31st Annual Salmonid Restoration Conference

March 13-16, 2013

at the River Lodge, Fortuna

CALIFORNIA DEPARTMENT OF FISH & WILDLIFE

Innovative Approaches to Fisheries Restoration

2013 Conference Co-sponsors

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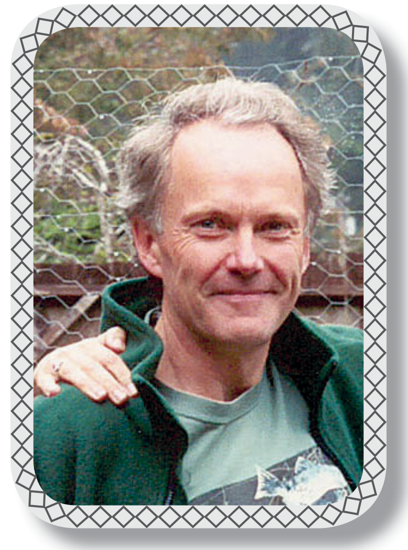
Innovative Approaches to Fisheries Restoration

SRF is pleased to be hosting the 31st annual Salmonid Restoration Conference in Humboldt County for the first time since 2005. The theme of this year's conference, "Innovative Approaches to Fisheries Restoration," sums up what you will see on the field tours and learn about in the workshops and conference sessions. Humboldt County has a long history with watershed restoration going back to the back-to-the-land movement of the 1970's and the days of Redwood National Park expansion in 1978. Early restorationists addressed the need to restore some heavily impacted watersheds acquired by the National Park System. Salmonid Restoration Federation emerged in the early 1980s as the watershed restoration movement was gaining momentum. The organization has been an important venue for restorationists to co-mingle with scientists, academics, and government agency representatives.



Humboldt County is perhaps the most remote and one of the least populated of any of our conference locations. However, that doesn't mean that it doesn't face significant challenges in the effort to restore fish habitat and further the cause of species recovery. With our remoteness and rural environment we are seeing new challenges even though we have made progress in our historical challenge of establishing working relationships with some of our area's larger landowners – timber companies and ranchers. Watershed and fisheries restoration have been embraced by many of our timber companies and ranchers who have seen how the compromises they have to make in their land management strategies are balanced by the benefits gained in restoring habitat and establishing positive working relationships with regulatory agencies and their neighbors. Restoration started in many of our watersheds because of the "back-to-the-land" movement that saw a new wave of homesteaders with an environmental ethic and desire to repair some of the damage caused by past management practices. In recent times we have seen another wave of homesteaders, not all of whom share the same environmental ethic of some of the back-to-the-landers of the 1970s. We see impacts on our streams from water withdrawals and the change in management that has led to new-growth forests that create a heavy draw on ground water in the hot summer months. Along with global warming and changing weather patterns you could call it the perfect storm descending upon the watersheds in which we are striving to achieve habitat restoration and species recovery.

The challenges in fisheries restoration are ever changing and that's why we have to have to have innovative approaches to fisheries restoration. At this year's conference we have leaders in innovation leading and participating in workshops, field tours, and conference sessions, which has become the norm for the conference and we know you expect nothing less. So on behalf of the Board of Directors of SRF, welcome to Humboldt County. May the conference exceed your expectations, send you home with new inspiration and information to apply in your watershed, and provide you an enjoyable and eventful conference.

Don Allan

Don Allan

SRF Board President

Welcome

The theme of this year's conference is "Innovative Approaches to Fisheries Restoration" and the conference agenda will highlight pioneering techniques, methodologies, and practices to restore and recover salmonids. The conference agenda will also explore the theories, philosophies, and science informing the development of restoration practices that mimic natural processes.

The conference agenda will focus on pressing issues that are affecting the future of the salmonid restoration field including diminishing funding, regulatory hurdles, climate change, water diversions, and balancing competing resources. SRF has tried to take a solution-oriented approach when crafting the agenda and looking at the future of the habitat restoration field.

To this end this year's workshops will examine innovative and successful restoration practices and protocols including estuary and off-channel habitat restoration, restoring natural processes, calculating instream flows, salmon life-cycle monitoring, and navigating hurdles to create successful restoration projects. Field tours will visit exemplary and cutting-edge projects on the North Coast including road decommissioning in Headwaters Forest, instream work in Redwoods State Park, bio-geomorphic approaches in the Lower Klamath, experimental wood loading in the Mattole, estuary restoration in the Salmon Creek Delta, community forest management in Arcata, and aquatic restoration in the Mad River.

Concurrent sessions will cover innovative approaches to fisheries and coho salmon restoration, landscape ecology of Pacific salmonids, water diversions, creating a sustainable restoration field, collaborative approaches in the Klamath basin, recovery plan implementation, rapid sea level rise, and Spring-run Chinook salmon.

SRF is thrilled to be hosting the conference in Fortuna, California, because of its proximity to some of the best remaining salmon strongholds and refugia and innovative projects to restore habitat. The conference serves as a venue to share newly adopted protocols, learn about pioneering restoration techniques, and engage in constructive discourse about fisheries recovery strategies.

The production and coordination of the annual conference is a collaborative and dynamic process that engages Salmonid Restoration Federation's Board of Directors, co-sponsors and colleagues. I want to thank all of the field tour, workshop, and session coordinators who have done an excellent job of building an exceptional agenda as well as all of the dedicated presenters who are sharing their expertise and experience.

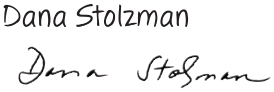
SRF appreciates all of our co-sponsors who generously contribute their ideas, time, and resources to the production of the conference. I would like to specifically thank our long-time co-sponsor the California Department of Fish and Wildlife for their conference agenda input and continued support.

SRF acknowledges all the conference participants who travel from near and far to participate in the largest salmon restoration conference in California. Lastly, I want to give a shout out to all of the work trade participants who work tirelessly to help the conference run smoothly. Your dedication to public service gives us hope for the future of the fisheries restoration field.

In addition to the conference, SRF will also be offering a host of other technical education trainings in the next year including the 7th Annual Spring-run Chinook symposium in the San Joaquin watershed, the 16th Annual Coho Confab on the Mattole River in August, and a Fish Passage Design and Engineering Workshop in Southern California next winter.

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

Dana Stolzman



Agenda Coordinator, Executive Director
Salmonid Restoration Federation

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Return to Light, by Sandy Eastoak

Original paintings by Sandy Eastoak available for purchase through SRF.

Estuary Enhancement and Off-channel Habitat Workshop

Wednesday, March 13

Workshop Coordinators: Don Allan, *Redwood Community Action Agency and* ***Michael Love, PE,*** *Michael Love & Associates*

Over the past decade a lot of attention has been focused on restoring estuarine and off-channel habitats around Humboldt Bay, in the Eel River Estuary, and in other areas of California, Oregon, and Washington. Fisheries biologists from the California Department of Fish and Wildlife have been monitoring salmonid usage of the estuary and tidally influenced freshwater habitat in the lower channels of tributaries to Humboldt Bay and have concluded that estuaries are key components in the life cycle of salmonids, particularly coho salmon. The same scientists have also noted the importance of providing high flow refugia so juvenile salmonids have areas of slow water in which to take refuge during high flow events to prevent them from being swept into the ocean prematurely. Longer time of residency in the estuarine environment equates to more opportunity to take advantage of growth opportunities in a relatively protected environment. The tidally influenced lower channels and estuaries provide rearing areas where the juvenile salmonids exhibit rapid growth thanks to the food rich environment. Increased size at out-migration has been shown to have a positive correlation with the survival to adult stage and returning as a spawner (Trush, 2007 SRF Conference).

This workshop will include project proponents and design engineers to discuss design considerations, opportunities and constraints, and an overview of the regulatory aspects of estuarine restoration from one of Humboldt County's CEQA experts who has prepared CEQA documents and permits for several local projects.

This workshop will provide attendees with insight on how to plan, design and permit estuary enhancement and off-channel habitat projects and will tell more of the story about the sites to be visited on the estuary/off-channel habitat tour.

Humboldt Bay Estuarine Restoration: The Big Picture

Craig Benson, Redwood Community Action Agency

This presentation will kick-off the Estuary Enhancement and Channel Habitat Workshop by giving a broad overview of Humboldt Bay's historic and current estuarine habitats and the efforts to date to "restore" this habitat in diked former tidelands around the Bay.

The presentation addresses the following four questions: 1) What is an estuary and what is the extent of Humboldt Bay's estuary?; 2) What is the overall condition of the estuary that we have inherited?; 3) What are we aiming for now in terms of restoring the estuary?; 4) How have we done so far?

The first part of this presentation will address the first question by positing several accepted definitions of what an estuary is and provide examples of the daily, seasonal, and episodic changes in Humboldt Bay's estuary. Moreover, the definitions of common terms, e.g., restoration, rehabilitation, remediation, reclamation, and enhancement will be briefly revisited to provide a common foundational understanding of the differences in the kinds of "restoration" work being implemented around Humboldt Bay.

A map overview of the past and current extent of salt marsh and its attendant slough network will be presented to exemplify the estuarine condition inherited by current generation. The Humboldt Bay that we have inherited is composed of a mosaic of natural and cultural landscape elements. This section will provide examples of some of the ecosystem elements that are primarily naturally-functioning and contrast them to ecosystem functions that have been altered through culturally-imposed structures.

The heart of the presentation is to provide an overview of the common goals, as well as the unique goals of over 30 estuary restoration efforts around Humboldt Bay. This will include a GIS-generated overview map of all known past & current estuarine restoration projects and the combined total acreage of the efforts to date. This will tie into a discussion of how to define a "reference condition" for restoration planning activities, as well as how certain discrete ecosystem functions and species have been selected and emphasized through a combination of regulatory and funding mechanisms and popular choice.

Lastly, a quantitative assessment of the acreage of estuarine habitat enhanced through current and planned restoration activities will be presented relative to the acreage of estuarine habitat in historic conditions. Qualitative observations will be posited relative to the cumulative progress towards meeting common restoration goals.

Addressing Geomorphic and Hydraulic Controls in Off-channel Habitat Design

Conor Shea, PhD, *U.S. Fish and Wildlife Service,*
Coastal Program at Humboldt Bay/Partners for Fish and Wildlife

Successful design and construction of off-channel habitats requires identifying and understanding a site's geomorphic and hydraulic controls. This talk will describe the hierarchy of geomorphic processes and controls that create and maintain off-channel habitats and describe appropriate design concepts that address these controls. Topics that will be discussed include: the importance of clearly identifying habitat goals and objectives in restoring or creating off-channel habitat for salmonids; the link between landscape and watershed scale controls and differing types of off-channel habitat features; and how to incorporate geomorphically appropriate elements and features in habitat design.

The talk will discuss the design of off-channel habitat features including backwater channels, cut-off chutes, split channels, tidal ponds, and side channel entrances and exits. Examples will be provided from natural and constructed off-channel habitats.

Regulatory Compliance and Constraints in the Coastal Zone: Estuary and Off-Channel Habitat Enhancement

Aldaron Laird, *Environmental Planner, Trinity Associates*

Coastal aquatic ecosystems are complex and dynamic environments; permitting habitat enhancement projects in this environment is nearly as complex and challenging. Compliance with Federal and State Coastal, Endangered Species, Water Quality, and Environmental Quality Acts will often affect project design and increase costs. The Coastal Act can be administered by a local land use agency as well as the Coastal Commission, and given the project's location, may require two permits. The application of the Endangered Species Act in coastal waters, depending upon species involved, can lead to consultations with three different agencies. Securing all of the necessary authorizations in tidal environments can be difficult when sovereign lands are involved, if a lease from the State Lands Commission is required. As the number of agencies and statutes with jurisdiction over a project increases, so do the challenges to produce a project design that can secure all of the authorizations necessary in the Coastal Zone. Adding to the permitting complexity, it is now necessary to take into account climate change, evaluate the vulnerability and function of estuarine and tidal enhancement projects to sea level rise, and assess the effect of the project on greenhouse gas emissions. Examples from several estuary and off-channel habitat enhancement projects will illustrate the number of regulatory agencies with jurisdiction over habitat enhancement projects and identify specific regulations that can often affect project design.

Off-channel & Side Channel Habitat Design Plan Criteria

Mark G. Smelser, Regional Engineering Geologist, California Department of Fish and Wildlife

Slow-water off-channel habitat areas are an essential component of freshwater ecosystems and are critically important nurseries for the rearing of juvenile coho salmon as well as other salmonids. Examples of such areas include sloughs, side channels, and ponds that are either permanently or seasonally flooded. As a result of anthropogenic modification of floodplains and the draining of wetlands, much off-channel habitat has been eliminated. In particular, it is reported that 91 percent of California's wetland area was lost during the 200-year period between 1780 and 1980. Wetland and off-channel habitat areas are not synonymous, but a strong relationship exists between the two and that statistic is useful as a "ballpark" with which to contemplate the magnitude of off-channel habitat elimination in California. When the loss of off-channel habitat is considered in concert with the decline of salmonid stocks, in particular coho salmon, it becomes clear that enhancement and creation of off-channel habitat is a worthwhile restoration activity. The worthiness of such projects has been demonstrated in Oregon, Washington, and British Columbia, but in California these types of projects are still relatively new and experimental.

The California Department of Fish and Wildlife supports enhancement and creation of off-channel habitat as a restoration activity, and has specific responsibilities for such projects. Firstly, because such projects involve modifications to the bed, bank, and channel of a stream, a Lake and Streambed Alteration Agreement must be prepared prior to implementation. A second link between the Department and off-channel habitat projects is through the Fisheries Restoration Grant Program where monies for the design and construction of such projects can be acquired. In both the regulatory and funding capacities, the Department has substantial responsibilities related to the technical review of a proposed project. In this particular case, the Department wants to ensure that off-channel habitat projects are designed and constructed to be naturally sustainable habitat features. To assist in the technical review and the realization of that overarching goal, the Department has prepared criteria for the design of off-channel and side channel habitats.

The design criteria are deemed necessary because despite the initial impression that an off-channel pond is little more than a depression in the floodplain, the design of such features as salmonid rearing habitat can be complex. The complexity arises from the presence of numerous physical variables (e.g., surface- and groundwater levels) and processes (e.g., fluvial hydraulics and sedimentation) that need to work together over a range of temporal scales and within the spatial constraints of the floodplain. Moreover, there are numerous risks (e.g., fish stranding, invasive plants, and avulsions) associated with such features as well as the need for periodic maintenance (e.g., dredging). Furthermore, because such features are relatively new and experimental in California, there is a need for formal monitoring to document the efficacy of these features. Included in the design criteria are a suite of recommendations related to: site selection; biological assessments; physical site characterizations; development of conceptual plans; hydrology and hydraulics analyses; engineering design; construction implementation; and post-project monitoring.

Muted Tidal Restoration Techniques & Results

Leo Kuntz, ***Nehalem Marine Manufacturing***

This talk will provide an overview of muted tidal restoration projects, equipment and results in Washington, Oregon and California. Leo Kuntz will discuss the use of compatible restoration as an alternative to full reconnection when under social and economic restraints. A short history of the evolution of muted tidal equipment and a update on the latest design technology will be presented. The talk will include an overview of successful tide gate and fish passage monitoring and the recovery of critical off-channel tidal habitat, focusing on, but not limited to, salmon recovery.

Response of Juvenile Salmonids to Habitat Restoration in the Tidal Portions of Humboldt Bay Tributaries

Michael Wallace, California Department of Fish and Wildlife

Estuaries have long been recognized as important nursery areas for some species of juvenile salmonids and recently there has been a growing understanding of the importance of estuaries to juvenile coho (*Oncorhynchus kisutch*) salmon. This has resulted in multiple habitat restoration projects being constructed and more planned in the stream-estuary ecotone (SEE) of Humboldt Bay tributaries. The California Department of Fish & Wildlife (DFW) is sampling selected projects to assess their performance and to provide information to the restoration community to help design and improve future restoration projects. DFG conducted fish and water quality sampling at habitat restoration sites in the tidal portions of Rocky Gulch, Wood Creek, and Salmon Creek to describe basic water quality and determine fish use, residence times, and rearing patterns at these sites. Preliminary results show that juvenile salmonids, especially coho salmon, moved into the newly restored sites as soon as they were accessible and water quality conditions allowed and reared there up to six months. Juvenile salmonids sought out freshwater habitat so the new estuary restoration sites provided mostly over winter rearing habitat from December to June, but low stream flows in the summer and fall allowed warm brackish water to enter the sites so that few salmonids were found there at these times. However, juvenile salmonids continued to rear in the estuary upstream of the brackish water. Specifically, Rocky Gulch is now providing over winter juvenile coho rearing habitat for the first time in decades and a population of endangered tidewater goby has become established in the project area. In Wood Creek PIT-tagged coho salmon from throughout the entire Freshwater and Ryan Creek basins utilize the stream and constructed off-channel pond showing that restoration projects in the estuary can provide benefit for the entire basin. In Salmon Creek DFG captured more juvenile coho in 2011-12 (after pond construction) than the previous seven years combined. Juvenile steelhead, especially large sized smolts, reared in the new ponds and large populations of tidewater goby have become established in some of the new ponds. Providing access to and improving connections between small tributaries entering the SEE and creating off-channel habitat appear to benefit juvenile salmonids.

Tidal Hydraulic Geometry Relationships in River Mouths on the Pacific Coast

Louis A. White, PE (Presenter), Jeremy P. Lowe, Michelle K. Orr, PE, and Philip B. Williams, PE, ESA PWA

Restoration of tidal marsh channel habitat is critical to impaired bird and fish species. Target species on the Pacific coast include coho and Chinook salmon, which are highly dependent on access to estuarine rearing habitat during their juvenile life stages (SRSC & WDFW 2005; Koski 2009; Schlenger et al. 2011). Development and historic land use practices severely impacted estuarine systems, especially off-channel, tidal rearing habitats. Restoration efforts are underway to create and restore off-channel functions in estuaries in Humboldt Bay, but a lack of local design guidelines for tidal channel and marsh restoration has encouraged the use of guidelines from San Francisco Bay (e.g. PWA & Faber 2004).

Hydraulic geometry and allometry are practical tools of applied geomorphology that are often used as a basis for sizing fluvial and tidal marsh channels in restoration design (Williams et al. 2002). Application of empirical tidal channel geometry relationships within the region of their development has proven effective in accelerating the evolution of tidal marsh habitat while minimizing excavation requirements (Williams & Orr 2002). Complications in comparing hydraulic geometry relationships between regions can arise from differences in tide range, sediment types, salinities and plant types, but also the relative influence of fluvial as opposed to tidal processes in the channel. Cross-regional comparison of San Francisco Bay relationships to other regions is limited, but there is reasonable agreement in Humboldt Bay (JAA 2008; NHE 2011) and in backwater areas in the Lower Columbia River Estuary (Diefenderfer et al. 2008). Observations in Puget Sound show a large variation of channel geometries between estuarine systems within the sound (Hood 2002; 2007).

Simple guidance is presented for developing hydraulic geometry relationships for a specific region using: (1) analysis of historic maps, charts, and surveys; (2) field data collection; and (3) scale adjustments and extensions of established relationships based on hydrologic and geomorphic parameters.

A key question that should be addressed when developing these guidelines and sizing tidal channels for habitat restoration is where the channel reach is located within the fluvial-tidal interface. Relationships for predicting channel geometries in the fluvial-tidal transition zone are less well developed, but appear to exhibit a compound shape that evolves spatially from tidal-dominated to fluvial-dominated geometries (Neary et al. 1998; Mead et al. 2000). Conceptual guidance will be presented focusing on sea level rise and the geomorphic response of the estuary.

The formation of distributary channels in the tidally influenced lower reaches of fluvial systems also determines channel geometry but is poorly understood. However, research on the evolution of distributary channels on the Skagit River Delta provides useful insight into the processes involved (Hood 2002) and its implications will be discussed.

Salt River Ecosystem Restoration Project

Michael Bowen, California Coastal Conservancy

The Eel River estuary is California's third largest estuary. From 1854 to 1890 the estimated acreage of tidal marsh was approximately 10,000 acres. This wide area contained a forceful tidal exchange, and the immense acreage provided a hospitable and ever-changing environment for a rich assemblage of species. Reclamation efforts accelerating in the late nineteenth century reduced this area by 90%. Wildlife resources diminished, and a vibrant agricultural economy flourished in its place. Several efforts are underway to restore lost habitat in the Eel River Delta while maintaining the economic integrity and vitality of Humboldt County's agricultural economy. Nowhere is this effort as ambitious as along the banks of the Salt River, near Ferndale. This balancing act is profoundly complicated, but the Humboldt County Resource Conservation District and its partners have worked with the agricultural, regulatory, and funding communities to launch an ambitious project that promises significant benefits to wildlife habitat and agricultural producers. Groundbreaking has begun, but it has involved many decades of planning, permitting challenges, legal challenges, funding challenges, and almost every imaginable—and unimaginable—speed bump on the road to success. Come learn more about the Salt River Ecosystem Restoration Project and other efforts underway in the Eel River estuary.

Wood Creek Tidal Marsh Enhancement Project

Jeff Anderson, PE, *(Presenter) and* ***Bonnie Pryor,*** *Northern Hydrology & Engineering*

Wood Creek is a small perennial tributary to Freshwater Slough, the second largest tributary to Humboldt Bay. Wood Creek and associated wetlands are located within the ecotone of Freshwater Slough. By 1933 (or earlier) a tide gate was installed on Wood Creek at its confluence with Freshwater Slough, and a majority of the tidal wetlands along Freshwater Slough and Lower Wood Creek were diked and converted to agricultural uses.

The Wood Creek Tidal Marsh Enhancement Project consisted of enhancing approximately 35 acres of tidal marsh within Lower Wood Creek, on a 54 acre parcel owned by the Northcoast Regional Land Trust. The primary goals of the enhancement project included (1) restore tidal hydrology and enhance brackish marsh habitat on 23.2 acres of former tidelands; (2) maintain 11.9 acres of existing brackish and freshwater marsh habitat; (3) restore fish access, slough channel functions, and associated aquatic habitat in a portion of Wood Creek for native salmonid species, and for numerous other fish and wildlife species; (4) expand habitat for listed fish species (salmonids and tidewater goby) in portions of lower Wood Creek, and in newly constructed tidal creek channels; (5) retain agricultural production on a portion (19 acres) of the seasonal wetlands that are fenced-off from the restored tidal marsh areas; and (6) provide opportunities for public access and education, wildlife interpretation, and recreation.

