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Plenary Session Abstracts

Beyond stationarity: river futures in an era of extremes

Presenting Author: **Jonathan Tonkin,** University of Canterbury

Session: **Monday Plenary Session**

Abstract

Climate change is altering the global water cycle. Extreme floods, droughts and heatwaves continue to increase in frequency with ongoing climate change. Such climate-driven extremes are already impacting river ecosystems, and models indicate these will continue to accelerate. Yet, much of river management is founded on the assumption of stationarity — those conditions observed in the past will continue. Particularly problematic is when unexpected shocks arrive that were foreseeable in hindsight. A shift is needed at this critical time from being reactive to proactive. In this talk, I will discuss research from my lab focusing on approaches to understand, forecast, and manage river ecosystems in flux. I will start with work focusing on how ecological communities are already changing in response to altered environmental cycles and progress to ways that we can foresee changes before they happen and embed resilience into rivers to cope with unknown future shocks. In short: we need to shift from restoration thinking to resilience thinking. Finally, I will discuss the need to work in new ways in times of rapid change, including transitioning from siloed research to more inter- and transdisciplinary ways of doing research.

River Restoration and Protection: Is the Glass Half-Full or is it Half-Empty? Can we rise to the occasion?

Presenting Author: **Felicia Marcus,** Stanford University

Session: **Tuesday Plenary Session**

Abstract

Sound science is essential to good policy but is not enough to guarantee it. Sound science and scientists play a crucial but underappreciated role in the policy arena. While underappreciation of the value of the science can stem from political judgments or a lack of caring, it more frequently can stem from a failure to communicate. Scientists and policymakers frequently talk about or at each other. To integrate good science more successfully into policy requires that they communicate with each other. Based upon a multi-decadal career in and out of government policymaking positions, advocacy, and non-profit institutions, Felicia will talk about what it takes to make the difference in the policy/political world and how important the work of the watershed science community is in making that difference. She will discuss the importance of this moment in history--where threats to river protection seem heightened with many rivers on the knife's edge in polarized times, but where there are also rays of hope for a long overdue paradigm shift. As she's learned, it takes more than technical skill to have an impact in an inherently political world.

Social-ecological river restoration: converging currents of science, governance, and resilience thinking

Presenting Author: **Brian Chaffin,** Clark Fork Coalition

Session: **Thursday Plenary Session**

Abstract

River restoration, including reconnection of ecosystems and revitalization of human-river relationships, cannot succeed in the modern era guided by science alone. Degradation of riverine landscapes is often deep and complex; legacies of industrial contamination layer across myriad landscape owners and human values leveraged to direct, control, and stifle natural processes. Restoration activities are further complicated by the scales at which key processes must be addressed, and the required navigation of a complex network of human values imposed on rivers, both historically and in modern legal, economic, and social contexts. 'Resilience thinking' offers a powerful lens for navigating this complexity. By recognizing rivers as coupled social-ecological systems, both scientists and practitioners are exposed to approaches that emphasize adaptive management, attention to feedbacks between people and ecosystems, and the capacity to work within—not outside of—human institutions and values. This perspective is especially valuable where legacies of degradation converge with deeply rooted human demands for water in riverine landscapes. To demonstrate the power of a resilience framing for river restoration, I present the challenge of river restoration in the Upper Clark Fork River of western Montana. Once the epicenter of copper mining in the USA, legacy contamination and slow but progressing remediation efforts continue to hold both public and private restoration efforts hostage, stalling progress toward system-wide recovery. The Upper Clark Fork is also a working agricultural landscape, economically dependent on the often-competing activities of irrigation and recreation. Chronic stream dewatering, combined with increasing impacts of climate change and ongoing distrust between producers and government agencies complicate restoration, even as major remediation has already occurred. At the same time, modern social and institutional processes have facilitated renewed tribal sovereignty over water which has begun reshaping water allocation and uses. In applying a resilience thinking lens to this case, I illustrate how river restoration science and practice can move beyond a reliance on technical fixes to embrace and leverage complex social-ecological realities, building pathways toward more durable and impactful restoration outcomes.

Oral Presentation Abstracts

Hydrological Controls on Mercury Storage in a Beaver-Dominated Reach: A Comparative Study of Surface, Porewater, and Groundwater Dynamics

Presenting Author:	**Clifford Adamchak,** University of Colorado, Boulder
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Session:	**Water Quality II - Contributed Session**

Abstract

Atmospheric deposition of mercury (Hg) is increasing in some regions of the Western U.S. When transported to anoxic environments, inorganic Hg can be transformed into methylmercury (MeHg), a bioaccumulating neurotoxin. Simultaneously, American beaver (Castor canadensis) populations are increasing, partially due to their use in river restoration. Within river systems, beavers create cascades of sequential dams that alter redox conditions that influence biogeochemical cycling. Studies show that MeHg concentrations increase downstream of new dams and dynamics change with changing stream flow but have only investigated Hg cycling at the pond scale. There is a need to understand how the culminative landscape effects of multiple beaver ponds at the reach scale changes the potential for methylation production, storage, and transport. I present results from the 2025 snow-free season where I collected surface, pore, and groundwater samples from Coal Creek, Crested Butte. I measured a variety of constituents including filtered total and MeHg in a beaver-dominated reach and a reach without beavers. The results will contribute to our quantification of how reach scale beaver activity influences biogeochemical cycling of Hg and illustrate how a beaver-dominated reach alters change in storage of mercury throughout the snow-free season.

Landscape-scale synthesis science: powering collaborative open science through a modern data stack

Presenting Author:	**Lucy Andrews,** California Department of Water Resources
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Session:	**Special Session 11 - Healthy Rivers & Landscapes**

Abstract

The Healthy Rivers and Landscapes (HRL) science program is committed to open science through rigorous data management, a modern data stack for hosting raw data and data products, open-source reproducible code, and public-facing visualizations and dashboards. This presentation will first examine the challenges in the Sacramento River watershed and Bay-Delta data landscape that have impeded HRL's open science objectives. It will then outline the open data science paradigm, user-centered development practices, and modern data stack that HRL employs to address these barriers. Through a case study of HRL tidal wetland synthesis science, this presentation will illustrate how the program's data infrastructure and capacity-building resources facilitate collaborative analysis, knowledge sharing, and the democratization of science. Attendees will leave with an understanding of HRL's interagency approach to modern data engineering and data science and how transforming siloed, patchwork datasets into a cohesive, accessible platform can advance ecological research and adaptive management.

Otoliths reveal early-life thermal bottlenecks in California's endangered salmon

Presenting Author:	**Kohma Arai,** University of California Davis
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Session:	**Fish Conservation & Management - Contributed Session**

Abstract

Climate change is affecting the phenology, distribution, and abundance of many organisms. The endangered Sacramento River winter-run Chinook salmon (SRWRC) is particularly vulnerable to drought and increased water temperatures. The SRWRC have been blocked from reaching their cold, spring-fed native spawning grounds, and are forced to spawn in the mainstem Sacramento River below the lowest dam, where eggs are exposed to high temperatures. As a result, balancing early-season water deliveries for agriculture with the thermal needs of salmon later in the season has become one of the most pressing water management challenges in California's Central Valley.

To quantify temperature-dependent mortality in early-stage SRWRC, we integrated field data, temperature models, and otolith analysis across a warm year (2021) and a cooler year (2022). Hatch dates and early-stage temperature exposure of juvenile survivors collected downstream were estimated using otoliths and stable oxygen isotopes.

In the warm year, survivors originated from gravel nests ("redds") within a narrow spatial and temporal window, whereas in the cooler year, successful redds were distributed more broadly across time. Survivors typically experienced cooler temperatures during the early incubation stage, while post-hatch temperatures appeared to have less influence on survival, suggesting a "critical period" of heightened thermal sensitivity.

Restoring Balance: Cultural and Ecological Education in Wetland Spaces

Presenting Author:	**Geoffrey Attardo,** University of California, Davis
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Session:	**Special Session 6 - Rivers as Classrooms: Blending Experiential Education into River Restoration Science & Project Monitoring**

Abstract

Wetlands are vital to local ecology and native culture and have been deeply impacted by colonization and development in California. This presentation highlights a collaboration between Wintun/Maidu cultural practitioner Diana Almendariz and UC Davis Medical Entomologist Geoffrey Attardo that integrates traditional ecological knowledge and scientific perspectives in community-based wetland restoration.

We describe a series of hands-on workshops where participants learn about the importance of wetlands to Indigenous communities in Northern California. These workshops include practices such as cultural burning, harvesting and processing wetland plants like tule (Schoenoplectus acutus) and cattail (Typha spp.), and traditional weaving and cordage-making. These materials are then used in restoration efforts to promote native plant growth and habitat resilience. Educational modules also introduce participants to wetland invertebrates and their ecological roles in water quality, nutrient cycling, and food web dynamics.

This integrative approach fosters ecological awareness and cultural reconnection, demonstrating how restoration can be both scientifically grounded and culturally meaningful.

Towards a functional flows perspective for tidal wetland fishes

Presenting Author:	**David Ayers,** University of California, Davis
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Session:	**Special Session 7 - Advancing Environmental Flow Management: Holistic Approaches for Sustaining Aquatic Ecosystems**

Abstract

Tides generate high frequency variability in eulerian habitat conditions, making it difficult to apply traditional habitat suitability models for estuarine organisms. Thus, scientists are often faced with ambiguity when trying to understand and optimize habitat restoration actions for various estuarine taxon. This is especially true of tidal wetland fishes which are the subject of worldwide restoration action. Decades of research on this taxon have provided key insights into their life history, namely the preferential use of shallow habitat (e.g., 0.4 – 1.4 m) to mediate predation risks and enhance nursery function. Unfortunately, little progress has been made transforming this conceptual understanding into actionable insights. We sought to address this knowledge gap by leveraging behavioral tendencies (e.g., intertidal migration) along with simple input parameters (e.g., tidal elevation and land surface elevation) to quantify dynamic habitat conditions. This approach allowed us to estimate the availability and accessibility of shallow rearing habitat across high frequency units of space and time. We also generated a series of habitat opportunity metrics (e.g., extent, duration, and rate of change in rearing habitat), inspired by the burgeoning field of functional flows in river science. As a case study, we compared our habitat metrics across two restored tidal wetlands with disparate morphologies but adjacent geographic locations. Our results suggest that the presumed positive correlation between shallow habitat and rearing function may be violated when restoration designs lack hydraulic scaling relationships (e.g., dendritic channel networks) often present in natural wetlands. Although fluvial and tidal systems vary in many respects, both possess cyclical environmental cycles (annual versus tidal) which can help reveal important functional relationships between the movement of water and habitat for native aquatic organisms.

A Preliminary Map of Historical Landscape Patterns in the Sacramento Valley

Presenting Author:	**Sean Baumgarten,** San Francisco Estuary Institute
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Session:	**Special Session 9 - Floodplains Forward: Aligning the Ecologies & Economies of Large River Valleys**

Abstract

Draining the largest watershed in California, the Sacramento River is a vital waterway connecting Northern California with the San Francisco Estuary. Historically, annual flooding cycles transformed the Sacramento Valley into a vast inland sea extending for miles on either side of the river, often sustained for months. Diverse and extensive wetland and riparian habitats occupied the river and flood basin landscape, which supported immense numbers of salmon, migratory waterbirds, and other fish and wildlife species. Nearly two centuries of levee construction, sediment deposition from upstream hydraulic mining, and agricultural development have transformed the Valley and severed many of the connections between the river and the surrounding flood basins, resulting in the loss of most of the historical floodplain and wetland habitats. This study used archival datasets to develop a preliminary map of historical landscape patterns in the core river-wetland corridor of the Sacramento Valley prior to major Euro-American modification, with next steps focused on refined mapping and descriptions of key processes and functions. This reconstruction of historical landscape patterns and processes provides foundational information to understand natural physical and ecological functioning, assess landscape change over time, and identify management and restoration opportunities to support functional and resilient floodplain landscapes.

Klamath Dam Removal: the World's Largest Fisheries Restoration Project Becomes Reality

Presenting Author:	**Michael Belchik,** Yurok Tribal Fisheries Program
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Session:	**Special Session 8 - Science for a Changing Klamath River Following the World's Largest Dam Removal**

Abstract

In 2000, PacifiCorp began its relicensing process for the Klamath Hydroelectric Project. From the outset of the process, Klamath Basin Tribes and other organizations expressed a desire for dam removal to be a viable alternative to the continued operation of the facilities. The Tribes led the way in developing science, navigating complex regulatory processes, prevailing in court, and incorporating media and direct action. In particular, prescriptive volitional fishway requirements paved the way for a settlement that was in the best interests of indigenous people and PacifiCorp. In 2016, the Amended Klamath Hydroelectric Settlement was signed, which outlined the process by which the dams would be removed. Thus began the long and complex process of doing scientific studies and writing management plans that would all result in the Detailed Plan for Klamath dam removal. As these studies were completed, the full spectrum of possible benefits began to reveal itself. Studies showed that dam removal would result in improvements to fish genetic and geographic diversity, access to stable sources of cold water, restoration of a lost run of Spring Chinook Salmon, water quality improvements, disease reduction, and improvements to the water temperature regime for salmon. As the project progressed, engineering challenges were met and overcome. Restoration plans for reservoir reseeding were implemented, and bigger plans for stream restoration for newly accessible habitats are now being implemented. Today, the Klamath Dam removal is complete, and restoration work has begun in earnest. This presentation will discuss the history, stakeholder engagement, and importantly, the perspective of the Yurok Tribe in the largest fish restoration project ever attempted. Dam removal is an important step in the restoration of the Klamath River, but it is not the end.

Using strontium isotopes to understand the effects of Klamath Dam removal on the early life history of juvenile Chinook Salmon

Presenting Author:	**Francisco Bellido Leiva,** University of California Davis - Center for Watershed Sciences
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Session:	**Special Session 8 - Science for a Changing Klamath River Following the World's Largest Dam Removal**

Abstract

Chinook salmon have been extirpated from historical spawning and rearing habitat within the Klamath River's upper basin since the construction of Iron Gate, Copco 1 and 2, and JC Boyle Dams. This, in combination with habitat degradation associated with reservoir operations, likely limited the expression of juvenile Chinook early life history traits by reducing critical rearing and spawning habitats. Recent dam removal efforts allowed Chinook salmon to repopulate the diverse upstream historical habitat , thus providing an opportunity to expand Chinook salmon juvenile early life histories. To better understand this "expansion", we first established a baseline by characterizing pre-dam removal life-histories using otolith strontium (Sr) isotope ratios (87Sr/86Sr), a valuable source of information to determine, retrospectively, natal origins and movement patterns among freshwater habitats. We developed a robust isoscape of the Klamath River from an extensive survey across the upper and lower basins and analyzed over 300 otoliths recovered from fall-run Chinook salmon carcass surveys below Iron Gate Dam from 2020-2024. Preliminary results indicate that most returning adults hatched either immediately below Iron Gate Dam and Bogus Creek or within the Shasta River, with several juveniles using different rearing areas in tributaries prior to outmigration to the Pacific Ocean.

A model for training the next generation of river managers in multidisciplinary community-centered science and outreach

Presenting Author:	**Athena Bertolino,** University of Washington
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Session:	**Special Session 6 - Rivers as Classrooms: Blending Experiential Education into River Restoration Science & Project Monitoring**

Abstract

Athena will present replicable learnings from designing and implementing a river-focused transdisciplinary graduate student traineeship at the University of Washington. She will share how they have structured the program in innovative ways to prepare students to tackle some of today's toughest societal and environmental challenges and become the next generation of freshwater leaders. She will also discuss how the program has been bringing the concepts of interdisciplinary science to the broader community to further foster knowledge of and interest in river science. The presentation will focus on how the program achieved its mission via a cohort-based model, welcoming 61 students spanning 13 departments across six colleges in five years. Athena will also share unique strategies for expanding public outreach and increasing representation in the field, highlighting activities where science and art intersect. Finally, she will showcase collaborative riverine research efforts the students are undertaking and provide highlights of the four Summer Field Institutes studying river-human interactions on the Skagit River (dam relicensing), Elwha River (dam removal), Bangladesh delta (flood planning), and Kennebeck River (post-industrial restoration).

Planning the Fluvial Future: The Many Benefits of Fluvial Corridor Mapping

Presenting Author:	**Michael Blazewicz,** Round River Design
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Session:	**Special Session 10 - Nature Based Solutions in River Restoration**

Abstract

Streams are not lines, they are corridors. Fluvial processes have largely been ignored in stream corridor management. Rapid change in stream location and scour and fill of floodplains are natural processes linked to stream system function and overall ecological health. Our presentation will provide an overview of how Colorado's Fluvial Hazard Mapping Program is being deployed to cost-effectively provide communities with information that can lead to long-term risk reduction as well as reap numerous secondary benefits related to stream corridor planning. This presentation seeks to challenge the planning and management communities to rethink our typical methods of defining stream-related hazards and transform our understanding of streams as living, dynamic corridors (not lines) that provide a multitude of benefits to a community when protected. Applications have varied widely from regulation to post-wildfire hazards, and the program is flexible enough to capture a stream's unique geomorphic and social characteristics. For more information, visit: www.ColoradoFHZ.com

Acoustic telemetry reveals juvenile steelhead movement patterns in a central California bar-built estuary

Presenting Author:	**Rosealea Bond,** University of California, Davis & NMFS SWFC
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Session:	**Special Session 12 - Advances in Bar-built Estuary Research: Physiochemical, Ecological & Management Perspectives**

Abstract

Bar-built estuaries (BBEs) are dynamic ecosystems that serve a critical role in the early life history of California's coastal salmonid populations. Juvenile steelhead trout (anadromous Oncorhynchus mykiss), in particular, are known to utilize BBEs as summer rearing habitat, despite environmental conditions that can periodically be suboptimal and physiologically stressful. Recent research conducted in the Scott Creek Watershed (Santa Cruz Co.) has indicated that recurrent movement into refuge areas may be commonplace and facilitate oversummer persistence when abiotic and (or) ecological conditions become unfavorable. Still, assessing patterns of fish movement and habitat use in highly dynamic BBEs poses many challenges, and our understanding of how juvenile steelhead utilize estuarine and adjacent freshwater habitat during a typical dry season is incomplete. To address this, we paired intensive environmental monitoring with acoustic telemetry to track fine-scale movement patterns and determine habitat use by steelhead during estuary rearing (July-December 2024). Specifically, we deployed a series of JSATS (Juvenile Salmon Acoustic Telemetry System) receivers throughout the lowermost 1.2 km of Scott Creek, which included the length of the estuary and 400 m of riverine habitat. Juvenile steelhead were captured in the lower estuary and tagged with acoustic transmitters during July (n = 146) and October (n = 94). We found the estuary had multiple mouth open-closure cycles over the study period, with distinct open periods that were tidally influenced (salinity range 0.1–32 ppt) and closed periods which routinely trapped saltwater and resulted in vertical stratification and warming (temperature range 13–24 ℃). Steelhead movement patterns were generally related to estuary conditions; however habitat use was highly variable among individuals. This study underscores that habitat connectivity is critical for juvenile steelhead persistence in BBEs and provides novel insights into juvenile steelhead behavior and fine-grained habitat use during the critical summer dry period.

Preliminary assessment of the effectiveness of side scan sonar in mapping changes in streambed texture following dam removals on the Klamath River, CA

Presenting Author:	**Sandra Bond,** United States Geological Survey
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Session:	**Special Session 8 - Science for a Changing Klamath River Following the World's Largest Dam Removal**

Abstract

Acoustic remote sensing of the riverbed using recreational-grade side scan sonar (SSS) is a low-cost method for mapping river substrates. This study tested the efficacy of SSS for imaging streambed textures and machine learning for substrate classification in the coarse-grained Klamath River, CA. In 2019, 2021, 2022, and 2023, before the 2023 and 2024 dam removals, we collected 151 scans along 175 river kilometers of the downstream river using a Humminbird side imaging sonar system. We post-processed the sonar recordings using PINGMapper 2.0, an open-source toolset for automated processing, segmentation, and classification of benthic substrates from sonograms. PINGMapper 2.0 generates georeferenced sonar mosaics, uses neural network models to predict seven substrate classes (fines ripples, fines flat, cobble boulder, hard bottom, wood, other, and shadow), and produces georeferenced substrate maps. For an accuracy assessment, underwater scaled images and on-screen digitizing were employed to locate patches of fine sediment and ripple marks indicative of sand and finer material. Though trained on coastal plain rivers, PINGMapper 2.0 successfully distinguished fine sediment from coarse sediment environments. Eighty-five percent of the ripple mark locations visually observed in the sonar imagery were correctly classified by PINGMapper 2.0 as fines-ripples or fines-flat in the classified substrate maps. Substrate maps can identify areas of fine-sediment accumulation, which are important foraging habitats for fish and invertebrate species. By collecting post-dam removal data and comparing the before-and-after sonograms processed with PINGMapper 2.0, we aim to enhance our understanding of how post-dam removal sediment transport impacts benthic habitats in downstream reaches of the Klamath River.

Supply and Retention of Coarse Carbon in Rivers with Different Land-use Legacies: Landscape Context Informs Management Objectives, Methods and Outcomes

Presenting Author:	**Wim Bovill,** The University of Melbourne
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Session:	**Special Session 10 - Nature Based Solutions in River Restoration**

Abstract

Replanting native riparian vegetation and reintroducing large wood are two common nature-based solutions in river restoration. Benefits are diverse but include increased supply (from bankside vegetation) and retention (by wood and other features) of coarse carbon, a basal resource supporting aquatic foodwebs.

Efforts to restore or augment local stocks of coarse carbon via these interventions deliver variable results, and we hypothesize that outcomes are dependent on the landscape context within which restoration sites are embedded. Local stocks of coarse carbon may be influenced by local geology (size of substrata) and by patterns of supply and retention upstream.

With field surveys across 32 sites (22 rivers) in southeast Australia we tested the relative influence of supply vs retention in limiting local stocks of coarse carbon, and whether this differed among sites categorised by substrata (sand, gravel, cobble) or by distributions of riparian vegetation locally vs upstream (Fully Forested, Fully Cleared, Cleared Upstream, Cleared locally).

Supply and retention both contributed strongly to coarse carbon densities, but relative contributions of supply vs retention were context-dependent, differing among substrata and vegetation categories. Stocks of coarse carbon may only be augmented by riparian planting in some contexts, and only by re-wooding channels in others.

How Far is Too Far? Varying Roles of Groundwater Source Temperature Modulation in Salmon-Bearing Streams

Presenting Author:	**Tyelyn Brigino,** University of South Florida
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Session:	**Special Session 2 - Groundwater-Surface Water Interactions in Riverine Landscapes Across Multiple Scales**

Abstract

Groundwater discharge is critical for stream functioning in the Kenai Peninsula Lowlands, Alaska, including modulation of flow and temperature. This is important for salmon habitat, as groundwater discharge buffers against summer stream warming and maintains flow in winter when streams might otherwise freeze. Our previous findings show that groundwater comprises ~70% of annual streamflow but varies seasonally, comprising ~50% of streamflow in spring/fall and ~80% of streamflow in summer/winter. However, groundwater emerges in the shallow subsurface on hillslopes and in the deeper subsurface in thin and discontinuous aquifers formed in buried channel deposits. While both are threatened by regional warming and drying trends, hillslope groundwater is primarily threatened by land use-land cover change and aquifer-outcrop groundwater is primarily threatened by increases in water withdrawal, as groundwater is the primary source of water supply in the rapidly developing region. We used hourly temperature measurements from 2021 to 2024 at 57 representative hillslope and aquifer-outcrop groundwater sites to assess the varying roles these two discharge types play in supporting salmon-bearing streams. While hillslope groundwater temperature fluctuates with atmospheric temperature, drying in the summer and freezing in the winter, aquifer-outcrop groundwater temperature remains ~3-5°C throughout the year. Additionally, we modelled the maximum surface flowpath lengths that both groundwater sources could travel before freezing in winter or warming in summer. Across different geomorphic settings, results suggest aquifer-outcrop groundwater consistently retains its thermal signature over longer flow paths compared to hillslope groundwater, which tends to equilibrate more rapidly with atmospheric temperature. Our work is incorporated into ongoing local and regional decision making and engagement, helping to translate science into management outcomes regarding water source protection.

