29th Annual Salmonid Restoration Conference

Holding the Line on Species Decline

March 23-26, 2011 in San Luis Obispo

2011 Conference Co-sponsors

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Restoring Salmonids—Holding the Line on Species Decline

SRF is pleased to be returning to San Luis Obispo for the 29th annual Salmonid Restoration Conference. Since last holding the conference in SLO in 2003, we've been to Davis, Fortuna, Santa Barbara, Santa Rosa, Lodi, Santa Cruz, and Redding. At each location, we focus on the issues in the local watersheds while including topics of wide ranging interest among the fisheries restoration community. Each locale gives us an opportunity to consider a theme appropriate for the state of salmon fisheries and the location of the conference.

This year the theme is "Restoring Salmonids—Holding the Line on Species Decline." When we say restoring salmonids, we really mean restoring salmonid habitat and access to that habitat, and our intent is that by doing those two things, we will restore and recover salmonid populations to the point that they become self-sustaining populations. In Southern California, and on the Central Coast, we are faced with enormous challenges trying to hold on to the populations we still have and creating the conditions that will allow them to recover as a population. But along with challenges, come opportunities. We look at the cost of replacing or retrofitting fish-barrier culverts in densely populated areas where we may be dealing with multiple lane freeways and we see high costs and formidable logistical challenges.

We also see the opportunity to bring fish back to rivers and creeks that may not have had any decent fish runs in many decades. The conditions under which southern steelhead evolved were challenging—creeks that dry up in the summer, long-hot summers—not the conditions we normally think are conducive to salmonids. And yet we hear stories in recent times of steelhead showing up in creeks in Los Angeles and San Diego. The Central and South Coasts had some productive rivers and good runs of steelhead, enough to make them popular destinations for Southern California fishermen back in the day before the cumulative impacts of highways, urban development, dams, and water diversions took their toll on the steelhead numbers.

When I think of the conditions Southern Steelhead evolved under, I think those have to be some tough fish! Those are the genes that we want to see survive and become the brood stock for future generations. So, we really do want to hold that line and not let any of these genetically important strains go the way of the passenger pigeon. We like our conferences to be a source of inspiration so conference goers don't get bogged down in all the bad news that could turn us all into cynics. We don't want to bury our heads in the sand and pretend that all is good in the salmon world but we also don't want to let the challenges become overwhelming and discouraging. Since attending my first SRF conference in 1984, I have found great value in and enjoyed getting together with like-minded folks working in fisheries science and restoration. The annual SRF conference can be sobering in the sometimes dire statistics we hear, but I always look at the conference as a call to arms for restorationists, and a good venue to arm restorationists with the information and tools we need to take back to our home watersheds to work on educating the public and applying sound science to the challenges ahead of us.

Don Allan

Don Allan
SRF Board Persident

Welcome

Welcome to the 29th Annual Salmonid Restoration Conference entitled, "Restoring Salmonids—Holding the Line on Species Decline," since the conference will address the challenge of recovery and restoration efforts in the face of salmonid extirpation, global climate change, water shortages, and California's evolving political landscape.

In this era of mass urbanization, state budget cuts, and diminishing salmon returns, it is more important than ever for fisheries scientists and restorationists to gather together to share resources, techniques, strategies, and methodologies to restore habitat and recover wild salmon populations.

SRF is excited to be hosting the conference back on the Central Coast. This has been a truly collaborative effort that has produced an exceptional agenda. This conference will undoubtedly spawn lively discussions about how to recover salmonids and restore habitat. The field tours showcase several multi-stakeholder efforts to restore steelhead habitat. The conference agenda also features sessions on restoration and recovery efforts for coho salmon and Chinook salmon.

Fisheries specialists, on-the-ground restorationists, students, agency personnel, legislators, and watershed stewards migrate from all over the Pacific Northwest and beyond to share in this premier fisheries restoration conference that addresses pressing issues like fish passage, dam removal, instream habitat restoration, stormwater pollution management, and how climate change affects salmonids recovery.

The production and coordination of the annual conference is a collaborative and dynamic process that engages Salmonid Restoration Federation's Board of Directors, co-sponsors, and colleagues. This year the host city was particularly helpful. I wish to thank Freddy Otte, the City Biologist for San Luis Obispo and Anna Halligan of Morro Bay National Estuary Program who helped to craft the conference agenda and involve the local restoration community. I would also like to thank our long-time co-sponsor the California Department of Fish and Game for their input and continued support of this annual conference. The Department of Water Resources has generously donated the printing of the annual Conference Proceedings—which is a gift to all conference attendees and presenters. The Proceedings are also available on our website so it can continue to be a resource for anyone to share and enjoy.

I would like to thank all of the volunteer session, field tour, and workshop coordinators for building an impressive agenda. Thanks to all of the participants who travelled so far to be here, and to the dedicated presenters. Thank you to all of our co-sponsors for your time, ideas, donations, and your vital contributions to help make this fisheries restoration conference a reality. Thanks to the SRF staff for all of your patience, persistence, and conference preparation. Finally, I would like to extend a heartfelt thanks to the dedicated SRF Board of Directors and all of the enthusiastic work trade folks who rock it every year. You're the backbone and the future of the fisheries restoration field.

SRF will also be offering a host of other technical education trainings in 2011 including the North Coast Fish Passage Design and Engineering Field School in May, the 6th Annual Spring-run Salmon Symposium in Nevada City in July, and the 14th Annual Coho Confab on the Smith River in August.

Please join us in our efforts to enhance the art-and-science of restoration and ultimately restore wild salmon populations.

Dana Stolzman

Dana Stolzman

Agenda Coordinator
Executive Director
Salmonid Restoration Federation

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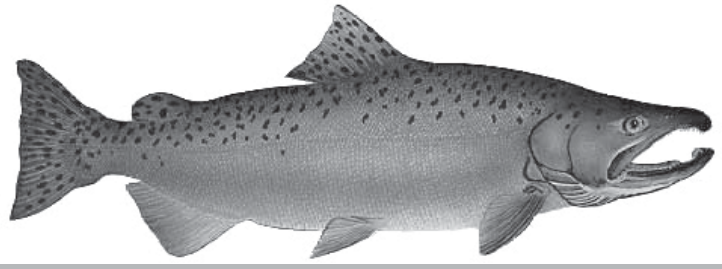


Thursday, March 24

SRF Annual Meeting and Thursday Evening Film Social

Friday March 25

Plenary Session: Holding the Line on Species Decline

How Changing Climate and Stream Temperatures Affect Salmonids

Barrier Identification, Design Criteria, Implementation, and Project Monitoring to Recover Steelhead

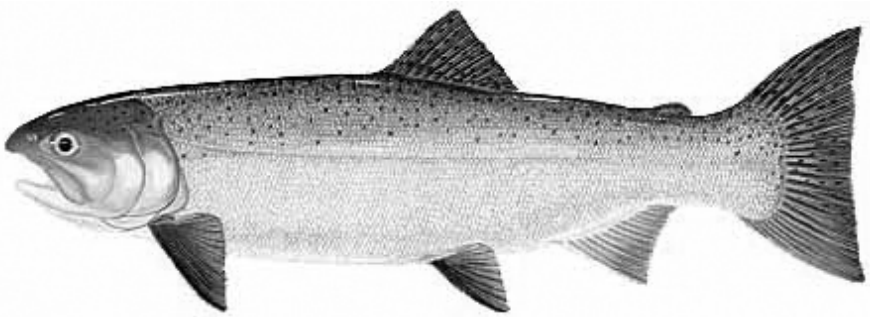
Friday Afternoon Concurrent Session 3

Enhancing Instream Flows: Springs, Seeps, and Groundwater Recharge

Friday Evening Poster Session

Saturday Morning Concurrent Session 1

Coho Salmon Recovery Efforts



On-the-Ground Salmonid Restoration: Obstacles and Opportunities

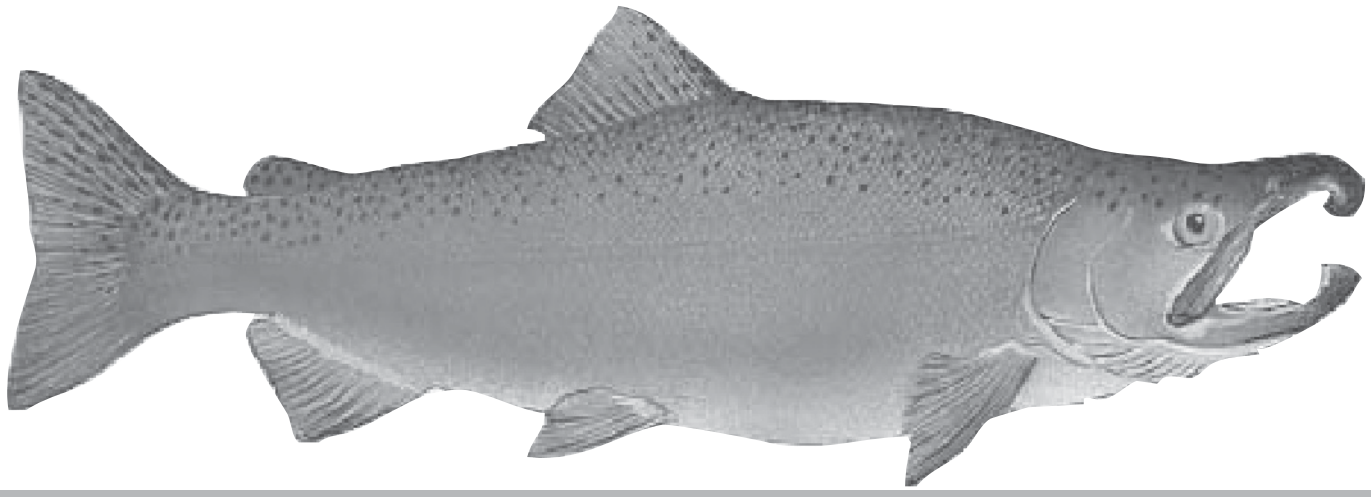
Population Status and Trend Monitoring

The Future of Chinook Salmon: Fisheries, Restoration, and Recovery

Salmon Strongholds: The Key to our Future

Saturday Afternoon Concurrent Session 3

Role of Estuaries and Lagoons in Sustaining Salmonid Populations



San Luis Obispo and Arroyo Grande Urban Creeks Tour

Wednesday, March 23

Tour Coordinators*: Freddy Otte, City of San Luis Obispo,* ***Steph Wald,*** *Central Coast Salmon Enhancement; and* ***Julie Thomas,*** *Coastal San Luis Resource Conservation District*

Segments of this moderately urbanized watershed in southern SLO County are managed by state, county, and city entities for different purposes. Recently, a memorandum of understanding was implemented to facilitate coordinated management planning between municipalities, special districts, managers, owners and interested NGOs. This tour will start upstream with a visit to Lopez Dam that is managed by the county for water supply. We will then proceed downstream to a City Park creekside property to see a reach of the flood control channel that is managed by the County for flood protection. The final stop will be at the estuary where we will see state park land that is managed for recreation and habitat. At each stop, staff from involved organizations and municipalities will join us to discuss the challenges of coordinated management including the Habitat Conservation Plan for Lopez Dam, City and County Stormwater Management Plans, the Arroyo Grande Creek Waterways Management Plan and EIR, off-highway vehicle access issues, groundwater pumping for residential and agricultural use, and fish-kills.

Sustainable Vineyards and Agricultural Tour

Wednesday, March 23

Tour Coordinator*: Anne Michul, Central Coast Vineyard Team*

The Sustainable Viticulture and Agriculture Practices tour will include several stops throughout the Central Coast that highlight and showcase sustainable creek restoration projects. The tour will begin with a classroom presentation on stream restoration practices and end with tours of Cal Poly State University—San Luis Obispo's stream enhancement and water quality control project site and other local vineyards dedicated to stream restoration. The tour will end with a tasting at Wolff Vineyards, a Sustainability in Practice (SIP)™ Certified Vineyard.

The Sustainability In Practice (SIP)™ Certification program evolved from nearly two decades of effort to understand and implement sustainable farming practices. When you find the SIP™ seal on a bottle of wine, you can be assured that growers are preserving and protecting the natural environment, treating their employees and community with care, and have sound business practices with a long-term view that protects both the present and the future.

Workshop Coordinators: ***Jonathan Thompson, Ronald Smith, Julie Wolford, and Louanne McMartin, Aquatic Invasive Species Program, U.S. Fish and Wildlife Service, Stockton, CA***

Workshop Session 1

Early Detection and Monitoring for Quagga and Zebra Mussels *(3.5 hours)*

Participants in this workshop will gain knowledge of methods for detecting early infestations of quagga and zebra mussels. The training is beneficial to watershed groups, reservoir or lake operators, government employees, and other water-based groups. The training will emphasize evaluation of fresh water bodies for quagga or zebra mussels, aquatic invasive species identification, and the impacts of invasive species.

Workshop Session 2

Invasive Species Risk Assessment and Planning (ISRAP) *(3.5 hours)*

Invasive Species Risk Assessment and Planning is a tool that manages the risk of moving invasive species during natural resource management activities. The first step in this risk management process is to conduct a risk assessment of potential pathways. A pathway is an activity or process through which a species may be transferred to a new location where it could become introduced. The risk assessment determines the significance of potentially moving species to an area where they may become invasive. Once it is determined that a pathway poses a significant risk, then a plan is implemented to reduce this risk. The plan is created using the Hazard Analysis and Critical Control Point (HACCP) planning process. As part of campaigns to help prevent the spread of invasive by increasing awareness, HACCP has become a recognizable brand. HACCP training workshops, a website, and an international standard have been created. The ISRAP process takes advantage of this pre-existing HACCP brand and planning process (with a few modifications) and combines them with the risk assessment to create a tool that is focused on preventing the spread of invasive species.

Sustainable Water Conservation: From Basins to Beavers, Ridgelines to Rooftops, and Laundry to Landscapes

Workshop and Tour Coordinators*: Brock Dolman, Director of the Water Institute, Occidental Arts and Ecology Center; and* **Meredith Hardy,** *California Conservation Corps*

This workshop will explore a variety of scales and project types—each demonstrating a number of creative applications ranging from capturing roofwater for both agricultural supply and residential, to reusing greywater at the home scale. We will explore the idea that not all dams are created equal—some need to be removed—some need to be put back in whether by historically widespread beavers themselves or by designs patterned on their hydro-engineering. Each of these strategies has the shared goal of improving water security and access for both people and fish.

This field tour in the afternoon will visit an in-progress rainwater catchment project and give participants the opportunity to install a low-tech roofwater catchment system off the water tanks that will be catching water off of rooftops. Participants will walk away with enough knowledge to install a low-cost, low-tech system at home.

Santa Maria/Sisquoc River Revival— Southern Steelhead Recovery in Action...Water Needed

Matt Stoecker, Stoecker Ecological Consultants

The combined length of the Santa Maria River and its large Sisquoc River tributary constitute one of the longest undammed and free-flowing rivers in the western United States. Over the past decade, several barriers to steelhead migration have been removed from the watershed and its tributaries further opening up access for steelhead recovery. The only known dam removal using explosives in the southern half of the state occurred in the watershed and almost the entire Sisquoc River basin is protected in public lands, wilderness areas, and wild and scenic river corridors. The remote Sisquoc River is one of the wildest and best-protected areas in California and contains over two hundreds miles of spawning and rearing habitat for southern steelhead. This watershed, in southern San Luis Obispo County and northern Santa Barbara County provides one of the best steelhead recovery opportunities in the southern steelhead DPS for the least amount of effort and cost. Water management and use in the lower watershed is one of the key challenges for realizing the watershed's true recovery potential and efforts are underway to better understand and remedy this issue. Join us on a visual tour of this unique watershed, its steelhead population, beaver benefits, completed fish passage projects, projects in the planning phases, and final steps needed to welcome a robust run of steelhead home.

Save Our Salmon (SOS)—
Salmon Creek Habitat Rehabilitation Program—Phase I

John Green, Gold Ridge Resource Conservation District

With funding provided by the NOAA Restoration Center through the American Recovery and Reinvestment Act of 2009, Gold Ridge Resource Conservation District is implementing the Save Our Salmon program—a suite of projects with the goal of attaining self-sustaining coho populations in Salmon Creek, a coastal watershed located in Sonoma County. Salmon Creek supports a newly reintroduced coho population, and is protected as part of the Sonoma Coast State Marine Conservation Area.

Restoration projects implemented as part of the SOS program include installation of large instream wood structures along two key stream reaches to enhance salmon habitat, enhancement of riparian vegetation to provide shading and a future source of instream wood, and erosion control projects designed to reduce delivery of fine sediment to the stream.

The largest element of the program aims to reduce stresses to the stream caused by water diversions during the dry summer months. A number of rainfall catchment and storage projects are being implemented with the goal of supplanting water diversions as outdoor, non-potable water supply. These projects range in size from 10,000 to over 230,000 gallons, and will serve both individual residences and agricultural operations.

SOS is also providing both short- and long-term economic benefits to the community of Bodega. In addition to providing employment for local restoration and construction professionals, the program supports the local agricultural economy by providing drought relief for some agricultural operations. In the long run, restoration of the coho will help to revive the local fishery, which has been decimated by the collapse of salmon populations.

Engineered "Beaver Pond" Pilot Project for Coho Recovery in the Mattole Headwaters

Tasha McKee, Sanctuary Forest Stewardship Program and Co-Executive Director, Sanctuary Forest

The goal of the Mattole Flow Program is to restore healthy dry season flows to the Mattole River headwaters for the benefit of salmon, other aquatic species and the human community. The program began in 2005 with the primary goal of ending dry season pumping through water storage and forbearance. However, an important finding of our research indicated that changes in human use would not be enough to restore healthy flows in extreme drought years. In the drought of 2008, this lesson was brought home as river reaches and tributaries unaffected by human use dried up that had never dried up before. Preliminary research begun in 2004 had shown that groundwater enhancement projects have the potential to restore healthy flows, even in drought years. Past land use practices including extensive logging and road systems have greatly decreased groundwater storage capacity resulting in higher winter runoff rates and lower summer flows. Groundwater storage projects are designed to sink and store some of the winter rain in the ground to augment summer flows. Groundwater storage projects also have the potential to lessen the devastating effects of increased flooding and drought predicted as part of climate change.

The urgency and need for streamflow improvement in the Mattole headwaters is extreme because the Mattole coho are literally at risk of extinction. Maps prepared by the Mattole Salmon Group from 2000-2009 snorkel survey data indicate that almost all juvenile coho in the entire Mattole river system oversummer in the headwaters and tributaries upstream of Bridge Creek. An overlay of low flow data shows that the reaches where most of the coho have been observed are the same reaches that dry up in low flow years. Mattole coho populations severely declined in 2008-2010 with only three live spawning fish and one redd observed in 2009-2010. Spring juvenile surveys only detected 100 juvenile coho in two tributaries, both of which have severe low-flow problems. Without streamflow improvement projects the Mattole coho will be lost and the entire Southern Oregon/Northern California Coast (SONCC) coho salmon evolutionary significant unit (ESU) of which they are a part of will be greatly weakened.

Sanctuary Forest is working with ecosystem analyst, Michael Pollock to design engineered "beaver ponds" for streamflow enhancement in the Mattole. Beaver ponds improve summer streamflow through ground and surface water storage and provide many other key hydrologic functions that are beneficial to coho. The engineered "beaver pond" will be designed to provide the same functions as ponds built by beavers. During the summer of 2010, Sanctuary Forest formed a collaborative team to design, implement and monitor pilot-projects on two Mattole tributaries. Site assessment, pre-project monitoring, and site-specific plans are underway. Implementation is planned to begin in the summer of 2011.

Sustainable Water Practices: From Greywater to Green Gardens

Laura Allen, *Greywater Action*

Most houses depend on a water supply resulting in negative impacts on the environment, from over-drawing the groundwater tables, over-pumping from rivers, to dams and long pipelines. Most of that water is used once, and sent "away" to a treatment plant or septic system, often releasing harmful chemicals and compounds into our rivers, bays, and oceans.

Through simple technologies of harvesting rainwater, reusing greywater (water from sinks, showers and washing machines), and implementing waterless toilets, a house can be transformed to save, conserve, and reuse water on site.

Overview:

- Existing water infrastructure
- Sustainable water technology options
- Harvesting rainwater
- Reusing greywater
- Waterless (composting) toilets and urine recycling
- Laws and regulations
- Global examples of sustainable water projects

Greywater, water from sinks, showers, and washing machines, can be easily and safely reused for outdoor irrigation. These systems can save water and money, energy and resources typically required to clean and treat wastewater, encourage healthier product choices, connect people to their water supply, and reduce strain on wastewater and septic systems.

Since California changed its greywater code in 2009, there has been a surge in simple, greywater system reuse. This talk will cover the technical, social, and practical aspects of residential greywater reuse, as well as highlight incentive programs in the state.

Overview:

- Greywater's potential for saving water
- Greywater system options
- Addressing environmental and public health concerns with greywater
- Permit exempt systems—laundry to landscape
- Incentive programs
- Future of greywater

A Re-assessment of the Historical Range of Beaver in California and Implications for Salmonids

Richard Lanman, MD (Presenter), *Chief Medical Officer, Veracyte, Inc*
and ***Christopher Lanman,*** *student*

North American beaver (*Castor Canadensis*) have been shown to have beneficial effects on salmonids, particularly in the arid West. Positive effects include creation of oversummering habitat (beaver ponds) for first year fish, conversion of seasonal streams to perennial, removal of sediments and pollutants via wetland creation, etc. Beaver are widely regarded as non-native in the Sierra Nevada, the San Francisco Bay Area proper, and coastal central and southern California. However, there are no recent reviews of the evidence for or against the historical range of beaver in California.

Methods: A review and integration of multiple lines of evidence, including historical naturalist and fur trapper records, oral histories, museum specimens, ethnographic material such as pictographs and ceremonial items, evaluation of habitat suitability, as well as radiocarbon dating of remnant beaver dams was conducted.