The presentation will discuss the overall design process, construction, and post-project monitoring results, and will include:

- Project background, goals and objectives.
- Pre- and post-project tidal hydrology data collection.
- Pre -and post-project water quality data collection.
- Modeling of pre- and post-project tidal hydrology conditions.
- Design of tidal marsh slough channel network using tidal wetland/slough channel geometric relations.
- Design of off-channel freshwater/brackish pond for salmonid habitat.
- Design of tidal hummocks for topographic complexity to support a range of wetland vegetation and wildlife microhabitats.
- Post-project monitoring results.
- Interpretation of post-project monitoring in relation to project designs, and lessons learned.

Quartermaster Reach Restoration

Jeff Peters (Presenter), *ICF International and* ***Lew Stringer,*** *Restoration Ecologist, Presidio Trust*

Since the turn of the last century, approximately 42% of tidally-influenced marsh habitat in the San Francisco Bay Area and along the California coastline has been lost to commercial, industrial, and residential development. Of particular significance is the 79% loss of associated brackish marsh habitat, which supports a diverse mixture of flora and fauna and complex ecological processes due to the interchange of freshwater and salt water. This project seeks to restore a functioning tidally-influenced marsh with a significant amount of brackish water habitat in between two previously restored water features—Crissy Field Marsh and the upstream riparian corridor called the Thompson Reach, within the Presidio of San Francisco. The objectives of the project are to: a) daylight the stream (currently within a culvert) to create a continuous hydrologic connection between Crissy Marsh and the Thompson Reach; b) create a continuous wildlife corridor between the upper watershed and Crissy Marsh; c) restore a diverse mosaic of coastal wetland and upland habitats to support native wildlife; and d) interpret the cultural history of the site. The highly urbanized setting and the cultural and historic resource values of the Presidio pose several unique challenges to restoration of the Quartermaster Reach. This presentation will examine these challenges, illustrate the desired landform components that will be incorporated in the marsh design, and present the current habitat and grading designs. The Quartermaster Restoration project is a collaborative effort between the Presidio Trust and the National Park Service.

Restoring Salmon Creek's Tidal Processes to Create a Diversity of Estuarine Habitats

Michael Love, PE, Michael Love & Associates, Inc.

Salmon Creek is the largest tributary to South Humboldt Bay. Over a century ago the complex network of tidal channels and marshes was diked and drained for cattle grazing. Salmon Creek was ditched and the channel isolated from tidal influence of the bay using tide gates. In the following years the drained marsh plains subsided and the salmon runs, for which the stream was named, plummeted.

In the mid-1980s the lower portions of these diked lands was incorporated into the Humboldt Bay National Wildlife Refuge. Beginning in 2001, a plan was set forward to restore a portion of the estuary on the refuge. The plan worked within the multi-species objectives of the Refuge and the infrastructure constraints (i.e. adjacent Highway 101) to create a project that benefits a diversity of freshwater and marine species. It included reintroducing limited tidal waters to Salmon Creek through use of tidal-muting gates, reconstructing meandering slough channels, raising subsided lands to support native saltmarsh vegetation, constructing off-channel brackish and tidal freshwater ponds in the upper ecotone of the estuary, placement of complex large wood structures, and connecting non-tidal wetlands in the Refuge to Salmon Creek for use by foraging salmonids. After eleven years of planning, design, permitting, and construction, this multi-phased project has reached completion and post-project effectiveness monitoring continues.

This presentation will focus on the design process, with an emphasis on lessons and insights learned through construction and physical monitoring of the project. It will include:

- Design of muting tide gates to restore estuarine function while avoiding flooding of adjacent infrastructure, now and with sea-level rise.
- Modeling and observed increases in sediment transport capabilities provided by reintroduction of tidal waters.
- The relation between tidal prism and a slough channel dimensions, and its use in channel design.
- Establishing the marsh plain elevations and topography in the lower project area to support native saltmarsh vegetation and create self-scour low-order tidal channels.
- Layout of off-channel and side-channel ponds in the upper ecotone for use by overwintering salmonids, and the observed post-project changes.
- Field design of large wood structures in ponds and slough channels to create cover and generate a variety of geomorphic responses.
- Modeling and observed salinity in off-channel ponds.
- General observations of sedimentation and erosion patterns.

Martin Slough Enhancement Project

Don Allan*, Redwood Community Action Agency—Natural Resources Services*
and ***Steve Allen, PE****, GHD, Inc.*

Martin Slough is a 5.5 square-mile watershed that is a tributary to Elk River and Humboldt Bay. The lower 7,000 feet of channel formerly included estuarine habitat and tidal wetlands that were converted to agriculture in the early 1900s by construction of dikes and installation of tide gates. In 1960 part of the pasture was donated to the City of Eureka to create the Eureka Municipal Golf Course. Channel straightening, filling of backwater habitats, and the exclusion of the tidal prism have degraded the habitat but the Slough continues to support coho salmon and fish monitoring conducted by the CA Department of Fish and Wildlife has found the Martin Slough coho to exhibit the highest growth rate of any of the sites sampled around Humboldt Bay.

In 2001 the Natural Resources Services (NRS) division of Redwood Community Action Agency (RCAA) formed a partnership with the City of Eureka, the golf course operator (CourseCo Inc.), and the private owner of a 40-acre pasture to look into options for restoring fish and wildlife habitat while reducing the frequency and duration of flooding on the pasture and golf course. RCAA hired local engineering consultants GHD (formerly Winzler & Kelly) and Michael Love & Associates to develop a feasibility study looking into enhancement options. A Technical Advisory Committee of stakeholders, regulatory agencies, and fish and wildlife management agencies was convened to develop project alternatives and select a preferred alternative. Project plans for estuary enhancement and tide gate replacement have been developed to the 30% design level. The project is currently preparing a CEQA document and starting to work on final designs. Implementation is anticipated to begin in 2013.

This presentation will focus on the design development process, with Don Allan giving a brief background on the project history and the design concept development as guided by a technical advisory committee. Project engineer Steve Allen of GHD will discuss the development of project designs.

The discussion of the design development will cover the available data used for the design, additional studies that were conducted to fill data gaps, the design process including the various models and tools used to inform the design, and the design iterations that occurred based on feedback from multiple stakeholders. Stakeholder feedback included the technical advisory committee which was comprised of multiple interests and changed through time including changing land ownership on a key parcel. The design development discussion will include tidal influence, non-tidal riverine system, tide gates which provide a muted tide cycle, the expanded channel and pond systems which provide a variety of habitat value as well as hydraulic storage capacity. Salt water intrusion will be discussed, from the benefits of control of invasive species such as reed canary grass to the challenges to the irrigation systems in the area. The design discussion will also include the challenges of working around wetlands, existing levees, an operating grazing operation, a golf course, and other interesting design components.

Navigating Hurdles to Create Successful Restoration Projects

Workshop Coordinators*: **Steve Allen, PE**, GHD, Inc.*
*and **Michael Love,** Michael Love & Associates*

The workshop will address hurdles faced during fisheries restoration projects, and offer approaches and solutions to achieve project success. In recent years, the fisheries restoration community has strived to address more challenging projects, whether in size and cost, complexity of the systems being modified, an uncertain climatic future, stakeholder interactions, funding, opposing regulatory objectives, or all of the above. Through these projects, common hurdles have been encountered, and with great effort, navigated successfully. By sharing these experiences, future projects can be better equipped to recognize and address these hurdles more efficiently.

Completing successful restoration projects often involves an interdisciplinary team working through a complex multi-staged process that generally requires:

- An understanding of the problem being addressed,
- Establishing clear goals and objectives,
- Gaining proper understanding and characterizations of the physical, biological, regulatory, and socio-economic factors influencing the project,
- Establishing strong partnerships with stakeholders,
- Identifying the appropriate approach for satisfying project objectives and developing a sound project design that can be supported by stakeholders,
- Securing funding for the various phases of the project, including planning, design, environmental compliance, construction, and monitoring,
- Selecting a qualified team to address the project needs,
- Selecting a qualified contractor and providing adequate construction support, and
- Providing post-project monitoring to meet regulatory requirements, demonstrate effectiveness of the project, and learn lessons for future projects.
- The complexity of the process requires persistent project management and coordination, with attention to details.

The workshop will highlight experiences and lessons learned from a diversity of perspectives, including those from funding, planning, permitting, design, and construction. Through exploring the lessons learned from past successful fisheries restoration projects, we gain insights to bring to our future projects, thus better ensuring success.

After the individual presentations are over, the speakers will gather at the front of the room as a panel to answer questions from the workshop participants. The panel will also further the dialogue regarding how we can work together to overcome the real challenges found in restoration projects to help create more successful projects moving forward.

What Actually Is a Successful Restoration Project?

Kevin E. Shaffer, *California Department of Fish and Wildlife*

Before one can navigate 'hurdles' standing between the restorationist and being able to implement and complete a successful project, we need to not only define, but agree, to what constitutes those hurdles, paths of navigation, and most importantly success. To tie these issues together in hopes of a useful illustration, projects will most often be related to the Department of Fish and Wildlife's Fisheries Restoration Grant and Coastal Monitoring programs.

For this presentation, assumptions had to be made as to at least partial definitions. For hurdles, I will discuss some specific California statutes/regulations/processes, such as lake and streambed alteration agreements, environmental review, grant and contract processes, and will touch briefly even on processes of other agencies, which may be viewed as hurdles. Then, there is the distant bureaucrat and administrative staff, the unyielding scientist or engineer. Perhaps less obvious are issues of successfully communicating your project in writing, and knowing, applying, and describing the best or at least feasible techniques that will be used to achieve success.

Navigation requires both selecting a course of action or direction and managing and adjusting one's path. Know the grant process, and become proficient. The cliché is 'do your homework'. But that means getting it reviewed, graded. For two-step grant programs, ALWAYS do the pre-proposal. For FRGP, that is not an option. So revisit your proposals that were successful, talk with your colleagues who are successful, consider having a colleague review your proposal. Above all else, for programs like FRGP, read the entire proposal, every year. Make no assumptions about what you think you know, what is expected or required, what someone else tells you. Call the contacts on the solicitation, go to the public workshops. In a literal sense, if you plan to navigate an ocean or mountain range, you need to plan for uncertainties, bring the needed resources to bear, and give yourself time. You should be planning for grant cycles a year in advance. For FRGP, use the previous year's template and decisions to guide you and provide some strategic elements to how to succeed.

Success will be defined simply as the creation of the project, including securing funding. Implementation, function, longevity, and broader integration within the watershed are for another discussion. Several elements, if concisely and accurately portrayed, should lead to success: 1) You are accomplished in the specific type of work being proposed; 2) When used, subcontracting is being used to improve an already strong proposal; 3) When partnering, there is shared responsibility and shared potential for success; 4) Scientific standards and field methods applied are the finest available; 5) You always submit your data, analyses, reports, and effectiveness updates; 6) Your past work speaks for you; fish and wildlife benefit from your activities.

Funding Successful Restoration Projects

Michael Bowen, State Coastal Conservancy

The successful restoration project is one of life's most uplifting experiences. And what is success? Criteria are helpful, but in our heart of hearts, we all wish to paraphrase Justice Potter's view on pornography, to wit: "I know a successful restoration project when I see it." Seeing it requires that the project was at least built, remained standing for twenty years, and is demonstrably and substantively improving habitat condition. An affirmative biological response is always welcome.

Conversely, achieving project success is at times one of the most mystifying and disheartening experiences of our lives. Why is this? And why do we trudge through the financial and procedural minefields on the front lines of restoration? Of course we carry on because we are committed to a better world; the rewards can be profound, and the alternative is dismal. But does doing good really need to be this hard?

Funders are seldom better informed or more experienced than restoration practitioners. The opposite is frequently the case. We are rarely engineers. We are frequently not professional biologists. We are merely bureaucratic cogs in the wheels of financial administration. However, funders may have a uniquely broad perspective on project success and failure. We also learn by rote why projects are hard. This is due to the fact that funders observe a broader regional array of projects. If nothing else, funders also know what projects cost, and how much funding is available to pursue particular goals and objectives. Funders are also compelled to scrutinize projects with a variety of criteria ranging from the transparent to the opaque. This presentation is given from the perspective of one project funder.

Hurdles are inevitable. Learning from the mistakes of others is of paramount importance. Due diligence includes gaining an understanding of and respect for regulatory opportunities and constraints, planning documents, legal frameworks, social constraints, and most of all human weakness. This does not mean one should avoid creative thinking or pushing the envelope. On the contrary; in habitat restoration as in life the journey should be as exciting as the destination. But measure twice and cut once with all your might.

Threading a needle through the nebulous concept, under the unfunded mandate, past the pseudo-science, around the unexpected lawsuit, over the perversely interpreted regulation, dodging the ubiquitous and unsolicited last-minute design changes, and onward towards the mobilization and attack of the Restoration Industrial Complex, the presenter will share cautionary tales, funding updates, and some successes as well as a rogues gallery of snafus possible only along California's magnificent coastline.

Design and Construction Checklists and Lessons Learned

***Marcin Whitman, PE, (Presenter)** and **Margie Caisley,** California Department of Fish and Wildlife*

Two of the tools used by the CDFW Eco-conservation Engineering Team when working with CDFW biologist and other project team members will be presented. These tools are typically used on projects that have an engineering component to them (e.g engineered stream bed to restore a stream profile for fish passage)

The first, used at the design stage, is a checklist of the items that are needed to assure a complete package is available for review. The checklist is just a distillation of material already available in the Restoration Manual. Assuring that a design package is complete avoids iterations, misunderstandings and expedites the project review. This last benefit is especially important as CDFW engineering department has very limited staff and design review is only one of their duties. When a review is hampered, there can often be significant delays to find staff time to revisit this step.

The second tool presented is the QA/QC spreadsheet for construction. This starts out as a general template that is then customized by the project designers to fit a particular project before construction starts. It provides a quick way to assure that key components of the project are being constructed as designed and to flag any field modifications of design that need to be addressed. Preparing this QA/QC spreadsheet before construction begins both stimulates good communication among the construction team and reduces uncertainty and task loading during the critical, and often limited, construction window.

Besides presenting these two tools, lessons learned from project successes and failures will be presented. One reoccurring lesson is that while engineered projects typically have long (e.g. 50-100 yr) design lives, projects rarely get follow-up after the first few years after construction. Knowing this, there needs to be a shift in how design is approached so that the substantial efforts put in will result in the intended long-term benefits to salmonids and other aquatic organisms.

Maximizing Large Scale Habitat Restoration Within a Working Landscape of Competing Land Use Objectives and Regulatory Policies: The Salt River Ecosystem Restoration Project

Donna Chambers, Humboldt County Resource Conservation District
and Misha Schwarz, GHD, Inc

The Eel River Estuary is recognized as one of the most ecologically important tidal marsh habitats in California and is designated critical habitat for salmon and steelhead under the Endangered Species Act. The Eel River Estuary is the third largest estuary in California and is bound by the largest contiguous prime agricultural land zoning within Humboldt County that provides the second highest valued crop to the County's economy.

Throughout the Eel River Estuary, agricultural lands now dominate what was historically forested riparian and wetlands habitat. The estuary historically consisted of a complex network of tidal channels and marshlands. Salt River, the largest freshwater tributary to the estuary, provided the primary freshwater drainage off the southern delta plain and provided rearing habitat and a migration corridor for salmonids and other culturally important aquatic species. The indigenous Weott People derived their name from the Eel River which in their language meant "plenty—from the immense quantities of Salmon obtained by them every fall in the Eel River Estuary…"

Following passage of the Reclamation Act, much of the estuary was transformed in the late 1800's from tidally influenced areas to grazed pasture. Levees were erected, tidal sloughs were channelized and approximately 2,900 acres of former estuarine habitat was reclaimed to highly productive agricultural land. The loss of tidal exchange resulted in significant changes to drainage patterns and habitat diversity. Consequently, many of the estuary tributaries, including the Salt River, have lost nearly all natural hydraulic function which has caused significant flooding, reduced agricultural land value, and diminished riverine and estuarine biodiversity.

With a broad range of project benefits spanning from habitat restoration for endangered species to flood alleviation for improved agricultural land productivity, the Salt River Ecosystem Restoration Project will rehabilitate 7.7-miles of Salt River channel, reconnect 15 miles of inaccessible salmonid habitat to the Eel River Estuary, restore 300 acres of tidal marsh, create 110 acres of riparian habitat and decrease flooding to over 800 acres of agricultural lands while bisecting approximately 50 private parcels. The $16M construction project has secured all stakeholder approvals and will be constructed over multiple years starting in 2013.

The presentation will cover the many project challenges associated with competing stakeholder objectives and conflicting regulatory policies encountered during the preliminary design and permitting processes. In response to these challenges, a discussion on adaptive design solutions developed through stakeholder collaboration and a multi-disciplinary team approach will be presented. The solutions will be presented in the context of developing a self-mitigating project that balances competing and conflicting goals while maximizing ecological restoration. Some of the challenges and associated adaptive design solutions presented will include balancing wetland impacts with creation of dissimilar wetland classifications and definitions; demonstrating long-term improved riverine habitat function and value to compensate for temporal riparian habitat impacts; and prime agricultural land enhancement by improved drainage to offset conversion of agricultural land to tidal wetlands. The presentation will explore the conflicting resource policies necessary for Federal, State and Local regulatory approvals and the adaptive design solutions needed to overcome these challenges.

Construction Considerations for Restoration Projects

Tony Williams, PE, Hanford Applied Restoration & Conservation

Despite what usually amounts to years of planning, permitting, and actual design, the construction phase of a restoration project is often the most challenging. Several factors may contribute to this condition including overall project scheduling beginning with the allotted timeframe for the bidding phase to the total time available to complete the project. Scheduling can be impacted by the timeliness of obtaining the necessary regulatory permits to the available environmental windows stipulated in those permits. Construction documents that are not adequately detailed for competitive bidding will make a project difficult to accurately prepare a construction bid. When cumulative permit requirements and project risks and liabilities are excessive, even a qualified contractor is placed in a difficult role. Restoration projects could benefit from a better understanding of what the key issues are from a contractor's perspective. I have been fortunate to experience restoration projects from many perspectives: I have worked on restoration projects for local, state, and federal agencies, as well as various non-profit organizations; worked for the US Army Corps of Engineers; designed restoration projects in the private sector; performed construction management for some of the largest coastal estuary restoration projects in California, and I currently work for a contractor who specializes in habitat restoration projects. My passion is restoration, and I have seen and experienced the challenges from these varying perspectives. I appreciate the desire to participate in a workshop where the various stakeholders have a voice and ability to provide constructive feedback about the challenges and opportunities of implementing restoration projects. All parties have a role to play, and the actual restoration project benefits when we understand the issues we all face, and how best to overcome those challenges so that the project and the ecosystem benefits in the end. I would welcome the opportunity to be an active participant in an open and honest discussion of restoration projects from a contractor's perspective, in order to offer insight and helpful suggestions of how we can collectively use our efforts to benefit the actual restoration projects that we all work so hard to achieve.

Permitting Salmon Habitat Restoration Projects in Coastal California

Jonathan Warmerdam (Presenter), *North Coast Regional Water Quality Control Board*
and ***Jennifer Carah,*** *The Nature Conservancy*

Restoration projects that promote habitat improvement for native salmon and trout often have extensive and sometimes confusing permitting requirements. In 2011, The Wood for Salmon Working Group developed a guidance document to assist restoration practitioners and landowners in navigating these permitting hurdles. The Wood for Salmon Working Group is an informal group of state, county, federal agency staff, and staff from environmental non-profits, private landowners, and consultancies. The group came together to develop a clear understanding of the regulatory permitting process for salmon habitat restoration projects involving wood placement in the United States National Marine Fisheries Service's Central California Coast (CCC) Evolutionarily Significant Unit (ESU) of coho salmon (*Oncorhynchus kisutch*). Additional goals included identifying potential mechanisms to simplify and coordinate the process, and incentivize implementation of more projects. In this presentation we will provide an overview of the permitting process for small habitat restoration projects for salmon in coastal California, and discuss multiple options for securing such permits, as well as specific ways to simplify permitting.

The Future of Moving Material as Oil Prices Rise

***Travis James, PE, (Presenter)**, GHD, Inc. and **Bill James**, JPods, Inc.*

Restoration projects often have large construction related costs associated with moving soil and other material from one location to another. Historically, this activity is done by trucks. Trucks not only move the weight of the load but their own weight as well. As part of the project process trucks regularly sit idling, waiting to be filled and then later sit idling, waiting to unload. Moving material from point to point frequently requires long access roads that cause unnecessary impacts. All of this inefficiency is not necessary.

Through the concept of personal rapid transit, this presentation will provide an alternative to moving material in this manner. Instead of a long access road, you can use elevated rails. The elevated rails allow you to span channels, sensitive habitat, and roads. The rails can be temporarily installed and moved as necessary. They can be long or short and they can have a single track or multiple branched tracks.

Instead of heavy trucks, you attach "pods" to the track to move material. The pods are strong enough for their intended activity but light when compared to trucks. The pods run on electricity and when they are not moving, they power down. They can be manually controlled or automated. All of this efficiency helps drive costs down and decreases impacts, allowing each dollar to stretch farther and allow more projects to be completed.

As we move into the future, oil prices will continue to increase. Therefore, costs to complete restoration projects will also increase. To help keep costs down will require us to find more efficient means to complete traditional tasks. This is just one concept to help achieve this goal.

Overcoming Project Hurdles with Private Landowners Using Bioengineering Technology to Create Ecologically Sound Solutions

Evan Engber, ***Bioengineering Associates***

Evan Engber, President of Bioengineering Associates, Inc. (BE), has been applying bioengineering technology to damaged streambank, riparian, and riverine areas for over 30 years. He is one of the contributing authors to the State of California Resource Agency Department of Fish and Game's "California Salmonid Stream Habitat Restoration Manual, third edition 1998". In 1994 Mr. Engber was awarded the United States Environmental Protection Agency Region 9 Hal Wise Award; "For exceptional leadership in promoting the control of non point sources of water pollution and ecological management and restoration of watersheds". In 2003 he was awarded the "Governor's Environmental and Economic Leadership Award, Certificate of Recognition, awarded for Innovative Bioengineering Technology; In recognition of meritorious contributions to environmental protection and resource conservation in the State of California".

Evan Engber will present what he has learned over the course of 30 years of designing, permitting, and constructing Bioengineering projects. The presentation will focus on the challenges of developing projects which achieve both the goals of the landowners as well as the requirements of the permitting agencies. Mr. Engber will use past projects as a tool to facilitate discussion of various hurdles that must be overcome.

There are many hurdles that must be overcome to achieve a successful restoration project. One of the largest hurdles is convincing landowners that a streambank stabilization project must at the same time be beneficial to the riparian and riverine and fisheries environment. From the landowners perspective any cost beyond erosion control such as habitat improvement, project monitoring, and maintenance are seen as additional, unnecessary costs. Other hurdles facing private landowners are the complexity of obtaining permits and obtaining funding assistance for streambank stabilization projects. The presentation will highlight how BE projects and its turnkey approach to design, permitting, and bioengineering construction has helped private landowners overcome project hurdles.

