documents, the Act envisions recovery plans as the central organizing tool for guiding and coordinating recovery efforts across a wide spectrum of federal, state, tribal, local, and private entities. Recovery planning is an opportunity to find common ground among diverse interests, obtain needed protection and restoration for salmonids and their habitats, and secure the economic and cultural benefits of healthy watersheds and rivers. Recovery planning is a collaborative effort that draws on the collective knowledge, expertise, and actions of communities and partnerships.

The newly merged NMFS West Coast Region is charged with recovery of 28 listed salmon and steelhead across California, Oregon Coast, Willamette and Lower Columbia, Interior Columbia, and Washington Coast. Recovery is organized by recovery domains and there are 12 across NMFS's West Coast Region with many salmon and steelhead recovery plans completed or underway. Recovery actions are designed to improve their survival across life stages and ensure populations are wild, abundant, and diverse. Recovery plans provide key information and strategies that can be used by practitioners. Mechanisms for recovery implementation are ultimately based on state, regional, tribal, local, and private conservation efforts underway or needed. Seeking a shared vision of success is the cornerstone of recovery. The Recovery session involves case studies on the formation and organization of stakeholder groups across the Pacific Northwest and California to develop and implement recovery actions. We will hear, in the session on Mechanisms for Implementation, from organized recovery boards, forums, and watershed groups such as those in the Interior Columbia River Basin and others across the West Coast Region about recovery implementation challenges (e.g. bi-state boundaries, permits, monitoring, and funding) and progress to date in overcoming these challenges.

This presentation will summarize the NMFS West Coast Region organization and touch upon state and federal recovery information and efforts for central California coast coho salmon, steelhead, and Chinook salmon.

Recovering Steelhead on the Edge: South-Central and Southern California

Mark Capelli, Steelhead Recovery Coordinator, NOAA Fisheries

In 1997 the National Marine Fisheries Services (NMFS) listed two distinct sub-populations (DPS) of steelhead within the southern half of coastal California at the southern extent of their range in North America: a threatened set of sub-population along the south-central coast and an endangered set of sub-populations along the south coast. The range of the southern sub-populations was extended from the Malibu coast south to the United States/Mexico border in 2002.

The NMFS Technical Recovery Team for Southern Steelhead has divided the South-Central and Southern California Steelhead DPSs into nine Biogeographic Regions, characterized by a distinguishing suite of physical, climatic, and hydrologic features. Recovery of the two southern steelhead DPSs will require the restoration of a minimum number of populations within each of the nine Biogeographic Regions. The core watersheds identified in this biological strategy are geographically dispersed across the recovery planning area (extending from Monterey Bay to the United States/Mexico Border) to preserve the existing diversity of life-history forms (ranging from anadromous to resident) and their evolutionary trajectories. Additionally, this biological strategy is intended to minimize the likelihood of extirpation of individual populations within each Biogeographic Region by natural perturbations (including periodic droughts and wildfires longer range climatic changes) and preserve the potential natural dispersal of fishes between watersheds.

The Recovery Plans for the South-Central and Southern California Steelhead DPSs identify a series of recovery actions intended to address the threats currently facing the species, as well as future threats posed by climate change, and related habitat transformations. Additionally, a long-term research and monitoring program is proposed to address a number of key issues (such as the relationship between anadromous and resident forms) and refine the population and DPS-wide viability criteria developed by the Technical Review Team. Recovery will require re-integrating the listed steelhead populations back into habitats in a manner which allows the co-occupancy of watersheds populated with approximately 27 million people. The ecosystem restoration strategy which focuses on restoring natural riverine and estuarine functions and features will also serve to benefit the suite of native species, including other federally and state listed species which these watersheds historically supported.

Recovering Central Valley Chinook Salmon and Steelhead

Brian Ellrott (Presenter) *and* ***Ryan Wulff,*** *Salmon Recovery Coordinators, National Marine Fisheries Service*

Millions of wild salmon and steelhead once returned to spawn in the foothills and mountains of California's Central Valley. Streams fed by rainfall, snowmelt, and cold water springs encircled the valley, fostering a diversity and abundance of Chinook salmon and steelhead. However, the mid-1800s ushered in sweeping changes to the landscape that ultimately led to declines in the abundance, distribution, and diversity of these fish. Gold mining, dam construction, water and hydropower management, and other land uses hindered fish populations from thriving in the Central Valley. By the 1990s, three of the valley's salmon and steelhead species were close to extinction and listed under the federal Endangered Species Act (ESA): Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead. Today, only a few of the historic populations remain, but a new ESA recovery plan provides a framework for recovering Central Valley's iconic fish.

In July 2014, the National Marine Fisheries Service released a plan to recover Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, and Central Valley steelhead. This recovery plan sets goals and prioritizes actions for the Sacramento-San Joaquin Delta and its watersheds, laying out steps to achieve the species' recovery. The goal of this recovery plan is to improve the biological status of winter-run Chinook salmon, spring-run Chinook salmon, and steelhead so they can be removed from the list of federally endangered species. The basic recovery strategy for these three species focuses on enhancing existing populations and reintroducing populations into their historical habitats.

Although NMFS is responsible for implementing the recovery plan, achieving the ESA goal of species delisting is beyond the scope of any one agency or group, and will not happen without cooperation among fishing, water, and environmental stakeholder groups, and public agencies at all levels of government. We all need to work together in order to attain the ESA delisting goal as well as the broader goal of restoring the Central Valley's salmon heritage and protecting it for future generations. For this presentation, we will summarize what is in the Central Valley Chinook Salmon and Steelhead Recovery Plan and will specifically explain how we are partnering with stakeholder groups and agencies and to implement it.

Putting Recovery Plans into Action in Southern Oregon and Northern California

Julie Weeder, Salmon Recovery Coordinator, NOAA Fisheries

Three species of salmonids are listed under the Endangered Species Act in the area from Oregon's Elk River to California's Mattole River. A recovery plan was released in September 2014 for the coho in this area (Southern Oregon/Northern California Coast coho salmon). This plan takes a regional view toward recovery of coho salmon across 13 million acres and nearly 10,000 miles of waterways.

Because of the scale of the effort, many recovery actions were developed to a population scale (roughly analogous to watershed scale), yet the sub-watershed location of needed actions must be known to carry them out effectively. Conservation partners familiar with a watershed can provide valuable knowledge about the best locations and approaches for carrying out recovery actions. The plan includes a robust prioritization system for recovery actions, but does not explicitly identify the actions to be pursued in the next 10 years, because of local factors such as landowner access which can affect how feasible an action would be in the short-term.

The National Marine Fisheries Service (NMFS) is collaborating with the local conservation community to take the next step beyond the recovery plan and identify the sub-watershed recovery actions to be pursued in the next 10 years in order to improve a population's status most efficiently. NMFS partnered with the Eel River Forum to identify these actions in the many populations that make up the Eel River, the third largest river in California.

Implementation Mechanisms in Oregon for Recovering Middle Columbia River Steelhead

Rosemary Furfey, Salmon Recovery Coordinator, National Marine Fisheries Service

As described in the opening remarks for this session, Endangered Species Act (ESA) recovery planning and recovery action implementation for Middle Columbia River steelhead distinct population segment (DPS) is conducted in Washington and Oregon. Each state has its own approach to developing recovery plans and implementing actions for steelhead populations within their jurisdiction. These plans were incorporated into the comprehensive "rolled-up" DPS-wide recovery plan adopted by the National Marine Fisheries Service (NMFS) in 2009. This presentation describes the work undertaken by the state of Oregon to produce its recovery plan for the populations of Middle Columbia River steelhead DPS in Oregon.

The state of Oregon engaged in recovery planning for the Oregon portion of the DPS based on Oregon's Plan for Salmon and Watersheds and the requirements of Oregon's Native Fish Conservation Policy, adopted in 2002 by the Oregon Fish and Wildlife Commission. The Native Fish Conservation Policy uses conservation plans as a means to identify and implement strategies and actions to restore and maintain native fish in Oregon. The conservation plan developed by Oregon meets the state's Native Fish Conservation Policy goals, as well as serving as the Oregon portion of NMFS's DPS-wide ESA steelhead recovery plan.

In Oregon, based on the hierarchical structure of steelhead populations within the DPS, there are three major population groups (MPGs) of steelhead (MPGs are independent populations in the DPS that share similar genetic, geographic, and/or habitat characteristics). Each MPG has its associated individual populations. The three MPGs are: Cascades Eastern Slope Tributaries (with three populations), John Day River MPG (with five populations), and Umatilla/Walla Walla Rivers MPG (with two populations). The scope of this geographic distribution of populations across the landscape determined which stakeholders and organizations Oregon, together with NMFS, worked with to develop the recovery plan and engage the public in review of the proposed recovery plan for the Oregon steelhead populations.

The Oregon Department of Fish and Wildlife, working in coordination with NMFS staff and a facilitator, developed this recovery plan for the Oregon Mid-Columbia steelhead as a collaborative process with broad technical, stakeholder, and public involvement from 2005 to 2009. The plan was written in coordination with the following groups formed for this process:

- Middle Columbia Sounding Board: The Middle Columbia Sounding Board consists of representatives of local communities, agricultural and timber interests, land managers, local jurisdictions, tribes, water users, and industry and environmental interests. They provided policy guidance in writing all aspects of the plan and ensured selection of locally appropriate and locally supported recovery actions needed to achieve recovery. The Board met at least quarterly each year, or more often as needed, to review and discuss new chapters.
- Middle Columbia Recovery Planning Team: The recovery planning team includes local experts representing state, federal, tribal, and watershed council technical representatives across the DPS. The team provided technical guidance and writing for all aspects of the plan.
- Management Action Teams: The three management teams include local experts representing state and federal natural resource agencies, tribes, watershed councils, and Portland General Electric. The team developed specific management actions for the steelhead populations.

This presentation will describe the process for developing this plan, together with a discussion of opportunities, challenges, and recommendations for next steps to implement the plan.

Implementation Mechanisms for Recovering Bi-State Middle Columbia River Steelhead

Nora Berwick, Salmon Recovery Coordinator, NOAA Fisheries

In 1999, the National Marine Fisheries Service (NMFS) listed the Middle Columbia River (MCR) steelhead distinct population segment (DPS) as threatened under the Endangered Species Act (ESA) of 1973 and reaffirmed that designation in 2006. The spawning range of the 20 MCR steelhead populations covers approximately 35,000 square miles of the Columbia River Plateau in south-central Washington and north-central Oregon.

Recovery of MCR steelhead necessitates development and implementation of recovery plans which include the goals, objectives, actions, and monitoring programs to track and report progress. Plans are only as good as the level of commitment to implement them. Coordination of the actions of diverse private, local, tribal, state, and federal parties is critical to success. This model exists in the MCR recovery plan that spans Washington and Oregon. NMFS worked with the state of Oregon's Department of Fish and Wildlife to form a Sounding Board comprised of local stakeholders to help write and implement the MCR Steelhead Recovery Plan. In Washington, NMFS coordinated with the Yakima Basin Fish and Wildlife Recovery Board, the Snake River Salmon Recovery Board, and the Washington Gorge Implementation Team to provide the local technical and stakeholder base to write and implement the MCR Steelhead Recovery Plan. Recovery boards in Washington are sanctioned by the state and coordinated through the Governor's Salmon Recovery Office. The Washington Gorge Implementation Team was developed in an area of the Middle Columbia where no recovery board exists. The Washington Gorge Implementation Team is comprised of the Washington Department of Fish and Wildlife, the Yakama Nation, Klickitat County, and local stakeholders from the Washington Lead Entity Process, conservation districts, and various other state and local habitat and watershed organizations. The Walla Walla River contains the only MCR steelhead population located in both Washington and Oregon. Recovery of the Walla Walla steelhead population necessitates close coordination between the Snake River Recovery Board in Washington and the Walla Walla Basin Watershed Council in Oregon.

The Middle Columbia River Forum, supported by both local and regional science teams, provides the organizational structure for communication and coordination of the recovery actions of these many players on a bi-state and multi-tribal level across the entire DPS. The Middle Columbia River Forum is guided by a Steering Committee made up of management unit leads, Executive Directors from the Yakima Basin Fish and Wildlife Recovery Board, and the Snake River Salmon Recovery Board, representatives from the Oregon and Washington governors' offices, NMFS, Yakama Nation, Confederated Tribes of Warm Springs, Confederated Tribes of the Umatilla Indian Reservation, Oregon Department of Fish and Wildlife, Washington Department of Fish and Wildlife, and Klickitat County.

Climate Change Vulnerability Assessments: The Road to Resilience and Adaptation

Friday Afternoon Concurrent Session 2

Session Coordinator*: Michael J. Furniss, MJ Furniss & Associates*

A Brief Introduction to Vulnerability Assessments: Conceptual Model, Terminology, and Early Lessons

Michael Furniss, *USFS, Redwood Sciences Lab (retired), MJ Furniss & Associates*

The terminology of climate change vulnerability assessment will be described, with recommendations for the use of terminology in collaborative assessments. The Intergovernmental Panel on Climate Change (IPCC) model for analysis, as modified by the United States Forest Service, will be described. Several examples, focused on water resources and aquatic systems, conducted on 12 national forests across the United States and two provinces in southern Ecuador will be introduced to illustrate the use of terminology and the conceptual model, and the lessons learned will be shared. The concept and implications of 'climatic refugia' will be briefly introduced in the context of the rain coasts of western North America.

Choosing and Using Climate Change Scenarios for Vulnerability Assessments of California's Salmonids

Nathan Mantua (Presenter), *NOAA Fisheries, Southwest Fisheries Science Center;* ***Amy Snover,*** *Climate Impacts Group;* ***Jeremy S. Littell,*** *United States Geological Survey, Department of Interior Alaska Climate Science Center;* ***Michael A. Alexander,*** *NOAA Fisheries, Earth System Research Laboratory;* ***Michelle M. McClure,*** *NOAA Fisheries, Northwest Fisheries Science Center; and* ***Janet Nye,*** *School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, NY*

Uncertainties in future climate are frequently cited as barriers for informing vulnerability assessments for species like Pacific salmon. With the current proliferation of future climate scenarios, defensible strategies for selecting a sub-set for analysis and decision-making are needed. Drawing on a rich literature in climate science and impacts assessment, we present general guidelines for choosing climate change scenarios for biological impacts assessment. We then apply these general guidelines to the specific case of California's salmonids, where the template of time/space habitat use for different life-history types of California salmonids is critical for identifying local climate drivers. In general, identification of appropriate scenarios involves: (1) identification of primary local climate drivers based on the climate sensitivity of the biological system of interest; (2) determination of appropriate source(s) of information for scenarios of future changes in those drivers, based in large part on consideration of the degree to which processes controlling local climate drivers are spatially resolved; and (3) selection of (a sub-set of) scenarios for analysis based on considerations related to observed emission trends, the risk tolerance and time horizon characteristics of the related decision, and the relative influence of natural variability. We recommend that analysts examine the full range of relevant climate scenarios for key local climate drivers, selecting specific scenarios for use in biological impacts assessment that appropriately represent this range vis-à-vis the risk tolerance of the associated decision. The most appropriate scenarios for a particular analysis will not necessarily be the "best" for any other because of likely differences in local climate drivers, climate impact pathways, and decision characteristics. This approach supports structured conversations between impacts scientists and decision makers about the implications of decision context for scenario selection and of scenario uncertainty for management response and highlights the importance of improved understanding of biological linkages to climate.

California Golden Trout: Can Their Warming Streams Handle Cattle Grazing and Climate Change?

Kathleen R. Matthews (Presenter), *Pacific Southwest Research Station, United States Forest Service, and* ***Sebastien Nussle,*** *University of California, Berkeley Environmental Science, Policy and Management*

To determine the current range of water temperatures in the streams inhabited by California golden trout, (*Oncorhynchus mykiss aguabonita*), we deployed and monitored water temperature recording probes from 2008-2013 in three meadows in the Golden Trout Wilderness (GTW). 90 probes were placed in three meadow streams: Mulkey Creek in Mulkey Meadow (2838 meters), South Fork Kern River in Ramshaw Meadows (2640 meters), and Golden Trout Creek in Big Whitney Meadow (2963 meters). Mulkey Meadow is currently grazed by cattle while Ramshaw and Big Whitney have been rested since 2001. Year-round water temperatures were successfully downloaded from 79 probes along with measurements of dissolved oxygen, flow, and shade. Water temperatures ranged from -0.1 to 26°C in Mulkey and Ramshaw meadows, while in Big Whitney Meadow maximum temperature did not exceed 21°C. Temperatures were highest in late July through mid-September. Shade was also low (<10%) in part due to cattle grazing and the lack of streamside vegetation. Future monitoring can build on the detailed temperature data reported here to further assess climate warming in the streams of this important native trout. Salmonids generally prefer cool water and become stressed when temperatures exceed 22°C. Thus, these results indicate that current GTW stream temperatures are high and may lack the resiliency to withstand increased water temperatures from climate warming, predicted to increase by 1 to 7°C within the next 100 years. Because climate warming and cattle grazing both contribute to stream warming, some recent publications have recommended that cattle grazing be terminated on public lands so that streams are more resilient to future climate warming.

Multi-year Drought Effects of Winter-run Chinook Salmon in the Central Valley

Joshua Israel, U.S. Bureau of Reclamation

In 2014, California continued to experience drought conditions. These drought conditions tested the flexibility of water management systems in the Central Valley to balance Endangered Species Act (ESA)-listed species protection and regulatory standards throughout the year. In the Central Valley, an interagency technical team evaluated a set of predictions about the impacts of drought on brood 2013 winter-run Chinook salmon. A conceptual model guided the evaluation of vulnerabilities and interactions between life stages of winter-run Chinook salmon and drought conditions and management actions. Changes in dam releases, temperature control, export volumes, and barrier operation were evaluated. The effect of these management drivers on habitat attributes and fish responses were measured. A similar assessment of key metrics will be presented for brood 2014 winter-run Chinook salmon. These results suggest environmental and management drivers both reduce resiliency in this population and elucidate increased monitoring and actions to consider for adaptation. In light of these findings, a multi-tiered life stage nested conceptual model will be integrated into Reclamation's Sacramento and San Joaquin Basins Climate Impact Assessment to show potential impacts due to climate change on ESA-listed species.

Flow Availability Assessment for Salmonid Recovery Planning, Russian River Watershed

Jeremy Kobor (Presenter) and Matt O'Conner, Matt O'Conner and Associates

Insufficient streamflow has been identified as a primary limiting factor for the recovery of coho salmon and other anadromous fish in northern California's Russian River watershed and elsewhere throughout the state. Efforts to protect and enhance stream flows require a comprehensive watershed-scale understanding of the processes responsible for baseflow generation, however detailed information is generally lacking, and managers are often forced to make decisions with regional ramifications based on highly localized data and/or coarse-scale mapping. Numerical hydrologic modeling provides a means of quantifying and understanding the controls on groundwater recharge and baseflow generation at a regional scale and provides a framework for evaluating the cumulative impacts of land- and water-use decisions and for testing flow enhancement alternatives.

A regional distributed hydrologic model has been developed for two Russian River tributary watersheds that have been identified as priority watersheds in the National Marine Fisheries Service's Recovery Plan for Central California Coast Coho Salmon: Dutch Bill Creek and Green Valley/Atascadero Creek. The model incorporates a wide variety of data describing the topographic, land cover, soil, hydrogeologic, and water use characteristics of the watersheds, and has been extensively calibrated to available streamflow gauging and groundwater observation data. The modeling methodology utilizes a robust, physically-based approach to describing stream/aquifer interactions, and is particularly well-suited to describing conditions in the baseflow-dominated flow regimes characteristic of these watersheds during the dry season.

A long-term simulation provided the basis for classifying the various streams in the watersheds into flow availability reaches based on water depth and discharge conditions. By relating the flow availability metrics with requirements specific to coho, the analysis allowed for the identification of the extent of reaches with suitable flow conditions where in-stream restoration work may be most effective, and for the identification of flow-limited reaches suitable for flow enhancement projects. Ongoing work is focused on evaluating the streamflow responses to changes in climate and land and water use (e.g. future increases in groundwater pumping and/or streamflow diversions, conversion of pasture and timber lands to vineyard cultivation), and for testing the efficacy of flow enhancement alternatives being discussed in the watershed such as the concept of diverting excess streamflow during the rainy season and storing it for release during the dry season.

By utilizing the results of this study, water managers and restoration practitioners will be able to focus their efforts on implementing the most effective restoration actions for a given stream reach and flow availability condition in order to maximize the benefits for coho recovery. This project is a joint effort between the Gold Ridge Resource Conservation District and O'Connor Environmental, Inc. with grant funding provided by the California Coastal Conservancy.

Predicting Tidal Lagoon Response to Future Conditions Using a Simple Quantified Conceptual Model

Dane Behrens, PhD (Presenter), Matt Brennan, PhD, PE, and Bob Battalio, PE, ESA PWA

Small, sandy coastal lagoons are common along the Pacific Coast, provide valuable habitat for salmonids, and are being squeezed by ongoing sea level rise and coastal development. These small lagoons function as tidal systems when a connection (inlet) exists between the lagoon and ocean, and as salt-stratified lakes when waves block the inlet with sediment ("inlet closure"). Seasonal freshwater inflows often scour a drainage outlet in the winter and spring which later becomes tidal as the fresh water inflows diminish. These lagoons are formed and influenced primarily by waves, which construct the barrier beach separating the lagoon from the ocean, and result in closure events, most often in the late summer and fall. The inlet/outlet-closed state can create favorable rearing habitat for juvenile salmonids, particularly steelhead. The frequency of closure events can potentially change in response to ongoing climate change and coastal development. However, typical modeling approaches, such as coupled hydrodynamic-wave-sediment transport modeling or traditional "equilibrium" modeling, have not successfully reproduced the rapid and complex morphologic changes to inlet state over long time periods.