Results: Early naturalist records suggest that beaver were present as far south as San Diego, and accounts of fur trappers suggest that beaver were present in the San Francisco Bay Area. Oral histories place beaver in the high Sierra in the Kings River and Carson River watersheds. Museum specimen records include beaver collected in 1855 in Santa Clara, California and in 1906 in Sespe, California by experienced collectors. Native American pre-European contact words for beaver exist for eastern and mountain Sierra Nevada tribes including the Washoe and Mountain Maidu. The authenticity of the Sespe Creek specimen is supported by the presence of a Chumash pictograph of a beaver at Painted Rock in the Cuyama watershed in the Sierra Madre mountains, about 35 miles from the Sespe Creek headwaters. An historical Chumash shaman's rain making kit made from the skin of a beaver tail was also collected near this area in the Sierra Madre. Suitability of habitat in California is established based on the 70-year success of beaver re-introductions in the Sierras, the Bay Area, coastal California, and southern California including Santa Barbara, Riverside and San Diego Counties. Finally, radiocarbon dated remains of a remnant beaver dam in Red Clover Creek above 4,500 feet in the Sierras suggest beaver were present in the high Sierra until 1850 A.D.

Conclusions: The presence of beaver may be up to 80 times more efficient than large, woody debris in promoting salmon reproductive success. Grinnell's 1937 assertions that beaver were only present in the Pit and Klamath River drainages (*C. C. shastensis*), the Central Valley (*C. C. subauratus*) and the Colorado River (*C. C. repentinus*), appear to be based on contemporary trappers' interviews and an incomplete review of museum specimen records. New information suggests that beaver were once widespread in much, if not most, of California, and the success of the circa 1940 re-introductions throughout the state for 70 years confirms that habitat is suitable in coastal streams (Big River (Mendocino County), Pescadero Creek (San Mateo County), Santa Ynez River (Santa Barbara County), Santa Margharita River (Riverside and San Diego Counties), Lake Tahoe and Yosemite). The States of Utah and New Mexico have formal plans to re-introduce beaver to restore streams and fish habitat. Although it cannot be proven that beaver were present statewide in California, an integration of the findings here suggests that beaver were native in much of the state, contrary to previous assertions.

Thinking Like a Slow SLO Watershed

Brock Dolman, *Director of the Water Institute, Occidental Arts and Ecology Center*

As the workshop facilitator Brock will expand on his ideas of Conservation Hydrology, which emphasizes the need in many areas for human development designs to move from the drainage to the retain-age. Instead of land use practices that, by design, capture and convey excess volumes of stormwater (discharging this often degraded water off-site), we will discuss LID management ideas on how landowners can slow it, spread it, and sink it on their site. He will then offer a short group breakout design exercise. In the afternoon he will co-lead the hands-on installation of roofwater harvesting gutters in collaboration with the California Conservation Corps and CalPoly.

Restoring Fish Access to Upstream Habitat Workshop and Tour

Thursday, March 24

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

Upstream fish passage improvement projects have been a major component of statewide salmon and steelhead recovery efforts for more than a decade. In this period, fish passage approaches and techniques have progressed substantially. The progression has been in large part through sharing our experiences, which grows our collective knowledge base and results in more effective projects.

This workshop will provide an opportunity for practitioners in the fields of fish passage and stream restoration to once again share experiences and lessons learned through case studies of both current and past projects.

The afternoon portion of the workshop will consist of a field tour of fish passage projects within the San Luis Obispo Creek Watershed. Beginning about a decade ago, actions were taken to restore steelhead passage throughout the watershed. Brian Stark, former director of the Land Conservancy of San Luis Obispo County, will lead a tour to seasoned fish passage project sites implemented by the Land Conservancy, City of San Luis Obispo, and CalTrans. Project types will include a small dam removal, boulder weirs, baffled culverts, and fishways.

Southern Steelhead Trout Restoration in Santa Barbara and Ventura Counties

Mauricio Gomez, Director and Erin Brown, Project Manager, South Coast Habitat Restoration

South Coast Habitat Restoration (SCHR) has been working on southern steelhead trout restoration efforts throughout Santa Barbara and Ventura Counties for a number of years. Two projects in 2010, the removal of a fish passage barrier and a creek bank restoration project, demonstrate their success in identifying projects, working with private property owners, securing project funding, all to voluntarily initiate stream restoration projects.

The Lion Creek project involved the removal of a barrier to steelhead migration to improve access to approximately nine miles of upstream habitat. Lion Creek is a tributary to San Antonio Creek which is a major steelhead tributary to the Ventura River Watershed. The project was a collaboration between private, nonprofit, local, state and federal agencies on private property in Ojai, California. The original low-flow crossing was removed and replaced with an 85 foot bridge which allowed for the regrading and restoration of the stream channel.

The Carpinteria Creek Bank Stabilization and Restoration project took place on a private avocado orchard in Carpinteria, California. The project involved the stabilization of 300 feet of creek bank, located along the mainstem of Carpinteria Creek, the focus of many recent efforts to restore steelhead trout access to the perennial headwaters of Carpinteria Creek. Prior to the project, the creek bank at the site consisted of near vertical banks as a result of the removal of riparian vegetation to make way for the avocado orchard. The banks contributed fine sediments into the watershed and the reach lacked riparian cover and bank stabilizing vegetation.

This presentation will discuss the stages of project development and implementation, as well as lessons learned. The presentation will also present information on other voluntary steelhead trout restoration projects planned for implementation in 2011 and 2012.

South Coast Habitat Restoration, a project of Earth Island Institute, works to restore habitat in Santa Barbara and Ventura Counties.

Sex in the City: Swimming Upstream to Spawn in an Urban Creek

George Johnson, *City of Santa Barbara*

This presentation will highlight some of the difficulties in restoring steelhead access to highly urbanized streams as well as potential solutions. Southern California has numerous urban streams/rivers that have severe fish passage barriers. This has had a negative impact to populations of the southern steelhead trout throughout the region. Mission Creek in the City of Santa Barbara has three significant fish passage barriers in the lower- to mid-watershed. These barriers prevent any adult steelhead trout from migrating upstream to suitable spawning habitat. During the last several years, the City of Santa Barbara, with funding from the California Department of Fish and Game Fisheries Restoration Grant Program, NOAA Open Rivers Initiative, and private foundations (Annenberg), has been working on removal of three keystone barriers on Mission Creek. The barriers include: 1) two concrete trapezoidal channels over one mile long; 2) the Tallant Road Bridge; and 3) the Highway 192 Bridge. During the summer of 2010, the City removed the barrier at the Tallant Road Bridge. The presentation will focus on the removal of the Tallant Road Bridge fish passage barrier as a case study with a discussion of design and construction techniques as well as lessons learned. The presentation will also include a brief discussion on the status and design for removal of the other keystone fish passage barriers at the Caltrans Channels and Highway 192.

Pismo Creek Fish Passage Improvement Project— Pushing the Limits of the Roughened Channel/Ramp Approach to Fish Passage: Implications for Design and Monitoring

John Dvorsky and Matt Weld, Waterways Consulting, Inc.

The Pismo Creek Watershed is a coastal drainage located south of San Luis Obispo, California. Fish passage barriers were evaluated in San Luis Obispo County and published in the San Luis Obispo County Stream Crossing Inventory and Fish Passage Evaluation (Greenspace The Cambria Landtrust, 2005). The Pismo Fish Ladder and Union Pacific Railroad culvert received a high priority rating with the Steelhead Recovery Coalition of the South Central Coast Fish Passage Task Force placing it as the county's third most severe Steelhead passage barrier.

The barrier consists of an eleven-foot elevation change between the Union Pacific Railroad concrete box culvert and the downstream channel. Shallow depths within the culvert itself also limit upstream and downstream fish passage. The site was retrofitted with a series of Denil ladders in the 1970's but maintenance requirements, poor hydraulic conditions, and changes in design criteria produce site conditions that are only passable within a narrow window of flow conditions.

Site constraints and property ownership make this a challenging fish passage barrier to remediate. Our presentation will discuss the design planning process in consideration of these constraints as well as how monitoring requirements influenced the design approach. We will discuss elements of the design, including the hybrid roughened ramp/boulder weir approach. In addition, we will discuss how the desire to conform to regulatory guidance was weighed against the unique site conditions for a roughened ramp design that significantly exceeds length and gradient variance from upstream and downstream conditions.

Fish Passage and Channel Restoration on Five Mile Creek, Klamath County, Oregon: Lessons Learned

Greg Guensch, P.E., CFM, Balance Hydrologics, Inc.

Balance Hydrologics partnered with the U.S. Fish and Wildlife Service and the landowner of Black Drake Ranch in Klamath County, Oregon to implement a stream management plan on Five Mile Creek that would enhance fish passage and aquatic habitat for bull trout, largescale sucker and redband trout. As one part of this initiative, Balance Hydrologics designed and constructed a fish passage/stream restoration project within the ranch on Five Mile Creek, a tributary to the North Fork of the Sprague River. Five Mile Creek is primarily spring fed with a baseflow of approximately 20 cfs, and average channel widths of 15 to 25 feet at the project site. The project reach is located in the lower portion of Five Mile Creek as it passes through a broad, flat, volcanic plain. The project site included a seven foot flashboard diversion dam, where the channel is sinuous and semi-natural upstream of the diversion and straightened/channelized downstream. The design involved excavating a 600 foot long new channel around the diversion using an abandoned channel scar as a basis for the new alignment, and filling the existing straightened channel with the excavated material. A series of 17 riffles was constructed to provide fish passage up the approximately seven foot elevation drop. Some of the challenges encountered during and after construction have included: 1) working in saturated conditions and liquefying soils, 2) low upstream bank elevations relative to the water surface elevation required to operate the irrigation weir at capacity, 3) sealing the cutoff channel completely without access to properly engineered material for the plug and without completely dewatering, 4) passing sediment through the system, and 5) dealing with the potential for extremely low flows. This presentation describes these challenges and discusses how they were overcome. It also explores the implications of these and other site constraints on projects of this type, and offers insights on how to incorporate solutions at the planning and design phase when enabling passage at irrigation diversions—a critical issue throughout the arid West.

If the upper Klamath Basin is made accessible to anadromous fish, this irrigation-diversion passage will open 26 miles of spawning and rearing habitat for salmon and steelhead.

Keywords: bull trout, redband trout, sucker, salmon, salmonid, diversion, pool-riffle, passage, restoration, irrigation-diversion compatibility, Sprague River, Klamath Basin.

Providing Passage for Summer vs. Winter Steelhead over Steamboat Creek Falls, North Fork Umpqua River: Considerations for Selective Passage and Proposed Alternatives

Michael Love, *Engineer, Michael Love & Associates*

Steamboat Creek lies within the Umpqua National Forest and is a major tributary to the North Fork Umpqua River, Oregon. The stream supports large runs of summer and winter steelhead. Steamboat Falls, located on Steamboat Creek, is nearly 25-feet tall. In 1958 a large fully enclosed concrete fishway facility was constructed along the south bank of Steamboat Falls to improve fish passage. Prior to construction, anecdotal evidence and drawings of the fall's historic topography suggests adult steelhead were able to ascend a chute along the south bank of the falls within a very limited range of flows. However, bedrock excavation and construction of the fishway eliminated the potential natural passageway, forcing fish to utilize the new fishway to migrate upstream.

As frequently as every other year the fishway exit becomes severely clogged with debris and sediment during fall and winter high flows and can not be cleaned out and made operable until late spring or early summer, when flows recede to safe levels for maintenance. This is suspected of blocking a portion of the winter and summer steelhead from accessing upstream habitat, and causes large numbers of summer steelhead to congregate and hold in the pool below the falls until the fishway is cleaned out.

The North Umpqua Foundation employed the services of Michael Love and Associates to assess existing and historical fish passage conditions and develop alternatives for improving fish passage at the falls. Besides being susceptible to debris and sediment clogging, the existing fishway was found to be out of compliance with current fish passage criteria at all streamflows. Developed alternatives included numerous modifications to the existing fishway aimed at improving sediment and debris passage, allowing for more regular maintenance at higher flows, and increasing the operational flow range to provide consistent passage for steelhead at flows that occur from late fall through early spring. Other alternatives included modifying the existing bedrock falls to create a "natural-like" passageway.

During development of alternatives, the design objective of providing consistent passage for steelhead during typical winter and early spring flows was questioned. It was suspected that winter steelhead may not have historically been able to ascend the falls to use the upstream habitat, and that improving passage for these fish could be detrimental to the summer steelhead population. Using the historical topography of the falls provided in the 1958 design plans combined with streamflow records from the downstream gaging station, a basic hydraulic analysis of the falls was conducted to provide a sense of the flow range in which steelhead may have been able to ascend the falls. Results suggest that the passage window was limited to flows that most frequently occur during the end of the snowmelt runoff period in late spring and early summer, and during freshets in early fall. During late fall through early spring flows would likely have been too high for steelhead passage, except during the driest years. These findings suggest that habitat upstream of the falls was historically utilized primarily by summer steelhead. As a result, the preferred modifications to the fishway have been refocused on improving passage for summer steelhead rather than both races of steelhead.

Emerging Techniques and Technologies for the Design and Completion of Fish Passage Projects: Examining the Use of 3-D Work Environments and Dynamic Objects for Improving Design, Stakeholder Communication, and Final Construction Drawings

Sydney Temple, P.E., *Principal, Questa Engineering Corporation*

Civil engineering and architectural fields are incorporating recent improvements in 3-D work environments and dynamic objects to design more efficiently and to create life-like renderings for communicating overall project intent. With only minor modifications to these traditional design work-flows, fish passage improvement designers can also benefit from the suite of standard tools incorporated in common 3-D work environments, such as AutoDesk's AutoCAD Civil 3D. Dynamic objects can be used to control key design variables such as channel slope, width, and sinuosity; thus enabling rapid evaluation of design alternatives. Aside from facilitating alternatives analyses, 3-D work environments are capable of overcoming less technical challenges, such as communicating design intent, by providing 3-D renderings that assist engineers, stakeholders, and regulatory officials in understanding and refining project designs. The benefits of 3-D work environments to fish passage improvement projects extend beyond design and project permitting as they are more capable of conveying the subtle nuances of fish passage design and geomorphic processes to those who actually complete the work: contractors. This talk will focus on the overall 3-D design workflow and how particular emerging techniques can be incorporated into fish passage improvement projects to improve design, stakeholder communication, and final construction drawings to improve overall efficiency and project success.

Controlling Road-related Erosion and Sediment Tour

Thursday, March 24

Tour Coordinators*: Danny Hagans, Pacific Watershed Associates (PWA),* ***Steph Wald,*** *Central Coast Salmon Enhancement, and* ***Chris Long****, Colorado State University, ITAM Coordinator*

A full day tour will review a variety of cost-effective erosion control and prevention techniques that have been used to reduce sediment delivery associated with road systems, so as to improve aquatic habitat conditions and lower long-term road maintenance costs. The emphasis will be on road upgrading techniques that reduce hydrologic connectivity, gully stabilization and various storm-proofing techniques for stream crossings, with some discussion of road decommissioning techniques.

Prior to the field visits, a workshop presentation utilizing time-lapse photography sequences will illustrate many of the actual construction techniques and challenges associated with upgrading and decommissioning stream crossings, installing armored fill crossings, outsloping roads, constructing rolling dips, etc..

The field tour will visit the Froom Creek watershed which is a tributary to San Luis Obispo Creek, and will tour the California National Guard Camp SLO training lands in the upper Chorro and Dairy Creek watersheds. This erosion control program is the most comprehensive upland water quality protection effort occurring throughout central and southern California projects.

Mountains to Sea Santa Rosa Creek Tour: A Myriad of Instream Restoration Projects

Thursday, March 24

Tour Coordinators*: Meredith Hardy, California Conservation Corps; Dave Highland, California Department of Fish & Game; and Ben Boer, Cambria Community Services District*

Come join us on a meandering jaunt and soak in some Central Coast flavor on one of San Luis Obispo County's northern-most steelhead creeks. From the headwaters in the Santa Lucia Mountains down 16 river miles to the Pacific Ocean the tour will unravel the mysteries of the Santa Rosa Creek Watershed. Past will meet present on restoration tour stops where differing techniques may be evaluated. Meet the barrier that won't go away. Meet the collaborators that have taken this beautiful creek under their fin in an effort to bring back the large runs of steelhead that once were.

Morro Bay Watershed Headwaters to Mouth Tour: Restoration at a Watershed Scale

Thursday, March 24

Tour Coordinators*: Jon Hall and Anna Halligan, Morro Bay National Estuary Program*

Morro Bay is one of 28 estuaries recognized by the EPA as nationally significant. Its watershed encompasses a variety of ecological habitats as well as rare plants and animals. The Morro Bay National Estuary Program is a non-profit that focuses on protecting important habitats within the Morro Bay watershed. It accomplishes this through understanding current habitat and water quality conditions, through research and monitoring, habitat restoration, and through community education and volunteer programs.

The Morro Bay tour will stop at several restoration projects, beginning in the headwaters of Chorro Valley, and concluding at a lookout of the estuary and watershed for final discussion and questions. Each stop will address different restoration techniques that target improving steelhead habitat and water quality. These techniques include, ranch road restoration, fish passage design, riparian fencing and native plant restoration, bioengineering techniques, instream structures, and floodplain restoration.

On this tour MBNEP staff will guide the group from the headwaters of the Chorro Valley watershed, located on Camp San Luis Obispo, through the watershed stopping in 4-5 locations, including Camp SLO to see ranch road restoration completed by Camp SLO and Pacific Watershed Associates. The second stop will be at Pennington Creek where two fish passage projects have been implemented, as well as a small bank stabilization project. The third stop will be on Cal Poly rangeland focusing on floodplain restoration, riparian fencing, bioengineering and instream structures. The group will meet Cal Poly range manager, Aaron Lazanoff, who will discuss how to manage cattle using sustainable methods. And, MBNEP's Annie Gillespie will join the group to talk about water quality monitoring that is correlated to restoration efforts.

The fourth stop will be at the Coastal San Luis Resource Conservation District's (CSLRCD) Chorro Flats floodplain restoration project. This project was implemented to catch sediment before it enters the estuary, and has been widely accepted as a success. Here the group will meet Julie Thomas of the CSLRCD to discuss land acquisition and restoration topics. The tour will commence after a brief hike up Black Hill, where tour attendees can view the watershed, estuary, and bay. In this location MBNEP staff can answer questions as well as discuss future restoration efforts within the bay and watershed.

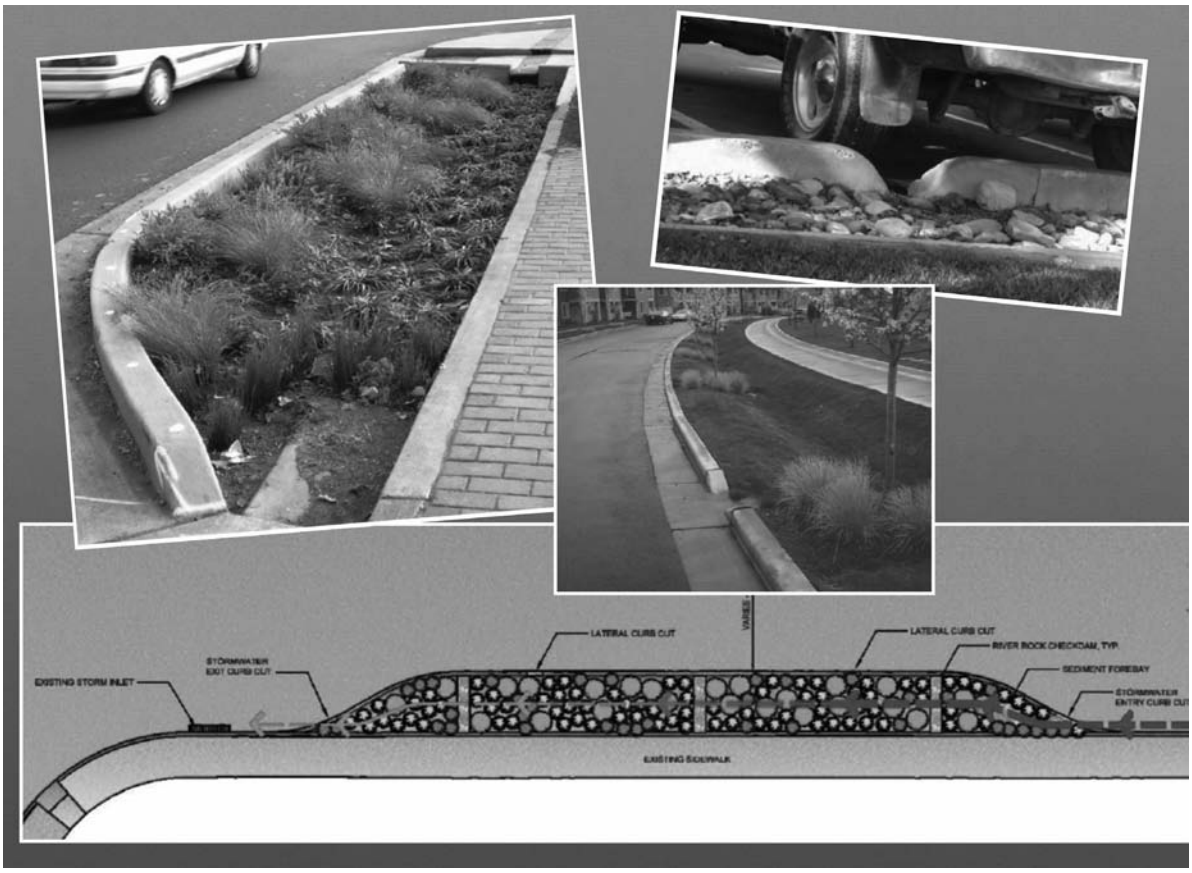
Workshop Coordinators*: Cheryl Lenhardt, PE, CEO of Lenhardt Engineering, Inc. and* **Nicole Smith,** *Coastal San Luis Resource Conservation District*

This workshop will address a variety of timely stormwater topics including the evolution of stormwater policies, implementation of stormwater regulations, Low Impact Development concepts and concerns, volunteer sampling and monitoring programs, and storm water issues from a watershed perspective.

Stormwater runoff refers to the rainfall and snowmelt washed off our roads, driveways, and parking lots. This water is full of toxic metals, oil, grease, pesticides, herbicides, sediment, bacteria and nutrients. All of this untreated water carrying pollutants eventually reaches local rivers and oceans, affecting salmonids and their habitat.

Polluted runoff is now widely recognized by environmental scientists and the EPA as the single largest threat to water quality in the United States. Stormwater pollution prevention programs are considered "unfunded mandates" by municipalities or those who are implementing them since they are required programs from the regulatory agencies. This makes it challenging to address water quality and pollution problems because there is typically no general funding or user fees to help offset costs for these programs.