The closing of the presentation will offer real world examples of how a project in the private sector can work perfectly and meet both the expectations of landowners and the permitting agencies while improving riparian and riverine habitat conditions for endangered species.

Arcata Community Forest Management as a Mechanism to Fund Watershed Acquisition, Recreation and Salmonid Habitat Restoration Tour

Wednesday, March 13

Tour Coordinators*: Todd Kraemer, Pacific Watershed Associates and Mark Andre, City of Arcata*

Historic land use and resource extraction in the watersheds of Humboldt Bay has significantly altered the natural landscape and impacted forest and aquatic biodiversity. Logging, road building, and levee construction over the last 100 years has impacted salmon habitat, degraded riparian areas and tide lands, and altered natural geomorphic processes. Historic barriers to implementing effective salmonid habitat enhancement and watershed restoration projects include leadership, fragmented landownership, and insufficient funding to meet match requirements set by federal and state grant programs. In the City of Arcata's model community forest, revenue derived from sustainable timber harvests are now used to leverage state and federal funding for land acquisition and ecological restoration projects from the headwaters to the tidewaters. The City of Arcata's community-based forestry program strengthens communities' capacity to build vibrant local economies, while protecting and enhancing local forest and aquatic ecosystems at the watershed scale. The City of Arcata's leadership, citizens, and technical advisory committees have been able to build a working community forest and wildlife sanctuary that supports a growing and sustainable economic and environmental restoration program.

The first elements of the 2,134-acre Arcata Community Forest were acquired in 1955. It was dedicated as the first municipally-owned forest in the State of California and was envisioned to be "managed for the benefit of all the citizens of the City, with the attention to watershed, recreation, timber management and other values" (Humboldt Times, 15 May 1955). Forest harvest revenues funded city-wide park acquisitions outright under a 1979 voter-approved parkland bond. In addition, since 2001, net revenue generated from sustainable timber harvests has leveraged state and federal grant funds to purchase more than 1,000 acres of additional open space, conservation easements, and fee title community forest. In 1999, the forest was the first in the United States to receive sustainability certification under the Forest Stewardship Council.

Headwater restoration projects include conversion of the even-aged second growth redwood forest to an uneven-aged forest stand, upgrading and decommissioning roads, stream channel restoration and fish passage projects, constructing community trails, selling carbon offsets, and reducing fuel-loading. The Arcata Baylands and McDaniels Slough Wetlands salt marsh restoration and tidal habitat enhancement projects have recently provided rearing habitat for juvenile salmonids in the estuarine environment. Approximately 600 acres of open space (formerly salt marsh and tidal lands) was acquired for not only habitat improvements but just as importantly, as part of the City's progressive retreat strategy to accommodate climate change and rising sea level. Tidewater restoration projects include salmon friendly tide gate installations, slough channel construction, off-channel habitat restoration, historic levee setbacks, riparian habitat enhancement, and planting projects that have improved aquatic biodiversity by increasing habitat capacity.

Restoration Tour in Bull Creek, Redwoods State Park

Wednesday, March 13

Field Tour Coordinator*: Larry Notheis,* *California Conservation Corps*

This project was a multi-faceted and multi-agency collaboration that has been a huge success for the salmonids in this watershed. Located in the majestic Humboldt Redwood State Park this project in the last few years has been a focal point for redd production and habitat usage that has not been seen for many years. From the early to mid 2000s, the Eel River Watershed Improvement Group (ERWIG), The California Conservation Corps (CCC), and the California Department of Fish and Wildlife (DFW) have worked very hard and in numerous ways to improve the salmonid habitat in Bull Creek. The focus reach and area up and down stream of Cuneo Creek has produced numerous pools that are up to eight feet deep from a traditional depth of only six to twelve inches. The riparian cover from willow mattresses and plantings along with sediment reduction from willow pods and baffles is quite evident and has played an instrumental part in the number of returning salmonids.

In the past two years redd surveys, carcass numbers, and fish counting performed by DFW and Watershed Stewards Project has shown that the salmonids in this reach predominantly use and inhabit the structures and locations where ERWIG and the CCC have focused their restoration efforts. This tour will focus on habitat restoration with many examples of best practices along with discussions and examples of challenges and the changing direction of in-stream structures and their design. Participants will observe structures that were designed for scour, thalweg development, bank stabilization, habitat improvement, cover, as well as bio-engineering that was focused on sediment control, bank stabilization, and riparian cover. This tour will also spend time in discussion and observation of the potential positive aspects of this restoration and the part it has played in the decrease in the number of Pike Minnow (*Ptychocheilus grandis*) located or observed in this reach.

Restoring Complexity and Resiliency to Instream and Off-channel Habitats for Salmonid Recovery in the Klamath River

Wednesday, March 13

Field Tour Coordinator*: Rocco Fiori, PG, Fiori GeoSciences*

Restoring complexity and resiliency to instream and off-channel habitats is needed to support self-maintaining salmonid populations. The Yurok Tribal Fisheries Program and its restoration partners have been using a bio-geomorphic approach that promotes the geomorphic processes necessary to form and maintain productive instream and off-channel habitat features. These techniques include: i) excavations that mimic or enhance naturally occurring valley landforms such as side-channels, alcoves, remnant oxbows and wetlands; ii) constructing log jams that provide cover, promote pool scour, sediment sorting and metering, and induce favorable hydraulics and connectivity to off-channel features; iii) constructing infiltration galleries to facilitate surface and ground water exchange that enriches dissolved oxygen levels in constructed off-channel features; and iv) bioengineering that integrates the use of willow and other riparian plants to add root cohesion, hydraulic roughness and vertical and horizontal vegetative structure and diversity to the site. Projects have demonstrated an approach to restore ecosystem resiliency and function in geomorphically dynamic settings influenced by high sedimentation, backwater flooding, lateral channel instability and low dissolved oxygen conditions. On-going monitoring indicates that natal and non-natal juvenile and adult fish utilize these habitats as soon as they are available. Case examples from four different hydro-geomorphic settings will be presented that illustrate design considerations and constraints and provide associated biological and physical monitoring results.

Instream Flow Workshop for Small Coastal California Streams

Thursday, March 14

Workshop Coordinator*: Bill Trush, PhD,* ***River Institute, Humboldt State University***

Small tributary streams (< 10 mi2 in drainage area) are the backbone of anadromous salmonid spawning and rearing habitat in many coastal California watersheds, yet they often do not receive the protection warranted. Can 10% of the mean annual yield in a small, anadromous salmonid-bearing stream be diverted safely? This workshop will take a real stream with real data, do limited additional fieldwork, and then develop a real diversion strategy, meeting (if possible) both objectives (annual yield and protection). The Workshop will rely on the culmination of four months of intensive field measurements accomplished by Dr. William Trush and students at Humboldt State University. These processed field data and other background data (e.g., 10-20 annual hydrographs for this stream) will be provided to all Workshop participants prior to the SRF Conference. The workshop will emphasize analysis over methodology, though both are clearly important. Workshop leaders will not advocate any specific strategy. This will be the participant's task, working ideally as groups (e.g., 2-3 from one agency or NGO). At the end, workshop participants will critique each strategy devised, based on achieving the diverted annual ac-ft targeted yet offering the best chance of protecting salmon and their stream ecosystem.

Mad River Aquatic Habitat Restoration Tour

Thursday, March 14

Field Tour Coordinators***: Margo Moorhouse,*** ***Salmonid Restoration Federation*** ***and*** ***Randy Lew,*** ***Pacific Watershed Associates***

The Mad River is one of the largest rivers in Humboldt County, originating in Trinity County and flowing into the Pacific Ocean just north of McKinleyville, CA. The watershed encompasses approximately 500 square miles and includes a 48,000-acre reservoir, known as Ruth Lake, 48 miles upstream from the confluence with the Pacific Ocean. This impoundment supplies water to two-thirds of the Humboldt County population and is operated by the Humboldt Bay Municipal Water District. In 1971 The Mad River Hatchery was built as a mitigation hatchery and historically propagated all three salmonid species; their current operations are limited to steelhead propagation. Current land uses include urbanization, gravel mining, grazing, and timber production in the middle and lower portions of the basin while, the upper basin is primarily managed by the National Forest Service.

The Mad River supports wild populations of steelhead, coho and Chinook salmon. Approximately 40 percent of the watershed is accessible to salmonids, limiting their distribution to the middle and lower Mad River. Many tributaries to the lower watershed provide valuable cold water habitat for coho salmon and other salmonid species. However, many of these tributaries lack suitable instream habitat, riparian canopy, are aggraded with sediment, and lack connectivity. For over two decades now restorationists have been working with public and private land owners utilizing various funding sources to remove fish passage impediments, restore connectivity, reduce anthropogenic sediment input, and to restore the riparian canopy.

In this field tour we will examine successfully completed projects in three tributaries to the lower Mad River Watershed. These projects will demonstrate different design criteria and approaches but they all have the same overall objectives; to restore, enhance, and improve aquatic habitat for salmonids.

Humboldt Bay Eel River Estuary Enhancement and Off-channel Habitat Field Tour

Thursday, March 14

Field Tour Coordinators*: **Don Allan,** Redwood Community Action Agency and **Michael Love, PE,** Michael Love & Associates*

Over the past decade a lot of attention has been focused on restoring estuarine and off-channel habitats around Humboldt Bay and in the Eel River Estuary. Fisheries biologists have concluded that estuaries are key components in the life cycle of salmonids, particularly coho salmon. They have also noted the importance of providing high flow refugia so juvenile salmonids have areas of slow water in which to take refuge during high flow events to prevent them from being swept into the ocean prematurely. The Estuary and Off Channel Habitat field tour will include visits to projects that are still in the planning stage as well as ones implemented in recent years in the two largest estuarine systems in Humboldt County. Stops will include the Salmon Creek Enhancement project on the Humboldt Bay National Wildlife Refuge, Martin Slough, Wood Creek, and McDaniel Slough. These sites include newly installed tide gates with muted tide regulators, new channels, large woody debris complexes, restored riparian areas and salt marsh, as well as sites in their pre-restoration condition. Project proponents and design engineers will be on hand to describe the projects and answer questions.

Salmon Creek Watershed Restoration: From the Headwaters Forest Reserve to Tidewaters

Thursday, March 14

Field Tour Coordinator*: Mitch Farro,* ***Pacific Coast Fish Wildlife and Wetlands Restoration Association***

This field trip will visit sites both in the Headwaters Forest Reserve and on the Humboldt Bay National Wildlife Refuge. Salmon Creek is the third largest tributary to Humboldt Bay and has received increasing attention due to the development of a watershed-wide fisheries restoration effort including both public and private lands. An overview of both the watershed setting and the scope of the restoration efforts from the headwaters to the tidelands in Salmon Creek will be presented.

The 7,400-acre Headwaters Forest Reserve, publicly acquired in March 1999, is managed for conservation by the US Bureau of Land Management (BLM) and the California Department of Fish and Wildlife (CDFW). The Reserve includes approximately 3,000 acres of old-growth redwood forest and an additional 4,400 acres of second growth forest which had been logged and roaded prior to public acquisition. In 2004 the BLM and California Department of Fish and Wildlife completed a management plan for the Reserve which calls for the removal of almost all the remaining roads throughout the Reserve along with forest restoration and development of recreation trails.

The BLM, in partnership with the Pacific Coast Fish Wildlife and Wetlands Restoration Association (PCFWWRA), began removing roads and other sediment sources in the headwaters of Salmon Creek in 2000 and has continued this work through 2012. Participants will hike to representative road decommissioning project areas to discuss sediment source inventories, project prioritization, techniques, equipment, costs, effectiveness, and monitoring.

The Humboldt Bay National Wildlife Refuge at the mouth of Salmon Creek was established in the early 1970s primarily to provide important coastal habitat for migrating shorebirds and waterfowl. In 1988 over 1,000 acres of former tidelands along lower Salmon Creek and adjacent areas was acquired by the U.S. Fish and Wildlife Service for inclusion in the Refuge. Several efforts to improve instream habitat conditions have taken place over the last decade in lower Salmon Creek.

The field trip will visit the location of the major tide-gate replacements, salt marsh restoration and new tidal channel excavations and off-channel ponds constructed on Humboldt Bay NWR. The trip will provide the opportunity to explore the issues involved in the design, permitting, construction and monitoring of this tidal salmonid habitat project.

Salmon Life Cycle Monitoring for the California Coastal Salmonid Population Monitoring Plan Workshop

Thursday, March 14

Workshop Coordinator***: Sean P. Gallagher,*** ***California Department of Fish and Wildlife***

The purpose of this workshop is to discuss recent work relating to salmon life cycle monitoring in context of the California Coastal Salmonid Population Monitoring Plan (CMP). The workshop consists of presentations by individuals and groups working on salmon life cycle monitoring in California and throughout the Pacific Northwest. The goal of this meeting is to bring experts working on monitoring salmonid life cycles in coastal California together to share with workshop participant's current monitoring efforts, field and laboratory methods, monitoring concepts, and to stimulate discussion on current and future research needs. Major themes include what is a life cycle monitoring station and how does life cycle monitoring science fit into the CMP, restoration, and recovery? Where is life cycle monitoring occurring with some examples from different areas? Should life cycle monitoring methods and data be standardized? What are some concepts and direction for future monitoring? How do we tie life cycle monitoring to stream and watershed restoration science?

Speakers in this workshop have a great deal of experience and knowledge to share regarding salmon life cycle monitoring and provide a number of perspectives ranging from on the ground implementation and methods to species management.

Current and Future Vision for Life Cycle Monitoring Stations within the California Coastal Anadromous Salmonid Monitoring Program

Kevin E. Shaffer, *California Department of Fish and Wildlife*

Much has been written regarding how to best assess and monitor populations of Pacific salmon and steelhead in estuarine and riverine ecosystems. Historically, California has not had scientific or management guidance to evaluate the population status and trend and the larger demographic units they comprise. That is no longer the case. The State has commenced with a program to monitor and assess steelhead and salmon along coastal watersheds, to examine juvenile and adult fish and habitat. A significant and essential element to California's program is establishing salmonid life cycle stations (LCms) within each Evolutionarily Significant Unit and Distinct Population Segment. These LCMs have been described in our Fish Bulletin, published in 2011 and in important monitoring documents from the states of Oregon and Washington.

Fundamental roles of LCMs include fresh-water and ocean survival; indices of variation in population abundance; differential levels of survival within and between populations being monitored; productivity and genetic variability of out-migrating fish; ecological and biological aspects of smoltification; levels and changes in habitat productivity and the relationship to fish productivity, spawning success, and juvenile survival or health. And where placement of LCMs corresponds to extensive restoration efforts, hatchery operations, or recreational angling, stations can be used to evaluate restoration effectiveness of restoration, hatchery effects and interactions with natural stocks, and angling effects on natural stocks, respectively.

As valuable as these stations will be, few stations have been set up in California. They must be carefully located, require trained and dedicated staff to operate, and necessitate annual financial commitment. It must be realized that these stations are fixed and permanent, because population monitoring is not measured in months or even years, but intervals of fish generations. Some of the best examples of working toward establishing and maintaining LCMs include Pudding Creek in Mendocino, Shasta River in Siskiyou, Lagunitas in Marin, and Scott Creek in Santa Cruz counties. Efforts are underway to pursue stations in California's two southern DPSs of coastal steelhead.

LCMs will have a central role in establishing and maintaining a sound, scientific foundation for California's coastal monitoring program. Their contribution to evaluating aspects of population abundance, productivity, survival, habitat relationships, and human activities will be indispensable to evaluating the viability of coastal salmon and steelhead. The Department is both committed and excited about proceeding with establishing new stations and partnering with NOAA Fisheries and other partners in shoring up California's coastal program.

Recovering Salmonids: Surviving Life Stages and Growing "Old" ... How Will We Know?

Joshua Fuller, *NOAA Fisheries Salmon and Steelhead Recovery Coordinator for the North Central California Coast Recovery Domain*

When a species is listed under the Federal Endangered Species Act (ESA) it becomes the responsibility of the Federal agencies to develop a plan for the species recovery. The United States Fish and Wildlife Service oversees recovery plan development for many terrestrial and aquatic species and NOAA Fisheries oversees recovery plans for anadromous or marine species. Planning for recovery of salmon and steelhead in California is organized into four recovery domains. Each domain includes one or more listed salmon or steelhead and recovery plans are in various stages of development or final. Currently, final recovery plans exist for the Southern California steelhead and Central California Coast coho salmon. The ESA requires recovery plans have objective measurable criteria that, when met, would result in a determination that the species is removed from the list. This talk will detail how life cycle monitoring of salmon and steelhead is used to inform recovery criteria as outlined in the NOAA Fisheries Recovery Plans.

Current Life Cycle Monitoring in California: Should Metrics or Methods be Standardized?

***Seth Ricker**, California Department of Fish and Wildlife*

The California Department of Fish and Wildlife and the National Oceanic and Atmospheric Administration ~ Fisheries cooperatively developed the Coastal California Salmonid Monitoring Plan (CMP). Two complementary tasks are considered high priority in the northern monitoring area and form the foundation of the CMP approach. The first task consists of probabilistic sampling of stream reaches within a defined region using spawning ground surveys (SGS) to establish the regional status and trends of adult salmonid abundance. The second task develops intensively monitored Life Cycle Monitoring Stations (LCMs) nested within the regional sample frame of the SGS. LCM studies have four primary objectives:

- estimate juvenile and adult abundance, and freshwater and marine survival rates,
- define the relationship between SGS observations and adult escapement,
- provide a study framework to investigate habitat-productivity relationships,
- characterize the diversity of life history patterns.

Whereas these objectives are shared by the current LCM stations operating in Northern California, the methods used vary among stations. In order to make inference into the similarities or differences in patterns of survival, life histories, or the efficacy of restoration actions across coastal California watersheds, standardized survey methods implemented in a unified design are desirable.

Current methods for estimating population vital rates at LCMs can be categorized into two approaches. The first approach estimates population abundance at important life stages or life stage transitions with a survey specific design such as mark-recapture of smolts at a trap to estimate juvenile migrant abundance, or weir marking and spawning ground recapture for adult escapement estimation. Survival between these life stages is then estimated as a derived parameter from these time-specific abundance estimates (e.g. adult abundance from a cohort divided by smolt abundance of the same cohort to yield a marine survival rate). The second approach is to use a full life cycle multiple period mark-recapture model to estimate survival rates, and derive abundance estimates from marked to unmarked fractions of animals at specific time periods.

With the expanding use of Passive Integrated Transponders (PIT) as a life-long individual tag, and the use of passive remote antenna 'recapture' of these tags at LCM stations, the possibility of incorporating a single design across LCM stations should be possible. This presentation will focus on discussing the advantages of a unified mark-recapture design across multiple stations, and present an example of a basic study design that is being proposed across five LCM basins in Northern California.

Pudding Creek Coho Life History Monitoring: An Example of a Successful Public-Private Partnership

David W. Wright (Presenter), *Campbell Timberland Management, LLC, and* ***Sean P. Gallagher,*** *California State Department of Fish and Wildlife*

Campbell Timberland Management (CTM) and the California Department of Fish and Wildlife, with oversight from NOAA Fisheries, have been monitoring coho salmon and steelhead in Pudding Creek, California since 2005. Research has focused on using an adult trap, spawning surveys, PIT tags, direct observation dives, summer juvenile abundance surveys, and a smolt trap to estimate adult escapement, juvenile abundance, juvenile growth, winter survival, and marine survival.

Fishery managers from both CDFW and CTM selected Pudding Creek as an index stream for their cooperative Coastal Salmonid Monitoring Project, which intends to assess regional (Mendocino County) salmonid abundance and life history tends. Index streams act as a calibration station where data generated from extensive, low-resolution regional sampling are compared to intensive high-resolution individual stream sampling data. Correlations and relationships developed from these comparisons are then extrapolated to determine region-wide trends. In Mendocino County, three Life Cycle Monitoring Stations (LCMS) were developed: Pudding Creek, South Fork Noyo River, and Caspar Creek.

Pudding Creek is an ideal watershed for studies focused on coho and steelhead in coastal north/central California. The aquatic habitat is characterized by low-gradient channel features with relatively cool and abundant pools. Logistically, the stream contains a dam near its mouth with a fish ladder for adult mark and recapture operations. The stream is relatively small (approximately ten miles of blueline stream), and, with a network of logging roads, it is also relatively accessible. However, 90% of the watershed is managed by CTM. Consequently, in order for systematic monitoring to occur, a mutually beneficial partnership was formed between CDFW and CTM. In this arrangement CDFW partially funds CTM staff hired for the project through the Fisheries Restoration Grant Program, while CTM funds other staff resources, infrastructure such as roads and trucks, and purchases of equipment such as screw traps.

Although the principal objective of the Pudding Creek LCMS is to calibrate metrics for regional abundance trend analysis, a secondary purpose is to establish a platform of infrastructure to assist researchers from agencies, universities, and institutions with further studies on coho salmon and steelhead in northern California coastal timberland watersheds.

In this discussion we highlight our cooperative arrangement as an example for others considering this monitoring approach. We discuss our methods, study area, infrastructure, and equipment used in the project. Finally, we provide some findings from this ongoing study.

Lagunitas Creek Life Cycle Monitoring: Lessons Learned and Future Directions

Eric Ettlinger, Marin Municipal Water District

Salmonid monitoring in the Lagunitas Creek Watershed, in Marin County, was first conducted by the Department of Fish and Wildlife (DFW) in 1970. The data collected on coho salmon and steelhead in Lagunitas Creek comprises one of the longest salmonid datasets for any stream on the California coast. Today, monitoring of salmonids is a collaborative effort between the Marin Municipal Water District, the National Park Service, and the Salmon Protection and Watershed Network. In 2012 Lagunitas Creek became a Life Cycle Monitoring Station under the California Coastal Monitoring Program (CMP). Expanded monitoring and new technologies (funded by DFW) will allow us to estimate coho salmon survival across life stages and stream reaches, and potentially link survival to habitat quality.

A DIDSON camera was employed to count spawners migrating upstream, and these data were used to estimate marine survival, calibrate spawner surveys and calculate spawner: redd ratios. Juvenile coho were PIT tagged throughout the watershed and two stationary antenna arrays near the mouths of Lagunitas Creek and its tributary, Olema Creek, will enable us to calculate overwinter survival. A rotary screw trap and two fyke net traps are being used to estimate smolt abundance as well as smolt condition.

This presentation will summarize our first year of monitoring under the CMP and where Lagunitas Creek salmonid monitoring will go from here.