We present an alternative approach, a simple time-series model which applies a lagoon water balance in parallel with a parametric model of the inlet and beach. We apply the model to the Russian River Estuary, demonstrating accurate predictive ability for both lagoon tides and inlet state. This approach provides a useful tool to understand existing lagoon conditions and to assess future management options. This approach has proved very useful toward addressing management questions, especially within the context of competing flood management and species protection objectives, sea level rise, and lagoon and estuary restoration.

Session Coordinator: *Tom Leroy, Pacific Watershed Associates*

Developing Plans to Integrate Wood Loading Techniques into Watershed Scale Restoration Planning

Tom Leroy and Chris Moore, Pacific Watershed Associates

Adding wood to impaired river systems with the overall goal of improving fisheries is becoming an increasingly popular restoration technique and is being employed throughout the Pacific Northwest. Indeed, within the Northern California restoration community, the number of wood loading projects and the diversity of restorationists employing the technique has been increasing rapidly over the last several years. Currently most restorationists are "cherry picking" sites for wood loading based on several criteria including broad based biological and geomorphic assessments, ease of equipment or work crew access, variations in landowner interest/willingness, and applicability of the restorationists preferred wood loading technique. In many instances, such as operating under the California Department of Fish and Wildlife Fisheries Restoration Grant Program or the National Resources Conservation Service instream habitat improvement program, restorationists approaches and techniques are constrained by antiquated guidance documents. The overall effect of this has been to implement wood loading projects that often have limited geomorphic response, primarily in the central reaches of watersheds. The danger in this lies in the possibility that restorationists neglect or don't understand the wood needs in the upper and lower portions of watersheds where wood tends to provide different roles in channel geomorphology and fish habitat.

We suggest that a more holistic approach to wood loading be considered by restorationists where the first step includes developing watershed scale plans that include or document: (1) existing geomorphic conditions; (2) current wood densities; (3) the role wood is currently playing in channel geomorphology and habitat creation throughout the watershed; (4) logistical plans that pair other proven restoration techniques (such as off-channel habitat creation or road decommissioning) with wood loading; (5) the most appropriate and applicable wood loading technique and structure type for individual stream reaches based on biological needs, land use projections, material availability, riparian conditions, geomorphic and geologic conditions, and downstream constraints; and finally, (6) prioritizes stream reaches for treatment. This type of planning will allow a restorationist to consider the wood needs for the entire watershed and develop plans that allow for the most cost-effective techniques to be employed in prioritized locations that consider the broader needs of a watershed. It will also allow for identification and mitigation of potential project constraints, something many restorationists are not currently considering.

Developing a restoration plan that takes into account the needs of the whole watershed as well as the management plans for the future allows restorationists to implement highly cost-effective wood loading projects. Through the development of the restoration plan, practitioners will observe how wood is currently performing within the watershed and how wood is interacting within the confined and unconfined reaches of the watershed. These observations will allow the practitioner to design wood jams through stream simulation techniques in the upper and central portions of watersheds or allow them to creatively mimic large wood jams in the lower portions of a watershed where appropriately sized key log material is no longer available.

Low-cost Restoration Techniques for Rapidly Increasing Wood Cover in Coastal Coho Salmon Streams

Jennifer Carah (Presenter), The Nature Conservancy; Christopher C. Blencowe, Blencowe Watershed Management; David W. Wright, Campbell Timberland Management; and Lisa Bolton, Trout Unlimited

Like many rivers and streams in forests of the Pacific Northwest, California north coast rivers and streams have been depleted of downed wood through timber harvest and direct wood removal. Due to the important role of wood in creating and maintaining salmonid habitat, wood augmentation has become a common element of stream restoration. Restoration efforts in North America often focus on building anchored, engineered wood structures at the site scale; however, these projects can fail to meet restoration goals at the watershed scale, do not closely mimic natural wood loading processes or dynamics, and can be expensive to implement. For critically imperiled populations of coho salmon in California, there is a strong impetus to achieve as much habitat restoration as possible in priority watersheds in the shortest time and with limited resources, so cost-efficient techniques are necessary. In this multi-site project, we investigated unanchored techniques for wood loading to evaluate cost and contribution to salmonid habitat in Mendocino County.

Over a period of six years, 72.4 km of stream were treated with 1,973 pieces of strategically placed wood. We found that unanchored wood loading techniques were much less costly than commonly used anchored techniques, reliably improved habitat, and retained wood at high rates (mean = 92%) in small- to moderate-sized streams, at least over the short term (<6 years).

The average cost of design and construction for the unanchored projects was $259 per log, equivalent to 22% of the cost associated with the anchored wood augmentation methods examined here. The unanchored wood placement techniques examined here are not appropriate for use in all contexts (e.g. large rivers, or rivers or streams with a lot of downstream infrastructure), but where appropriate, can increase the pace and scale at which habitat is restored for salmon due to their lower cost.

Watershed Scale Fish Habitat Restoration in Tributaries of the Lower Klamath River

Rocco Fiori (Presenter), Fiori GeoSciences, and Sarah Beesley, Yurok Tribal Fisheries Program

Since 2007, we have applied a suite of techniques to restore in-stream and floodplain fish habitats within priority tributaries of the Lower Klamath. The primary techniques include road deconstruction, tree planting, wood loading, channel shaping, and construction of off-channel features in a top-down complementary approach. Collectively, this approach has been used to: (1) increase hydraulic and habitat complexity at the reach scale; (2) enhance and link existing biological hotspots; and (3) extend geomorphic habitat forming processes through valley segments to the watershed scale. Our work demonstrates a variety of restoration techniques capable of operating over a range of geomorphic conditions and spatial scales needed to affect the freshwater life stages of coho and other salmonids. Our monitoring supports a prevailing notion that small bank based logjams (<8 logs attached to one streambank) is an effective tool to increase in-stream cover in first to third order streams. This technique relies on wedging logs against and into existing streambank features (e.g. riparian trees, large stumps, and landforms) as the primary resisting element(s) in the design. However, the challenge with this technique is finding enough suitable locations where preexisting resisting elements coincide with the appropriate channel feature(s) (typically pool heads and runs) to maximize the benefits for fish. In second order and larger stream reaches, we have constructed a variety of logjam configurations that achieve a wide range of design objectives that include forming pools, providing cover, racking mobile wood, retaining and sorting spawning gravels, maintaining connectivity to off-channel features and split flow channels, inducing backwater zones, forcing hyporheic exchange, and recharging floodplain aquifers. A common design element in these logjams is the use of log posts and pins. Posts and pins function as one of the primary resisting elements in the logjam design and allow the features to be constructed at locations necessary to optimize the design objectives. By incorporating posts and pins in our designs, we have constructed bank based jams, channel-spanning jams, bar apex jams, and debris baffles that would otherwise require imported quarry rock and artificial anchors to achieve a similar factor of safety. In third order and larger stream reaches, the racking capacity of the larger constructed logjams (especially bar apex jams) will allow us to conduct low-cost wood augmentation efforts until natural recruitment processes are attained. Design details and biologic and geomorphic performance will be presented. This work illustrates the success that occurs when stakeholder, landowners, agencies, and practitioners can work together.

Heliwood Placement in the Mattole Estuary

Sungnome Madrone and Drew Barber (Co-Presenters), Mattole Salmon Group

The "Wood is Good" mantra is still real, but how we put the wood in the streams and rivers and what types of structures we build with the wood is constantly changing. Evolution of large wood placement in the Mattole has gone from simple wood placement of the 1980s to larger, complex, and heavily cabled, so-called "stable" structures built in the 1990s, to recent efforts at building "engineered log jams" (ELJs) in the 2000s. In the 2010s the new craze is "Chop and Drop." Structures have gotten more complex and larger, but at the cost of adding lots of metal rebar and cable to the stream. "Chop and Drop" does not involve metal and is a rapid loading process, but often does not include attached root wads that can add to stability of the wood.

The Mattole estuary has seen its share of this process with seven large ELJs being constructed in the lower river/estuary over a 10-year period. Monitoring of these structures has shown that they can move significantly in higher flows, as the rocks crack and the cable comes loose and breaks. While still providing valuable habitat we began to question if there wasn't another way to do large wood loading and get closer to mimicking natural process. In other words could we do "whole tree loading" that would include the root wads, tree boles, and all the branches? One thing is clear. You cannot haul these whole trees on trucks.

The Mattole Restoration Council (MRC) and the Mattole Salmon Group (MSG) have done lots of riparian planting over the years that will add to natural large woody debris recruitment over the coming decades but what can we do now to help the patient survive while we work on long-term health care? We have to implement a triage approach that creates immediate habitat improvements to get the patient (river) breathing again.

After hearing about successful projects that used helicopters for large wood placement, we began to think this was a serious possibility. We worked with the Bureau of Land Management, the United States Fish and Wildlife Service, California Department of Fish and Wildlife, National Oceanic and Atmospheric Administration, Nature Conservancy, National Fish and Wildlife Foundation, Department of Water Resources, local landowners, and the MRC and MSG and raised the funds, secured the permits, and finalized the placement plans in cooperation with our local Technical Advisory Committee which includes the above organizations.

In the fall of 2013, we had the trees tipped and staged and the helicopter became available to haul 200+ whole trees. We had two weeks notice that the helicopter was coming and in less than 12 hours of flight time we had moved over 200 whole trees and placed them at various locations throughout the lower river and estuary. The trees have been PIT-tagged and GPSd, along with documenting their size, length, complexity, and orientation, so that we can monitor their movements at certain flows and understand their effectiveness over time.

Can the CHaMP Protocol Detect Habitat Changes Resulting From the Addition of Large Wood to a Northern California Stream?

Elizabeth Mackey (Presenter), Wendy E. Holloway, and Chris Bell, Pacific States Marine Fisheries Commission; Sean Gallagher, California Department of Fish and Wildlife; David D. Wright and Emily Lang, Campbell Global, LLC

The California Coastal Salmonid Population Monitoring Plan (CMP) studies regional status and trends in adult coho salmon and steelhead and conducts life-cycle monitoring in select streams (LCMS) in Mendocino County. Two of these streams, Pudding and Caspar Creeks, are being studied as part of an effectiveness monitoring program in a Before-After-Control-Impact (BACI) design wherein high levels of large wood will be added to over 15 kilometers of the mainstem of Pudding Creek, using Caspar Creek as the control stream. The purpose of this multi-year study is to test the hypothesis that strategically and surgically placing large wood into most of Pudding Creek's suitable salmonid habitat will increase coho salmon and steelhead growth, survival, and abundance by increasing the quantity of their summer and winter habitat.

We are using the Columbia Habitat Monitoring Program (CHaMP) protocols and tools to assess salmonid habitat in both streams. These methods are being used to quantify geomorphic status and trends through the application of rigorous topographic surveys and the measurement of various habitat attributes. These data are converted into salmonid habitat such as gradient, sinuosity, the ratio of fast to slow-water habitat, pool frequency, particle size and embeddedness, and wood density. Additionally, the topographic data and maps are used to monitor rates of deposition and erosion and to detect geomorphic change over time.

As the first project to utilize the CHaMP methodologies in the state of California, we are presented with the unique opportunity to evaluate its use in coastal redwood systems. Here, we present data from the first three years of the Pudding/Caspar Creeks BACI study and use the results to date to speculate on potential changes in habitat from the prescribed wood treatment and discuss the use, applicability, and value of implementing the CHaMP protocol to assess this and other large wood salmonid habitat restoration projects in coastal Northern California.

Using Helicopters to Improve Salmonid Habitat in a Snake River Tributary, Combining Aerial and Ground Implementation Strategies to Address Habitat Deficiencies

Eric Hoverson, Confederated Tribes of the Umatilla Indian Reservation Fisheries Habitat Program

The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) Fisheries Program utilized helicopters in combination with track hoes to address factors limiting salmon production in a two-mile reach of the upper Tucannon River in Washington during August, 2014. A total of 825 trees and 500 boulders were placed into the stream channel and riparian area.

Helicopters are an effective means of incorporating whole trees into river channels to improve salmonid habitat complexity. Benefits of placing mature trees via aerial application include increased capability to access isolated source materials, precise placement into remote areas, reduced disturbance and preservation of riparian and riverine features towards accelerated healing, and capability to transport large trees with full crowns. Combining aerial application with various ground refining techniques is an effective means of achieving ultimate project success.

Degraded and disconnected habitat conditions in the Tucannon River Basin have contributed to a decline in salmonid abundance from historical levels. Reduction of habitat is primarily due to impacts associated with catastrophic fires that burned 150,000 acres in the watershed during 2005-06. In addition, levees have straightened significant portions of the stream network, resulting in simplified aquatic habitat and decreased efficiency of ground and surface water interactions.

The CTUIR Department of Natural Resources created a First Foods Policy Program to protect, improve and restore proper habitat conditions required to sustain traditional foods of the CTUIR. A River Vision document was created to acknowledge the specific requirements of First Foods and guide restoration process towards preserving and reinvigorating such staples. Marriage of the two guidance documents promotes best management practices towards sustaining valued natural resources for use in daily life as well as special subsistence ceremonies. These internal protocols ensure that the Tribal community has the capability to continue practicing and preserving valued traditions of CTUIR culture by means of clean water and habitat suitable for salmonids.

A variety of habitat monitoring techniques and habitat assessments were used to determine existing conditions, identify factors limiting salmonid abundance, and select priority areas for restoration. Primary objectives of the project were to improve habitat complexity, reconnect the floodplain, and rectify fish passage. Proper riverine function was sought with natural aesthetics to reflect preferences of Tribal philosophy in regard to processes associated with First Foods production and River Vision management.

Restoration of the two-mile restoration project resulted in increases of the following: number of pools increased from 58 to 167, channel length increased by 1,242 meters, habitat–type complexity index increased from 133 units to 258, undercut values increased from 20% to 46%, wood complexity index increased from 2.1 to 3.1, sinuosity increased from 1.26 to 1.65, and river complexity index increased from 3.78 to 9.88. Landowner coordination and intra-agency coordination was an important determinant of the restoration strategy selected. Technique applicability, proper implementation, attention to detail, effective monitoring, and adaptive management ultimately determined project success.

Session Coordinators: *Lisa Hulette, The Nature Conservancy, and Kevin Shaffer, California Department of Fish and Wildlife*

A New Salmon Joint Venture for California: Collaboration for Recovery

***Rene Henery (Presenter)**, Trout Unlimited; University of Nevada, Reno; Chris Unkel, American Rivers; and Jacob Katz, California Trout*

California's antiquated systems for water delivery and flood management have resulted in the precipitous decline of salmon, steelhead and many other native species. In addition, the resulting loss of dynamic river flow, floodplain inundation, and groundwater recharge poses significant challenges to human communities, both because of our growing need for reliable water supply and flood storage and as a result of the regulatory burden associated with managing for listed species. Salmon and steelhead recovery is critical for successful and sustainable water management in California. Until these species are on a trajectory to viable, stable, and self-sustaining populations, the turmoil over water use, quality and storage, flood management, floodplain land use, and a myriad other matters will continue unabated.

Much has been done over the years to conserve CA salmon and steelhead including regulation of take and engagement in isolated habitat restoration projects. The scientific building blocks for recovery of listed salmonids such as spring-run Chinook and steelhead have been created; plans to double fall-run Chinook have been published and targets set. But, the specific, measurable objectives necessary to achieve those targets have yet to emerge and populations continue to be severely impacted or teetering on the edge of extinction. The time has arrived for all of the active and concerned parties—the public land managers, the wildlife agencies, the regulators, the conservation NGOs, the commercial fishermen and sports anglers, and others—to come together in a collaborative effort to design a path to recovery and steward its implementation on the ground. We propose the formation of the Salmon Joint Venture as the means for achieving this objective.

Fortunately, we have the precedent of a highly successful model to guide us: The Central Valley Joint Venture (CVJV) targets recovery of waterfowl and other migratory birds. It just celebrated its 25th anniversary and has proven to be one of the most successful conservation efforts of the past two decades. The CVJV's approach to setting objectives, coordination, funding, policy support, and restoration project implementation for wetlands and migratory birds contributed to a remarkable recovery of waterbird populations. Salmon and steelhead pose a more complicated challenge, given their life histories, habitat requirements, and contentious dialogue around water in California. However, drawing on the lessons learned in the CVJV, we believe that we can create a similar Joint Venture focused on salmonids that will support diverse and broad interests working together to overcome the many challenges facing Central Valley salmon populations.

Scaling-Up Streamflow Restoration for California´s Salmon and Steelhead

Matt Clifford (Presenter), Trout Unlimited; Darren Mierau, California Trout; and Lisa Hulette, The Nature Conservancy

California coho salmon and steelhead are under threat of extinction in the next few decades. To reverse these declines, recovery efforts must be better coordinated across watersheds, regions, and partnerships. A strategic partnership and three-year action plan between The Nature Conservancy, California Trout, and Trout Unlimited has been forged to direct actions that will lead to viable, self-sustaining populations of coho salmon and steelhead in California.

Unlike other anadromous salmonid species that spend only a few months in freshwater between emerging from their eggs and migrating to the ocean, coho and steelhead live the first year of their lives in freshwater and depend on a steady supply of cold, clean water to survive California's warm, dry summer months. It is an evolutionary strategy that has served them well until wine grapes, orchards, hay fields, row crops, dairies, marijuana farms, and cities tapped the same sources during the driest part of the year. Current conflicts between water demands for cities and agriculture and the needs of aquatic resources in coastal areas can be resolved with creative solutions; there is enough water if it is used more wisely. However, the timing and the rate at which water is typically diverted in summer often causes pools to dry up, rivers to become disconnected, and water to become too warm for coho and steelhead to survive.

Most of the changes our groups seek for the benefit of salmon and steelhead can also benefit landowners in the form of increased water supplies, safer drinking water, drought preparedness, and fire safety. For example, constructing on-site storage ponds enables farm and vineyard owners to divert water in the winter, when streamflows are plentiful, and reduce diversions in the summer and early fall when flows are unreliable and instream flow needs are critical. Storage tanks allow rural residents to do the same thing. And installing frost fans can allow vineyards to stop diverting water altogether to protect their crops from frost in the spring, when sudden drawdowns can strand and kill young salmon and steelhead.

Keeping cold clean water flowing for coho and steelhead has immediate life and death benefits: succeed and they survive, fail and they die. Changing the timing of a diversion and securing an instream dedication of water doesn't take decades to show results; the benefit may be immediate, direct, and hopefully permanent. Will this program alone save the coho? Not by itself. But if we can significantly improve streamflow, beneficial effects of other recovery actions will be enhanced.

Integration of Watershed and Fisheries Recovery in California's Private and State Timberland Operations and Regulatory Processes

Richard Gienger, Sierra Club Representative, State Coho Recovery Team

Logging operations have gone through a 'sea change' since the modern California Forest Practice Act of 1973, and the application of the California Environmental Quality Act (CEQA), and water quality and endangered species statutes to that process. The Board of Forestry and CalFire have the authority to require restoration measures to be implemented as part of their legislative and regulatory authority. Some important restoration activities have become part of the forest regulatory process, especially as regards roads. Other important areas for fisheries and watershed recovery have had less progress. An adequately reformed cumulative effect process would provide a blueprint for recovery from legacy damages. The scale at which cumulative watershed effects are supposed to be evaluated and responded to in the timber harvest process is the same scale that the Coho Recovery Strategy calls for Recovery Plans to be carried out, limiting factors to be determined, and data to be collected and organized. These "Planning Watersheds" are referred to as the CalWater 2.2 Planning Watersheds that usually range from five to ten-thousand acres.

AB 1492 went into effect in September 2012. Among other things, it finances the Forest Practices review process in California through retail taxes on many lumber products, seeks to determine efficiencies and ecological performance, and will provide funding in the future for watershed restoration & fuel hazard reduction. It also resulted in the hiring by the Natural Resources Agency of a person to help give oversight to forest practices from the perspective of the Agency and California Environmental Protection Act. Unfortunately, the first move was to make a Board of Forestry Effectiveness Monitoring Committee (EMC) the venue for determination of AB 1492's efficiencies and ecological performance.

Due to opposition to this action placing the EMC as the sole venue, a flow chart was constructed for three inter-related working groups (Data and Monitoring, Leadership, and Ecological Performance) which would interface with the EMC—with public input outside of all four entities. It is unclear whether or not various administrative assurances of action will include determination of efficiencies and ecological performance through organization of information by Planning Watershed and by multidisciplinary and multi-stakeholder foundational pilot projects to ensure adequate information procedures for evaluation and response to cumulative impacts with a focus on location of sites where recovery measures are warranted in forested Planning Watersheds. All Timber Harvest Plans (THP) require every watercourse to be walked and adverse impacts to be mapped and/or described and located. This information is available electronically in most coastal watersheds vital for salmon and steelhead recovery, but is disorganized and scattered. Restoration efforts need to be integrated into the forest practice process through information accessibility, quality, and formatting—a reform important to all stakeholders: landowners, Registered Professional Foresters, resource agencies and departments, the restoration community, and the public. Existing grant programs will be part of the implementation of AB 1492, but reform of how information is presented in the THP process will facilitate more restoration, in more key areas, and for a much longer period of time.