Natural processes and river restoration: revisiting when rivers can heal themselves and when intervention is needed

Presenting Author:	**Rocko Brown,** Cramer Fish Sciences
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Session:	**Special Session 10 - Nature Based Solutions in River Restoration**

Abstract

River restoration for aquatic species hinges on the idea that habitat is both limited and degraded, and that targeted interventions can improve it beyond the river's current potential. This raises two key questions: when can a river recover naturally, and when is active intervention necessary?

We addressed these questions in an incised, sand-bed reach of a regulated river, focusing on habitat for juvenile Chinook Salmon—a keystone and economically important species. First, we assessed whether river bars provide suitable rearing and outmigration habitat. We then mapped habitat changes associated with bar formation using two habitat suitability metrics. To understand bar occurrence, we applied geomorphic theory and identified key physical controls. Finally, we used meander migration simulations to evaluate how land management and strategic interventions could promote self-sustaining habitat.

Our findings suggest that even in degraded river corridors, river bars are naturally occurring features that support juvenile salmon habitat. Habitat extent is increasing where space and erodible, unarmored banks exist. Bar formation is strongly linked to channel width and bank erodibility. Simulations indicate that actions like land acquisition and armor removal can enable sustainable, long-term habitat creation, supporting restoration efforts even in highly altered systems.

Relative sediment supply and excess shear stress drives the evolution of restored side channels in a regulated river

Presenting Author:	**Rocko Brown,** Cramer Fish Sciences
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Session:	**Special Session 3 - Restoring & Revitalizing Large Alluvial Rivers & Their Floodplains to Support Biodiversity & Multiple Goals**

Abstract

Side channel restoration—including creation, rehabilitation, and enhancement—is widely used to mitigate habitat loss in regulated rivers. While short-term ecological benefits are well documented, longer-term geomorphic evolution is less understood. Naturally occurring side channels form at dynamic bifurcations shaped by slope and sediment supply, whereas restoration efforts in regulated systems often aim for fixed design targets (e.g., a set inundation area at a specific flow).

We monitored two restored side channels along a regulated California river over five years to evaluate post-restoration geomorphic and habitat changes. Our goals were to document changes and assess how excess shear stress and relative sediment supply influence channel evolution. We measured sediment and large wood budgets, bed profiles, grain size, bar formation, and inundation patterns, and interpreted these in the context of reach-scale and geomorphic-scale shear stress.

The steeper, upstream site experienced more erosion and a loss of low-flow habitat due to higher excess shear stress, while the downstream site remained stable and gained habitat. Reach-scale excess shear stress was a useful proxy for sediment supply, explaining observed differences. Both channels lost more large wood than they recruited. Normalized rates of geomorphic change declined over time, suggesting most adjustments occur soon after construction.

Religion and River Conservation in Nepal: Attitudes toward Environmental Change at Sacred Hindu Riparian Sites

Presenting Author:	**Patton Burchett,** William & Mary
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Session:	**Special Session 5 - Revitalizing Community & Landscape by Connecting Rivers, People, & Science Through Field Experiences**

Abstract

Drawing on ethnographic fieldwork from 2023–2025 at Nepal's four holiest Hindu sites, or chaar dham—each located by a sacred river—this paper explores varied Hindu responses to rapid and ongoing environmental changes brought about by climate change and development. It asks: How have Nepal's chaar dham been affected by anthropogenic environmental changes? How do Nepali Hindus understand and relate to the rivers at these sites, and what are their reactions to changes in water flow and quality in these rivers? The paper investigates how Hindu beliefs, values and practices regarding the sacred rivers at these sites exist in a tense and complex relationship with, on one hand, conservation efforts, and on the other, development initiatives intended to bring economic and quality-of-life benefits.

Linking Flow Dynamics and Fish Movement: Implications for Chinook Salmon Survival in the Klamath Basin

Presenting Author:	**Summer Burdick,** United States Geological Survey
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Session:	**Special Session 8 - Science for a Changing Klamath River Following the World's Largest Dam Removal**

Abstract

Juvenile survival during outmigration is critical for maintaining Chinook salmon (Oncorhynchus tshawytscha) populations in regulated river systems. In California's Klamath River Basin, water managers coordinate flow releases and hatchery schedules to improve juvenile migration and reduce mortality from Ceratonova shasta, a parasite prevalent in the slow, warm waters of the "infectious zone" between Interstate 5 and Seiad, CA. The 2024 removal of four hydroelectric dams upriver of the infectious zone significantly altered flow conditions, prompting a need for updated management strategies. This study uses acoustic telemetry data from tagged juvenile Chinook salmon from 2022 to 2024 to examine how flow, temperature, and fish length influence (1) migration initiation in hatchery-reared sub-yearlings and (2) travel rates for both sub-yearling and yearling juveniles. We evaluate how release timing and river conditions affect overall migration duration and time spent in the infectious zone—factors that strongly influence survival. Results show that juvenile salmon traveled faster during periods of lower flow and higher temperature, with fish length also influencing travel speed. These findings offer guidance for coordinating hatchery releases with river flow conditions to minimize infection risk and improve survival. Optimizing migration timing may not only support Klamath River salmon recovery but also benefit species such as the endangered southern resident killer whale (Orcinus orca), which depends on Chinook as a key food source.

Advancing Los Angeles River watershed goals through the California Environmental Flow Framework

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Session:	**Special Session 7 - Advancing Environmental Flow Management: Holistic Approaches for Sustaining Aquatic Ecosystems**

Abstract

The LA River California Environmental Flows Framework Project (LA River CEFF) has convened a diverse group of watershed stakeholders in an unprecedented opportunity to advance watershed goals through a structured decision-making process that will culminate in flow recommendations for the LA River. The project builds on previous watershed analysis and utilizes the new California Environmental Flows Framework (CEFF) to understand how LA River flows are linked to — and best support achievement of — the range of watershed goals established by planning documents and informed by stakeholder input under existing and potential future conditions. The LA River CEFF is ongoing, but its analysis and stakeholder collaboration to date already serves as a unique case study in applying CEFF to revitalize an urban watershed and promote a virtuous cycle for achieving watershed goals. Working closely with the project's Technical Working Group, the LA River CEFF provides a systematic approach for stakeholders to incorporate goals into the analysis and specify conditions that support achieving these goals. Its inclusion of biodiversity and human goals along with its focus on changing watershed conditions ensures stakeholders are engaged and supportive of the project's development of flow recommendations that balance restoring the LA River with other social values.

Conaway Ranch Tule Canal Corridor Enhancement Project

Presenting Author:	**Chris Campbell,** Verdantas, Inc.
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Session:	**Special Session 3 - Restoring & Revitalizing Large Alluvial Rivers & Their Floodplains to Support Biodiversity & Multiple Goals**

Abstract

The Tule Canal Corridor Enhancement Project at Conaway Ranch is part of a larger holistic vision to transform Tule Canal in the Yolo Bypass. The vision is centered on creating a multi-functional corridor informed by the six pillars of the Yolo Bypass Cache Slough Partnership that would benefit flood conveyance, agriculture, habitat, water supply, water quality, and recreation. More specifically, the goal is to enhance a 4.3-mile reach of the Tule Canal bordering the ranch's eastern boundary towards this larger vision by respecting flood functions, supporting long-term agricultural production, restoring the ecological function of riparian and wetland habitats, maintaining and improving water delivery and water quality, and enhancing recreational opportunities.

To understand the feasibility of the project, a study was conducted to assess the ability of a project to meet the goals of the Partnership and meet the performance objectives defined for the project against evaluation criteria informed by those developed through Floodplains Reimagined. Multiple concepts were evaluated to include optimizing the conveyance capacity to more frequently activate the floodplain, recontouring the floodplain to create a dynamic mosaic of habitats, and enhancement of infrastructure to improve agricultural production. This process led to better outcomes and identification of a preferred project.

Evaluating approaches for protecting environmental flows in decentralized water management systems

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Session:	**Special Session 7 - Advancing Environmental Flow Management: Holistic Approaches for Sustaining Aquatic Ecosystems**

Abstract

Flow is often altered by humans through decentralized, small-scale diversions that are distributed across a river network. Protecting environmental flows in decentralized water management settings requires regulation of individual water users to prevent flow depletion beyond ecologically harmful limits. The most common approaches used to protect environmental flows in such settings involve establishment of (1) bypass flow thresholds or (2) alteration limits as a percentage of natural flow. Here we evaluated four such approaches by assessing their relative degree of ecological protection and water security. We found that the two percent-of-flow methods were effective in protecting ecological water needs, while also offering water users a relatively high degree of water security in watersheds where overall demand is relatively low. However, in watersheds with higher existing demand, such as those with industrial scale agriculture, other allocation approaches will likely be needed to meet existing water needs. The two bypass approaches we evaluated provide more water for human use, however one has substantial implementation feasibility constraints that limit its utility, and the other has potential for serious ecological impacts without added protections. For all allocation approaches, our results suggest that additional off-stream storage capacity would help to enhance water security by allowing water users to shift some or all diversions from the dry season, when demands are high but availability is low, to the wet season, when water is more abundant.

Wonders of the Mekong: A Foundation for Sustainable Development and Resistance

Presenting Author:	**Sudeep Chandra,** Tahoe Institute for Global Sustainability and Biology Department, University of Nevada
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Session:	**Special Session 5 - Revitalizing Community & Landscape by Connecting Rivers, People, & Science Through Field Experiences**

Abstract

The Mekong River supports the world's largest inland fishery and remains a hotspot of biodiversity, providing critical habitat for 800+ fish species and large charismatic species, including the recently recorded world's largest freshwater fish, a 661-pound giant stingray, as well as river dolphins and giant turtles. The river's hydrologic flood pulse supports this production and biodiversity and maintains fertile floodplain ecosystems along the river and down to the delta in Vietnam, creating the "rice bowl" of Asia. With foundational support from the U.S. Agency for International Development, the Wonders of the Mekong program builds capacity across traditional political boundaries and through institutions of higher education, implements outreach and communication strategies to highlight the natural, economic, and cultural capital of the Lower Mekong River, and conducts applied research that supports the sustainability of a healthy Lower Mekong system. To date, the program has implemented projects with 40+ communities focusing on conservation, research, and monitoring efforts; held 100+ community events and training workshops; published 60 peer-reviewed, open-access scientific publications; trained more than 5,000 students and professionals in conservation science; worked with communities to rediscover a presumed extinct species and identify world-record-sized freshwater fish; disseminated 30+ stories featured in international media outlets, including National Geographic, with more than 1 billion global media impressions annually; influenced public policy by having two major dams reconsidered through science-based cost-benefit analysis; and mobilized 5,000 youth through anti-plastic campaigns across Cambodia. This presentation will highlight the program's successes in sustaining a healthy river ecosystem while outlining future directions for Wonders of the Mekong.

Restoration at Scale: Ecological renewal and reconnection with the Klamath River Renewal Project

Presenting Author:	**Daniel Chase,** Resource Environmental Solutions
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Session:	**Special Session 8 - Science for a Changing Klamath River Following the World's Largest Dam Removal**

Abstract

Removal of four hydropower dams on the Klamath River in northern California and southern Oregon is the largest dam removal and river restoration project in the country. Tribal communities had long advocated for an undammed and restored river, citing the negative impacts on Tribal fisheries, health, and culture. After decades of advocacy and work, in Fall 2024, dam removal was achieved. The historic project restored free-flowing conditions and volitional fish passage to hundreds of miles of the Klamath River, once the third largest producer of salmon on the West Coast, and is leading to landscape level change seldom seen in a single project. The Klamath River Renewal Corporation selected RES to lead restoration for this ambitious effort, as well as accept liability associated with ensuring restoration meets ecological and biological performance standards and long-term goals/objectives. This presentation provides a look at the landscape scale change that has occurred over the past two years of the project, approaches used for restoration and lessons learned, and will provide an update on the tributary restoration actions undertaken in 2025.

Improved flood-routing schemes for flash floods in mountainous streams to better represent floodplain processes

Presenting Author:	**Nicholas Christensen,** Colorado State University
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Session:	**Special Session 1 - Advances in Floodplain Science & Implications for Riverscape Resilience**

Abstract

Intensifying flooding in the American West threatens human infrastructure, human life, and ecological integrity. Flash floods are a particularly dangerous form of floods as they rise quickly leaving little time to evacuate. Understanding the way in which flash floods propagate through mountain stream networks is essential to determining our management strategies. Most standard routing methods were developed for gradually sloping systems with small variations in time and space. These methods have not sufficiently been tested in steep systems with short time to peaks. We further this understanding by contrasting the predictions of models with varying degrees of detail in such systems. We developed 7 models ranging in detail and physical realism for three sites in the Colorado front range. We developed a fine mesh 2D hydrodynamic model, a coarse mesh 2D hydrodynamic model, a spatially uniform 1D hydrodynamic model, and four formulations of Muskingum-Cunge hydrologic routing. For each model we compared output hydrographs to the fine mesh 2D hydrodynamic model using Nash Sutcliffe Efficiency (NSE), difference in peak flow attenuation (|〖ΔQ〗_(a/l)|), and differences in predicted total volume retained within the model (|〖ΔV〗_ret|). We found that model agreement varied nonuniformly between modeling strategies. We found that the standard Muskingum-Cunge routing method was insufficient in reproducing the flood hydrographs from the 2D model as it underpredicted mass retention within the floodplain and overpredicted peak outlet discharge (|〖ΔV〗_ret|=4%,|〖ΔQ〗_(a/l)|=11.7). The model which most effectively reproduced the fine detail 2D hydrodynamic model was a novel Muskingum-Cunge routing scheme with mass loss scaled by the inundated floodplain volume. This method had an average NSE=0.945, average |〖ΔQ〗_(a/l)|=8.77%, and average |〖ΔV〗_ret|=3.47%. The results of this study indicate that for routing flash floods in mountain streams, simple schemes can improve performance.

Morphological Variability at Bar-Built Estuaries

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Session:	**Special Session 12 - Advances in Bar-built Estuary Research: Physiochemical, Ecological & Management Perspectives**

Abstract

Bar-built estuaries alternate between open and closed phases due to sediment bars forming at river mouths. This study examines the Carmel River, California, where the Carmel River State Beach (CRSB) forms a natural barrier between the river lagoon and Carmel Bay. During winter rainfalls, the lagoon fills and floods wetlands, threatening nearby homes. When closed, the CRSB prevents water flow into Carmel Bay until water levels reach overtopping height. The beach closes when river discharge decreases in summer. The five-year dataset includes water level measurements, breach velocity observations, and GPS surveys before and after breaching events. The study demonstrates beach accretion and erosion rates across seasons ranging from drought to wet years. Post-breaching erosion can reach several meters, yet beaches can fully close within a single day. Accretion rates decrease as beach elevation increases, suggesting a steady state elevation exists. One result of morphological transition is that the dissolved oxygen (DO) response within the lagoon depends on both mouth state and relative location, leading to some areas with variable DO and others with stable DO levels. This research helps quantify the impacts of variable river mouth morphology on hydrodynamic processes, addressing challenges posed by morphological changes at different scales.

Realizing the Vision of a Cohesive Science Program for Guiding Adaptive Management for Healthy Rivers and Landscapes in California's Largest Watershed

Presenting Author:	**Louise Conrad,** California Department of Water Resources
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Session:	**Special Session 11 - Healthy Rivers & Landscapes**

Abstract

The Healthy Rivers and Landscapes program proposes a novel approach to meeting environmental regulations for supporting native fishes through integration of environmental flows, habitat, and collaborative science and governance. The proposal includes 155 – 825 thousand acre-feet of flow and over 20,000 acres of habitat across major tributaries to the Bay-Delta watershed, which drains 40% of California's land mass. A keystone component of the Healthy Rivers and Landscapes Program is a comprehensive science program that will set the approach for evaluating program benefits. Traditionally, science programs across upper watershed tributaries and the Delta have developed their own monitoring methodologies and research priorities. The Healthy Rivers and Landscapes science program endeavors to improve cohesion by building a science infrastructure that can inform adaptive management at the full watershed scale. The program's peer-reviewed science plan contains over 50 hypotheses for assessing the efficacy of the program in a multi-scaled approach, from local to system scale, and seasonal to interannual evaluations. The plan includes standards for monitoring Chinook Salmon populations and identification of major information gaps. The program aims to erode these gaps, which in turn will enhance the use of decision-support tools, such as life-cycle models for Central Valley Chinook salmon.

Floodplain Roughness, Fine Sediment and Riparian Vegetation Recruitment: Case Study on the Lower Yuba River

Presenting Author:	**Danielle Conway,** South Yuba River Citizens League
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Session:	**Physical Processes - Contributed Session**

Abstract

Roughness is a key element in floodplain restoration to encourage natural geomorphic processes such as deposition, scour, and sediment sorting. Roughness is often achieved in floodplain restoration through the installation of large woody material, or log jam, structures; however, wood procurement and handling can often be cost prohibitive for grant funded projects and require a degree of engineering to ensure their stability. On the Lower Long Bar Salmonid Rearing Restoration Project, we used cobble material sourced from the Project's spoils to create "roughness features" throughout the restored floodplain to promote benefits associated with a heterogenous floodplain-alcove complex. Post-implementation monitoring utilized a combination of ground and UAV survey methods to answer the following questions: (1) Will area, depth, and volume of deposited sediments be greater downstream of constructed floodplain roughness features? (2) Will vegetation recruitment, growth, and survival be greater downstream of constructed floodplain roughness features?

Variation in groundwater-surface water interactions promotes fish life-history diversity

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Session:	**Special Session 2 - Groundwater-Surface Water Interactions in Riverine Landscapes Across Multiple Scales**

Abstract

Recent research suggests that variation in groundwater-surface water interactions can alter emergence timing and growth of young-of-the-year (YOY) rainbow trout (Oncorhynchus mykiss). To further characterize and understand the effects of hydrologic variation on rainbow trout life-history diversity in Northern California, we assessed emergence timing and YOY growth in multiple snowmelt, spring-fed, and hybrid streams (where discharge was made up of both runoff and spring-fed components). Our findings indicate that the unique hydrology of spring-fed streams in Northern California altered rainbow trout life-histories leading to earlier spawning and emergence times. Preliminary data suggests that YOY rainbow trout were, on average, 66 days older in spring-fed streams than runoff streams. Differences in age likely led to greater overall growth, where YOY were 2.3X longer and 14.3X heavier in spring-fed than snowmelt streams. Spring-fed fish had fork lengths ranging from 45-136 mm and wet weights from 7-32 grams, while fish in snowmelt streams had fork length from 44-85 mm and weights from 1-6 grams. Additionally, we found that fish in hybrid streams exhibited intermediate growth rates compared to spring-fed and snowmelt systems. These findings are illustrative of the effect of hydrologic processes on life-history characteristics of aquatic species and the potential effects of climate change on aquatic ecosystems.

A tale of two rivers: do watershed practices dictate water quality in Nebraska's grasslands?

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Session:	**Special Session 3 - Restoring & Revitalizing Large Alluvial Rivers & Their Floodplains to Support Biodiversity & Multiple Goals**

Abstract

Grassland rivers provide important habitat and migration corridors, nutrient and sediment regeneration in riparian areas, and recreational and ecotourism opportunities. While Nebraska has >79,000 river miles, many are impacted by nutrient pollution, riparian disturbance, or other stressors. In this two-year study, we compare ecological indicators in two rivers of similar size, but at two extremes: the Niobrara River (a National Scenic River) and the Elkhorn River (highly impacted by agricultural and urban activities). Nutrient concentrations were twice as high in the Elkhorn as in the Niobrara, a condition reflected in greater rates of primary production and a 10X increase in algal biomass in the Elkhorn. Interestingly, algal growth in both rivers showed signs of nutrient limitation, suggesting future increases in nutrient pollution could worsen eutrophic conditions in either ecosystem. Our aquatic macroinvertebrate survey suggests similar macroinvertebrate functional groups are present in both rivers, but their isotopic signatures reflect different pollution impacts: Elkhorn macroinvertebrates are twice as enriched in N stable isotopes, compared to Niobrara macroinvertebrates. Bacterial microbial composition comparisons also reflect higher levels of pollution in the Elkhorn. We suggest that grassland conservation and management practices in the Niobrara watershed have helped minimize stressors in this ecosystem.

Using diatom taxa to discriminate reservoir sediments in the downstream river and estuary following dam removals on the Klamath River, CA

Presenting Author:	**Jennifer Curtis,** U.S. GEOLOGICAL SURVEY
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Session:	**Special Session 8 - Science for a Changing Klamath River Following the World's Largest Dam Removal**

Abstract

A key question regarding the Klamath River dam removals was the timing for flushing reservoir sediments out of the basin. The reservoir sediments consist primarily of dead algae that accumulated over decades, largely due to the senescence of seasonal algal blooms. Diatoms, silt-sized algae with siliceous hard parts and unique environmental signatures, are also a major component of fluvial and estuarine sediments in the Klamath River basin. This study evaluated the efficacy of diatom taxa as biological tracers of allochthonous reservoir sediment to verify the presence and determine the persistence of reservoir sediments in downstream environments. Between 2018 and 2023, we collected 75 samples of reservoir, fluvial, and estuarine sediments and analyzed the diatom taxa. Results showed clear differentiation between diatom taxa in reservoir samples and the downstream samples. Reservoir samples contained abundant valves and fragments of planktonic and diverse benthic/tychoplanktonic taxa, while fluvial and estuarine samples were nearly 100% benthic/tychoplanktonic taxa, with rare, reworked valves of small planktonic species. Following the 2024 dam removals, planktonic diatoms served as a primary indicator of allochthonous reservoir sediments in downstream reaches. This study demonstrates that diatoms are effective biological tracers for monitoring the fate and transport of silt-sized reservoir sediments in the Klamath River, thereby informing future dam removals in similar systems worldwide.

Unique opportunities and complex challenges of large-scale floodplain restoration at the confluence of California's largest rivers

Presenting Author:	**Mike Davis,** River Partners
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Session:	**Special Session 3 - Restoring & Revitalizing Large Alluvial Rivers & Their Floodplains to Support Biodiversity & Multiple Goals**

Abstract

Floodplains are among the most productive and diverse ecosystems on Earth. However, floodplain loss outpaces the loss of many other landscape types, making their stewardship critically important to global biodiversity. In the Central Valley of California, River Partners is advancing restoration of floodplain ecosystems at a scale that can meaningfully improve function of riverine ecosystems and provide resiliency to climate change. Implementing projects in the context of one of the world's largest water conveyance and flood control systems, the collapse of native freshwater biodiversity, and socio-political imperatives for returning land to indigenous communities has unique challenges that hold lessons for floodplain restoration globally. We describe the challenges and opportunities of planning multiple integrated floodplain restoration projects at the confluence of California's largest rivers and highlight the tools and approaches necessary for navigating multi-objective project outcomes. We show how integrating multiple projects and diverse interested parties across a large landscape has potential to meet ambitious climate and recovery goals, providing a model for floodplain restoration practitioners worldwide.