Steelhead Life Cycle Monitoring in Central and Southern California: Challenges and Pitfalls?

Dana McCanne (Presenter) and Chris Lima, California Department of Fish and Wildlife, and Heidi Block, Pacific State Marine Fisheries Commission

The California Coastal Monitoring Plan is divided into two areas with the Southern Monitoring Area extending from the Pajaro River to the Mexican border. The only salmonid species in the Southern Monitoring Area is steelhead (*Oncorhynchus mykiss*), which comprises two Distinct Population Segments (DPS). The Southern California Steelhead DPS (SCS), listed as endangered under the Federal Endangered Species Act (ESA), includes all anadromous water from the Santa Maria River in Santa Barbara County to the Tijuana River in San Diego. *O. mykiss* express two main life-history forms: resident rainbow trout and anadromous steelhead.

There are many issues that have to be resolved if we are to successfully monitor and learn about steelhead in this monitoring area. First, while anadromous streams further north are mostly dominated by the steelhead life-history form, the SCS is likely dominated by resident rainbow trout. While some assumptions are made about large, silvery *O. mykiss* being anadromous steelhead, the appropriate life-history classification is currently uncertain. Methods for estimating the anadromous fraction of *O. mykiss* for a given population must be developed at Life Cycle Monitoring Stations.

Another issue for the Southern Monitoring area is: does what we know about the physical tolerances and life-history strategies for steelhead in general apply to southern steelhead? Most knowledge about steelhead was generated from studies in northern rivers where environmental conditions differ greatly from those found in the Southern Monitoring area. Southern populations of *O. mykiss* evolved in an arid climate. There are numerous years when insufficient rainfall prevents steelhead from ascending many streams, leaving reproduction to resident rainbow trout. In addition, natural catastrophic events, namely wildfires, can extirpate an entire watershed, which can only be colonized by anadromous steelhead. The 2011-2012 water year was below average with the summer of 2012 being dry and warm. Despite this, several fish rescues in the summer of 2012 found *O. mykiss* surviving in fair condition with temperatures as high as 25°C or dissolved oxygen less than 2 mg/l; conditions generally considered unsuitable for steelhead.

It is believed that there are fewer than 500 steelhead in any given year ascending the streams in the SCS. The rarity of steelhead within the more abundant resident rainbow population creates challenges in locating steelhead. Once steelhead are located, handling them is often constrained by federal ESA rules. Permitting issues combined with an investigator concern over the potential for harm makes conducting the necessary research challenging.

One of the tools used in SCS life cycle monitoring stations is the Dual Frequency Identification Sonar (DIDSON). DIDSON enable counting steelhead without handling or interfering with migration. However, DIDSONs are expensive. Add in high human population numbers and you get a recipe for theft or vandalism for anything left unattended in most monitoring locations. Given that steelhead are rare, pulling the DIDSON during times when fish can be migrating is not advisable. Manning stations around the clock is expensive, adding to the already high cost of the equipment.

PIT Tags and Life Cycle Monitoring in the Russian River

Gregg E. Horton, Sonoma County Water Agency and Mariska Obedzinski, U.C. Cooperative Extension and CA Sea Grant

The Coastal Monitoring Plan (CMP) lists estimates of smolt abundance and counts of returning adults at Life Cycle Monitoring Stations as the basis for estimating freshwater and ocean survival for anadromous salmonid populations in coastal CA river systems. Unfortunately, the difficulties inherent in operating trapping facilities during the high water conditions prevalent during winter time coho and steelhead migration periods make this a difficult task in most places. This problem is even more pronounced in larger systems where the negative effects of winter/early spring flows on trapping efficacy at times make data we collect that solely rely on these methods untenable. When coupled with assumption violations for commonly used capture-mark-recapture (CMR) approaches like the 1-trap DARR design that arise as a result of fish behavior (e.g., trap avoidance by previously marked fish, mortality prior to the opportunity for recapture), the resulting bias in smolt abundance and associated survival estimates can be high. In tributaries to the Russian River, we have been relying on PIT tags and fixed-place PIT antennas both with and without outmigrant traps to estimate pre-smolt survival, emigration and smolt abundance directly using CMR models. We show how our approach can be used with the 2-trap DARR estimator to estimate abundance as well as how to implement a multistate CMR model to obtain un-confounded freshwater estimates of pre-smolt true survival and emigration. By PIT-tagging individuals during pre-smolt life stages we have also been able to address questions relevant to habitat quality, genetic differences and habitat use. Advances in PIT technology have allowed the advent of antennas that are flush with the stream bottom making it feasible to use these same approaches in larger tributaries and mainstem rivers to estimate relevant pre-smolt/smolt metrics and to estimate/enumerate PIT-tagged adults upon their return to freshwater. A new PIT antenna array on the lower mainstem Russian River consisting of a multiplexing reader capable of simultaneously recording data from up to 24 antennas on a year-round basis is providing some very encouraging early results that are relevant to successful implementation of the CMP in coastal California river systems.

Life Cycle Monitoring and DIDSON Cameras: Promise and Pitfalls

Walter Duffy (Presenter) *and* ***Matthew Metheny,*** *U.S. Geological Survey, California Cooperative Fish and Wildlife Research Unit, Humboldt State University*

Dual frequency identification SONAR (DIDSON) can be a valuable tool for estimating escapement of adult salmon to California Rivers where traditional survey methods may not be practical. This technology is versatile and relatively easy to use, it can provide 24-hour monitoring of fish passage at rates of up to 7,000 fish per hour throughout a season, can be used to establish run timing curves and provide information on size of fish.

The DIDSON technology does have limitations, primary among these being detection range and species identification. Detection range is limited to 15 m when operating at high frequency and 40 m at low frequency. Analysis software does not currently allow users to differentiate among species in rivers where multiple species occur and run timing overlaps.

We discuss an application of DIDSON to estimate escapement of adult coho salmon, Chinook salmon, steelhead and coastal cutthroat trout to Redwood Creek, Humboldt County. We also discuss selection of monitoring locations that minimize DIDSON's limitations, estimating error for escapement estimates and an approach to separating species with overlapping run timing. We conclude with some observations on the applicability of DIDSON to monitoring trends in abundance of salmon and steelhead in California.

Recent Innovations in Process-Based Restoration Workshop and Tour

Thursday, March 14

Workshop Coordinators*: Tasha McKee,* *Sanctuary Forest and* ***Michael M. Pollock, PhD,* *NOAA Fisheries, Northwest Fisheries Science Center*

This workshop and tour will introduce stream restorationists and managers to emerging, innovative definitions and strategies for restoring natural processes and resiliency essential for recovery of ESA listed salmonids. Presentations and interactive discussions will explore historic conditions and processes that are now missing from stream systems with a focus on off-channel habitat, large wood and beaver dams. We will examine the key role and functions of these attributes and structures including stream morphology, sediment transport, ground and surface water hydrology, floodplain connectivity and pool habitat. In the context of restoring salmon habitat, participants will walk away with an understanding of how different stream conditions play a different role depending on their position in the watershed. They will be exposed to a broad range of structure types and learn about the benefits different stream conditions and structures accrue to salmon.

A field tour will follow the morning presentations to provide examples of these concepts and will include site visits to South Fork Bear Creek and Baker Creek in the Mattole River headwaters. South Fork Bear Creek exemplifies high quality habitat with connected floodplains and wetlands, multiple channels, islands, and high resilience to flood and drought. In contrast, Baker Creek characterizes many of the disturbed Mattole headwaters reaches with entrenched channels, disconnected floodplains, reduced groundwater storage, low summer flows, lack of pool habitat, and poor resilience. Baker Creek is also the site of a pilot project to restore coho habitat and the tour will include a discussion of this project with problem statement, desired outcomes, hypotheses, potential risks analysis and pre and post project monitoring. Project features to be visited include channel spanning log "overflow" structures installed in October of 2012 along with an alcove formed through reconnection of an historic side channel. The tour will also include project design discussions and options for reconnecting another historic side channel and disconnected pond. Throughout the tour we will discuss the concepts of stream evolution and habitat as they apply to South Fork Bear and Baker along with restoration strategies to recover natural processes and ecosystem benefits.

Finding Resilience Through Restoration of Habitat Capacity for Pacific Salmonids

Thomas Williams, PhD, NOAA Fisheries, Southwest Fisheries Science Center

Restoration of habitat for Pacific salmonids requires restoration of ecological processes. Natural processes result in a range and diversity of habitat conditions that allows for the expression of life-history diversity; life-history diversity provides resilience to salmonid populations in dynamic environments because not all individuals necessarily need to be using the same habitat or need to be exhibiting the same behavior at any one time or place. Anthropogenic modification of these processes through various land-use and development activities has simplified habitats thereby constraining the opportunities for the expression of a diversity of life histories. Restoration of habitat diversity built upon a conceptual foundation that considers ecological processes, historical conditions, and current constraints is needed to move forward towards restoring resilient stream systems and fish populations.

Should Streams Be Managed as Drainage Networks or Habitat Networks?

Michael M. Pollock, PhD, NOAA Fisheries, Northwest Fisheries Science Center

Many hydraulic engineers and fluvial geomorphologists have historically viewed stream systems as drainage networks that if functioning properly, should efficiently route water and sediment downstream. In this view natural instream obstructions such as wood, rocks or beaver dams are not desirable because they may create unpredictable changes in channel morphology that would impact the movement of sediment and water and may affect stream stability. This view has extended to the science of stream restoration and the regulatory environment that guides restoration projects, where channels must often be engineered to remain vertically and laterally stable and to move sediment and water at the rate designed over the life of the project. If instream structures are included in a restoration project, they must often be designed to be stable and to not substantially impede the downstream movement of sediment or water. We argue that this view is outdated and that instream obstructions that dynamically alter both the vertical and horizontal position of the stream are essential to the recovery of salmon habitat. We further hypothesize that there are spatial patterns to the numerous types of instream obstructions that historically existed in watersheds and that the ecological functions provided by a particular type of obstruction depends on watershed position. For many types of obstructions, key to creating habitat beneficial to salmon is the ability to substantially decrease the sediment and water transport capacity of a stream, and to do so both stochastically and dynamically. From this perspective, salmon-sustaining streams are recognized as a network of dynamic habitat patches that move in three dimensions.

A Stream Evolution Model Integrating Habitat and Ecosystem Benefits

Brian Cluer (Presenter), *Southwest Regional Geomorphologist, NOAA's National Marine Fisheries Service and* ***Colin Thorne,*** *University of Nottingham, Nottingham, UK*

While channel evolution models (CEM) provide an organizational structure for considering river channels and their complex response to disturbances (for example changes in base level, channelization or alterations to the flow and sediment regimes), physically and ecologically streams comprise more than their channel. We review longstanding CEMs and propose a revised model, updated in light of several decades of research and practical experience, including realization that the single thread, meandering channel form may not represent the natural or pre-disturbed state, an assumption implicit to CEMs. The proposed Stream Evolution Model (SEM) includes a precursor stage featuring a multi-threaded channel, and stream evolution as a cyclical phenomenon within which natural channels evolve, and disturbed channels may recover to a former stage or repeat parts of the cycle rather than evolve through all stages in linear fashion. The hydrologic, hydraulic, morphological and vegetative attributes of the channel during each evolutionary stage are associated with key habitat and ecosystem benefits. Our personal experience was combined with information gleaned from recent literature to construct a fluvial habitat scoring scheme that distinguishes clearly the relative ecological values of different channel stages. Consideration of the links between channel evolution and ecological services leads to improved understanding of the ecological status of modern, managed rivers compared to their unmanaged, natural counterparts. The potential utility of the SEM, with its interpretation of habitat and ecosystem benefits, includes improved river management decision making with respect to future capital investments in river conservation, restoration, and species recovery.

A Pilot Project to Restore Coho Habitat in the Mattole Headwaters

Tasha McKee, *Sanctuary Forest and* ***Michael M. Pollock, PhD,*** *NOAA Fisheries, Northwest Fisheries Science Center*

The Mattole River headwaters have been the focus of salmon restoration efforts for more than three decades. Historic impacts including logging and removal of wood from streams have been partially addressed through sediment reduction, tree planting, and instream habitat structures. However, in the last decade, low streamflows have severely impacted the limited coho habitat in the headwaters. Streamflow impacts from human use are successfully being addressed through a storage and forbearance program (storing water from the wet season for use during the dry season), resulting in measurable increases in summer low flows. However, the more significant impacts of climate change and a pattern of longer dry seasons along with loss of groundwater storage from land use impacts need to be addressed to restore flows sufficient to maintain adequate summer rearing habitat for salmon. Steelhead, Chinook, and coho populations are currently at historic lows, with coho nearly extirpated, adding urgency to the need to restore headwater streams such that they again flow year round. We are developing a pilot research project that involves placing instream logs to affect channel hydrologic and morphologic processes for the purpose of increasing groundwater recharge and ultimately aggrading an incised bedrock stream that currently has limited habitat value. We will quantify expected positive outcomes from the project including increases in summer stream flows, pool habitat, off-channel (overwintering) habitat, floodplain connectivity, channel sinuosity, spawning gravels and the extent of floodplain vegetation. The project will be discussed in terms of hypotheses, desired outcomes, potential risks analysis, and pre and post project monitoring. The outcomes of this study should be relevant to recovery efforts throughout the range of salmon, but particularly in more arid climates.

Opening Remarks

Wesley Chesbro, ***California State Assemblymember***

Assemblymember Wesley Chesbro has served in both houses of the California Legislature and on the California Integrated Waste Management Board, the Humboldt County Board of Supervisors and the Arcata City Council. Throughout his life as a public servant, Mr. Chesbro has been a passionate advocate for the environment.

Mr. Chesbro moved from Southern California to the North Coast in 1969 to attend Humboldt State College. Even before his first election to public office, Chesbro devoted much of his time to fighting for the environment. One of his earliest political victories was spearheading a campaign to convince Humboldt County voters to reject a proposal to dam the Mad River and flood the Butler Valley. Chesbro co-founded the Arcata Community Recycling Center in 1971 and served as its first director. The ACRC was one of the earliest community recycling centers in California and operated successfully for 40 years.

Chesbro co-founded the Northcoast Environmental Center and served as its first executive director. He helped defeat the peripheral canal, fought to save local open space and has championed coastal protection laws, including being a leader in the fight against off-shore oil drilling off the North Coast of California.

Chesbro won his first election at age 22 in 1974, when voters in Arcata elected him to the City Council and re-elected him in 1978. In 1980 he ran successfully for a seat on the Humboldt County Board of Supervisors, representing District 3, and won re-election in 1984 and 1988. He served in the State Senate representing District 2 from 1998-2006.

In November 2008, voters on the North Coast returned Chesbro to the Legislature, this time in the State Assembly, District One. Assemblyman Chesbro's district stretches from Bodega Bay to the Oregon border, encompassing all of Del Norte, Humboldt, Trinity, Lake and Mendocino counties, and Northern and Western Sonoma County. Voters re-elected Chesbro to the Assembly in 2010 and again in 2012 to the re-drawn District 2.

As a member of the State Assembly representing the North Coast, Chesbro chairs the Natural Resources Committee and the Legislature's Joint Committee on Fisheries and Aquaculture and serves on the Pacific Fisheries Legislative Task Force.

Chesbro is the author of several pieces of ground-breaking environmental legislation to stop the flow of plastic pollution into the ocean, to implement sustainable ocean fishing practices, and to provide citizen review of DFW Fishery Restoration Grant Program proposals.

In 2012, Chesbro co-authored Assembly Bill 1961, the Coho Salmon HELP Act, empowering the California Department of Fish and Wildlife to use a one-stop process for approving immediate on-the-ground habitat restoration projects. AB 2284 authored by Chesbro, imposes additional penalties for stream diversion, pollution and littering related to illegal controlled substance cultivation. Additionally, Chesbro played a pivotal role, on the final day of session, ushering through legislation that will provide funding, through an assessment of retail lumber, for salmon restoration and DFW Timber Harvest Plan reviews.

Going Beyond Science: The Importance of Engaging Youth and Diversity in the Restoration Movement

Larry Notheis, ***North Coast Director, California Conservation Corps***

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

How can we do this? Diversifying your membership is not enough. There is a mantra we can learn and practice as our organizations move forward: Diversity, Equity, and Inclusion. In my talk, I will explain how these three ingredients will lead to growth and resiliency of your organization and benefit the wild creatures and places you work to protect. I will give examples about how some organizations have already realized that their relevancy was dependent on their diversity and share what steps they have made to ensure that their membership reflects the population they serve. No one demographic has the numbers or resources to tackle the immense global and/or watershed-specific challenges that we are faced with today. It will take everybody. We are on the precipice of a great opportunity to engage all of our populations in the stewardship of our watersheds. Being hesitant to this reality may result in the undoing of many of our recent political and educational gains.

Bringing It All Together: The Vital Ingredients of Innovative Fish Restoration

Mike Belchik, Senior Scientist, Yurok Tribe

What does it take to restore a river? What "innovative" approaches are needed? As we face a myriad of issues that affect fish, from more traditional causes of fish decline such as hatcheries, sedimentation, roads, and dams to ones in the future such as marijuana cultivation, climate change and GMO frankenfish, and still others we haven't yet been introduced to, the question remains: "What does it take to restore these rivers?" In this talk, I offer my unique perspective as a non-native that works for the Yurok Tribe, who has a responsibility to manage and restore the Klamath River. I do not purport to know or to present Yurok Culture, but instead, I offer my own observations of the ways that the Yurok's unique perspective have affected the way that I view science and restoration efforts. Often, this knowledge is referred to as Traditional Environmental Knowledge (TEK), and while some attempts to incorporate TEK have been made for restoration efforts, it is a difficult concept to marry to the paradigms and practice of western science. I do not represent myself here as an expert, but over time, some of the principles of TEK have profoundly affected the way that I view science and fish restoration. Make no mistake, TEK has shaped the way that the Tribe has involved itself in large-scale restoration efforts such as the KBRA and the KHSA. For example, TEK says that in order for restoration to be successful, it must incorporate a "mountains to the sea" concept. Secondly, we as restorationists must begin to recognize ourselves as part of the system, rather than a separate entity. This has profound implications as to the ultimate goals of restoration. Examples of "humans excluded" paradigm of restoration would include the Wilderness Act, fire management and the current MLPA which prohibits human "take" in certain areas. Finally, TEK demands a view toward the future and a questioning of how actions done today will affect future generations. In the case of the KBRA, it was climate change that drove a lot of our thinking. For example, shrinking snowpacks demand that fish be given free access to spring sources of cold water in the Upper Basin, that agricultural demand be stabilized in a permanent and orderly fashion, and that long-term fixes of water quality that include large-scale ecological restoration begin now. For restoration of larger ecosystems, such as our rivers, to be effective, western science and restorationists must begin to actively incorporate these principles into their thinking.

Science as a Second Language: Translating Science into Action to Protect and Restore Salmon

Christina Swanson, PhD, *Director, Science Center, Natural Resources Defense Council*

Protection and restoration of salmon in Northwest Pacific watersheds is a multi-faceted challenge. The environmental and anthropogenic threats facing these species are neither few nor simple, and the natural resources and ecosystems required by the fish are also highly valued by people, setting the stage for competition and conflict. While successful programs ultimately require action at multiple levels, including public policy, the law and societal commitment, science is the essential foundation for any effective plan. Fortunately, salmon—a keystone species in many watersheds—are well studied, their habitat requirements are well understood, and they are remarkably resilient. But how do we translate our extensive scientific understanding of this fish to guide development of plans to solve such complicated problems?

I suggest that there is a short sequence of logical steps for translating science into a plan of action. The first is to figure out "What have you got?" and describe the problem that your plan is intended to address. Science, in the form of observation and monitoring, is the best tool for getting a clear picture of the current conditions—environmental or biological—and how those conditions have changed in the past or will change in the future. The next step is to decide "What do you want?" In the case of natural resource management, this is in part a societal decision. But for management of living resources like salmon, it is also a scientific one to identify, for example, the abundance, productivity, diversity and distribution levels necessary to maintain viable populations. Science is absolutely essential for the next step to answer the question "What are the causes?" of the problem. In order to fix a problem, you need to correctly identify the factors—loss of habitat, harmful pollutants, or overharvest—that are contributing to the current undesirable condition and which, if you change them, will help achieve your goal. Further, if the science is sufficient, it is useful to prioritize the causal factors relative to their importance and the sensitivity of the problem to changes in those factors. A plan that makes changes in things that have large impacts on salmon is more likely to be effective than one that focuses on minor or less immediate causal factors. And finally, since most problems have multiple causes, a good planning effort will consider "What are the alternative approaches?" for solving the problem, mixing and matching different science-based actions and then evaluating (or predicting) which action or combination of actions is most likely to effectively address the problem so that you can meet your goal. Regardless of the scale or complexity of the threats to salmon in your restoration arena, a planning process that ignores some of the controllable causal factors (usually the ones that are unappealing or "hard" to address) to focus on a limited subset of the causes (usually the "easy" ones) is an incomplete translation of science that is less likely to produce an effective plan.

Managing California Salmonids in a Changing Landscape

***Chuck Bonham**, Director, California Department of Fish and Wildlife*

Chuck Bonham was appointed as Director of the California Department of Fish and Wildlife, September 6, 2011. Prior to his appointment as Director of Fish and Wildlife, Mr. Bonham served in a number of roles for Trout Unlimited over ten years, including since 2004 as the organization's California director.

Mr. Bonham was responsible for developing, managing, and implementing TU's programs in California. These programs include the California Water Project, Sportsmen's Conservation Project, and restoration and watershed projects in both northern and southern California. In addition, Mr. Bonham was a senior attorney for the organization.

Mr. Bonham also served on the Board of Directors of the Delta Conservancy, whose mission is to conserve, sustain and enhance the cultural, agricultural, recreational, wildlife and natural habitat resources of the River Delta region, as well as develop and promote sustainable protection, management and stewardship programs through research and education.

Mr. Bonham received his J.D. and Environmental and Natural Resources Law Certificate from the Northwestern School of Law of Lewis and Clark College, in Portland, Oregon. Before Trout Unlimited, he was a Peace Corps volunteer in Senegal, West Africa, and an instructor and guide at the Nantahala Outdoor Center, in Bryson City, N.C.

Mr. Bonham brings a diverse background and a longstanding appreciation for the outdoors to the position.

Director Bonham will speak about the direction of Department of Fish and Wildlife under his leadership.

Implementing California's Salmonid Recovery Plans

Session Coordinator and Presenter*: Julie Weeder,* *Recovery Coordinator, NOAA Fisheries*

Starting in the mid 1990s, NOAA's National Marine Fisheries Service (NMFS) listed 10 anadromous salmonid species as threatened or endangered under the Endangered Species Act (ESA), and the state of California listed coho salmon north of San Francisco under California's Endangered Species Act (CESA).