A Salmon Safe Harbor Agreement for Dry Creek—Piloting a New Tool in the ESA Tool Box for the National Marine Fisheries Service in the Russian River Watershed

Dan Wilson and Robert Coey (Co-Presenters), NOAA Fisheries, West Coast Region

Safe Harbors are allowed through Section 10 of the Endangered Species Act (ESA) through issuance of an enhancement of survival permit to non-federal landowners. The National Marine Fisheries Service (NMFS) is piloting this tool in the Russian River Watershed. Presenters will discuss the elements of a Safe Harbor Agreement, expand upon the following questions below and more, and present a case study on how the process has been developed and is going in the Dry Creek Watershed.

What Is a "Safe Harbor Agreement"?

A Safe Harbor Agreement (SHA) is a voluntary agreement involving private or other non-federal property owners whose actions contribute to the recovery of species listed as threatened or endangered under the ESA. In exchange for actions that contribute to the recovery of listed species on non-federal lands, participating property owners receive formal assurances from NMFS that if they fulfill the conditions of the SHA, NMFS will not require any additional or different management activities by the participants without their consent.

What Are "Safe Harbor Assurances"?

Safe Harbor Assurances are assurances provided by NMFS in the SHA that allow the property owner to alter or modify enrolled property, even if such alteration or modification results in the incidental take of a listed species to such an extent that it returned the species back to the originally agreed upon baseline conditions.

What are the Elements of the Dry Creek Programmatic Safe Harbor Agreement?

Because the habitat conditions for coho and steelhead are currently degraded, for NMFS, an "elevated baseline" is required for participation in this SHA. The elevated baseline for this SHA is defined by the anticipated improved habitat conditions that would likely occur once a Habitat Enhancement Project has been constructed. An "elevated baseline determination" is necessary to document a "net conservation benefit" which must be demonstrated to be sufficient to contribute, either directly or indirectly, to the recovery of the covered species. A net conservation benefit for the enrolled property is determined by considering the cumulative benefits associated with the enhancement, restoration, or maintenance of covered species' suitable habitat on the enrolled property and any off-setting adverse effects attributable to the incidental taking of lawful activities.

Who Benefits?

In Dry Creek, the benefits are enhanced habitat and fish populations, regulatory certainty, and a reliable water supply. NMFS has the responsibility for recovering salmonids under the ESA, and in the Russian River, which is 95% privately owned, private landowners hold the key. Dry Creek provides a water supply for over 500,000 people, a hatchery, and habitat for listed salmonids. SHAs provide regulatory certainty to landowners for their lawful agricultural operations, as long as the enhanced habitat is not degraded, and an incentive to maintain critical habitat, providing fish the time and space they need to regain their populations.

Yurok Tribe Fisheries Restoration and Perspective in the Lower Klamath

Sarah Beesley, Yurok Tribal Fisheries Program

The Yurok Tribal Fisheries Program (YTFP) is likely the largest tribal fisheries management team in California. YTFP is comprised of four divisions focused on the management and restoration of anadromous and native fish populations of the Klamath Basin. Since the late 1990s, YTFP's Lower Klamath Division (YTFP-LKD) has been working with various partners to assess native fish runs and their habitats in a manner that leads to comprehensive, process-based watershed restoration. This presentation will focus on our fisheries restoration approach in the Lower Klamath Sub-Basin, techniques currently being implemented (i.e. constructed wood jams, riparian restoration/bioengineering, and off-channel habitat enhancement), and the science driving our restoration program (e.g. Klamath Coho Ecology Study). The Yurok Tribe, like many northern California tribes, has a unique perspective on resource management due to the close connection between native peoples and their environment that has existed since time immemorial. YTFP, with our restoration specialist Rocco Fiori, has been implementing innovative, process-based restoration techniques in priority Lower Klamath tributaries since 2007. The presentation will also highlight restoration partnerships and synergy as well as address complexities associated with implementing YTFP-LKD's restoration program.

Are *We* Resilient—How Will California Implement Effective Anadromous Restoration?

Gail Seymour (Presenter) and Kevin Shaffer, California Department of Fish and Wildlife

Many agencies, regional, state, and federal, are involved in funding and partnering with restoration organizations and groups to restore or enhance river habitat for California's coastal salmon and steelhead trout. The Department of Fish and Wildlife is entering its fourth decade implementing the Fisheries Restoration Grant Program, and the National Marine Fisheries Service is in its second decade providing substantial funding for Pacific salmon through the Pacific Coast Salmon Recovery Fund. These are but two examples of organized, scientific, and funding activities in California.

The broad restoration community now recognizes many essential issues that require attention in order to make progress on recovery and restoration—the need for restoring estuaries, moving from project level to watershed level restoration, incorporating acute and chronic environmental change into all restoration projects, focusing on water availability and quality for habitat and fishes, evaluating the effectiveness of restoration practices, incorporating new and innovative techniques to achieve and maintain habitat restoration.

Recognition of these issues, the finalization of several recovery plans in the state, increased competition for finite restoration dollars, and the environmental effects from drought and climate change will present challenges to the restoration community in the future. How can and will we respond?

Session Coordinator: *Karen Gaffney, Sonoma County Agricultural Preservation and Open Space District*

Innovative Tools, Data, and Planning for Riparian Corridor Conservation

***Tom Robinson**, Conservation Planner, and **Karen Gaffney (Co-presenters)**, Conservation Planning Program Manager, Sonoma County Agricultural Preservation and Open Space District*

The Sonoma County Agricultural Preservation and Open Space District is a voter-approved special district that protects the diverse agricultural, natural resource, and scenic open space lands of Sonoma County for future generations. To this end, the District conserves greenbelts between cities, farmland, biological resources, wildlife habitat, and land for public recreation. The District has invested significant public funds to protect watersheds and stream corridors that are important for supporting biological diversity, and will continue to do so into the future. Given that the District protects land in perpetuity, and the myriad decisions to prioritize effective conservation actions, high quality data and planning are critically important to acquiring and enhancing the most important conservation lands. In the last several years, the District has substantially enhanced its data and tools to support science based planning for prioritization of conservation actions. Data such as Light Detection and Ranging (LIDAR) and fine scale vegetation mapping support models, analyses, and tools that have refined our ability to accurately map existing riparian zones and develop future targets for long term functional stream corridors. These analyses integrate fluvial geomorphic and hydrologic processes, vegetation and habitat, land use/land cover, and socioeconomic data to document the multiple benefits associated with riparian corridors. In order to convey these multiple benefits to the general public and decision makers, the District has developed non-traditional datasets related to carbon sequestration, natural capital values, climate adaptation resiliency, flood resiliency, education, recreation, and economic cost-benefit analyses related to natural versus built capital options. These data and tools are foundational to objective, science-based planning which in turn supports well informed decision making by policy makers and funders, leading to on the ground conservation actions to protect and enhance riparian corridors.

Conserving Stream Ecosystems and Working Lands in Perpetuity

***Misti Arias,** Acquisition Program Manager, and **Sheri Emerson** (Co-presenters), Sonoma County Agricultural Preservation and Open Space District*

The Sonoma County Agricultural Preservation and Open Space District acquires and stewards land to protect the diverse agricultural, natural resource, and scenic open space lands of Sonoma County for future generations. The District has protected over 106,000 acres (10% of Sonoma County) since its inception in 1990, and has continually evolved its land acquisition and stewardship strategies and tools in order to be more effective at achieving its mission. The District has invested significant public funds to protect watersheds and stream corridors that are important for supporting biological diversity, and will continue to do so into the future. New tools that are emerging and are being explored for riparian corridor protection include affirmative easements, spatially or temporally limited easements, layering of multiple funding and policy strategies in a particular geography, working with multiple contiguous landowners, incorporation of in-stream flow objectives, as well as refinements of the District's primary tool, the conservation easement. These new conservation tools may allow land conservation organizations to protect key watersheds and stream corridors more effectively and ensure more adaptive capacity under expected future climate regimes. In addition to evaluating and testing new tools for land acquisition, the District has evolved its strategies and methods for stewardship of protected lands, including implementing watershed and stream corridor restoration projects by engaging the public in long-term habitat enhancement efforts. A riparian corridor enhancement project on Mark West Creek, an important steelhead and coho stream in the Russian River watershed, has included the active involvement of multiple groups and schools over a five-year period. This model of public engagement includes a diverse cross-section of the public, focuses on education and capacity building, is cost effective, increases the sense of ownership by our constituents, and results in multiple, long term benefits to the watershed and the community.

The North Coast Resource Partnership: Multiple Benefits for Watersheds & Communities

Jen Jenkins Kuzmar (Co-presenter), Planning Supervisor, County of Humboldt, and Leaf Hillman (Co-presenter), Karuk Tribe

The North Coast Resource Partnership (NCRP) is an innovative, stakeholder-driven collaboration among local government, watershed groups, tribes, and interested partners in the North Coast region of California. The NCRP regional boundary mirrors that of the State Water Board's Region 1 and is comprised of seven counties, multiple major watersheds, and a planning area of 19,390 square miles, representing 12% of California›s landscape. The NCRP integrates long term planning and high quality project implementation in an adaptive management framework, fostering coordination and communication among the region's diverse stakeholders. The NCRP's focus areas include restoring salmonid populations, enhancing the beneficial uses of water, promoting energy independence, reducing greenhouse gas emissions, addressing climate change, supporting local autonomy and intra-regional cooperation, and enhancing public health and economic vitality in the region's economically disadvantaged communities.

Since its inception in 2004, the NCRP has received over $3 million in planning funds, and over $49 million in implementation funding for over 60 projects throughout the region. In the last decade and into the coming decade these funds result in benefits to communities on the North Coast including:

- Water Quality and Supply: increases in streamflow, sediment reduction, contributions toward Total Maximum Daily Loads (TMDL) goals
- Habitat Enhancement: invasive plant removal, fish passage improvement, aquatic/riparian habitat restoration
- Energy Independence/GHG Emissions reduction: upgrading water/wastewater facilities to become more efficient, biomass energy projects

Additionally, the projects implemented by the NCRP have resulted in numerous economic, socio-economic, and ecosystem services benefits, such as carbon sequestration, reduced flood damage, enhanced firefighting capabilities, education and conflict reduction, road maintenance cost reduction, and reduced costs for TMDL enforcement.

The NCRP leadership and technical committees include North Coast Tribes, representing over 30 tribes in the North Coast region. The NCRP integrates Tribal priorities and objectives into NCRP planning documents, and provides funding and technical assistance for Tribal projects and priorities. With targeted funding from the Department of Water Resources, the partnership has worked with a NCRP Tribal engagement coordinator to ensure tribal participation through the partnership and implementation of priority tribal projects.

Deepening the Roots of Conservation Science

Chuck Striplen, PhD, San Francisco Estuary Institute—Aquatic Science Center

The various fields comprising what we describe as "conservation science" have made significant advances in recent decades. We now have a far better understanding of landscape processes, the ecological needs of threatened species, and are better able to anticipate challenges to come with a changing climate. But there is still room for growth. Relatively new fields of investigation are both contributing to and challenging conservation science. Two such fields are historical ecology and traditional ecological knowledge (TEK). Both fields utilize novel data to inform conservation science, and both require new relationships and approaches to recover, analyze, and understand this new information. As these fields expand and contribute new perspectives and information to conservation, new analytical frameworks and intellectual alliances must evolve to include their interdisciplinary and multicultural aspects. Projects incorporating TEK and historical ecology into restoration design are becoming more common. Examples from Sonoma and San Mateo Counties will be discussed, including the development of foundational floral and faunal datasets from archaeological contexts, and wetland and riparian reconstructions to inform large-scale restoration initiatives.

Engaging Diverse Communities in Restoration and Conservation

Raquel Ortega and John Griffith (Co-presenters),
and Larry Notheis, California Conservation Corps

Two years ago was the first time in our nation's history in which more non-white Americans were born than white. Americans of color are now almost 37% of the total US population. In 10 years, more than half of all American children will be people of color. Yet, you would never notice these statistics if your only point of reference was the memberships and employees of environmental groups. According to the Natural Resources Council of America, only 11% of employees at natural resource organizations are non-white. The Center for Diversity and the Environment's Executive Director, Marcelo Bonta, states that in his work, "Most environmental organizations have less than 9% people of color working on their staff and board of directors." If conservation groups wish to remain relevant into the future, they will need to diversify. There are all kinds of people living in watersheds who could be advocating for salmon and restoring rivers, but one rarely sees much diversity in the conservation, sustainability, and even our own salmon habitat restoration movement.

In my talk, I will explain how growth and resiliency of your organization is important. I will give examples about how some organizations have already realized that their relevancy was dependent on their diversity and share what steps they have made to ensure that their membership reflects the population they serve. No one demographic has the numbers or resources to tackle the immense global and/or watershed-specific challenges that we are faced with today. It will take everybody. We are on the precipice of a great opportunity to engage all of our populations in the stewardship of our watersheds. Being hesitant to this reality may result in the undoing of many of our recent scientific, political, and educational gains.

Session Coordinators: *Charlotte Ambrose*
and ***Nora Berwick,*** *NOAA Fisheries, West Coast Region*

Working with Veterans to Implement Recovery Plans in California

Bob Pagliuco, *NOAA Fisheries*

The National Oceanic and Atmospheric Administration and California Conservation Corps (NOAA/CCC) Veterans Corps program employs post-911 military veterans to conduct Endangered Species Act-listed salmon and steelhead population monitoring and habitat restoration to assist with species recovery. During their first few weeks on the job, veterans are provided with intensive training courses such as spawner survey and swiftwater rescue trainings, to prepare them for the technical and physically demanding work ahead, and ensure a safe working environment. Once training is complete, the veterans currently work with mentors from the California Department of Fish and Wildlife and the United States Forest Service to implement high priority monitoring and restoration projects. Currently, six veterans are employed by the program in Northern California, and plans are underway to expand the program with four more veterans in Southern California at the CCC Los Padres (San Luis Obispo) and Camarillo Centers.

The NOAA/CCC Veterans Corps implements NOAA Fisheries management and recovery priorities for salmon and steelhead through on-the-ground restoration and monitoring. Monitoring activities include spawner surveys and juvenile dive surveys to determine salmon and steelhead abundance and distribution in high priority salmon and steelhead populations, characterizing habitat to determine appropriate restoration treatments, and implementing on-the ground restoration of riparian, off-channel, and instream habitat. The NOAA/CCC Veterans Corps are implementing high priority recovery actions through these activities. The Veterans Corps monitoring work in the Klamath River also assists NOAA and its fisheries management partners in implementing the Magnuson Stevens Act. Klamath River Chinook adult abundance data collected by the Veterans Corps is provided to the Klamath Ocean Harvest Model to forecast the impacts of ocean and river fisheries on Klamath River fall Chinook.

In addition to assisting NOAA with implementing fisheries management and recovery goals, the NOAA/CCC Veterans Corps increases veterans' job skills, and thus future work opportunities, through training and on-the-ground experience with experts in the fisheries field. The program focuses on providing a career path for successful participants. In addition to developing work skills and increasing job opportunities, veterans in the program are also eligible to receive college tuition and a $5,000 AmeriCorps education award. The following is a link to a video developed by NOAA highlighting the Veterans Corps program and the opportunities it provides to NOAA, the partners, and the veterans: *www.youtube.com/watch?v=zM4TENrPs08.*

As of May 2014, these veterans have conducted spawner surveys on over 950 miles of stream, conducted over 220 miles of juvenile and adult snorkel surveys, assessed habitat on 28 miles of stream, conducted 40 days of downstream migrant trapping, and completed 32 habitat restoration projects. In addition, the veterans have received 17 fisheries-related trainings that have helped them develop additional skills and build up their resumes.

Coalition Based Steelhead Recovery Efforts in Coastal Southern California

Sandra Jacobson, South Coast Steelhead Coalition Coordinator, California Trout

The National Marine Fisheries Service Southern California Steelhead Recovery Plan describes specific goals and strategies for preventing the extinction of steelhead populations within the Southern California Distinct Population Segment (DPS). A central tenet of the Recovery Plan is that a viable DPS will consist of a sufficient number of viable discrete populations that may be spatially dispersed but adequately connected to achieve the long-term persistence and evolutionary potential of the species. The Recovery Plan further addresses factors limiting the species' ability to survive and reproduce in the wild as a roadmap for recovery efforts. These limiting factors are tightly linked to features of their life history as an anadromous species, and are particularly acute in highly urbanized Southern California. The most common threats include some combination of low instream water flow, groundwater extraction, degraded water quality, fish passage barriers, non-native vegetation and aquatic species, low population numbers, and fragmented or isolated populations. To effectively address these complex challenges, the South Coast Steelhead Coalition has formed to identify, prioritize, and implement projects that integrate steelhead recovery efforts in San Diego, Orange, and Riverside Counties. This Coalition mobilizes federal, state, regional, and local entities and non-governmental organizations to move projects forward based on sound science and the technical and operational capabilities of Coalition participants. Recent molecular genetic analysis of southern California trout populations revealed two populations of native trout within the Coalition area that are of southern California steelhead descent. These populations are isolated in freshwater streams near remote headwaters of their native basins and have adopted a completely resident life history. Concerted efforts to protect and expand these populations are projected based on the fact that they are rare genetic resources and hold promise for improving genetic diversity and fitness of fragmented native rainbow populations. Progress of the South Coast Steelhead Coalition will be discussed in the context of increasing resiliency of native trout populations through expanded geospatial distribution, and leveraging improved connectivity in waterways as fish passage barriers are removed to promote recovery of the endangered southern California steelhead.

Coho Recovery South of the Golden Gate: Partnerships for Preventing Local Extinction, Expanding Populations, and Building Ecosystem Resiliency

Jim Robins, *Principal Ecologist, Central Coast Integrated Watershed Restoration Program, Alnus Ecological*

The 2012 Final Recovery Plan California Central Coast (CCC) Coho Salmon represents a clear and compelling call to action: "….NMFS alone cannot shift the trajectory of CCC coho salmon from extinction to recovery. Coho salmon recovery will require a united community forming alliances and strategically implementing recovery actions to this single purpose…. Their dire status is a call for immediate action to prevent their extinction by, among other things, restoring habitat conditions and watershed processes across their historical range. The situation is daunting, but it is not hopeless."

In no place is this call to action more critical than along the coast south of the Golden Gate, throughout the Santa Cruz Mountains Diversity Strata. As noted in the recovery plan, this call to action is daunting but is not hopeless. The urgency of the National Marine Fisheries Service (NMFS) message has been heard loud and clear throughout the communities along coastal San Mateo and Santa Cruz counties. Over the past decade, staff from the NMFS Restoration Center and Science Center have provided locals with various tools to support recovery of listed salmonids ranging from programmatic permits to technical assistant and from enforcement to cutting edge hatchery science. While the integration of these components within the NMFS family has not always been perfect or well-coordinated, over the past five years, and especially since the release of the CCC Coho Recovery Plan, it appears from the outside that significant strides have been made to better link and coordinate regulation, recovery, science, and funding. Working both independently as well as through the Central Coast Integrated Watershed Restoration Program (IWRP is a partnership led by the local Resource Conservation Districts and State Coastal Conservancy with local, state, and federal resource agencies aimed at working collaboratively to identify, design, permit, fund, and implement the highest priority restoration projects), local governments, non-governmental organizations, land trusts, special districts, business, and private landowners are getting onboard to collaboratively develop workable restoration and resource management actions that balance private interests (property rights, water rights, economic rights, etc.) with the public trust. Through the recovery plan, NMFS has rallied the troops and gotten the attention of the public. Now we need NMFS to take a strong leadership role with state agency partners to develop new strategies and mechanisms that support the innovation and flexibility needed to address difficult issues such as modifications to water rights for protection of instream flows, protection and creation of winter refugia in incised channels, and accelerated recruitment and cost-effective installation of large woody debris in lower reaches of coastal streams that lack conifers.

This talk will focus primarily on: (1) the perceived risks and rewards of working to recovery coho south of the Golden Gate; (2) recommendations based on a decade of lessons learned through IWRP to accelerate the pace, scale, and effectiveness of investment in coho recovery; (3) highlighting key time-sensitive windows of opportunities along the San Mateo and Santa Cruz coast that need to be exploited while open if we are to realize coho recovery; and (4) a plea for continued and expanded investment and coordination with the NMFS Science Center and academic institutions as a critical piece of assessing effectiveness of various recovery efforts and enabling real adaptive management and learning.

Partnering to Advance Central Valley Salmon and Steelhead Recovery

Claire Thorp (Presenter), and Andrew Purkey, National Fish and Wildlife Foundation, Western Water Program

Water transactions and associated restoration efforts which improve and enhance aquatic habitat will be critical components of successful salmon and steelhead recovery in California's Central Valley where imperiled populations struggle to survive in the face of decreased freshwater flow, rising stream temperatures, and disconnected tributaries. The ongoing drought, groundwater over-drafting, and diminishing snow pack in the west is exacerbating a long-standing competition for freshwater flow that naturally arises as a result of human and fish and wildlife needs and altered hydrological landscapes. The National Fish and Wildlife Foundation's Western Water Program has a history of supporting voluntary water transactions and innovative tools to improve habitat conditions, provide incentives for land owners and managers, and find the balance between the competing interests and requirements of people, fish and, wildlife.