*connected to another presentation by author Nicole Kwan titled: "Expanding Side Channel Habitat and Floodplain Connectivity in the Lower Feather River Corridor"

Predicting Fish Movement in a Fragmented Riverscape to Inform Freshwater Mussel Reintroduction

Presenting Author:	**Megan DiNicola,** Utah State University
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Session:	**Fish Conservation & Management - Contributed Session**

Abstract

Freshwater Unionid mussels are obligatory parasites on host fish during reproduction, which makes mussels highly dependent on host fish to move or migrate during the infestation period so mussels can colonize new areas of a river. As mussel populations decline and reintroductions are more widely used to support the remaining mussel populations, it is important to know not only where to reintroduce mussels, but also how far up and downstream recolonization is likely to happen based on fish movement. Host fish movement in fragmented rivers is relatively unknown, which further limits the ability for managers to create reintroduction and restoration plans that support continuous, self-sustaining mussel populations. This study combines data from a fish movement study and a physical barrier assessment in the Mission Reach of the San Antonio River, Texas, where a large-scale restoration was completed in 2013, with a historic hydrologic analysis from a nearby USGS gauge to build an empirical model to estimate fish passage success during the infestation period. This model can be used in concert with known suitable habitat characteristics for freshwater mussels to provide river managers with a more complete estimate of reintroduction and recolonization success in restored but serially fragmented rivers.

Understanding the role of small and medium sized flow events – informing environmental flow management

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Session:	**Special Session 7 - Advancing Environmental Flow Management: Holistic Approaches for Sustaining Aquatic Ecosystems**

Abstract

Environmental flows are being increasingly used to re-create the natural variability of the flow regime, restoring small and intermediate flow events and providing water to floodplain wetland ecosystems. In doing so, environmental flow managers need to be able to define specific expected outcomes. This can be challenging in highly variable systems where the ecological response from large events overwhelms those from much smaller events. Here we use 10 years of data from 72 sites across the northern Murray-Darling Basin, Australia, to illustrate the importance of providing small and intermediate sized flow events for structuring floodplain and wetland vegetation communities. Our data highlights the potential for environmental flows to be used to reduce the duration of the dry phase experienced by floodplain wetland ecosystems leading to an improved cover of important floodplain wetland plant species. At a site scale, we also demonstrate the role of reinstating small events for improving the capacity of vegetation to respond to large flood events. This provides important input to environmental flow decision making as well as evidence that can be used in communicating the importance of restoring key elements of the flow regime.

Estimating the multiple benefits of riparian restoration on ecosystem functions and services: biodiversity conservation, water quality, and soil health

Presenting Author:	**Lisa Eash,** Point Blue Conservation Science
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Session:	**Special Session 3 - Restoring & Revitalizing Large Alluvial Rivers & Their Floodplains to Support Biodiversity & Multiple Goals**

Abstract

In California's Central Valley, wetland degradation has substantially diminished vital ecosystem benefits, including water quality maintenance, carbon storage, flood mitigation, and biodiversity support. Large investments have been made to restore riparian areas in the Central Valley, but comprehensive monitoring data which reflect both above- and below-ground ecosystem benefits are lacking. As part of a recent initiative to restore riparian habitats on agricultural lands in the San Joaquin River watershed, we quantified a suite of ecosystem indicators for soil carbon storage, water quality maintenance, soil structure, and biodiversity support both in established restoration sites and in agricultural fields prior to restoration. We present differences between established restoration sites and agricultural fields as an estimate for potential gains in ecosystem benefits following restoration efforts. Additionally, we estimate the magnitude of the restoration impact on certain benefits and evaluate where and how to prioritize these benefits.

Geochemical Evaluation of Rusting Rivers in Arctic Alaska

Presenting Author:	**Taylor Evinger,** University of California, Davis
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Session:	**Water Quality I - Contributed Session**

Abstract

Streams and rivers in Alaska's Arctic region provide essential ecosystem services to rural communities and are vulnerable to the effects of rapid climate change and widespread permafrost thaw that can release toxic metals to aquatic environments. Recent observations from northern Alaska identified 75 rivers draining permafrost landscapes affected by metal mobilization following thaw, resulting in abrupt color change of streams and river reaches. This study evaluated changes in water chemistry in six watersheds across Alaska's Arctic region to test the hypothesis that streams and rivers impacted by thaw-driven acid rock drainage exhibit elevated concentrations of sulfate, particulate iron, aluminum, manganese, and dissolved zinc, copper, and cadmium. Results show that concentrations of both dissolved and particulate analytes were highest within the first 5 km of inputs of acid rock drainage and decreased to concentrations consistent with upstream river concentrations at 20-30 km downstream. Temporal trends in a single watershed reveal a greater than 200% increase in sulfate concentrations coinciding with the onset of acid rock drainage in 2019. These findings provide the first detailed evaluation of climate-induced metal mobilization in streams and rivers in Arctic Alaska, which is important for the quality of the region's drinking water and fish habitat.

Beaver Restoration as a Nature-Based Solution for Sustaining Sierra Nevada Streamflows During Drought

Presenting Author:	**Chloe Faehndrich,** University of California, Berkeley
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Session:	**Special Session 10 - Nature Based Solutions in River Restoration**

Abstract

Beavers are ecosystem engineers that modify watersheds and river flow regimes. By building dams, they restore channel-floodplain connectivity, stabilizing flows and increasing groundwater storage. Beavers are increasingly considered a nature-based solution to water scarcity in the dry West where snow droughts reduce snowpack and advance snowmelt in mountain streams. The California Department of Fish and Wildlife is working to restore beaver to Sierra Nevada watersheds where they can help capture and store snowmelt to sustain flows during drought. Despite promising ecological and hydrological implications, the consequences of this restoration on California's watersheds and freshwater resources remain unknown. This work uses the Soil and Water Assessment Tool Plus to model the effects of increased beaver populations on water storage and river flows in the Sierra Nevada under varying beaver density and climate scenarios. Field surveys enhanced modeling by providing estimates of dam age, size, depth, and morphology, as well as habitat characteristics influencing dam placement. These data informed beaver dam parameterization, and the Beaver Restoration Assessment Tool's dam capacity estimates guided the restoration scenarios tested. Modeling the consequences of beaver restoration on watershed hydrology in an ecologically realistic way may improve predictions of their impact on Sierra Nevada river flow regimes.

Riparian Planting and Natural Recruitment: Let Nature do the Work

Presenting Author:	**Bobbie Flores,** Cramer Fish Sciences
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Session:	**Special Session 10 - Nature Based Solutions in River Restoration**

Abstract

Planting riparian trees is a common practice for river restoration projects and is generally a mitigation requirement when existing trees must be removed as part of the restoration action. Although short-term (3-5 year) survival documentation is generally a permitting requirement, longer term monitoring of tree establishment is generally not conducted. Natural recruitment and establishment following riparian restoration is even less studied even though it is assumed restoration actions designed to improve ecosystem function (i.e. improved depth to groundwater, increased floodplain inundation frequency) will promote conditions suitable for riparian tree recruitment and survival.

The lower Yuba River has been the focus of multiple large scale salmonid rearing habitat restoration projects that have constructed miles of side channel, floodplain, and roughness features over roughly 200 acres in a reach heavily impacted by historic gold mining. A key aspect of these projects is tracking long-term riparian tree recruitment and survival of planted trees to better understand successional patterns and changes in species composition across space and time in the years following restoration implementation.

The Volunteer Stewardship Program: a emergent collaborative approach to monitoring ecosystems in agricultural lands of Washington State USA

Presenting Author:	**Alexander Fremier,** Washington State University
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Session:	**Special Session 4 - Data to Decision: Who Governs Ecological Monitoring of the River Commons?**

Abstract

Governmental programs for river conservation often rely on mandated, agency-led (top-down) approaches. More bottom-up strategies are increasingly being adopted, following more than a decade of scholarship and guidance from leading organizations. To evaluate the effectiveness of these approaches, new monitoring strategies need development and testing. Washington State (USA) initiated the Voluntary Stewardship Program in 2011 to facilitate bottom-up conservation and monitoring of 'Critical Areas' in agricultural lands, aiming to promote agricultural viability while conserving ecosystems. River-related critical areas include Frequently Flooded Areas, Critical Aquifer Recharge Areas, and Fish and Wildlife Habitat Conservation Areas (~aquatic and riparian habitat). VSP counties can leverage voluntary conservation actions at the watershed scale to avoid direct regulatory oversight if monitoring demonstrates that ecosystems are being maintained or enhanced. Each county that opts in to VSP must identify and prioritize critical areas (with limited monitoring resources). A state-level technical panel reviews counties' monitoring reports periodically. We present examples of collaborations between WSU (land-grant) and VSP Monitoring Coordinators to show how researchers can support the development of robust, low-cost monitoring strategies that help facilitate bottom-up monitoring in a variety of settings across Washington. VSP illustrates the potential of novel solutions emerging from coordinated local-state level efforts to improve adaptation to changing social-environmental realities.

Living with Living Rivers

Presenting Author:	**Ian Fuller,** Massey University
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Session:	**Special Session 5 - Revitalizing Community & Landscape by Connecting Rivers, People, & Science Through Field Experiences**

Abstract

Rivers are inherently dynamic but have long been engineered and managed as though they were static. The true dynamism of our rivers, and the limitations of our management paradigm, has been revealed during recent catastrophic floods in Aotearoa New Zealand. These events have exposed the vulnerability of our society to social and economic disruption along our river corridors, significant repair costs, and wider impacts on adjacent transport corridors. While there is always a role for flood protection (static-river paradigm), moving towards allowing room for rivers (dynamic-river approach) is equal parts a scientific and knowledge challenge as it is an institutional and collective public action challenge. This paper discusses a cross-disciplinary opportunity towards operationalising rehabilitation efforts that seek to give Room to the River. How should we make this happen in Aotearoa? To successfully address this question, we need to understand our awa as living entities in our physical, social and cultural landscapes.

Effects of Floodplain Connecting Channels on the Morphodynamics of Channel Networks

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Session:	**Special Session 3 - Restoring & Revitalizing Large Alluvial Rivers & Their Floodplains to Support Biodiversity & Multiple Goals**

Abstract

Water, sediment and nutrient distributions in channel networks play an important role in nourishing fluvial habitats, and are largely determined by the equilibrium morphology of channel bifurcations. While the equilibrium of a single channel bifurcation has been extensively studied, the equilibrium of a channel network consisting of multiple channel bifurcations remains elusive. Here, we studied the channel networks with connecting channels linking the bifurcating branches, i.e., the "bifurcation-connecting channel" units that are commonly found in rivers, deltas and estuaries. We demonstrated through numerical simulations how a connecting channel in the channel network can lead to an oscillatory water partitioning under moderate Shields stress and channel aspect ratio, in addition to the steady-state solution reported in previous studies. The oscillatory water partitioning indicates a newly discovered periodic solution, which is an autogenic behavior under constant boundary conditions. We found that the periodic solution is primarily due to the dynamic interactions between bifurcation instability and water surface slope advantage in the two branches modulated by the reversible discharges through the connecting channel, under moderate Shields stress and channel aspect ratio. In such cases, the developed slope advantage in the subordinate branch can suppress the deepening of the dominant branch and eventually lead to the shifting of the dominant branch. Our results improve the understanding on the evolution and restoration of channel networks under increasing human interventions.

Spatial Distribution of Anatoxins in Benthic Mats Across a Northern California River Network

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Session:	**Water Quality II - Contributed Session**

Abstract

Benthic harmful cyanobacterial blooms in rivers are a growing global concern, threatening aquatic ecosystems and public health. Which factors drive where toxin-producing cyanobacteria occur and when they produce toxins across river networks is unclear. To identify environmental factors predicting spatial and temporal variation in a toxin-producing cyanobacteria, Microcoleus, and the neurotoxic anatoxins they produce, we sampled 14 stream reaches (6 mainstem & 8 tributaries) spanning environmental conditions within the Scott River watershed, Northern California, USA. We sampled monthly from June to October 2024, measuring environmental parameters, such as light, water chemistry, flow, and geomorphology, estimating Microcoleus mat percent cover, and collecting mats for anatoxin analysis. Microcoleus occurred at every study reach throughout the season during at least one sampling event, indicating widespread presence despite site differences in light, water chemistry, and flow. Early season, mats were most extensive in tributaries, and percent cover increased in August across both tributaries and mainstem sites. Toxin levels during 2024 were relatively low compared to values previously measured by the Quartz Valley Indian Reservation Natural Resource Office in 2022 and 2023. Identifying environmental drivers of Microcoleus mat distribution and associated anatoxin production will inform monitoring strategies and better mitigate ecological and public health risks.

CASE STUDIES ON THE USE OF LIDAR DATA FOR HYDRAULIC MODELING OF UPSTREAM FISH PASSAGE

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Session:	**Special Session 7 - Advancing Environmental Flow Management: Holistic Approaches for Sustaining Aquatic Ecosystems**

Abstract

LIDAR data, supplemented by survey-grade real time kinematic global positioning system and total station data, was used as the basis for the topography for a two-dimensional HEC-RAS model of upstream passage of adult steelhead (Oncorhynchus mykiss) on the Ventura River, Ventura County, California, USA. For the Santa Clara River, Ventura County, California, USA, LIDAR data was the sole basis for the topography for three two-dimensional HEC-RAS models of upstream passage of adult steelhead, since the entire channel was dry when the LIDAR data was collected. The results of the HEC-RAS models were used to identify flow levels that met the minimum depth and width thresholds needed for adult steelhead to migrate upstream through the study reach on each stream. A minimum passage depth criterion of 0.21 m was used for adult steelhead. The results of the predictive modelling will be used by the California Department of Fish and Wildlife to identify flow criteria that protect migrating upstream steelhead.

Mitigating Effects of Hydropower Use in Large River Systems

Presenting Author:	**Juergen Geist,** Technical University of Munich, Aquatic Systems Biology
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Session:	**Special Session 7 - Advancing Environmental Flow Management: Holistic Approaches for Sustaining Aquatic Ecosystems**

Abstract

Several recent hydropower projects target the installation of innovative technologies and the modernization of existing conventional facilities, both aiming at reducing adverse ecological effects on river systems and their biota. Within a 10-year project, we assessed the ecological effects of several conventional and innovative hydropower solutions in Germany. Our findings show that across all study sites, physical barriers were not able to prevent the vast majority of specimens from turbine entrainment. Resulting mortality rates and external and internal injuries patterns were highly influenced by turbine type, operation mode, fish species and size. On the other hand, several restoration measures within hydropower-impacted river systems were successful in improving fish passage, and creating habitats for the complete life cycles of endagered species. Based on the characterization of larval drift patterns and movement analyses of > 20,000 PIT-tagged fish in the River Inn, a comprehensive assessment of the success of individual measures concerning fish passage and habitat restoration has been conducted and used for evidence-based adaptive management. This approach integrates various stakeholder groups and a joint decision-making and can serve as a template for implementing mitigation measures in other river systems with hydropower use.

Hydrogeomorphic predictors of beaver dam density and implications for beaver-based restoration

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Session:	**Special Session 10 - Nature Based Solutions in River Restoration**

Abstract

Beaver extirpation from many streams in recent decades has left a gap in stream management. With increasing interest in process-based restoration techniques mimicking beaver, a greater understanding of the large-scale hydrogeomorphic habitat conditions that predict the capacity for streams to support beaver dams is an area of research need. In this study, we use a combination of remote sensing technologies and on the ground observations to catalog beaver dam locations in a variety of streams, starting with work in California. Ground mapped beaver dam locations are compared to large-scale hydrogeomorphic conditions. We look at publicly available datasets and biologically relevant ratios not currently included in beaver habitat modeling practices, such as discharge relative to valley width and discharge relative to channel width. Through this work, we can begin making recommendations for the inclusion of additional datasets into existing beaver habitat modeling programs to improve model function for a variety streams. Our results can inform future beaver-based restoration efforts.

Mimicking Nature: a comparison of seasonal hydraulic habitat in pools created by BDAs, beaver dams, and scour pools

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Session:	**Special Session 10 - Nature Based Solutions in River Restoration**

Abstract

Beaver mimicry, such as installing beaver dam analogs (BDAs), is increasingly employed as a restoration tool in degraded aquatic systems. BDAs are organic 'soft' structures designed to work with stream and meadow processes to slow flow, trap sediment and organic matter, support riparian vegetation, and promote diverse instream and meadow habitats. While improved habitat productivity has been shown to result following stream restoration using BDAs, direct impacts to streamflow and hydraulic conditions (e.g. depth, velocity), important to native aquatic species, remain uncertain. This project seeks to better understand the potential effects of BDAs on habitat diversity by assessing how hydraulic conditions near BDAs, active beaver dams, and unaltered reference reaches change across the dry season at multiple sites in California, USA. Preliminary results indicate that both BDAs and beaver dams significantly reduce upstream water velocities compared to reference sites throughout the summer season. Pools upstream of BDAs appear to have lower hydraulic complexity than pools upstream of natural beaver dams. These results have implications for how restoration may impact habitat diversity and thus desired conditions for native aquatic species across dry season low flows.

An experimental approach to studying the effects of impaired hydrographs on stream habitats, food webs, and a juvenile salmonid

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Session:	**Special Session 7 - Advancing Environmental Flow Management: Holistic Approaches for Sustaining Aquatic Ecosystems**

Abstract

Valuable freshwater habitats are rapidly declining in response to climate change and anthropogenic flow alterations. This has deleterious effects on the species that live within these habitats. The response of stream organisms to flow alterations associated with water pumping and climate change is an area of research need. We look at how these short- and long-term flow alterations affect stream organisms and their physical habitats, with a primary focus on juvenile rainbow trout (Oncorhynchus mykiss), a fish of cultural, economic, and ecological importance. Using a series of replicated stream channels at the Sierra Nevada Aquatic Research Lab, I conducted two experiments to measure the effects of impaired streamflow on juvenile Oncorhynchus mykiss, their habitats, and stream food webs. The first experiment was conducted in 2023 and tested the effects of repeated, short-term flow alterations, or those common with water pumping projects. The second experiment, conducted in 2024, tested the effects of projected alterations to streamflow patterns based on end-of-century climate conditions. Understanding how organisms and habitats respond to human-altered streamflow is the first step towards addressing and minimizing human impacts to ensure the continued existence of ecologically and culturally valuable species and their habitats.

The importance of high streamflow and bank erosion for the Bank Swallow, a sentinel species of alluvial river systems

Presenting Author:	**Greg Golet,** The Nature Conservancy
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Session:	**Special Session 3 - Restoring & Revitalizing Large Alluvial Rivers & Their Floodplains to Support Biodiversity & Multiple Goals**

Abstract

We evaluated factors that regulate the population growth rate of Bank Swallows to inform strategies for its recovery and to assess its value as an indicator of riparian ecosystem health. In North America, over the past 50 years, this species, which depends upon erosion for its cutbank breeding habitat, has declined at a rate considered extreme. In our 25-year study of the Bank Swallow population on the Sacramento River, the breeding population fluctuated widely but declined at an average overall rate of 1.5% per year. Periodic high streamflow played an important role in maintaining the population, and its effect on the population growth rate was time-lagged by 1 year. This suggests that high flow conditions may have improved rates of Bank Swallow reproductive success and/or survival, leading to increased recruitment into the breeding population in the subsequent year. We also found evidence for density-dependent population growth. Our study establishes the critical importance of high streamflow and bank erosion to maintaining Bank Swallow breeding populations. It informs recovery strategies for the species and identifies the Bank Swallow as an appropriate indicator of alluvial river ecosystem processes.

Understanding changes in salmonid trophic pathways and aquatic food webs during dam removal with stable isotope analysis

Presenting Author:	**Brandi Goss,** University of California, Davis
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Session:	**Special Session 8 - Science for a Changing Klamath River Following the World's Largest Dam Removal**

Abstract

Food webs are a known metric for ecosystem and community health and how they change in response to restoration efforts can be an indicator of success. Food resources can also be important for individual and population resilience in the face of environmental changes. Yet, studies that assess entire food webs are often absent from restoration monitoring. Here, we use stable isotope analysis and theb Bayesian mixing model MixSIAR to estimate dietary contributions in aquatic food webs before, during, and after the Klamath dam removal to better understand if and how food webs change througout this process and what factors influence those changes. We sampled 8 sites, 4 from the mainstem Klamath river from just below the old Iron gate dam to Seiad, and 4 tributary sites that are geographically paired with the mainstem sites to serve as reference sites. We sampled primary productivity sources, aquatic invertebrates, and fin clips from juvenile salmonids to facilitate food web reconstruction for each site.

Precipitation Intensities Triggering Post-Wildfire Flows Across Five Burn Scars

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Session:	**Disturbance & River Dynamics - Contributed Session**

Abstract

Convective afternoon storms, often powered by monsoonal weather patterns, can produce storms over post-wildfire burn scars of short duration but of sufficient intensity to trigger debris flows. These flows often occur down steep side canyons, carrying significant sediment loading and woody material. The magnitude of these triggering intensities remains an open question – thus, confirmed flow events tied to given rainfall events are of immense value. Throughout the 2024 and 2025 (forthcoming) seasons, we tracked precipitation amounts and intensities in watersheds across five burn scars in Colorado and Idaho, of varying ages of burn. Tipping buckets, manual rain gauges, and data provided by external agencies all informed the precipitation amounts and intensities. We additionally recorded data via water level loggers and timelapse cameras to pinpoint the specific instances of debris flow at the outflows of multiple burned watersheds within these scars. In this presentation, we aim to provide the precipitation intensities which triggered individual slides, as well as those instances where a slide did not occur despite significant precipitation intensities. Our hope is that this information will be useful for current and future post-wildfire recovery studies as well as agencies such as the National Weather Service.

Community Priorities for Climate Change Adaptation in Freshwater Systems

Presenting Author:	**Madeline Grupper,** University of Melbourne
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Session:	**Special Session 5 - Revitalizing Community & Landscape by Connecting Rivers, People, & Science Through Field Experiences**

Abstract

Water resource models play a crucial role in water markets and management. There is growing interest in how community perspectives can be represented in these models to better capture complex socio-ecological systems and represent the diverse interests of stakeholders. Traditionally, these models have relied on economic indicators to represent human interests, but economic factors are only one aspect of stakeholder values. Different stakeholders often have a diverse range of priorities. We examine how community value systems could be incorporated in water resource modelling by conducting semi-structured interviews with community members in the Goulburn-Broken Catchment. Through the interviews, we identified core justifications that drove stakeholder decision-making. We developed conceptual maps illustrating how specific values were prioritised under resource scarcity for each value system. We used these maps to adjust indicators within an existing water resource model of the Goulburn-Broken Catchment. This project is an exploratory effort to understand how to represent different value systems in existing water resource models. Our results will provide a starting point to integrate diverse stakeholder values into water resource models, better reflecting the complexities of real-world freshwater decision-making. We aim to increase avenues for stakeholder representation in water management, ultimately supporting inclusive and effective resource planning.

Planning with Purpose: Decision-Support Tools for Managing Groundwater Contributions to Salmon Streams and Communities

Presenting Author:	**Edgar Guerron-Orejuela,** University of South Florida
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Session:	**Special Session 2 - Groundwater-Surface Water Interactions in Riverine Landscapes Across Multiple Scales**

Abstract

In south-central Alaska, groundwater plays a vital role in supporting people and nature. Groundwater discharges from seeps and springs into riparian wetlands and streams where it augments streamflow, modulates stream temperatures, and delivers nitrogen subsidies, all essential in maintaining healthy habitats for juvenile salmonids. Simultaneously, groundwater is the primary source of drinking water across the region. As populations grow and climate pressures intensify demand for this vital resource, it is more important than ever for managers to make informed decisions. To support this need, we developed two GIS-based tools that offer insights into groundwater dynamics at a landscape scale. The first tool uses readily available geospatial data and a multicriteria decision analysis framework to generate a map of groundwater recharge potential (GWRP), which is highest in regions with high precipitation, coarse-grained unconsolidated deposits, flat terrain, and undeveloped land cover. This model shows that more than 83% of the region has a moderate or greater capacity for groundwater recharge. The second tool applies machine learning techniques to readily available geospatial data to estimate the probability of groundwater discharge from seeps and springs. This model relies on six topographic variables: profile curvature range, distance to flowlines, elevation, topographic roughness index, flow-weighted slope, and planform curvature. Results show that groundwater discharge is concentrated near rivers, including headwater streams. Together, these tools provide practical, spatially explicit information to guide decision-making and management of land and water resources, empowering the local community to maintain groundwater benefits for human and natural users.