The California Regional Water Quality Control Board is addressing stormwater issues through a variety of programs—many of which have evolved significantly from their previous iterations. This workshop will elaborate on the tie between regulation and receiving water benefits. Contributors include regulators, field practioners, planners, biologists, and engineers. Come to this workshop to learn what's new, why it matters and how you can effect change.



What IS the Problem?

Susan Litteral, *Engineer, Natural Resources Conservation Service, USDA*

Whiskey is for drinking and water is for fighting is an old cliché. What is the truth of this phrase in California? Do water issues have to lead to a bar-room brawl or can we have a lively conversation in a social drinking situation?

Hydraulic flow regimes in California have been significantly altered. The Spanish missionaries, the '49 gold-rush miners and the modern engineers have all contributed to the current conditions. Based on this historic framework I will give an overview of our current issues with water supply, flood control and water quality.

What are the consequences of these changes and what options are available to reverse or minimize these impacts? The current alphabet soup of CWA, NPDES, WDR, LID, LEED, and BMPs are all efforts to help address these issues. How do these integrate into a cohesive plan? Is there hope for a reversal of 250 years of impacts? Can we deliver a menu of mixed drinks that satisfies everyone's tastes and keeps them in the conversation?

Water Quality Permitting: Compliance with Construction, Industrial, and Municipal General Permits

David Innis, *Regional Water Quality Control Board*

Since the 1980s, EPA and the State Water Resources Control Board have implemented regulatory authority to restrict the input of pollutants in stormwater running off industrial facilities, construction sites, and impervious urban developments into municipal storm sewers, creeks, and streams. More recently, the State Board and the Central Coast Water Board adopted new regulations and embarked on new specific programs and initiatives for the protection of aquatic habitats. Our efforts include new regulations for construction projects and industrial facilities, expanded authority to regulate urban pollution sources employing municipal Storm Water Management Programs, Total Daily Maximum Loads (TMDLs), Clean Water Act Section 401 Water Quality Certifications, a new Joint Effort for Hydromodification Control and Low Impact Development Initiative, and a variety of grants for non-point source pollution. These recent changes complement our continued oversight of stormwater runoff and our efforts to expand the cooperative program to limit pollutants in discharges from agricultural activities. We wrap everything into our long-term perspective to promote our vision of Healthy Watersheds.

Effective beginning July 1, 2010, the General Construction Permit[1] requires risk assessments for all projects disturbing one acre or more. Risk includes projects with potential to discharge to sensitive water bodies based on CWA 303(d) listed impairments and beneficial uses specific to salmonid habitats. Everything is tracked in the new on-line Storm Water Multiple Application and Report Tracking System—SMARTS[2].

Over the past two years we've enrolled over 38 municipalities, universities, and military bases in the Municipal Storm Water Permitting Program Each municipality develops and implements a Storm Water Management Plan/Program (SWMP) to reduce the discharge of pollutants to the maximum extent practicable (MEP).

Specific to reducing the rate and volume of run-off from newly completed development and redevelopment projects, the Central Coast Water Board has begun the two-year Joint Effort for Hydromodification Control[3]. This project is a key step in the Central Coast Water Board's progressive, stepwise process to achieve healthy watersheds.

Wider ranging sources of pollution are regulated through the Total Maximum Daily Load program that we implement through Municipal permits. We also re-defined areas of impairment through the Central Coast Ambient Monitoring Plan (CCAMP)[4] including southern steelhead critical habitat. This has expanded the 303(d) list[5] and prospect to develop more TMDLs.

Over the past five years, the Central Coast Water Board has also implemented the Agricultural Regulatory Program that regulates discharges from irrigated agricultural lands. Both the urban and agriculture communities are working to reduce inputs and apply new sustainable practices.

Stormwater, Joint Effort, 401, TMDL and Ag regulatory efforts are part of the Central Coast Water Board's vision to achieve Healthy Watersheds[6] and tangible water quality improvements. Our vision focuses on healthy aquatic habitats, proper land management, and clean groundwater. The performance measures complementing these General Permits, TMDLs, and Agricultural Regulatory Program provide the basis for the Central Coast Water Board efforts to protect the beneficial uses and water quality objectives that support healthy watersheds and salmonid habitats.

1 http://www.swrcb.ca.gov/water_issues/programs/stormwater/construction.shtml
2 https://smarts.waterboards.ca.gov/smarts/faces/SwSmartsLogin.jsp
3 http://www.swrcb.ca.gov/rwqcb3/water_issues/programs/stormwater/
4 http://www.ccamp.org/ (see CCAMP Data Browser)
5 http://www.swrcb.ca.gov/rwqcb3/water_issues/programs/tmdl/303d_list.shtml
6 http://www.waterboards.ca.gov/centralcoast/board_info/agendas/2009/jun/item3/item3_June_stf_rpt.pdf

Complying with a Municipal Stormwater Management Plan

Freddy Otte, *City Biologist and Stormwater Coordinator, City of San Luis Obispo*

The City of SLO and other small Municipal Separate Storm Sewer System (MS4s) have been enrolled in the State Water Resources Control Board's (SWRCB) program mandated by the EPA to improve stormwater quality and restoring a more natural peak flow cycle. By implementing 160 of 276 different BMP's (Best Management Practices), the efforts to prevent pollution (trash, chemicals, and sediment) from entering the creek were largely successful. Over 400 tons of trash and debris have been removed during the two years the City has been working on this program and as time goes on and the public becomes more educated on what we are doing and why, hopefully their attitudes and actions will change to align with our efforts in controlling stormwater pollution. Construction sites, storm drain cleaning, creek clean-up activities and education on "green" alternatives to how things have been historically done are the key elements of the City's SWMP (Stormwater Management Plan). With an effectiveness monitoring component built into the program, there is an opportunity to annually look at the program and constructively look for ways to comply with the permit conditions without having to re-evaluate the entire program. The permit is slated to cover five years but based on the results from the annual reporting, this is a program that will likely become mandatory from here on out. Collaboration is the key to success based on the economy and the requirements put forth in the SWMP's and SLO County has taken steps to achieve this. The LID (Low Impact Development) component will have the biggest impact on how development further modifies stormwater runoff from sites through innovative ways to retain stormwater, filter stormwater through bioswales, and reduce the rate at which stormwater enters a waterway. The recent methodology was to "transport stormwater off the site as quickly as possible" so efforts to shift that thinking are being implemented at an accelerated rate along with new construction practices and requirements to determine where the majority of pollution is coming from today.

Vegetated Biofilters in Agricultural, Residential, and Urban Settings: Benefits and Regulatory Constraints

LynneDee Althouse, *Principal Scientist, Althouse and Meade, Inc.*

Plant material, alive and dead, reduces pollutant discharge to streams as it contacts flowing water. This positive effect of vegetation on water quality is called biofiltration. Live vegetation absorbs dissolved ions while decaying biomass provides habitat for beneficial microorganisms that utilize some pollutants as an energy or nutrient source. In addition, plant material physically reduces suspended sediment loads by reducing water flow velocity, allowing solids to settle out.

Vegetation buffers the effects of wind and water erosion, while reducing pollutant loads that reach waterways. Biofilters can be used adjacent to agricultural fields, in residential developments, and in urban areas to reduce adverse impacts of human land use practices on water quality. Vegetated buffer strips, vegetated swales, bioswales, filter strips, wetland filters, cover crops, and infiltration basins are types of biofilters that are recommended by the U.S. Environmental Protection Agency, Natural Resources Conservation Service, and state resource protection agencies. Before implementation of biofilter practices, land managers need to consider potential regulatory constraints associated with waterway protection. For example, in California, the Department of Fish and Game regulates activities that may alter riparian zones, vegetation associated with a drainage, under their 1600 code. If biofilter construction required removal of willows, or cottonwood trees, a permit may be required from the Department of Fish and Game. The U.S. Army Corps of Engineers regulates dry and wet channels that contain an ordinary high water mark (Clean Water Act section 404). The Regional Water Quality Control Board regulates discharges to state waterways through the Clean Water Act (section 401), the Porter Cologne Act, and the National Pollutant Discharge Elimination Act. Thus, any action that affects a waterway and its associated vegetation may be regulated—a permit may be required, depending on proposed direct effects to the regulated wetland, stream, ephemeral drainage, river, pond, or lake.

Morro Bay First Flush Monitoring Results in Data Driven Public Awareness

Annie Gillespie (Presenter) and Ann Kitajima, Morro Bay National Estuary Program

The Morro Bay Volunteer Monitoring Program kicked off a "First Flush" urban stormwater runoff monitoring in the early hours of October 17, 2005. Modeled after the highly successful program in Monterey Bay, program volunteers rushed to collect samples of the first slug of urban stormwater runoff following the long summer dry season. Initial laboratory results were both eye-opening, and 'awe-inspiring'. Analysis revealed high concentrations of dissolved zinc and copper, elevated concentrations of oil and grease, and disturbing concentrations of *E. coli* fecal indicator bacteria. A broad wave of media attention fueled public interest in the monitoring activity and resulting data. The effort caught the ears and attention of staff across multiple public and private sector agencies. The success of the monitoring and the enthusiastic public response sparked an expansion of the program, which wrapped up in 2009.

Multiple seasons of First Flush monitoring revealed that constituents of concern are highly variable over short timescales and across relatively small landscapes. Although the monitoring did not reveal statistically significant trends, awareness of stormwater pollution and the 'First Flush' phenomenon has grown by magnitudes. The use of First Flush data as a public awareness tool has been an unexpected, but highly valuable, benefit of the monitoring program.

The North Coast Stormwater Coalition's Non-Point Source Pollution Prevention Program: Program Elements, Successes and Lessons Learned with Small Local MS4s

Natalie Arroyo, *Redwood Community Action Agency*

The North Coast Stormwater Coalition (NCSC) is a community coalition currently comprised of staff from Humboldt and Mendocino County cities and municipalities, local non-profits, interested consultants and community members. In 2006, the Coalition partnered with Redwood Community Action Agency's Natural Resources Services Division (NRS) to propose a comprehensive non-point source pollution prevention program, with a wide range of goals and methods to address stormwater needs in our relatively rural, spread-out communities. While NRS was the applicant, the implementation is being conducted by a partnership consisting of NRS, the City of Eureka, City of Fortuna, City of Arcata, and the County of Humboldt, representing the unincorporated communities of McKinleyville and Shelter Cove. The CA State Water Resources Control Board provided Prop. 50 funds to conduct the following:

- Work with the partnering cities/ municipalities to fulfill unmet needs in their SWMPs, including increased presence and outreach to local businesses, stormwater management database tracking software and training, and an Illicit Discharge Detection and Elimination Program
- Hold five Stormwater BMP Workshops to address topics for the following industries/ activities: Construction, Automotive/ Trucking Facilities, Landscaping/ Gardening/ Nurseries, Cement Contractors/ Permeable Pavement, and Restaurants
- Stormwater quality public outreach and education (including cigarette butt receptacles, dog waste disposal stations, interpretive signage, bus board ads, posters, magnets and many more)
- Install stormwater filters at key storm drain locations within the project area
- Create a website and regional hotline for the NCSC (*www.humboldtstormwater.org*)
- Retrofit a former dam site on Jolly Giant Creek in Arcata to reduce sediment impacts in that watershed
- Create an Low Impact Development (LID) Strategy, identifying one site per municipality (five sites) where LID features could be used, and develop conceptual-level plans for each site

This presentation will entail a brief overview of the program's elements, with a focus on addressing or answering the following:

- Highlights will be presented in an engaging, photo-driven manner
- Outreach and education materials created by this program will be presented and if desired, the templates for these can be shared with attendees
- What program elements are the most unique? What regional challenges made this program different from other stormwater programs?
- What was the most successful or effective? How can this be replicated in other communities?
- What aspects of this program were the most challenging, and how can the functionality of these stormwater management elements be improved?

Developing Safe Harbor Agreements

LynneDee Althouse, Principal Scientist, Althouse and Meade, Inc.

Agricultural operations may establish or maintain habitat for endangered species while they maintain legal protection regarding accidental "take" (harming, harassing, or killing) through use of a federal Safe Harbor Agreement. The U.S. Fish and Wildlife Service (USFWS) established a process to collaborate with private property owners in order to protect endangered species that do or may occupy habitat in or near agricultural operations. The collaborative agreement is considered an "enhancement of survival" permit by the USFWS and authorizes incidental take to the permittee who offers to protect and enhance habitat for a covered species. The Safe Harbor process involves baseline studies to assess habitat quality and local populations of endangered species proposed to be included in the agreement. The agreement includes agreed upon baseline conditions for each of the covered species within the enrolled property. Management actions are identified that accomplish the expected net conservation benefits to the species and the agreed upon timeframes for these management actions to remain in effect. A description of potential incidental take is included in the agreement, as well as an opportunity for the USFWS to rescue covered species upon termination of the Agreement.

The USFWS must comply with all applicable Endangered Species Act (ESA) provisions before completion of the Safe Harbor Agreement. They conduct an internal ESA Section 7 review followed by a public comment period. If the project is found to comply with the ESA, the USFWS issues an ESA Section 10(a)(1)(A) permit. The final agreement allows the permittee to return the property to its baseline conditions at the end of the agreement.

This presentation will briefly cover the difference between a Habitat Conservation Plan, a Biological Opinion, and a Safe Harbor Agreement. Different permitting processes and proposed landuse practices affect the USFWS's determination regarding the appropriate ESA tool to authorize incidental take of a listed species.

An Integrated Watershed-based Approach to Stormwater Management

Lynn Rodriguez, Watersheds Coalition of Ventura County

Stakeholders in Ventura County are working together to resolve water management challenges and protect and restore local ecosystems as part of the Integrated Regional Water Management Program (IRWMP) established in 2004 following passage of Proposition 50. Under the umbrella of the Watersheds Coalition of Ventura County (WCVC), three watershed committees meet regularly to address a variety of resource management strategies contained in the 2006 WCVC IRWM Plan which was adopted by over 34 local entities. The objectives of the Plan include: protecting and improving water quality; protecting and restoring ecosystems; protecting people, property and the environment from adverse flooding impacts; reducing dependence on imported water; protecting, conserving and augmenting water supplies; and providing water-related recreational, public access and educational opportunities.

Stormwater management and prevention of polluted runoff are significant elements of the IRWM Plan and implementation program. The stakeholder-driven watershed committees within each of the three major watersheds (Ventura River, Santa Clara River and Calleguas Creek) throughout the WCVC region have identified and begun implementing projects that reduce runoff and capture and treat stormwater flows. This effort is being conducted in conjunction with implementation of the County's Municipal Stormwater Permit (MS4), which was recently adopted by the Los Angeles Regional Water Quality Control Board.

The stakeholders engaged in this process in each local watershed are: cities; County agencies such as the Watershed Protection District, Resource Management Agency and County Executive Office; sanitation districts, water agencies, and agricultural entities; business organizations; non-governmental and environmental organizations; citizens and citizen groups; and others. The WCVC coordinates its efforts with other existing groups that address stormwater management and pollution prevention, such as the volunteer water quality monitoring efforts of Santa Barbara Channelkeeper and Ventura Coastkeeper; the Ventura Countywide Stormwater Quality Management Program, the City County Planning Association; and the stakeholder advisory group formed as part of the Regional Water Quality Control Board- funded study "Aligning Land Use and Water Quality Protection in Ventura County".

Local cities and water agencies have adopted landscape ordinances, development conditions and mitigation measures which promote or require low impact development (LID) and maximum retention of water on-site. Similar requirements are contained in the MS4 Permit for Ventura County and are addressed in the Technical Guidance Manual guiding implementation of best management practices in the County.

The success of local integrated efforts to manage stormwater and reduce runoff-related pollution to local surface and groundwaters, depends on engagement of all stakeholders, communication and collaboration on solutions and projects and an ongoing education in the community. All stakeholders need to understand the role they play in managing stormwater and which practices they can implement. Using a watershed-based approach is cost effective, provides broad benefits and eliminates duplication of effort.

This session will address how to integrate stormwater management, pollution prevention and other water management strategies using a watershed-based approach. Examples will be provided from experiences in Ventura County, including the Watershed University Program, and the ongoing efforts of the Watersheds Coalition of Ventura County.

SRF Annual Meeting and Thursday Evening Film Social

Thursday, March 24

Come attend the SRF Annual Meeting and meet Board members, hear a review of SRF's projects and trainings in 2010, and our plans and educational trainings in 2011 including the Fish Passage Field School, Spring-run Chinook Symposium, and the Coho Confab.

STRAW: Students and Teachers Restoring A Watershed

STRAW: Students and Teachers Restoring A Watershed. chronicles the growth of STRAW from its origins in 1992 as a fourth grade class project to restore the California freshwater shrimp into a larger project spanning the San Francisco North Bay that has allowed students to restore over 20 miles of the local creeks. In the process, the STRAW program has galvanized community and led to significant educational innovations by connecting kids with their local watersheds. Come and see how a student-driven environmental restoration project can transform both a watershed AND a community.

Damolition

This documentary, produced by Matt Stoecker is about the demolition of Horse Creek Dam on the Sisquoc River. The dam was a migration barrier to southern steelhead and other species in this northern Santa Barbara County watershed. Following detailed studies of the dam, accumulated sediment, hydrology, and biological characteristics, a collaborative working group identified several alternatives for removing the dam. The group ultimately agreed that the remote and relatively small Horse Creek Dam offered a unique opportunity for using explosives to effectively remove the dam with minimal disturbance to the surrounding area and downstream environment. In October 2006, a diverse group of stakeholders spent two days camping near the dam and preparing it with explosives that blew concrete sky high, opening more than 19 miles of historic steelhead habitat and improve stream flows.

Watershed Revolution

Rich Reid's documentary *Watershed Revolution* asks the question "What is a Watershed?" The answer is explored through interviews with concerned citizens working to protect and preserve the Ventura River watershed while stunning high definition cinematography highlights the beauty of the river. The unique challenges faced by a river that is the sole source of water for a thirsty community are brought to life and will change forever your definition of a watershed.

Watershed Revolution is a 30-minute film that profiles community members and organizations working to protect and restore this watershed. It highlights the need for open space and floodplain protection, sustainable agriculture, and community awareness of our most precious resource: water.

Towards "Ecosystem-based Management"—A Case Study: Ventura River, California

Paul Jenkin, *Surfrider Foundation and Matilija Coalition*

What is Ecosystem-based Management (EBM) and how does it apply to salmonid restoration?

The Ventura River bioregion is increasingly stressed by urban pressures and fragmented management. This is manifested in conflicts over water supply, precipitous decline in anadromous fisheries, flood damages, loss of habitat, beach erosion, and degraded surface and coastal water quality.

The 2004 Joint Ocean Commission report identified the need for coordinated management of coastal resources. Progress within the Ventura River watershed has led to the pending implementation of two precedent-setting projects; Matilija Dam removal and Surfers' Point beach restoration. Increased attention on the watershed and emerging planning processes may provide significant opportunities for integrated Ecosystem-based Management (EBM). However, to be effective, watershed-based planning needs to incorporate all levels of government and community. Making the linkages between land use, water supply, and water quality, and demonstrating the benefits of multi-purpose projects is a timely and critical issue.

Integrating watershed EBM goals into local policy may best be realized through pilot projects that demonstrate the value of an integrated approach. This presentation outlines ongoing efforts to implement a vision for sustainable coastal management through a holistic set of demonstration projects including the Surfers' Point Managed Shoreline Retreat project, the Matilija Dam Ecosystem Restoration Project, Urban Watershed Management, and Integrated Watershed Management Planning. Lessons learned in the Ventura River watershed are relevant to all coastal communities.

Restoration of Habitat Capacity for Salmon Populations

Thomas Williams, Ph.D., National Marine Fisheries Service, Southwest Fisheries Science Center

Restoration of habitat for Pacific salmon and steelhead requires restoration of ecological processes and dynamics Natural processes result in a range and diversity of habitat conditions that allow for the expression of life history diversity. Anthropogenic modification of these processes through various land-use and development activities have simplified habitats thereby constraining the opportunities for the expression of a diversity of life histories. Contemporary snapshots of population behaviors and dynamics in highly modified systems can lead to erroneous conclusions regarding which habitat restoration actions might be most beneficial to the long-term persistence of these fish populations. Restoration of ecological processes built upon a conceptual foundation informed by historical conditions and current constraints is needed to move forward towards restoring resilient stream systems and fish populations.

Stream Restoration, Beaver and the Ephemeral Nature of Existence

Michael Pollock, Ph.D., NOAA Fisheries, Northwest Fisheries Science Center

The Pacific Northwest has become an epicenter of stream restoration efforts, primarily for the purpose of improving salmon habitat. While there are myriad restoration techniques, the goal of many projects is to convert simplified stream habitat into complex stream habitat. This is often achieved by adding physical structure to streams and by increasing planform complexity. While "complexity" is challenging to quantify, restored habitats often have a more varied and higher density of instream habitat types, and increased interactions with both floodplains and alluvial aquifers. A simple technique for restoring salmon habitat that has been growing in popularity has been to reintroduce beaver to suitable habitat. Beaver were once widespread throughout North America, including most of California. The dams beaver build result in dramatic hydrologic and geomorphic changes to stream and riparian habitat that generally benefit salmon. I discuss the basic principles of stream restoration in terms of the expected physical changes that are likely to occur when structure is placed in streams, using beaver dams as an example, and how an understanding of the four-dimensional nature of stream habitat can help to design multi-functional restoration projects that persist through time.

A View on the 112th Congress

Congresswoman Lois Capps, 23rd District of CA

The Congresswoman will provide insight into the U.S. Congress's current term, with a focus on prospects for environmental legislation and funding opportunities for endangered species and habitat restoration. She will highlight some priority projects in her district aimed at improving habitat for salmonid species.