Both ESA and CESA require development of planning documents that describe how to reduce a species' extinction risk enough so that it can be removed from the list. NMFS and the California Department of Fish and Wildlife have developed these documents, which detail the actions needed to improve each species' condition.

Many of these documents have recently been released for public review, others have been finalized. These documents are used by NMFS, CDFW, and other entities to determine how proposed policies and funding decisions would most benefit listed salmonids.

Many questions remain about the best way to use recovery plans to facilitate recovery of listed salmonids. What can be done to promote voluntary actions listed in the plans? Can the plans be used to obtain additional funds for implementation of recovery actions? What entities will guide implementation of the plans—NMFS or CDFW alone, or some other implementation team? What can be learned from Washington and Oregon, where some recovery plans were finalized years ago? How would one integrate all the plans into an implementation approach? This session will explore these questions.

Implementing Central Valley Chinook Salmon and Steelhead Recovery

Brian Ellrott (Presenter) and Ryan Wulff, NOAA Fisheries

Human development of the Central Valley, California has not been compatible with many native species, including anadromous fish. This incompatibility is evident in the fact that nearly all populations of winter-run Chinook salmon and spring-run Chinook salmon have already been extirpated from the Central Valley and there are very few wild salmon and steelhead remaining. To help restore healthy salmon and steelhead runs to the Central Valley, the National Marine Fisheries Service (NMFS) is working with public stakeholders and agency co-managers to finalize its recovery plan for the Sacramento River winter-run Chinook salmon Evolutionarily Significant Unit (ESU), the Central Valley spring-run Chinook salmon ESU, and the Central Valley steelhead Distinct Population Segment. The goal of this recovery plan is to improve the biological status of these three species so they can be removed from the list of federally endangered species. Although NMFS is responsible for developing and implementing the recovery plan, achieving the delisting goal is beyond the scope of any one agency or group and will not happen without the cooperation of stakeholders and public agencies at all levels of government. We will all need to work together to most effectively utilize limited funds. In addition to the Recovery Plan, other agency-driven planning efforts intended to restore anadromous salmonids in the Central Valley include the California Department of Fish and Wildlife's Ecosystem Restoration Program (ERP) and the Central Valley Project Improvement Act (CVPIA) administered by the U.S. Bureau of Reclamation and U.S. Fish and Wildlife Service. There is great opportunity for coordination among these three planning efforts - the Recovery Plan is ripe for implementation, the ERP is embarking on a new implementation phase, and the CVPIA is developing a revised process to guide implementation. For this presentation, we will summarize what is in the Central Valley Chinook Salmon Recovery Plan and will specifically explain how we will work with agencies and stakeholders to implement it.

The Recovery Strategy for California Coho Salmon —An Update and the Way Forward

Stephen Swales, PhD, Fisheries Branch, California Department of Fish & Wildlife

In 2004 California Department of Fish & Wildlife produced the Recovery Strategy for California Coho Salmon. Since then the Department has made progress in implementing numerous range-wide and watershed-wide recovery tasks, listed in the Strategy, to restore coho salmon populations to coastal watersheds. Through the Fisheries Restoration Grants Program, between 2004 and 2012 a total of 433 projects benefiting coho salmon recovery in the State, at a total cost of over $100 million, was funded. The majority of these projects involved the restoration and enhancement of suitable freshwater and estuarine habitats for juvenile rearing and adult spawning. A wide range of stakeholder groups have been involved in carrying out these projects. Additionally, statewide recovery actions have included improvements in permitting and regulatory enforcement and the operation of conservation hatcheries on the Russian River at Warm Springs and on Scott Creek at Kingfisher Flat. However, despite all these actions, coho salmon populations throughout the State continue to decline, sometimes to the point of extirpation. What can be done? In this paper we will consider the potentially available options for coho salmon recovery in the state. These might include: increased inter-agency collaboration in implementing recovery plans, expansion of captive rearing/conservation hatcheries, accelerated implementation of habitat restoration programs, a change in emphasis from species-based recovery to ecosystem-based recovery, focusing on the restoration of ecological processes. State and federal coho salmon recovery plans are based on lengthy timelines due to the many recovery tasks that need to be implemented. However, there is also a need for short-term recovery measures designed specifically to prevent imminent population extirpation, such as is currently being implemented by the Priority Action Coho Team (PACT) for coho salmon in the Central California Coast ESU by CDFG, NOAA Fisheries and a range of stakeholders. It is likely that without major expansions to the implementation of recovery programs, coho salmon populations throughout the state will continue to decline.

Using Recovery Plans to Guide Recovery Implementation Efforts and NOAA Funding Decisions

Scott M. Rumsey, PhD, *NOAA Fisheries, Northwest Region, Protected Resources Division, Branch Chief for the Columbia Basin and Pacific Coast, and Program Manager for the Pacific Coastal Salmon Recovery Fund*

With the completion of several Endangered Species Act recovery plans for West Coast salmon and steelhead, NOAA must shift its focus from planning for recovery to implementing recovery. However, the vast majority of recovery implementation is accomplished by state and tribal co-managers, local governments, and private entities. So how can NOAA assist in recovery implementation and help ensure that the high-priority recovery actions detailed in the recovery plans are being implemented?

This presentation will overview several NOAA efforts to assist and guide recovery plan implementation. The Pacific Coastal Salmon Recovery Fund has invested over $1 billion dollars in salmon recovery to date. NOAA is prioritizing projects for funding that explicitly address the population limiting factors identified in recovery plans. NOAA is also developing analytical tools for evaluating whether the restoration projects being implemented across the landscape are indeed addressing the identified limiting factors. Reporting the results of these analyses and demonstrating that limited resources are being appropriately prioritized is critical to maintaining available funding streams for salmon recovery. NOAA has also developed a web-based Recovery Action Mapping Tool to assist recovery implementers in identifying the recovery actions specified for their watershed(s). This tool will also support NOAA's reporting to Congress and the Administration on the progress being made in implementation. Research and monitoring is also an essential tool for adaptively implementing salmon recovery. In the Northwest Region, NOAA is supporting the implementation of coordinated status and trend monitoring of all listed salmon and steelhead populations. NOAA is also prioritizing Intensively Monitored Watersheds and large-scale habitat status and trend monitoring to evaluate the effectiveness of recovery strategies in restoring ecological processes, and to inform adaptive recovery implementation.

Engaging the Public in Recovery Plan Implementation

Jeanette Howard, PhD, *Associate Director for Science, The Nature Conservancy*

Government agencies, private landowners and conservation organizations spend tens of millions of dollars on salmon restoration actions annually in California. However, outside of the salmon restoration community there is little knowledge of the activities that have occurred in California, and the work that still needs to be done. This talk focuses on restoration activities that have been conducted in watersheds within California's coho range over the past decade, and seeks to answer three questions:

- What has been done?
- What still needs to be done?
- What is the economic value of restoration?

We propose that these type of overviews are needed to more actively engage the public in recovery plan implementation. Our work highlights the need for more transparent and accessible information about both past restoration activities and actions needed to restore, recover and protect California salmon. It is our hope that this overview fills a much needed gap in our understanding of the scale of activities that have occurred in California, and the need to protect those investments through implementation of priority recovery plan actions.

Pacific Salmonid Recovery at a Crossroads: Toward a More Strategic Approach to Recovery Plan Implementation

Darren Mierau, North Coast Area Manager, California Trout

In 1991, Nehlsen, Williams, and Lichatowich wrote "Pacific Salmon at the Crossroads", which listed 101 native salmonid stocks throughout the Pacific Northwest at high risk of extinction and called for a new paradigm for recovery. Despite the well-intentioned efforts by many scientists and restoration practitioners, recovery efforts in California still appear at the same crossroads 21 years later, and most if not all salmonid stocks described in this seminal work have inevitably continued to decline. Notably since this publication, we witnessed the listing of SONCC coho, a catastrophic Klamath River fish-kill, the first-ever closure of coastal California ocean fishing, more proposed major water developments (Bay-Delta Conservation Plan, Shasta Dam), shrinking funding resources, and continued local extirpations. Only an apparently perfect alignment of optimal river and ocean conditions in the past few years has temporarily stabilized plummeting populations. Clearly the status quo signals continued declines.

Another notable contribution to recovery efforts is the development of recovery plans by State and Federal agencies, prompted by ESA listing. Draft or final recovery plans have been prepared for Chinook salmon and steelhead in the Central Valley, Southern CA steelhead, Central Coast Coho, and North Coast Coho. These Plans provide a rationale and modeling framework for assessing the historical species structure, distribution, and abundance; targets for recovery; and specific on-the-grounds details. However, detailed and prioritized implementation strategies capable of leveraging funding resources to carry it out are not adequate.

Three primary actions are suggested to steer the course toward a successful recovery implementation:

- Do not continue to ignore the major societal/policy shortcomings our current recovery efforts fail to address, best expressed by Robert Lackey et al. (2006) in "Salmon 2100: The Future of Wild Pacific Salmon". The four "core policy drivers" described by these authors include: (1) rules of commerce, (2) the increasing scarcity of key natural resources, (3) regional human population levels, and (4) individual and collective preferences. Strategies to address these policy issues should form the core of our recovery efforts.
- The salmon and steelhead restoration industry has matured rapidly and has capacity for expansion, providing good "infrastructure" jobs with long-term societal benefits; however, our ability to be strategic, prioritize actions, and gauge our success/failure has not kept pace. We must develop detailed implementation strategies, obtain the needed resources, and implement a well-structured recovery effort to prevent extinction of these listed species. Attaining depensation thresholds for all independent populations which currently support salmonids should be the initial goal of this effort.
- Current levels of state and federal funding will not accomplish recovery. We need a clear and specific recovery implementation strategy, spelling out funding needed to prevent extinction of each listed California salmon and steelhead ESU, as the next phase of recovery.

Addressing Water Diversions That Impact Salmonids and Watershed Health

Session Coordinator*: Mark Lancaster,* *Five Counties Salmonid Conservation Program*

Marijuana Cultivation's Impact on Fisheries

Scott Greacen, ***Friends of the Eel River***

Widespread and increasing cultivation of marijuana across Northern California generates significant but difficult to measure impacts on key fisheries resources. In the South Fork Eel River alone, tens of millions of dollars of fisheries restoration investments by the public over the last two decades—and the viability of the South Fork Eel coho salmon run, itself critical to the viability of the SONCC complex—appear to be at greater risk due to cultivation-related impacts.

Addressing the range of impacts requires careful discrimination between both classes of impacts (eg, stream diversion, fertilizer inputs, pesticide contamination, sediment inputs) and the wide-range of growing operations generating those impacts. Water diversion can be one of the most problematic cumulative effects of marijuana cultivation. It is not readily susceptible to correction through conventional law enforcement, but may be more effectively addressed through community-based models that emphasize best practices, including storage of winter rainfall to supply reasonably-scaled growing operations. Other, similar impacts—diversions and pollution associated with very large scale cultivation in "trespass" grows—are likely to require more effective enforcement, but may also be addressed indirectly by restructuring incentives that drive high-impact behaviors.

Overall, moving state and local policy toward regulation of marijuana cultivation practices offers the best prospect of reducing cultivation-related impacts and ensuring the continued recovery of North Coast fisheries and associated public trust resources. Such policy changes will in turn depend on the willingness of key federal agencies to accept local regulation as an alternative to current prohibition-oriented federal policies.

A Strategy for Improving Spring-run Chinook Salmon and Steelhead Passage in Lower Antelope Creek

Jay Stallman, Stillwater Sciences

Anadromous salmonids in Sacramento River tributaries have experienced substantial declines, in large part, due to reductions in streamflow by water development and related impediments to migration. Antelope Creek, which joins the Sacramento River near Red Bluff, provides critical habitat for the listed Central Valley spring-run Chinook salmon ESU and Central Valley steelhead DPS. Edwards Diversion Dam, located just beyond the canyon mouth, regulates flow in valley floor reaches of Antelope Creek during much of the spring-run Chinook salmon and steelhead migration periods. A new fish ladder was constructed at the dam in 2007, and additional measures are being implemented to prevent entrainment of out-migrating salmonids in two diversion canals. With these measures in place, solutions to restoring salmon and steelhead populations in Antelope Creek hinge on improving conditions that influence migration through valley floor distributary channels connecting the upper watershed to the Sacramento River. We investigated hydrology, water temperatures, channel hydraulics and morphology, and salmonid habitat in mainstem Antelope Creek and associated valley floor distributaries downstream of the diversion dam in 2009 and 2010 to identify potential migration barriers and opportunities for improving fish passage. The Craig Creek distributary offers the best conditions for salmonid migration due to a combination of shorter stream length, higher spring and summer baseflows, higher quality habitat, and unobstructed fish passage. Potential migration barriers in other longer distributary channels result from little or no surface flow, warm water temperatures, persistent channel-spanning beaver dams, and dense aquatic vegetation. Dynamic channel morphology at the Craig Creek distributary junction complicates flow routing and creates unique challenges in managing instream flow. An effective solution for improving adult and juvenile fish passage in mainstem Antelope Creek and its distributaries downstream of the diversion dam will require (1) providing adequate high quality instream flow during critical migration periods, (2) establishing a stable channel configuration at the Craig Creek distributary junction that can reliably route baseflow to target reaches, and (3) selectively modifying key barriers in other distributaries that offer potential passage during winter and early spring floods. Ongoing stream gaging, water quality monitoring, and 2D hydrodynamic modeling at the Craig Creek distributary junction are being conducted to inform development of a collaborative fish passage improvement strategy funded by the United States Fish and Wildlife Service's National Fish Passage Program.

Water Conservation and Off-channel Storage to Restore Instream Flows in Sonoma County

John Green, Lead Scientist / Project Manager, Gold Ridge Resource Conservation District

Lack of sufficient streamflow can be a critical issue during the late summer and fall in coho and steelhead habitat streams in Sonoma County. The relatively high population density and extensive agriculture of the North Bay create elevated water demand during the dry season, when streamflow is already low. This temporal mismatch tends to mask the fact that the problem is not one of water shortage, but a failure in water management. The Gold Ridge RCD and our partners are working to improve summer flows in these streams while increasing water supply security using a range of methods. We are working with the Russian River Coho Partnership on science-based approaches to identifying restorable flow-impaired stream reaches, quantifying critical instream flow thresholds for coho in these reaches, and using that information to identify, plan and implement a variety of water management projects. These projects include implementation of water conservation measures to reduce water demand; installation of irrigation efficiency measures; development of alternative water sources, including rainwater catchment; provision of water storage so that water can be diverted during times of high flow for use during the dry season; and adjustments to the timing and rate of diversion. We believe the science shows that with careful management, it is possible to provide for both human water needs while not impairing habitat for threatened and endangered salmonids.

Giving Can Be Complicated—Instream Dedications to the Environment from a Water Rights Owner's Point of View

John Letton, *former Trinity County Judge and owner of Indian Creek Lodge*

In early 2001 a Trinity County ranch owner submitted a surprising proposal to an RFP from the Department of Fish & Game under the Fishery Restoration Grants Program (SB 271). The proposal was, in essence, for the landowner to give up his pre-1914 rights to irrigate by an inefficient traditional dam/ditch system on Indian Creek, a major tributary of the Trinity River, in exchange for funding to install an efficient pump driven irrigation system. Under the proposal the water saved would be dedicated to the environment in perpetuity under Water Code Section 1707, resulting in quantifiable permanent improvement in Indian Creek's spawning and rearing habitat for Chinook, coho, and steelhead. In return, the landowner would have a new point of diversion for a closed pumping system and an appropriation of sufficient water for irrigation—about 1% of the amount being diverted into the inefficient ditch system.

After the project was approved for funding in early 2002 the landowner was informed that he was the first person in California to attempt to dedicate instream water to the environment, and what appeared to be a simple concept might be difficult to implement—and indeed it was. Hence, the title for this presentation, "Giving Can be Complicated".

Changing Community Water Use Practices to Increase Flows for Salmonids

Tasha McKee, *Sanctuary Forest and* ***Sara Camp Schremmer,*** *Humboldt State University*

Sanctuary Forest developed the Mattole Headwaters Storage and Forbearance program in response to the severe low flows of 2002 and outcomes from community meetings.

This presentation will provide an overview of the program and explore application of key concepts to other watersheds.

The Mattole program began with a feasibility study to determine if changing human water use would make a difference in summer streamflows. The next steps included the development of fisheries protection criteria, a forbearance agreement, landowner outreach and education, and agency collaboration and permits. Ongoing implementation includes forbearance and storage installation along with effectiveness and compliance monitoring. Management of the program involves low flow season monitoring along with landowner notices and technical support needed to ensure forbearance. The program has been very successful, with increased water security for people and increased streamflow for salmonids. Education and outreach have fostered community appreciation and pride in the program with many households practicing conservation and installing some storage on their own.

A new study was initiated late in 2012 in order to determine the social and ecological feasibility of transferring the successful Mattole Headwaters Storage and Forbearance program to Redwood Creek, a tributary on the South Fork of the Eel River that has experienced similar low flow problems over the years. The feasibility study, which is expected to run through the summer of 2013, is a collaborative effort between a Humboldt State University sociology graduate student, Sanctuary Forest, Salmonid Restoration Federation, and several other organizations and individuals with expert knowledge of the watershed's functions and structures. The feasibility study is designed to answer three questions: 1) can summer streamflows in Redwood Creek be improved through changing human water use practices?; 2) Are there other significant causes of low flows that need to be assessed such as land use practices? 3) Is the Redwood Creek community interested in developing and participating in programs to improve summer streamflows?

Climate, Cumulative Effects and Conditions to Counter Them

Mark Lancaster, *Five Counties Salmonid Conservation Program*

A review of 140 years of Weaverville rainfall data reveals a dramatic change in annual patterns, especially in the last four decades. Rainfall records across California reflect similar patterns. Fish, notably coho salmon, are adversely affected by a "thousand pin pricks" each too small to measure and too far upstream to be understood. In addition, rapid and unplanned water diversions undermine years of effort and millions of dollars spent on conservation habitat work.

Since 1987, the author documented numerous fish kills associated with residential, fire, industrial, marijuana, and agricultural land use. His presentation looks at the subtle, cumulative effects of water diversions on fish habitat and considers simple changes in water-withdrawal practices to reduce impacts on fish (ignoring the legal issues of water rights and focusing on the existing diversion practices). It also explores the complex issues of meeting beneficial water uses in a growing rural population and provides examples of workable solutions.

Session Coordinator*: Sungnome Madrone,* *Mattole Salmon Group*

Can Shifting State Funds Become a Catalyst for Greater Conservation?

Mark Lancaster, *Five Counties Salmonid Conservation Program*

Since 1972, California has had an unwavering and ever increasing approach of regulation and state control that many people, ranging from environmental community leaders to industry timberland owners, have suggested are not yielding benefits consistent with the costs to taxpayers. At the same time the state has gone deep into debt selling bonds to finance habitat and water quality protection rather than adequately funding these needs from gas and other taxes revenues. Is there a need to examine the effectiveness of the current structural foundation of California's approach to habitat and water conservation?

This presentation explores a smorgasbord of possible changes in state and local funding strategies, tax and regulatory approaches, and new landowner incentives to enhance fish, forests, wildlife, and water quality. Suggested shifts in current taxes, new user and impact fees, and other actions could result in $185 million per year in increases in state funds for habitat and water quality will be discussed. These fund shifts would have other benefits, including new incentive options and development of a stable base funding for the restoration economy and workforce. Reducing conflict with land owners who are "fortunate" enough to own critical habitats and manage for those habitat elements needs to be a goal of the State of California in the 21st century.

The State of California has three broad approaches to habitat conservation—regulation (often duplicative), state control, and bond funded, grant-based awards to agencies and non-profits. These approaches, as currently implemented, may be creating disincentives for the public, private landowners, and land stewards leading to habitat destruction of the resources they strive to protect.

Bond funded conservation programs have produced significant habitat and water quality achievements while correcting past public and private infrastructure problems that were impacting critical resources. However, the reliance on bonds with high-interest rates is unpopular—especially in weak economic periods. Tax payers associate debt with restoration and water quality protection under current models. In addition, the state cannot sustain these conservation achievements after funds from bonds expire. While grant funds can rapidly decline, the taxes and revenues associated with the underlying public causes of resource impacts continue to accumulate and are spent on capital expansion (highways, high speed rail, etc).

The fluctuations in restoration funding are out of proportion to the revenue sources that can be directed towards balancing development and habitat conservation. The lack of stable base funding precludes the development of tax-based landowner incentives. The incentives that California and the federal government provide for agriculture, timber production, and private alternative energy development are all good indications that similar efforts could potentially benefit habitat conservation.

The unstable funding for restoration work has resulted in chaotic expansion and contraction of restoration-based skilled workforces. The fluctuations and lack of long-term stability of funding sources disrupts and dislocates skilled workers while also preventing lenders from fully capitalizing restoration workforces. Funding changes need to be made to create the incentives-based stewardship and to support a stable, efficient, and effective restoration community.

Counting Salmon in California: A Return on Investment for Effective Salmon Conservation

Lisa Hulette, *Director, California Salmon Initiative, The Nature Conservancy*

Throughout California and much of the Pacific Northwest, wild salmon are disappearing—as are the jobs and way of life that depend on them. In California we are experiencing the steepest decline in salmon populations in the West. Those populations that do survive face grave threats: there is not enough water in streams at the right times; water temperatures are too high; passages to spawning grounds are blocked; estuaries have been altered; and habitat for rearing young fish is missing.

A significant legislative milestone was reached this year when the Governor signed Assembly Bill 1961 (Huffman—Coho HELP Act of 2012). The Act, also known as Assembly Bill (AB) 1961, aims to remove burdensome permitting obstacles that inhibit private landowners, particularly timber companies, from implementing high priority salmon recovery actions for the streams that run through their properties. Once AB1961 takes effect and timber companies and other landowners begin salmon habitat restoration projects on their properties, a critical question will arise: how do we know these projects are successful and are resulting in more fish?

Currently, the scientific and regulatory community do not know how many salmon come back to spawn in California coastal rivers. Without population data, it is difficult to correlate salmon population changes to specific restoration projects. We are thus hamstrung in our ability to measure the cost effectiveness of recovery actions and to adjust our actions accordingly. Measuring progress and end results is a common practice in business and is viewed as a best practice in conservation. However, tracking progress and results in salmon conservation, particularly in California, is rare. State and federal agencies do monitor salmon populations that continue to support commercial fishing, but spend little in the way of resources (technical and financial) to monitor wild coastal salmon and steelhead, which are no longer part of a commercial fishery in California due to their low numbers. Government agencies and conservation organizations spend tens of millions of dollars on salmon restoration actions annually in California; however they spend only minor amounts on monitoring returning spawners. Therefore, the salmon restoration community has little understanding of how cost-effective recovery actions have been.