This presentation will describe a variety of voluntary transaction agreements, opportunities presented by emerging water markets, and tools for incentivizing the participation of agricultural producers, along with lessons learned over 12 years of working with public and private stakeholders to develop solutions that make ecological and economic sense.

Recovery Plan Implementation Through the Eel River Forum

Darren Mierau, California Trout

The Eel River is California's largest coastal watershed, spanning over 3,856 square miles, an area roughly equivalent to the Shasta, Scott, Smith, Redwood Creek, and Russian River watersheds combined. The Eel is renowned for its high sediment loads, large rainfall-induced floods, and large annual water yield. The average annual water yield for the Eel River at Scotia is approximately 5.8 million acre-feet. The December 24, 1964 flood of record at Scotia was 752,000 cubic feet per second!

Salmon and steelhead runs were large too. From 1853 to 1922, estimates of the annual catch approached 2 million pounds of salmon and nearly 500,000 pounds of steelhead (California Department of Fish and Wildlife, 2010). Yoshiyama and Moyle (2010) estimated that combined annual salmon and steelhead runs in the Eel River likely exceeded one million adults in good years. With relatively little development in the basin (fewer than 100,000 people in the basin), the Eel River also possesses enormous recovery potential. But despite substantial restoration investment in many parts of the watershed by many restoration practitioners over the past several decades, efforts to integrate basin-wide recovery planning, prioritization, and monitoring have proven quite challenging.

In July 2012, at the request of CalTrout, the Eel River Forum was convened. The Forum is a consortium of 22 member organizations including public agencies, Indian tribes, conservation partners, and public members working together toward restoration of this iconic river. The Forum has held monthly meetings with in-depth presentations and discussions spanning a range of issues, including basin-wide monitoring activities, water quality and impaired summer flows, sediment and Total Maximum Daily Load implementation, the Eel River estuary, and a review of the PG&E Potter Valley Project. A charter was drafted, revised, and adopted in June 2013. The Forum is now developing an Eel River Action Plan, which will provide a summary of issues the Forum has identified as primary factors impairing salmonid recovery and ecological health of the Eel River and identify a set of actions which would contribute to improving watershed health and the recovery of salmonid and other fishery resources. In the coming years, a partnership between the National Marine Fisheries Service (NMFS) and the Eel River Forum will facilitate implementation of the Eel River Action Plan and NMFS' Recovery Plans. Consensus on priority recovery actions from the Eel River Forum Charter members and citizens throughout the watershed will provide a strong platform for achieving species recovery.

Implementing Steelhead Recovery at the Local Level in the Bi-State Walla Walla Basin

Brian Wolcott, *Executive Director, Walla Walla Basin Watershed Council*

The Walla Walla Basin Watershed Council (WWBWC) and the Snake River Salmon Recovery Funding Board have teamed up with NOAA Fisheries, Oregon Department of Fish And Wildlife, Washington Department of Fish and Wildlife, local tribes, and other restoration partners in the bi-state Walla Walla basin to assess conditions, and develop a prioritized Mid –Columbia Steelhead recovery plan. The WWBWC is a local non-profit, formed under state legislation and with county commissioner endorsement to assess watershed conditions, work with landowners to develop and implement restoration projects, and monitor the improvements. The WWBWC is comprised of 13 board members representing local interests, including irrigated agriculture, recreational fisheries, local Native American tribes, and municipal governments. In Oregon, the Oregon Watershed Enhancement Board (OWEB) is a state agency dedicated to restoring watershed health and is overseen by a diverse board with representatives from state agencies, federal agencies, Native American tribes, municipalities, and private citizens. OWEB leads a competitive statewide granting program for assessments, planning, restoration, outreach, and monitoring activities. OWEB's funding is a combination of federal salmon dollars and Oregon lottery revenue. OWEB also has helped oversee and support the creation of over 60 watershed councils in river basins across the state of Oregon. Since its formation in 1994, the WWBWC has brought in over $18 million from OWEB, Bonneville Power Administration, Oregon Water Resources Department, Washington Department of Ecology, Environmental Protection Agency, Natural Resources Conservation Service, United States Fish and Wildlife Service, county agencies, and private foundations to improve fish passage, habitat, stream flows, water quality, and groundwater levels, while educating students on watershed science and monitoring restoration results. The WWBWC has coordinated bi-state with partners in Washington on workshops and trainings, matched state funding for bi-state monitoring and restoration actions, and developed bi-state funding outreach campaigns. Results include dozens of fish passage projects completed, flows restored to a river that historically went dry every summer, miles of riparian habitat projects completed, and increases in salmon, steelhead, and bull trout population numbers and usable habitat.

Salmon Recovery—Local Solutions to Regional Challenges

Steve Martin, *Executive Director, Snake River Salmon Recovery Board*

The Snake River Salmon Recovery Board (SRSRB) is comprised of the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), one county commissioner, and two stakeholders from five counties in southeast Washington. This board of 18 members prepared and submitted, and is now overseeing implementation of, the adaptive management and reporting of a federally approved salmon recovery plan. The SRSRB is a component of the State of Washington's ESA approach where regional organizations, largely aligned with Evolutionarily Significant Unit/Distinct Population Segment boundaries, are encouraged to self-initiate for the purpose of developing salmon recovery plans supported by science and community. Implementation is a natural outcome when stakeholders engage with scientists in developing the goals, objectives, strategies, and most specifically, the actions. Since its inception in 2002, the SRSRB has guided more than $30 million in federal, state, and private funding based on the priority areas and actions established in the recovery plan. Federal, state, tribal, and private funds have been leveraged, actions broadened, and community support enhanced. Local solutions to regional challenges can be very effective.

Actions have led to results. When the plan was first written, water temperatures were in excess of 80°F, sediment levels exceeded 50%, floodplains were isolated from the rivers, and riparian forests were minimal. Fast forward to today in the Tucannon River, water temperatures have not hit 73°F in the last seven years, sediment is now 5%, five miles and 200 acres of floodplains are reconnected, and riparian forests are approaching 80% of historic conditions. In the Walla Walla, bi-state coordination has led to ground water recharge and monitoring in critical locations, coordinated monitoring of salmon across the state line, and a flow enhancement strategy that may lead to even greater flows in the near future. Planning is time consuming and it is difficult to reach consensus, but when all partners are working in harmony, actions lead to results.

Beyond the Thin Blue Line: Floodplain Processes, Habitat, and Importance to Salmonids: Part I

Saturday Morning Concurrent Session 2

Session Coordinators: *Tommy Williams, NOAA Fisheries, Southwest Fisheries Science Center, and Brian Cluer, NOAA Fisheries, West Coast Region*

Detecting and Designing Synchronous Channel and Floodplain Habitats

Rocko Brown, University of California, Davis

In restoring channels and floodplains for ecological species, scientists and practitioners need to be able to unify the analysis and design of these vital landforms. This talk will discuss how varying levels of channel and floodplain syncing can be assessed and designed using a suite of conventional and advanced tools. Channel-floodplain syncing is when topography and flow regime are coupled in a quasi-equilibrium state in harmony with the surrounding landscape and land use. From this, we can identify synchronous channel-floodplain systems, that is, those that are topographically linked to their flow and sediment regimes, from asynchronous ones. In this talk I will show several real world examples of synchronous and asynchronous channel-floodplain systems from California and abroad. Next, I will go over several ways we can assess how "synced" channels are with their floodplains. Beyond assessing channel-floodplain dynamics, we also need to apply our knowledge of functional floodplains to create new environments that are subject to non-physical process constraints such as existing land use, water regulation, etc. I'll briefly present and discuss RiverSynth, an Excel tool that allows users to generate a wide array of channel and floodplain topographies that are easily adjustable. These can then be rapidly iterated to optimize configurations of synchronous channel and floodplain topography that meet specific eco-hydraulic goals for habitat restoration. In closing, limitations and applications in California and beyond are discussed.

Development of a Multi-threaded Wetland Channel Complex and the Implications for Salmonids

Lauren Hammack (Presenter), *Prunuske Chatham, Inc.;* ***Mariska Obedzinski,*** *University of California Cooperative Extension; and* ***Joe Pecharich,*** *Earth Resources Technology, NOAA Fisheries Restoration Center*

Willow Creek in western Sonoma County is a tributary to the lower Russian River within the estuary. This 8.7 square mile watershed has a long history of human habitation, natural resource use, and channel modifications. In the last 30 years, lower Willow Creek has evolved from an incised single-thread channel to a multi-threaded channel and wetland complex. The current multi-threaded channel form is thought to closely reflect the conditions that existed in the alluvial valley prior to European settlement, land clearing, and aggressive channel management practices. Few examples exist today of the marshy willow and alder thickets that likely covered the low valley bottoms of our Central and Northern California coastal watersheds. Willow Creek provides a unique analog to study the development, evolution, and habitat value of multi-threaded wetland channel complexes. Understanding the role these historic channel complexes played in the population dynamics of coho salmon may be critical to successful recovery efforts.

Historically, Willow Creek had a robust coho salmon population. True to the regional story, the population began to crash in the 1970s. While other nearby watersheds maintained a remnant population of wild coho, the last coho was seen in Willow Creek in the mid-1990s, despite the perception that habitat in the upper watershed was in good condition. By the early 2000s, it became apparent that there was a fish passage issue, as no steelhead were accessing the watershed either. Regular dredging of the channel within the lower valley bottom had been occurring since the 1950s to maintain channel capacity and keep a bridge clear of sediment. In 1987, after State Parks purchased lower Willow Creek, the historic practice of dredging the channel was halted. This started the evolution of lower Willow Creek from hay fields and a straightened channel to its current complex form. It also led to the road across the valley becoming a barrier to fish passage.

In 2012, a new bridge was installed to allow passage into the multi-threaded channel wetland complex. Given the complexity of channels in the valley and the diffused flows across the floodplain at higher winter flows, there was some concern among fisheries biologists that the fish passage issues would not be solved with the installation of the bridge. Despite these concerns, coho salmon and steelhead immediately began accessing and utilizing the watershed after the bridge was installed.

Fisheries monitoring has been conducted by a team consisting of staff from University of California Cooperative Extension and California Sea Grant, National Marine Fisheries Service Restoration Center, and Prunuske Chatham, Inc. The extensive monitoring program includes spawning/redd surveys, summer snorkel surveys, Passive Integrated Transponder-tag antenna arrays, and downstream migrant trapping. Both broodstock-released and wild coho salmon have successfully navigated the lower Willow Creek wetlands to spawn and rear in the watershed. Data from the first two monitoring years indicates that during non-drought winters a portion of the juvenile coho cohort migrate to the lower wetlands to rear. A study to compare growth rates in fish rearing in the lower wetlands versus the upper watershed will be conducted this year.

Restoration of Fluvial Processes, Floodplains, and Habitat in Lower Butano Creek

Chris Hammersmark, cbec, inc.; John Klochak, United States Fish and Wildlife Service; Setenay Bozkurt, PE, San Francisco Regional Water Quality Control Board; and Irina Kogan, San Mateo Resource Conservation District

Human modification of Butano Creek and its watershed has dramatically accelerated sediment delivery to the creek channels, as well as altered the amount of erosion, transport, and storage of sediment within the valley bottom, as compared to historical rates. The creek has become disconnected from its floodplain due to incision as a result of channel management activities, including the removal of large wood, ditching, and realignment of channels. Floodplain disconnection has transformed areas that once provided sediment storage into areas where sediment is produced due to channel incision and widening. Channel-floodplain disconnection has also dramatically reduced the amount of floodplain habitat available to salmonids and the increased sediment loads have led to the degradation and simplification of remaining channel habitats as well as limiting fish passage due to channel aggradation downstream in the Pescadero Marsh. Analysis with hydrodynamic and sediment transport models indicates that floodplain reconnection and restoration via channel roughening through the installation of engineered wood structures will restore some of the crucial floodplain processes that have been lost, leading to reduced sediment delivery to the downstream reach and improved habitat conditions. Due to the dramatic increase in sediment loads, substantial amounts of floodplain reconnection will be required. Work is underway to refine the first round of proposed projects and to develop designs while funding is being sought for project implementation.

Doomed to Die on the Straight and Narrow: Can We Break the Levee to Let Recovery Flow?

Sean Hayes (Presenter) and Jeffrey Jahn, NOAA Fisheries

Salmon recovery planning and restoration is largely contingent upon restoration of habitat processes and the resulting habitat. In the case of Endangered Species Act (ESA)-listed species, this requires that parties who may may adversely affect listed species and/or critical habitat consult with the National Marine Fisheries Service to ensure their actions do not jeopardize the Evolutionarily Significant Unit (ESU) or Distinct Population Segment (DPS). The "catch 22" is that the initial alteration of river habitats from functional floodplains to leveed channels often caused the population decline and ESA listing. Once the listing occurs, the river state is considered static from a management perspective, such that a broken river to which ever fewer adult salmon return, and increasingly more juveniles die, has no "take" associated. A biological opinion (BiOp) on a proposed restoration action includes an environmental baseline section that describes the current habitat and fish, but this can be challenging if there is a lack of data on current mortality rates and associated causes. Working across the landscape from headwaters to ocean, recent studies have documented several things. First, survival in the freshwater portions of our California river systems is often worse than we presumed and previously attributed to ocean issues. We know from several studies that salmon prefer estuarine and wetland habitats that are very productive with high-growth potential. Concurrently we observed life-history strategies for some juvenile Pacific salmonids that included emigrating from habitats with higher survival rates, but lower growth potential, to habitats with lower survival rates but with increased growth potential. In some of these cases we found higher adult return rates (2 to 10X increase in marine survival) for those fish that used rearing habitat that posed higher mortality risk, as a group these fish exchanged survival for freshwater growth with the result being greater marine survival and a greater percentage of individuals completing their life cycle and returning as spawning adults. In many cases these critical (and often lost) life-history traits that are the key to recovery. The idea that a healthy well-functioning habitat can have very high mortality rates can be a challenge in forming a BiOp. If we want to facilitate the restoration of lost crucial habitats, it is critical that we provide the science, particularly in the form of peer reviewed publications, to document real scenarios where reduced juvenile survival in estuaries, wetlands, and floodplains can be compensated for by increased survival at later life history stages, with a net increase in escapement that will ultimately facilitate recovery. Once documented, this can feed into the BiOp process which will analyze take and habitat and discuss the long-term benefits of the project to the habitat, individual fish, population, and ESU or DPS. With these data, we show how the current baseline condition is dysfunctional and that a restoration project might improve this by providing improved habitat for one or more species.

You Are What You Eat: Isotope Tools to Track Floodplain Rearing of Native Fishes

Rachel Johnson, NOAA Fisheries, Southwest Fisheries Science Center

Benefits of floodplain rearing for salmonids have been well documented, yet the population-level benefit in terms of increased survival during downstream migration and ocean residence remain unquantified. This is largely due to methodological challenges linking habitat-use in one life stage to long-term survival benefits. Here we explore whether differences in the floodplain food web relative to the riverine food web provide a unique "fingerprint" that could be used to identify individuals that spent a portion of their early life rearing on the Yolo Bypass. The phytoplankton in the water in the Yolo Bypass has been shown to have a uniquely lower sulfur isotope composition (δ34S) than phytoplankton in other water sources in rivers and the Delta, presumably because of rice farming providing a useful fingerprint for the base of the food web (Kendall, Bay-Delta Science Conference, 2010). Like carbon isotopes and unlike nitrogen isotopes, sulfur isotopes of organisms show minimal change with increasing food web position. Thus, isotopic differences at the base of the food web propagate up the trophic hierarchy from the water, to invertebrate prey, and into the muscle and ear bone (otolith) protein of fishes feeding on that food web. We will present results on sulfur isotopes in prey items in the stomach, muscle, and fin tissue of archived juvenile salmon collected on the floodplain in 1999, relative to juveniles foraging in the mainstem Sacramento River. Results from this study will be discussed in the context of whether sulfur isotopes are a unique, temporally, and spatially robust marker functioning at the appropriate scales to characterize floodplain habitat use by juvenile fish. Sulfur isotopes are permanently recorded in otoliths and future work will investigate their use to reconstruct floodplain habitat use and residence time for different native fish species such as salmon, steelhead, sturgeon, and splittail.

Cost-Effective Planning for Large-Scale Floodplain Habitat Restoration in the Salmon River, Western Siskiyou County

Jay Stallman (Presenter), Joel Monschke, and Joshua Strange, Stillwater Sciences; and Karuna Greenberg, Salmon River Restoration Council

The Salmon River Restoration Council (SRRC), Stillwater Sciences, and their partners are planning large-scale floodplain habitat restoration and enhancement along the Salmon River in western Siskiyou County. Extensive mine tailings on Salmon River floodplains currently impair salmon and steelhead populations by prohibiting winter and spring inundation of potential rearing habitat, reducing riparian vegetation establishment, and contributing to elevated summer water temperatures. These impairments especially limit anadromous salmonid populations in mountainous rivers with intrinsically less floodplain habitat. We evaluated restoration potential over 55 river miles, based on delineation of geomorphic reach types using Light Detection and Ranging (LiDAR) data, summer water temperatures using thermal infrared (TIR) imagery, legacy mining disturbances, and existing infrastructure. We subsequently analyzed site conditions and floodplain habitat restoration opportunities in detail at a pilot site on the lower South Fork Salmon River. The approach involved (1) mapping to interpret geomorphology, characterize surface and shallow subsurface materials, and assess excavation potential; (2) developing a conceptual restoration design and preliminary grading plan; and (3) assessing floodplain inundation during biologically relevant flows under existing and restored conditions using a one-dimensional hydraulic model. The restoration design involves lowering an existing high-flow side channel and adjacent floodplains to increase inundation, constructing alcoves, placing large wood, re-contouring mine tailings, revegetating the riparian corridor, and enhancing cold water sources for summer thermal refugia. Implementation will increase floodplain inundation area by approximately 75% under each design flow, thereby increasing winter refuge and spring rearing habitat for juvenile steelhead and coho, fall-run Chinook, and spring-run Chinook salmon. This approach highlights the use of LiDAR and TIR imagery, geomorphic mapping, hydraulic analysis, and proven design features to cost-effectively prioritize and design restoration at sites with the greatest potential to increase salmon and steelhead production.

Session Coordinators: *Neil Lassettre and Justin Smith, Sonoma County Water Agency*

Improving Monitoring: Identifying The Missing Links Between Stream Restoration: From Design to Evaluation

***Zan Rubin (Presenter)** and **George Matthias Kondolf**, University of California, Berkeley, Landscape Architecture and Environmental Planning; **Blanca Rios-Touma**, Universidad Tecnológica Indoamérica; and **Mary Powers**, University of California, Berkeley*

Stream restoration projects commonly attempt to enhance ecosystems by creating more complex and varied habitats. Although widely implemented, there is little understanding of the success to date of such projects. There is also little agreement on the best methods to quantify success. We reviewed the methods of 26 peer-reviewed evaluation studies and investigated the influence of study design on evaluation results.

Of the 26 studies, many did not implement rigorous study designs. For example, only 46% of the studies used quantitative measures of habitat, 62% included only one year of post-project monitoring, 46% used zero or one control (unrestored) sites, and 62% did not include reference (best potential ecological condition) sites. Studies that used more rigorous designs (e.g., sampled more years, measured habitat quantitatively) were more likely to find increased ecosystem diversity and richness in response to heterogeneity enhancement.

More fundamentally, all studies used macro-invertebrate diversity and/or richness as the measure of ecological success. We question the logic of assuming that reach-scale diversity or richness is useful as a universal measure of ecosystem integrity. Monitoring and evaluation should first establish hypotheses and conceptual models based on watershed perturbations and set specific milestones towards a sustainable, dynamic, and healthy ecosystem. Restoration targets should be defined based on regional, historical, and analytical reference conditions and by conducting manipulative experiments that can help predict ecosystem responses to restoration actions. It is important to understand if habitat heterogeneity projects are succeeding, but it is not yet possible to draw general conclusions. Evaluations also need more rigor and connection to project specific goals, rather than relying on generic metrics.

Comparison of Benthic Invertebrate Community Structure and Diet Composition of Steelhead Trout in Dry Creek, California

Andrea Dockham (Presenter), and Gregg Horton, Sonoma County Water Agency, and Margaret Wilzbach, Humboldt State University

Dry Creek, located in Sonoma County, is one of the main producers of salmonids in the Russian River watershed because of its year-round release of cold clear water from Warm Springs Dam. Since construction of the dam, the stream exhibits much less seasonal variation in flow and offers favorable year-round temperatures of 12-13°C to support salmonid growth. However, morphological changes in the creek associated with the dam, including channel incision, armoring of the streambed, high current velocities, and bank erosion have reduced habitat availability for rearing fish. The effect of dam-associated changes on the structure of benthic invertebrate assemblages and their availability as prey to juvenile salmonids has not been previously investigated.

To provide baseline data on benthic macroinvertebrates for monitoring salmonid habitat enhancement currently conducted on the creek, and to evaluate prey availability for juvenile salmonids, we sampled the macroinvertebrate benthos and diets of steelhead trout along a longitudinal gradient from Warm Springs Dam to the creek's confluence with the mainstem Russian River. Previous studies conducted by the Sonoma County Water Agency have established that growth of steelhead in Dry Creek differs among reaches and with distance from the dam. If prey availability is contributing to factors restricting the success of juvenile salmonids in Dry Creek, our expectation is that prey abundance will parallel reach-specific differences in fish growth. Samples are still being processed; preliminary qualitative observations suggest both seasonal and reach-specific differences in assemblage structure and diet composition.