From Flume to Field: Modeling Equivalent Roughness of Channel-Spanning Log Jams Using Head Loss and Porosity

Presenting Author:	**Aleah Hahn,** Colorado State University
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Session:	**Special Session 10 - Nature Based Solutions in River Restoration**

Abstract

Log jams create backwatering pools, increase hydraulic complexity, and provide key habitat for numerous species, yet have been historically removed from rivers for navigation and flood control. Now, their ability to create habitat features, retain sediment, and improve floodplain connectivity has increased their popularity as a technique in river restoration. However, predicting energy loss through jams remains poorly understood, particularly when rapid field assessment of jams limits the amount of available data. No established method has been developed that accounts for jam characteristics and flow conditions to determine an effective roughness coefficient that can be easily applied in hydrodynamic models. To address this gap, we analyzed 217 flume experiments conducted by Schalko (2018) and Follett (2020) on channel-spanning jams. Using paired upstream and downstream depths from the published flume experiments, we calculated head loss through the jam and developed a non-linear design equation that predicts a non-dimensional head loss using the flow's Froude number and the jam's porosity. Our initial results find a strong inverse relationship with porosity and head loss. Current work aims to apply our non-linear equation on theoretical channels to calculate an effective roughness value, such as Manning's n, which can later be applied in hydrodynamic models.

Does instream restoration promote diversity of foraging tactics used by juvenile coho salmon?

Presenting Author:	**Tyson Hallbert,** University of California, Davis
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Session:	**Special Session 10 - Nature Based Solutions in River Restoration**

Abstract

Stream ecosystems are often described as mosaics of microhabitats that together promote both species and life history diversity. Habitat degradation in streams often reduces complexity by removing critical habitat features that promote behavioral diversity and resource partitioning in aquatic taxa. For salmonid fishes, complex habitat allows individuals to distribute themselves across suitable areas and thereby exploit the array of resources present in stream ecosystems. Here, we are studying whether instream habitat conditions created by beaver dam analog restoration promote diversity of foraging tactics used by coho salmon (*Oncorhynchus kisutch*). Using underwater videography to observe fish foraging behavior, we are examining habitat thresholds that promote behavioral shifts in foraging tactics. To pair with behavioral observations, we are collecting measures of food abundance for salmon to examine if habitat conditions in restored areas influence the availability and production of invertebrate prey. This study will aid in identifying how the addition of critical habitat features influences resource availability and behavioral diversity in juvenile salmon.

A Golden Multi-Benefit Opportunity – Habitat Enhancement, Flood Risk Reduction and Local Jobs – The Hallwood Floodplain and Side Channel Restoration Project

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Session:	**Special Session 3 - Restoring & Revitalizing Large Alluvial Rivers & Their Floodplains to Support Biodiversity & Multiple Goals**

Abstract

Gold Rush era anthropogenic actions in the Yuba River Watershed altered geomorphic and hydraulic conditions and available habitat for rearing juvenile salmonids in the lower Yuba River. The Hallwood Side Channel and Floodplain Restoration Project was designed to enhance ecosystem processes for juvenile rearing fall- and spring-run Chinook salmon and Central Valley steelhead. Implementation was completed in fall 2023 through a Public-Private Partnership that was supported by interested parties at federal, state and local levels, and leveraged relationships with aggregate mining landowners facilitating innovative, economical approaches to habitat enhancement and flood risk reduction. The design increased inundation frequency and duration in perennially and seasonally inundated side channels, removing unnatural constraints between channel and floodplain areas and reducing predator habitat. Over five years of construction, 157-acres of juvenile salmonid rearing habitat was created or enhanced, including two miles of perennial channels and alcoves and six miles of seasonal side channels. The habitat enhancement actions also led to a 3 ft reduction in the 100-yr water surface elevation in the project reach. This presentation will focus on project planning, design and implementation, and a subsequent talk will present results of the robust biological monitoring program.

This talk is the first part of a two-part talk on the Hallwood project. The second talk will be delivered by Avery Scherer. It would be best if these two talks were in the same session and presented back-to-back.

How does drought alter the synthesis and cross-ecosystem transfer of long-chain polyunsaturated fatty acids (LC-PUFA) from riverine to adjacent terrestrial ecosystems?

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Session:	**Disturbance & River Dynamics - Contributed Session**

Abstract

Adult aquatic insects emerging from freshwater systems fertilize surrounding watersheds, playing a crucial role in supporting riparian predators such as spiders, lizards, birds, and bats. Research on these cross-ecosystem subsidies has typically focused on the quantity of aquatic insects transported, overlooking nutritional aspects, specifically the omega-3 long-chain polyunsaturated fatty acids (ω3 LC-PUFAs) that are rare in the terrestrial environment but critical to vertebrate growth, immune function, and reproduction. Increasing evidence suggests that global change stressors (e.g., altered light and temperature) can decrease the production of ω3 LC-PUFA, but effects of river drying on ω3 LC-PUFA synthesis and transfer remain largely unknown. Here, we reviewed existing research on how drought impacts the production and transfer of ω3 LC-PUFAs from riverine to terrestrial ecosystems. We also identified challenges and opportunities for future research. Key mechanisms include reductions in surface water and habitat connectivity linked to changes in algal communities and the base of production (e.g. favoring LC-PUFA-poor cyanobacteria and detrital-fueled production); reductions in hydroperiod length that constrain stream insect life cycles; behavioral responses of invertebrates to drying that prevent them from grazing diatoms (e.g. due to hyporheic habitat use); and changes in emergence phenology that could decouple peak insect emergence from the timing of riparian predator needs. To illustrate some of these mechanisms, we also present data from a pilot study on ω3 LC-PUFA profiles and compound-specific stable isotopes from immature and emergent insects from a pristine intermittent watershed in Pinnacles National Park, CA. Given expected increases in drought frequency and severity globally, incorporating nutrient quality into models of cross-boundary resource flows will be key to understanding and mitigating climate-driven ecosystem change.

Natural levee dynamics on a changing floodplain

Presenting Author:	**Hima Hassenruck-Gudipati,** Southern Oregon University
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Session:	**Special Session 1 - Advances in Floodplain Science & Implications for Riverscape Resilience**

Abstract

Natural levees develop during overbank floods and, in doing so, shape future river-floodplain connectivity, sediment dynamics, and vegetation patterns. Using repeat lidar and field data from the Trinity River (Texas, USA), we document spatial and temporal variability in levee growth across multiple floods and river bends. Levee extension is primarily driven by bedload transport across the levee surface, focused in shallow, constructional channels that narrow and become shallower with distance from the river and often terminate in delta-like fronts. These features reflect spatial gradients in sediment concentration and overbank flow dynamics, underscoring the importance of levee morphodynamics. Lidar differencing between 2011-2015 and 2015-2017 reveals that deposition volumes consistently decrease moving into the backwater zone and towards Trinity Bay. However, grain size distributions for all levee deposits (median: 123 μm) remain relatively invariant, diverging from model predictions based on riverbed sediment and indicating that suspended sediment from the bed alone cannot explain observed deposition. Bank erosion contributes additional material. These findings highlight how levee growth is shaped by both down-river sediment supply and local river-bank erosion, modulated by floodplain water levels. Sediment accumulation can raise floodplain surfaces and reduce overbanking flow in some areas, but it also suppresses vegetation and increases tree mortality in zones of greatest sedimentation. By linking bend-scale changes with system-scale trends, we show how floodplain inundation patterns govern sediment routing and surface evolution. These insights advance understanding of how natural levees contribute to hydrologic connectivity, nutrient transport, and riverscape resilience.

Two Fish Swim into a Bar: Using Otolith Microchemistry to Evaluate Salmonid Rearing Potential in the Mattole River Lagoon

Presenting Author:	**Emma Held,** Cal Poly Humboldt
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Session:	**Special Session 12 - Advances in Bar-built Estuary Research: Physiochemical, Ecological & Management Perspectives**

Abstract

The Mattole River in rural northern California flows into a natural bar-built estuary, a feature that has been documented in the watershed since the late 1800s. The annual sandbar forms each year due to a combination of low summer flows and excess sand deposited by high energy waves, disconnecting the river from the ocean for 1-4 months each summer. This barrier results in some proportion of outmigrating juvenile Chinook salmon to remain in the lagoon during the hottest months of the year (lagoon-rearing life history), while others outmigrate in the spring (ocean-rearing life history).

Historically, the Mattole lagoon likely had a relatively higher rearing capacity due in part to a complex slough network on the south side and moderate summer temperatures. Poor land use practices and large flood events in 1955 and 1964 caused tremendous amounts of sediment to pour in from higher in the watershed, dramatically reducing the size of the lagoon. Lagoon studies in the mid-1980's documented a sharp decline in juvenile Chinook salmon growth rate and abundance following mouth closure. This decline was attributed to high summer water temperatures and density dependence mortality following mouth closure (Busby and Barnhart 1995; Downie et al. 2003), sparking decades of research, monitoring and restoration in the Mattole lagoon.

Otolith microchemical analysis has long been used to understand migration patterns and movement between environments of differing water chemistry. In this study I've analyzed strontium:calcium and barium:calcium ratios across approximately 320 adult Chinook otolith samples to reconstruct juvenile life histories. The chemical profiles show the length of lagoon residence for each fish, and can help determine the contribution of lagoon-rearing juveniles to the adult spawning population. In this study I determine if lagoon-rearing is a viable life history strategy in the Mattole River.

Implementing flow planning, modeling, and monitoring in California's Central Valley

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Session:	**Special Session 11 - Healthy Rivers & Landscapes**

Abstract

In California's Central Valley, the Bureau of Reclamation manages releases out of its reservoirs to meet numerous objectives including flood control, water supply, hydropower, and environmental purposes. Releases are made to support the temperature and flow needs of the environment and fishes downstream of these facilities. In the last decade, Reclamation has increased the use of its facilities for environmental flows that attract adult salmon, improve juvenile outmigration survival, and promote initiation of outmigration. Environmental flows are evaluated, based on estimating consequence and considering tradeoffs among purposes and among and within species. Reclamation has supported development of tools to assess potential impacts and benefits of the action to inform flow scenario planning efforts, although more work is necessary on the causal linkages between improved fishery responses and flow actions. Planning processes are further complicated by constraints and uncertain hydrological forecasts, but close coordination has proven effective at reducing this source of uncertainty among technical participants and decisionmakers. Monitoring assesses the effectiveness of environmental flow actions and inform updated management actions. This presentation will focus on sharing lessons learned about planning, modeling, and monitoring environmental flows implemented as part of Reclamation's long-term operations plan for the Central Valley Project.

Spatially Explicit Prioritization for Riparian Restoration in the Central Valley of California using Habitat Suitability Models from Multiple Taxa

Presenting Author:	**Autumn Iverson,** Point Blue Conservation Science
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Session:	**Special Session 3 - Restoring & Revitalizing Large Alluvial Rivers & Their Floodplains to Support Biodiversity & Multiple Goals**

Abstract

Spatial prioritizations can be valuable tools for riparian restoration decision-making, especially in a region with widespread agriculture, historical riparian forest loss, and limited opportunities for land acquisition like the Central Valley of California. In collaboration with restoration funders and practitioners, we determined a list of riparian species that drive conservation and management investment decisions. We then developed a prioritization for protecting existing riparian land cover throughout the Central Valley using spatially explicit Habitat Suitability Models (HSMs) for a variety of taxa that rely on riparian habitat, including the riparian focal birds species from the Central Valley Joint Venture (CVJV) and other species of conservation concern. Including previously published HSMs for species, we used Zonation with appropriate filters (e.g., already publicly-managed land) to create a map that highlights the priority opportunities for riparian restoration throughout the Central Valley to meet CVJV acreage targets. We also compared the impacts of different weighting schemes for each species (e.g., special status species get more weight than non-special status species) on the distribution of priority restoration areas. Results will identify "no-regrets" options for landscape-scale decision-making; those places that are valuable regardless of the species considered due to meeting multiple objectives under current constraints.

Quantifying Salmon Habitat Restoration and Management through the Eyes of the Fish

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Session:	**Special Session 11 - Healthy Rivers & Landscapes**

Abstract

Quantifying the outcomes of large-scale restoration and management actions is essential for evaluating their effectiveness. For juvenile salmon, this task is particularly challenging because the fish are too small to tag and go to the ocean for multiple years before returning as adults. Recent advancements in isotope analysis of sequential layers in archival structures- such as otoliths and eye lenses-have opened new pathways for understanding salmon life histories. These techniques allow the fish to tell us their stories by revealing where they came from and what habitats they used throughout their lives. In the Central Valley of California, the role of floodplains in enhancing fish growth through abundant food resources is well established. Yet a key question remains: does early access to floodplain off-channel resources (e.g. nursery habitats) lead to disproportionately higher survival to adulthood compared to other freshwater environments? Here, we used stable isotopes ($\delta^{34}S$, $\delta^{13}C$, and $\delta^{15}N$) in sequential lamina of salmon eye lenses to detect juvenile use of off-channel versus riverine food webs. By comparing isotope signatures in out-migrating juveniles and returning adults, we quantify differential recruitment linked to early habitat use. This study highlights the power of isotope analysis in eye lenses a novel tool to quantify the population-level benefits of specific habitats across the full life cycle of migratory fishes.

The influence of surface age on floodplain sediment organic carbon pools

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Session:	**Special Session 1 - Advances in Floodplain Science & Implications for Riverscape Resilience**

Abstract

Floodplains are increasingly recognized as important sites of sediment organic carbon (OC) storage, but few studies assess how differences in floodplain surface age influence OC storage. The presence of different sediment OC pools – slower-cycling mineral-associated organic carbon (MAOC) and faster-cycling particulate organic carbon (POC) – could be important to storage due to differences in resistance to decomposition. We assess MAOC and POC pools in relation to surface age on the Snake River in Grand Teton National Park, USA. We collected sediment cores and measured OC content (% by mass) of MAOC and POC pools to determine OC stock (Mg C per ha) at 87 locations. To estimate surface age, we used historic aerial imagery, maps, and dendrochronology. We found variations in the relative proportions of MAOC to POC depending on location in the floodplain (e.g., younger bars versus older surfaces). Floodplain locations with intermediate surface age (20-50 years old) had the highest OC stocks, whereas younger (0-20 years) and older surfaces (> 50 years) had lower OC stocks. These results will aid in understanding how surface age and different sediment OC pools influence floodplain OC storage and will help inform restoration practices aimed at storing more OC on the landscape.

Reconnecting Rivers Globally: Featuring Klamath, Los Angeles, and European Rivers

Presenting Author:	**Wendy Katagi,** McMillen, Inc
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Session:	**Klamath River Dam Removal**

Abstract

Reconnecting rivers means reconnecting people across the globe as aging infrastructure, public safety, biodiversity, and public access unite people and nature. There is a growing movement to rethink river management, particularly in urban areas, to balance human needs and ecosystem health. From the Klamath Dam removals to the Los Angeles River to dam removals across European rivers, free flowing rivers are opening doors to conservation and integrated water resource management solving multiple needs while bringing back native species close to extinction. Klamath River, now free flowing over 400 miles, serving as a model for many who are working to remove dams and barriers across Europe. Luxembourg is implementing a national Free Flow Strategy to restore river connectivity and revive aquatic life. EU Nature Restoration Law aims to restore at least 25,000 kilometers of free-flowing rivers by 2030. In the glorious Angeles National Forest of the Arroyo Seco, over 4,000 native rainbow trout are thriving in the headwaters of the Los Angeles River (LAR) along with mountain lions, black bears, and endangered least Bells vireo. Here begins the remarkable story of how this charismatic endangered fish is driving a movement in one of the most urbanized rivers in the world. With over 10 million people along the LAR and tributaries, the City of Los Angeles and partners are implementing the first leg of fish passage for the endangered steelhead trout in concert with the LAR California Environmental Flows Framework (CEFF), Pure Water recycling programs, and over 80 restoration projects along the LAR. The project will serve as an outdoor lab to monitor and support fish migration, biodiversity, flood operations, and maintenance activities as part of a larger program to reconnect fish and wildlife species across significant ecological areas in the LAR watershed bridging gaps where we-people and nature must coexist.

Sharing Butte Creek

Presenting Author:	**Jacob Katz,** California Trout
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Session:	**Special Session 10 - Nature Based Solutions in River Restoration**

Abstract

California's most dramatic example of a sustained population-level response to conservation action didn't come in one of the state's relatively unpopulated, "wild", forested, coastal watersheds. Instead, smack dab in the center of the Sacramento Valley, Butte Creek Spring-run Chinook salmon dramatically rebounded in the midst of one of the largest and most intensively farmed valleys on Earth. Only a handful of adults returned to watershed prior to the early '90s when restoration actions removed small dams and screened agricultural diversions. Shortly thereafter the number of returning adults jumped and has averaged between 5,000 and 20,000 a year for the last couple of decades.

Why the dramatic and anomalous response of Butte Creek salmon to this suite of impressive but by-no-means-unique conservation actions (similar work has been done in many other CA rivers). One piece of that answer is that it is the only tributary of the Sacramento River that is still consistently connected to floodplain wetlands. Butte Creek demonstrates the potential for explosive population-level response when a riverscape is able to provide all salmon freshwater life stages with the sequences of biophysical conditions needed to graduate to the next, even amid an ecologically fragmented and highly managed landscape.

Floodplain Forward: Aligning Ecological and Economic Outcomes

Presenting Author:	**Jacob Katz,** California Trout
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Session:	**Special Session 9 - Floodplains Forward: Aligning the Ecologies & Economies of Large River Valleys**

Abstract

Human land and water uses often interrupt the natural processes that create and sustain the patterns of landscape-scale biophysical conditions to which native biota is adapted. In the Sacramento River where native fish are balanced on the edge of extinction, recovery of endangered Sacramento River salmon populations requires transformational landscape-scale change now to allow these native fish to recognize the patterns under which they evolved and to which they are adapted which in turn emerge as water interacts with landscape through which it flows.

Enter the Floodplain Forward Coalition consisting of over 27 organizations of landowners, irrigation districts, academic researchers, fishermen, and fish and bird conservation NGOs in the Sacramento River Basin, dedicated to reactivating the Sacramento Valley floodplain to benefit fish, wildlife, and people. The coalition, motivated by the belief that "only with landscape-scale restoration can we expect a population-level response," has collectively developed a portfolio of "ridge top to river mouth" multi-benefit projects. These landscape-scale, nature-based solutions not only improve ecosystem conditions for salmon and other wildlife, but also replenish groundwater supplies and enhance floodplain resilience for the benefit of local communities.

Towards real-time evaluation and communication of streamflow depletion impacts associated with groundwater withdrawals

Presenting Author:	**Ben Kerr,** Foundry Spatial
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Session:	**Special Session 2 - Groundwater-Surface Water Interactions in Riverine Landscapes Across Multiple Scales**

Abstract

While groundwater and surface water have historically been regulated as separate resources, policy and regulations requiring their conjunctive management are emerging in several jurisdictions, and a complicated network of government organizations with regulatory control and interests over various aspects related to water management exist. For example, a local government agency responsible for well permitting may need to consider impacts on groundwater-dependent, federally regulated, species at risk.

In order to consider these impacts, information on potential impacts is required. A common approach to evaluating these impacts is to develop a coupled, numerical groundwater-surface water model. To do so requires highly qualified personnel, and significant time and budget to collect data, calibrate, and validate the model(s), and then ongoing technical support to evaluate applications as they come in.

A gap exists between the administrative need for objective information and the accessibility of that information. We propose that this need can be met through the implementation of web-based decision-support tools, supported by analytical depletion function models, which can be implemented quickly, and at a minimum, used to screen applications for potential impacts.

Monitoring Yolo Bypass flooding using Sentinel 1 and 2 satellite imagery & calculating metrics of floodplain inundation

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Session:	**Special Session 3 - Restoring & Revitalizing Large Alluvial Rivers & Their Floodplains to Support Biodiversity & Multiple Goals**

Abstract

Floodplain inundation is the structuring force creating habitat heterogeneity which supports high biodiversity in floodplain habitats. Studies have shown that even an engineered flood bypass like the Yolo floodplain supports multiple ecosystem functions such as migration, spawning and rearing habitat for waterfowl and fish, and serves as an important resource to downstream food webs.

We used a dense time series of Sentinel-1 (S1) and Sentinel-2 (S2) images to map floodplain inundation over multiple water years in the Yolo Bypass. The inundated area derived from these maps was plotted over time to produce a spatio-hydrograph. A generalized additive model (GAM) was used to fit a curve through the spatio-hydrograph to create a continuous time series. The continuous time series was then used to calculate floodplain metrics such as peak flooded area, flood timing, rate of rise, rate of fall, and duration of flooding. The inundation maps were also used to calculate other metrics such as lateral connectivity and its evolution through the flood period, depth profiles of flooded area, and the changing mosaic of aquatic and terrestrial habitat during each flood event. These metrics are directly related to ecosystem processes and can be used as indicators of ecosystem health.

Ecological outcomes from environmental watering in the Murray-Darling Basin: ten-year evaluation outcomes and a look to the future

Presenting Author:	**Alison King,** CSIRO Australia
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Session:	**Special Session 7 - Advancing Environmental Flow Management: Holistic Approaches for Sustaining Aquatic Ecosystems**

Abstract

Since 2014-15, the Australian government's Flow-MER (Monitoring, Evaluation and Research) program has monitored and evaluated the annual and cumulative ecological outcomes of Commonwealth Environmental Water (CEW) in the Murray-Darling Basin (MDB). Monitoring occurs on-ground in several areas across the MDB. The Basin-scale evaluation utilises available data and aligns to legislated objectives to protect, restore and/or enhance the hydrological regime, biota and ecosystems.

Basin-scale evaluations have been conducted for 6 themes – hydrology, vegetation, native fish, species diversity, ecosystem diversity, foodwebs and water quality. Approaches to the evaluation of the contribution of CEW to observed environmental outcomes differ among themes and is highly dependent on the data available. For example, some themes have sufficient data to model and compare environmental outcomes both with and without CEW (counterfactual modelling), and infer outcomes outside of monitored areas. Others are only able to provide qualitative assessment of outcomes where CEW has been used. To the best of our knowledge, the Flow-MER Program is globally unique in its purpose, scale, and its ecological coverage. This presentation will explore ecological outcomes over the first 10 years and describe new Program changes including expansion of Area-scale monitoring footprint and the inclusion of cultural outcomes as an evaluation theme.

Benefits for Wales- Reservoir reoperation to implement functional flows

Presenting Author:	**Megan Klaar,** University of Leeds
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Session:	**Special Session 7 - Advancing Environmental Flow Management: Holistic Approaches for Sustaining Aquatic Ecosystems**

Abstract

Increasing demand for water resources in southeast England have led to proposals for the transfer of water between Welsh and English river catchments to address differences in water availability and demand. As part of these proposals, potential reoperation of flow releases from a reservoir in mid Wales to provide water resources and support a better and more resilient downstream aquatic community was investigated. Using published and grey literature of relevant species and catchment characteristics twinned with a unique natural flow typology, suitable functional flow targets were determined. Utilisation of the inverted temperature regime of water releases from the reservoir were identified as an important functional flow in driving instream processes and contributing to enhanced ecosystem resilience to downstream communities. Compensation release regimes based on antecedent ('wet/normal/dry') flow conditions and resource availability were further identified to provide inter-and intra-annual variability and disturbance elements which are otherwise missing from current reservoir operations. This exercise has created a framework for a more adaptive approach to reservoir management which fulfils the transfer of water resources to English regions while also providing benefits to donor Welsh catchments.