Water Temperature Evaluation for Anadromous Fish in the Lower San Joaquin River and its Tributaries

Andrew G. Gordus, Ph.D., *California Department of Fish and Game*

The California Department of Fish and Game (CDFG) monitored water temperatures in the lower San Joaquin River and its three east-side tributaries, the Merced, Stanislaus and Tuolumne Rivers to evaluate whether or not cold water beneficial uses for critical life stages of Chinook salmon (*Oncorhynchus tshawytscha)* and steelhead (*Oncorhynchus mykiss*) were being met. Critical life stages for Chinook salmon include adult migration, egg incubation, smoltification, and smolt migration, and for steelhead, summer rearing. CDFG used the United States Environmental Protection Agency's (EPA Region 10) (2003), Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards that utilize criteria comprised of a seven day average of the daily maximum water temperature (7DADM). Criteria for adult fall-run Chinook salmon migration is 18° C, for spawning/egg incubation is 13° C, for smoltification is 15° C, for smolt outmigration is 18° C and for steelhead rainbow trout summer rearing season temperatures is 18° C. The EPA's temperature criteria presented above is a chronic threshold designed to protect a population of anadromous fish across multiple generations.

Water temperatures, for the period of study, in all four river systems were too warm for anadromous fish during all of their life stages. Elevated water temperatures can cause premature adult mortality as adults migrate into the river system to spawn (i.e. pre-spawn mortality); cause reduced egg viability for eggs deposited in redds; and reduce smolt out-migration survival as smolts leave the nursery grounds and migrate through the eastern tributaries and San Joaquin River to the Delta. Secondary effects occur as well, especially in predator-rich systems like Central Valley rivers. As thermal optima for anadromous fish are exceeded at temperatures above 18°C, major predators are just entering their thermal optima. As such, salmon and trout become more vulnerable to predation. The results also indicated that during wet years water temperatures were cooler overall, especially on the tributaries, which is indicative that increased water flows provide cooler water temperatures during each season, and provide more suitable habitat for longer lengths of the reach.

The San Joaquin Basin Chinook salmon stocks are the southern most population in this species historical range. Throughout the historic inland range of the Chinook salmon and steelhead, their primary water source was from snow melt streams and rivers. Another major source of cold water was from ground water flows, seeps or springs. Cool water temperatures were also maintained by shade produced from trees and vegetation within the riparian zones. Today, cold snow melt water is blocked and stored by dams; and ground water pumping within the San Joaquin River Basin has diminished subsurface flows to the rivers. Today, natural water flow regimes which these fish evolved with no longer exist, resulting in the extirpation of three salmon races and the serious decline of the last remaining fall-run Chinook salmon population to the point where listing as an endangered species may now be warranted. Without changes in the flow regime and water temperatures, populations of all anadromous fish will continue to decline and remain potentially at risk of extinction.

Effect of Elevated Water Temperature on Juvenile Klamath River Basin Chinook Salmon Growth, Immune Function, and Smoltification

J. Scott Foott, *U.S. Fish & Wildlife Service, California-Nevada Fish Health Center*

Juvenile Klamath River basin Chinook salmon typically experience water temperatures > 20° C during the spring and summer. Several trends observed in diurnal fluctuation experiments representative of summer conditions will be discussed. First, salmon show an acclimation response (stress, immune function, bioenergetics) to elevated temperature and can return to a state similar to control fish. While gill Na-K-ATPase activity, shows depression at higher temperatures, activity is quite plastic and does not reflect saltwater adaptation capacity. Various immune parameters show considerable variation in fish reared at elevated temperatures without overt immunosuppression. Replication rate of fish pathogens at elevated temperature may play a greater role in disease during the summer than impaired immune function. Data from a series of laboratory studies will be contrasted with observations of field collections.

Modeling Stream Temperatures Using High-resolution Satellite-derived Numerical Weather Forecasts: Application to the Sacramento River, California

Andrew Pike (Presenter), Eric Danner, *and* ***Steve Lindley,*** *National Marine Fisheries Service, Southwest Fisheries Science Center, Santa Cruz, CA;* ***Forrest Melton, Ramakrishna Nemani,*** *and* ***Hirofumi Hashimoto,*** *NASA Ames Research Center, Moffet Field, CA, USA*

In the Central Valley of California, river water temperature is a critical indicator of habitat quality for endangered salmonid species and affects re-licensing of major water projects and dam operations worth billions of dollars. Consequently, there is considerable interest in modeling water temperature dynamics in such regulated rivers. However, the accuracy of current stream temperature models is limited by the lack of spatially detailed meteorological forecasts, and few models quantify error due to uncertainty in model inputs. To address these issues, we developed a high-resolution deterministic 1-dimensional stream temperature model (sub-hourly time step, sub-kilometer spatial resolution) in a state-space framework, and applied this model to Upper Sacramento River. Our model has the capability to both hindcast and forecast water temperatures, utilizing real-time meteorological forecasts.

The model uses physically-based heat budgets to calculate the rate of heat transfer to/from the river. We consider heat transfer at the air-water interface using atmospheric variables provided by the TOPS-WRF (Terrestrial Observation and Prediction System—Weather Research and Forecasting) model—a high-resolution assimilation of satellite-derived meteorological observations and numerical weather simulations—as inputs. The TOPS-WRF framework allows us to improve the spatial and temporal resolution of stream temperature predictions. The hydrodynamics of the river (flow velocity and channel geometry) are characterized using densely-spaced channel cross-sections and flow data.

Water temperatures are calculated by considering the hydrologic and thermal characteristics of the river and solving the advection-diffusion equation for heat transport in a mixed Eulerian-Lagrangian framework. We recast the advection-diffusion equation into a state-space formulation, which linearizes the highly non-linear numerical system for rapid calculation using finite-difference techniques. We then implement a Kalman filter to assimilate measurement data from a series of five temperature gages in our study region. This data assimilation technique greatly improves model accuracy, prevents model drift, and effectively assesses the error and uncertainty of our model predictions.

Modeled hindcasted temperatures for several test periods (May—November 2008, 2009, and 2010) substantially improve upon the existing daily-to-monthly mean temperature standards. Modeled values closely approximate both the magnitude and the phase of measured water temperatures. Our model results reveal important longitudinal patterns in diel temperature variation that are unique to regulated rivers, and may be critical to salmon habitat. Additionally, we can provide real-time 72 stream temperature forecasts. Ultimately, end users will be able to access the forecast model online, run various scenarios of water discharge and temperature under forecasted weather conditions (3-5 days, and seasonal), and inform decisions about water releases to maintain optimal temperatures for fishery health.

Improved Water Temperature Models for Water Allocation Decisions in the Central Valley

Eric Danner, Ph.D. (Presenter), Andrew Pike, Ph.D., *and* ***Steve Lindley, Ph.D.,*** *National Marine Fisheries Service, Fisheries Ecology Division, Southwest Fisheries Science Center;* ***Kirstin Holsman, Ph.D.,*** *National Marine Fisheries Service, Northwest Fisheries Science Center;* ***Forrest Melton*** *and* ***Ramakrishna Nemani, Ph.D.,*** *NASA Ames Research Center, Moffett Field, CA; and* ***Balaji Rajagopalan, Ph.D.,*** *University of Colorado, Boulder, CO*

When making decisions about water allocations, state and federal water project managers must consider the short-term and long-term needs of agriculture, urban users, hydroelectric production, and flood control. They are also required by the Endangered Species Act (ESA) to make sure their decisions do not jeopardize the continued existence of any endangered or threatened species. The National Marine Fisheries Service (NMFS) evaluates water project impacts on threatened and endangered salmonids and provides a decision on these impacts by issuing a Biological Opinion.

On the Sacramento River in northern California, the current decision support tools used in water allocation decisions are based on temperature models that operate on monthly or weekly time steps at individual compliance points along the river. Temperatures at these scales cannot take into account the spatiotemporal temperature dynamics, such as diurnal fluctuations, that can be critical to salmonid survival.

Generating stream temperature estimates in near real time, at fine spatiotemporal scales, and over large geographic areas is problematic using existing modeling approaches. We use high resolution environmental data from the Ecological Forecasting team at NASA as inputs into a state-space heat budget model to produce high resolution stream temperature estimates for the upper Sacramento River. Our model includes nowcasting and forecasting capabilities that provide stream temperature estimates for every 1km of stream reach at 15-minute intervals. These results are made available to fisheries managers and water project managers through an interactive web site.

Climate Change Adaptations to Prevent Loss of Aquatic Ecosystem Services: Case Study for Spring-run Chinook Salmon in Butte Creek, California

Lisa C. Thompson (Presenter), Peter B. Moyle, *and* ***Chris Mosser,*** *University of California Davis, Davis, CA;* ***David Purkey****, Stockholm Environment Institute, Davis, CA,* ***Marisa Escobar,*** *Stockholm Environment Institute, Davis, CA; and* ***David Yates,*** *National Center for Atmospheric Research, Boulder, CO*

Spring-run Chinook salmon (*Oncorhynchus tshawytscha*) are particularly vulnerable to climate change because adults reside in freshwater for the summer before spawning in autumn. We hypothesized that climate-induced flow and temperature changes will lead to critical reductions in the persistence of spring-run Chinook salmon. Our objective was to determine streamflow and temperature regimes that would lead to long-term reductions in spring-run Chinook salmon in a California stream and evaluate management adaptations to ameliorate these impacts. We assembled an analytical framework, coupling climate data with watershed hydrology and salmon population dynamics models. We used WEAP, an integrated watershed hydrology, water management, and temperature model, to simulate weekly mean streamflow and temperature in Butte Creek, California. WEAP outputs drove SALMOD, a spatially explicit and size/stage structured model that predicts population dynamics of salmon in freshwater systems. We calibrated and validated WEAP to historical observed summer streamflow, and temperatures for 1995-2005 and 1986-1995, respectively. We calibrated SALMOD to adult salmon summer mortality from 2001–2008. Both models adequately fit historical data, and together with climate data, constitute a framework able to predict streamflow- and temperature-related mortality of spring-run Chinook salmon, and to evaluate water management adaptations to ameliorate negative climate impacts on fish in current or future scenarios. We then used this framework to make predictions through the century, taking climate change into account. We used bias-corrected and spatially down-scaled climate data from six General Circulation Models and two emission scenarios for the period 2010—2099, to run two linked models, and generated a range of future outcomes. WEAP predicted that summer base flows were lower, and water temperatures were higher for both climate scenarios vs. historical conditions. SALMOD predicted increased summer thermal mortality of adult salmon; the population was predicted to decline for all climate scenarios and model combinations. We tested three management adaptations: (1) Cease diversion of water for power production, (2) Store cold reservoir water upstream for release during hot weather, (3) Combination of adaptations 1 and 2. Adaptations 1 and 3 resulted in cooler temperatures, more adults surviving to spawn, and extended population survival time. We are currently testing other management adaptations for Butte Creek, and also considering the effects of these water management changes on hydropower generation.

Climate Change Scenarios and their Implications for Chinook and Coho Restoration Strategies in Northern California

Vimal Golding (Presenter), *Watershed Stewards Project, Mattole Restoration Council*
and ***Seth Zuckerman,*** *Wild and Working Lands Program Director, Mattole Restoration Council*

In the coming decades, climate change will have increasingly profound effects on salmonids and the ecosystems they inhabit. Consequently, in order to be successful over the long term, efforts to protect and restore salmonid populations will need to account for the effects of climate change. This presentation summarizes regionally specific scenarios for climate change in California and reviews the scientific literature on the implications of climate change for the field of habitat restoration. These two reviews are then synthesized to identify future problems and produce suggestions for strategies that can make restoration efforts more robust in the face of climate change.

Our study identified both chronic and stochastic impacts that deserve the attention of restoration practitioners, which may vary regionally across the state. Low summertime flows and high in-stream temperatures are key problems in coastal watersheds that will increase in importance in the coming decades, while timing of spring snowmelt will have a greater effect on watersheds that include high-elevation terrain. Additionally, a possible reduction in the quality of ocean habitat will make healthy in-stream and estuary habitat increasingly important for salmonid conservation. Smolts emigrating at larger sizes will have greater chances for survival and eventual reproductive success. Accordingly, life-histories in which fish spend longer periods of time in streams before going to the ocean may become increasingly important, highlighting the importance of summer rearing habitat. While instream habitat recovers, summer rescue rearing and the reclamation of habitat through reintroductions may also play a role in ensuring the persistence of salmonid species. Habitat restoration alongside tidal reaches of rivers and bays, in anticipation of sea level rise, will help avoid the loss of important estuarine habitat.

Stochastic threats include high peak flows, which can be addressed with greater attention to road storm-proofing, as well as increased fire risks owing to greater evapotranspirative stress. Fire threats can be addressed through more thorough fuel reduction work and controlled burning to avoid catastrophic, stand-replacing fires that would affect the micro-climate for aquatic species. As climate change increases in magnitude over the coming centuries, ecosystems will change in response to their new climatic conditions. Ultimately, promoting the development and persistence of complex ecosystems will be key to ensuring that these changes will be adaptive rather than destructive.

Environmental Factors Controlling a Persistent Population of Southern California Steelhead (*Oncorhynchus mykiss*)

Ethan Bell, *Aquatic Ecologist (Presenter) and* ***Frank Ligon,*** *Senior Aquatic Ecologist Stillwater Sciences; and* ***Rosi Dagit,*** *Senior Conservation Biologist Resource Conservation District of the Santa Monica Mountains*

The life history and habitat interactions of southern *Oncorhynchus mykiss* populations have received less attention than their Pacific Northwest counterparts. We have developed a conceptual model describing the factors controlling *O. mykiss* population dynamics in Topanga Creek, southern California, based on nine years of focused studies. In general, the population seems to be stable despite high summer water temperatures and poor habitat conditions in the lagoon. We conclude that factors allowing the population to persist include the relationship of resident and anadromous life histories, high-quality summer and winter rearing habitat, and food availability sufficient to maintain growth at high temperatures. Based on our research we have identified high-priority actions for the recovery of the population in Topanga Creek, including restoration of the lagoon, and protecting Topanga Creek from any future water diversions. We have also identified key factors for the recovery of southern California steelhead more generally, including recognizing the importance of small populations, and maintaining connectivity between marine and freshwater environments.

SWAMP Bioassessment Reveals High Quality Habitat in Morro Bay

Annie Gillespie (Presenter) and Ann Kitajima, Morro Bay National Estuary Program

The Morro Bay Volunteer Monitoring Program has played a leading role in collecting macroinvertebrate and bioassessment data in the Morro Bay watershed for nearly ten years. Periodic training and calibration exercises with the Central Coast Regional Water Board staff have allowed the Volunteer Monitoring Program to keep current with modifications to field protocols and laboratory requirements. In 2008, the program became one of the first volunteer programs in California to adopt the full 2007 SWAMP Bioassessment Protocol for monitoring.

Field teams of four, led by one or two program staff members, have conducted 26 assessments at sites in the Morro Bay watershed since adopting the SWAMP protocol in 2008. The growing data set has revealed high-quality habitat at sites that were previously unstudied or inaccessible. The SoCal IBI metric has indicated that many of the sites score within the two highest habitat quality categories.

The bioassessment data augments ambient chemical water quality data collected by the program and provides a comprehensive picture of water quality and salmonid habitat in the Morro Bay watershed. In addition to the high-resolution data, the monitoring effort has boosted public interest in riparian ecology and salmonid restoration efforts. Multiple outreach publications and presentations have included bioassessment data and increased understanding of the subtleties of local stream ecology.

Southern Steelhead Population Trends in the Lower Santa Ynez River—A Decade of Monitoring Results

Scott Volan (Presenter), Scott Engblom,
and ***Timothy H. Robinson,*** *Cachuma Conservation Release Board*

The fisheries monitoring program and habitat enhancement effort initiated by the Cachuma Water Agencies on the Lower Santa Ynez River (LSYR) in Santa Barbara County have shown a modest increase in smolt production and returning adult southern steelhead (*Oncorhynchus mykiss*) over the past decade. A total of ten enhancement projects (which include passage barrier fixes, streambank remediation, and supplemental watering systems) have been completed within the tributaries of the LSYR and have culminated in an overall increase in the steelhead trout population on the river. Migrant trapping, snorkel surveys, and redd surveys are used to assess both the transient and over-summering population of fish within the LSYR basin, and are used as performance evaluation metrics for completed enhancement projects. Salsipuedes Creek (closest to the ocean) and Hilton Creek (furthest from the ocean) are routine monitoring locations that show different population trends based on their hydrology, proximity to the ocean, habitat quality, and gene pool. Data on smolt production and the number of returning adults will be presented in context of several environmental variables that influence life history strategies within these two drainages. Late arriving adults and spring smolt runs suggest the importance of spring rains and storm runoff to assure migration opportunities to the ocean. This is particularly true for Hilton Creek due to the distance to the ocean and Salsipuedes Creek due to its dependence on natural flows.

Coon Creek: Restoring Access to High Quality Habitat

Freddy Otte (Presenter), *City of San Luis Obispo Biologist & Stormwater Coordinator*

In the 1990's the City of SLO looked into a Water Reuse Program but several conditions were imposed to protect steelhead trout in SLO Creek. A number of conditions and studies were required in the Biological Opinion for NOAA Fisheries due to the potential impacts to steelhead in SLO Creek. One of these was a population survey for the watershed. Once the agencies discovered there were many fish in the lower section of creek that could be impacted, additional mitigation was required. Consultation with CDFG and NOAA Fisheries identified the opportunity to remove a barrier on Coon Creek. A Habitat Suitability Index was completed on both creeks to ensure the mitigation was appropriate. The 12 miles of creek habitat on SLO Creek that may have been impacted was offset by opening six miles of habitat upstream of the barrier on Coon Creek. Design considerations regarding the alternate access to the Diablo Canyon Nuclear Power Plant, as well as adjusting for the down-cutting which had occurred over the years, resulted in a 550 foot long project area with 25 rock weirs to compensate for the difference in grade. A similar project was completed by the City of San Luis Obispo in 2002 and many lessons were learned about the installation of weirs that lend well to the design of the structures in Coon Creek. Once the project was complete in fall 2004, a heavy rain season helped to excavate pools that produce some of the best spawning and rearing habitat in the County. To ensure fish were able to negotiate the structures, NOAA Fisheries required a fish monitoring plan to be implemented over the next three years looking for adult steelhead returning to the system, recolonization of the project area, and smolt identification in the estuary.

Watershed Characterization and Monitoring of Restoration Projects Using the California Rapid Assessment Method (CRAM)

Cara Clark (Presenter), *Moss Landing Marine Laboratories (MLML),* ***Ross Clark*** *and* ***Kevin O'Connor,*** *Central Coast Wetlands Group at MLML*

The California Rapid Assessment Method (CRAM) is a tool designed to assess the habitat condition of wetlands and riparian areas, including streams and rivers. The method has four universal attributes which quantify the overall condition: Buffer and Landscape Context, Hydrology, Physical and Biotic Structure. CRAM has been used to characterize wetland condition within watersheds, regions and the entire state using a probabilistic ambient survey. The tool has also been used in targeted assessments of restoration projects. Specifically CRAM is useful for pre- and post-restoration or impact assessments. A watershed characterization of the Morro Bay watershed reveals the range of conditions in the watershed and helps to set appropriate targets for future restoration projects. Characterization documented that Morro Bay watershed condition is better than the ambient condition of the state, but lacks streams of optimal condition. This information is valuable to watershed managers to identify restoration opportunities and compare specific sites to the condition of streams throughout watershed. Examples of restoration projects monitored throughout Central California using CRAM include fish passage barrier removal projects on Arroyo Hondo Creek, Corralitos Creek, Arana Creek, Arroyo Burro Creek, Whitehouse Creek, Gaviota Creek, Zayante Creek, and San Luis Obispo Creek, as well as projects to improve habitat and water quality, and wetland creation and enhancement.

Trabuco Creek Fish Passage Projects

***Wendy Katagi, CEP,** and **Ted Johnson, PE, (Presenters)**, and **Brian Murphy, PE,** CDM; and **George Sutherland,** Trout Unlimited*

Although numerous at one time, Southern California steelhead (*Oncorhynchus mykiss*) have been rare in Orange County waters since the mid 1950s. Inconsistent water levels, increased water temperatures, invasive exotic plants and animals, and decreased access to spawning habitat led to the placement of steelhead on the endangered species list in 1997. Access to prime spawning grounds in the Santa Ana Mountains within the San Juan Creek watershed has been blocked by barriers on Trabuco Creek, a major tributary within the watershed. Although Trabuco Creek is one of the most pristine watersheds in southern California, two complete fish passage barriers have prevented southern steelhead from accessing its critical habitat. The first barrier is a grade control structure beneath the Metrolink Rail crossing. The second barrier is a concrete grade control structure approximately 0.5 miles upstream at the complex of bridge crossings of Camino Capistrano, the Interstate 5 Freeway (I-5), and Rancho Viejo Road.

Trout Unlimited (TU) and the California Wildlife Conservation Board (WCB) initiated a comprehensive strategy to address the fish passage problems on Trabuco Creek created by the Metrolink and I-5 barriers. Remediation of the dual barriers is proceeding in parallel. The presentation will discuss information on the strategy to address both barriers through two proposed fish passage projects. The projects entail construction of fishways to reconnect the migration corridor. The I-5 fishway is a step pool steelhead bypass channel while the Metrolink fishway is a roughened channel. The presentation will detail site conditions, fish passage hydrologic and hydraulic analysis, fishway selection, and the stakeholder outreach process.

Making the Most of What We Have: Balancing Water Supply with Environmental Enhancement Through Conjunctive Use in the Lower San Lorenzo River Watershed

Chris Coburn (Presenter), John Ricker, Mike Cloud, and Kristen Kittleson, Santa Cruz County Environmental Health

The San Lorenzo River watershed is a 138 square mile watershed located in northern Santa Cruz County, CA. It is a critical water supply watershed and is home to numerous threatened or endangered species, including steelhead and coho salmon. Portions of the watershed have been identified in the draft coho recovery plan as critical to the species recovery, with increasing baseflow as a key strategy. The City of Santa Cruz Water Department obtains approximately 65% of its water from the San Lorenzo River and the San Lorenzo Valley Water District obtains approximately 50% of its water from tributaries of the river. The Santa Margarita formation, which underlies portions of the watershed, is a major source of drinking water for the City of Scotts Valley and surrounding rural residential areas. Current water demand exceeds sustainable supply within the watershed, resulting in an overdrafted aquifer, diminished streamflow, inadequate long-term supply, and environmental degradation. Santa Cruz County in partnership with the Scotts Valley and San Lorenzo Valley Water Districts, and the Cities of Santa Cruz and Scotts Valley, is investigating the feasibility of conjunctive use alternatives including large-scale water exchanges and aquifer recharge enhancements to address these challenges. The purpose of the conjunctive use study is to utilize technical information and develop projects and strategies for improved management of our limited water resources. The concept behind this project is that better management of groundwater basins and streamflow diversions will likely increase summer stream baseflow, which will benefit threatened and endangered fish populations at the same time improving water supply sustainability.