Jam 'in for Salmon: Monitoring Channel Response to Large Wood Placement

Kathleen Morgan, *Gualala River Watershed Council*

The Gualala River Watershed Council's (GRWC) Cooperative Monitoring Program is designed to assess watershed conditions under a Quality Assurance Plan approved by the North Coast Regional Water Quality Control Board (Quality Assurance Project Plan (QAPP) for Monitoring Sediment Reduction in the Gualala River Watershed, Williams, K., and Morgan, K., 2002). Under the QAPP, data is collected annually on the physical and biological condition of the watershed allowing evaluation of ecological events, trends, and the effectiveness of restoration projects.

The program incorporates a stream reach methodology that quantifies habitat quantity and quality by collecting data on channel morphology, water quality and quantity, riparian composition, large wood abundance and salmonid populations. The program has 37 established monitoring reaches watershed-wide and 17 years of data.

In 2000, GRWC implemented a restoration program focused on the placement of unanchored large wood into stream channels. One component for monitoring the restoration program was to include large wood placement in two established monitoring reaches that had four years of baseline data. A control reach with equivalent baseline data was also established to monitor natural changes to the environment. Long-term results show a measurable increase in habitat quality, most notably in channel morphology processes.

Monitoring channel morphology in conjunction with a reach monitoring protocol is one of the most useful metrics to monitor habitat suitability for salmonids. The inclusion of stream reach monitoring in restoration planning and management allows the evaluation of specific project performance and provides the information necessary for adaptive planning.

Immediate Fish Response to Stream Habitat Enhancement in the Spawning Reach of a Highly Altered Central Valley Stream

Andrea Fuller (Presenter) and Jason Guinard, FISHBIO

Gravel and gold mining, in conjunction with an altered flow regime and artificially suppressed replenishment of coarse sediment, have resulted in deterioration of the lower Stanislaus River into a homogenous, incised channel with few functional floodplains or other off-channel rearing areas. Long-term monitoring of Chinook salmon escapement and subsequent juvenile production indicates that insufficient availability of suitable spawning and juvenile rearing habitat may limit in-river production of anadromous salmonids. To alleviate these population constraints, the Oakdale Irrigation District and the Anadromous Fish Restoration Program jointly funded the Honolulu Bar Restoration Project, which was designed with the primary objective of increasing and enhancing juvenile salmonid rearing habitat along a mile-long section of the primary spawning and rearing reach. This was achieved through re-contouring 2.4 acres adjacent to an existing side-channel to function as a small floodplain and by using harvested material to construct shallow gravel benches along the main channel margin.

Periodic post-construction assessment of habitat use during winter and spring over the past two years suggests that localized benefits were rapidly realized in the restored area, as evidenced by spawning activity and consistent utilization for rearing by juvenile salmonids across a broad range of sizes. These findings illustrate that such restoration projects can provide nearly immediate amelioration of habitat scarcity in Central Valley rivers. Encouraging and facilitating natural production is crucial to the long-term sustainability of native fish populations, and restoration and management plans for Central Valley salmonids would benefit from the inclusion of rearing habitat enhancement in natal spawning areas where habitat limitations have been identified.

Broadening the View of "Limiting Factors" vs. "Process-based" Restoration Strategies to Maximize Systematic Endangered Species Planning and Recovery in the West

Derek Booth (Presenter) and Jenna Scholz, Cardno, and Tim Beechie, NOAA Fisheries, Northwest Fisheries Science Center

Across human-disturbed landscapes, effective planning and recovery of endangered species face multiple challenges. Currently, we approach solutions to these problems from either of two fundamentally different, but potentially complementary, perspectives. We offer two examples of West Coast recovery planning efforts to suggest how integrating these strategies can improve salmon recovery throughout the West.

The first "bottom-up" strategy proceeds from the long-standing paradigm that when a critical habitat is in short supply, a bottleneck results and this habitat becomes limiting. "[Limiting factors analysis] is designed to identify potential physical limitations to fish production that may be moderated or removed by habitat rehabilitation or enhancement programs" (Reeves et al. 1989). This approach, embraced by the United States Bureau of Reclamation for recovery planning in the Columbia Basin and elsewhere, assesses reach-scale features to identify suitable habitat recovery actions that address known limiting factors. This guidance uses a systematic structure to identify "potential actions to preserve, initiate, and/or create the identified target conditions." Although there is no a *priori* limitation on the geographic scale of such actions, the scale of these reach assessments and their recommended projects strongly imply a local focus. The advantage of this approach is its direct link between restoration actions and habitat creation; its primary limitations are the restrictive scale of both analyses and actions as typically implemented, and an associated tendency to emphasize opportunistic restoration efforts.

The second "top-down" strategy for restoration planning embraces the principles of process-based restoration (Beechie et al. 2008, 2010). In developing this framework, these authors have applied the hierarchical understanding of streams in their watershed context to guide stream restoration planning, advocating that the restoration of watershed-scale processes should, in general, supersede the construction of strictly reach-scale conditions. Although this perspective is extensively quoted in many of the recent restoration planning documents throughout the West Coast region, its implementation in practice is far more challenging than its widespread acceptance might suggest. Its advantages emphasize addressing the causes of degradation rather than their symptoms, and it invokes self-sustaining watershed and riverine processes to maintain conditions that might otherwise be a source of long-term maintenance or outright project failure. However, its fundamental assumption is that restoring normative watershed processes will create and support desired habitat features, regardless of whether those linkages are fully understood.

In our experience, restoration planning typically focuses on one or the other of these strategies, precluding the potential benefits of more consciously integrating them both. We believe the current challenge is less in accepting the framework of "process-based restoration" than in finding how best to implement its guidance through recovery planning and, ultimately, in on-the-ground implementation. Two examples from the Columbia Basin, a reach assessment along the Methow River and the "Atlas Process" in the Grande Ronde watershed, illustrate how integrating these two perspectives can improve region-wide restoration planning and implementation. We encourage not only a broader view of what constitutes a meaningful restoration "project" but also a more fundamental appreciation, and application, of the process-based view of the restoration landscape.

Validating Restoration Design and Implementation Actions at the Upper Junction City Channel Rehabilitation Site, Trinity River: Embracing Uncertainty and Learning From Progress

David Bandrowski (Presenter) and David Gaeuman, Trinity River Restoration Program, U.S. Bureau of Reclamation

The strategy of the Trinity River Restoration Program (TRRP) is to recover the salmonid fishery downstream of two major dams by restoring physical process and creating more rearing habitats using system-wide and site specific techniques. This process-based restoration effort includes a combination of five major components: high flow releases and natural flow regime management, channel rehabilitation, gravel augmentation, watershed restoration, and adaptive management. A strategic combination of these five management actions is now beginning to induce process-based change and new cause-and-effect dynamism. This holistic approach to the Trinity River ecosystem recovery over the past ten years has resulted in new learning and better understanding of reach-scale physical and biological processes. A key aspect to the success of the restoration actions is effectively validating both the physical and biological components of the habitat that is being actively designed and implemented. Implementation of site-scale channel rehabilitation and gravel augmentation projects have improved channel complexity and have resulted in an increase in salmonid habitat quantity and quality. Channel rehabilitation, coarse sediment additions, and large wood introductions in combination with high flow pulses from the dam have been the catalyst to propagate system-wide change on the Trinity River. To date, over thirty large-scale rehabilitation projects have been implemented to induce geomorphic change and to create more available habitats. Design elements such as split flow channels, floodplains, alcoves, wood jams, mid-channel islands, and side channels are just some of the types of features that have been constructed to transform the simplified channel of the Trinity River to a more complex system. Through the past several years, there has been a dramatic shift in design and implementation techniques on the Trinity River. Restoration actions have evolved from predominantly working in the floodplain to a more strategic and aggressive approach within the active channel to promote dynamic change and lateral migration. Through a decade of effectiveness monitoring and scientific rigor, new trends are emerging and informing future design and implementation approaches and methodologies. A unique adaptive management framework has provided the flexibility to design and implement new techniques, which has allowed for applied learning and critical progress. Embracing uncertainty, restoration designs are now using feature-specific objectives, associated metrics, and predictive-based models to help guide and inform decision making and to strategically select design alternatives. The Upper Junction City restoration project was implemented in 2012 and incorporated robust physical and biological metrics into the design process. Over the past two years, the TRRP has been evaluating the project's design performance through effectiveness monitoring. This evaluation includes the validation of the physical responses to a range of flows and the corresponding utilization of rearing habitat within the project features. The presentation will demonstrate the integration of two-dimensional hydraulic models with habitat suitability criteria to inform design alternatives. In addition, predictive-based morpho-dynamic physical response models will demonstrate advancements of balancing stream power and hydraulic conveyance with slow water habitats. On-going effectiveness monitoring is now bridging critical gaps and enhancing design approaches to help guide us into the future.

Saturday Morning Concurrent Session 4

Session Coordinator*: Amy Trainer, JD, West Marin Action Center*

Funding the Future and Touching the Third Rail: How California Passed a Water Bond and Finally Regulated Groundwater

Tina Cannon Leahy, *Principal Consultant, Assembly Water, Parks and Wildlife Committee*

After a spate of general obligation bonds in the late 1990s and early 2000s, California hadn't passed a new water funding measure since 2006. In 2009, former Governor Schwarzenegger called a special session of the Legislature to address water-related issues that were still unresolved at the close of the regular session. During those negotiations, an $11.14 billion bond emerged as part of a historic five-bill package. Unfortunately, it was later considered, especially in a struggling economy, to be so bloated in size and filled with special "pork" projects as to be unpassable on the ballot. As a result it skipped twice like a pebble, first being moved from the November 2010 general election to the 2012 general election, and then again from the 2012 general election to 2014. This presentation will discuss how the Legislature made an unprecedented effort to reach out to stakeholders and citizens and craft Proposition 1, which replaced the 2009 water bond with a slimmed-down and focused $7.545 billion measure that passed with over 67% of the vote.

Groundwater has long been the "third rail" of California water policy even though, or perhaps because, California is the number one consumer of groundwater in the nation. In times of "normal" precipitation, groundwater makes up about 40% of the state's overall supply. In times of drought that percentage can shoot upwards of 60% and for some areas groundwater is always 100% of their local water supply. The state had made previous attempts to manage groundwater but those statutes were limited to actions that were voluntary, incentivized by state funding, or both. As a result, California held the dubious distinction as the last state in the country without an enforceable statewide groundwater regulation.

This presentation will describe the events in California that led up to the historic and seemingly impossible moment when Governor Brown signed the Sustainable Groundwater Management Act and related legislation. Also covered will be the basics of how and when local agencies must develop and adopt Groundwater Sustainability Plans in California's high and medium priority groundwater basins and sub-basins, which are the most relied upon for drinking water and irrigation, and the dual roles of the State to provide technical assistance in the development of plans or to act in an enforcement capacity if locals are unable or unwilling to engage in sustainable groundwater management.

An Integrated Approach for Enhancing Dry Season Flows in North Coastal California

Joel Monschke (Presenter), Jay Stallman, and Joshua Strange, PhD, Stillwater Sciences

Dry season (i.e., July-October) flows in north coastal California watersheds have decreased over the past half-century due to changes in climate, land-uses, and associated water demands. Less flow during the dry season can stress juvenile salmon and steelhead, potentially limiting their populations and the success of recovery strategies that target physical habitat restoration. We propose an adaptable, three-step framework for developing informed water resource management decisions and restoration actions that address problems created by low dry-season flow in watersheds ranging from 10 to 50 square miles in size. Step 1 assesses the magnitude and key mechanisms of hydrologic change in a watershed. Step 2 analyzes the feasibility of achieving desired instream flow through management actions. Step 3 involves designing appropriate solutions that consider site-specific conditions. We will develop the framework in Redwood Creek, a tributary to South Fork Eel River, where a water conservation program has been initiated to improve salmon and steelhead habitat. Framework development will build on lessons learned in the Mattole River, where a community-supported water storage and forbearance program has increased dry season flows. An interdisciplinary team working in Redwood Creek will identify opportunities and constraints based on analyses of water use, flow and aquatic habitat conditions, hydro-geomorphic processes, and land uses. The team will employ coupled hydrologic and temperature models in developing a long-term plan that includes the most effective actions for enhancing dry season flow conditions. Site-specific prescriptions may include residential and agricultural tank storage, multi-use off-channel ponds for water supply and groundwater recharge, and opportunities for cool instream flow augmentation during critically warm and dry periods. Effectiveness monitoring will guide future implementation in Redwood Creek and the stepwise framework developed in Redwood Creek will serve as a timely model for similar efforts elsewhere in the North Coast region.

Instream Flow Objectives for Priority Sacramento Tributaries

Daniel Schultz, State Water Resources Control Board

The Public Trust Unit in the Division of Water Rights at the State Water Resources Control Board (State Water Board) is working to identify tributaries with high public trust resource value and develop and implement flow criteria and flow objectives intended to provide for the reasonable protection of public trust resources. The Public Trust Unit's current focus is the development of flow objectives for priority tributaries to the Bay-Delta, with a focus on the Sacramento River watershed. Often referred to as Phase 4 of the Bay-Delta effort, this work includes (1) development of non-binding flow criteria; (2) development of flow objectives and implementation plans; (3) adoption of policies or regulations that incorporate flow objectives, adaptive management, and implementation plans; and (4) implementation of policies or regulations through conditioning of water rights and other measures as appropriate.

Flow criteria will provide the technical basis for the development of flow objectives, but will not have regulatory effect. In July 2013, the State Water Board submitted a document to the Delta Science Program (DSP) to request assistance in identifying one or more scientifically defensible methods to develop flow criteria for priority tributaries to the Bay-Delta. In response, the DSP convened an independent panel of experts to evaluate a variety of methods which could be used for this purpose, and the panel provided a recommendation to the State Water Board in March 2014. The DSP expert panel recommended a seven-step hybrid approach using stream classification, blocking of the hydrograph for hydraulic analyses, site specific information where available or essential, extrapolating the understanding of flow-ecology relationships from other sites to the study catchment or segment, interaction between scientist and stakeholders, and an effective adaptive management protocol.

State Water Board staff is incorporating the expert panel recommendations and related public comments received earlier this year to develop a method of setting flow criteria which is anticipated to be released with the Phase 4 Strategy (Strategy) document. The Strategy will serve as a roadmap for the State Water Board, staff, and stakeholders, and will include information such as the goals and objectives of the Phase 4 effort; the process that the State Water Board staff anticipates will be used for development and implementation of flow objectives in priority tributaries; a framework for development of tributary-specific policies or regulations and flow objectives; identification of priority tributaries; and identification of key elements, objectives, and steps of the Phase 4 process to inform and engage stakeholders and ensure successful implementation of tributaries specific policies or regulations and flow objectives. The Draft Phase 4 Strategy and Flow Criteria Method are targeted for release in early 2015 for public comment.

Creative and Voluntary Solutions to Increasing Flows in the Shasta River Watershed

Lisa Hulette, Senior Project Director, Salmon Program, The Nature Conservancy

In 2012 The Nature Conservancy officially launched the Shasta River Water Transaction Program. The purpose of this program was to secure in-stream flows for salmon during strategic times of the year when fish need it most, while continuing to support a healthy and active ranching community in the Shasta River Watershed. To date, over 4,600 acre-feet of water have been left in-stream to the benefit of fish through this effort. This presentation will highlight the tools used to secure water instream while balancing the needs for water by the agricultural community in the Shasta. These tools include:

- The permissive use of California Water Code Section 1707 to add fish and wildlife as a beneficial use to water rights that provides flexibility and security of leaving water instream when fish need it most but still allows for its use for irrigation
- The short-term acquisition of water instream using forbearance agreements during strategic times of year
- Short-term transfer of water rights to other beneficial users (i.e., municipalities) whose secondary benefit is instream flows between point A and B
- Creation of a guidance document for water right holders interested in engaging in the §1707 process

In addition to presenting on the different tools that have been used in the Shasta River to secure water instream, we will also highlight the science we've collected in the basin which quantifies the improvements to water quality that has resulted in leaving water instream for fall Chinook in September. The data collected around water transactions has been summarized in an article that has been submitted to the Journal of Water Resources Management and Planning and is currently under review for publication.

California Water Law, Water Transactions for Instream Flow, and New Opportunities to Integrate Surface and Groundwater Accounting

Tom Hicks, Attorney at Law

Most landowners know that when it comes to appropriative water rights, it is "use it or lose it." This historic perspective has had the effect of maximizing water diversions from streams and rivers to preserve rights at the expense of in-stream conservation values. 2014 combined drought, a new Water Bond, and historic groundwater legislation, which present exciting and emerging opportunities for conservation professionals to develop projects that enhance streamflow and meaningfully bring groundwater basins into sustainable yield.

This presentation will introduce conservation professionals to basic and important concepts in California water law including appropriative and riparian surface water rights, groundwater, reasonable and beneficial use, and the emerging use of Water Code Section 1707, which allows existing appropriative and riparian water rights to be not-diverted and left in-stream for fish and wildlife beneficial uses without risk of abandonment or forfeiture.

The presentation will introduce attendees to recent developments in California groundwater law and water bond with an emphasis on how to improve instream flows and aquatic conservation values through voluntary water right transactions (sale, lease, and/or donation) and instream transfers. Finally, this presentation will provide perspective on how to integrate legal considerations with practical project level implementation details.

Engineered Groundwater Recharge in the Upper Mattole River, Humboldt County, California: Can the Scale of this Solution Match the Scale of the Problem?

Brad Job, *Senior Civil/Environmental Engineer, Pacific Watershed Associates*

It has long been understood that in Mediterranean climates, groundwater discharge to surface water is the source of nearly all base flow during the dry season. Many human activities have adversely affected the capacity of watersheds to absorb and retain groundwater. These negative impacts include gullying, compaction of surface soils, excavation of deep road cuts, changes in vegetation cover, loss of soil litter, soil loss, and groundwater extraction. The Mattole River, located in northwestern California, is approximately 62 miles long with a watershed area of about 300 square miles. Over the last 13 years, there has been a notable decline in the moving seven day average low flow. The past three drought years withstanding, there had not been a statistically significant decline in measured rainfall during this period.

The Mattole River hosts populations of coho salmon, Chinook salmon, and steelhead. The declining low-flow trend, along with historic channel incision, creates adverse conditions for juvenile salmon and steelhead rearing. Inadequate dry-season flows cause a large number of juveniles to become trapped in disconnected pools in the late summer and early fall where they experience high mortality. In 2011, Sanctuary Forest, a local non-profit organization, partnered with the Bureau of Land Management to undertake a restoration project in Baker Creek, a tributary to the upper Mattole. This effort involved construction of a series of channel-spanning log check dams/weirs to collect fine and course sediment with a goal of refilling the gullied channel to increase groundwater retention and simultaneously creating better juvenile salmonid habitat. Part of the project area was the former location of a shingle mill and the stream alignment and grade have been significantly altered by heavy equipment over the last century.

Because of the geometric and budget limitations, only a few structures could be built every year, with a total of 13 thus far. Thus, the project was conceived with a full implementation timeline of about a decade. In addition to the long-term goal of enhancing groundwater retention, the other primary project objective was to create more slow water habitat for juvenile fish by backwatering abandoned meanders that would have otherwise gone dry in the summer when water surface elevations drop.

While it was anticipated that the project benefits would not be apparent for several years, there was a nearly immediate response from the fish. Prior to project implementation, it had been eight years since a coho redd was observed in Baker Creek. However, in the winter following the first round of construction, two redds were observed upstream of the project and about a thousand juvenile coho were counted in the subsequent spring. After the second season of construction, two coho redds and about two thousand juveniles were observed.

Although the spawning response was very notable, the groundwater response has been slower to develop. Given the magnitude of the low-flow problem, this raises the question of whether groundwater recharge can be scaled up to a size where it will offer benefits to the entire watershed.

Saturday Morning Concurrent Session 5

Session Coordinator*: Cynthia LeDoux-Bloom, PhD, AECOM*

River Regulation: The Decoupling of Salmon and Freshwater Habitats

Joseph Merz, *PhD., University of California Santa Cruz and Cramer Fish Sciences*

Large-scale regulation of anadromous rivers has removed vast expanses of former freshwater habitat from highly prized populations of North American Pacific salmon. While loss of habitat above rim dams has received significant attention over the past half century, regulation has also set several unforeseen processes in motion that further decouple salmon from remaining freshwater environments. I looked at datasets collected on several California Central Valley streams, including mitigation hatchery population demography and altered sediment and hydrologic regimes. Reduced size of returning adults, coupled with armored spawning beds, has significantly reduced the amount of spawning habitat available to some populations. Furthermore, armored banks and channel incision, in concert with damped hydrographs below dams, has further reduced the duration and frequency of seasonal rearing habitat available to juvenile salmon. I will discuss the ramifications of these observations and potential mitigation to support the long-term management of remaining anadromous waters where salmon still exist.