A Rapid Tool for the Assessment of Floodplain Wetland Service for States & Tribes to Meet Compensatory Mitigation Needs

Presenting Author:	**William Kleindl,** Montana State University
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Session:	**Special Session 9 - Floodplains Forward: Aligning the Ecologies & Economies of Large River Valleys**

Abstract

US Federal policy requiring no overall net loss (NNL) of wetland functions and values led to several assessment approaches to meet compensatory mitigation requirements for CWA §404 and reporting requirements for CWA §305. The bulk of these focuses on assessing the ecological function, yet the quality of function alone does not entirely drive policy and management. That is why NNL also requires an assessment of value (now replaced with services). Wetland functions produce sink and source products that provide the natural capital necessary to support provisioning, regulating, and cultural services that help maintain human well-being. Existing ecological service assessments are poorly integrated into standard wetland monitoring and assessment tools to meet CWA and other management needs. Our proposed tool will be a seamless module for existing wetland assessment tools. This conceptual approach assesses the wetland's capacity to provide a function as exists within the current wetland assessment tools. The beneficiaries and their ability to access these functions define a scalable opportunity. The combination of the functional capacity and the opportunity to access that capacity defines the ability of the wetland to provide that service. The functional and service capacity, then, are units that can be accounted for in compensatory mitigation.

Management and Externalities within the Socioecological System of Dynamic Floodplains: Insights from Portfolio Theory

Presenting Author:	**William Kleindl,** Montana State University
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Session:	**Special Session 9 - Floodplains Forward: Aligning the Ecologies & Economies of Large River Valleys**

Abstract

Floodplains perform ecological processes (functions), producing ecological products that help maintain human well-being (services). Their quality depends on the underlying land use and land cover (LULC) shaped by land managers. The assessment of decisions is frequently achieved with multi-metric indices (MMIs). Yet these assessment tools are usually static in time. However, floodplains are a shifting mosaic driven by dynamic natural land/riverscape disturbances as well as dynamic anthropogenic land-use decisions. How do we use MMIs to capture the dynamic nature of floodplains? To address this, we turn to modern portfolio theory (MPT), which offers effective analytics to inform relationships between system volatility and condition. Here we harness 39 years of remotely sensed data along the 240 km Flathead River system in Montana and British Columbia. We established multiple reaches and management zones: silviculture, preservation, and agriculture/urban-dominated. We developed a simplified habitat MMI where the metric is an asset class and the combination is an index representing a habitat capacity function portfolio. We apply the MMI across all reaches and years. MPT provides the mean condition of the habitat functions, a measure of the volatility across those decades, and insights to regulatory and management at large time scales.

Restoring Lateral Connectivity to a large floodplain river on the coastal plain of North America

Presenting Author:	**G Mathias Kondolf,** University of California Berkeley
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Session:	**Special Session 1 - Advances in Floodplain Science & Implications for Riverscape Resilience**

Abstract

Restoring lateral connectivity between mainstem and secondary channels on floodplains can take many forms, with projects for salmonid refugia in the US Pacific Northwest and along large, highly-engineered European rivers among the best known. On the Apalachicola River in Florida, the nature of the disconnection differs from most of the examples reported in the literature. The Apalachicola River floodplain is exceptional in North America because its floodplain is essentially unurbanized and not disconnected by flood control dikes; it still experiences inundation from large floods. The floodplain is largely forested by native tree species, and its morphology is unusually intact, with and extensive network of secondary channels ("sloughs"), which provide critically important habitat for juvenile fish and other species, and which provide nutrients for the base of the food chain of Apalachicola Bay. A major impact to the river ecosystem was a failed navigation project, in which the US Army Corps of Engineers dredged over 33Mm 3 to maintain a 2.75-m deep channel in a loose sandy bed from the 1950s to 1990s. During the period of active dredging, large areas of sand were exposed, and sand was transported in suspension into secondary channels, where sand deposited, creating sills that block flows and disconnect the channels. Three pilot projects now aim to restore circulation in anthropically-clogged sloughs by removing sand deposits and trees blow-down by Hurricane Michael in 2018, which left channel spanning logs every 19 m on average. These restoration measures respond to the specific conditions of this river with its distinct history, and differ from most prior examples of secondary channel restoration. Preliminary results show improved hydrologic connection to the mainstem at significantly lower flows than pre-restoration.

Riparian Methylmercury Production Increases Riverine Mercury Flux and Food Web Concentrations

Presenting Author:	**Virginia Krause,** University of California, Davis
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Session:	**Water Quality I - Contributed Session**

Abstract

The production and uptake of toxic methylmercury (MeHg) impacts aquatic ecosystems globally. Rivers can be dynamic and difficult systems to study for MeHg production and bioaccumulation, hence identifying sources of MeHg to these systems is both challenging and important for resource management within rivers and main-stem reservoirs. Riparian zones, which are known biogeochemical hotspots for MeHg production, are understudied as potential sources of MeHg to rivers. Here, we present a comprehensive quantification of the hydrologic and biogeochemical processes governing MeHg concentrations, loads, and bioaccumulation at 16 locations along 164 km of the agriculturally intensive Snake River (Idaho, Oregon USA) during summer baseflow conditions, with emphasis on riparian production of MeHg. Approximately one-third of the MeHg load of the Snake River could not be attributed to inflowing waters (upgradient, tributaries, or irrigation drains). Across the study reach, increases in MeHg loads in surface waters were significantly correlated with MeHg concentrations in riparian porewaters, suggesting riparian zones were likely an important source of MeHg to the Snake River. Across all locations, MeHg concentrations in surface waters positively correlated with MeHg concentrations in benthic snails and clams, supporting that riparian produced MeHg was assimilated into local aquatic food webs. This study contributes new insights into riparian MeHg production within rivers which can inform mitigation efforts to reduce MeHg bioaccumulation in fish.

Expanding Side Channel Habitat and Floodplain Connectivity in the Lower Feather River Corridor

Presenting Author:	**Nicole Kwan,** FlowWest
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Session:	**Special Session 1 - Advances in Floodplain Science & Implications for Riverscape Resilience**

Abstract

The Feather River, a tributary to the Sacramento River, has been impacted by dams, mining, levees, and urban development. These factors have contributed to significant declines of fall and spring run Chinook salmon and Central Valley Steelhead by reducing spawning habitat for adults and off channel rearing habitat for out-migrating juveniles. To improve conditions, several restoration efforts are underway to restore floodplain habitat near the confluence of the Feather and Sacramento Rivers. Here we discuss a project in the lower Feather River corridor which will reestablish historic flow paths and improve connectivity to the Sutter Bypass. To design this project, we used a combination of historic data, topographic and bathymetric surveys, 2D hydraulic modeling, and iterative design to create a suite of viable alternatives. We then quantify floodplain habitat under pre and post design conditions to determine which alternatives maximize suitable salmonid habitat, providing the greatest opportunity for improved rearing success. We further seek multi-benefit opportunities to improve water quality and aquatic and terrestrial habitat for other species. By integrating modeling, planning, and habitat suitability criteria we advance effective science-based decision making in the restoration of critical habitat in the Feather River.

Connected to another presentation by author Mike Davis

Global export of biomass and contaminants from water to land by aquatic insects

Presenting Author:	**Stefano Larsen,** Edmund Mach Foundation
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Session:	**Special Session 1 - Advances in Floodplain Science & Implications for Riverscape Resilience**

Abstract

The production of anthropogenic chemicals has increased sixfold in the last decades and represent major drivers of global change. Streams and rivers receive contaminants from the watershed, but also export them back to land via the bioaccumulation and emergence of adult aquatic insects. This flux of contaminants can offset the benefits of transported subsidies and increase the exposure of terrestrial consumers. Here, leveraging extensive dataset on in-stream insects production and contaminants concentration, we provide the first global estimates of biomass and contaminant fluxes from water to land. Rivers export an average of ~1910 mg of dry-mass/m2/y of adult aquatic insects. That translates to ~860 mg of carbon/m2/y, which is similar to previous estimates. GAM models accounting for precipitation and global river surface areas estimate that the global flux of adult aquatic insects is ~2.8 million metric tons of dry mass and ~1.2 million metric tons of carbon. We combined these mass estimates with predictions of contaminant tissue concentrations derived from predicted aqueous concentrations. The results suggest global export of ~0.5 metric tons of Hg, 5 metric tons of Pb, and 1.3 metric tons of Se, from water to land.

Development and Implementation of a New Environmental Flow Regime on the Trinity River, CA

Presenting Author:	**Christopher Laskodi,** Yurok Tribe
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Session:	**Special Session 7 - Advancing Environmental Flow Management: Holistic Approaches for Sustaining Aquatic Ecosystems**

Abstract

The construction of Lewiston Dam in the early 1960s blocked 109 miles of critical salmonid habitat and diverted most of the Trinity River flow to the Sacramento River. A precipitous decline in returning salmonid species to the Trinity River soon followed. To address these declines, several pieces of legislation, policy decisions and a decade-long study led to the signing of a Record of Decision (ROD) in 2000 and the formation of the Trinity River Restoration Program (TRRP). This partnership of federal and state resource agencies, Tribes, and Trinity County was established to restore the Trinity River and the species that depend upon it. The ROD provided considerable improvement in flow management, including annual hydrographs dependent on inflows to Trinity Lake. Nevertheless, adult salmon populations continued to decline. TRRP used a science-driven approach to expand flow management temporally, leading to the first known winter dam releases in the Central Valley Project specifically designed for environmental benefit. Although the process was science-driven and followed previously agreed-upon procedures, several social, economic, and political factors created challenges and slowed implementation. Here, we describe the long and bumpy road from development to the implementation of Environmental Flow management on the Trinity River.

Restoring ecosystem function and phenological synchronicity through flow management on the Trinity River, CA

Presenting Author:	**Ken Lindke,** CA Department of Fish and Wildlife
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Session:	**Special Session 7 - Advancing Environmental Flow Management: Holistic Approaches for Sustaining Aquatic Ecosystems**

Abstract

Rivers and streams in the Pacific Northwest exhibit extremely high variability in flow magnitudes, geomorphic dynamism, and ecosystem processes on both intra- and inter-annual scales. The timing, duration, magnitude and variability of these processes have shaped on evolutionary time scales the phenologies of the aquatic organisms that exploit them. What happens when anthropogenic intervention decouples physical and biological processes spatially and temporally? On the Trinity River in Northwest California, the construction of impassible dams and water abstraction has left the once iconic river and the fish and wildlife that depend on it in a severely depressed state. Numerous pieces of legislation and a decades-long study led to annual water allocations and rulesets to design flow releases. After twenty years of prescribed flow management, conditions in the Trinity River have improved, but progress has not met expectations. Recent efforts to design environmental flows that realign physical and biological phenologies have led to two years of implementation and the prospect of a new era of flow management on the Trinity River. Preliminary data provide encouraging results while ecologists await additional years of implementation. Existing robust long-term monitoring and modeling will be an integral component of future implementation.

Synthesizing understanding of beaver sedimentation in river corridors

Presenting Author:	**Katherine Lininger,** University of Colorado Boulder
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Session:	**Physical Processes - Contributed Session**

Abstract

Beavers modify geomorphic and ecological processes in river corridors (the channel, floodplain, and hyporheic zone) through dam construction, canal excavation, and associated activities. Beaver dams slow and pond water, promoting sedimentation, increasing carbon storage, raising water tables, and modifying vegetation assemblages. Multiple studies have found that beaver pond sedimentation rates and average sediment depths are related to factors such as pond geometry (e.g., width versus length, dam height), pond age, reach-scale slope, contributing drainage area, and basin lithology. However, there has yet to be a systematic comparison of the factors influencing sediment characteristics in beaver ponds across different environments. Here, we compile previously published datasets from North America and Europe to assess the range and drivers of sediment volumes, depths and sedimentation rates. Our synthesis indicates that pond connectivity (e.g., on-channel versus off-channel), pond area, lithology, climate zone, and pond age influence sediment dynamics. We also highlight future research needs to advance understanding of the impact of beaver on sedimentation and sediment storage in river corridors. Our findings have implications for river restoration efforts that incorporate beaver mimicry structures and beaver reintroduction.

Restoration incorporating living shorelines, Stage 0 alluvial fans, and other design measures for climate adaptability on a 1,000 acre floodplain of the Lower Columbia River

Presenting Author:	**Curtis Loeb,** Wolf Water Resources, Inc.
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Session:	**Special Session 3 - Restoring & Revitalizing Large Alluvial Rivers & Their Floodplains to Support Biodiversity & Multiple Goals**

Abstract

The Lower Columbia Estuary Partnership, Port of Camas-Washougal, U.S. Fish and Wildlife Service, Bonneville Power Administration, and others partnered to reconnect nearly 1,000 acres of historic Columbia River floodplain and reduce flood risks at the Steigerwald National Wildlife Refuge located southeast of Washougal in Clark County, Washington. Reconnection of the floodplain presented numerous technical challenges, including ensuring no adverse impacts to Washington State Route 14 and designing a levee and floodwall to meet strict regulatory, flood risk reduction, and habitat objectives. Reconnection was particularly challenging given anticipated changes in climate (higher winter flows and higher summer stream temperatures) and future increases in watershed development. Three distinct design measures were developed to improve resiliency to climate risk and uncertainty. (1) A vegetated wind-wave overbuild berm was designed in lieu of riprap to protect the levee from extreme winds and associated wave erosion, as well as to accommodate transitioning wetland and riparian habitats up the topographic slope due to changing river stages. (2) The design also incorporated peak flows scaled to account for anticipated future development and higher intensity winter storms, as predicted by climate models. Consequently, a floodwall along Gibbons Creek was designed for discharges 20% larger than current peaks. (3) Finally, the design targeted full floodplain connectivity (Stage Zero target condition) in restoring Gibbons Creek's 80-acre alluvial fan while also ensuring functionality of instream habitat at the base of the alluvial fan. These three climate resiliency design measures were based on several simple yet often underestimated concepts including space, scale, imprecision, and redundancy, and the focus of the presentation will be on how these ideas can be applied in similar constrained environments and changing climates to yield high functioning floodplain habitat.

Development Dreams and Riparian Realities in Nepal: Assessing Community Attitudes to Environmental Change in a Hydropower Nation

Presenting Author:	**Sapana Lohani,** Institute for Integrative Conservation, William and Mary
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Session:	**Special Session 5 - Revitalizing Community & Landscape by Connecting Rivers, People, & Science Through Field Experiences**

Abstract

Nepal's rivers are critical to both its economy and cultural life, and the well-being of local communities. In recent years, rapid growth in hydropower development and extractive industries - particularly riverbed gravel mining - has generated economic opportunities but also significant disruption. Riparian communities have been especially affected, as the construction of dams, roads, and conservation zones has disrupted traditional livelihoods and cultural practices, reduced access to clean water, and altered river ecosystems. Climate change has compounded these pressures, bringing erratic rainfall, prolonged droughts, and increased flooding. Together, infrastructure expansion and environmental change have created a crisis of water access, cultural loss, and ecological displacement. Yet, it is not entirely clear how much everyday Nepalis know about climate change, nor what their attitudes are toward the environment, and how humans should live in it. Drawing on survey data and focus group discussions conducted with riparian communities in each of Nepal's major river basins in 2023-24, as well as interviews with and policy research on the Nepali hydropower section, this paper investigates (1) the vital geopolitical and policy context of hydropower development in Nepal; (2) local understandings of climate change and attitudes toward the environment (human-nature relations); (3) perceptions of changes in river access and water quality; (4) the resulting impacts on livelihoods, cultural identity, and health; and (4) community responses ranging from adaptation to resistance.

Reconstructing Long-Term Historical Hydrologic Alteration to Support Environmental Flows in Texas

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Session:	**Special Session 7 - Advancing Environmental Flow Management: Holistic Approaches for Sustaining Aquatic Ecosystems**

Abstract

Understanding and quantifying hydrologic alteration is essential for effective watershed management and ecological conservation. This study developed a modeling framework to predict reference hydrology and assess and model hydrologic alteration across Texas using publicly available geospatial datasets. A two-stage random forest regression approach was used to model reference flow conditions at gaged locations based on natural predictors. Alteration was calculated as the deviation of observed values from these modeled reference conditions. A second set of models predicted hydrologic alteration using anthropogenic predictors. Reference hydrology models performed well (mean $R^2 > 0.9$), with stream classification identified as a key driver. Hydrologic alteration models exhibited more variable performance (R^2 range: 0.45–0.89), with land use variables consistently ranking highest in predictive importance. Predicted alteration patterns exhibited both spatial and temporal variability, with a general trend toward increasing surplus flow conditions over time, especially in eastern Texas. This modeling framework enables large-scale prediction of hydrologic alteration and provides insight into its primary drivers, offering a valuable tool for anticipating the impacts of future development on flow regimes.

Exploring the hydrologic variation of large volcanic spring-fed river systems in Northern California

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Session:	**Special Session 2 - Groundwater-Surface Water Interactions in Riverine Landscapes Across Multiple Scales**

Abstract

Coldwater is one of California's most indispensable ecological resources. In the spring-fed rivers of Northern California, many species (e.g. Rainbow Trout, Chinook Salmon, McCloud River Redband, etc.) are dependent on coldwater, yet there is a continued lack of understanding surrounding the hydrological contributions of volcanic aquifer springs to river ecosystems. Here we assessed the variation in volcanic spring inputs and effects on water temperature during summer baseflow in the Upper Sacramento watershed. Stream flows were manually measured throughout the summer baseflow period (July 1- September 31, 2024) using Acoustic Doppler Current Profiler (ADCP) and rated to assess continuous stream discharge. In Burney Creek, summer baseflows averaging 3.96 m^3/s (140 ft^3/s) were 100% comprised of spring inputs, leading to stable temperatures with a maximum weekly average temperature (MWAT) of 9.5 °C and maximum weekly maximum temperature (MWMT) of 10.5 °C. Springs in the McCloud River account for 78% of the 20.22 m/s (714 ft^3/s) average summer baseflows, resulting in an MWAT of 8.2 °C and an MWMT of 9.4 °C below the springs, a 1.5 °C (15.3%) and 1.2 °C (11.2%) reduction from temperatures observed upstream of the springs. Spring input in the Upper Sacramento River contributed approximately 30% of the 3.11 m^3/s (110 ft^3/s) average summer baseflow, leading to an MWAT of 11.8 °C and an MWMT of 15.0 °C, a 0.5 °C (4.0%) and 1.2 °C (7.6%) reduction from those observed upstream. While springs contribute varied proportions of summer baseflows to these systems, the resulting conditions provide regional coldwater refugia, which will be increasingly more important as California's climate shifts toward increased summer temperatures and reduced winter snowpack. Understanding the influence of large coldwater aquifer springs can help guide the preservation of both the hydrological benefits for downstream water use and the local ecological benefits for dependent species.

Headwater Biophysical Response to Extreme Precipitation Events: A Case Study from Hurricane Helene and the Southern Appalachians, USA

Presenting Author:	**Anna Marshall,** University of Tennessee
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Session: **Disturbance & River Dynamics - Contributed Session**

Abstract

In the Southern Appalachian Mountains of the United States and throughout global river networks, headwater catchments dominate stream network length yet remain underrepresented in river research- particularly regarding their biophysical responses to disturbance. Localized extreme precipitation events in these steep, often forested systems can generate rapid pulses of water, sediment, and large wood, introducing variability in transport and storage processes. In fall 2024, Hurricane Helene delivered intense rainfall to an already-saturated landscape, triggering widespread flooding and mass movements across the region. This event offers a unique opportunity to examine the geomorphic imprint of episodic large wood recruitment and redistribution in headwater streams with a legacy of human alteration. We investigate spatial patterns of wood recruitment, transport, and storage across stream orders, linking flood dynamics to catchment-scale biophysical responses. By characterizing these processes, we aim to better understand the capacity of headwaters to attenuate flood inputs and influence downstream sediment and carbon fluxes. In doing so, we hope insights from this work can inform global discussions on catchment-scale resilience to climate extremes, post-disturbance management, and the restoration of headwater systems in mountainous landscapes.

Implications of flow management on biogeomorphic feedbacks on the Green and Yampa Rivers

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Session:	**Special Session 1 - Advances in Floodplain Science & Implications for Riverscape Resilience**

Abstract

Flow regulation of rivers has resulted in changes to channel geometry and riparian vegetation. Along the Green River decreases in peak flows have promoted proliferation of riparian vegetation resulting in sediment deposition, channel narrowing, and channel simplification. To understand the relationship between changes in flow regime and channel narrowing, we analyzed ten years of riparian plant data coupled with plot inundation-duration and elevation data along 19 sites on the Green River and three sites along the Yampa River. The sampling years cover a range in peak flows from 2015 through 2024. We observed significant increases in vegetative cover during the low and average flow years, while in the wetter year we observed a slight decrease in cover. These results confirm that in low flow years reduced physical disturbance allows encroachment of riparian vegetation. Additionally, we observed an increase in elevation of more densely vegetated plots compared to sparsely vegetated plots in wetter years. These results suggest that vegetation establishment in low flow years is subsequently entrapping sediment and reducing erosion in wetter years. Findings from this study suggest that flow peaks with high magnitude and duration can promote wide, complex channels which ultimately improve habitat for threatened and endangered fishes.

Reconciling biodiversity, ecosystem services, and climate mitigation in California rice fields

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Session:	**Special Session 9 - Floodplains Forward: Aligning the Ecologies & Economies of Large River Valleys**

Abstract

A considerable challenge in cultivating sustainable agroecosystems is maintaining agricultural outputs while protecting biodiversity. Rice is a notable example of integration of agricultural productivity and biodiversity conservation. For decades, flooding rice fields in winter has offered critical wetland habitat to California wildlife. However, increased drought conditions threaten water availability, and flooded rice systems are known methane emitters. It is imperative to understand the benefits of flooding rice fields to farmers and biodiversity for informed management. We used a systems-level approach to determine how introducing fish into California rice fields might benefit growers, conservation, and sustainability. At an industrial rice farm, we experimentally excluded waterbirds and added fish in a full-factorial design across eight plots, measuring ecosystem services to rice growers and methane emissions. Preliminary results showed that fish grew rapidly in winter-flooded rice fields and reduced methane emissions three-fold, likely by inducing a trophic cascade whereby zooplankton consumption indirectly bolstered methanotrophic bacterial populations. As climbing water prices lead some growers to reduce winter flooding, our research has implications on how fish introductions can bolster agronomic benefits and mitigate costs. Additionally, this work may provide a path for rice growers to address concerns about agricultural greenhouse gas emissions through fish introductions.

Assessing Aquatic Food Web Responses to Tidal Slough Restoration Using Low-Impact Techniques

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Session:	**Special Session 11 - Healthy Rivers & Landscapes**

Abstract

To inform San Francisco Bay-Delta management and restoration design, we evaluated environmental responses to the Dutch Slough Tidal Restoration Project using a Before-After-Reference-Impact (BARI) study design. Spatiotemporally coupled data on water quality, zooplankton and fish were collected through continuous water quality monitoring, video imagery, and eDNA sampling methods. Pre-breach, we observed significant differences in water quality between newly constructed channels and adjacent reference sites. Post-breach, we detected significant changes in fish species composition. Paired mixed-effects BARI models were used to account for environmental variability across the 2021–2023 monitoring period and isolate breach and restoration design effects on key variables that affect food web dynamics. Tidal channel complexity, size, and interaction with adjacent wetlands influenced water quality, chlorophyll a, zooplankton, and fish densities and diversity. While native fish were present in the newly constructed channels, non-native fish dominated the community. Phytoplankton and zooplankton production in these channels may be exported to adjacent habitats, potentially contributing to short- and long-term ecosystem sustainability. These preliminary findings provide insights into the early ecological evolution of restored tidal channels and highlight implications for adaptive management in wetland habitat design. Furthermore, our approach demonstrates the utility of low-impact sampling methods for generating robust ecological data.