Phase 1 of this project, funded with Proposition 50 funds, evaluated streamflow, fishery regulations, existing infrastructure and other constraints to determine potential feasibility and benefits. The next steps to implement these strategies include developing engineering-level designs and cost estimates and addressing legal and regulatory constraints. This presentation will provide an overview of these efforts, highlighting opportunities and constraints, as well as the potential benefits from project implementation.

Links Between Bedrock Characteristics, Base Flow and Salmonid Habitat in Coastal Streams of Central and Southern California

E.B. Yates (Presenter), HydroFocus, Inc., and Barry Hecht, Balance Hydrologics, Inc.

Groundwater discharge sustains perennial base-flow in the upper reaches of many coastal streams south of the Golden Gate. Many of these perennial reaches support steelhead and rainbow trout (*Oncoryhnchus mykiss)*. The rate and duration of base flow depend substantially on the groundwater storage characteristics of bedrock materials underlying the watershed. These perennial headwater reaches may sustain only small numbers of fish during droughts, but the value of these refugia is increasing as downstream reaches underlain by unconsolidated alluvial materials become more intermittent under the influence of groundwater pumping. Both the chronic and drought-period summer-rearing roles will become increasingly essential if weather patterns become more extreme in the future, as is predicted (IPCC, 2007).

This paper investigates the relationship between bedrock aquifer properties and the volume of low-flow during late-summer months. We also consider multi-year carryover of groundwater storage, which can be essential to sustaining base-flow during droughts. We developed quantitative relationships between base flow volume, recession rate, watershed area, rainfall, and bedrock geology in selected coastal streams with good records. We related the base flow characteristics to the amount and quality of salmonid spawning and rearing habitat using information from historical fish surveys, which are typically qualitative in nature. Finally, we discussed the vulnerability of base-flow to increased groundwater pumping or changes in climate or land use, and we contrasted the vulnerabilities of bedrock and alluvial reaches.

Uncertainty and Episodic Variability of Beach-sand Supply in Managing Pilarcitos Lagoon, San Mateo County, California

Brian Hastings, *Balance Hydrologics, Inc.*

Summer flows can increase up to five times over pre-fire conditions following large-scale watershed fires. This 'post-fire premium' is critical to survival of steelhead and coho following large burns, as pools are fully filled with sand and debris. Additionally, widespread sedimentation with sand complicates downstream passage of smolt during the May/June down-migrant season, both due to marked widening and flattening of the channel and greater infiltration losses to the bed. Loss of shading, although generally partial, means that very low flows are additional subject to heating and algal growth.

We quantified the additional summer flows available to support juvenile salmonids using gaging records for the Arroyo Seco and Big Sur River in Monterey County following the Marble-Cone (1977) and Basin Complex-Indians (2008) fires. We compared these with the San Lorenzo River, an unburned watershed of similar size immediately north of Monterey Bay. Both flow rates and the reliability of flow were markedly higher following the fires, gradually returning to pre-fire conditions after about five years.

We ascribe the increased summer flows primarily to diminished evapotranspiration once the chaparral and other deep-rooted vegetation are burned. The unconsumed shallow groundwater is available to flow to the channels, a flow attenuated by progressive regrowth of the vegetation. We use differences in the Arroyo Seco and Big Sur record to illustrate differences in hydrogeologic and atmospheric processes, and in the depth at which water is stored in the different rock types underlying the two watersheds.

The post-fire increase in baseflow is probably critical to salmonid survival during the heightened environmental stresses of the fire-recovery period. The nature of these flows needs to be understood such that they can be appropriately protected and reserved for instream use during the post-fire period.

Stream Baseflow Persistence in Watersheds Supported by Granitic Aquifers

Scott Brown (Presenter), Mark Woyshner, and Barry Hecht, Balance Hydrologics, Inc.

Unique conditions in several north-flowing tributaries to the Carmel River provide insight into dry-season sources of ground water, and pathways through which water flows to the stream. These streams, which support steelhead spawning and rearing habitat, exhibit highly variable baseflow conditions both longitudinally and seasonally. Some reaches dry in all but the wettest years, while others have sustained baseflow throughout the summer except under the driest conditions. One steep-walled crystalline-bedrock stream, with a discontinuous thin veneer of alluvium atop the bedrock-controlled bed, is relatively free of the bed sedimentation, allowing for close measurements of flow, temperature, and specific conductance that help trace the varying sources that support summer baseflow.

We analyzed 15 years of rainfall and streamflow records, and conducted longitudinal surveys of baseflow conditions over a six-year period, to describe the varying patterns of baseflow recession and persistence following years of differing rainfall characteristics. We found that with adequate rainfall, aquifers recharged relatively easily and readily supported high baseflow, not only for the subsequent dry season but for several consecutive seasons. Varying from year to year, baseflow persistence into the dry season is related not only to annual rainfall and rainfall patterns, but also to years elapsed since very wet years.

As a separate line of evidence, specific conductance was found to increase into the dry season and during periods of very low flows, and can be used as an index of 'dryness' for stream. This finding is especially promising in watersheds prone to high sedimentation events, which tend to obscure variations in measurable flow under ultra-low-flow conditions.

Through use of multiple lines of evidence, we have established a monitoring program that can be used, though tracking of rainfall and at-a-point streamflow and specific conductance measurements, to identify critical years when habitat would be most constrained. These findings can also be used to identify effects of changes in the watershed, such as increased groundwater withdrawal or wildfire, by detecting recession patterns that are inconsistent with the multi-year response to rainfall years that support high recharge to the supporting aquifer.

Why Up and Down Matters in the Design of Off-Channel Habitats

Rocco Fiori (Presenter), *Fiori GeoSciences;* ***Monica Hiner, Sarah Beesley, Scott Silloway, Andrew Antonetti, Robert Grubbs,*** *Yurok Tribal Fisheries Program;* ***Will Harling*** *and* ***Charles Wickman,*** *Mid-Klamath Watershed Council*

Low dissolved oxygen (DO) concentrations are generally considered to be a limiting factor that affects the growth and survival of juvenile salmonids. Yet our combined monitoring of fish use and DO in natural and constructed off-channel habitats in the Mid and Lower Klamath Basin indicate large numbers of juvenile fish are present in waters where minimum DO concentrations can range from 0 to 3.0 mg/L. Case studies from recently constructed off-channel habitats that evaluate macro- and micro-scale controls on fish use patterns, DO and the interaction of surface and ground-water will be presented. The focus will be on methods and results of hydrogeologic investigations at six sites constructed at different geologic settings in the Mid and Lower Klamath Basin in 2010. Our preliminary results indicate sites with low DO provide critical overwintering habitats where juvenile fish can forage in low velocity refugia.

Experiences with Enhancing Fish Friendly Habitat on a Highly Modified River System in California

***Chris Bowles (Presenter)** President, **J. Stofleth, M.S.,** Associate, **Chris Hammersmark,** and **S. Diaz,** cbec eco-engineering; **J. Hannon,** Fisheries Biologist, U.S. Bureau of Reclamation; **D. Cox,** Biologist, US Fish & Wildlife Service; **J. Merz, Ph.D.,** Senior Scientist, Cramer Fish Sciences*

The vast majority of rivers in California have been extensively anthropogenically modified by impacts such as dams, reservoirs, urbanization, flood control levees and general channelization. These impacts have had serious damaging consequences to the geomorphic, and hence ecologic, function of these river systems, most relevantly in this instance to the starvation of downstream sediment supply as a result of dam construction, and the corresponding impacts to anadromous fisheries.

The Lower American River is a jewel of river running through the conurbation of Sacramento, California. Extreme hydrologic regulation of the river by Folsom Dam, and the corresponding starvation of sediment to the downstream river, combined with the resultant blockage of fish passage to the upstream habitat, has had serious consequences to native Chinook and steelhead salmon that depend on the Lower American River for prime habitat. In the last three years, concerted efforts by agencies such as the U.S. Bureau of Reclamation, U.S. Fish & Wildlife Service, California Department of Fish and Game, NOAA Fisheries, Sacramento County Parks and the Sacramento Water Forum has resulted in three fisheries enhancement projects in the Lower American River, focusing on spawning and juvenile rearing habitat. The projects have involved feasibility, design and implementation of gravel augmentation and side channel construction and rehabilitation.

Details of the main components of the feasibility and design of these projects are provided. Experiences gained through the construction of the projects are discussed. Monitoring data are highlighted to demonstrate the success, or otherwise, of the projects, including data corresponding to the use of the sites for spawning and rearing by Chinook and steelhead salmon.

Insights Gained from Scale Analyses of the Endangered Southern Steelhead in the Lower Santa Ynez River, Santa Barbara County

Sarah Horwath (Presenter), Scott Volan, Scott Engblom,
and Timothy H. Robinson, *Cachuma Conservation Release Board*

Monitoring efforts of southern steelhead (*Oncorhynchus mykiss*) in the Lower Santa Ynez River (LSYR) have resulted in over 2000 scale and tissue samples from migrant captures since monitoring began in 1995. Scale analysis on southern steelhead is complicated by multiple environmental factors and varying environmental conditions that influence fish growth rates, life history strategies, and the resulting scale patterns observed. It is important to utilize all relevant data that influence growth rates (water year type, stream water quality, capture date, etc) and scale interpretation. Genetic analysis using microsatellites and single nucleotide polymorphisms has confirmed recaptures of individual fish, providing a unique opportunity to compare scale patterns from the initial to the recaptured fish and the elapsed time between each. These analyses have resulted in an understanding of the time of annulus formation, period of accelerated growth within the year, rates of circuli formation, and estimates of growth rates for southern steelhead. Variations in growth patterns due to differing stream ecologies have been seen between two distinct tributaries within the LSYR drainage. Developing a skilled eye to recognize these growth patterns of southern California fish has enabled analysis of scales from non-recaptured fish. Life history data collected from this analysis will enable informed management decisions relating to water releases, habitat restoration and southern steelhead conservation.

Morro Bay On-Farm Coastal Water Quality Implementation Project: Coastal San Luis Resource Conservation District

Nicole Smith, *Coastal San Luis Resource Conservation District*

The seven-year Morro Bay On-Farm Coastal Water Quality Implementation Project, also known as "Project Clearwater", a partnership of the Coastal San Luis Resource Conservation District (CSLRCD) and MBNEP, resulted in completion of an array of water quality improvement projects incorporating over 150 best management practices (BMPs) in accordance with Natural Resource Conservation Service (NRCS) standards. These projects included installation of off-creek watering systems for cattle and corresponding riparian fencing, stream head-cut remediation, road improvements to prevent erosion, and habitat enhancement for steelhead trout and red-legged frogs.

Project Clearwater resulted in protection of over 52,000 feet of stream bank and improvements included over 51,500 feet of riparian fencing, 17 watering troughs/ tanks, 74,592 feet of pipeline, two stream crossing improvements, one fish passage improvement, and over 21,000 feet of vegetation management and debris removal. Altogether, these implementation projects will provide estimated benefits to the Morro Bay estuary and its watershed, over a ten year period, of reduction in sedimentation by 9,014 tons, and prevention of deposition into streams of over 421 tons of manure, with corresponding reductions in inputs of bacteria, nitrogen and phosphorus. The project's education and outreach component engaged over 480 growers, ranchers and environmental community members through a series of workshops, watershed tours, and tailgate meetings. Funding partners for these projects included the MBNEP, State Water Resources Control Board (SWRCB), Packard Foundation, State Coastal Conservancy, Offsite Mitigation Fund, NRCS, Department of Conservation (DOC), Farm Bureau, Cal Poly, UC Cooperative Extension, and individual landowners.

The Salmon Monitoring Advisor: A Hierarchical Web Site to Help Design and Implement Salmon Monitoring Programs

Pete Adams (Presenter), *Southwest Fisheries Science Center, National Marine Fisheries Service, Santa Cruz, California;* ***R. Peterman*** *and* ***K. Holt,*** *School of Resource and Environmental Management, Simon Fraser, University, Burnaby, British Columbia, Canada;* ***B. Dorner,*** *BC Canada;* ***D. Drake,*** *Oregon Department of Environmental Quality;* ***H. Geiger,*** *St. Hubert Research Group;* ***C. Jordan,*** *NOAA Fisheries;* ***D. Larsen,*** *Pacific States Marine Fisheries Commission;* ***S. Leider,*** *Governor's Salmon Recovery Office;* ***R. Lincoln,*** *State of the Salmon;* ***A. Olsen,*** *Western Ecology Division, National Health and Environmental Effects Laboratory, U. S. Environmental Protection Agency;* ***C. Parken,*** *Fisheries and Oceans Canada;* ***J. Rodgers,*** *Oregon Department of Fish and Wildlife; and* ***S. Walbridge,*** *National Center for Ecological Analysis and Synthesis*

Salmon managers, scientists, and non-governmental organizations face substantial challenges designing cost-effective monitoring programs to assess both status and time trends in abundance, productivity, spatial structure, and diversity of salmon populations. We have developed a web-accessible knowledge base called the "Salmon Monitoring Advisor" to help such people choose designs that (1) reliably estimate changes in salmon indicators, and (2) estimate the relative contribution of climate-driven mechanisms to those observed changes (compared to changes caused by other factors). This web site provides a systematic, structured framework to help users develop clear goals and objectives, as well as design and implement salmon monitoring programs that are reliable, informative, and cost-effective. The site is accessible in a hierarchical manner to reflect diverse audiences, including (1) scientists who design monitoring programs and/or analyze the resulting data, (2) technical staff who implement monitoring designs in the field, (3) people involved in providing funding for monitoring programs, and (4) managers and decision makers in government agencies or in local or regional salmon conservation organizations. This web site is named "Salmon Monitoring Advisor" because it provides advice and guidelines to help users work through the essential steps involved in designing monitoring programs to meet stated objectives, and provides pros and cons of different designs, rather than being prescriptive about which design best meets a particular monitoring objective. The web site uses seven sequential steps to guide monitoring design and implementation and provides extensive explanations and real-world examples for each step.

Use of Dual Frequency Identification Sonar (DIDSON) to Estimate Low Abundance Salmonid Escapement in California Watersheds

Kerrie Pipal, Mark Jessop, *and* ***Peter Adams,*** *Fisheries Ecology Division, Southwest Fisheries Science Center, National Marine Fisheries Service*

Steelhead (*Oncorhynchus mykiss*) and coho salmon (*O. kisutch*) are listed as Threatened or Endangered under the Endangered Species Act throughout most of California. Monitoring these fish presents difficult challenges since their abundances are so low that often a complete census of these populations is needed. Dual frequency identification sonar (DIDSON) is a promising new technology that could potentially be used to monitor adult salmonids runs in California streams and rivers under highly variable environmental conditions. We tested the feasibility of using DIDSON to estimate steelhead escapement in two systems with low abundance in central California: the San Lorenzo River and Scott Creek in Santa Cruz County. DIDSON uses sonar to produce high-quality images in turbid water, which allows for detection and enumeration of fish, as well as estimation of fish size and swimming direction. Each deployment yielded insight into equipment durability, the importance of site selection, data management techniques, and how fish behavior affects data processing. These deployments lead to much improvement in operational techniques. Our 2006 experiment in the San Lorenzo River lasted eight days and was focused on equipment durability. The DIDSON counts from this site yielded 41 upstream migrants compared to 46 passed at an upstream fish trap. There were some differences in operation time between the two methods which may account for the discrepancy. The Scott Creek (2008) deployment will also span the entire steelhead run season and data validation will be possible using results from a weir located 200 meters downstream.

Improving Steelhead Trout Habitat Along Carpinteria Creek

***Erin Brown,** Project Manager, and **Mauricio Gomez,** Director, South Coast Habitat Restoration*

South Coast Habitat Restoration (SCHR) has been involved in steelhead trout restoration projects throughout Santa Barbara and Ventura Counties. A recent creek bank restoration project demonstrates their success in working with private property owners to voluntarily restore riparian structure and steelhead trout habitat.

The project was located along the mainstem of Carpinteria Creek, Santa Barbara County, which has been the focus of many recent efforts to remove steelhead migration barriers and restore access to the perennial headwaters. The property is owned by the Cate School, and the land use is agricultural as an avocado orchard. Prior to the project, the creek bank at the site consisted of near vertical banks as a result of the removal of riparian vegetation to make way for the avocado orchard. The banks were contributing fine sediments into the watershed and the reach lacked riparian cover and bank stabilizing vegetation.

The goal of the project was to improve steelhead habitat, water quality, stream bank conditions, and riparian vegetation in the Carpinteria Creek watershed. Working from designs developed by Questa Engineering, the project involved the laying back of two ~100 foot sections of near vertical creek banks to a 2:1 slope. One to two tons of imported rocks were placed in a trench along the toe of the slope to further stabilize the bank. Regrading of the top of bank roads into a drain was done in order to prevent over bank flow and erosion. Finally revegetation efforts were done through seeding and planting of native species in partnership with the California Conservation Corps. The new, more gradual grade of the creek bank will be less likely to erode fine sediments into the watershed and will also allow for the establishment of riparian trees and understory vegetation, which will further help stabilize the bank. In the middle section of the project four large root wads were installed in the creek bank to help deflect the flow and protect it from further erosion. The banks were not laid back in this section in order to maintain four large oaks at the top of the bank. In total nine avocado trees along the top of bank were removed in order to make way for native riparian tree species.

SCHR continues to be involved in ongoing restoration efforts throughout the Carpinteria Creek Watershed which has some of the highest potential for restoring the endangered southern steelhead trout. In total five major barriers have been removed from the watershed, with four more still to remove in order to restore complete anadromy to the watershed.

2006-2009 Periphyton Results from Three Sites on the Yurok Indian Reservation

Scott Sinnott, *Environmental Specialist, Yurok Tribe Environmental Program*

The goal of the Yurok Tribe Environmental Program in sampling periphyton on the Lower Klamath River within the boundaries of the Yurok Indian Reservation (YIR) is to understand the extent of nutrient pollution, the prevalence of toxic cyanobacteria in the riverine environment, and the potential risk both pose to the food web and human health. In the long-term, this sampling will assist in illustrating pollution variation between water years and provide a basis to judge effectiveness of short-term and long-term management and regulatory actions taken to abate pollution throughout the Klamath River Basin.

This poster presentation will focus on periphyton data gathered at three sites on the YIR: Klamath River at Turwar USGS Gage (TG), Klamath River upstream of Weitchpec (WE), and Trinity River upstream of Klamath River confluence at Weitchpec (TR) during sampling years 2006-2009. It will discuss the dominant types of periphyton detected at each sampling location, the presence or absence of blue-green algae at each sampling location, and the trends of periphyton metrics at each site across sampling seasons.

Spatial and Temporal Covariability in Life-history Parameters of Chinook Salmon (*Oncorhychus tshawytscha*) in the Northeast Pacific

Patrick Kilduff, Ph.D., (Presenter) *and Louis W. Botsford, Department of Fish, Wildlife and Conservation Biology, University of California, Davis*

Understanding how different populations respond to a variable environment is necessary to anticipate and evaluate population persistence as environmental conditions change, possibly through climate change. The translation of atmospheric and oceanographic processes to fluctuations in age-structured populations requires knowledge of temporal and spatial variability patterns in both the population and environmental signals and a mechanistic understanding of how that variability acts in age-structured populations. Fluctuations in many Pacific salmon populations covary with indices of ocean productivity; however, exactly how environmental forcing interacts with population dynamic mechanisms to produce fluctuations remains unclear, impeding effective management and conservation. My dissertation research will: (1) determine the spatial and temporal variability in survival and spawning age of Chinook salmon (*Oncorhynchus tshawytscha)* in the northeast Pacific; (2) identify environmental variables most strongly associated with observed patterns of survival and spawning age distributions; and (3) analyze population models to examine how observed oceanic environmental variability influences age-structured population dynamics of Chinook salmon. In this poster, I present patterns of spatial and temporal variability in Chinook salmon vital rates from California to southeast Alaska calculated using the Pacific States Marine Fisheries Commission's Regional Mark Processing Center (*www.rmpc.org*) coded wire tag data and outline my framework for improving our understanding of how oceanic variability relates to population dynamics.

Southern California Steelhead Spawning Observations in Two Dammed Rivers

Richard A. Bush, *Southwest Region, Protected Resources Division, National Marine Fisheries Service*

The ecology of spawning *Oncorhynchus mykiss* (both anadromous and resident forms) is a topic of uncertainty in the southern California steelhead Distinct Population Segment. The National Marine Fisheries Service (NMFS) initiated the use of a standard spawning ground survey protocol in 2009/2010 to conduct redd counts in southern California coastal drainages where endangered steelhead populations exist. Surveys were conducted in the Malibu Creek and Ventura River watersheds after the first measurable precipitation on Dec 19, 2009, through May 28, 2010. Index reaches in the Ventura River watershed (6.6-km) below Matilija Dam and the entire anadromous reach of Malibu Creek downstream of Rindge Dam (4.8-km) were surveyed bi-monthly (pending river conditions). Spawning activity was collectively observed from Jan 25, 2010, through May 14, 2010, in the study rivers. Stream temperature at redd locations ranged from 11.5°—18.0° C at time of observation. Spawn timing was distributed throughout the survey season, with approximately 46 percent of spawning activity observed 1 – 2 weeks after freshets. The mainstem Ventura River streamflow (USGS 11118500) range was 36—68 cfs at the time of spawning based on estimated redd age, and Malibu Creek streamflow (USGS 11105510) range was estimated to be 18—39 cfs. Redd size in the mainstem Ventura River (n = 20) ranged from 0.22—2.47m^2, while the redd size in Malibu Creek (n = 6) ranged from 0.48—2.36m^2. Redd size in San Antonio Creek (n = 17), tributary of the Ventura River, displayed a narrower size range than what was observed in the mainstem Ventura River (0.35—0.86m^2). Season total spawning density (i.e., redds per kilometer) in the Ventura River watershed ranged from zero to 23.0 redd/km, while spawning density was 1.3 redd/km in Malibu Creek. The findings from these early studies indicate that the amount of spawning is patchily distributed throughout both study watersheds and that the timing of redd construction is related to periods of elevated streamflow. Redd size and direct observations of spawning *O. mykiss* suggest that anadromous and resident *O. mykiss* spawn concurrently in southern California watersheds. Future studies are planned to extend the current understanding of steelhead spawning ecology at the southern geographic extent of the species' range.