Survival Improvements at Fish Guidance Systems Designed to Improve Safe Downstream Passage of Anadromous and Catadromous Fish

Shane Scott, *Principal, S. Scott & Associates, LLC*

Many anadromous fish species, such as Pacific and Atlantic salmon (*Oncorhynchus spp., Salmo salar*), the shads and river herring (*Alosa spp.*), and catadromous species including the American eel (*Anguilla rostrata*), are in danger of extinction throughout some or all of their range. Impacts to these populations include entrainment at hydroelectric dams and other water conveyance facilities. State and federal laws now mandate protection of these and other fish populations. Facility operators must often implement physical or operational modifications to reduce fish entrainment. This presentation will document the improved juvenile fish passage survival results at several Fish Guidance System (FGS) installations in North America including CA, WA, and ME. The FGS has been demonstrated to successfully guide downstream migrating fish to safer bypass routes, thereby reducing entrainment and improving survival. Most fish species migrate downstream in the thalweg, taking advantage of higher water velocities. The FGS is designed to exploit this migratory behavior and guide fish to a safer point of egress. The FGS is composed of a series of floating panels anchored across the river channel. The design and configuration of the FGS varies at each site according to hydraulic conditions and species present. Acoustic telemetry and hydroacoustic studies conducted on various FGS installations indicate that a significant number of downstream migrating juvenile salmonids were successfully guided to a safer bypass route in a variety of facility configurations and hydraulic conditions. Further research is needed, but the FGS should also provide significant survival benefits to other downstream migrating fish species that demonstrate similar migration behavior, including juvenile shad and herring (*Alosa spp.*) and kelts (*O. mykiss, S. salar*). Further investigations will elucidate modifications to improve downstream survival of adult eels (*A. rostrata*).

Making Use of a Big Estuary —California Chinook Salmon Fry and Salty Water

Yvette Redler (Presenter) and Rosalie del Rosario, NOAA Fisheries

Recent population crashes of Sacramento River fall-run Chinook salmon (fall-run) have resulted in a review of management practices and continued concern over the general state of California's largest watershed. Understanding migration and rearing strategies of Chinook salmon juveniles in the Sacramento-San Joaquin Delta is essential for managing fishery and natural resources. This study focuses on the emigration trends of naturally spawning Sacramento River fall-run over multiple years and across hydrologic conditions. We examined Delta outflow, riverine pulse flows, and salinity gradients at several monitoring sites in San Francisco Bay and western Delta to understand environmental cues to fall-run outmigration.

Life history diversity exhibited by wild fall run helps foster resilience to the species. Central Valley fall-run are dominated by hatchery-origin fish which are released as smolts during spring. Natural spawning still occurs in several rivers in the Central Valley, as evidenced in monitoring stations by their earlier winter migration and fry life stage.

Estuarine rearing is a life history strategy observed in many northern watersheds and several studies have shown that a significant portion of spawning adults reared in brackish waters as fry. Loss of suitable habitat and/or hydrological conditions in the highly altered fresh and brackish estuaries of the Sacramento-San Joaquin Bay-Delta appear to limit the use of the estuary by Sacramento River fall-run fry. This can lead to further loss of diversity in rearing strategies for the Sacramento River fall-run population that is already dominated by hatchery stocks.

The goal of the study is to highlight the environmental conditions that make estuarine rearing of wild populations possible in the San Francisco Bay, which can inform management of the Bay and Delta. Plans to restore tidal marsh habitat in the Sacramento-San Joaquin Delta and Bays are being considered and understanding the hydrology needed to ensure its successful use by Chinook salmon should be of high importance. If a long-term goal is to increase life history diversity to promote further resilience in Sacramento River fall-run, it is important to understand under what conditions diverse life history strategies may be expressed.

Salmon Feeding Strategies and the Bioenergetic Modeling of Juvenile Chinook salmon (*Oncorhynchus tshawytscha*) Growth During a Drought in the San Joaquin River, California

Taylor Spaulding (Presenter), James Pearson, and Steve Blumenshine, PhD,
California State University, Fresno

Salmon fisheries managers often use models to determine the growth of individuals for a variety of objectives. Most models of salmon prey use only incorporate activity costs for one feeding strategy: ambushing, also known as drift foraging, when making growth assessments or predictions. This ignores a second foraging strategy, actively searching for food, because it is believed to be inefficient or biologically irrelevant. We propose that fish may need to include an active foraging strategy to meet their energy needs under certain situations, such as when prey is scarce, difficult to find, or if low water velocities do not promote high drift delivery. To investigate this we will test how the growth observed in a cohort of wild juvenile Chinook salmon in the San Joaquin River during a drought compares to predictions of growth derived from models of the two feeding strategies. This study will seek to provide evidence that current fisheries models need to become more sophisticated to properly estimate the growth of individuals and habitat production potential especially during less than optimal environmental conditions. The more accurate model can also then be used with future prey and environmental data from the San Joaquin River to more accurately predict juvenile salmon growth.

Genetic Analysis of Central Valley *O. mykiss*: Patterns, Processes, and Recovery Planning in a Modified Landscape

Devon E. Pearse (Presenter), Alicia Abadía-Cardoso, *and* ***Martha Arciniega-Hernández*** *University of California, Santa Cruz;* ***John Carlos Garza, PhD,*** *NOAA Fisheries, Southwest Fisheries Science Center; and* ***David Vendrami****, Università degli studi di Ferrara, Italy*

Steelhead/rainbow trout (*Oncorhynchus mykiss*) are found in all of the major tributaries of California's Central Valley, which contains the rivers and streams that drain into the Sacramento-San Joaquin River system. This river system is heavily impacted by water development projects and agriculture, and current populations of *O. mykiss* are supported by hatcheries and managed under protection from the ESA. We have applied genetic analysis of microsatellite and SNP loci to *O. mykiss* in the Central Valley to identify patterns of population structure and introgression by out-of-basin stocks, used parentage analysis of individual hatchery steelhead for studies of movement and reproductive success, and evaluated relationships among populations isolated above barrier dams. In contrast to patterns typical of coastal steelhead, many Central Valley *O. mykiss* populations within the same tributary were not found to be each others' closest relatives, and we found no relationship between genetic and geographic distance among the below-barrier populations. In addition, while introgression by stocked hatchery rainbow trout strains does not appear to be widespread among above-barrier populations, steelhead in the American River and some neighboring tributaries have be extensively introgressed by coastal steelhead. Additional analysis has contributed to ongoing recovery efforts, including evaluation of the influence of specific genomic regions on the probability of anadromy in a given population or individual.

Measuring the Effects of an Invasive Species and Drought on the Macroinvertebrate Community Composition in Topanga Creek, California

Lizzy Montgomery, *Resource Conservation District of the Santa Monica Mountains,*
and ***Crystal Garcia,*** *Watershed Stewards Project and Resource Conservation District of the Santa Monica Mountains*

Benthic macroinvertebrate (BMI) sampling was conducted at two sites in Topanga Creek from 2003-2014. In this period, Southern California experienced extreme drought conditions (US Drought Monitor 2014). Examining trends in species composition over this period allows for a relatively long-term analysis of potential effects of drought on BMI communities. Southern California Coastal Index of Biotic Integrity (SCC-IBI) was applied and compared regionally to other streams in the upper Santa Monica Bay. We also tested for correlations between biotic integrity and water quality conditions. The following trends regarding the BMI community of Topanga Creek emerged during the course of this study: 1) relative abundance of *Baetis sp.* and *Simulium sp.* positively correlated to wet year rainfall up to 31.44", 2) high and low rainfall disturbed BMI community stability, 3) intensifying drought conditions through winter 2012/2013 may have caused a significant shift in species composition in Topanga Creek from a *Baetis sp., Simulium sp, Chironomidae* dominated community to a *Chironomidae, Amphipoda, Ostracoda* dominated community, 4) functional feeding group (FFG) composition varied less than taxa composition, 5) SCC-IBI scores for Topanga Creek ranged from 'Poor' to 'Fair,' and 6) regional comparison of Topanga Creek indicate relatively lower BMI biotic integrity. Long-term monitoring is important for tracking the influence of changes in climatic conditions on BMI community and should be continued in Topanga Creek where BMI communities are an important food source for endangered southern steelhead trout and other native aquatic species of special concern.

Additionally, the presence of invasive red swamp crayfish (*Procambarus clarkii*) in Topanga Creek was first recorded in 2001. The population has since increased, with a population explosion during an extended period of low flow since 2011. Within the Santa Monica Mountains, *P. clarkii* has been linked to diminishing numbers of California newt (*Taricha torosa*), a species of special concern (Katz 2013). To address these concerns, a student citizen science program was conducted from September 2013 through February 2014 to remove crayfish from a 200 meter reach of Topanga Creek. The following metrics were collected and compared between the removal reach and an upstream, adjacent 200 meter non-removal reach: water quality (temperature, salinity, pH, conductivity, dissolved oxygen, turbidity), nutrient levels (nitrate, nitrite, ammonia, orthophosphate), number of crayfish removed, and macroinvertebrate communities. The following metrics were collected within the Removal Reach only: catch per unit effort, average crayfish length, and sex distributions of removed crayfish. The results indicate that the effects of crayfish on nutrient levels are low or non-existent; however, the presence of crayfish seems to correlate with lower BMI biodiversity. This study was conducted to gain a better understanding of the effects of *P. clarkii* in the Topanga Creek ecosystem.

Determining What Actions to Implement in your Watershed: A Guide for SONCC Coho Salmon

Julie Weeder, *Recovery Coordinator, NOAA Fisheries*

The final recovery plan for coho salmon in Southern Oregon and Northern California (SONCC coho salmon) was released in September 2014. The plan describes all actions (over 3,000 total) necessary to recover this evolutionarily significant unit (ESU), which is made up of forty populations that occur in two states over some 13 million acres. The plan provides a roadmap for how to recover this ESU that National Marine Fisheries Service (NMFS) encourages others to follow so that we can achieve recovery of this species most quickly.

With so many actions and limited resources, it is imperative that the restoration community prioritize actions so that the most important ones can be undertaken first. In addition, it is important to allow flexibility so that opportunities (such as access to private land) can be utilized to put restoration on the ground. NMFS applied a prioritization system to aid implementers in choosing the best recovery actions both within individual populations and across populations. NMFS encourages others to use this prioritization system when determining what actions to implement, as it helps to focus efforts on activities that will have the most benefit to SONCC coho salmon. The system was used to assign priorities to individual actions based on six questions:

1. Is the action needed to prevent the subject population from going extinct, or would the action meaningfully reduce the extinction risk for the entire ESU?
2. Is the action needed to prevent a significant decline in a population or its habitat?
3. If questions 1 and 2 do not apply, is this action needed to achieve Endangered Species Act (ESA) recovery of SONCC coho salmon?
4. If the answers to questions 1 through 3 are no, would the action contribute to broad-sense recovery goals (recovery beyond that needed to delist under the ESA)?
5. Does the action benefit a population that is currently at high risk of extinction?
6. Does the action benefit coho salmon immediately (within three years) because they are already in or near the area?
7. Does the action address one of the factors most limiting this population?

This prioritization system is very useful in determining the type of recovery action to pursue and the population where it should occur. The system does not explicitly identify the actions to be pursued in the next ten years, because of local factors, such as landowner access, which can affect how feasible an action would be in the short-term. Given the scope of the recovery plan, most recovery actions were identified at a watershed scale (e.g., Redwood Creek) or a stream scale (e.g., Prairie Creek). NMFS welcomes the opportunity to work with restoration communities to identify the sub-watershed recovery actions to be pursued in the next ten years in order to improve a population's status most effectively.

Building on Recovery Planning: a Process for Identifying, Quantifying, Prioritizing, and Validating Cost-effective Coho Salmon Restoration Actions

Joshua Strange, PhD, Stillwater Sciences

We developed an objective and nested-scale approach for identifying, quantifying, prioritizing, and validating coho salmon restoration actions that build on existing restoration frameworks in the federal recovery plans and the California recovery strategy. Given the tenuous viability of coho in California, it is imperative that we use the best available information and tools to strategically and rapidly implement habitat restoration actions most likely to promote recovery in the near-term. We developed an integrated set of analytical tools within a step-wise process to validate whether a given watershed with an independent coho population is summer or winter habitat limited, which is then further refined to identify cost-effective locations for restoration actions and quantify population and recovery-based targets for the amount of habitat restoration needed. Our scientifically-based approach consists of four primary steps: (1) map potential spawning and summer rearing habitat for each watershed to quantify maximum potential population size given these constraints; (2) estimate the extent and map locations of existing and restorable winter rearing habitat, with an emphasis on low-gradient floodplain areas, to determine maximum potential population size given winter habitat constraints; (3) refine these estimates by screening out channel reaches that are too warm for coho, dewatered, or inaccessible; (4) use these spawning, summer, and winter habitat estimates to validate the key limiting habitat and determine the maximum smolt production and adult returns before and after restoration using components of a physically based coho life-cycle population model. Model outputs will then be used to determine the amount of habitat that needs to be restored to meet recovery targets for specific watersheds. Spatial habitat data from the prior steps will then be refined to identify specific locations that take advantage of channel/floodplain features and watershed attributes for cost-effective and strategic implementation of restoration actions within the context of the recovery targets and plans.

2D Hydrodynamic Based Logic Modeling Tool for River Restoration Decision Analysis: A Quantitative Approach to Project Prioritization

David J. Bandrowski, Trinity River Restoration Program, U.S. Bureau of Reclamation

In the field of river restoration sciences there is a growing need for analytical modeling tools and quantitative processes to help identify and prioritize project sites. Two-dimensional (2D) hydraulic models have become more common in recent years and with the availability of robust data sets and computing technology, it is now possible to evaluate large river systems at the reach scale. The Trinity River Restoration Program (TRRP) – U.S. Bureau of Reclamation in Northern California, is now analyzing a 40-mile segment of the Trinity River to determine priority and implementation sequencing for its Phase II channel rehabilitation projects. A comprehensive approach and quantitative tool has recently been developed to analyze this complex river system referred to as: 2D-Hydrodynamic Based Logic Modeling (2D-HBLM). This tool utilizes various hydraulic output parameters combined with biological, ecological, and physical metrics at user-defined spatial scales and flow discharges. These metrics and their associated algorithms are the underpinnings of the 2D-HBLM habitat module used to evaluate geomorphic characteristics, riverine processes, and habitat complexity. The habitat metrics are further integrated into a comprehensive Logic Model framework to perform statistical analyses to assess project prioritization. The Logic Model will analyze various potential project sites within the 40-mile restoration reach by evaluating connectivity and key response variable drivers. The 2D-HBLM tool will help inform management and decision makers by using a quantitative process to optimize desired response variables while balancing important limiting factors in determining the highest priority locations within the river corridor to implement restoration projects.

Effective river restoration prioritization starts with well-crafted goals that identify the biological objectives, address underlying causes of habitat change, and recognize that social, economic, and land use limiting factors may constrain restoration options (Bechie et al. 2008). In addition, effective management actions need to be tied to a structured decision making process that connects decisions to objectives (Clemen and Reilly 2001). Applying natural resources management actions, like restoration prioritization, is essential for successful project implementation (Conroy and Peterson, 2013). The analysis demonstrates how this approach can be effectively applied to a large river restoration program to help prioritize projects systematically and objectively. All too often restoration actions are site specific without considering and evaluating ecosystem scale processes, protection of existing high quality habitats, or an understanding of the effectiveness of specific restoration techniques (Roni et. all. 2002). With over two decades of scientific literature and applied practice, the restoration community has a thorough understanding of the role of channel morphology in the formation of physical habitats (Montgomery and Buffington 1998) and the relationship between hydraulic parameters of depth and velocity to habitat quantity and quality (Singh 1989). Model utilization requires restoration science not only to embrace uncertainty (Wheaton et. al. 2008), but to integrate bio-physical diversity, variability, and complexity into river management (Brierley 2008). Evaluating tradeoffs and examining alternatives to improve fish habitat through optimization modeling (Null and Lund, 2012) is not just a trend but rather the scientific strategy by which management needs embrace and apply in its decision framework.

A Multi-faceted Approach to Restoring the Sediment Impaired Elk River in Humboldt County, CA

Bonnie Pryor, *Northern Hydrology and Engineering*

Elk River, the largest tributary to Humboldt Bay and natal stream to four species of anadromous salmonids, is undergoing intensive watershed-wide recovery efforts to remediate impacts associated with excessive historical channel sedimentation. Resource agencies and stakeholders are resolving the complex ecological and social issues resulting from sediment impairment by implementing a multi-faceted approach developed in tandem with the Total Maximum Daily Load Implementation and Monitoring Plan for Elk River. The approach includes: (1) Waste Discharge Requirements to reduce future sediment loads from timberlands, (2) a Recovery Assessment and Implementation Framework to alleviate existing sediment impairments and improve ecosystem function through mechanical channel rehabilitation, and (3) a Stewardship Program to coordinate stakeholder participation in recovery planning and implementation. The Recovery Assessment and Implementation Framework, underway since May 2014, is defining existing and desired future conditions, identifying site-specific opportunities and constraints, and predicting system trajectory under existing and future sediment load and mechanical rehabilitation scenarios. Given the large amount of stored sediment that may be affected by recovery efforts, this overall approach is critical in addressing the potential effects of rehabilitation actions on sedimentation patterns and aquatic habitat within and between treated reaches. In 2012, we developed a two-dimensional hydrodynamic and mobile-bed sediment transport model to assess sediment load reduction on channel recovery in a 2.5-mile pilot reach of Elk River. The Recovery Assessment and Implementation Framework is now expanding this modeling tool and associated field data collection to assess channel and aquatic habitat conditions and evaluate the effectiveness of potential restoration actions along 20 miles of the North Fork, South Fork, and mainstem Elk River. The approach will be used to assess effects of restoration actions in treated and untreated reaches, reach-specific recovery rates, and data collection priorities supporting adaptive management. This approach utilizing sediment transport models supported by targeted field data collection to predict geomorphic and aquatic habitat trajectories is gaining wide-spread use in restoration planning and is vital in large, complex projects where recovery is anticipated through a combination of treatments occurring at varying spatial and temporal scales and at significant cost.

A Science Framework and Reach-wide Plan for Restoring Coho Salmon Habitat in Lower Ten Mile River

Jay Stallman (Co-presenter), Stillwater Sciences, and Lauren Hammack (Co-presenter), Prunuske Chatham, Inc.

An interdisciplinary team of scientists and restoration practitioners developed a framework and reach-wide plan for enhancing coho salmon habitat in the lower Ten Mile River in Mendocino County, California. This opportunity was possible through the cooperative efforts of The Nature Conservancy, landowners, NOAA Restoration Center, and CDFW's Fisheries Restoration Grant Program. The project area includes two miles of the South Fork and five miles of the mainstem Ten Mile River channels and the broad alluvial valley bottom immediately upstream of their confluence. Winter refuge and rearing habitat availability is considered a key factor limiting survival and growth of coho salmon within this core recovery area. Conservation easements established over the channel and adjacent floodplains at the freshwater-estuarine ecotone provide numerous opportunities to improve winter habitats by reconnecting and enhancing relict off-channel features (e.g., side channels and floodplain depressions), increasing bankfull channel complexity, and promoting dynamic geomorphic processes. The South Fork project reach provides more opportunities for off-channel and in-channel habitat enhancement due to less confinement, more complex flow paths, and fewer infrastructure constraints. The science framework synthesizes information about winter habitat conditions, channel morphology, sediment dynamics, and flood and lagoon inundation to identify functional winter habitat for juvenile salmonids and relict topographic features that provide cost-effective opportunities for creating and enhancing off-channel habitats. The framework guided habitat restoration design by defining objectives, desired habitat conditions, effective approaches, potential treatment areas, and anticipated benefits to coho salmon. The habitat enhancement plan, which integrates the framework with input from a Technical Work Group and addition site constraints and opportunities, includes conceptual designs for a mosaic of 30 site-specific projects on the South Fork and mainstem Ten Mile River that will collectively result in nearly 4.5 miles of complex rearing habitat. The suite of potential projects includes off-channel ponds, flooded wetlands, side channel complexes, and engineered log jams. Several site designs in the downstream reaches of the project area take advantage of seasonal estuary inundation during the fall and early winter. Prioritization of sites for more detailed design and implementation over multiple phases considered the feasibility of utilizing relict off-channel features, potential for dynamic geomorphic processes to create desired conditions over time, estimated increase in winter habitat capacity and juvenile coho production under treated conditions, demonstration value, and funding availability.

Coho Habitat Restoration Strategies & Projects, Russian River Tributaries, Sonoma County

Matt O'Connor, O'Connor Environmental, Inc.

Freshwater habitat for coho salmon is limited by many factors. Our focus is on declines in summer base flow, both natural and management-induced, and by loss of summer rearing habitat associated with stream channel erosion and sedimentation and simplification by loss of woody debris. To assess summer base flow in streams, we are implementing a physically-based, spatially-distributed model of watershed hydrology that integrates surface water and groundwater processes (MIKE SHE hydrological modeling system) in Green Valley Creek and Dutch Bill Creek. The project is funded by CDFW's Fisheries Restoration Grant Program (FRGP) and is coordinated by Gold Ridge RCD. The model predicts the distribution and magnitude of stream flow and simulates channel hydraulics throughout the watershed channel network. The model will be used in part to guide coho habitat restoration by helping to prioritize among sites based on flow conditions, and in part as a restoration design tool for evaluating restoration plans with respect to channel hydraulics and habitat conditions. The model is described with respect to model outputs, simulation, and prediction. Model inputs, development, and calibration are being presented separately. In-stream habitat restoration efforts, including project planning and implementation, have been funded by CDFW FRGP in cooperation with property owners and coordinated by Gold Ridge RCD and Sonoma RCD. Three examples of channel restoration and habitat enhancement projects are discussed. In Salt Creek, an intermittent tributary of Mill Creek on private property, large woody debris (LWD) was placed by a contractor (Bioengineering Associates) using an excavator to improve habitat and reduce bank erosion, and eroding banks were restored in a 0.2 mile reach with a drainage area of 0.7 mi2. LWD was placed to maximize stability; design peak flow depth was about two to three feet. The project was implemented in 2012. In Thompson Creek, a perennial tributary of East Austin Creek located on California State Park property, LWD was placed to enhance in-stream habitat in a 0.3 mile reach with a drainage area of about 1.0 mi2. LWD was obtained on-site and installed by CCC to maximize stability without traditional anchoring; design peak flow depth was about three to four feet. The project was implemented in 2013. In Porter Creek, a perennial tributary of the Russian River located on private property, LWD was placed by a contractor (Blencowe) using a wheeled log skidder and backhoe to enhance in-stream habitat in a 0.4 mile reach with a drainage area of about 5.2 mi2. LWD was placed to maximize stability without traditional anchoring; design flow depth was about 5 to 6 feet. The project was implemented in 2014. The foregoing group of projects suggests an integrated watershed habitat restoration approach combining a comprehensive and spatially explicit hydrologic model with project planning, design, implementation, and monitoring. This approach would simultaneously describe habitat conditions, assess habitat limitations, track habitat improvement, and allow for predictive simulation modeling of habitat conditions to evaluate watershed management.