Beaver Dam Loss Decreases Floodplain Connectivity in Colorado Headwater Streams

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Session:	**Special Session 1 - Advances in Floodplain Science & Implications for Riverscape Resilience**

Abstract

As ecosystem engineers, beavers significantly modify river corridor form through dam building. When beavers are removed from a system, their unmaintained dams wash out, altering the stream's hydrologic regime. The assumption that beaver dams increase floodplain connectivity is frequently presumed but is not well explored. Moreover, many contemporary river restoration techniques aim to restore natural functions historically provided by beavers without fully understanding the hydrological benefits of past beaver activity. Thus, we seek to quantify the change in floodplain connectivity caused by the loss of beaver dams at three headwater tributary sites in the Kawuneeche Valley, Rocky Mountain National Park, Colorado. Historically occupied by beavers, declining tall willow availability has resulted in beavers abandoning the area. We developed two-dimensional steady-state hydraulic models in SRH-2D to compare metrics of floodplain connectivity under historical (beaver active) and present (no active beaver) scenarios. Metrics included volume of water on the floodplain, fraction of flow through the floodplain, volumetric flux into the floodplain, and residence time. We observed that the loss of beaver dams decreases floodplain connectivity across all connectivity metrics (up to 96.5% loss in connectivity). The greatest changes occurred for the lowest recurrence interval simulated floods, suggesting that beaver dams have the greatest impact on floodplain connectivity at smaller, more frequent discharges.

Relative effects of beaver dam analogs on the growth and density of stream rearing salmonids

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Session:	**Special Session 10 - Nature Based Solutions in River Restoration**

Abstract

Studies have shown beaver dam analogues (BDAs) to be a useful tool in addressing issues such as channel incision, floodplain disconnection and groundwater depletion.

However, little research has explored the impact of BDAs on the growth and abundance of fish rearing in the ponds they form. Additionally, no studies have examined the effects of BDAs on coho salmon, an imperiled species in California. To address these data gaps, we identified four salmonid-bearing streams in northern California on which BDAs have been installed. We weighed, measured and uniquely marked individuals of four salmonid species captured in BDA ponds and untreated reference pools. We returned to each site numerous times throughout the year to recapture and measure tagged fish, allowing us to calculate individual growth rates. To explore differences in relative abundance, we blocked off habitat units and enumerated the number of individuals present. Preliminary results indicate that in some streams, BDAs can generate significant increases in salmonid abundances and growth rates. The findings of this study will provide insight into the biological benefits that can be gained through BDA installation, as well as the contexts in which those benefits are maximized.

Budget-based Functional Flows and Implications for Management and Policy

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Session:	**Special Session 7 - Advancing Environmental Flow Management: Holistic Approaches for Sustaining Aquatic Ecosystems**

Abstract

Environmental flow policies often rely on static minimum thresholds that fail to reflect the dynamic variability of natural river systems. This work introduces a framework for designing budget-based environmental flows that draw on unimpaired flow estimates to derive a continuous representation of river flow conditions across water year percentiles. The resulting flow regimes vary seasonally and interannually, mimicking ecological cues in natural systems.

This presentation overviews a systematic comparison of environmental water budgeting strategies, including percent-of-unimpaired-flow, reservoir storage-linked allocations, and budget-optimized approaches. Using metrics that reflect seasonality and interannual variability, we assess how hydrograph design choices—such as peak flow inclusion, ramping rates, and baseflow variability—impact total environmental water demand. Performance is evaluated based on how well different budgeting approaches reproduce the natural distribution and frequency of flow metrics across water year types.

This work offers practical tools for translating functional flow theory into policy and management, emphasizing the importance of variability as a primary objective of environmental flows.

Addressing streamflow depletion due to groundwater pumping - unified modeling approaches and process uncertainty

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Session:	**Special Session 2 - Groundwater-Surface Water Interactions in Riverine Landscapes Across Multiple Scales**

Abstract

Functional flows for streams and rivers (with an emphasis on dry season baseflows), groundwater well ordinances that are protective of public trust resources, and sustainable groundwater management protecting groundwater-dependent ecosystems at a statewide level, all rely on an in-depth understanding of surface water-groundwater dynamics. Currently, technical gaps exist that limit our ability to evaluate streamflow depletion impacts due to groundwater pumping. This work explores modeling approaches to estimate streamflow depletion due to groundwater pumping across several distinct geographies and geologic environments, and presents emerging modeling approaches to evaluate streamflow depletion caused by groundwater pumping in Sonoma County and Scott Valley, CA. Results indicate that based upon the complexity of the hydrogeologic setting, various factors (perennial vs. non-perennial streams, geologic heterogeneity, recharge, phreatophytic evapotranspiration) may or may not be necessary to consider. Working with experts in both analytical and numerical groundwater modeling techniques, these pilot projects serve as use-case investigations, helping to develop unified modeling solutions to evaluate streamflow depletion in these project areas and build towards the development of decision-support tools and best management practices.

Benthic macroinvertebrate responses to Klamath Dam removal: an examination of salmonid food resources downstream of Iron Gate Dam

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Session:	**Special Session 8 - Science for a Changing Klamath River Following the World's Largest Dam Removal**

Abstract

The removal of four hydroelectric dams on the Klamath River will likely restore hydrologic and ecosystem processes within the basin that have been disrupted for over a century. However, sediment fluxes associated with dam removal can impact benthic habitat and water quality downstream of former dam sites. The release of reservoir sediments from reservoir drawdown and dam deconstruction on the Klamath not only increased turbidity and sediment deposition downstream, but also caused temporary declines in dissolved oxygen. This study investigates food web responses to Klamath dam removal downstream of Iron Gate Dam during a critical period of juvenile salmonid growth and outmigration in the late spring. Benthic invertebrate communities were characterized using kick net samples and salmonid prey availability was assessed using drift and non-lethal gastric lavage sampling of juvenile fish in paired tributary and mainstem sites before (2022, 2023) and during dam removal (2024). Preliminary results suggest that benthic macroinvertebrate abundance and biomass in the mainstem sites were not severely impacted by winter/spring sediment fluxes, but was more impacted in late fall in 2024 immediately following dam removal. Prey resource availability to juvenile salmonids was similar across all study years. These results may be confounded by impacts of the McKinney fire, which introduced substantial sediment loads into the river in our study reach between the 2022 and 2023 sampling periods. Results from this study are intended to inform future dam removals that may impact sensitive life stages of anadromous fish and their invertebrate prey.

Safeguarding America's rivers: the urgent need for expanded protections

Presenting Author:	**Julian Olden,** University of Washington
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Session:	**Special Session 4 - Data to Decision: Who Governs Ecological Monitoring of the River Commons?**

Abstract

To address the enduring and deepening crisis facing fresh waters, many nations have recently made bold commitments towards freshwater protection targets. However, the lack of comprehensive databases and integrative frameworks currently hampers a robust evaluation of current freshwater protections and prioritization of future opportunities to meet these goals. The National Protected Rivers Assessment provides the first-of-its kind evaluation of river protection for the United States by reconciling the disparate array of major federal, state, tribal and private protection mechanisms into a multifaceted index that accounts for the intended protection of key ecological attributes of rivers. We report that just over one-tenth of river length of the contiguous United States and less than one-fifth of rivers nation-wide are currently protected at a level deemed viable. The vast majority of the states have less than 10% of their river length subject to intended viable protection, and only four states currently exceed 30% of in-state viable protection. Even more striking is the highly variable degree of upstream out-of-state viable river protection for U.S. states, which points to opportunities for heightened coordination among neighboring states who have shared waters. Lowland headwater streams and intermittent watercourses are consistently underprotected. Protection is also often spatially misaligned with other conservation objectives, where only a small fraction of watersheds displaying high biodiversity value, habitat intactness, and importance to drinking water supply are being offered adequate (30% of river length) protection. Our assessment of river protection highlights the urgency to increase new, and fortify existing, protections for rivers in the years to come if we are to meet ambitious conservation targets, reverse the curve of biodiversity loss, and ensure that the benefits of healthy rivers are realized for all.

Effective Communication Strategies during the Construction and Operations of the Big Notch at the Fremont Weir

Presenting Author:	**Luke Olson,** California Department of Water Resources
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Session:	**Special Session 9 - Floodplains Forward: Aligning the Ecologies & Economies of Large River Valleys**

Abstract

The Yolo Bypass contains 59,000 acres of floodplain in the Central Valley and has supported many of California's native fish species, most notably the Chinook Salmon, Oncorhynchus tschawytscha and White Sturgeon, Acipenser transmontanus. To address the loss of ecological floodplain habitat from a century of constructed levees and weirs, the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project, also known as the Big Notch Project, creates a gated notch in the Fremont Weir to create a hydrologic connection between the Yolo Bypass and Sacramento River more frequently and for a longer duration. Given the diverse economic interests in land use within the Yolo Bypass — including farming, hunting, and recreation — transparent and effective communication between project management and landowners has proven to be a key part of Big Notch and other landscape-scale restoration efforts. This presentation will review the successful strategies the Big Notch Project team has utilized throughout construction and will share plans for upcoming communications as the project pivots to operations. Key communication ideas that will be shared in this presentation include sharing digestible information for all parties that relate ecological needs and changes to decisions on how the structure will operate.

Informing Floodplain Restoration through a Nationwide Assessment of High-Magnitude Streamflows

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Session:	**Special Session 3 - Restoring & Revitalizing Large Alluvial Rivers & Their Floodplains to Support Biodiversity & Multiple Goals**

Abstract

As interest in floodplain restoration grows among U.S. NGOs and water agencies, identifying rivers with suitable flow regimes is increasingly important. Successful restoration depends on high streamflow occurring at least once to twice a year and lasting several days to weeks to support sediment transport processes and hydrologic connectivity. To aid project planning, we developed a nationwide database of high-magnitude streamflow (HMF) characteristics, including volume, duration, frequency, and seasonality, at more than 4,200 U.S. Geological Survey stream gages across the continental U.S., using daily discharge records from 1990-2020. Annual HMF volumes above the 90th percentile ranged from 0.01 km³/year to 0.1 km³/year and were roughly half as large at the 95th percentile. Most 90th percentile HMF events lasted 4-15 days and occurred 3-8 times annually. Western U.S. and Florida gages exhibited longer average durations, up to 71 days, highlighting opportunities to spread low-intensity flows across floodplains. We illustrate regional differences in restoration potential through case studies and discuss how restoring floodplains over aquifers with groundwater stress, such as California's Central Valley, the High Plains, and the Mississippi River Alluvial, may also enhance groundwater recharge and dry-season baseflows.

Rivers of Food: rivers support one-third of global food production through their water, nutrients, sediment and habitat

Presenting Author:	**Jeff Opperman,** World Wildlife Fund
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Session:	**Special Session 5 - Revitalizing Community & Landscape by Connecting Rivers, People, & Science Through Field Experiences**

Abstract

By 2050, global food-production systems will need to feed 10 billion people. Rivers' importance for food production has long been recognized since the first civilizations emerged in river valleys. A single resource tends to dominate attention and policies focused on rivers and food: water for irrigation. However, rivers also support food production through their nutrients, sediment and habitat. Here we quantify global food production from rivers through: (1) irrigation; (2) fisheries, including from rivers but also from other habitats connected to rivers via flows of water, sediment and nutrients, including floodplains, wetlands, deltas and near-shore marine environments; (3) flood-recession agriculture, the planting of crops on floodplains as floodwaters recede; and (4) deltas that require continued deposition of sediment carried by rivers; these deltas are among the most productive agricultural regions on the planet. We found that rivers support nearly 1/3 of all global food production. Rivers' various food-production pathways can conflict with each other and with other uses of rivers (e.g., hydropower) and these pathways will be stressed by climate change. A holistic understanding of rivers as sources of food is key for ensuring their sustainable management and maintaining their role in food security, health and a sustainable food future.

From zero flow to a hundred CFS: Radon and other isotopic tracers explain groundwater-surface water interactions in a mountainous catchment

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Session:	**Special Session 2 - Groundwater-Surface Water Interactions in Riverine Landscapes Across Multiple Scales**

Abstract

Precipitation patterns in mountainous regions are becoming more variable, impacting storage and runoff, and increasing uncertainty in groundwater-surface water (GW-SW) interactions. We are studying Burney Creek in northern California, a headwater stream to the Sacramento River, that provides critical habitat for native fish. Given its simple hydrology, Burney Creek enables study of climate change effects on GW-SW interactions and hyporheic processes.

We conducted multi-season surveys along Burney Creek from the uppermost perennial, GW-fed reach to Burney Falls, where streamflow exceeded 100 cfs at baseflow. Radon-222 (222Rn) was used to quantify GW discharge by leveraging rock-water interaction properties and short half-life (3.8 days). Streamflow measurements were used to quantify flux. Tritium (3H) and sulfur-35 (35S) were used for GW age calculation, identifying input from decadal and current-year precipitation. Stable water isotopes were used to trace GW sources, noble gases to infer recharge elevation, and nutrients as an indicator of stream productivity. Across surveys, 222Rn activities varied between 2.1 ± 1.4 pCi/L to 392 ± 90.4 pCi/L, which aligned with increased GW discharge. Calculated 3H ages ranged from 14.8 to 31.3 years, with older ages during baseflow and younger during runoff. 35S was detected in spring samples, indicating same-year precipitation during runoff conditions. Nutrient concentrations increased with GW discharge, highlighting the importance of GW-fed streams for native fish. Our research findings suggest that same-year precipitation makes Burney Creek vulnerable to drought in the long-term, but its decades-old GW component may offer short-term resilience. This work demonstrates the utility of tracers in characterizing groundwater-dominated mountainous streams. This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344. LLNL-ABS-2005202.

Predicting in-stream microbial contamination using hydrological model

Presenting Author:	**Pramod Pandey,** University of California, Davis
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Session:	**Water Quality II - Contributed Session**

Abstract

In ambient water bodies such as rivers, increased level of bacterial pollution poses risks to animal and public health, and controlling it requires enhanced understanding of microbial transport at watershed scale. One of the major sources of these microbial contamination is considered to be livestock waste. E. coli present in manure can survive for extended period of time in environment, and when animal waste is used as a fertilizer, waste borne E. coli could reach to streams and rivers through overland transport processes. Further, in-stream processes such as resuspension and deposition influence bacterial contamination in stream bed sediment and stream water column. In this research, an extensive field study was conducted to monitor E. coli levels in stream water column and sediment. In addition, an in-stream bacteria transport model was developed to predict bacteria concentrations at watershed scale. The model was integrated with the soil and water assessment tool (SWAT) tool to determine in-stream bacteria concentrations in an agricultural watershed. We anticipate that the approach used here can help in improving existing understanding of bacteria transport from upstream to downstream reaches under different flow conditions.

Effects of Inundation Dynamics on Carbon Storage in Montane Headwater River Floodplains

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Session:	**Special Session 1 - Advances in Floodplain Science & Implications for Riverscape Resilience**

Abstract

Floodplains serve as carbon storage hotspots due to periodic inundation during flood events that support vegetation growth, nutrient rich sediments, and subsurface organic matter accumulation. Specifically, mountain stream floodplains store substantial amounts of soil organic carbon (SOC) relative to their watershed area. However, the relationship between inundation dynamics (e.g., inundation recurrence) and SOC content and stocks in floodplains is poorly understood.

This study aims to evaluate how inundation dynamics affect floodplain SOC in mountain headwater streams. We hypothesize that SOC accumulation will follow a non-linear response to floodplain inundation, with intermediate inundation recurrence intervals yielding the highest carbon storage. To test this hypothesis, we collected soil cores from four floodplains in the Colorado Rockies across a range of elevations that are slated for floodplain connectivity restoration. Our coring locations were chosen based on pre-selected elevation bins relative to the channel. In addition, we are developing hydrodynamic models of each stream corridor to quantify inundation patterns and link them to SOC distribution. Laboratory analysis of the soil cores to determine SOC content is underway, along with model development. We anticipate presenting preliminary results for one or more stream corridors highlighting the relationship between flow dynamics and SOC storage in floodplains.

Klamath River Chinook salmon juvenile outmigration survival modeling with time-varying environmental covariates

Presenting Author:	**Russell Perry,** United States Geological Survey, Western Fisheries Research Center
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Session:	**Special Session 8 - Science for a Changing Klamath River Following the World's Largest Dam Removal**

Abstract

Dam removal in the Klamath River has reconnected access to 675 km of potential spawning and rearing habitat for anadromous salmon populations. This in turn could alter future populations dynamics for juvenile salmon outmigration and survival. To better understand the baseline for current outmigration survival dynamics in the lower Klamath River, we conducted a survival analysis using detection data from acoustic-tagged juvenile Chinook salmon during outmigration seasons in 2022-2024. We developed space-for-time survival models with integrated travel times to evaluate the effects of time-varying environmental covariates on survival and migration rates throughout the lower Klamath River. Results of preliminary models had estimated mean daily survival rates between 0.95 and 0.99. We identified a strong relationship between water temperature and survival, with survival dropping significantly at high temperatures. Preliminary results also showed a strong temporal relationship for migration rates, with fish migrating faster as the season progressed. Future years of data collection will provide more information on the effects of environmental variables on survival and will also allow us to evaluate changes over time post- dam removal. In addition, survival and movement parameter estimates will be used to better inform population models used to evaluate habitat and water management actions.

Characterization of Current and Future Sediment Loading in the Petaluma River Watershed, CA

Presenting Author:	**David Peterson,** San Francisco Estuary Institute
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Session:	**Physical Processes - Contributed Session**

Abstract

Evaluating future streamflow and sediment loading in river systems is necessary for planning and managing for resilient watersheds and ecosystems. In this study of the Petaluma River watershed of California, we quantified the average annual sediment supply in a detailed, field-based sediment source assessment and used a hydrological model to estimate possible changes in streamflow and sediment loading based on four future climate projections.

Over the past several decades, the average annual sediment supply from the Petaluma River watershed to the channel network is estimated to be approximately 59,000 t/yr, equivalent to an average annual sediment yield of approximately 185 t/km2/yr, similar to estimates for other watersheds in the region. For future climate projections, we found that streamflow and sediment loading is projected to change dramatically in some areas of the watershed for certain models. Changes in average daily streamflow ranged from -20% to +20% in mid-century and -12% to +60% by end-of-century. Changes in average annual sediment load ranged from -45% to +125% in mid-century, and -18% to more than +250% by end-of-century. These results will help inform adaptive management for watershed resilience by identifying areas of increasing erosion and sediment supply.

Managed Retreat in the Context of Flood Mitigation, Floodplain Connectivity, and Climate Change

Presenting Author:	**Nicholas Pinter,** University of California
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Session:	**Special Session 1 - Advances in Floodplain Science & Implications for Riverscape Resilience**

Abstract

In a world of increasing flood magnitudes and frequencies on many rivers, one response has been the Netherland's "Room for the River" policy, with other countries aspiring to that goal. In addition to mitigating flood damages, a Room for the River approach helps to protect and restore the hydrologic and ecological connectivity of floodplains. Society – and high-income societies in particular – struggle with accommodation of natural processes, but so-called "managed retreat" from floodplains has been implemented for more than a century, including at least 25 examples worldwide of wholesale community relocations. The number is significantly high when studies include other, non-floodplain relocations, which provide broader and highly relevant lessons learned. Implementing these relocations is challenging, often politically fraught, and more expensive than simply rebuilding in place after a flood disaster, but managed retreat can provide a permanent solution to repetitive flooding as well as providing a host of potential add-on benefits to streams, floodplain, and other aquatic ecosystems. Managed retreat has been framed as the future of climate-change adaptation, although it is unclear how much relocation can be scaled up. But both successful and unsuccessful retreat projects provide lessons learned for addressing the broad range of future climate threats.

Quantifying primary production exports from tidal wetlands in the San Francisco estuary

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Session:	**Special Session 12 - Advances in Bar-built Estuary Research: Physiochemical, Ecological & Management Perspectives**

Abstract

The highly altered upper San Francisco Estuary (SFE) lies at the confluence of the Sacramento and San Joaquin Rivers, where severe declines in phytoplankton production have been linked with a collapse of the pelagic food web, threatening populations of native fishes. Regional authorities are pursuing tidal wetland restoration as a tool to help mitigate these declines, with the assumption that increased shallow-water habitat area will augment pelagic production. However, production exports from tidal wetland sites have yet to be quantified. We seek to assess the pelagic production flux between four SFE tidal wetlands and their adjoining waterways over the course of a tidal cycle. At the breaches of three restored and one reference wetland site, we collected water grabs throughout the flood-ebb cycle 2-4 times per tide, per site. Nutrients, organic matter, chlorophyll a, and other water quality parameters were sampled concurrently. We then conducted oxygen depletion incubations to estimate net primary production (NPP), gross primary production (GPP), and community respiration (R) at each sampling event. Preliminary data reveal notable differences in NPP and GPP between flood and ebb tide, though the directionality and magnitude of these differences vary by site and season. This study will improve scientific understanding of tidal ecosystem metabolism, and offer key insights into restored wetland function within the SFE.

Tidal marsh restoration in the Sacramento-San Joaquin River Delta

Presenting Author:	**Lyndsay Rankin,** United States Geological Survey
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Session:	**Water Quality II - Contributed Session**

Abstract

The Sacramento-San Joaquin River Delta supplies fresh water to millions of acres of farmland and two-thirds of California's population. Fresh water from the Delta mixes with saltwater from the San Francisco Bay forming the largest estuary on the Pacific Coast. It is an extensive agriculture, recreation, and species rich habitat that is threatened by changes in freshwater availability, flooding, sea level rise, and invasive species. Located at the confluence of the Sacramento and San Joaquin Rivers, Dutch Slough was purchase by the CA Department of Water Resources in 2003. The restoration from agriculture land to a tidal marsh was designed to provide habitat for native species, contribute to scientific understanding of ecological restoration under an adaptive management framework, and provide shoreline access and educational opportunities. After extensive planning, site engineering, and native vegetation planting, the restoration was breached to tidal waters in 2021. Our team monitored marsh development and ecosystem function by assessing geomorphic processes, water quality, plant community response, and carbon sequestration/cycling. We documented variable changes in marsh elevation based on the geomorphic structure of the site as well as expansion of native marsh vegetation. Water quality monitoring continues to record tidal influence in water level, salinity, and temperature. Greenhouse gas emissions varied spatially and temporally across the site. Seasonal carbon flux patterns were more similar to reference tidal marshes compared to pasture and impounded lands. Lower elevation areas recorded greater CO2 uptake while mid elevation areas recorded greater methane emissions one year following the breach, mirroring vegetation coverage at the different elevations. Site design and vegetation planting resulted in net positive carbon uptake across the site. Dutch Slough is continuously monitored as a living laboratory and used to inform future restoration in the Delta.