Can Steelhead in Extreme Conditions Grow Large Enough to be Successful Smolts? A Study of Bioenergetics in the Napa River Watershed, California

***Frank Ligon** and **Ethan Bell**, Aquatic Ecologists, Stillwater Sciences*

Nearly all steelhead (*Oncorhynchus mykiss*) populations in California are currently listed as threatened or endangered under the federal Endangered Species Act. Steelhead must reach a certain size (~ 170 mm) before smolting to have a sufficiently high ocean survival to sustain a population. The primary factors that influence size and outmigration are food supply and water temperature. Many streams in California have either naturally low flows or have had their flows reduced or both. Low flows can lead to increased water temperatures and reduced macro invertebrate production and drift. The Napa Valley experiences very high summer temperatures relative to coastal streams and flows in the Napa River and its tributaries are very low due to diversions. To determine if growth rates are reduced in tributaries to the Napa River, we studied seasonal steelhead growth from summer 2005 through spring 2006. In this study a total of more than 3,300 steelhead from four cohorts were captured and given individual marks. Of these, over 400 were recaptured at least once. Based on low instream flows (pools often isolated), high water temperatures (20–25°C), and reduced channel complexity, we expected to document a population with very low growth rates. We did find essentially no growth during summer and early fall. However, moderate growth rates in the spring compensated for poor conditions in the low flow period and resulted in age 2+ juveniles large enough to expect high ocean survival. Despite what we considered bioenergetically adverse or extreme conditions, steelhead were able to reach sizes comparable to other populations in much cooler and wetter environments.

Challenges to Coho Recovery in Central California—Insights from a Local Life Cycle Station

Sean A. Hayes (Presenter), Arnold Amman, Morgan Bond, Alison Collins, Danielle Frechette, Chad Hanson, Jeff Harding Andrew Jones, Bruce MacFarlane, Ann-Marie Osterback, Jeff Perez, Ian Ralston, Erick Sturm, and Brian Wells, SWFSC Fisheries Ecology Division, NOAA Fisheries

Coho salmon face challenges at every step of their life cycle in Central California watersheds due to a combination of natural life history traits, anthropogenic and natural challenges. The rigid three-year life cycle, followed by most fish and females in particular, increases their susceptibility to threats such that any significant challenge along the life history pathway has the potential to eliminate an entire cohort. Adults returning to central California watersheds have the latest spawn timing of any population along the West Coast, forced by the delayed opening of streams where sandbars have formed across the mouths during summer and fall. This is exacerbated by early winter dry periods during December and January, which further preclude access to streams. Under these situations, the entire returning cohort can be gathered waiting just offshore for the first storm event, during which period they appear to be quite vulnerable to pinniped predation. The highly synchronized return of these fish to local rivers makes them particularly susceptible to scouring of redds that can occur in watersheds that have predominatly low-density mudstone substrates, which move easily during high flows. This problem is worse in the more densely populated watersheds, due to the lack of large woody debris, which are removed to prevent flooding, and the preponderance of roads, hard surfaces, and storm drains that can cause even mild storm events to result in high-velocity flows. Summer and fall rearing in upper watershed habitat depends in part on the delicate balance between having sufficient canopy cover to maintain cool stream temperatures, but allowing enough light to allow primary productivity and food. In association with this is a natural low-flow period during summer and fall due to a lack of rain. Loss of wetland habitat, water withdrawals for anthropogenic purposes and reduced winter ground water recharge resulting from rapid runoff in urban watersheds also reduces rearing space. Data suggest coho are locally adapted to utilize estuarine habitat for a brief period during spring downstream migration for a potentially critical growth spurt necessary to marine survival just before ocean entry. However, channelized drainage areas often delay the necessary transitional lagoon habitat formation until later in the summer, months after smolts have left the system. Loss of growth attained during estuarine rearing makes fish more susceptible to mortality following ocean entry. Challenges to marine survival have been exacerbated in recent years by more dynamic ocean conditions that have resulted in poor ocean primary productivity and low prey availability. Finally, just as fish are entering the ocean, they appear to suffer from increased predation from avian predators whose populations are growing in response to anthropogenically subsidized food resources. While the above laundry list of challenges may seem grim, the insights gained from full life cycle monitoring provide a more holistic view of the full watershed and what is needed for integrating management solutions to provide the tools necessary for the recovery of this species.

Juvenile Coho Salmon Use Newly Constructed Tidal-Freshwater Pond

Michael Wallace, California Department of Fish and Game

Wood Creek is a small tributary to Freshwater Creek Slough, Humboldt Bay, in coastal Northern California. Fifty acres of the lower watershed occupies diked former tideland and estuarine habitat now owned by the Northcoast Regional Land Trust. Redwood Community Action Agency designed and implemented a multi-faceted habitat restoration project which included removing a tide gate at the mouth of Wood Creek and building an off channel pond to increase over-winter habitat for coho salmon. The California Department of Fish and Game's Natural Stocks Assessment Project (NSA) designed a study to monitor the effectiveness of these restoration techniques by determining if: 1) juvenile salmonids used the new off channel pond; 2) juvenile salmonid rearing patterns and distribution changed after project completion, and; 3) water quality in Wood Creek changed after project completion. NSA conducted monthly pre- and post-project fish and water quality sampling in Wood Creek and installed PIT tag antenna arrays at the mouth of Wood Creek and in the new pond to detect PIT tagged fish at these locations. The tide gate was removed and the pond was constructed in late summer of 2009. NSA found that brackish water became more prevalent and tidal flow increased throughout Wood Creek after project completion. The new pond contained brackish water until high winter stream flows flushed the saltwater from the pond in December 2009. The pond water remained fresh during the winter and spring until low stream flows allowed saltwater to reach the pond in June 2010. Water salinity in Wood Creek was more variable in the tidal channels downstream of the pond throughout the winter and spring and varied with stream flow and tidal stage. Overall, dissolved oxygen and water temperature varied little between pre- and post-project measurements. NSA captured far more juvenile coho salmon in Wood Creek than other salmonids, both before and after project construction. NSA found a seasonal pattern of sub-yearling coho moving into Wood Creek during the spring followed by a greater number of yearling coho in winter months, suggesting that it was providing important over-winter rearing habitat for coho both before and after project construction. NSA found that large numbers of juvenile coho began using the new pond by January 2010 and reared there throughout the winter and spring. The coho catch distribution in Wood Creek, especially during peak abundance, was more concentrated in the upstream sites after project construction. However, the new pond provided additional habitat for coho upstream of the brackish water. From January to June 2010, the PIT tag antenna detected 152 coho salmon, one steelhead, and two cutthroat trout in the new pond. During the same time period only 7% of the salmonids physically captured in the pond contained PIT tags, showing that the antenna was detecting only a small portion of the salmonids in the pond. The mean time between first and last detection for individual coho (a surrogate for residence time) was 23 days (range 1-87 days). Wood Creek provides important over winter habitat for juvenile coho salmon at a time when main stem Freshwater Creek and Slough may be too high and fast to support many yearling coho. Based on this data the restoration project appears to have met one of its goals by providing additional over winter rearing habitat for coho salmon.

Preventing Coho Extirpation in the Mattole River Watershed

Keytra Meyer, *Mattole Salmon Group*

The Mattole watershed coho population is a NOAA designated Core Population, a Functionally Independent Population, the most southern extent of the SONCC ESU, and the most isolated population in the ESU. As such, the recovery of the Mattole coho population is essential to the recovery of the SONCC coho salmon ESU. Restoration of the Mattole watershed has been occurring since 1980, focused on direct salmon enhancement, instream habitat enhancement, and sediment reduction. Despite these efforts, the Mattole coho population has been, on average, below the depensation level of 250 adults for over 20 years, with the 2009/2010 return the lowest on record. Coho salmon are now limited to the upper 10 miles of the watershed due to poor habitat conditions. In 2010, the Mattole River and Range Partnership completed the Mattole Coho Recovery Strategy outlining innovative efforts to prevent coho extirpation in the Mattole watershed and work towards recovery of the SONCC coho salmon ESU. This presentation outlines current recovery efforts in the Mattole watershed, focusing on the Mattole Recovery Rearing Program, Mattole Tank and Forbearance Program, Mattole Instream Enhancement Program, and Mattole Wetland Enhancement and Groundwater Recharge Program.

Coho Recovery in Lagunitas Creek—If Not Here Then Where?

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

Lagunitas Creek has supported the largest population of coho salmon (*Oncorhynchus kisutch*) in Central California but recent population trends have seen a dramatic and alarming decline in returning adults, as has been reported in other coastal California streams. Despite favorable watershed management conditions and extensive habitat enhancement efforts, the numbers of coho spawners has been less than 30% of what they were just a few years ago. The Lagunitas Creek experience demonstrates just how difficult it is to achieve and sustain anadromous salmonid protection and recovery. It also is a lesson in where habitat enhancement and population monitoring efforts should be focused to give the best hope for successful recovery. I will briefly review the management actions that have occurred in the watershed and then discuss the main conclusions that have come out of the past 15 years of restoration efforts.

We monitor the major life history phases for coho in the creek (adult spawning, juvenile, and smolt stages) and have a data set that goes back to the 1970s, which provides valuable long-term population trends. Having information on these life stages has allowed us to develop a reasonably good understanding of the coho population dynamics and the factors that influence them.

Even with the extensive monitoring effort, it has been difficult to link our habitat enhancement actions to changes in the populations. For example, over 60 large woody debris structures have been installed and they are certainly utilized by the coho but we do not have data that has allowed us to directly link the habitat benefits to coho survival. We can build it and they do come but it's been difficult to show how that influences the population numbers.

The coho population of Lagunitas Creek is influenced by many factors, including floods, droughts, ocean conditions, and freshwater habitat quality. Population gains resulting from habitat enhancement efforts can be overwhelmed and even undone by larger, episodic forces.

A limiting factors analysis conducted for coho in Lagunitas Creek in 2007 identified winter habitat as the primary limiting factor. Up until the limiting factors study, the habitat enhancement efforts in the watershed focused on sediment reduction and instream summer habitat. As a result of the limiting factors analysis, we are shifting our habitat enhancement efforts to also consider winter habitat for coho, in the hopes of increasing winter survival from the juvenile to smolt stage. Over the long term, habitat enhancement efforts must continue; this is what stands the best chance of increasing salmonid populations and preventing their extinction.

Recovery of Coho Salmon in the Shasta River Watershed

Mark Pisano, *Senior Environmental Scientist,*
California Department of Fish and Game, Northern Region

The Shasta River watershed of Siskiyou County in Northern California has long been recognized as a very important producer of salmon and steelhead for the Klamath Basin. Currently, this watershed supports fall-run Chinook salmon, coho salmon, steelhead and previously supported healthy populations of spring-run Chinook as well. Large-scale landscape changes began in the Shasta valley in the early-to-mid 1800s when gold fever reigned. Since then, conversion of the landscape has continued for agricultural purposes and water development. Drought and global climate change have also had a negative impact on the aquatic environment. Additionally, high summer water temperatures and water withdrawals for agricultural purposes continue to suppress quality spawning and rearing habitat in the watershed.

Although the Shasta River also has a long history of habitat restoration intended to improve production and survival of salmonids, coho populations have dwindled in the watershed to the point where two of three cohorts are essentially extirpated. The third is barely hanging on.

Prior to the state listing of coho salmon in 2005, the California Fish and Game Commission adopted the "Recovery Strategy for California Coho Salmon" (2004). A component of that strategy included a Scott and Shasta Pilot Program which is intended to address coho salmon recovery relative to agricultural water and land use in the Scott and Shasta watersheds. The Commission also identified the need to develop a programmatic implementation framework that both works towards coho recovery while providing authorization for the "take" of coho salmon incidental to otherwise lawful routine agricultural activities such as water diversion. While the California Department of Fish and Game works to implement the Pilot Program, a wide variety of on-the-ground restoration projects continue by the local community.

Consistent monitoring of adult coho salmon returning to spawn in the Shasta River began in 2001. Annual operations of rotary screw traps to estimate production from the Shasta watershed for each salmonid species and life stage also began in the early 2000s and continue to date. New studies to determine instream flow needs for salmonids in portions of the Shasta River are ongoing and a spawning gravel assessment of several key areas has been completed. Several water use efficiency studies and irrigation tailwater assessments have also been completed. Intensive juvenile rearing habitat evaluations have resulted in a better understanding of successful coho life history strategies in the Shasta River.

Information from all these efforts will help identify limiting factors and assist in prioritization of recovery task implementation. Improved access to private property and relatively new information highlighting juvenile coho habitat distribution and the importance of cold spring water accretions to the Shasta River may help lead to increased production and survival of coho salmon and other cold water fish from the Shasta River.

In this presentation, recent coho research efforts and implementation of key coho recovery tasks in the Shasta River will be summarized.

Emergency Measures for Recovering California Coho Salmon Populations on the Verge of Extirpation

Stephen Swales and Michael Lacy, Fisheries Branch, California Department of Fish and Game, Sacramento

Coho salmon populations in river systems throughout northern California have declined dramatically over the last fifty years, and many populations are now on the verge of extirpation. Recovery strategies for coho salmon have been prepared by state and federal agencies and millions of dollars have been spent on habitat restoration programs in key watersheds. Nonetheless, these strategies and programs have so far not been successful in preventing the ongoing decline in coho populations throughout the State. Emergency measures are therefore under consideration to prevent the extirpation of coho salmon in California waters. This paper discusses the range of options that are available, with examples, to halt the decline in coho populations. These options include management actions that identify and address key limiting factors for coho survival (e.g., habitat accessibility and quality) which can be applied to priority habitat restoration and protection programs in key watersheds. In situations where coho populations are close to extirpation, consideration may be given to implementing captive rearing and rescue programs, including the construction of purpose-built conservation hatcheries, and intra- and inter-basin fish translocation. The enforcement of permitting and regulatory requirements is also an important aspect of species recovery, as well as increased levels of education and outreach to the general public and government agencies. Without a commitment to emergency recovery measures it is feared that California coho salmon may soon be lost to future generations.

Restoration Field Guide— A User-Friendly Guide for Restoration Techniques in Riparian Habitats

Brian B. Stark, *Conservation Operations Director, Ojai Valley Land Conservancy;*
and ***Kaila Dettman,*** *Deputy Director, Land Conservancy of San Luis Obispo County*

This presentation outlines the contents of a newly published field guide for habitat restoration in riparian habitats. The field guide, published in July 2010, is an outgrowth of habitat restoration projects funded by the Avila Beach Trustee Council, a partnership between the California Department of Fish and Game (CDFG) Office of Spill Prevention and Response (OSPR) and the U.S. Fish and Wildlife Service (USFWS). The Trustee Council retained the Guide's authors through the Land Conservancy of San Luis Obispo County to assist in the planning and implementation of projects designed to restore or replace resources damaged by the Avila Beach oil spill. Between 1999 and 2008, multiple projects were completed that addressed migration barriers for steelhead, stream bank stabilization and revegetation, in-stream habitat for steelhead, invasive species removal, and water quality enhancement.

During each of the restoration projects, the authors relied heavily on published guides to develop implementation strategies. These published resources provided extensive information regarding how projects should look when constructed. However, they contained very little information of a practical nature relating to "how" the projects should be built and what potential problems could arise during construction. Project delays caused by accidents, unforeseen problems, and insufficient materials on site make projects more costly and complicated than necessary. They may also result in damage to habitats and injury to people. It was only through the experience gained in the field, or communicated by other experienced restoration managers, that methods were developed to address common problems associated with common project types.

The purpose of the field guide is to share the experiences of the authors and other restoration organizations gained during implementation of restoration projects so fellow project coordinators can better plan construction projects while saving time and money. Case studies will bring to life some challenging problems and potential mistakes common on restoration projects. The concepts presented here are field tested, and will help users prepare for and solve common problems that may arise during a project.

Preliminary Evaluation of Off-Channel Habitats Constructed in Tributaries of Lower Klamath River

Rocco Fiori (Presenter), Fiori GeoSciences; Monica Hiner, Sarah Beesley, Dave Weskamp, Scott Silloway and Steven Nova, Yurok Tribal Fisheries Program

Off-channel landforms such as side-channels, remnant oxbows, beaver ponds and hydrologically connected wetlands provide critical rearing habitats for juvenile salmonids, especially coho. These landforms once dominated coastal valley landscapes and were part of a complex floodplain architecture that served to enhance surface and groundwater exchange and storage, prolong baseflows, and provide nutrient rich, low velocity habitats. These conditions allowed juvenile fish to persist during periods of low flow and readily attain mass and lipid content thereby increasing their likelihood of returning from the ocean as adults to spawn. Many of these landforms have been degraded or eliminated as part of past and on-going land management and regulations that favor simplified channel systems, and the filling and draining of wetlands. The concomitant loss of off-channel landforms and channel complexity can force juvenile fish to occupy higher velocity habitats where they must expend more energy for fewer nutrient resources and as a result are more likely to enter the ocean at a sub-optimal mass thereby reducing their chances of surviving to spawn. The coho ecology project lead by the Yurok and Karuk Tribes has documented significant use of off-channel habitats in the estuary and coastal tributary valleys by juvenile coho emanating from throughout the Klamath Basin. To improve floodplain habitat complexity and increase coho production we have begun to construct off-channel habitat features designed to mimic the form and function of landforms that were once commonplace in the coastal valleys of the Lower Klamath River. During the 2010 season four off-channel features were constructed. In Terwer Creek a high flow side channel (T1), an enhanced oxbow pond (T2), a side channel/deep water wetland complex (T3), and in McGarvey Creek a wall-based side channel (M1). The T1 and T2 features are underlain by coarse grained alluvial sediments with a high degree of surface and groundwater interaction. The T3 and M1 features are underlain by stratified fine-grain floodplain deposits that have hydraulic conductivities that are several orders of magnitude lower than the T1 and T2 sediments. Pre- and post construction conditions are currently being monitored and evaluated to assess project effectiveness and inform future restoration efforts. Key variables being evaluated include fish use patterns relative to feature design, hydrogeologic controls, water fluctuations, wood loading, dissolved oxygen and water temperature. We hypothesize dissolved oxygen levels may be a limiting factor for fish in the M1 feature because the primary hydraulic connection is via backwater from the downstream entrance and a decreased potential for hyporheic exchange due to low hydraulic conductivities of the underlying sediments. The outcome of this monitoring will be useful to identify key design considerations and constraints for effective side channel construction in these settings. Construction details and preliminary monitoring results will be presented.

A Scale-Dependent Variational Approach To Riffle-Pool Design Towards Process-Based Objective Design

Rocko Brown, *Philip Williams & Associates, Inc.*

The practice of restoration, rehabilitation, and enhancement of rivers and streams is clearly an evolving mosaic of disciplines that is notably young. The primary forms of manipulation on fluvial systems are related to whether we manipulate the boundary or input system controls, through flow regulation and channel grading. Regardless of the type of manipulation there is a rapidly increasing call for process based variability in channel geometry to facilitate the creation and maintenance of habitat heterogeneity. While the calls for process based variability is abundant in the literature, guidance on implementation of these concepts is severely limited. The primary tools for practitioners are reach averaged estimates of channel geometry through empirical and analytical derivations that greatly simplify processes at the geomorphic scale, where restoration is most commonly performed. Moreover, the generation of design topography (i.e. grading plans) is currently subjective.

The purpose of this talk is to disseminate a design approach by the author for objectively determining sustainable riffle pool geometry that utilizes design tools in a hierarchal fashion and incorporates scale-dependent variability in riffle and pool units for the restoration, rehabilitation, and enhancement of salmon habitat. A review of the unique duality between riffle and pool units is presented along with mechanisms for formation and maintenance. The goal is to enable designers to generate fluvial topography through process-based metrics that obey the laws of physics and are objective, rather than subjective. The design approach presented herein can be used in both planning and design.

North Fork Sprague River Restoration, Bailey Flat, Klamath County, Oregon

Brian Hastings, *Geomorphologist/Hydrologist, Balance Hydrologics, Inc.*

Two recently-signed pacts to remove four hydroelectric generating dams on the Klamath River in northern California and Oregon would re-open more than 350 miles of riverine habitats to salmonids and other fish. In preparation for this eventuality, the United States Fish and Wildlife Service (USFWS) has been spearheading a cooperative program to restore, create and otherwise enhance habitats in the upper Klamath Basin watershed for when salmonids and other anadromous fish once again can migrate up through the Williamson, Sprague, Sycan and Wood Rivers. The restoration is also critically driven by habitat needs of two endangered suckers, plus redband trout and federally-threatened bull trout, which have made these rivers some of the premier fisheries streams in the western states.

A key 1.3-mile reach of the North Fork Sprague River, where it emerges from the Fremont National Forest, was straightened and aligned in the 1960's along one side of the canyon to support grazing pasture. The straightened reach was held in place by riprapped levees in an attempt to stabilize the channel and minimize flooding. Private property owners and the USFWS retained Balance Hydrologics to re-naturalize the channel, restore channel-floodplain functions, and enhance aquatic habitat. This restoration will immediately benefit native redband and bull trout, as well as Klamath large-scale sucker, all species of concern. The project is a lynchpin of agency efforts to prepare habitat suitable for re-establishing anadromous salmonids following the pending removal of the four Klamath River dams. Conceptual designs and flow simulations were developed in 2009 and project construction was completed in 2010 under Balance Hydrologic's direction. This will be one the largest restoration projects yet attempted in the upper Klamath watershed.

Monitoring Annual Trends in Abundance and Distribution of Steelhead Above and Below Matilija Dam, Ventura, California

Paul Jenkin, *Surfrider Foundation & Matilija Coalition*

Population and habitat surveys of the endangered southern steelhead have been conducted on the Ventura River since 2003 in association with the Matilija Dam Ecosystem Restoration project.

The objective of the ongoing studies is to establish baseline conditions prior to dam removal and contribute information on the variability of populations for the Steelhead Recovery Planning process. The key scientific question is the variation in annual populations in the drought-and-flood climate of Southern California, and the ultimate response of fish populations to a large-scale watershed restoration project such as dam removal.