TNC will compile current and historic adult salmon spawning population data, organize it and publish it in a user-friendly, web-based format and in annual snapshot documents, alongside watershed specific restoration accomplishments to demonstrate the value of metrics to support an increase in funding from both public and private sources. TNC will share this Salmon Snapshot with a broad range of stakeholders in order to advocate for the establishment and funding of a coast-wide monitoring program.

The California Department of Fish and Wildlife is the lead agency charged with monitoring our California salmon populations, but is underfunded. TNC is developing a coalition of supporters to advocate for a California State mandated and funded coast-wide monitoring program. Securing funding for a coast-wide monitoring program may prove difficult. Monitoring, while important for measuring effectiveness, is less appealing than conservation action to decision-makers who appropriate funds on an annual basis in politically fraught economic context. However, it is imperative that we show that money invested in California on salmon restoration is being well-spent, and as a result we have definitive and defensible information that salmon are returning to our coastal streams.

Conservation Investment: Partnering with Private Capital to Protect Salmon Habitat

Noah Levy, *Lands Program Director, Sanctuary Forest*

In a time of dwindling public resources, local and regional conservation groups are increasingly looking for ways to partner with investment funds in order to achieve collaborative conservation outcomes more effectively and at a greater scale. Such partnerships, when they work well, can align the strengths of two very different types of actors. A local conservation group brings a fine-grained awareness of local conservation threats, opportunities, and priorities along with relationships to local residents and landowners; while an investment fund brings the ability to act quickly to seize such opportunities, and the resources to leverage limited public funding in order to conserve or restore larger areas efficiently.

Sanctuary Forest, a land and water trust based in the Mattole watershed, is now close to completing the first phase of a landscape-scale conservation project in partnership with a "conservation investor"—that is, an investment fund that seeks to affect ecological and community benefits alongside long-term financial returns. This project, the Lost Coast Redwood and Salmon Initiative, is focused on several key coho-bearing tributaries of the Mattole and South Fork Eel watersheds—an hour away from this year's conference location, in the heart of California's Lost Coast. The first phase of this project, a working forest conservation easement on 4700 acres of sensitive forest and riparian habitat, is currently being considered for possible funding in late 2013.

Noah Levy will discuss some of the organizational challenges and lessons learned by Sanctuary Forest in the course of developing this partnership and the project it spawned. We will discuss how this project's location in the heart of marijuana-growing country—including over 1500 acres of a notorious former pot-growing operation—creates both an additional layer of challenges, and a significant opportunity to prevent future forestland fragmentation across similar landscapes in the region. Finally, we'll discuss how a balanced approach to the restoration needs and timber potential of these neglected forestlands can point the way to long-term outcomes that will equally benefit watershed health and local economic stability.

Planning and Implementation of Watershed and Fisheries Recovery—in the Context of California's Private and State Timberland Operations and Regulatory Processes: the Past, the Present, and the Potential Future

Richard Gienger, ***Board member of the Redwood Forest Foundation, Inc. (RFFI)***

Logging operations have gone through a 'sea change' since the modern California Forest Practice Act of 1973, and the application of the California Environmental Quality Act (CEQA), and water quality and endangered species statutes to that process. The Board of Forestry and CalFire have the authority to require restoration measures to be implemented as part of their legislative and regulatory authority. Some important restoration activities have become part of the forest regulatory process, especially regarding roads. Other important areas for fisheries and watershed recovery have had less progress. An adequately reformed cumulative effects process would provide a 'blueprint-for-recovery' from legacy (historical) damage. This reform would be focused at a CalWater Planning Watershed scale that generally is around 5,000 to 10,000 acres per Planning Watershed. This is the scale that the cumulative watershed impacts assessment/analysis is required to be done for Timber Harvest Plans (THPs). It is also the scale for recovery plans, limiting factors, and data collection/organization called for by the Timberland Recommendations of the California Coho Recovery Strategy. By integrating these processes great progress can be made in understanding conditions and implementing corrective measures that need to be taken for recovery of forestlands, salmonid fisheries, and other important related values and resources.

The Economic Landscape of Salmonid Recovery in California

Hezekiah Allen*, Executive Director, Mattole Restoration Council*

This presentation will take a pragmatic and outside the box approach to reviewing the economic landscape of salmonid recovery in California for potential revenue streams and cost savings. The presentation is specifically focused on a community based non-profit perspective of restoration and accordingly is framed with a discussion of the multitude of benefits derived from the "restoration economy." Within this context, four specific tools for sustaining restoration activities will be explored: efficiency and harm/cost reduction, fee for service activities, for profit subsidiaries, and mechanisms for embedding restoration into existing economic activity.

There are many ways to improve efficiency within the restoration sector. These include organizational reforms to operate more efficiently, through job sharing and increased collaboration. Efficiency can also be improved by distributing the workload by using property taxes as an incentive encouraging more active stewardship on the part of residents and landowners. This will provide the additional benefit of reducing harm to the recovering watersheds. Lastly, a brief discussion of AB 1961 will explore the possibility of additional permitting and regulatory fixes to reduce project implementation costs.

Fee for service activities provide an opportunity for organizations to diversify revenue streams. While this approach will likely not provide the bulk of the funding needed to implement successful restoration strategies it can help to provide seed money for projects and retain critical staff members.

Non-profit organizations must generally focus their attention, time, and resources on their charitable purpose. However, non-profits can own—in whole or in part—for-profit companies. A review of the guidelines for ensuring an IRS compliant ownership structure will open the door to a wide world of benefits. The benefits of for-profit subsidiaries include greater flexibility in compensating employees by offering stock options and other incentives, wider access to financing sources, business management devoted exclusively to commercial activities and financial benefit realized when the for-profit subsidiary tax deductible payments to its parent. Many watershed councils depend on community events for fundraising so this presentation will explore how a for-profit event production company might leverage significant resources towards restoration.

There is a tremendous amount of economic activity taking place within the watersheds upon which recovery depends. Reviewing four of these industries—timber, cannabis, wine, and tourism—will provide an opportunity to review specific mechanisms or strategies for integrating salmonid recovery into the basic economic fabric of Northern California.

This presentation will move quickly over a broad landscape of possibility. It is not meant to be a comprehensive and exhaustive discussion of any of the specifics ideas discussed. Rather, it is fast paced and exciting presentation meant to inspire future conversations and focused work groups to explore, develop, and implement these or similarly creative strategies.

Diversifying Our Portfolio: Options for Expanding Our Watershed Funding Sources

Ann L. Riley, PhD, ***Watershed and River Restoration Advisor***
San Francisco Regional Water Quality Control Board

Reliance on bond funding through state propositions placed the watershed community in a precarious and vulnerable situation with the bond freeze of 2008-2009. Subsequently, various meetings and discussions among members of the watershed community have identified other potential means of funding our work. A sustainable funding source just coming into existence is the cap and trade auction funded Green House Gas Reduction Fund set up in 2012 by the state legislature with AB1532. This legislation provides a broad outline on the legislature's directions for how to spend cap and trade funds and includes water and resources conservation projects and jobs creation as eligible for funding. Over the next year in 2013 the State Department of Finance and Air Resources Board are directed to work with stakeholders and other state resource agencies to devise a more specific plan for how to allocate what is projected to be about a billion or more dollars a year in the Green House Gas Reduction Fund. Watershed projects can both reduce green house gas emissions and assist with climate change adaptation. Therefore watershed organizations should provide information on what we do to aid these discussions. Other discussions on potential politically feasible future state funding sources have included putting a public goods charge on water bills, and replacing the two-thirds vote needed for local water, stormwater and flood management measures, with majority vote requirements. California remains the only oil producing state without a severance tax and this is also mentioned as a potential source of funds for watershed work. Local funding opportunities can include using transportation measures containing environmental mitigation funds, and alliances with the business community and local work force investment boards.

The Stewardship Act: Financial Incentives for Land Stewardship

Sungnome Madrone, *Executive Director, Mattole Salmon Group*

Purpose: To incentivize stewardship actions of private landowners for protection of air, water, soil, forests, wildlife, and fish, and to minimize the impacts of climate change. To invest in green infrastructure through watershed restoration.

Goal: To increase private sector investments into the watershed restoration industry and to help move restoration practices up front into practices that prevent environmental damage through sound watershed planning and projects.

Opportunity: California counties are updating their general plans with many new and improved sections on things such as water resources, energy resources, open space, circulation, and many other focus areas. Unfortunately, while these new and improved sections are a good step in the right direction, on their own they will not be effective. This creates an opportunity to change the underlying foundation of these laws to help make our environmental laws more effective while rewarding responsible stewardship of the land and public trust resources.

Problem: The current permit system and tax codes (state and federal) treat everyone the same and the compliant get the run around, delays, and great expenses, whereas the un-compliant get away with all kinds of environmental damage with no penalties. The single-track approach to regulating results in a lack of enforcement, environmental damage, and ultimately is a great expense for society. This is inherently wrong.

Solution: To create a two-track permit and tax system that encourages and rewards responsible land stewardship in one track (the Stewardship Track), while allowing others to take the current (Standard) track. With viable choices for which track to take, where good actions are rewarded, we can penalize irresponsible land use activities effectively because the regulatory laws are then only needed to be enforced on a small portion of the populace. If the permit and tax incentives for good stewardship are designed properly most folks would probably carry out responsible land use activities.

How: Through tax reform and the General Plan Update Process, create ordinances and tax law changes that codify good stewardship practices. One approach might include an annual audit by Natural Resources Conservation Service (NRCS), perhaps in collaboration with Watershed Groups, where they visit a stewardship applicants land and if they are performing 80% or better on all Best Management Practices (BMP's) (as contained in NRCS literature and guidelines and Department of Fish and Game (DFG) restoration manuals), then they stay qualified for the stewardship program. This program would contain effective state and federal tax-breaks and permit streamlining and cost reductions. They would then invest into watersheds.

Evaluating the Benefits of Salmon Carcass Analogs for Restoring Nutrient Subsidies and Ecosystem Services to Improve Salmonid Growth in the Russian River Watershed

Robert Coey, Melanie D. Harrison (Presenters), *and* ***Michael Donahue,*** *National Marine Fisheries Service, Southwest Region*

Returns of anadromous salmonids in the Pacific Northwest have declined dramatically in the past century, reducing delivery of marine-derived nutrients (MDN) via decomposition and uptake of salmon eggs and carcasses to coastal watersheds. MDN have the potential to increase production (fish, biofilm, and macro-invertebrate growth) and enhance water quality (increased nitrogen and phosphorous concentrations). Solutions to restoring MDN and food web productivity in freshwater ecosystems suffering depressed salmon runs have been studied in Alaska, Oregon, and Washington, and have been shown to have profound effects on nutrient processing, ecosystem production and salmonid growth. Specifically, salmon carcass analogs (dried processed hatchery salmon pellets) have been shown to be a potential viable tool for restoring MDN and aquatic productivity in freshwater streams where nutrient or carbon deficits are believed to limit production.

Historically, California efforts to recover listed salmonid populations have principally focused on restoring physical habitat to produce a biological response, with minimal focus on measuring or recovering MDN. More recent efforts have combined habitat restoration with the augmentation of juvenile abundance via conservation hatchery programs. This approach presumes however, that sufficient freshwater system nutrients are available to the food web (in absence of MDNs) to provide the food that the additional numbers of stocked fish need to reach a healthy size, survive a seawater transition, and two years in the ocean. For example, in the Russian River, the historically estimated anadromous fish returns were in the tens of thousands, which potentially contributed hundreds of thousands of pounds of MDN to the freshwater ecosystem. Recovery efforts have stocked up to 120,000 juvenile coho salmon into restored and refugia streams within the basin. However, this stocking is in absence of the adult abundance that historically provided MDN for early life stage nutrition. Salmon analogs could be a viable short-term tool for MDN enhancement until populations of coho, Chinook and steelhead are recovered such that natural productivity cycles are restored.

A pilot project is in development in Northern California to combine stocking of juvenile coho salmon with the seeding of salmon carcass analogs developed by AquaDine, Inc. located in Healdsburg, CA. The overall project objectives are to: (1) restore nutrient cycling; (2) increase the growth and survival of salmonids; and (3) monitor and minimize any unintended negative ecological effects. Objectives would be met by monitoring of fish growth and abundance, biofilm and macro-invertebrate growth as well as water quality sampling to monitor unintended nutrient loading in treatment and non-treated control streams.

This work is highly relevant to the recovery of threatened and endangered species, as salmon carcass analogs have the high potential to be a short-term tool for helping restore stream food web productivity until fish communities rebound. Presenters will discuss the current status of MDN research, the pros and cons of MDN efforts using salmon carcasses vs. analogs, a proposed project in the Russian River to study the effects of seeding AquaDine "Salmalogs" in RRCBP stocked streams, and opportunities and challenges for initiating MDN projects in California.

Large-Scale Coho Salmon and Steelhead Habitat Enhancement in Dry Creek, Russian River, CA

David Manning (Presenter), *Principal Environmental Specialist, Sonoma County Water Agency,* ***Peter LaCivita,*** *Regional Fisheries Biologist, U.S. Army Corps of Engineers,* **Robert Coey,** *Fisheries Biologist, National Marine Fisheries Service, Southwest Region, and* **Eric Larson,** *Environmental Program Manager, California Department of Fish and Wildlife, Bay-Delta Region*

To provide water supply and flood control for 600,000 residents, the Sonoma County Water Agency and U.S. Army Corps of Engineers regulate flow from Warm Springs Dam/Lake Sonoma along 14 miles of Dry Creek, a major Russian River tributary. Bordered by 170 private properties, Dry Creek flows through a highly valuable grape growing region. To improve stream flow and habitat conditions for coho salmon and steelhead, the National Marine Fisheries Service issued a 15-year Biological Opinion in September 2008 that mandates large-scale enhancement of six miles of Dry Creek summer and winter instream and off-channel rearing habitat at a total cost of $36 to $48 million dollars. Guided by an adaptive management and monitoring plan, enhancement work is designed in phases and construction began in 2012.

This presentation focuses on advances made during the assessment, design, and early implementation phases of this ambitious project. We will provide insights on approaches that we found most helpful in a system with considerable technical and institutional challenges. Major challenges included developing designs to complement the geomorphic attributes of each reach, establishing metrics to determine project success, and appropriate scales and types of effectiveness monitoring (feature scale vs. site / reach scale). Complexities in validation monitoring due to very low densities of coho, difficult sampling conditions, and variable levels of landowner participation are additional factors that necessitated a well-planned approach.

A Short History of Large Wood Abundance, Accelerated Wood Recruitment Methods, and Effectiveness Monitoring in Several Mendocino County Streams

David W. Wright (Presenter), *Campbell Timberland Management,* ***Lisa Bolton,*** *Trout Unlimited,* ***Jenifer Carah,*** *The Nature Conservancy,* ***Christopher Blencowe*** *and* ***Dave Kajtaniak,*** *California Department of Fish and Wildlife*

Coastal Mendocino County stream channels have undergone large fluctuations in wood loads in the last century from anthropogenic factors. Most of these streams have either historically supported coho salmon and steelhead, or they still do so today. Although it is commonly believed that many of these channels are presently deficient in large wood structural elements, and the present paucity of wood in channels is also believed to be one of many factors influencing the decline of coastal Mendocino Salmonids, the history of anthropogenic variance of wood abundance in these channels is not often described.

An understanding of past logging related influences on channel wood abundance is helpful in order to evaluate the design and effectiveness of stream habitat enhancement projects that intend to load unanchored logs into channels to correct these perceived deficiencies, a process often identified as "Accelerated Recruitment."

In this discussion, we highlight South Fork Ten Mile River as a case study in the recent history and treatment of wood in coastal Mendocino streams, and, additionally, we disclose the monitoring results of Accelerated Recruitment project effectiveness based on before and after Stream Habitat Inventory Surveys. We will also discuss monitoring limitations based on these surveys and present monitoring results from other similar projects in nearby Mendocino streams.

The South Fork Ten Mile River (SFT), which drains 38.6 mi^2, is an third/fourth order low-gradient watercourse located in Mendocino's coastal redwood region near the city of Fort Bragg. The basin, a tributary to Ten Mile River, has been nearly continuously in timber production for over a century. The river, as well as the other forks of the Ten Mile, supports coho salmon, steelhead, and a small population of Chinook salmon. In 2007 and 2008, an Accelerated Recruitment project was implemented in SFT where 330 logs were installed at 138 individual sites over a ten-mile stream reach. None of the enhancement structures were anchored using traditional anchoring methods. Habitat Inventory Surveys were conducted prior to project implementation by the project crew, and by post implementation by CDFW crews in 2012.

The summary results from these surveys of this large wood enhancement project and others such as Inman Creek, Kass Creek, and the North Fork Garcia River will be presented.

Stream Wood Restoration Designed for Salmon and Habitat Heterogeneiety

Rocco Fiori (Presenter), *California State Parks and Fiori GeoSciences,* ***Joel Benegar,*** *and* ***Andrew Stubblefield,*** *Humboldt State University, Department of Forestry and Wildland Resources,* ***Conor Shea,*** *U.S. Fish & Wildlife Service, and* **Thomas Dunklin,** *Thomas B. Dunklin Productions*

Whole tree materials are recognized as important components of stream ecosystems. Unfortunately, instream wood materials were depleted from many stream ecosystems during past timber harvest, agricultural clearing, and stream cleaning practices, and natural recovery to meaningful levels continues to be limited by wood pirates and firewood cutters. The recognition of the ecological importance of wood materials within stream and floodplain ecosystems has led scientists and resource managers to advocate for the re-introduction of large wood directly into these environments. The common applications of instream wood restoration often falls short of producing habitat features capable of producing deep pools, cover, habitat diversity, and floodplain connectivity. Current research shows that natural wood jams, with increased wood piece counts and volumes, are more effective at producing the hydraulic and geomorphic conditions necessary for creating and sustaining complex habitat. This study showed that wood jams constructed with whole tree materials, increased wood piece counts, and greater wood volumes were more effective than simple structures at creating the hydraulic conditions necessary to increase instream complexity, geomorphic function, and aquatic habitat quality.

Results were based on an evaluation of changes to surface sediment textures and channel morphology at ten constructed wood features built with varying complexity and wood volumes. Eight of these features were complex wood jams constructed with whole tree materials including large diameter trees with attached rootwad, logs, and branches. Each complex jam was designed based on site conditions to interact with seasonal variations in stream flow, floodplain morphology, and the dominant sediment transport regime.

Two of the studied features were "simple structures" constructed in 1995 and comprised of one or two logs anchored to imported boulders with cable. The simple structures were designed following a standard California restoration protocol. Results indicate that complex wood jams were more effective than simple fish habitat structures in achieving common restoration objectives that include: (1) increasing percentage pool cover; (2) increasing scour pool habitat; (3) metering and sorting salmon spawning gravels; and (4) improving habitat heterogeneity. In addition, the effectiveness of individual constructed jams improved as the overall wood piece count and volume within the jam increased. Fisheries monitoring data suggest that juvenile fish densities increased at the sub-watershed scale in association with instream wood loading efforts. Results also suggest that in order to support the winter and over-summering habitat needs of juvenile coho salmon, a lower bound for wood loading of 269 m3/ha should be considered for similar third to fourth order tributaries. Additionally, favorable response in fish use and densities occurred where wood jams were very complex, mimicked naturally occurring jams, and were constructed using whole tree materials.

Creating Coho Off-Channel Rearing Habitat in the Middle Klamath Sub-basin —Results and Lessons Learned

Will Harling (Presenter), *Mid Klamath Watershed Council,* ***Toz Soto,*** *Karuk Tribe Fisheries Program,* ***Charles Wickman,*** *Mid Klamath Watershed Council, and* ***Shari Anderson****, Humboldt State University*

Results of an ongoing coho ecology study in the Klamath River by the Karuk Tribe and others have pointed to the need for more high-quality winter rearing habitat in the Klamath River system to prevent further declines in coho salmon runs. Human alteration of low-gradient stream reaches in tributaries to the Klamath River have disconnected floodplains, greatly decreased the amount of available coho winter rearing habitat, and subsequently affected survival and growth rates of coho salmon rearing in Klamath tributaries. To address this need, the Mid Klamath Watershed Council, Karuk Tribe, and partners have been constructing off-channel habitats in key coho tributaries within the Middle Klamath Sub-basin since 2010. Initial results show these constructed habitats provide high quality rearing habitat for juvenile coho salmon, particularly during the winter months. Results from water quality and biological monitoring of the five constructed habitats since construction, as well as design, construction, and maintenance considerations, will be addressed in this presentation.

Using Section 1707 to Improve Instream Flow Conditions in the Shasta River for Coho and Chinook Salmon

Amy Hoss (Presenter), *The Nature Conservancy, Shasta River Project Director*
and ***Amy Campbell,*** *The Nature Conservancy, Shasta River Project Associate*

California Water Code Section 1707 allows that "Any person entitled to the use of water, whether based upon an appropriative, riparian, or other right, may petition the board for a change for purposes of preserving or enhancing wetlands habitat, fish and wildlife resources, or recreation in, or on, the water."

In 2005 and 2009, The Nature Conservancy (TNC) purchased two adjacent cattle ranches along the Shasta River with water rights under the Shasta River Adjudication (these water rights include 11 diversion points totaling 18.11 cubic feet/second (cfs); varying priority dates, all pre-1914, high priority rights). These ranches were purchased because of their location in the Upper Shasta River watershed, an area with important salmon spawning and rearing habitat and water rights to important cold water sources. The water rights associated with these properties originate from four different bodies of water: the Shasta River, Big Springs Creek, Hole in the Ground Creek, and Little Springs Creek.

In July 2012, TNC submitted to the State Water Board Division of Water Rights eight 1707 petitions for the 18.11 cfs. With these 1707 petitions, TNC is requesting that the State of California recognize fish and wildlife as a beneficial use of the TNC-owned water rights in the Shasta River Watershed. While these petitions request this change, TNC intends to keep irrigation and stockwater as the other beneficial uses of these water rights. TNC will continue to use these water rights for irrigation of cattle pastures, but at times we will cease irrigating and instead use this water for instream benefits. Our hope is that these 1707 dedications are approved and in place by the 2013 irrigation season. There are currently no other 1707 dedications in the Shasta River Watershed.