Caps and Floors: Developing site-specific percent-of-flow diversion rates and flow thresholds for risk-informed, holistic environmental flow management

Presenting Author:	**Suzanne Rhoades,** Applied River Sciences
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Session:	**Special Session 7 - Advancing Environmental Flow Management: Holistic Approaches for Sustaining Aquatic Ecosystems**

Abstract

Holistic environmental flow management requires balancing environmental and anthropogenic needs. We present a framework for modifying the natural hydrograph for consumptive uses that reduces risk to ecological processes and protects functional flows. We developed flow recommendations using flow-ecology models in several watersheds throughout Northern California to represent habitat for focal salmonid species at different life stages (e.g., spawning adults) and behaviors (e.g., profitable drift foraging). We then developed acceptable diversion caps, as a percent-of-unimpaired flow (POF), that protects the habitat amount within an acceptable range, depending on risk tolerance, compared to that under unimpaired conditions. For example, we identified POF rates between 8-30% that maintain > 90% of unimpaired habitat for select salmonid species and life stages per site. Lower allowable POF rates were typically observed in the lower-flow months. These site-specific POF diversion rates protect known ecological functions, as well as other aspects of the hydrograph (e.g., fall pulse flows), and could be used regionally to provide protection in across streams. Finally, the addition of a seasonal flow threshold, or floor, where all diversions cease, can be an additional level of protection to maintain important known flow-dependent ecological functions.

A Quarter Century of Monitoring Demonstrates the Long-Term Impact of Riparian Restoration on the Breeding Bird Community in California's Lower Putah Creek Watershed

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Session:	**Special Session 3 - Restoring & Revitalizing Large Alluvial Rivers & Their Floodplains to Support Biodiversity & Multiple Goals**

Abstract

Restoration of riparian ecosystems is a priority for conservation in California's Central Valley, where rivers and floodplains provide critical habitat and essential ecosystem services within a highly modified agricultural landscape. Yet few studies have quantified long-term wildlife responses to these restoration efforts. Here, we present findings from 26 years of breeding bird monitoring along the lower Putah Creek watershed following implementation of the 2000 Putah Creek Accord, a landmark agreement to improve instream flows and ecosystem management. Annual point count surveys at eight to 14 sites from 1999–2024 reveal sustained, multi-decadal changes in the breeding bird community. Our analysis documents four distinct population trajectories among native riparian and woodland-associated species: (1) several species continue to increase as riparian habitat quality improves; (2) some species peaked in abundance 10–15 years post-restoration and have since declined as vegetation matured and early-successional habitat diminished; (3) others reached stable upper limits and maintained consistent populations; and (4) a subset have declined in conjunction with broader regional trends. These long-term patterns underscore the value of sustained, site-based monitoring in capturing dynamic, species-specific responses to restoration and demonstrate how coordinated riparian management can support native biodiversity while contributing to multiple ecological and social values in California's working landscapes.

A collaborative, interdisciplinary, multi-course approach to river water quality monitoring

Presenting Author:	**Chelsie Romulo,** University of Northern Colorado
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Session:	**Special Session 5 - Revitalizing Community & Landscape by Connecting Rivers, People, & Science Through Field Experiences**

Abstract

The Colorado River Watch program is a statewide volunteer water-quality monitoring program where river steward groups manage data collection and initial analysis along rivers. The Geography and Sustainability, Earth Sciences, and Chemistry departments of the University of Northern Colorado (UNCO) recently revived an abandoned monitoring site in Greeley, CO along the Cache la Poudre River. This case study demonstrates how multiple departments at the same institution can collaborate to manage a water-quality monitoring site to build unique skills among students in different courses and majors as well as support interdisciplinary collaboration and research. So far, one course in each program includes the monthly water quality activities as required field excursions and three students have become river monitoring leaders for independent research projects. This program forms the foundation for the new River Studies and Leadership certificate offered in collaboration with the River Management Society at UNCO. Students have expressed increased interest in river stewardship and science and the program also supports a City of Greeley river restoration initiative to develop river access such that the river provides some of the original ecological structure an function that has been lost as well as acts as a community anchor for our city.

The River Field Studies Network: Connecting Rivers, People, & Science through Immersive Field Education

Presenting Author:	**Andy Rost,** University of Nevada
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Session:	**Special Session 5 - Revitalizing Community & Landscape by Connecting Rivers, People, & Science Through Field Experiences**

Abstract

The River Field Studies Network, a National Science Foundation funded project, connects rivers, people, and science through immersive field education. The network coalesced around the central idea that field education in, on, and around rivers creates transformational experiences that address the paired challenges of conserving imperiled river ecosystems and training the next generation of river scientists. Our flagship offering, The River Scholars Program, is a one-year training cycle designed to increase instructors' ability to teach in the field, manage river field safety, increase outdoor skills, scale river lessons to river field courses, and build a greater sense of belonging. The scholar program culminates in the publication of open-source river field education lessons developed by the River Scholars. To date, we have hosted five River Rendezvous, graduated three cohorts of River Scholars, contributed to the development of new river field courses, and supported the publication of 26 open-source river field education lessons that, collectively, have been viewed and downloaded over fifteen thousand times. As we approach the end of our NSF funding, we are excited to expand our current collaborations, develop future partnerships and build a sustainable future for river field education to promote healthy river and human ecosystems.

Mapping Opportunities to Implement Nature-Based Solutions for Aquifer Recharge in the Western US

Presenting Author:	**Claire Ruffing,** The Nature Conservancy
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Session:	**Special Session 2 - Groundwater-Surface Water Interactions in Riverine Landscapes Across Multiple Scales**

Abstract

There is an urgent need to improve the resilience and sustainability of water resources in the western United States. With surface water resources nearly fully allocated in many western states, water users are turning to groundwater to fulfill their water supply needs. Natural aquifer recharge projects for storing excess runoff and flood flows can benefit surface water-to-groundwater interactions by slowing and spreading water as it moves across the landscape thereby allowing more time for subsurface percolation, aquifer recharge and in many cases, important ecological co-benefits. These projects provide an opportunity to enhance water supplies, increase drought resilience, and improve ecosystem conditions but more work is needed to understand where and how these projects should be implemented in order to gain the maximum benefits for people and nature. This project uses a GIS-based multi-criteria decision making model to identify optimal locations where the physical and hydrological conditions are most likely to facilitate groundwater recharge across the western U.S. This study provides a spatially explicit prioritization framework for aquifer recharge project planning that includes conceptual linkages for maximizing ecological benefits such as cold water refugia, habitat connectivity, and instream flow protection.

Reviving Dormant Salmon Life Histories Through Reintroduction to Spring-Fed Habitat & Tribal–Western Science Partnership

Presenting Author:	**Rachael Ryan,** University of California Davis
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Session:	**Special Session 5 - Revitalizing Community & Landscape by Connecting Rivers, People, & Science Through Field Experiences**

Abstract

Sacramento River Winter-run Chinook salmon are a critically endangered species, found only in California's Sacramento River watershed. These salmon(nur) co-evolved with the Winnemem Wintu peoples in the cold, spring-fed, high elevation waters of the Winnemem Waywaket(McCloud River). However, for over 70 years, Shasta Dam has blocked their access to these ancestral habitats, confining them to the warmer valley floor of the Sacramento River, where they have struggled to persist. In response to their

looming extinction, a collaborative effort to reintroduce Winter-run back to spring-fed waters above the dam was launched in 2022. This partnership is led by the Winnemem Wintu, California Department of Fish and Wildlife, and NOAA Fisheries. Now entering its fourth season, we present how Western science and innovative monitoring techniques, and traditional Tribal knowledge can work in alignment to support recovery. Innovative methods - designed to minimize harm to fish and honor Winnemem values - have allowed us to track increasing diversity in the salmon's size and timing of outmigration, including extended periods of in-river rearing. These findings suggest a

"reawakening" of life history strategies dormant or suppressed on the valley floor. Such findings are helping to guide reintroduction strategies towards reunifying nur with the Winnemem Waywaket under the stewardship of the Winnemem Wintu people once more.

Spatiotemporal dynamics of surface water extent across Nepal's major river basins

Presenting Author:	**Sara Sayedi,** William & Mary
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Session:	**Special Session 3 - Restoring & Revitalizing Large Alluvial Rivers & Their Floodplains to Support Biodiversity & Multiple Goals**

Abstract

Nepal's river systems, critical for sustaining agriculture, ecosystems, and drinking water supply, are under mounting pressure from climatic and anthropogenic stressors. Despite their central role in supporting dry-season water availability, perennial rivers are increasingly at risk of reduced flow due to rising temperatures, altered precipitation regimes, upstream hydropower infrastructure, and intensifying irrigation demands. Yet, there remains limited empirical evidence quantifying long-term surface water trends across diverse river systems. This study analyzes spatiotemporal changes in surface water extent across nine major river basins in Nepal from 1990 to 2024, with a focus on dry seasons when water scarcity is most acute. Using monthly Landsat composites and a Random Forest classifier, we generated 30-meter resolution water maps. Trend analysis and group comparison models were applied to evaluate differences across basins and between glacial-fed and groundwater-fed systems. The analysis revealed heterogeneous trends: groundwater-fed rivers showed statistically significant dry-season declines, while glacial-fed systems remained more stable. Our results highlight the vulnerability of Nepal's river systems and identify critical seasonal windows for targeted conservation of water resources. These findings underscore the need for urgent investments in dry-season flow monitoring, aquifer recharge, and catchment-scale water conservation strategies.

Drivers of wood loads and temporary storage in headwater streams following catastrophic blowdown

Presenting Author:	**Juli Scamardo,** Utah State University
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Session:	**Disturbance & River Dynamics - Contributed Session**

Abstract

Forest blowdown, or the widespread felling and snapping of trees due to high wind speeds, can substantially increase the amount of downed large wood (LW) on the landscape. Despite high recruitment potential, few studies have investigated the influence of blowdown on in-channel LW volumes and the subsequent capacity for sediment and water storage. In June 2021, a frontal storm caused widespread blowdown across parts of southeastern Australia, creating an opportunity to better understand interactions between landscape morphology, blowdown intensity, large wood recruitment, and in-channel hydrogeomorphic changes. Blowdown area and density (trees per unit area) were mapped remotely across the Wombat State Forest, Victoria, and paired with field-based measurements of in-channel LW and associated sediment and water storage in the Lerdederg River and tributaries. Study reaches were characterized by a range of hillslope gradients, aspects, blowdown intensity, and channel and floodplain widths. Eleven percent of the WSF area was blown down by the June 2021 storm, with winds that exceeded 100 km/hr from a non-typical direction. The blowdown event was the dominant source of in-channel LW, delivering 88% of the volume. LW volumes were more influenced by valley morphology, particularly valley bottom width, than blowdown characteristics (area or density. Most LW (85% by volume) accumulated in porous jams, and about 33% of LW stored sediment and/or water, with storage more likely behind pieces that touched the channel bed. Catastrophic blowdowns like the June 2021 storm could significantly impact the wood regime and morphology of forested, headwater channels, particularly as extreme wind events are expected to increase in magnitude and severity in the future.

Sediment transport under changing supply conditions during reservoir drawdown and removal of four large Klamath River dams

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Session:	**Special Session 8 - Science for a Changing Klamath River Following the World's Largest Dam Removal**

Abstract

The removal of four dams on the mainstem Klamath River in Oregon and California, USA, has presented novel suspended-sediment transport conditions by giving the river access to sediment accumulating in the reservoirs since 1918. Turbidity monitoring and suspended-sediment concentration (SSC) sampling were conducted before, during, and after the dam removals as part of an inter-agency collaborative effort that included the Klamath River Renewal Corporation, Resource Environmental Solutions, the Karuk and Yurok tribes in California, and the U.S. Geological Survey (USGS). These data were used to generate ordinary-least-squares regression models to compute time series of SSC and suspended-sediment loads at six mainstem USGS streamgages spanning 300 river kilometers downstream of the former dam sites. The reservoir drawdowns prior to dam removal introduced large amounts of fine-grained sediment into the coarse-grained river corridor causing elevated turbidity and SSC exceeding 20,000 mg/L. Multiple stages of the dam removal process, including reservoir drawdown, geomorphic flows for sediment mobilization, and the breach of historic cofferdams, resulted in dynamic sediment-transport conditions exhibiting supply-limitation driven hysteresis patterns. This work provides insight into differences between fine-sediment transport related to dam removal and natural sediment transport events.

Salmon-thing Special: Monitoring Salmonid Growth, Residence Time, and Predation at a Large-Scale Rearing Habitat Restoration Project on the Yuba River

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Session:	**Fish Conservation & Management - Contributed Session**

Abstract

Beginning with the Gold Rush, anthropogenic actions have reduced and degraded juvenile salmonid habitat on the Lower Yuba River. The Hallwood Side Channel and Floodplain Restoration Project, completed in fall 2023, enhanced ecosystem processes for juvenile fall and spring-run Chinook salmon and California Central Valley steelhead. The Project increased inundation frequency and duration during the rearing period in a network of perennially and seasonally inundated side channels, removed unnatural constraints between main channel and floodplain areas, and reduced predator habitat. The Project included a robust monitoring program that measured the effect of restoration on a range of ecological parameters. A central feature of this program was a rearing and growth study of tagged juvenile Chinook salmon, which included components to investigate salmonid predation and diet. Salmon rearing at the Project site displayed longer and more diverse residence times relative to an unrestored backwater control site and more diverse prey composition relative to fish rearing in the main channel. Seine surveys documented a dramatic reduction in potential predation at the Project site, with no piscivorous species observed post-implementation. This multi-stakeholder collaborative project achieved large-scale river restoration and generated a wealth of data to document positive ecological outcomes for juvenile salmonids.

How do we know if a project is a multibenefit project? Evaluating the effectiveness of the IUCN Global Standard

Presenting Author:	**Anna Serra-Llobet,** University of California Berkeley
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Session:	**Special Session 1 - Advances in Floodplain Science & Implications for Riverscape Resilience**

Abstract

As the benefits of floods (e.g., habitat, groundwater recharge, etc.) and the need for more adaptive systems for flood risk management are more widely recognized, policies are now being adopted worldwide to encourage multibenefit projects to reduce flood risks and restore floodplain ecosystems at the same time. But how do we know if a project is archiving these multiple goals? We have applied the Global Standard develop by the International Union for the Conservation of Nature to the Johnson Creek Restoration Project to see if the project undertaken by the city of Portland is good example of nature-based solution/multibenefit project. In this presentation we will explain the limitations of the Global Standard and we will propose some recommendations for improvement.

Place Based Paddling: Experiential Learning for a Secure Water Future

Presenting Author:	**Jack Severson,** UC Merced
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Session:	**Special Session 5 - Revitalizing Community & Landscape by Connecting Rivers, People, & Science Through Field Experiences**

Abstract

Rivers are the world's great connectors—linking the highest mountain peaks to the deepest ocean basins, all while weaving together landscapes, ecosystems, and communities. As environmental, social, legal, and economic pressures on freshwater systems intensify, the call for thoughtful, collaborative water leadership grows ever pressing. At a critical juncture for water systems and society, we present the successes of the Climate Adaptation Science Academy Experiential Learning Expedition program. Embracing the connective spirit of rivers, CASA ELE convenes an interdisciplinary cohort of graduate students from across California, Utah, and New Mexico for a week-long experiential learning expedition addressing climate adaptation science in real time. Participants explore a selected watershed through facilitated discussions, site visits, and a multi-day whitewater rafting trip down a Western river. Along the way, they engage with scientists, resource managers, Tribal leaders, and one another—developing both a systems-level understanding of water challenges and the interpersonal skills essential for team-based science. This immersive program fosters lasting connections with mentors, professionals, peers, and the river itself. We highlight CASA ELE as an immersive, place-based learning model worth replicating and expanding to meet the growing need for collaborative water leadership across watersheds globally.

The State of America's Floodplains: Making the case for functional floodplains as a vital national resource

Presenting Author:	**Eileen Shader,** American Rivers
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Session:	**Special Session 1 - Advances in Floodplain Science & Implications for Riverscape Resilience**

Abstract

Floodplains are among the most productive and biodiverse ecosystems on the planet and provide myriad benefits to humans including flood reduction, groundwater storage, and nutrient and sediment retention. However, floodplains and their functions are threatened by human actions like construction of levees and dams, agricultural land use and urbanization. In 2023, the Natural Floodplain Functions Alliance and Wetlands Mapping Consortium identified the need for a national geospatial dataset to track floodplain integrity to promote floodplain conservation. American Rivers and Conservation Science Partners have developed the National Floodplain Assessment of the United States, a data-driven nationwide inventory of present-day floodplain protection status and floodplain integrity. The assessment reveals that approximately 15% of floodplain area in the contiguous U.S. and 20% across the entire U.S. are currently intended for protection by at least one mechanism, and more than 90% of floodplains in the contiguous U.S. and 70% across the entire U.S. are subject to some degree of compromised lateral and longitudinal connectivity and/or habitat alteration. This presentation will describe the National Floodplain Assessment methodology and results, the Floodplain Explorer webtool, and how this data is being utilized to advocate for decision-makers to protect and restore floodplains and their critical functions.

Combined Effects of Reintroduced Megafauna and Hydrological Regime Shift on Floodplain Vegetation Dynamics

Presenting Author:	**Dongdong Shao,** Beijing Normal University
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Session:	**Special Session 3 - Restoring & Revitalizing Large Alluvial Rivers & Their Floodplains to Support Biodiversity & Multiple Goals**

Abstract

Megafauna reintroduction is increasingly considered as an option for ecological restoration, yet it remains unclear how these initiatives influence floodplain vegetation communities, particularly when combined with concurrent hydrological regime shift. In this study, the joint impact of reintroduced megafauna and hydrological regime shift on the distribution and growth of floodplain vegetation communities were evaluated using decadal observational data collected at the Milu (Elaphurus davidianus) reintroduction floodplain site in Hubei Shishou Milu National Nature Reserve, China. The training sample migration method and random forest classifier were applied to time-series Landsat images to produce annual 30 m vegetation maps, i.e. Carex spp. (hygrophyte), Phragmites australis (hygrophyte), Xanthium mongolicum (xerophyte) and forest, of the study area during 1993-2023. Time-series annual maximum NDVI of each vegetation type were calculated as an indicator to represent growth status. Annual variation in Milu population and three hydrological indices, i.e., inundation depth, frequency and duration, were collected to assess their combined effects on vegetation dynamics through the generalized linear mixed model (GLMM). The results showed that vegetation communities with varying adaptation to hydrological regime shift responded differently to Milu reintroduction. Overall, the growth of hygrophytes was significantly reduced. The hydrological regime shift had a more profound impact on the distribution of vegetation communities, where the reduction in duration and frequency of floodplain inundation is the best predictor of the increase in cover of xerophytes. These findings deepen our understanding of the ecological consequence of megafauna reintroduction in floodplain wetlands, and have important implications for the management of these initiatives under growing environmental changes.

Three years of joint learning in reuniting winter run Chinook salmon (nur) to their ancestral waters

Presenting Author:	**Marine Sisk,** Winnnemem Wintu
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Session:	**Special Session 5 - Revitalizing Community & Landscape by Connecting Rivers, People, & Science Through Field Experiences**

Abstract

Construction of Shasta Dam flooded Winnemem Wintu villages and sacred ceremonial sites displacing the Tribe and their Nur (Chinook salmon) from the cold life sustaining waters of the Winnemem Waywaket (McCloud River, CA USA) where they had lived synergistically since time immemorial. In 2022, Sacramento River winter run Chinook salmon faced the third year of a consecutive drought and concerns of their extinction on the valley floor catalyzed action to reunite eyed eggs to their ancestral waters on the Winnemem Waywaket. California Department of Fish and Wildlife, NOAA Fisheries, US Fish and Wildlife Service, Department of Water Resources, US Forest Service, University of California, and the Winnemem Wintu Tribe worked together to establish a genetically diverse founding population, welcomed the salmon home through ceremony, cared for embryos in stream side incubators, collected downstream juvenile migrants, and transported them downstream of Shasta and Keswick dams to continue their journey to the ocean. In 2025, we welcomed home our first Winnemem Waywaket-imprinted adult in 70 years! Here, we will discuss the evolution of project implementation, lessons learned, as well as the science, monitoring, and modeling frameworks for the effort. The success of this effort, diverse perspectives, and strengthening partnerships provides newfound hope for the reestablishment of nur and Winnemem Wintu strongholds in the Winnemem Waywaket critical to the recovery of California salmon in the climate future.

Factors controlling the formation of the Congaree River floodplain (South Carolina, USA): implications for floodplain restoration

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Session:	**Special Session 1 - Advances in Floodplain Science & Implications for Riverscape Resilience**

Abstract

We aimed to determine the natural and anthropogenic factors controlling the evolution of the Congaree River floodplain (South Carolina), and apply this knowledge for restoration purposes. Field research was based on geological and geophysical methods, geochemical analyses, sediment dating, and analysis of aerial images and historical maps. We identified the following types of palaeochannels recorded in the floodplain deposits:

- large-scale meanders formed between 16,000 and 12,000 cal. BP by climate warming and dense vegetation cover
- meanders shifting by avulsions between 12,000 and 3,000 cal. BP influenced by base-level rise and increased flood frequency
- compound meanders active during the last 3,000 years in relatively drier climate conditions
- floodplain deposition during the last >200 years caused by deforestation of the Piedmont. The legacy sediments were marked by increased concentrations of Rare Earth Elements, heavy metals, Rb, K, P, and Na.

We used this reconstruction to create a framework describing past and modern processes forming the floodplain. The aim is to increase the awareness of environmental managers, which processes are possible to be restored, and which are not. This knowledge is important in floodplains, where the sedimentary record of natural processes is overprinted by human-induced floodplain formation.

A Method to Implement Natural Flow Regimes for Regulated Rivers

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Session:	**Special Session 7 - Advancing Environmental Flow Management: Holistic Approaches for Sustaining Aquatic Ecosystems**

Abstract

Rivers and streams throughout the world have been dammed for flood control, irrigation, hydropower, and water storage for centuries. Dams service the economic and development needs of societies well, but continue to degrade the ecology of rivers, aquatic species, and the habitats upon which they depend. In order to conserve dwindling aquatic species and their habitats in dammed rivers, methods are needed to help river managers and dam operators implement flow releases at timescales and in patterns that are ecologically relevant. We present a method to synchronize flow releases from dams with changes in local hydrology, while staying within predefined constraints of flood control, water allocations and regulatory constraints. We demonstrate a penalized optimization technique that estimates parameters to scale the flow of a proximal unregulated river system, resulting in simulated dam releases that are synchronized with natural hydrologic patterns. This real time management (RTM) technique can be used at a variety of timescales, from hourly to monthly and can incorporate many system-specific constraints. We used the Trinity River, California as an example, and scale flows according to a proximal gage on the Salmon River. We calculated metrics including correlation with nearby unimpaired rivers, coefficient of variation (CV), Richardson-Baker flashiness index (RBI), and Baseflow Index (BFI). Our method produced hydrographs with greater flow variation throughout a larger portion of the water year than current management strategies, while yielding metrics similar to those calculated from unimpaired flow patterns. We also suggest a preferred method for calculating CV when evaluating natural flow regimes and planned releases from dams. The RTM framework is a new tool that can be implemented by river managers to achieve variation in dam releases that more closely approximate natural variation while achieving synchronicity with unimpaired river systems.