Session Coordinators: *Tommy Williams, PhD, NOAA Fisheries, Southwest Fisheries Restoration Center, and* ***Brian Cluer,*** *NOAA Fisheries, West Coast Region*

Mimicking Hydrologic Process to Restore Ecological Function

Jacob Katz, *California Trout*

Inundated floodplains provide ecosystem services including flood attenuation, nutrient cycling, groundwater recharge, and habitat for fish, birds, and other wildlife. Before major European settlement in the mid-1800s, seasonal floods routinely transformed the winter Central Valley into a vast mosaic of wetland habitats. Each winter and spring, flood pulses covered the floodplains, creating broad, shallow wetland flood basins, and greatly increasing the overall wetted surface area of the aquatic system. The abundant wildlife of the historical Central Valley (think birds to turn the sky black and fish to fill the rivers) was a direct result of these seasonal floodplains.

Primary productivity in aquatic ecosystems takes place in the photic zone where sunlight penetrates the water column. Wide, shallow, fertile floodplains create a photic zone many times greater in extent than that of the river channel. These floodplain "solar cells" warmed as they caught sunlight, creating near-ideal midwinter conditions for turning solar energy into food (phytoplankton). The prolific primary production facilitated by spreading water out and slowing it down on the floodplain supported robust populations of bugs (zooplankton and aquatic insects), which in turn were eaten by birds and fish. This simple but tremendously productive floodplain food web (algae-bugs-fish and wildlife) was likely the primary engine of productivity supporting the once-prolific numbers of fish and waterfowl in the pre-development Central Valley.

The pre-development Sacramento Valley flood basins were low-gradient, shallow aquatic systems that drained slowly after flood pulses. Now they are engineered to drain efficiently and rapidly, shedding high volumes of storm water quickly through incised, armored drainage channels. This rapid, high-volume drainage is the antithesis of the natural prolonged, broad, and shallow pattern of floodplain inundation. The abundant food resource facilitated by the hydrologic process of floodplain inundation was lost as marshes and floodplains were diked and drained for flood control, agriculture, and development. Essentially, our flood and agricultural water infrastructure starves our river systems by depriving them of the foundation of the aquatic food chain — the primary productivity created in the surface waters of shallowly inundated floodplains. Recovery of salmon and other native fish populations will likely be impossible without first re-establishing or mimicking the natural flood processes that are the foundation of the aquatic foodweb.

Experiments on the managed agricultural floodplain habitat at Knaggs Ranch in Yolo Bypass have demonstrated that mimicking historical floodplain processes — slowing down floodwater and spreading it out over the rice fields that have largely replaced the floodplain wetlands of the lower Sacramento Valley — produces phenomenal primary production to support prolific invertebrate numbers. This abundance, in turn, results in rapid growth and improved body condition of juvenile salmon rearing on these "novel" floodplain habitats. By mimicking natural processes, we provide salmon with conditions similar to those under which they evolved and to which they are adapted. In essence, exposing native species to a system they can "recognize" allows populations to respond favorably and rapidly and is an important step towards recovery of self-sustaining populations.

Building Landscape Hydrologic Resilience to Climate Change Is Analogous to, and Synonymous with, Salmonid Ecosystem Restoration

John McKeon and Brian Cluer (Co-presenters), NOAA Fisheries

Adaptation of local landscapes to climate change, projected to manifest as a growing increase of weather extremes including drought and storm intensity, is a challenge every community will face over the next 50 years. The challenges in adaptation to a changing climate, and resulting strategies developed, will be unique to local landscapes, land use patterns, existing infrastructure, seasonal climate and hydrologic regime, and longer term climate cycles.

When using a systems analysis approach to restoration of salmonid ecosystems, by necessity we consider the constraints of these same local attributes. The hurdles and challenges in developing and carrying out effective restoration plans also include institutional inertia, difficult or counter-productive regulatory requirements, established resource-use economic systems, widely accepted and overly simplistic conventional wisdom regarding cause and effect relationships of salmonid population declines, and cultural and sociological resistance to change perceived to threaten the status quo.

We describe project development based on systematic ecosystem assessment of salmonid life-history-cycle habitat associations; place based historical ecology; and use of transparent decision analysis frameworks to gain community support to develop and carry out two central California salmonid ecosystem restoration projects initiated by NOAA Fisheries. Case studies include projects in the Russian River Catchment Basin of Mendocino County, and the Redwood Creek Catchment Basin of Marin County.

The Rise of the Stage Zero Channel as a Stream Restoration Goal

Michael Pollack, PhD (Presenter), Northwest Fisheries Science Center, NOAA Fisheries, and Brian Cluer, NOAA Fisheries

The stage zero channel (sensu Cluer and Thorne 2013) is increasingly being recognized as having intrinsic high value because of the multiple and synergistic ecosystem goods and services that such channels provide. Stage zero channels have well connected floodplains with elevated water tables, spatially variable hydrologic regimes, and structurally complex aquatic and riparian habitat. As such, they provide incredibly valuable habitat for a suite of terrestrial and aquatic taxa, including several Pacific salmon species that are in decline. In this presentation, we provide an overview of the features and types of stage zero channels, where in the landscape they are likely to be found, how they evolve under natural conditions, and restoration techniques for converting less ecologically valuable channel types into stage zero channels. We compare the structure and function of stage zero channels to more traditional channel restoration targets. We conclude that new approaches to stream restoration are needed that take into account society's economic and ecological imperatives to create resilient, structurally complex and dynamic systems, and that the spatial scale of restorative actions should be expanded where possible to better recognize and integrate the interdependent nature of longitudinal, lateral, and vertical linkages in stream systems.

Restoration of Riparian Forests and Ecosystem Processes and Implications for Salmon

Katie Ross-Smith (Presenter) and Jennifer Hammond, Cardno

Riparian forests are of critical importance to maintenance and restoration of salmonids and salmonid habitat. Riparian vegetation is a source of aquatic invertebrates on which salmonids feed. Riparian trees are a source of wood to the channel that creates and maintains instream habitat and provide cover for juvenile fish. Large wood and riparian trees and shrubs affect floodplain flow paths and geomorphic processes that promote topographic complexity. The tree canopy and overhanging vegetation provides shade that lower summer stream temperatures and influence light availability. And, the vegetation provides bank stabilization and water quality protection. Restoration of riparian forests and riparian ecosystem processes along salmon streams has been identified as an important component for salmon restoration.

The objectives of this study were to develop tools to guide restoration decisions to support salmonid restoration by identifying the primary determinants for successful riparian recruitment (hydrologic and geomorphic) and aspects of flow management needed for long-term sustainability of riparian forests. To identify tools and determinants of riparian vegetation that can support salmonids, studies assessing riparian vegetation recruitment and survival related to hydrologic and geomorphic processes were conducted on three reaches in two Northern California inland rivers, with historic anadromous fish habitat. These assessments included: vegetation surveys, tree core analyses, topographic surveys of rooted elevations of the cored trees, reach-specific stage-discharge relationships and modeling, and annual hydrograph analyses. Availability of suitable substrate for establishment created by scouring high flow events; timing of spring peak recession that varied by water year and elevation; the recession rate of the spring snowmelt stage recession; and site-specific controls on inundated width and depth and water availability within the floodplain were identified as the primary determinants for successful recruitment years at the study sites. The results were used to develop tools to guide and communicate evaluations of flow management on riparian forests to managers and stakeholders and can also be used to assess potential riparian responses to flow management actions or regional climate change models that may affect the long-term sustainability of restored streams and the future distribution and complexity of riparian forests that are important for salmon restoration.

Yolo Bypass Widening into the Elkhorn Basin: A Multi-Benefit Opportunity for Floodplain Habitat, Flood Relief, and Fish Passage

Jai Singh (Presenter), Chris Bowles, and Chris Campbell, cbec engineering, inc.

Large-scale projects addressing seasonal floodplain habitat, flood relief, and fish passage needs are critical for the survival of threatened salmonids in the face of climate change and a growing California population. Local agencies in the Sacramento region and the State of California are collaborating on a feasibility study of widening the Yolo Bypass into the Elkhorn Basin. The Elkhorn Basin is bordered by the Sacramento River to its north and east, the Yolo Bypass to its west, and the Sacramento Weir bypass to its south. Given its location and existing topography, the Elkhorn Basin presents a significant opportunity for increasing floodplain habitat, reducing flood risk, and enhancing fish passage. Initial hydraulic analyses demonstrate that degrading and setting back existing levees in the northern Elkhorn Basin could generate as much as 1,830 acres of floodplain habitat inundated for two weeks every two of three years between December 1st and May 15th. In addition to providing habitat for juvenile salmonids in winter and spring months, this additional floodplain area could provide a seasonal habitat for waterfowl and a net primary production export to the Delta via the Yolo Bypass. A preliminary 2-D hydrodynamic modeling of a coupled Elkhorn Basin and Yolo Bypass system has been developed to assess floodplain inundation and habitat conditions, flood attenuation, and agricultural impacts. Active management of the Elkhorn Basin may also enhance the ecological utility of floodplain habitat generated by increasing the duration and area of inundation. Finding a solution that maximizes ecological benefits while also meeting flood relief goals, agricultural needs, and economic constraints will require creative collaboration among agency staff, landowners, non-profits, and engineering firms. These stakeholders will need to determine specific project objectives, a site design, an operation regime, and compensation schemes for farmers providing fish habitat.

Enhancing Channel and Floodplain Connectivity: Improving Salmonid Winter Habitat on Lagunitas Creek, Marin County, California

Greg Kamman (Presenter) *and* ***Rachel Kamman,*** *Kamman Hydrology & Engineering, Inc.;* ***Rocco Fiori, PG,*** *Fiori GeoSciences;* ***Bill Trush, PhD,*** *Humboldt State University River Institute;* ***Eric Ettlinger*** *and* ***Gregory Andrew,*** *Marin Municipal Water District*

A Limiting Factors Analysis completed on Lagunitas Creek in 2008 identified winter habitat as the limiting factor for both coho salmon and steelhead populations in the watershed. Fall juvenile and spring smolt survey data indicate notable declines in the numbers of juvenile coho during the winter months. It is hypothesized that winter habitat in Lagunitas Creek is limited during base flow to bank-full periods.

Recently, Marin Municipal Water District, in partnership with the National Park Service and California State Parks, executed a CDFW Fisheries Restoration Grant Program grant to evaluate salmonid winter habitat conditions and develop plans to enhance winter habitat for coho and other salmonids in the Lagunitas Creek watershed. Phase 1 of this two phase investigation included an assessment to: evaluate existing juvenile salmonid winter habitat in Lagunitas Creek and lower Olema Creek, prioritize winter habitat needs, and identify opportunities for winter habitat enhancement to increase the winter carrying capacity of coho salmon and steelhead. Findings of the Phase 1 Winter Habitat Enhancement Assessment center on two primary hypotheses that limit winter habitat: 1) an above average percentage of channel geometries display a high ratio of depth to wetted perimeter, resulting in elevated velocity conditions in a disproportionate amount of mainstem channel, even during winter base flow conditions; and 2) much of Lagunitas Creek has become a single, entrenched channel displaying a reduced frequency, duration, and magnitude of winter overbank flows that inundate floodplain and side channel areas, historically more available for high flow refugia.

Phase 2 of the project focused on developing site-specific designs to increase the winter habitat carrying capacity for salmonids in Lagunitas Creek. Winter habitat enhancement work within the creek corridor also considered potential impacts to, or benefits for, California freshwater shrimp (*Syncaris pacifica*), a federally endangered species. An overall self-maintaining design approach was developed to guide individual project plans at a number of locations, with minimal earthwork and disturbance to existing riparian and wetland habitat. All designs propose installing a variety of Engineered Log Jams (ELJs) within Lagunitas Creek to both locally aggrade the channel and backwater/deflect water into existing perched side channels on a more frequent basis. In many instances, the ELJs are designed to grow in size over time by capturing and retaining wood, debris, and sediment. Log jams in Lagunitas Creek have been observed to be one of the primary mechanisms to achieve the desired bed aggradation and geomorphic diversity that benefit salmonids. Project designs are intended to enhance or restore this natural process and promote geomorphic evolution of more active high flow (side) channels and floodplain.

Session Coordinators: *Neil Lassettre and Justin Smith, Sonoma County Water Agency*

Dry Creek Habitat Enhancement Project Adaptive Management Plan: Evaluating Physical and Biological Response

Neil Lassettre (Presenter), David Manning, and Gregg Horton, Sonoma County Water Agency; and Robert Coey, NOAA Fisheries, West Coast Region

Habitat characteristics that affect salmonid freshwater life stages include physical (habitat quantity and quality), chemical (water quality and temperature), and biological (predator abundance, food availability) conditions. While the links between habitat condition and salmonid ecology are well-known, the biological response to changing a specified condition can be difficult to detect, requiring a robust monitoring program that adapts to clear signals detected in the data. The Sonoma County Water Agency's Dry Creek Habitat Enhancement Project used information on current conditions to inform the design of projects to enhance juvenile coho salmon and steelhead habitat along a one-mile reach of Dry Creek, a tributary to the Russian River. The reach is intended to demonstrate potential techniques to be applied to future project phases along six miles of Dry Creek over the course of several years. Enhancement approaches target off-channel areas (constructed backwaters and side-channels), stream banks (bioengineered bank stabilization structures and engineered logjams), and in-channel areas (boulder fields and constructed riffles) to create hydraulic and escape cover for coho and steelhead juveniles and promote macro-invertebrate production. Sonoma County Water Agency is monitoring the ecological and physical effectiveness of the enhancement features and validating juvenile salmonid usage following an Adaptive Management Plan that integrates data to evaluate enhancement measures. The project is being evaluated at multiple scales: feature (e.g., backwater or constructed riffle), site (collection of features), enhancement reach (collection of sites), and project reach (collection of enhancement reaches) against performance measures and evaluation outcomes will guide future actions. The project is being carried out as part of the Reasonable and Prudent Alternative of the Russian River Biological Opinion, which outlines habitat goals as well as other potential alternatives.

Monitoring the Effectiveness of Fish Passage Projects in Coastal Northern California

Ross Taylor (Presenter), Ross Taylor and Associates, and Leah Mahan, NOAA Fisheries

For the past 15 years, the treatment of salmon and steelhead migration barriers has been a common restoration action. For example, between 1998 and 2012 the Five Counties Salmonid Conservation Program assisted Del Norte, Siskiyou, Trinity, Humboldt, and Mendocino counties in completing 65 fish passage projects; improving fish access to nearly 150 miles of habitat. Many of these projects involved replacement of culvert barriers with bridges, open-bottom arch culverts, and embedded culverts. Other projects retrofitted existing culverts with baffles or weirs. Ross Taylor and Associates (RTA) started monitoring Five Counties' fish passage projects in 1999 at Morrison Gulch, two years prior to the treatment of this high-priority barrier located in Humboldt County.

Monitoring is a vital component of a comprehensive fish passage project for several reasons. First, implementation monitoring confirms that a particular project was built as designed, which has relevance to other types of monitoring. Second, validation monitoring may provide insight that certain assumptions made in project design were correct (or not). Finally, effectiveness monitoring is used to confirm that project objectives were met. Besides providing fish access to upstream habitat, project objectives may also include: maintaining channel bed and bank stability, allowing for channel head-cutting, meeting specific water depth and velocity requirements during migration flows, or restoring other watershed processes such as bedload movement.

As a leading funder of fish passage projects in California, The NOAA Restoration Center's Open Rivers Program has supported project monitoring to further the knowledge base of how to implement successful projects and to document the biological benefits of these relatively expensive restoration projects. In 2009, NOAA Fisheries contracted with RTA to monitor fish passage projects using a two-tier level of methods. Tier 1 methods are applied to all projects supported by the Program, whereas the more intensive Tier 2 monitoring is applied to a subset of funded projects.

This presentation describes NOAA's two-tiers of fish passage monitoring and provides a summary of specific projects where these methods have been utilized. Examples of monitoring results will also be provided.

Validating the Effectiveness of an Off-channel Habitat Enhancement Project in Green Valley Creek through Use of PIT Tag Detection Systems

Mariska Obedzinski (Presenter) and *Amelia Johnson, California Sea Grant and UC Cooperative Extension*

During the summer of 2014, Gold Ridge RCD, NOAA Restoration Center, California Department of Fish and Wildlife, and cooperating landowners partnered to construct an off-channel habitat enhancement project in lower Green Valley Creek to increase winter rearing habitat for juvenile salmonids. California Sea Grant and UC Cooperative Extension (UC) are using PIT tag technology to monitor fish use of the new off-stream channel. UC's monitoring infrastructure of PIT tag antenna arrays in Green Valley Creek and a population of PIT-tagged juvenile hatchery coho that are released each year upstream of the project site as part of the captive broodstock effort created a unique opportunity to evaluate the new habitat enhancement project. By placing additional PIT tag antennas in the new channel, as well as in the main channel upstream and downstream of the project site, we are able to track fish movement in and out of the new off-channel habitat and estimate the proportion of coho passing the project site that enter the newly created channel, the timing of entry in relation to flows, and residence time within the new channel.

Changes in Stream Habitat Conditions in the Mattole River Watershed Over Two Decades

Nathan Queener, Mattole Restoration Council

The Mattole River watershed in Humboldt County, California has been the location of extensive sediment reduction and salmonid habitat enhancement activities over the past three decades. However, little quantitative data has been developed that investigates changes in aquatic conditions over this time period.

Stream habitat data collected by multiple agencies and organizations from 1991 to 2011 in 65 stream reaches was examined for evidence of changes in conditions over time. Data from the same stream reaches were treated as matched pairs for the purposes of analysis and also compared to relevant target values for the region.

Statistically significant increases in riparian canopy cover and the percentage of reach length composed of pools, and decreases in cobble embeddedness and reach median pool depths, were observed between the 1990s and 2003-07 time period. Other pool depth metrics showed either a slight decrease or no change, but none of these values were statistically significant. In a smaller subset of reaches, sampled in 2011, fine sediment conditions also improved, while pool depth and frequency results were mixed.

Nearly all fine sediment metrics met state and federal target vales in a majority of stream reaches. The majority of canopy cover values compared favorably to targets, except in larger streams. Pool depth and frequency metrics rated poorly when compared to all targets. Large wood occurrence also fell far short of targets, even though our methodology likely over-estimated the number of key pieces of wood.

Improvements in sediment and canopy cover conditions are similar to observations from other regional watersheds where declining sediment loads and fine sediment have been documented. The lack of increase in pool depths may be related to decreasing sediment supplies decreasing bar amplitude, and increasing substrate size decreasing scour depth for a given flow event, along with scarce instream wood.

In logged streams wood abundance will continue to decline for a period after harvest while decay and fluvial transport of wood continue at a greater rate than recruitment. Given recovery rates and the timing of harvest in the watershed prior to modern riparian buffer requirements, wood abundance may have been declining in many streams over the last few decades, and natural recruitment rates may remain insufficient to lead to increases for another decade or more. While decreasing sediment loads and incising channel elevations are generally considered a positive trend, in the absence of sufficient instream wood to force localized aggradation, connection with flood terraces, and hydraulic complexity, these improving sediment conditions may actually decrease the availability of habitat for coho salmon juveniles during winter flows.

Continued attention to road maintenance by landowners and managers should help maintain the trajectory of sediment recovery. Improving forest conditions and directly increasing the amount of instream wood will likely be necessary to improve wood and pool conditions, especially for coho salmon, within a time frame shorter than multiple decades.

Enhancing Salmon and Steelhead Habitat in the Nimbus Basin, Lower American River, California

Chris Hammersmark (Presenter), PhD, P.E. and Ben Taber, P.E., cbec, inc. eco engineering; Julie Zimmerman, PhD, U. S. Fish and Wildlife Service; John Hannon, U. S. Bureau of Reclamation; and Joe Merz, PhD, Cramer Fish Sciences

In the last seven years, concerted efforts led by agencies including the U.S. Bureau of Reclamation, U.S. Fish & Wildlife Service, California Department of Fish and Wildlife, NOAA Fisheries, Sacramento County Parks, and the Sacramento Water Forum have resulted in a suite of habitat enhancement projects in the lower American River. These projects have focused on the creation and enhancement of spawning and juvenile rearing habitats for steelhead and Chinook salmon. In 2014 a project was constructed in the Nimbus Basin, which is located immediately below Nimbus Dam at the upstream limit of anadromy. The project includes: a side channel complex with multiple branches and resulting hydraulic environments, floodplain benches, the placement of large woody material, as well as the augmentation and enhancement of a degraded riffle in the main channel. The Nimbus Basin project was unique in that it used material generated from the excavation of the side channel complex to create spawning habitat in the main channel, as well as to improve the textural composition of the floodplain benches. No imported material was required. The effectiveness of this project will be shown through monitoring data documenting fish utilization at this new site and other enhancement sites. Monitoring data indicate high utilization of the various project sites by spawning and rearing salmonids.