The Matilija Coalition received a Fisheries Restoration Grant to support two years of comprehensive monitoring of steelhead populations on the Ventura River in 2010 and 2011. The data set is presented, along with observations and recommendations regarding limiting factors to current populations and recovery actions needed.

A Programmatic Approach to Second-growth Logging on Non-industrial Lands in the Mattole Watershed as a Way of Protecting a North Coast Salmon Stronghold

Seth Zuckerman, *Wild and Working Lands Program Director, Mattole Restoration Council*

Recent trends in stand age and environmental regulation pose new challenges for the management of nonindustrial timberlands on California's North Coast and their continued value in the protection of salmonid refugia.

Second-growth stands in the Mattole watershed are now approaching economic maturity, at ages of 50 to 65 years. For non-industrial landowners who rely on timber income for the economic viability of their family ranches or other holdings, the feasibility of logging second-growth forests may make the difference between continued operation of the family ranch and subdivision or parcelization, which would fragment wildlife habitat and lead to increased water withdrawals from area streams. Salmonid refugia may therefore benefit from continued economic feasibility of second-growth logging, provided it is carried out in an ecologically sensitive manner.

At the same time, however, non-industrial owners confront the fall-out of regulations aimed at curbing the excesses of timber firms oriented toward short-term profit. The increased costs of geological reports; biological, botanical, and archaeological surveys; and cumulative impact analyses have pushed the cost of timber harvest plans to an average of $30,000 or more. These steep planning costs decrease the feasibility of light-touch harvests, and directly result in more trees being cut in order for landowners to meet a given net revenue target.

With support from Proposition 40 funds via the State Water Resources Control Board, the Mattole Restoration Council has crafted a programmatic approach to the regulation of second-growth cutting through its Mattole Forest Futures Program. It aims to reduce permitting costs by about half for landowners who abide by a set of guidelines that are more prescriptive than the state's Forest Practice Rules. (*www.mattole.org/ptei*r) For instance, streamside buffers are wider, clearcuts and other forms of even-aged management are disallowed, and net new road-building is limited to one thousand feet per plan. Site-specific Program Timber Harvesting Plans are expected to be filed beginning in summer 2011, and the first harvests under the program are anticipated for 2012.

Similar programmatic approaches—aimed at aiding smaller landowners while upholding rigorous standards of environmental protection—may be of use in other salmon strongholds to help make the satisfaction of local human needs compatible with the habitat needs of threatened salmonids that thrive there.

California Coastal Salmonid Population Monitoring: Strategy, Design, And Methods

Pete Adams (Presenter), *National Marine Fisheries Service, Southwest Fisheries Science Center;* ***L.B. Boydston,*** *Fisheries Consultant;* ***Sean Gallagher*** *and* ***Michael Lacy,*** *and* ***Kevin Shaffer,*** *California Department of Fish and Game;* ***T. McDonald,*** *West Inc.*

Currently in California, coastal salmonid monitoring occurs in locations where there is local interest and these monitoring are efforts disconnected from each other. What is needed is a coast-wide coordinated monitoring effort to assess status and trends of these fishes. Without this type of monitoring, we can not know what condition salmonid populations are in and whether our actions are helping or harming these populations. The California Coastal Salmonid Population Monitoring Plan has been developed to gauge the condition and recovery of coastal salmonids and uses the Viable Salmonid Population concept; abundance, productivity, spatial structure, and diversity; as a framework. It divides California into Northern and Southern areas with a boundary north of the Pajaro River. In the Northern Area, adult abundance will be estimated through expanded redd surveys selected in a random, spatially-balanced way, and in the Southern Area, adults will be counted at fixed stations. This difference is due to changes in species composition and extreme low abundance in the south. Productivity is calculated as the change in adult abundance. Spatial structure will be monitored using juvenile summer-fall snorkel surveys. Diversity traits are locally different, and will need to be examined using local diversity monitoring plans. Finally, life-cycle monitoring stations will be used to estimate marine and freshwater survival. These stations would have an adult counting station, redd surveys above the counting station, and outmigrating trapping station which would provide "fish-in, fish-out" estimates. The plan also outlines the important infrastructure functions of data management, data reporting, and monitoring performance review.

How Do We Know How Many Salmon Returned to Spawn? Implementing the California Coastal Salmonid Monitoring Plan in Mendocino County, California

Sean P. Gallagher, *California Department of Fish and Game*

California's coastal salmon and steelhead populations are listed under the California Endangered Species Act and Federal Endangered Species Act. Both listings require recovery plans and monitoring to provide measures of recovery. Since 2004 the California Department of Fish and Game and NOAA Fisheries have been working to develop a plan for monitoring California's coastal salmonid populations (the California Coastal Salmonid Monitoring Plan- CMP). This plan outlines a strategy to monitor salmonid populations status and trends at evolutionarily significant regional spatial scales, while still providing population level estimates. For the CMP, data to evaluate adult population status are collected in a rotating panel design using a spatially balanced probabilistic (e.g. Generalized Random Tesselation Stratified- GRTS) design. Under this scheme a two-stage approach is used to estimate regional population status. Regional redd surveys (stage 1) are conducted in stream reaches in a GRTS sampling design at a survey level of 15% or ≥ 41 reaches, which ever results in fewer reaches, of available habitat each year. Spawner: redd ratios, derived from smaller scale census watersheds (stage 2) where "true" escapement is estimated using capture-recapture methods, are used to estimate regional escapement from expanded redd counts. Beginning in 2008-09 we applied the results of our previous pilot studies to estimate salmonid escapement for the Mendocino coast region, the first implementation of the CMP in the state. Here we present the results of the first two years of this monitoring effort and discuss our findings in context of expanding the CMP to all of coastal California. We discuss sample frame development, sample size, and present escapement data for six independent and eight potentially independent populations and two Diversity Strata within the Central California Coho Salmon Evolutionarily Significant Unit.

Overview of Population Trends in and Current Monitoring Efforts for Southern Steelhead

Mark H. Capelli, *National Marine Fisheries Service*

The National Marine Fisheries Services has listed two Distinct Population Segments of steelhead (*Oncorhynchus mykiss*) within the southern half of coastal California: a threatened sub-population along the south-central coast and an endangered sub-population along the south coast to the U.S. Mexico border. These listings were based on an assessment that stocks of most of the coastal and inland drainages between Monterey Bay and the U.S. Mexico Border have been severely depleted. However, the precise numbers of annually returning adults and rearing juveniles in virtually all of these watersheds remains unknown. A variety of factors complicates the monitoring of populations of southern steelhead. Some of these include: the naturally highly fluctuating nature of southern steelhead populations; the flashy nature and prolonged turbidity of many coastal watersheds; the extensive areas to be monitored versus the current low density of adults; and the lack of a clear distinction between anadromous versus non-anadromous forms of southern steelhead.

Currently, only four of the core watersheds identified in the National Marine Fisheries Service's draft steelhead recovery plans for the two southern steelhead Distinct Population Segments have active monitoring programs for adult, anadromous fishes: Carmel River, Santa Ynez River, Ventura River, and the Santa Clara River. These programs are relatively recent (with the Carmel River having the longest time-series of observations), and each has limitations which create uncertainties regarding the accuracy of the number of fishes annually reported. Other recent monitoring efforts and incidental observations on smaller watersheds such as San Luis Obispo, Mission, Malibu, and Topanga Creeks have provided valuable information about steelhead use of these watersheds, but the data collected is not readily comparable between watersheds because of differing levels of monitoring effort and methods.

The California Department of Fish and Game and the National Marine Fisheries Service are in the process of developing a Coast Wide-Monitoring Plan for Pacific Salmonids that will provide a framework for monitoring the status of steelhead in a consistent manner, allowing a more rigorous assessment of the current status and trends of southern steelhead. Completion and implementation of the Plan will be challenging, both logistically and fiscally. However, as part of the proposed monitoring strategy the California Department of Fish and Game has initiated steps to deploy the first of a series of monitoring devises (DIDSON cameras) which are designed to deal with some of the challenges of monitoring steelhead in California coastal watersheds.

Instituting a long-term monitoring program for Southern steelhead will be essential in refining the current provisional Distinct Population Segment and individual population viability criteria the National Marine Fisheries Service's draft recovery plans for South-central and Southern California coast steelhead, as well as quantifying the current status and longer-term trends of steelhead populations.

Determining the Hatchery Composition of In-river Spawning in Chinook salmon on the Feather River

Jim Hobbs, *University of California, Davis*

In-river spawning of hatchery derived Chinook salmon and stocks from adjacent watersheds compromise the genetic integrity of the wild Yuba River population through outbreeding depression and genetic homogenization. To determine the hatchery composition and stock integrity of in-river spawning Chinook salmon we proposed to utilize the otolith microstructure and microchemistry techniques on otolith samples collected during carcass surveys planned in fall 2009. Here we propose to use Sr isotopes in otoliths as a natural tag to identify hatchery from wild individuals. Otolith Sr isotopes (87Sr/86Sr) can be used as natural tags to identify hatchery and wild produced Chinook salmon returning to the Feather River watershed because hatchery practices utilize an ocean based feed which elevates the otolith 87Sr/86Sr compared to in-river reared fish (Kennedy et al 2000, Barnett-Johnson et al 2005, 2008). Using the otolith calcium architecture and the Sr isotope ratios (87Sr/86Sr), we determined the proportion of hatchery derived adult fish spawning in River from 2002-2008. Our results show that a significant proportion of in-river spawning Chinook salmon are hatchery fish. In addition, a large proportion of spring run identified fish where actually Fall-run fish, suggesting a significant introgression of runs as well as hatchery origins.

This study supplies resource managers with critical information regarding the influence of hatchery Chinook salmon on the Central Valleys' largest stock of Fall-run Chinook. The effect of outbreeding of hatchery fish into the wild population could be a factor associated with the population collapse.

Historical Overview of Eel River Salmon and Steelhead

Ronald M. Yoshiyama (Presenter) and Peter B. Moyle,
Department of Wildlife, Fish and Conservation Biology, UC Davis

The Eel River basin historically supported significant populations of at least five distinct kinds of anadromous salmonids, including fall-run Chinook salmon, coho salmon, winter and summer steelhead, and coastal cutthroat trout. In addition, there were smaller numbers of chum and probably occasionally some pink salmon. The historical plenitude of salmon in the Eel River motivated the establishment of a commercial salmon fishery as early as 1854, along with associated salting, pickling and canning operations. A single salmon cannery operated intermittently on the Eel River during the late-19th to early-20th centuries, producing a peak output of 15,000 cases of canned salmon during 1883.

The cannery and pickling data can be roughly translated into minimal population estimates that average about 93,000 fish per year during the period 1857-1921 and evidently approached 600,000 fish in the peak year 1877, mostly Chinook salmon. Because the cannery and pickling records result in a very conservative estimate of Chinook numbers, the records suggest that historic runs of Chinook salmon probably ranged between 100,000 and 800,000 fish per year, which declined to about 50,000-100,000 fish per year in the first half of the 20th century.

The most realistic and reliable points of reference for past population levels of Eel River salmonids are the abundance estimates reported by the California Fish and Wildlife Plan for the mid-1960s through the 1970s. The salmonid populations had already experienced decades of commercial harvest and habitat degradation, but their numbers still were at fairly high levels—e.g., tens of thousands of spawners in the South Fork Eel River alone. In the 1960s, it was estimated that Chinook salmon averaged 56,000 spawners annually in the entire Eel River basin and coho salmon averaged 14,000 spawners annually. Steelhead numbers during the early-1960s were estimated at 82,000 spawners for the entire Eel River system.

After the great floods of 1955 and 1964, annual Chinook salmon runs were generally much less than 10,000 fish. The most recent numbers suggest that less than 1,000 wild adults per year have returned to the Eel River basin in recent years.

For coho salmon, historic numbers of spawning adults were probably in the range of 50,000-100,000 fish per year. Over the first half of the 29th century, there still may have been runs of 20,000-40,000 coho, based on angler reports. By the 1960s, the number of coho spawners was likely less than 15,000 fish, with the numbers dropping by about 5-10% of spawners per year in subsequent years. Coho salmon thus appear headed for extirpation from the Eel River basin by 2025, if not sooner.

Both winter and summer steelhead have also undergone severe declines in the basin. Based on habitat availability and the few population estimates that exist, historic numbers were likely 100,000-150,000 steelhead adults per year (both runs combined), declining to 10,000-15,000 by the 1960s. Present steelhead numbers are probably considerably less than 1,000 in both runs.

The distribution of salmon and steelhead in the Eel River basin has not changed as much as their abundance, although probably many populations are now missing. Remnant populations, especially of winter steelhead, remain in much of the historic habitat.

Historically, in wet periods with good ocean conditions, the Eel River probably supported runs totaling over a million salmon and steelhead—800,000 Chinook, 100,000 coho, and 150,000 steelhead—and about half that number were present in less favorable years. At present, the numbers seem to be, on average, about 3,500 fish total (±1,000) per year—about 1,000 Chinook, 500 coho, and 2,000 steelhead. These numbers are very approximate, but they are the best that can be supported by existing information. Regardless, they represent a 99% decline in numbers.

Judging from the long-term trends, we conclude that coho salmon, Chinook salmon, and steelhead are all on a trajectory towards extinction in the Eel River basin, with only winter steelhead being widely enough distributed and abundant enough to persist beyond the next 50 years.

A Standard Method for Evaluating Species Status

Jacob Katz (Presenter), Rebecca Quinoñes and Peter Moyle,
Department of Wildlife, Fish and Conservation Biology, UC Davis

In conservation biology, lack of regional standardized species status assessments leads to:

- mismatched geographic scales between assessments and the jurisdiction of conservation managers
- shifting baselines, the inability to compare the status of the same taxon through time, and
- the inability to compare status across taxa, greatly complicating attempts to determine conservation priorities

At the global scale, there has been much progress on standardizing conservation status assessments over the last 20 years, especially by the (IUCN). Standardization has transformed the International Union for the Conservation of Nature's Red Lists of endangered and vulnerable species into powerful tools for highlighting patterns of global biodiversity loss. The Red Lists, however, are of limited utility for on-the-ground assessment of extinction threats to specific populations. At this scale, population viability analysis and other related tools are extremely robust but also very data-hungry. The monitoring effort needed to collect the data for such analyses makes them prohibitively expensive in all but the most special circumstances.

Conducting assessment of all taxonomically related species (i.e., inland fish or amphibians) within a bioregion will allow the use of the same metrics for all taxa. The resulting analysis will reveal landscape-scale and species-specific causes of decline that are not apparent when a single species is assessed alone. Comparison of an entire bioregion's taxonomic species assemblage will also help identify species that are not currently threatened but may become so in the future. This last point may be the most important of all. We cannot continue to only assess the threat of extinction for those species already approaching it. We must get ahead of the extinction curve.

Historically, most conservation assessments have used different protocols and methods between reports, so that sequential assessments of the same taxon are not directly comparable. This makes it difficult to track the abundance/population trends of individual taxa and accurately assess conservation status. Consecutive use of the same standardized protocol through time will create the continuity needed to track relative changes in species' vulnerability to extinction. The use of a standardized protocol will also allow the direct comparison of status between different taxa, an important tool in the prioritization of conservation efforts and allocation of precious conservation funds.

This talk will present the details of our standardized protocol and report the results of its application to all 129 native inland fishes of California.

Evaluating River Rehabilitation Effectiveness on Chinook Salmon Rearing Habitat in a Large, Regulated River System in Northern California

J. Alvarez (Presenter), Hoopa Tribal Fisheries Department, Hoopa Tribe; D.H. Goodman, U.S. Fish & Wildlife Service; and A. Martin, Yurok Tribal Fisheries Program, Yurok Tribe

Many stream rehabilitation efforts are conducted on the Pacific Coast of North America, but few of these include a quantitative evaluation of their effectiveness at obtaining restoration goals, particularly in large river systems. We developed a methodology to evaluate the effectiveness of habitat restoration on large-scale rivers. The methodology has been evaluated and applied on the Trinity River system in northern California. The completion of the Trinity Division of the Central Valley Project in 1964 drastically altered the aquatic ecosystem and contributed to the drastic decline of anadromous fish populations. A large-scale restoration program was initiated in 2000 to improve the aquatic habitats of anadromous salmonids, as well as other aquatic species, through a multi-faceted rehabilitation effort, including flow management, mechanical channel rehabilitation, and coarse sediment augmentation. One of the primary goals of the rehabilitation effort is to increase Chinook salmon rearing habitat, the primary limiting factor for their populations. To evaluate the effectiveness of the rehabilitation efforts, we have developed a spatially explicit habitat evaluation methodology targeting Chinook salmon rearing habitat. The rearing habitat evaluation was applied on the Trinity River to evaluate changes in habitat availability at restoration sites for the Trinity River Restoration Program and provide feedback to the adaptive management framework. We applied a pre-construction and post-construction study design to evaluate bank rehabilitation effectiveness. These evaluations can be used to compare different sites and treatment types.

Restoring the San Joaquin River: Restoration Objectives, Challenges and Lessons Learned from the First Full Year of Planned Interim Flow Releases to the River

Rod Meade, *Restoration Administrator, San Joaquin River Restoration Program*

For the first time since 1946, the San Joaquin River conveyed non-flood flows to San Francisco Bay during the spring of 2010. The San Joaquin River Restoration Program (SJRRP) is responsible for this historic achievement. The SJRRP is the product of a Settlement approved by a federal Court after 18 years of litigation and it links the Bureau of Reclamation, Friant Water Users and Natural Resource Defense Council and other Settling Parties in a commitment to restore a 153-mile stretch of the River. This presentation describes challenges related to achieving the Settlement's Restoration Goal, which is to " . . . restore and maintain fish populations in 'good condition' in the main stem of the San Joaquin River below Friant Dam to the confluence of the Merced River, including naturally-reproducing and self-sustaining populations of salmon and other fish." The SJRRP is one of the nation's most ambitious river restoration program attempted to date and, in order to achieve the continuous San Joaquin River flows to San Francisco Bay in 2010, the Program has had to confront a range of technical, political, legislative, regulatory and funding obstacles. This paper focuses on the technical challenges and related "lessons learned" during preparation for, and implementation of, the first year of Interim Flows. Interim Flows are experimental flows designed to enable much-needed to be compiled to inform future implementation of the Restoration Flows that will support the water conveyance, management and habitat restoration actions needed to support the "naturally-reproducing and self-sustaining" populations of salmon and other fish and otherwise comply with the terms of the Settlement. Primary current and future challenges to successful completion of the SJRRP also are discussed.

Developing a Strategy to Reintroduce Spring-Run Chinook Salmon into the San Joaquin River

Michelle Workman, *Fisheries Biologist/Habitat Restoration Coordinator, U.S. Fish and Wildlife Service*

One of the goals of the San Joaquin River Restoration Program (SJRRP) is to restore and maintain fish populations in "good condition" in the mainstem San Joaquin River below Friant Dam to the confluence with the Merced River, including naturally reproducing and self-sustaining populations of salmon and other fish. One objective in achieving this goal is the successful reintroduction of anadromous salmonids to the Restoration Area, with a primary emphasis on Spring-run Chinook salmon, the historically dominant race present in the San Joaquin system, and a secondary emphasis on Fall-run Chinook salmon. A strategy to determine appropriate donor stock(s), reintroduction methods, and monitoring plans have been developed by an interagency team within the San Joaquin River Restoration Program (SJRRP). This presentation describes both the process for developing the strategy, and the specific elements of the strategy.

Preliminary Rehabilitation Planning in Support of Chinook Salmon in the Lower Yuba River

Chris Hammersmark (Presenter), *Ecohydrologist, and* ***Chris Bowles,*** *President cbec eco-engineering;* ***Gary Reedy,*** *South Yuba River Citizens League, River Science Director;* ***John Bair,*** *Riparian Botanist, and* ***Scott McBain,*** *Fluvial Geomorphologist, McBain & Trush*

The status of Chinook salmon in the lower Yuba River warrants investment in rehabilitation actions to improve the resiliency of populations that are impacted by poor or uncertain survivorship downstream. Anthropogenic factors, dating back to hydraulic gold mining and inclusive of the current regulated flow regime, contribute to the need for improving fry and juvenile rearing habitat quantity and quality via rehabilitation of the channel habitats and riparian vegetation in the lower Yuba River. This initial effort focuses on the Parks Bar to Hammon Bar reach of the Yuba River, but efforts are underway to expand the geographic scope to include the entire lower Yuba River. The primary goal of rehabilitation is to improve rearing habitat quality and diversity and can be achieved using a variety of rehabilitation elements, which include planting riparian vegetation, reconnecting floodplain areas, constructing side channels and backwaters, and creating in-channel habitat features (e.g., large wood). Using a combination of these rehabilitation elements, several potential rehabilitation projects are proposed (cbec 2010). To implement the proposed effort five "next steps" are recommended: 1) coordinate monitoring and evaluation efforts to refine rehabilitation objectives and evaluate project effectiveness; 2) promote research on critical questions for prioritizing and designing restoration projects; 3) implement pilot projects for riparian planting and wood placement that test both design features and performance; 4) convene a technical forum for developing additional rehabilitation concepts and subsequent pilot projects; and 5) develop a comprehensive rehabilitation plan for the lower Yuba River corridor.

Proposed Gravel Management Plan to Support Chinook Salmon Recovery Efforts on the Shasta River, California

Darren Mierau, McBain and Trush, Inc.

Regulation of sediment supply and streamflow in the Shasta River basin may have direct and adverse consequences for anadromous salmonid habitat, present-day population abundance, and future population recovery. In recognition of the reduced sediment supply and spawning gravel abundance, inventories and augmentation efforts in the Shasta River basin were conducted by the California Department of Water Resources (DWR) in the early 1980s. These augmentation efforts were successful at attracting spawning salmonids, but a program to resupply spawning gravel was not developed and the augmentation projects were not maintained. As a result, habitat benefits created by past gravel augmentation efforts were eventually lost as spawning gravels dispersed downstream during high flows and the alluvial features they created winnowed away. To evaluate whether contemporary sediment supply and spawning gravel storage could be limiting salmonid populations, we studied aspects of gravel supply, storage, routing, and quality as they relate to spawning habitat. The study findings suggest spawning gravel quantity in the mainstem Shasta River and in key tributary reaches may be limiting Fall-run Chinook salmon fry production during high escapement years, and spawning gravel quality may be limiting Chinook and coho salmon fry production in all escapement years via impairing egg survival-to-emergence in some locations. Based on these study results, a Spawning Gravel Augmentation and Enhancement Plan was developed for Chinook and coho salmon. The Spawning Gravel Augmentation and Enhancement Plan proposes to: 1) increase spawning gravel quantity via spawning gravel augmentation, improved gravel routing through diversion structures, and improved access to under-utilized spawning reaches, and 2) improve spawning gravel quality via fine sediment maintenance flow releases and pilot augmentations of clean gravel. Recommendations in action, location, and sequence are tailored to target specific life-history tactics of Chinook and coho salmon in the basin. Current spawning habitat conditions for Chinook salmon are also summarized, and enhancement strategies for population recovery via spawning gravel augmentation and enhancement actions are proposed.