To best balance the use of these water rights for irrigation and instream benefit, information was needed regarding what water quality and quantity impacts these water rights could have if left instream. Numeric model simulations of potential flow augmentation scenarios were completed to examine the potential effects of contributing water rights to baseflows rather than diverting them for irrigation (Willis and Deas 2012). Simulation results illustrated the water temperature effects of using existing water rights to augment flow volumes locally and on the reach scale. The results of flow augmentation varied depending on the timing, location, relative volume, and relative temperature of the diverted water right to the receiving body of water. These model results were then assessed in the context of over-summering juvenile coho and other juvenile salmonids. Additionally, experiments are planned for 2013 to further refine our understanding of the effect flow augmentations may have on mainstem water temperatures.

Geographic Patterns and Environmental Regulation of Outmigration Timing of Coho Salmon (*Oncorhynchus kisutch*) Smolts in North America

Brian C. Spence, *Fisheries Ecology Division, Southwest Fisheries Science Center, National Marine Fisheries Service*

The transition from fresh to salt water marks a critical phase in the life history of coho salmon. The timing of outmigration by smolts is presumed adaptive to maximize survival. However, regional differences in patterns of outmigration across their North American Range indicate that the selective regimes and processes that shape migratory behavior differ among regions. Analysis of migration timing of smolts from 53 coho salmon populations from Alaska to California indicates strong latitudinal gradients in migration patterns with trends toward later, shorter, and more predictable migrations with increasing latitude. Population groupings based on migration traits appear concordant with major coastal oceanic domains in the northeast Pacific Ocean that smolts enter, suggesting that the patterns reflect adaptation to differences in the timing and relative predictability of favorable windows of opportunity in the marine environments. Further, we find evidence that the influence of various environmental factors controlling migration varies across populations and presumably regions. In an Alaskan population, migration probability appears regulated primarily by photoperiod, water temperature, and the interaction between these terms. The high reliance on photoperiod appears consistent with selection pressures favoring outmigration time during the narrow and predictable window of favorable marine conditions in the Coastal Downwelling Domain of the northeast Pacific Ocean. In contrast, two Oregon populations examined respond to a broader suite of environmental cues including photoperiod, temperature (absolute and change), streamflow (absolute and change), and lunar illumination. This suggests that no single freshwater factor serves as a reliable indicator of favorable ocean conditions in the highly dynamic Coastal Upwelling Domain, and that selection processes along the migration pathway may play a larger role in determining which proximate environmental cues are used by smolts to trigger movement. Understanding these population- and region-specific differences is critical for predicting how coho salmon may respond to changes in climate.

Movement, Growth, and Survival of Juvenile Coho Salmon in the Shasta River

***Chris Adams (Presenter)**, Humboldt State University and **Peggy Wilzbach**, USGS California Cooperative Fish Research Unit, Humboldt State University*

Movement, growth, and survival of juvenile coho salmon (*Oncorhynchus kisutch*) were assessed on a watershed scale using PIT tags and a network of instream antennas in the Shasta River, a highly productive Klamath River tributary in interior Northern California. A multi-state mark-recapture model was used to estimate apparent survival, movement, and detection probabilities of tagged juvenile coho salmon during the summer and winter periods in 2011-2012. Reach-specific estimates of apparent survival were made for outmigrating age-1 smolts from the upper Shasta River to the Klamath River in the spring of 2012 using a Cormack-Jolly-Seber mark-recapture model. Juvenile coho salmon in the upper Shasta River displayed rapid growth rates (young of the year over 100 mm fork length by their first June) and a variety of life histories, including outmigration at age-0.

Early Emigration Of Juvenile Coho Salmon In Freshwater Creek

Darren Ward (Presenter), Jennifer Hauer, *Department of Fisheries Biology, Humboldt State University,* ***Seth Ricker,*** *and* ***Colin Anderson,*** *California Department of Fish and Wildlife, Anadromous Fisheries Assessment and Monitoring Program*

Coho salmon in California are State and Federally listed species, requiring efforts to monitor populations and estimate key demographic rates. Estimates of survival of juvenile coho through their first winter and the total abundance of smolts that migrate to sea are an important component of this population monitoring. These estimates are typically based on smolt trapping during spring smolt outmigration and do not account for an unknown proportion of the population that emigrates from the natal stream habitat at other times of the year. We used a mark-recapture study to estimate (1) apparent overwinter survival, or the proportion of fall-marked individuals leaving during typical spring smolt outmigrant sampling, and (2) the probability of early emigration, or the proportion of fall-marked individuals leaving prior to the initiation of outmigrant sampling.

Sampling was conducted in Freshwater Creek, a small coastal stream in northern California (Humboldt County) over two winters from 2010-2012. Apparent overwinter survival estimates for six different reaches ranged from 13.2 - 49.3% in 2010-2011 and 10.5% - 19.5% in 2011-2012. A large proportion (ca. 50%) of the juvenile coho that emigrated from the study site left before the spring smolt run and overwintered in estuarine wetland habitat. Adjusted estimates of total survival from fall stream habitats to the estuary, accounting for early emigration, ranged from 34.4-55.1% in 2010-2011 and 20.9-46.2% in 2011-2012. However, true overwinter survival is unknown because we do not know what proportion of the early emigrants that overwintered in the estuary survived the winter. Our results clearly demonstrate that early emigration in the fall and winter is substantial and, if left unaccounted for, may lead to considerable underestimates of smolt abundance and overwinter survival.

Identification of Chromosomal Regions Under Divergent Selection In Steelhead/Rainbow Trout

Devon Pearse (Presenter), *and* ***John Carlos Garza,*** *Fisheries Ecology Division, NOAA Fisheries Southwest Fisheries Science Center,* ***Michael Miller,*** *University of California, Davis, and* ***Alicia Abadía-Cardoso,*** *NOAA Fisheries Southwest Fisheries Science Center and UC Santa Cruz*

Rapid adaptation to novel environments may be accompanied by genetic changes in specific genomic regions. A variety of approaches have been used to identify marker loci with greater differentiation between populations than expected by purely neutral genomic processes, which can localize regions of the genome linked to genes affected by divergent natural selection. Although such regions may be population specific, identification of the same genomic regions in multiple studies provides concordant evidence that a particular region contains important genes for the selected traits. In *Oncorhynchus mykiss*, we have identified a genomic region on a single *O. mykiss* chromosome that appears to be under strong divergent selection for these life-history traits above and below waterfall and barrier dams. Here we extend our previous efforts to identify genes under differential selection and explore the developmental differentiation between resident and anadromous fish separated by barriers to upstream gene flow. Accurate identification of regions in the genome that are under divergent selection between these and other life-history forms will extend our knowledge of the genetic basis of rapid adaptation, as well as providing useful information for the management of this species.

Density-dependent Habitat Use in Juvenile Salmonids: Detection in Long-term Monitoring Data and Implications for Design of Assessment Programs

Walter G. Duffy (Presenter), *USGS Fish and Wildlife Coop Research Unit, Humboldt State University, and* ***Eric P. Bjorkstedt,*** *NOAA Fisheries, and Department of Fisheries Biology, HSU*

The relationship between habitat characteristics and the abundance and distribution of organisms is a central focus of ecological research, and has important implications in management applications that range from evaluating habitat quality to designing surveys that efficiently yield information on population status. With respect to survey design, it is especially important to understand how habitat-distribution relationships change with population status and habitat quality. In this study, we present 12 years of data on habitat characteristics and the abundance and distribution of juvenile coho salmon collected from stream surveys in Prairie Creek, California, and analyze this data to quantify how the distribution of individuals among habitats changes from year to year as a function of population size. A preliminary analysis revealed a clear pattern in which juvenile coho concentrate in pools at low density, but begin to occupy first run habitats and then riffles as density in preferred habitats increases with population size during the first several years of the time series; we will present results that evaluate how robust this relationship has been over recent years. Having quantified these patterns, we briefly consider how such density-dependent distributions might affect the ability of small-stream surveys to assess changes in population status over time.

Human-induced Trait Change in a Recently Collapsed Salmon Population Complex

Stephanie M. Carlson, PhD, (Presenter), Eric R. Huber, *and* ***Kristina Cervantes-Yoshida,***
Environmental Science, Policy, and Management, UC Berkeley, and ***William H. Satterthwaite,***
Applied Mathematics and Statistics, UC Santa Cruz

Recent research highlights the importance of population diversity in generating a variance-buffering (portfolio) effect. Implicit is the idea that populations adapted to different conditions will differ in traits that affect their relative productivity. This bottom-up effect of inter-population trait variability on portfolio dynamics has heretofore not been explored explicitly. We address this issue through a focus on a recently collapsed salmon population complex: the fall Chinook stock complex originating from California's Central Valley. Recent work suggests that the collapsed stock complex is comprised of multiple populations with synchronous dynamics and, thus, only a weak portfolio effect. Moreover, the strength of the portfolio effect has weakened in recent decades, possibly due to hatchery management practices. Here, we focus our attention on the timing at which salmon transition from freshwaters to the ocean, a known bottle neck period in the salmon life cycle. We postulate that hatcheries have altered the mean and variance in the timing of this transition by releasing fish over a narrow range of dates and sites. To test this idea, we have compiled data on hatchery releases across five decades from the five Central Valley hatcheries to characterize among and within hatchery stock variation in this fitness-related trait.

Our preliminary results suggest several patterns. First, through time, an increasing proportion of hatchery salmon have been released into the San Francisco Estuary, as opposed to the rivers, which affects their ocean arrival patterns as downstream (estuary) releases are released closer to the ocean than upstream (river) releases. Second, by comparing the mean and variability in release timing between those fish released to the estuary and those released in river, we found that releases to the estuary generally occurred later in the year and over a narrower range of dates than releases to the river. Our ongoing work is exploring the generality of these results across all five Central Valley hatcheries propagating fall-Chinook. Our long-term goal is to understand whether this human-induced trait change has ecological consequences for the stock complex by asking whether hatchery release practices have homogenized variation in outmigration timing and intensified match-mismatch dynamics in this system.

Stakeholders, Salmonids, and Sediment: Over Twenty Years of Restoration in The French Creek Watershed

***Stuart Farber (Presenter)**, W.M. Beaty & Associates*
*and **Sari Sommarstrom**, Sommarstrom & Associates*

In 1990 a watershed assessment indicated the French Creek watershed was delivering significant amounts of decomposed granite coarse sediment to the Scott River. The French Creek Watershed Advisory Group was formed to reduce sediment delivery in the French Creek watershed. Stakeholders and partners included public and private landowners, Federal, State and County agencies, local landowner associations and conservation groups. A road management plan that included road drainage improvements, road surface rocking, seasonal road closures and road abandonment was developed and implemented. A monitoring plan, including channel, biological and effectiveness monitoring, was developed to measure response of stream channel reaches to road management plan implementation. Monitoring results found coarse sediment in pools was reduced from 32% to less than 12%. Number of steelhead (*Oncorhynchus mykiss*) captured during electrofishing increased during 13 years of monitoring, while biomass of steelhead remained relatively unchanged. Apparently absent from the watershed prior to restoration efforts, coho salmon (*Oncorhynchus kisutch*) captures increased with identification of one strong cohort class and two weaker cohorts. Cooperation between stakeholders and partners made restoration of stream channel habitats and monitoring possible and developed mutual understanding and trust of scientific results.

Applying Creativity, Persistence, and Collaboration to Ensure Comprehensive Fisheries Restoration in the Lower Klamath

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

The Yurok Tribal Fisheries Program (YTFP) is comprised of four divisions focused on the management and restoration of anadromous and native fish populations of the Klamath Basin. Since the late 1990s, the Lower Klamath Division of YTFP has been working with various partners to assess native fish runs and their habitats in a manner that leads to comprehensive, process-based watershed restoration. This presentation will focus on our partnership with the Karuk Tribe to study juvenile coho ecology in the Klamath River and how this research has guided restoration efforts in the mid- and Lower Klamath Sub-basins; as well as our partnerships with resource agencies and Green Diamond Resource Company and how these relationships have resulted in implementation of innovative and cutting-edge restoration in the Lower Klamath Sub-basin. The presentation will also address the complexities of working in the coastal zone and estuary. Projects highlighted in this presentation include wood loading efforts and off-channel habitat construction in priority, coastal tributaries of the Lower Klamath Sub-basin.

Coho Salmon in the Shasta River —Does Restoration + Supplementation + Regulation = Recovery?

Curtis Knight, California Trout

Coho salmon in the Shasta River have reached critically low levels with effective population size of less than 50 returning adults in recent years indicating a high risk of extinction. Within the context of declining fish numbers, extensive research has identified probable limiting factors for survival and restoration priorities are being implemented. The success of restoration projects at restoring coho salmon numbers will take time to materialize and there are improvements still to be made. However, coho numbers are so low that the population depensation effects may not allow coho to respond to improving habitat conditions. This has led to a collaborative supplementation effort to improve coho salmon numbers in the Shasta River. Several supplementation options are being explored including transporting returning adults from neighboring streams or Iron Gate Hatchery and injecting eyed eggs into the spawning gravels. In the meantime, the regulatory environment for landowners in the Shasta Valley is uncertain. In many respects, the fate of coho salmon in the Shasta River rests with a handful of landowners and water users. Following a failed watershed wide permitting program, regulatory options are being explored that provide landowners protection in exchange for tangible on-the-ground improvements in water management and habitat.

Tools to Promote Restoration of Both Communities and Instream Habitats in the Shasta River and Beyond

Amy Campbell, Klamath Project, The Nature Conservancy

The Nature Conservancy acquired two cattle ranches to help increase salmon populations in the Shasta River Watershed in Northern California. Our primary objectives with these acquisitions are to: implement significant stream restoration projects and to develop solutions that help in recovery salmon populations while making sure that small agricultural operations are kept whole.

The following assumptions were made: 1) threats associated with irrigated agriculture must be abated if we are to meet long-term conservation goals for salmon and other species, 2) landowners would be amenable to leave water instream if they are provided with the flexibility in their operations and if they have assurances that their contribution will not result in the permanent loss of their water right.

This presentation will highlight some of the projects implemented by TNC to test these assumptions including: 1) identify simple, cost-effective ways for landowners to reduce tailwater returns, 2) experimenting with the use of drought tolerant grasses on irrigated pasture to test their applicability in a high-dessert environment and to analyze their tolerance to little or no water during times of the year when fish need water, 3) work individually with irrigators to install monitoring equipment on-farm to help inform their water management decisions and to make recommendations on how management could be changed to improve water quality instream, and 4) identifying ways to provide more water instream but use real-time monitoring to monitor impacts both instream and on irrigated pastures.

The Klamath Agreements: Opportunity for Conflict Resolution or Basin Polarization?

Troy Fletcher, Executive Director, Yurok Tribe

In 2010, the negotiations for the Klamath Basin Restoration Agreement (KBRA) and the Klamath Hydroelectric Settlement Agreement (KHSA) concluded, and the agreements were signed. The agreements were the result of a change in strategy by the Yurok Tribe and others; a change from confrontation, media wars and litigation to responsibility, problem solving and self-determination. The Yurok Tribe brings a unique perspective to the management of the Klamath Basin because the Yurok Tribe, as expressed in its culture and Constitution, has a duty of stewardship that is inextricably woven into its identity as a people. The Yurok Tribe is located at the mouth of the river, and the fish that the Tribe depends on swim upstream to all corners of the Basin, so the Tribe has a vital interest in everything that happens. To the Yurok Tribe, Klamath Falls is local. The Scott Valley is local, and the Trinity and its connection to the Central Valley is local. Solving these big problems requires big solutions. It is this responsibility to lead, to take care of and to steward everything from the mountains to the ocean that inspired the Tribe to take this different approach. There are some of our friends who don't agree with this approach, which involves collaboration, leadership, big thinking, and some very tough decisions, but we are convinced that the approach embodied in the KBRA and KHSA is the right approach, and the one that will lead toward recovery of the Klamath Basin and its natural resources.

How the Klamath Basin Restoration Agreement Informs Conflict Resolution in Scott Valley

S. Craig Tucker, PhD, *Klamath Coordinator, Karuk Tribe*

For decades, Tribes, fishermen, environmentalists and irrigators have fought over water and fisheries protections throughout the West. Nowhere have these struggles been more heated that in the Klamath Basin. Recently, a subset of stakeholders from all sides of the debate have risen above the fray and proposed bold yet balanced solutions for a subset of Klamath water and fisheries problems. What were the factors that led to this abrupt turnaround? What lessons learned during the development of the Klamath Basin Restoration Agreement can be used to resolve conflicts in other areas of the Klamath Basin such as the Scott Valley? This presentation will discuss factors that led to the development of the KBRA and consider how a similar approach could resolve similar issues in other parts of the Basin.

Restoration and Monitoring in California's Oldest Municipal Park: Alum Rock Park, San Jose, CA

P. Travis James, PE (Presenter) and Steve Allen, PE, GHD, Inc.

Penitencia Creek flows through Alum Rock Park, California's oldest municipal Park. The Park was founded in 1872 and is located in the foothills east of San Jose. Penitencia Creek supports populations of threatened steelhead trout and is surrounded by unique geology, mineral springs, and abundant wildlife. Even before the Park's founding, European settlers began to alter the Creek's course and today there is almost no part of the channel that has not been manipulated. Park features, over the years, have included two railroads, an aviary, a zoo, a dance pavilion, a tea house, log cabin, a music court, both men's and women's bath houses, an indoor swimming pool, and a merry-go-round. All of which required significant creek and floodplain alterations due to the extremely limited level ground available. Although some features still remain, the Park is now progressing to a more natural setting, focusing on hiking trails, education, and restoration.

At some point within the last century a concrete weir was constructed across Penitencia Creek to create an in-channel pool for Park visitors. Through scour and ongoing channel incision, a five-foot drop developed downstream of the weir, which created a fish passage barrier. In the summer of 2012 the fish passage barrier was removed by constructing 300 feet of roughened channel consisting of chutes and pools that mimic the stream morphology and restores fish passage. The primary focus of this presentation will be the ongoing channel monitoring, including methodology and current results, but will also include the challenges encountered during design and construction. The monitoring concluded to date includes an as-built survey, flow velocity and depth throughout the project reach, and recording plant survival. Hydraulic performance of constructed roughened channels is not frequently compared to design hydraulic calculations and, therefore, post-construction monitoring data can be used to better inform future designs. It is our overall intention to document the functionality of this channel for the engineering and restoration community and to work with the Park's education facilities to help inform the 100,000 annual visitors, many of whom are school children, about the importance of this type of work within our watersheds.

The Effects of Habitat Enhancements on Juvenile Coho Salmon Carrying Capacity in a Tributary to the North Umpqua River

Dirk Pedersen, *Stillwater Sciences*

We are using an experimental approach to test the effects of habitat enhancement structures on juvenile coho salmon carrying capacity in East Fork Rock Creek, a disturbed Western Cascades stream with high potential for increasing coho salmon production. The 1.6-mi study reach is within the Oregon Coast Coho Salmon ESU distribution and has suitable summer water temperatures but simplified channel characteristics with low wood loading that is well-suited for large wood enhancements. Benefits of habitat enhancements in the EF Rock Creek study reach are being evaluated through direct evaluation of coho salmon carrying capacity within a before-after-control-impact (BACI) experimental framework. The study tests the effectiveness of large wood and boulder structures at increasing juvenile coho winter carrying capacity by creating pools in riffles and increasing habitat complexity in existing pools and runs. Site designs were collaboratively developed to optimize site-specific conditions, but enhancement sites and the number of pieces of wood or boulders used to construct them were randomly selected. Site designs were guided by the principle that juvenile coho salmon over-winter survival is related to availability of high-quality summer rearing areas spatially connected to low-velocity winter refuge habitat that persists over a wide range of flows. Over-winter habitat retention and coho salmon abundance observed during pre-treatment monitoring informed development of enhancement site designs. We monitored juvenile coho salmon abundance using a two-phased sampling approach to estimate carrying capacity during fall, winter, and spring of each year for three years before and after treatment. A 3.2-year recurrence interval flood occurred in the study reach prior to initiating post-treatment monitoring. We are evaluating the geomorphic effects of enhancement structures by surveying longitudinal profiles and mapping bed surface texture to determine the effects of structures on bed material sorting, residual pool depths and thalweg profile variability. Results regarding the relationship between density of pieces (large wood or boulder) and coho salmon overwinter carrying capacity will help guide future habitat enhancement in the Rock Creek basin.

The Passage Assessment Database: a Tool for Stream Habitat Connectivity Restoration Via the Publicly Available CalFish Website

***Anne Elston** and **Laura Ryley (Presenters)**, Pacific States Marine Fisheries Commission*

In recognition of the importance of restoring California's once-abundant salmon and steelhead populations, an inter-agency cooperative project was initiated to inventory barriers to fish passage throughout the coastal watersheds of California. The Passage Assessment Database (PAD) is an ongoing map-based inventory of known and potential barriers to anadromous fish in California. The PAD compiles currently available fish passage information from agencies, organizations, groups and landowners throughout California.

The PAD allows past and future barrier assessments to be standardized and stored in one place, and enables user-friendly online access and analysis of available data in a GIS environment. The PAD enables the analysis of the cumulative impacts of barriers on salmonid migration in the context of overall watershed health, as well as the identification of barriers suitable for removal or modification. It is also an important tool for determining and tracking the outcomes of passage improvement projects. The PAD is publicly available via the CalFish website (*www.calfish.org*).

CalFish, a California Cooperative Anadromous Fish and Habitat Data Program, is a multi-agency website and map viewer presenting fish and aquatic habitat data in California. The Calfish website was created to serve a two-fold mission: 1) To create, maintain, and enhance high quality, consistent data that are directly applicable to policy, planning, management, research, and recovery of anadromous fish and related aquatic resources in California; and 2) To provide data and information services in a timely manner in formats that meet the needs of users.

The PAD presentation will include a description of the history of the PAD, a detailed overview of the types of data it contains, a discussion of the data sources, a demonstration of CalFish as a tool to access and review PAD data, and a discussion of how future contributions can be made to the dataset.

The Potential of Abandoned Gravel Pits to Benefit Salmonid Populations in Northern California

***Brian Cluer (Presenter)**, Habitat Conservation Division, NOAA's National Marine Fisheries Service, **John McKeon, Joe Heublein, Joel Casagrande,** and **Melanie Harrison,** Protected Resources Division, NOAA's National Marine Fisheries Service, and **Michael Beck**, Endangered Habitats Conservancy*

The longitudinal fragmentation of river ecosystems, a dominant factor in the decline of migratory fish populations, has attracted the majority of efforts in freshwater ecosystem restoration and fishery management. Dam removal or retrofitting with passage, other migratory barrier removal, and stream flow agreements are common conservation and restoration tools for the lotic aquatic environment. However, the importance of lentic environments naturally associated with streams is not widely appreciated or emphasized. Civilizations have aggressively drained wetlands for centuries, and built flood control projects in most alluvial valleys in developed countries. For example, California took the Federal Swamp Land Act seriously, between 1820 and 1990 converting 2.2 million acres of wetland (85 percent of the total wetland acreage) that the US Government then ceded to the State. This resulted in a paradigm where wetlands and other lentic habitats were no longer cognitively associated with salmonids. In fact streams were considered by most managers and some scientists as simply their channel, which is only a partial definition of stream. A legacy of this paradigm remains.