Cattle Exclusionary Fencing and Off-Channel Watering on Salsipuedes Creek (Santa Ynez River) in Support of Southern Steelhead

Timothy Robinson (Presenter), Scott Engblom,
and Scott Volan, *Cachuma Project Water Agencies*

Salsipuedes Creek joins the Santa Ynez River approximately ten miles upstream from the Pacific Ocean. The creek and its tributaries comprise the largest stream system on the lower Santa Ynez River (LSYR) below Bradbury Dam, providing 27 miles of stream habitat in the western Santa Ynez Mountains and Santa Rosa Hills. The watershed of 52 square miles is hilly rangeland composed of oak woodland, chaparral, and grassland, with limited agriculture along the valley bottoms. Salsipuedes Creek and its primary tributary, El Jaro Creek, were designated by the National Marine Fisheries Service (NMFS) as critical habitat for endangered southern steelhead, *Oncorhynchus mykiss* (*O. mykiss*), due to their historic and high quality spawning and rearing habitat, perennial flow, and close proximity to the Pacific Ocean. In 2000, NMFS issued a Biological Opinion to the U.S. Bureau of Reclamation (USBR) outlining reasonable and prudent measures to minimize impacts of the Cachuma Project to steelhead. The Cachuma Operation and Maintenance Board (COMB) implements the LSYR Fisheries Monitoring and Restoration Program on behalf of the USBR. Since 1993, biologists with the Cachuma Project have monitored a persistent population of *O. mykiss* in the Salsipuedes Creek drainage. Cattle access unfenced sections of the creek from adjacent rangelands and move laterally up and down the stream corridor, denuding riparian vegetation, increasing the potential for erosion, nutrient loading, sedimentation and turbidity, and generally reducing water quality such as elevated stream water temperatures. These detrimental effects on *O. mykiss* can be reduced or eliminated by installing exclusionary cattle fencing along the top of the banks and an off-channel watering system that keep cattle out of the riparian corridor.

In the spring of 2014, a first-of-its-kind for the Santa Ynez River valley exclusionary cattle fencing project was installed along three miles of lower Salsipuedes Creek to improve habitat and water quality for southern steelhead. Near-term results have shown a reduction in turbidity, sedimentation, and nutrient loads in the creek. Over the long-term, it is expected that riparian vegetation will recover and increase the shading and aquatic habitat, resulting in cooler water temperatures and improved spawning and rearing conditions for *O. mykiss*. Anticipated long-term benefits will be discussed in context of steelhead recovery in the Santa Ynez River basin and across the Monte Arido Highlands Biolgreographic Population Group and Southern California Distinct Population Segment.

Maintaining Flows and Water Quality for Eel River Coho Recovery —Taking Lessons from the Russian River

Scott Greacen, Executive Director, Friends of the Eel River

The Recovery Plan for Southern Oregon – Northern California Coast (SONCC) Evolutionarily Significant Unit (ESU) of Coho salmon, released by the National Marine Fisheries Service (NMFS) in September 2014, identifies sediment discharge and water diversions associated with the Emerald Triangle's booming marijuana industry as critical drivers of the continuing decline of the South Fork Eel River's remnant coho population.

Recovery of the South Fork Eel coho population is indispensable to the survival and recovery of the SONCC ESU. Thus, recovery of coho salmon in the region requires effective change in policies and practices to dramatically reduce impacts associated with commercial marijuana cultivation. Coho and other watershed-dependent wildlife were teetering at the brink of extinction well before the dramatic expansion in open marijuana cultivation, however. Steep declines in salmonid populations and watershed productivity resulted from dramatic alterations to key habitats, including estuary, floodplains, and tributary streams. Most are associated with the mid-20th century boom of the North Coast timber industry.

While those legacy impacts have been partially addressed through decades of restoration efforts, their extent and persistence reflect the extreme vulnerability to disturbance of the still largely undeveloped Eel River watershed. The region's unstable geology, high seismic activity, and exposure to precipitation extremes give the Eel a baseline sediment load among the highest observed. The damage done to the watershed by the 1964 flood, in large measure a consequence of the proportion of the watershed subjected to clearcut logging in preceding decades, is still reflected in poor floodplain and channel conditions which remain significant burdens on coho survival and reproduction.

Nonetheless, keeping the marijuana industry from driving coho to extinction in the South Fork Eel confronts us with the unsustainability of the status quo in several dimensions. Policymakers and citizens are moving toward cannabis legalization, but without consensus, as yet, on how best to regulate the industry. Regulatory agencies, having moved past marijuana prohibition, remain orders of magnitude short of the resources necessary to protect streamflows and water quality through an enforcement-led approach. Even writing permits for more than a subset of existing operations would far exceed agency capacity, without ensuring impacts are sufficiently reduced to allow recovery.

Drawing on lessons from the Russian River watershed, among others, we can map traps which the Eel may still hope to avoid, taking useful lessons from others' experience. Among these: (1) address systemic disturbance before carrying capacity is lost; (2) mere compliance with existing regulations is unlikely to secure recovery; (3) a combination of regulation and incentives, including amnesties and even subsidies, may offer the most effective path to protecting public trust resources; (4) while every industry resists regulation, appropriate combinations of sideboards and incentives can create opportunities for self-governance that may yield higher performance in meeting conservation goals.

Potter Valley Project Overview: Licensing, Operations, and Fisheries Protection

Paul Kubicek (Presenter), *Senior Consulting Scientist – Aquatic Biologist, Pacific Gas and Electric Company, and* ***Park Steiner,*** *Fisheries Biologist, Steiner Environmental Consulting*

The Potter Valley Project is a 9.2-MW hydroelectric project in the upper Eel River and Russian River watersheds owned and operated by Pacific Gas and Electric Company. It consists of an inter-basin diversion of water from the upper Eel River at Cape Horn Dam to the East Branch Russian River in Potter Valley, which began in 1908. The project was originally licensed in 1922, relicensed in 1983, and received an amended license from the Federal Energy Regulatory Commission (FERC) in 2004. The amended license incorporated fisheries protection measurers designated by the National Marine Fisheries Service in its Reasonable and Prudent Alternative (RPA). Project operations under the RPA and amended FERC license represent a balancing of water needs, primarily power production, fisheries protection in the Eel River (Chinook salmon and steelhead), irrigation water delivery in the Russian River, and recreation. The current average annual diversion (2007-12) is 77,000 ac-ft, which is 21.9% of the estimated unimpaired flow in the Eel River at the point of diversion and 1.8% of the estimated unimpaired flow at Scotia. The historical average annual diversion (1923-72) was 155,000 ac-ft.

Minimum flows in the Eel River below Cape Horn Dam designed to mimic the pattern and timing of the natural hydrograph were initiated in the fall of 1979 as part of the FERC relicensing process. The results of fishery monitoring studies and water modeling efforts since then have contributed to the modification of the minimum flow regime and the ultimate development of the RPA-required regime. Under the RPA, the minimum flow can be adjusted daily, except in August-September when flows are set to approximate unimpaired flows. Minimum flows during the remainder of the year are based on a calculated index flow (70% of the unimpaired flow) subjected to cap and floor limitations. Actual flows are typically higher than RPA-required minimums due to natural accretion and the release of buffer flows to ensure compliance with RPA requirements.

Other fisheries protection measures maintained at the project include a fish ladder at Cape Horn Dam and a fish screen at the diversion. The original fish ladder was in place as early as 1915 and major improvements were completed in 1987. The original fish screen was put into operation in 1972 and replaced in 1995.

Extensive fishery monitoring studies associated with project operations have been conducted over the years. Current annual studies include: performance monitoring (hydrologic statistics and fish ladder counts), Chinook salmon carcass surveys, water temperature monitoring, summer fish monitoring, pikeminnow monitoring and suppression, and bald eagle surveys. Data from these studies will be analyzed and used during the upcoming project relicensing process to help identify potential changes in project operations for the protection of Chinook salmon and steelhead in the Eel River, while balancing beneficial water uses in both the Eel River and Russian River watersheds. The current amended license expires on April 14, 2022. A Notice of Intent to File License Application must be filed by April 14, 2017, and an Application for New License must be filed by April 14, 2020.

Potter Valley Project Blockwater Investigation

Alison O'Dowd (Presenter) and *William Trush, PhD,* *Humboldt State University River Institute, Department of Environmental Science and Management*

A Biological Opinion written by the National Marine Fisheries Service in 2002 requires the Potter Valley Project on the Eel River mainstem to retain 2500 acre-ft annually (labeled 'blockwater') to be released when needed for anadromous salmonid adult upstream migration and/or juvenile downstream migration. This mandated blockwater has been released only twice since WY2002; in the spring of WY2012 and late summer of WY2014. Productive juvenile rearing habitat in the upper mainstem Eel River during downstream migration requires: (1) abundant riffle habitat supporting a highly productive benthic macroinvertebrate (BMI) population and (2) abundant/high-quality anadromous salmonid juvenile and smolt physical rearing habitat. Both are essential to promoting growth and ultimately anadromous salmonid population recovery. Habitat-riverflow relationships are being developed using hydraulic measurements and modeling of riffles and runs over the historic range of upper mainstem Eel River springtime streamflows from the Tomki Creek confluence downstream to the Middle Fork Eel River confluence. Two primary tasks of this project were to: (1) specify the magnitude/duration of blockwater releases that could measurably improve juvenile growth during downstream migration and (2) consider an operational trigger for releasing blockwater to improve downstream juvenile and smolt migration, which will likely depend on ambient tributary streamflows below Van Arsdale Dam and time-of-year (e.g., a release in mid-March in contrast to mid-May depending on early- or late-spring rainfall). Annual unimpaired hydrographs were employed to establish baseline conditions from which to objectively evaluate ecological benefits of various blockwater release strategies.

Lake Mendocino's Role in Russian Flow and Fisheries Management

David Manning, Environmental Resources Manager and Don Seymour, Principal Engineer, Resource Planning, Sonoma County Water Agency

Constructed in 1959, Coyote Valley Dam and Lake Mendocino are vital components of the US Army Corps of Engineers' and Sonoma County Water Agency's Russian River Project. The reservoir provides flood control, recreation, agricultural irrigation, and water supply for more than 600,000 residents in Mendocino, Sonoma, and Marin Counties. Flows released from the lake sustain Chinook salmon and steelhead spawning along 65 of miles of the upper Russian River provide year-round rearing for juvenile steelhead in a 30 mile reach below the dam and support nearly 30 species of fish including a diverse assemblage of natives. However, decreases in Lake Mendocino inflow and storage from reduced Potter Valley Project (Eel River) diversions, hydrologic differences between the Eel River and Russian River watershed, and the recent drought have greatly affected the reliability of the reservoir and are stressing threatened salmonids in the upper Russian River watershed. The Sonoma County Water Agency is working in collaboration with the National Marine Fisheries Service, California Department of Fish and Wildlife, US Army Corps of Engineers, and State Water Resources Control Board to modify Lake Mendocino releases, implement new minimum flow requirements to comply with the 2008 Russian River Biological Opinion, and enhance conditions for threatened fish. Water Agency resource planning staff has also engaged a diverse group of stakeholders including municipal and agricultural water users, water management agencies, and researchers from NOAA's Office of Atmospheric Research, National Weather Service, and Scripps Institution of Oceanography to help understand and improve Lake Mendocino reliability. Our presentation will describe Lake Mendocino's role in managing Russian River fisheries and water resources and will provide a brief overview of ongoing efforts to facilitate management of this critical water supply.

Long-term Trends in Streamflow in the Eel/Russian Basins and California's North Coast

Eli Asarian (Presenter), Riverbend Sciences, and Thomas Lisle, Stillwater Sciences

Using streamflow data from the U.S. Geological Survey, we assessed long-term trends in streamflow on California's North Coast, with a focus on the Eel River but including other basins. Precipitation data from the National Climatic Data Center and other sources were assembled into a daily time series and used to calculate an antecedent precipitation index (API) for the watershed contributing to each stream gage. API is a precipitation summary which provides high weight to recent precipitation and low weight to precipitation that occurred many months ago. A regression model of the relationship between API and streamflow was used to calculate precipitation-adjusted streamflow, which statistically reduced the year-to-year fluctuations caused by variable precipitation and allowed evaluation of the underlying streamflow trend. The use of daily precipitation data is an improvement on recent similar analyses that relied on monthly precipitation data.

During the summer and early fall, streamflow has significantly declined in recent decades in many streams. This is only partly due to a decline in September precipitation across much of the study area. Precipitation-adjusted streamflow has also declined significantly in many streams, indicating that other factors are also contributing to streamflow declines. Potential contributors to declining precipitation-adjusted streamflow include increased water withdrawals by humans and changes to vegetation/forest structure, as well as other climate factors such as decreased fog and increased air temperature. Lack of data, especially regarding human water withdrawals, make it difficult to quantify the relative importance of these factors in each particular gaged watershed; however, streams with extremely low human population density and little or no agriculture were less likely to have significant declines in streamflow or precipitation-adjusted streamflow.

Is There a Place for Percentage Flow Management in California's North Coast Region?

Gabriel Rossi, *Fisheries Hydrologist, McBain and Associates*

The life histories of salmon and steelhead in California's North Coast streams are bound to the shape and timing of the seasonal recession limb of the annual hydrograph. The seasonal recession is a gradual reduction in baseflow, typical of streams in the Mediterranean climate, which occurs between April and September. Throughout California's North Coast region, mounting authorized and unauthorized riparian water diversions, as well as a changing climate, influence the magnitude, shape, and timing of the seasonal recession. The State Water Resources Control Board's "Policy For Maintaining Instream Flows" (SWRCB 2010) established "principles and guidelines for maintaining instream flows for the protection of fishery resources, while minimizing water supply impacts on other beneficial uses of water, such as irrigation, municipal use, and domestic use." But these guidelines apply only between December 15th and March 31st, when streamflow is typically abundant in coastal streams. Continued unregulated riparian and appropriative diversion throughout seasonal recession can negatively affect stream dwelling organisms, including out-migrating smolts and over-summering juvenile salmonids. The fate of anadromous salmonid populations in Northern California's coastal streams may hinge on a prudent diversion management strategy during this period of the annual hydrograph.

Traditional management of instream flows has not recognized the value of streamflow variability during the seasonal recession. Establishing static bypass flows designed to protect one priority life history need (e.g., fish passage), will not promote salmonid population recovery or improve overall stream ecosystem health during the seasonal recession. To address the importance of a naturally variable flow regime, a growing number of states and countries (including the states of Oregon, Florida, Maine, and Virginia, as well as Canadian provinces, and members of the European Union) are using a "percent of flow" (POF) diversion strategy. The POF approach allows diversion and storage of a specified percentage of the daily natural streamflow that preserves natural flow variability. However, several challenges exist which must be addressed if the POF method can be safely applied in North Coast streams to protect public trust resources, while minimizing water supply impacts. These challenges can be divided into three groups: implementation, biological validation, and regulatory compatibility.

This presentation will describe the tradeoffs between POF and traditional instream flow management tools, identify some challenges to implementing a POF management strategy, and consider opportunities and constraints for POF management as a tool to recover and sustain fisheries and other ecological resources in North Coast streams, while allowing prudent diversion for human consumption.

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SRF News

8th Spring-run Chinook Symposium

Summer 2015, Chico, CA

The 8th Annual Spring-run Chinook symposium will highlight recent restoration efforts in Butte and Battle Creek, regional status reports on Spring-run populations, genetics, FERC relicensing, climate variability, and population trend monitoring.

SRF Resources

SRF's new website features helpful restoration resources about pressing topics like Water Conservation and Water Rights Education.

18th Annual Coho Confab

August 21-23, 2015, Western Sonoma

SRF, in cooperation with the California Department of Fish and Wildlife, Gold Ridge Resource Conservation District, and other non-profits and fisheries agencies will explore coho recovery strategies and techniques. The Confab will feature tours of large woody debris placement, water conservation efforts, stream bank stabilization, and fish passage projects. This Confab will visit exemplary restoration sites in Willow Creek, Dutch Bill watershed, Dry Creek, Mark West, and other tributaries of the Russian River.

The Other Migration

By Dana Stolzman

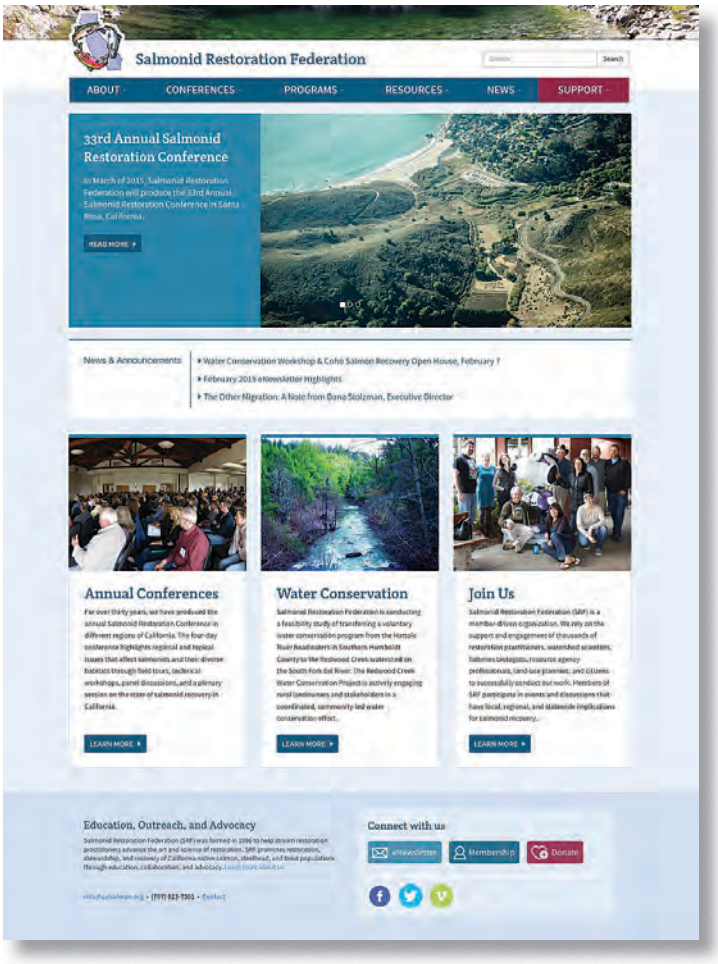
If you are in the salmon restoration field, chances are that you obsess about fish migration. Even if you are not religious or spiritual, you probably pray that all the elements align (water, dissolved oxygen, biological imperative, and habitat conditions) so that salmon are triggered to return home and spawn. When contemplating a web migration, it's hard not to think in salmon migration analogies—the stakes are high, and the barriers are formidable.

Unless you have supervised a massive website content migration, you cannot really fathom the intricacies. Everything needs to be considered from the architecture to the fine details. You spend many, many hours contemplating the concepts and how to execute branding, social media, navigability, and security. A content migration allows you to step back and look at how much an organization and a field have evolved. For an organization like SRF that has existed for over three decades, it is awe-inspiring to take stock of how much the salmon restoration profession and SRF have grown.

A content migration also gives you an immense appreciation for all those who have helped along the way: the founders, the pioneers, the scientists, the on-the-ground practitioners, and the restoration heroes. A web migration makes you truly appreciate your previous and current web developers as well as your loyal, uber-competent, and dedicated staff.

We contemplated a web migration for many years but having overseen two migrations, I knew the additional workload and how many questions must be contemplated before embarking, such as wire-framing, coding, and other mysterious elements that are the building blocks of a contemporary, responsive website.

Responsive means that you can look at the website from any device, preferably not while driving. SRF knew that we wanted a website where we could manage the content (Content Management System) and that it would interface with a CRM (constituent relationship management database). Just as some



of you dream in acronyms, these were our daily dilemmas: how to migrate 30 years of data and ten years of electronic resources so everything communicated on the back end and users could navigate seamlessly on the front end. SRF has tried to adapt and to be responsive for the beneficial use of all who participate and share our mission of salmon restoration and recovery.

I could not be more grateful for those who founded SRF, our Board of Directors who help envision how to best serve our constituents, and the SRF Program Manager and web designer who crafted the elegant solutions that will launch us forward and help us stay timeless with the interwebs.

Go ahead, check it out, you can even try to break it but be sure to let us know if you do.
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SRF Mission Statement

The Salmonid Restoration Federation was formed in 1986, to help stream restoration practitioners advance the art and science of restoration. Salmonid Restoration Federation promotes restoration, stewardship, and recovery of California native salmon, steelhead, and trout populations through education, collaboration, and advocacy.

SRF Goals & Objectives

1. To provide affordable technical and hands-on trainings to the restoration community.
2. Conduct outreach to constituents, media, and students to inform the public about the plight of endangered salmon and the need to preserve and restore habitat to recover the species.
3. Advocate on behalf of continued restoration dollars, protection of habitat, and recovery of imperiled salmonids.

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