Bay Delta Conservation Plan: Permanent Closures or a Ray of Hope for the Chinook Salmon Fishery

Zeke Grader, Pacific Coast Federation of Fishermen's Associations

The Bay Delta Conservation Plan was developed by water contractors and water agencies to develop a Habitat Conservation Plan, under the Endangered Species Act, to allow the "take' of endangered species, most notably salmon, in the pumping of Delta water for export to the San Joaquin Valley and Southern California. Dominated by water interests, the effort over the course of some 120 meetings, has been to develop a plan for publicly financed restoration projects around the Delta and upstream, in return for the development of a water conveyance facility—either a peripheral canal or under the Delta tunnel—to maintain or expand current levels of water exports. Recent scientific studies have determined that to restore the Bay-Delta—the most important estuary on the west coast of the Americas—that freshwater inflow to and west through the Delta to the Bay would be necessary for the restoration of the estuary and recovery of ESA-listed species. The election of Jerry Brown and the science studies have thrown a curve to the water agencies and contractors, and hope to fishing and conservation groups and Delta residents that it may still be possible to design a Bay Delta Conservation Plan that will, in fact, restore the estuary, recover listed Winter and Spring-run Chinook and other listed fish, and help to rebuild the economically-important Central Valley Fall-run Chinook populations.

Introduction to the North American Salmon Stronghold Partnership and Development of the Stronghold Approach

Mark Trenholm, *North America Program Director, Wild Salmon Center*

Populations of native Pacific Salmon are broadly distributed from Japan around the Pacific Rim to California, and runs of wild salmon have generally been declining in the southern range of North America since the mid 1800s. More than 29% of the estimated 1,400 populations of native salmon and trout in the contiguous western United States have been lost (Gustafson et al. 2007), and roughly one third are currently listed under the Endangered Species Act. As efforts to recover these populations continue, significant threats to healthy wild salmon ecosystems persist, threatening the long term viability of currently strong populations. Declines in these strong populations could not only limit the effectiveness of recovery efforts, but also reduce the resilience of populations to environmental changes triggered by climate change, population growth, and other challenges.

To ensure that currently healthy populations do not suffer the same declines as listed and extirpated populations, a consortium of state and federal agencies, private organizations, and tribes has convened to establish the North American Salmon Stronghold Partnership. The Stronghold Partnership is a voluntary, incentive-based effort intended to supplement ongoing ecosystem protection and restoration efforts by promoting the conservation of the healthiest remaining wild Pacific salmon ecosystems—salmon strongholds—and the wild populations which rely on them. The core of the Partnership's work focuses on defining and advancing "the stronghold approach", which seeks to: 1) scientifically identify a network of salmon strongholds; 2) promote the development and implementation of prevention-based strategies to protect strongholds and their wild populations from emerging threats; and 3) examine the root causes of limiting factors in strongholds and support new and innovative approaches to address them.

Wild Salmon Center and our non-federal partners are seeking to institutionalize the stronghold approach by supporting passage of the Pacific Salmon Stronghold Conservation Act. This Act will complement efforts to recover threatened and endangered stocks by expanding federal support and resources for the protection and restoration of salmon strongholds in North America.

A Process for Establishing a Network of Salmon Strongholds Around the Pacific Rim

Gordon Reeves (Presenter), *PNW Research Station, Corvallis, OR,* ***Tom Miewald,*** *US Fish and Wildlife Service, Portland, OR and* ***Michael Schindel,*** *The Nature Conservancy, Portland, OR*

Conservation organizations and government agencies around the north Pacific Ocean are expanding efforts to conserve wild populations of native salmonids, including considering the establishment of areas where the production and conservation of these fish is emphasized. We used an optimization model, Marxan, to illustrate a process for indentifying a potential network of freshwater strongholds based upon attributes such as respresentiveness, flexibility, irreplaceability, and complementarity, and consideration of species abundance and diversity. Factors such as the presence of dams, hatcheries, and developed lands were also considered. We established sequential conservation goals based on the proportion of total abundance of salmonids in each ecoregion. The selection process was done in a step-wise manner and has the potential to be the basis for a Rim-wide network of strongholds that contributes to the long-term persistence and productivity of wild salmonids. The process could also be used at smaller spatial scales. Development of a final network will require a cooperative effort of the involved entities and the scientific community to establish goals and objectives. Additionally, it will require consideration of factors such as climate change and environmental complexity.

The Ecological Need for the Salmon Stronghold Approach in California and Integrating this Strategy with Existing Restoration, Recovery, and Conservation Programs

Kevin Shaffer, *Fisheries Branch—Anadromous and Native Fish Conservation, California Department of Fish and Game*

The condition of salmon and steelhead populations across California has been an essential conservation topic since the 1920s. Up to the 1970s and early 1980s, focus was placed on many land-based, human practices: gold mining, river canaries, forestry practices, etc. As the century ended other issues rose: commercial harvest, water storage and conveyance, hatchery management, rapid expansion of human populations. New federal and state statutes focused on protection of native species threatened or endangered with extinction, and within two decades, this protection was deemed necessary for the vast majority of populations of Chinook and coho salmon and steelhead in California. The 1980s also saw the development of coastal restoration and in the 1990s restoration in the Central Valley became a primary focus for fisheries and water agencies.

Statutory protection and its associated recovery actions and freshwater and estuarine habitat restoration were and are crucial programmatic strategies to ensure anadromous salmonids are maintained and to regain recreational, tribal, and commercial fisheries both in the ocean and inland waters. But two important developments reveal that current approaches are not sufficient: (1) improvements in science, especially in ecology, hydrology, and geo-morphology have informed us about functioning watersheds, land practices, and response of salmon and steelhead, and (2) acknowledgement that restoring habitat and focusing on recovery of the most-at-risk populations has not provided anticipated and necessary results over the last 30 years.

A consequence of these developments is the fundamental concept of protecting and enhancing watersheds where ecological processes are highly-functioning, land practices are in tune with the ecology of the watershed, fish populations are either stable or increasing, and human communities are dedicated to maintaining and improving conditions both terrestrially and aquatically.

California has the southern extent of three species of anadromous salmonids. This has significant genetic diversity and biological adaptation values. What is more, what exists in California corresponds to species-wide and genus plasticity across the entire eastern Pacific region and essential ecological role of the salmonids in California waters. Given the rate of declining populations of salmonids, protecting the best populations and watersheds we have left in the State is a crucial component of overall conservation. Moreover, with continuing human encroachment, ongoing struggles over water management, and growing knowledge and concern about what climate change may mean for aquatic ecosystems and species, the time has arrived to put as much emphasis on protecting and promoting salmonid strongholds as Californians dedicate to recovery and restoration.

Stronghold Identification in the Lower 48: The California Model

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and ***Amber Gladieux,*** *GIS Analyst, Wild Salmon Center*

Delineation of salmon strongholds is based on expert judgment, spatial and empirical data and decision support tools. This report explains the methodology used in the identification of six salmon strongholds in California (CA). This process may be summarized as follows:

- First, a project team consisting of state, federal, and non-governmental organization (NGO) representatives approved eco-regional boundaries, reviewed the stronghold identification methodology, and established a working list of CA salmon experts to engage in an evaluation of the state's wild populations.
- Second, these salmon and steelhead experts provided their assessments of the biological status of 507 populations, which yielded a map of strong populations.
- Third, the project team analyzed the strong population data, along with Trout Unlimited's Conservation Success Index (CSI) by using a conservation decision support tool called Marxan to identify high conservation value watersheds.
- Finally, the project team presented the methodology and results of this process to the Stronghold Partnership Board, which approved the CA Salmon Stronghold map.

This approach represents the Stronghold Partnership's most comprehensive and technically rigorous stronghold identification process to date. The technical elements of this approach will soon be used in Oregon, Idaho, and Washington. In each of these states, to ensure consistency across the range of strongholds, project teams convened by the Stronghold Partnership will undertake these essential steps: 1) a comprehensive expert assessment, 2) utilization of DSM decision support tools to identify strong populations, 3) utilization of Marxan to develop spatial design alternatives, and 4) expert review and selection of final alternatives, including consideration of scale, connectivity, suitability, and protective status. Collectively, the strongholds identified using this process represent less than five percent of the state, ten percent of salmon bearing streams, and roughly 70 percent of the diversity of salmon and steelhead populations in California. These strongholds include a total of 69 populations of which 29 were rated as strong, diverse, and wild.

Assessment of Threats to Strongholds: Assessment with Trout Unlimited's Conservation Success Index

Kurt Fesenmyer (Presenter) and Jack Williams, Trout Unlimited

The Conservation Success Index (CSI) is a geospatial tool developed by Trout Unlimited to analyze the status of native salmonids across their historic range and develop place-based conservation strategies for protection and restoration efforts. The CSI provides a common framework to quantitatively evaluate each species/run of salmon and steelhead in California across 14 indicators related to range-wide conditions, habitat integrity, and future security. We demonstrate an application of the CSI to the California Salmon Strongholds analysis, specifically as a tool for describing the existing and future threats facing strongholds. Current threats include existing water and transportation infrastructure, within-watershed and downstream barriers, and temperature stressors. Anticipated future threats include land conversion related to urban and vineyard development, resource extraction, sedimentation risk, and climate changes related to temperature, flow, and precipitation regimes. We discuss the pattern and implication of these and other threats across the network of strongholds.

Future Steps: Identifying Bottlenecks and High Impact Strategies

Jeanette Howard (Presenter), *Pacific Salmon Ecosystems Program,*
and ***Wendy Millet,*** *Director, and* ***Sally Liu,*** *The Nature Conservancy*

The Conservancy is focused on building a new and integrated paradigm to protect all stages of the salmon life-cycle—from headwaters to sea. Building on our work with NOAA to apply our conservation planning process to the California Coho Recovery Plans, we developed the Salmon Life-Cycle Investment Program (SLIP). SLIP helps align conservation actions around the specific needs of salmon at each life-stage and link those actions—from headwaters to sea—to assure coordinated and strategic investments.

Scientists have used the integrated "life-cycle" concept for years but it has rarely been applied to guide conservation strategies on the ground. With SLIP, practitioners focus on key questions about (1) the critical factors limiting salmon survival at each life stage, (2) the connections and tradeoffs between conservation actions at each stage and (3) the existing or future strategies to address bottlenecks and create a complete and healthy life-cycle for salmon.

SLIP is a comprehensive life stage and geographic analysis, and can also be used to identify patterns across multiple salmon runs and target where new larger-scale strategies are needed. Using this approach, we hope to achieve the following combination of place-based work, policy and science:

- Fundamentally change the investment paradigm of public and private partners and improve coordination among management entities from headwaters to sea.
- Engage partners around a shared toolbox for prioritizing and investing so as to assure critical places become safe from threats.
- Ensure a network of healthy salmon runs that represent genetic and geographic diversity in the face of climate change and support healthy ecosystems and sustainable economies.
- Explore "unchartered waters" of salmon movement in the ocean and identify priorities for protection.

Conceptual Modeling as a Tool to Identify Controls on Salmonid Habitat Availability in California Central Coast Lagoons

***Christina Toms, PWS** (Presenter) and Stuart Siegel, **PhD, PWS,** Wetlands and Water Resources; **Peter Baye, PhD,** Annapolis Field Station; **Brian Hastings, Jonathan Owens,** and **Barry Hecht,** Balance Hydrologics; **Don Alley,** D.W. Alley and Associates*

As recent research has elaborated on the critical nature of coastal lagoon habitats to the life cycles of salmonids and other special-status species, these systems have received increased attention by resource management agencies and landowners as well as the scientific community. However, much of this attention has focused on biological and ecological functions of interest—not the physical processes driving the dynamics behind these functions. As a result, efforts to manage or enhance these ecosystems are often stymied by inadequate assessments of short-term and long-term dynamics in controlling fluvial and coastal processes. In an attempt to address this deficiency, the authors present an integrated conceptual modeling approach that they have successfully implemented at two very different coastal lagoons: Laguna Creek Lagoon in Santa Cruz County and Pilarcitos Lagoon in San Mateo County. This approach is based upon focused field data collection, historic aerial photograph interpretation, and a rigorous review of scientific literature and related historical resources. The models are used to both identify potential management and enhancement measures and help assess the feasibility of these measures.

Morphological Classification of California Coastal Lagoons: Challenges and Implications for Management

Peter Baye, Ph.D. (Presenter), Annapolis Field Station,
and Christina Toms, Wetlands and Water Resources

Coastal lagoon morphology is governed by complex dynamics between fluvial and coastal processes. Frequently, coastal lagoon habitats are classified according to their position relative to the tidal frame, though many (if not most) of these systems in northern and central California are actually varying degrees of supratidal. For example, in lagoon systems with highly aggraded floodplains and channels, true "lagoon" habitat (of value to rearing salmonids) is restricted to backshore runnels and impounded upper intertidal/supratidal flats. These distinctions are often not made clear in the literature, so the authors present a conceptual morphological classification system to aid in assessment and management planning.

Geologic Controls and Episodic Variability of Sediment Supply in Managing Pilarcitos Lagoon, San Mateo County, California

***Brian Hastings (Presenter), Barry Hecht,** and **Jonathan Owens,** Balance Hydrologics; and; **Christina Toms,** Wetlands and Water Resources*

An interdisciplinary team of scientists recently developed a suite of enhancement options for Pilarcitos Lagoon, an unusual hyper-elevated freshwater lagoon near Half Moon Bay, California. The primary objective of enhancement is improving passage for steelhead, both upstream adult migrants and downstream-migrating smolts. Our investigations found that the size, elevation, and permeability of the beach berm were by the far the dominant factors affecting the duration of steelhead migration windows. Yet very little was known about the littoral sand supply and the local terrestrial sources which govern the height of the berm, its permeability, and several key factors which affect how, when and where the system can breach.

We estimated the littoral sand supply in two independent ways: (1) longshore drift mobility simulations using standard Corps of Engineers models, and (2) beach-retreat calculations over 5- and 20-year periods, adjusted with local particle-size distributions to eliminate silt and gravel fractions. Results differed by nearly an order of magnitude, compounded by the construction of Pillar Point Harbor four miles to the north in the late 1960s, which sharply interrupted the volume and continuity of longshore drift. Terrestrial delivery was estimated from the results of a detailed 3-year sediment budget based on detailed suspended and bedload sediment measurements that we had earlier collected, validated by samples collected for this study. Because the sediment data had been collected during wet, normal, and dry years, our measurements provided useful information on year-to-year variability under normal watershed conditions. Previous studies, however, had demonstrated that roughly half of the sediment load transported to the lagoon may enter the stream system during (a) episodic events, such as widespread debris flows observed following the 1955 and 1982 storms, or large-scale wildland fires, and (b) major anthropogenic erosional events such as the plume which followed collapse of the Ox Mountain Landfill impoundment and wholesale creek sedimentation following major storms during reconstruction of State Highway 92. Since increases in episodic sediment supply are expected during the 50- to 100-year life of the watershed management plan, it is important to estimate episodic sediment contributions. The presentation will describe the methods we used to attempt to characterize large-magnitude uncertainties in sediment delivery from both littoral and terrestrial sources.

Wood Creek Tidal Marsh Enhancement Project

Don Allan, *Natural Resources Services division of Redwood Community Action Agency*

Wood Creek is a tributary to Freshwater Creek, tributary to Humboldt Bay, in coastal Northern California. Wood Creek watershed is approximately one-half square mile with 30 acres of the lower watershed occupying diked-former tideland and estuarine habitat. The Wood Creek Tidal Marsh Enhancement Project (the Project) was designed to restore partial tidal function, with goals of creating over-wintering habitat for coho salmon, refugia for tidewater goby, a tidal channel network, a restored brackish marsh plain, and wildlife habitat. The project was, and continues to be, a collaboration involving multiple funders, project partners, consultants, and landowners.

The Project started with a feasibility study conducted between 2001 and 2004 that considered four alternatives. A stakeholder group selected the preferred alternative, which was implemented after grants were secured to prepare final plans, a CEQA document, and permit applications. The final plans incorporated the findings and recommendations of biologists from the California Department of Fish and Game (CDFG), with the goal of creating over-wintering habitat for juvenile coho and restoring a tidal marsh. The CDFG biologists have been sampling tidally influenced reaches of creeks around Humboldt Bay, including Wood Creek, to determine abundance, distribution, and habitat utilization of this brackish-freshwater ecotone by juvenile salmonids, especially coho salmon. The biologists found that the slightly brackish portions of Humboldt Bay tributaries provide essential over-wintering habitat for juvenile coho.

The preparation of final plans included developing a hydraulic model to determine the relationship between the muted tide prism and the size of the marsh plain and tidal channels needed to sustain the network of tidal channels and ponds, and an experiment to calibrate the hydraulic model. In 2009 the project was implemented. Observations over the first winter indicate that the hydraulic model accurately predicted the extent and elevation of tidal inundation. Post project fish sampling has documented the use of the habitat by juvenile coho salmon.

This talk will discuss the planning and design effort needed to get this project ready to implement, the implementation, and the results of one year of post project monitoring.

Bar Built Estuary and Lagoon Use by Central California Salmonids; Pre-ocean Purgatory or Lost Paradise?

Sean A. Hayes (Presenter), Arnold Ammann, Morgan Bond, Alison Collins, Danielle Frechette, Jeff Harding, Andrew Jones, Bruce MacFarlane, *and* ***Ann-Marie Osterback,*** *Southwest Fisheries Science Center, NOAA Fisheries*

Recent studies in Scott Creek indicate estuary/lagoon habitat is critical to salmonid recovery. Specifically, both steelhead and coho salmon acquire additional growth prior to ocean entry that increases their chances of marine survival. Many juvenile steelhead and coho salmon migrate downstream below marine survival size thresholds, often followed by a few weeks of additional spring growth in the estuary and some steelhead remain in the estuary after lagoon formation. During summer, these fish experience rapid growth but face challenges from water quality and predators that force them upstream during the fall, necessitating adequate flows for upstream migration. They overwinter in the upper watershed before moving downstream a second time, entering the ocean the following spring, much larger than smolts that reared solely in the upper watershed. Unfortunately, water diversions, bar breaching, and habitat loss have been fundamentally altered most lagoons in Central California inhibiting these complex life histories.

Fragmented Habitats: Can the Sisquoc River Reach the Sea?

Ethan Bell (Presenter), Stillwater Sciences, and Michael Bowen, Coastal Conservancy

Public Resources Code 10000-10005 requires the Department of Fish and Game to recommend instream flow levels to the State Water Resources Control Board. The Board then considers those recommendations when evaluating applications for appropriative water rights permits. The Ocean Protection Council funded a series of instream flow assessments, including the Santa Maria River, to assist the Department of Fish and Game comply with Public Resources Code 10000-10005.

In 2008 the California Department of Fish and Game (CDFG) identified the Santa Maria River as a high-priority for instream flow analysis. Historically the Santa Maria River watershed supported a population of anadromous steelhead (*Oncorhynchus mykiss*). Currently, a resident population of *O. mykiss* is found in the upper watershed, and anadromous spawning is infrequent. This prioritization was developed by regional staff from CDFG, the State Water Resources Control Board (Water Board), the U.S. Fish and Wildlife Service (USFWS), and NOAA National Marine Fisheries Service (NOAA Fisheries). Streams were ranked in part on: 1) the presence of steelhead; 2) the likelihood that CDFG flow recommendations would improve significantly conditions for anadromous steelhead; 3) the availability of recent flow studies or other relevant data; and 4) the availability of partners/willing landowners.

The goal of the Santa Maria Instream Flow Study is to identify the frequency, duration, and magnitude of surface flows in the Santa Maria River, and to determine flows that would be needed for steelhead to migrate between the Pacific Ocean and habitat in the upper Sisquoc River.

Recommended flows will likely be determined based on the observed historical (pre-regulation at Twitchell Dam) timing, frequency, duration, rate-of-change (pattern) and magnitude of discharges in the Sisquoc, Cuyama, and Santa Maria rivers. Specific objectives of this effort include:

- Determine the magnitude, timing, and duration of flows (cfs) required to allow adult O. mykiss to migrate from the estuary upstream to access suitable spawning and rearing habitat upstream of the confluence of the Cuyama and Sisquoc rivers (approx. 35 river miles) under wet, normal, and dry water year types; and
- Determine the magnitude, timing, and duration of flows (cfs) required to allow juveniles (and kelts) to migrate downstream of the confluence of the Cuyama and Sisquoc rivers to the estuary under wet, normal, and dry water year types.
- A second goal of this study is to assess habitat suitability in the Santa Maria River estuary for steelhead rearing and over-summering. These analyses will be based on water quality monitoring and fish sampling in the estuary.

Some assessment of steelhead habitat conditions in the Sisquoc River will also be conducted.

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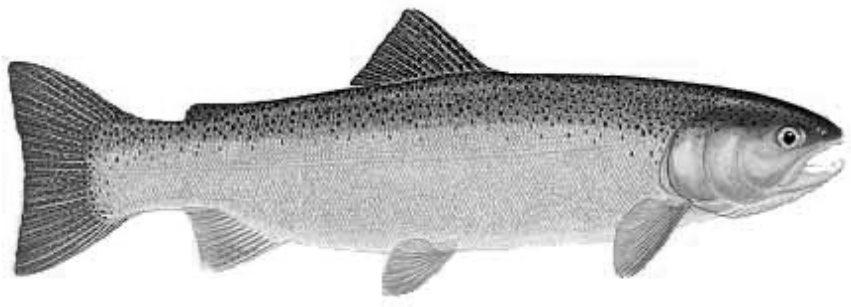

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SRF Mission Statement

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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