With the advent of micro-scale fish tracking technology and careful scientific investigations it has recently become apparent that highly migratory fish use and thrive in off-channel habitats such as seasonally inundated floodplains, some flood control channels, wetlands and meadows—lentic habitats. Furthermore, recent science shows salmonids benefiting from artificial pit habitats from Alaska to California. Some fisheries research scientists are now convinced that lentic aquatic habitat and salmonids population recovery are intrinsically linked, while implementation lags.

This new understanding of salmonid habitat stimulated an initiative to review the common approach and legal framework of gravel pit abandonment, or reclamation. We have led an initiative to question the standard practice and assess the opportunities that abandoned gravel pits present as relatively unwanted property. A partnership has formed where the Endangered Habitats Conservancy (a non-profit NGO in association with the landowner), NMFS science centers, USGS, consulting scientists and engineers will study the feasibility of, and recommend the ecologically superior recontouring and connection to the river of 350 acres.

Funding for the study was granted by the California State Coastal Conservancy, and additional implementation funding is being sought. The consortium is proposing to plan and implement a viable and permanent alternative that reconnects the river with the gravel ponds now found in the floodplain by reshaping the banks and surrounding lands, in order to provide dynamic and productive off-channel nursery and refuge habitat for threatened and endangered salmon and other native species, and to allow this landscape to undergo fluvial evolution that makes habitat rich and diverse into the future. Upland, emergent wetland and riparian habitat will be restored to benefit the suite of plants and animals, particularly song birds, naturally associated with healthy river systems.

Our research colleagues in the USGS are interested in this project because abandoned stream-side gravel pits are a universal problem for which a good solution has not emerged. The successful restoration of this property can serve as a template for other terrace pits along the Russian, and other rivers with similar conditions world-wide.

A Method for Identifying Current and Restorable Salmonid Habitat on Northern California Timberlands

Nicholas Simpson, ***Humboldt Redwood Company***

Humboldt Redwood Company (HRC) has developed a survey method to identify legacy and newly formed fish passage barriers while accurately measuring the extent of fish bearing (Class I) streams within and adjacent to proposed timber harvest plans (THPs). A model incorporating stream gradient and watershed area, generated from a property wide "last fish" survey, calculates a sampling frame for all potential fish bearing reaches in, adjacent to and downstream of the THP. Once a sampling frame is generated, field surveys identify species specific fish distribution, habitat types and migrational barriers, in order to calculate the length of current and restorable habitat. Ultimately, the feasibility of restoration in the context of the reach function in the watershed is determined.

This method enables HRC to strive toward its Aquatic Habitat Conservation Plan goal of maintaining or achieving a properly functioning aquatic habitat condition across the property, while also meeting harvest requirements from the state of California. Multiple case studies show how migration barriers have been identified and are now prioritized for future salmonid restoration projects.

Innovative Approaches to Process-Based Stream Restoration: Can the Regulations Keep Pace?

Michael M. Pollock, PhD, *NOAA Fisheries, Northwest Fisheries Science Center, Seattle, Washington and* ***Brian Cluer,*** *NOAA Fisheries, Habitat Conservation Division, Santa Rosa, California*

Our understanding of how streams historically functioned is rapidly evolving. Accumulating evidence suggests that many streams and rivers had complex flow patterns with multiple, anastomosing channels that were formed in part by numerous obstructions such as beaver dams, large wood and living vegetation, and that these obstructions elevated water tables such that floodplains were regularly inundated. In this understanding, stream channels, adjacent wetlands and riparian vegetation are viewed together as inseparable components of complex stream ecosystems. Recognizing these components as an integrated ecosystem better reflects both the influence of biota on physical fluvial processes, as well as the dynamic and transitory nature of particular habitat elements within these systems. Current paradigms in stream restoration are shifting towards recognition of the stochastic and dynamic complexity of stream ecosystems and the effect of biota in shaping physical fluvial processes. Embedded in this paradigm shift is the recognition that much of the complexity in stream ecosystems derives from obstructions to flow that slow and redirect the movement of sediment and water. We also observe that there are spatial patterns to the numerous types of instream obstructions that historically existed in watersheds and that the ecological functions provided by a particular type of obstruction depends on watershed position. Current regulations governing the restoration of stream ecosystems emphasize restoration of channel form (usually single-thread) rather than processes and focus on the importance of keeping channels largely free of obstructions so that sediment and water can be efficiently routed downstream. Regulations governing stream restoration efforts would benefit from revisions to reflect the importance of instream obstructions such as beaver dams, log jams and living vegetation in creating complex, dynamic anastomosing channels patterns and in elevating water tables such that portions of floodplains are regularly or consistently inundated.

Geology Is Destiny: Rapid Sea Level Rise and Civilization, Worldwide, and on the Pacific Coast

Michael J. Furniss, *US Forest Service, Pacific Northwest Research Station, and Humboldt State University*

There is a saying that "Civilizations exist by geologic consent." Considering sea level since the last ice-maximum about 20,000 years ago, it is clear that human civilization developed largely during a time of nearly-static sea levels. The marine-land interface would be expected to develop progressively more productive aquatic biota under such conditions, and stable, long-term human coastal settlements supported by this biota. This period of static sea level began ending about 100 years ago, and is very likely to be decisively over, as rapidly rising seas are caused by human greenhouse gas emissions that are increasing the heat capacity of the atmosphere and increasing global temperatures.

This presentation will look at sea level through geologic time and across the globe, and put local projections of sea level and its impacts in a time and space perspective.

Sea Level Rise Adaptation Planning Process on Humboldt Bay

Aldaron Laird, *Environmental Planner, Trinity Associates*

Humboldt Bay has the highest rate of relative sea level rise in California. The shoreline of Humboldt Bay has been significantly modified from its natural state. Nearly 9,000 acres of inter-tidal wetlands and tidal channels have been diked off from the Bay. The three major tidal slough systems on Humboldt Bay have been nearly completely channelized, simplifying their aquatic habitat. The future of estuarine environments on tributaries to Humboldt Bay will be affected by sea level rise. Adaptation planning for sea level rise on Humboldt Bay began in 2010 when the State Coastal Conservancy funded the Humboldt Bay Inventory, Mapping, and Sea Level Rise Vulnerability Assessment Project. The next phase of the vulnerability assessment has been funded to prepare inundation models and ground water modeling. This second phase also includes convening a working group to facilitate development of a regional approach to sea level rise adaptation planning. Land use authorities, land management agencies, and resource agencies, will participate in this two-year planning effort. The shoreline of Humboldt Bay is predominately composed of artificial structures like earthen dikes, which if not maintained or fortified, can erode and breach, flooding former tidelands. The uniformity of Humboldt Bay's shoreline elevation, particularly the diked shoreline, leaves it vulnerable to overtopping when sea level rises between two and three feet above the mean monthly maximum water elevation. Adaptation planning for sea level rise on Humboldt Bay is imperative if we are to retain inter-tidal wetlands and estuarine habitat and the species that are dependent upon these environments.

Can Existing and Restored Humboldt Bay Tidal Wetlands Keep Pace with a Rising Sea Level?

Jeff Anderson (Presenter) and Bonnie Pryor, Northern Hydrology & Engineering

Tidal marsh restoration projects around Humboldt Bay have largely focused on expanding the freshwater-estuary ecotone that is utilized by stream-rearing salmonids. Projects have ranged from a focus on restoring tidal action to channels only (i.e. Gannon Slough), recovery of a portion of the tidal prism with an unconstrained marsh area (i.e. Wood Creek), recovery of the full tidal prism over a constrained marsh area (i.e. Jacoby Creek) or recovery of a portion of the tidal prism with a constricted marsh area (i.e. Rocky Gulch). All of the Humboldt Bay tidal wetlands are subject to alteration by sea level rise concurrent with vertical ground motion. The ability of tidal wetlands to keep pace with increasing sea level is hypothesized to be dependent on a combination of the delivery of suspended sediment via tidal action or freshwater tributaries, production of organic matter through vegetation growth and decay, and tidal range. Conceptually, wetlands that do not receive adequate marsh building sediments and/or are constrained by a restricted tidal range may accrete at a slower rate, dependent on vegetation growth and decay. While wetlands are subject to a full tidal range, adequate sediment supply and/or a freshwater tributary may accrete at a faster rate. A simple mobile-bed sediment transport model was developed to illustrate differences in long-term marsh accretion rates in response to accelerated sea level rise subject to: (1) full tidal range and tidal sediment supply, (2) restricted tidal range and tidal sediment supply, (3) full tidal range and tidal sediment supply with a tributary delivering a fluvial sediment supply, and (4) restricted tidal range and tidal sediment supply with a tributary delivering a fluvial sediment supply. The mobile-bed model accounts for suspended sediment deposition with the effects of vegetation held constant. We use a combination of field-based observations, literature findings and numerical modeling to provide insight on the stability of Humboldt Bay tidal wetlands to a rising sea level.

Eustasy, Tectonics, and Sediment Accretion: Understanding the Primary Factors that Control Locally Observed Sea-Level

***Thomas H. Leroy, PG, (Presenter)**, Pacific Watershed Associates and Cascadia GeoSciences,*
Whelan Gilkerson,** Pacific Watershed Associates, and **Jason R. Patton,
*and **Todd Williams**, Cascadia GeoSciences*

Understanding the factors that control locally observed sea-level change and their relative influence is fundamental to conducting coastal development projects including community adaptation planning and environmental restoration. In most coastal locations that have not been subjected to the most recent Pleistocene continental glaciation, the primary factors controlling relative sea-level are eustasy (a worldwide change in water volume), tectonics (land-level changes), and sediment accretion (long-term deposition of sediment within inter-tidal and sub-tidal areas). Developing a localized understanding of these three factors will allow coastal restorationists and engineers to quantify with uncertainty future sea-level change and assess how they may individually or collectively influence their project within a stated design life. Eustatic sea-level change rates are time dependent and typically are developed at a global or regional scale by entities such as the Inter-governmental Panel on Climate Change. Refining these global estimates for local use is typically beyond the capacity of local engineering entities. Tectonic land-level changes are time and location dependent and have to be evaluated at the local level based on a detailed understanding of on-going and future geologically driven vertical land-level changes. Sediment accretion rates are time and location dependent and therefore must be considered/evaluated at appropriate spatial and temporal scales. At a site level, a detailed understanding of variables including but not limited to geomorphic conditions, tidal hydrodynamics, vegetation growth and decay, consolidation, and sediment supply are important.

Modeling Relative Sea-Level Change and Its Impacts to Eelgrass and Salt Marsh Distribution within Humboldt Bay, Northern California

Whelan Gilkerson (Presenter) and Thomas H. Leroy, PG, Pacific Watershed Associates

Humboldt Bay in Northern California provides a unique opportunity to investigate the effects of relative sea level change on estuarine intertidal habitat distribution as driven by cyclical tectonic and ongoing eustatic sea level processes. This combination of superimposed influences in conjunction with anthropogenic alteration of the landscape complicates our ability to forecast the future extent and configuration of the intertidal zone and associated habitats (e.g. eelgrass and salt marsh) around Humboldt Bay. Digestion for practical purposes is confounded by the fact that the uncertainty for eustatic sea level change is a magnitude issue while the uncertainty associated with the tectonic land level changes includes magnitude, timing and sign (uplift vs. subsidence). Despite the collective uncertainty, we model the superimposed effects of tectonically driven land level change, eustatic sea level rise, and tidally driven sediment accretion, on the spatial distribution of intertidal elevations capable of supporting eelgrass (*Zostera marina*) and salt marsh habitat within Humboldt Bay. We employ graphics depicting conceptual ideas along with maps generated from the modeling results to develop easy to understand, locally plausible estimates of future sea level and corresponding landscape changes over the next 100 years; a time frame consistent with local planning but longer than typically stated design lives of engineered restoration projects. These modeling results can be used as a starting point to help identify current knowledge gaps as well as support future sea level rise planning efforts. Currently the largest sources of uncertainty in the Humboldt Bay area are: 1) understanding the timing, magnitude, and distribution of tectonic uplift and subsidence, and 2) understanding long-term sediment accretion dynamics (behavior) in inter-tidal and sub-tidal estuarine environments.

Evaluating Tidal Marsh Sustainability in the Face of Sea-Level Rise: A Hybrid Modeling Approach Applied to San Francisco Bay

Michelle Orr (Presenter) *and* ***Matt Brennan,*** *ESA PWA,* ***John Callaway,*** *University of San Francisco,* ***Lisa Schile,*** *UC Berkeley,* ***Grant Ballard,*** *Point Reyes Bird Observatory, and* ***Diana Stralberg,*** *Point Reyes Bird Observatory and University of Alberta*

As the global climate changes, rising sea levels threaten the sustainability of tidal marshes. The extent to which tidal marshes will be affected by sea level rise (SLR) depends primarily on present land surface elevation, sediment supply and rate of sea level rise. In this study, we explore the sustainability of coastal wetlands in response to a combination of sea level rise and sediment availability conditions, using the San Francisco Bay landscape as a case study.

We developed a hybrid modeling approach that couples a physical process treatment of marsh accretion dynamics with spatial variation across an estuary. By combining a marsh accretion model with regional variability in mineral and organic sediment accumulation and starting elevations, we produced a set of estuary-wide and spatially-varying marsh elevation projections for a range of sea-level rise scenarios.

The model's results improve our understanding of marsh responses to SLR, thereby informing management strategies for these ecosystems. Our model results can be used to assess the vulnerability and restoration potential of individual sites. Management decisions about future large-scale restoration locations could have major implications for development of habitat and longer-term resiliency of these wetlands, underlining the need for recommendations based on spatially explicit projections. The model's most optimistic scenarios for marsh habitat sustainability rely upon high levels of organic contribution and sediment loads. For high rates of sea level rise and suspended sediment concentrations less than 150 mg/L, upland habitat will have to be accessed for restoration in order to maintain marsh habitat.

Perspectives on Adult Spring-run Chinook Salmon Migration: Challenges and Opportunities for Persistence and Recovery in a Dramatically Warming Climate

Joshua Strange, PhD., *Senior Fish Biologist, Stillwater Sciences*

Spring-run Chinook salmon are reliant on snowmelt and cold, higher elevation reaches due in part to their need to over-summer in freshwater prior to spawning, which also makes them especially vulnerable to shifts in water temperature and flow patterns. Adults must not only safely arrive at their destinations, but also have sufficient fitness to resist fish diseases, evade predators, compete with other spawners, and fully complete spawning. Individual migrants have some flexibility in the use of behavioral tactics to respond to changing environmental conditions, with resulting trade-offs, but ultimately proactive management is required to maximize the probability of persistence and recovery of many populations. Fortunately, a suite of emerging and proven tools and strategies exist to craft effective and proactive management actions. This presentation shares the author's perspectives on the related challenges and opportunities based on his research and the work of colleagues on spring-run Chinook salmon in the Klamath-Trinity, Sacramento, San Joaquin, and other river basins. For example, biotelemetry research in Klamath-Trinity basin found that the slow to moderate migration rates of adult spring-run Chinook salmon increased their accumulation of thermal units experienced regardless of water temperature, which can elevate the risk of disease and bioenergetic related mortality even in the absence of acutely stressful water temperatures. Thermal refuges are presumed to be important, but the influence of scale is highlighted by the finding that en route thermal refuges at the confluence of cold tributaries were rarely used and failure to arrive at cold, reach-scale holding areas before migratory conditions became deleterious resulted in poor survival. Surprisingly, the apparent success of summer-run Chinook salmon on the Trinity River demonstrates the species ability to migrate successfully through otherwise inhospitable conditions during brief, weather-induced cooling events and endure acute thermal stress if sufficiently cold, reach-scale thermal refuge holding habitat awaits them at their destination. Conversely, telemetry tagging of adult springers stranded en route to holding areas in Butte Creek indicated that emergency relocation efforts are unlikely to be successful. These findings emphasize the importance of maintaining adequate conditions in accustomed migratory pathways in time and space along with protecting the thermal integrity of cold-reach-scale holding habitat. Biotelemetry can detect subtle but important context-sensitive dynamics between migration behaviors and environmental conditions that is important for guiding management actions. Coupled with water temperature models, down-scaled climatic models, and life-cycle population monitoring and modeling, this suite of tools provides the ability to predict likely population-level responses to global warming and potential management actions. However, to achieve persistence and recovery given anticipated levels of global warming, it's important that management actions are sufficiently large in scale, comprehensive, and visionary such as large-scale floodplain restoration; reintroductions via removal of dams, barriers, and construction of new fish passage facilities; targeted cold-water reservoir releases; and creative use of new water infrastructure specifically for fisheries purposes. While not all populations of spring Chinook salmon are predicted to persist, we have the ability to maximize chances of persistence and/or recovery for many important populations in natural and regulated river systems.

Potential for Thermal Refugia for Over-summering Spring-run Chinook Salmon

Lisa C. Thompson, PhD, (Presenter), John Largier, and Jaime Ashander, University of California Davis

Spring-run Chinook salmon (*Oncorhynchus tshawytscha*) are particularly vulnerable to climate change because adults reside in freshwater for the summer before spawning in autumn. The modeling results from a previous study suggested that climate-induced flow and temperature changes will lead to critical reductions in the ability of spring-run Chinook salmon in Butte Creek, California, to survive the summer in order to spawn. However, in that study we identified several habitat components that we were unable to include in the model, but that may increase the summer survival probability of spring-run Chinook salmon. These model gaps included potential cold water refuges such as thermally stratified deep pools and cold groundwater inputs from springs. In 2012 we conducted a field study to determine whether deep pools in Butte Creek thermally stratify, in order to be able to include this information in future management scenarios. We placed Onset Stowaway® temperature loggers in three pools within the section of Butte Creek in which adult spring-run Chinook salmon over summer. The pools had maximum depths of 4—5 m, were the deepest pools within the approximately 3-km reach we surveyed, and were suggested to us as particularly deep pools by managers and local residents. In each pool a logger was placed in the riffle at the head and at the tail of the pool. At the deepest point in each pool we placed a logger string with a logger at the bottom, surface, and at 1-m intervals in between. One logger was placed in a tree near each pool to monitor air temperature. All loggers were set to record data at the same 10-min interval, and operated continuously from August 3—30, 2012. Preliminary analyses indicate that none of the pools showed significant thermal stratification during the sample period, although two pools showed warmer water in the top 1-m at midday. All pools showed a pattern of daily temperature oscillation with minimum and maximum water temperatures at approximately 0800 h and 1600 h, respectively. During the sample period water temperatures ranged from 14—22°C and air temperatures ranged from 11—49°C across the three sites. The results from this study will be used to inform the development of a fish habitat suitability model for use in the assessment of small hydropower operations.

Evolutionary and Conservation Genetics of Spring-run Chinook Salmon in California

John Carlos Garza, PhD, ***Southwest Fisheries Science Center, National Marine Fisheries Service and Institute of Marine Sciences, University of California Santa Cruz***

Many of the larger basins of the west coast of North America that support populations of Chinook salmon (*Oncorhynchus tshawytscha*) have both a fall-returning ecotype and a spring-returning one. These spring-run fish also differ in the timing of reproductive maturity relative to migration and, historically, in the spatial distribution of spawning activity within the basin. Spring-run salmon typically enter the basin reproductively immature, hold in cool water pools through the summer, then move into headwaters streams to spawn in the fall.

In the last century, many headwater streams historically used by spring-run Chinook salmon have been isolated above dams and other barriers to anadromous migration, and the ecotype was consequently lost in many basins and has been in decline throughout the rest of its range. Hatchery propagation intended to mitigate these declines has been of questionable value and has likely resulted in an increase in hybridization with fall-run Chinook salmon.

I describe a body of genetic data from all of California's extant spring-run Chinook salmon populations, and the geographically proximate fall-run populations, that informs our understanding of the evolution of the spring-run ecotype in California and more widely in North America. I will provide detailed evaluation of population genetic structure of spring-run salmon in the Sacramento and Klamath river basins, including an analysis of the dynamics of spring-run recolonization of two tributaries (Battle and Clear creeks) of the upper Sacramento River. I will also provide an overview of the two spring-run hatchery programs in California (at the Feather River and Trinity River hatcheries) and their role in population biology of the species. Finally, I will outline how the information derived from genetic analysis can inform the restoration and recovery of this important ecotype of one of the world's most important fishes.

Salmon River Spring Chinook—What to Do in a "Pristine" Watershed?

Karuna Greenberg, Salmon River Restoration Council

This presentation will look at past, present and future monitoring and recovery efforts for Salmon River spring Chinook. Data will be examined from various monitoring efforts, including juvenile outmigrant trap, adult population surveys, and spawning and redd surveys. The data will be used to examine the capacity of the Salmon River to support a viable population of spring Chinook, and to inform what future restoration and recovery efforts might look like. Although the Salmon River supports a small but stable run of wild spring Chinook, further recovery has been hampered by its lack of productive rearing habitat. We'll look at what future restoration efforts should look like in order to help remedy this limitation.

Klamath Spring Chinook Harvest Management

Dave Hillemeier, ***Yurok Tribal Fisheries Program***

The harvest of Klamath Basin spring Chinook is not currently managed on a cooperative, region-wide basis. However, there are harvest management actions, both direct and indirect, that constrain harvest of spring Chinook. These management actions include, but are not limited to: closures of Tribal commercial and subsistence fisheries, ocean fishery constraints to protect other stocks, and bag limits and/or time-area closures for in-river sport fisheries. Lacking is a coordinated management process, similar to what is implemented for Klamath Basin fall Chinook. Such a process would quantify appropriate harvest levels based upon analyses of the population dynamics of the spring chinook population. This would be followed by the annual determination of the harvestable surplus of the stock and the management of each fishery based upon a legally mandated or agreed upon allocation scheme.

Some managers have expressed interest in developing a harvest management structure for spring Chinook, similar to what currently exist for Klamath fall Chinook. Challenges that are encountered when considering the harvest management of Klamath Basin spring Chinook include the following: 1) not all fisheries that impact Klamath spring Chinook are monitored regularly (e.g. much of the river recreational fishery), 2) policy decisions need to be considered regarding whether Klamath Basin spring Chinook should be managed as one population, similar to what is done for fall Chinook, or multiple sub- stocks, and 3) there is little age structure information available regarding natural stocks, which limits the ability to assess the population dynamics of these stock to determine appropriate harvest levels. While managing the harvest of Klamath spring Chinook is attainable, it will require the commitment of all management entities to monitor and analyze fisheries in a manner similar to what is currently done for fall Chinook.

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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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