Fish Habitat and Morphological Response to Multiple Ecological Floods in a Regulated Alpine River

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Session:	**Special Session 7 - Advancing Environmental Flow Management: Holistic Approaches for Sustaining Aquatic Ecosystems**

Abstract

Ecological floods, or e-floods, have emerged as a promising river restoration strategy to mitigate the impacts of dam regulation on downstream ecosystems. However, their effectiveness in restoring habitat quality—particularly in morphologically altered alpine systems—remains site-specific and requires precise assessment. In this study, we investigate the morphological and mesohabitat dynamics induced by five ecological floods of varying peak and duration in the lower Spöl River (Switzerland), a regulated alpine river subject to an annual e-flood program since 2000. The study reach, located downstream of the Ova Spin dam, is heavily influenced by sediment inputs from the unregulated Ova da Cluozza tributary, which delivers large volumes of poorly sorted material that the regulated mainstem often fails to transport. To evaluate e-flood impacts on river morphology and habitat suitability for brown trout (Salmo trutta), we conducted pre- and post-flood mesohabitat surveys in 2018, 2019, 2023, 2024, and 2025, analyzing changes in water depth, velocity, and substrate. We also assessed long-term morphological evolution using aerial imagery and high-resolution terrain data. Results indicate that habitat suitability in the lower Spöl remains low, with adult-suitable habitat rarely exceeding 10–15% of the wetted area and juvenile suitability often close to zero, mainly due to the channel's inability to transport excess gravel. Across all years, e-floods induced only minor changes in flow and velocity distributions, leading to negligible mesohabitat improvements. In contrast, significant morphological changes occurred locally, including river widening and bed aggradation exceeding 2 meters. These are likely driven by sediment wave propagation from the Cluozza and the limited sediment transport capacity of e-floods. We argue that the limited habitat response is due to poor substrate sorting, aggradation, low hydraulic variability, and limited morphological heterogeneity.

Links between governance and riparian restoration to improve water quality in the Nooksack River watershed, Washington State USA – British Columbia, Canada.

Presenting Author:	**Amanda Stahl,** Washington State University
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Session:	**Special Session 4 - Data to Decision: Who Governs Ecological Monitoring of the River Commons?**

Abstract

In the US Pacific Northwest, various policies promote riparian buffers to improve salmon habitat and nutrient management, with co-benefits for human health and ecosystem services. However, piecemeal governance of buffer implementation and monitoring complicates watershed-scale evaluation; at a given location, individuals, nongovernmental organizations, and local, state, federal and Tribal governmental organizations may be involved. Understanding this complexity is essential for determining buffer effectiveness and prioritizing future actions or incentives. The Nooksack River watershed and Bellingham Bay in northwestern Washington face water quality issues in surface and groundwater, making it a useful case to illustrate the complexity of governance for riparian buffers. We mapped 15 sources of governance capacity across the watershed and then overlaid a map of existing woody riparian buffers (from airborne LiDAR) to categorize areas of high versus low capacity and presence versus absence of buffers. Montane areas have larger contiguous areas with existing buffers and high policy ranking, related to fish and forestry practices. However, most of the nutrient inputs occur in agricultural regions of the lower watershed, where buffers are narrow and patchy regardless of policy ranking. These maps can support monitoring to evaluate buffer effectiveness and highlight key areas to prioritize for improved outcomes.

Using functional flows to assess streamflow alteration

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Session:	**Special Session 7 - Advancing Environmental Flow Management: Holistic Approaches for Sustaining Aquatic Ecosystems**

Abstract

Environmental flows are needed to represent ecosystem need for water and help balance water use for human activities and ecosystem functions. However, environmental flows management is often hampered by a lack of data that characterizes existing alteration. To represent ecosystem needs, the California Environmental Flows Framework (CEFF) identifies 5 functional flows and calculates metrics that quantify the natural ranges for each flow based on observed gage data. Additionally, we developed a model that reports predicted natural functional flow metrics for all streams. Next we need to understand existing conditions, which are only known in gaged locations. To better understand actual flows and alteration, we modeled daily streamflow across California at the reach scale for a 20-year period (2000-2020) using a long short-term memory neural network model. First, we compared the modeled daily outputs to gages with minimally disturbed and disturbed conditions across a range of water year types (wet and dry) to assess model performance. We then used the daily dataset to calculate functional flow metrics and compared our results to the predicted natural flows database to assess patterns in flow alteration. Functional flows metrics can be used to identify ecologically meaningful flow alteration patterns and to prioritize effort.

Managing the managed: A case study on the utilization of a flood protection bypass habitat for the benefit of ecosystem and society

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Session:	**Special Session 3 - Restoring & Revitalizing Large Alluvial Rivers & Their Floodplains to Support Biodiversity & Multiple Goals**

Abstract

In the Central Valley of California, the Sacramento River used to have expansive floodplains that inundated a large portion of the valley. This created fertile alluvial soils, attracting settlers to drain the swamplands to cultivate the land and establish cities. The levee system along Sacramento River was created for this purpose, including flood bypasses (i.e., Yolo Bypass and Sutter Bypass) that act as flood protection during high flow. Flood bypass structures were designed to protect communities and agricultural lands. However, they also represent floodplain habitat remnants, providing essential ecosystem services. Sutter Bypass, an 7284 ha floodway extending from Colusa, California to the Yolo Bypass near Knights Landing, California, is one such area. Since 2019, we've conducted research to characterize food web production and habitat use of the Sutter Bypass floodplain by juvenile Chinook Salmon (Oncorhynchus tshawytscha). This includes elucidating how physical processes via flooding a managed floodway can support a productive and biodiverse river ecosystem. Currently, we are assessing flooded agriculture and managed wetland habitat contributions to rearing habitat for juvenile Chinook salmon. These data help water managers enhance multi-benefit systems that strive to meet the needs of both the ecosystem and local communities.

Regional Temperature-Response Relationships Help Inform Urban River Management in a Changing Climate

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Session:	**Water Quality I - Contributed Session**

Abstract

Aquatic communities are sensitive to temperature fluctuations, with deviation from optimal ranges adversely affecting ecological health, directly or indirectly, through temperature mediated changes in water quality. Compounding this, flow alterations due to natural or anthropogenic factors further influence stream temperature, increasing the impacts on aquatic biota. In semi-arid, urban environments, such as southern California, these factors are particularly pronounced with shallow depths, high ambient temperatures and warm discharges (associated with stormwater or wastewater effluent). To support decision-making around flow and temperature management we developed regional relationships between biological indices based on benthic macroinvertebrates and algae (as measures of ecological health) and temperature. Using boosted regression trees, we identified important predictor variables and temperature metrics. We then applied logistic regression to develop regional temperature-ecology response curves aligned with biological condition thresholds. Our results indicate that healthy biological condition can be supported with maximum weekly temperatures ranging from 82 □F to 87□F (28o-31oC). We focused on maximum weekly temperature due to its relevancy to regulatory requirements and proposed management actions. These response curves are now being used by managers to identify temperature sensitive locations and assess the degree of temperature control necessary to achieve healthy biological conditions in light of current and future expected climatic conditions.

A European-wide efficacy assessment of river restoration for fish

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Session:	**Special Session 3 - Restoring & Revitalizing Large Alluvial Rivers & Their Floodplains to Support Biodiversity & Multiple Goals**

Abstract

River restoration initiatives are widespread across Europe, yet their benefits for fish communities often remain uncertain. Many projects struggle to meet ecological targets, raising questions on their overall efficacy. We compiled fish community and environmental data from 560 restoration sites in 44 rivers across 12 European countries (2000–2023), covering floodplain reconnection, shoreline restoration and by-pass channels. We related juvenile fish community metrics to local habitat and water-quality parameters (e.g., depth, substratum size, dissolved oxygen, habitat heterogeneity), restoration type and age, and landscape factors (e.g., land use, population density, barrier proximity). Our results indicate that small-scale physical habitat restoration led to increases in local richness and abundance, especially in projects older than five years. However, landscape-scale drivers exert a stronger influence on the recovery of regional diversity patterns and functional trait composition. Proximity to barriers limits migratory and flow-preferring species, with unaltered or enhanced connectivity delivering clear benefits. These findings underscore that successful restoration depends not only on "how" habitats are restored but also on "where" interventions occur. We recommend coupling targeted local habitat measures with basin-scale planning (minimizing urban pressures, leveraging suitable land-use settings and prioritizing barrier removal) to maximize fish biodiversity gains and support the EU Water Framework Directive and Nature Restoration Regulation.

Salmonid movement between a leveed, bar-built estuary and upstream habitat in old-growth redwood forest

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Session:	**Special Session 12 - Advances in Bar-built Estuary Research: Physiochemical, Ecological & Management Perspectives**

Abstract

Flexible life history strategies enable salmonids to capitalize on seasonally favorable food availability and habitat conditions at different locations throughout a watershed. Habitat conditions in bar-built estuaries are particularly variable throughout the year, with important implications for the growth and survival of salmonid species that use these habitats. Levee construction in Northern California's Redwood Creek has reduced the size and complexity of estuarine habitats, potentially increasing the rate and magnitude of seasonal changes from productive rearing habitat to stressful conditions following bar closure. We tracked the movement of several listed salmonid species between the Redwood Creek estuary and Prairie Creek, the closest major tributary to the estuary, which is considered a salmonid stronghold. We found considerable differences in estuary use between species. Coho and Chinook salmon primarily utilized estuary habitat during outmigration with little upstream movement. Coho salmon mostly emigrated prior to bar closure, but many Chinook remained in the lagoon for the dry season. Trout had a more flexible strategy, with many individuals using the lagoon during summer and later moving upstream to winter in the tributary. These data highlight the importance of restoring interconnected habitats in bar-built estuaries to the benefit of multiple life histories of juvenile salmonids.

Wild Classrooms: Blending Restoration Science with Experiential Education

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Session:	**Special Session 6 - Rivers as Classrooms: Blending Experiential Education into River Restoration Science & Project Monitoring**

Abstract

The South Yuba River Citizens League (SYRCL) serves as the Yuba Waterkeeper and is dedicated to uniting and inspiring people to protect and restore the waters, forest, and communities of the Yuba River watershed through five pillars: Advocacy, Watershed Science, Community Engagement, Education, and the Wild & Scenic Film Festival. The Education Department acts as a vital connector across departments by engaging students of all ages to support SYRCL's conservation and restoration efforts.

Through programs ranging from salmon-focused curriculum for elementary students to field science expeditions where high school students help collect monitoring data in alpine meadow restoration sites, SYRCL leverages the river and watershed as a dynamic outdoor classroom. Students work alongside SYRCL scientists collecting meaningful data while witnessing the benefits of our restoration actions firsthand. Using case studies from these programs, this presentation explores how experiential learning can increase scientific understanding, foster environmental stewardship, deepen student connection to nature, while contributing to SYRCL's ongoing restoration work. Involving students directly in data collection and analysis at restoration sites, SYRCL demonstrates how youth education can be integrated into SYRCL's science programs, project monitoring, and restoration tasks, while creating mutual benefits for the students and SYRCL's conservation goals.

Ecological risk assessment to inform regional instream flow management

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Session:	**Special Session 7 - Advancing Environmental Flow Management: Holistic Approaches for Sustaining Aquatic Ecosystems**

Abstract

Streamflow alteration can degrade aquatic ecosystem health, particularly in unregulated systems where decentralized diversions and distributed impacts make flow management complex. Natural resource managers need tools that can be applied over entire watersheds or regions to evaluate potential ecological consequences of flow diversions and to identify protective ranges of alteration. Risk based approaches provide an advantage over traditional approaches of establishing flow targets by providing the flexibility to adjust management objectives based on risk tolerance, the needs of different species, and trade-offs with other water demands. In this study, we developed an ecological risk framework for informing acceptable flow diversion rates, leveraging existing studies and datasets to account for varying risk profiles of specific species and life-stages of interest. We evaluated regional ecological risks associated with incremental increases in diversion from unimpaired flow for different (1) species life-stage needs, (2) annual climate conditions, and (3) physical channel settings. The framework is designed to protect both habitat needs of target species and the broader ecological functions supported by the natural hydrograph's shape and timing. By integrating multiple lines of evidence, we identified acceptable degrees of departure from natural flow conditions. We applied this framework in a coastal watershed in northern California, USA, synthesizing risk curves to reveal inflection points that correspond to ecologically protective levels of flow alteration. These insights can help inform policies for managing decentralized water systems that balance human use with aquatic ecosystem protection.

Monitoring River Function and Natural Community Response Following Patapsco River Dam Removals in Maryland, USA

Presenting Author:	**Jessie Thomas-Blate,** American Rivers
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Session:	**Physical Processes - Contributed Session**

Abstract

The Mid-Atlantic Region of the U.S. is one of the most prolific places in the world for restoring rivers through the practice of dam removal. For the past 15 years, researchers have been monitoring Maryland's Patapsco River to document changes to the river geomorphology, function, and natural communities resulting from the removal of three dams. Research teams have examined movement of sediment, fluctuations in river flow, and shifts in biological communities, including migratory fish, resident fish, and benthic macroinvertebrates. All studies have shown either a positive or neutral response to the dam removals, with no long-term negative impacts indicated within five years post-removal. This extensive monitoring effort can serve as a model for more complex dam removals on moderately sized rivers. It also serves to support the idea that rivers have a remarkable ability to restore themselves once they are released from the confines of a dam.

The Dynamic Mosaic of Floodplains

Presenting Author:	**Martin Thoms,** University of New England
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Session:	**Special Session 1 - Advances in Floodplain Science & Implications for Riverscape Resilience**

Abstract

Floodplains are landscapes of enhanced biodiversity and the provision of ecosystem services. Located at the intersection between terrestrial and aquatic environments, floodplains are subjected to multiple disturbances. Floodplains are disturbance driven ecosystems, subject to periodic wetting and drying that occur at a range of frequencies, magnitudes and durations that result in a mosaic of biophysical structures and functions. Tree communities are important natural floodplain assets and how they respond to wetting and drying, in time and space, is critical to understanding the dynamic mosaic of floodplain ecotones and for their management. A 20-year data set of monthly evapotranspiration is used to investigate the function response of two floodplain tree communities, across the Lower River Murray floodplain in SE Australia. Changes in evapotranspiration are explored using the concept of an adaptive cycle. Adaptive cycles portray the dynamic response of ecosystems as a cyclic process with four phases: exploitation, conservation, release, and reorganization. The concept is applied to the response of floodplain vegetation to water availability.

Redundancy or progress? Resilience thinking and riverine landscapes

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Session:	**Special Session 3 - Restoring & Revitalizing Large Alluvial Rivers & Their Floodplains to Support Biodiversity & Multiple Goals**

Abstract

The concept of river resilience acknowledges the ability of societies to live and develop within dynamic riverine landscapes. Debate about the role and understanding of resilience and riverine landscapes is part of the scientific method, but disciplinary disunity about the utility and ways to approach resilience thinking in research and policy may leave river science out of the management and policy process. Collaborations, debate, and increased exposure allow attitudes and perceptions towards emerging concepts to be explored constructively. An analysis of attitudes and perceptions around 'river resilience' is analysed from a series of directed workshops that longitudinally track the convergence of ideas, principles and concepts that can be used to advance the resilience of rivers as social ecological systems. Results show that resilience thinking is an emerging research area that provides a distinctive framework for advancing river research and management rather than offering a 'conceptual wrapper' of well-established concepts and methods. While important debates remain about the context of resilience in river science, this study touches on many current preoccupations inside and outside of the discipline and highlights that resilience does provide important focal points for collaborative research, education, and innovation.

Diversification of Green Sturgeon Movements in Relation to River Flow Through the Sacramento – San Joaquin Delta

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Session:	**Special Session 7 - Advancing Environmental Flow Management: Holistic Approaches for Sustaining Aquatic Ecosystems**

Abstract

The threatened Southern Distinct Population Segment (sDPS) of Green Sturgeon spawn only in the heavily modified waterways of California's Central Valley. Managers are tasked with the challenge of ensuring species survival while balancing human and environmental water needs. However, we lack essential information about sDPS Green Sturgeon response to environmental conditions such as the flow regime that could aid in their management. We explored sDPS Green Sturgeon spawning migration behavior through the Delta and evaluated the effects of mean discharge and functional flow metrics on migration route selection, duration, and success. We found that higher mean discharge had a significant effect on more fish selecting the direct Sacramento River route instead of migrating through the Delta, as well as longer migration durations and higher rates of successfully reaching their spawning grounds. In addition, we found that wet season metrics (e.g. wet season flow median magnitude and duration and spring peak magnitude) were best at predicting route selection, migration duration, and success. Further exploring the relationship between migratory behavior and flow, especially aspects of the flow regime that can be manipulated by managers to improve river conditions for sDPS Green Sturgeon, could support the conservation of this valuable species.

Rebuilding Community-River Connections: Bear Creek as a Transformative Living Laboratory for Science and Education at Southern Oregon University

Presenting Author:	**Jamie Trammell,** Southern Oregon University
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Session:	**Special Session 6 - Rivers as Classrooms: Blending Experiential Education into River Restoration Science & Project Monitoring**

Abstract

Rivers create ideal natural classrooms where students engage in experiential education while contributing to scientific understanding and ecological recovery. At Southern Oregon University, Bear Creek functions as a dynamic outdoor classroom where Environmental Science, Policy and Sustainability students develop skills through hands-on restoration monitoring following a devastating fire five years ago. This urban waterway provides an exceptional opportunity for students to participate in recovery science in their own backyard.

Our program integrates academic instruction with restoration science through service-learning courses and capstone projects. Students collect water quality data, conduct vegetation surveys, monitor geomorphological changes, and evaluate restoration outcomes—building technical proficiency while contributing meaningful data to community partners. The urban setting allows students to observe interactions between human infrastructure (including the unhoused community) and ecological processes across all phases of restoration science.

We will share specific learning modules, assessment strategies, and student outcomes, demonstrating how river-based experiential education enhances scientific literacy and professional development, while generating actionable data that advances Bear Creek's ecological recovery and reconnects the community with this vital waterway.

Relating in-channel wood characteristics to pool-riffle morphology

Presenting Author:	**Shayla Triantafillou,** Colorado State University
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Session:	**Special Session 10 - Nature Based Solutions in River Restoration**

Abstract

The presence of large wood (LW) as a flow obstruction results in closely spaced pools relative to expected spacing in similar channels with no wood. General trends from several regions have shown that as the amount of wood in a river increases, the pool spacing decreases for a given section of channel. Relationships between the characteristics of individual wood volumes and the associated pool volume and between reach-scale wood load, wood accumulation spacing, and pool volume, however, are poorly constrained, yet may be of most interest in river management and restoration that reintroduces large wood and engineered logjams. These relationships likely vary by region, river corridor morphology, and LW piece characteristics. Until the ability to numerically model the interactions between large wood and pool formation improves substantially, understanding and predicting pool volume in relation to LW will continue to depend on empirical data from diverse regions. We present data exploring the relationship between LW characteristics and pool depth from the field in northwestern Montana and northern Colorado. Additionally, we explore how channel gradient and disturbance history affect this relationship. Lastly, we discuss the implications of LW and pool morphology for river restoration that uses LW.

Wading the East Rapti River: using a natural laboratory to teach about biodiversity assessments in Nepal

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Session:	**Special Session 6 - Rivers as Classrooms: Blending Experiential Education into River Restoration Science & Project Monitoring**

Abstract

Despite the high cultural, ecological, and economic importance of aquatic resources, comprehensive and consistent information on aquatic biodiversity is lacking for many regions. This is particularly relevant in Nepal, a region experiencing significant development under accelerated rates of climate change. Biodiversity assessments are critical to understand the health and status of river ecosystems and require properly designed surveys and trained personnel. In 2023, a team of scientists and professors from Nepal and the US developed the first college-level course at the Agriculture and Forestry University (AFU), Nepal focused on field-based aquatic biodiversity assessments. The course used a hybrid structure of recorded lectures, synchronous online discussions, and in-person, hands-on field experiences in the East Rapti River, Nepal, followed by in-lab activities at the AFU campus. For several students, this was the first interaction they had with any river ecosystem. The excitement and enthusiasm of the students demonstrated the importance of immersive learning and reinforced the need to use natural classrooms to arouse greater interest and stronger connections with the environment. The course provided a template for AFU to design a similar course in the undergraduate curriculum, and future iterations of the course will be led primarily by instructors in Nepal.

From River to Classrooms: Youth Monitoring Salmon Health to Protect River Ecosystems

Presenting Author:	**Becca VanArnam,** University of California, Davis Center for Community and Citizen Science
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Session:	**Special Session 6 - Rivers as Classrooms: Blending Experiential Education into River Restoration Science & Project Monitoring**

Abstract

This project engages youth, including those from continuation high schools, juvenile detention facilities, deaf and hard of hearing programs, and college access programs, in hands-on, place-based science focused on an urgent restoration challenge: thiamine (B1) deficiency in Central Valley salmon. First documented in 2020, symptoms of this deficiency manifest as spinning, lethargy, and death. In response, the Center for Community and Citizen Science in collaboration with NOAA Fisheries, the California Department of Fish and Wildlife and the University of California, Davis Center for Watershed Sciences co-developed a research and education program that has enabled over 3,500 high school students to participate in salmon monitoring across California's freshwater systems.

Students raise salmon from egg to fry, collect environmental and biological data, and help investigate the relationship between egg thiamine levels and survival rates. Their work contributes directly to an ongoing scientific investigation, allowing them to make meaningful contributions to conservation research while building environmental science agency. This presentation shares findings and lessons from implementing the program in diverse educational settings, with a focus on strategies for expanding access, supporting inclusion, and building authentic partnerships between students and scientists.

By bringing river science into classrooms—and classrooms to the river—we explore how experiential environmental education can foster a deeper understanding of ecological systems, engage students in stewardship, and revitalize relationships between youth and their watersheds.

What have we learned from 100 years of restoring rivers?

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Session:	**Special Session 10 - Nature Based Solutions in River Restoration**

Abstract

Re-establishing physical structures, normative rates and magnitudes of physical, chemical and biological processes are common to many river and floodplain management strategies. Despite legal mandates, increasing expenditures, and the growth of the river restoration industry, river ecosystems continue to decline. River restoration projects have increased exponentially over the last two decades and their expenditure now exceeds >$1 billion a year. As the practise of river and floodplain restoration continues to grow, the need to develop sound scientific principles is important especially given the number of organisations active in restoring rivers and policy initiatives focused on the topic. Disparities in stakeholder interests, scientific knowledge, scale of activities, and system constraints all contribute to uncertainties in river restoration. Using a data base of >1200 river restoration activities undertaken between 1920 and 2024, in the Driftless Area of the midwestern USA, we examine changes in river restoration strategies over time. We seek to address three critical questions of river restoration. 1). Has the approach to river restoration changed over time and in space? (2) Have river restoration projects between co-developed and co-designed by river scientists and river communities? (3) What has been learned in relation to the science of restoration in the Driftless Area?

Increasing bird biodiversity along Central Valley rivers: analysis of baseline and post-restoration data to inform restoration strategy

Presenting Author:	**Ashley Verna,** River Partners
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Session:	**Special Session 3 - Restoring & Revitalizing Large Alluvial Rivers & Their Floodplains to Support Biodiversity & Multiple Goals**

Abstract

The Central Valley has been dramatically transformed over the last century by human activities, resulting in once abundant bird populations reduced to relatively small populations or locally extinct. To inform restoration design and support conservation of Central Valley birds, we evaluated the success of riparian restoration sites in meeting Central Valley Joint Venture's objectives for species' breeding densities. We performed point count surveys, vegetation surveys and audio recordings in known-age restoration sites, remnant riparian forests, and planning sites. We compared CVJV focal species objectives to actual densities as calculated by point counts.

While restored sites met the objectives for at least one riparian species, no site met the objective of more than three. Given that there was considerable variation among species and sites, when considering sites on a landscape scale, restoration has resulted in the creation of suitable habitat for riparian focal bird species. Notably, species not present were associated with early successional stages in riparian vegetation. Anthropogenic changes interrupt ecological processes that would drive a mosaic of successional stages in this landscape, therefore targeted management must increase the amount of early successional habitat. Managers can disturb/replant older sites, and ensure new large-scale riparian restoration projects are continually planted.

Cultivating Belonging and Teamwork in a River Field Course: An Experiential Education Approach

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Session:	**Special Session 6 - Rivers as Classrooms: Blending Experiential Education into River Restoration Science & Project Monitoring**

Abstract

Belonging and teamwork are critical for student success in demanding field settings like river courses, yet STEM training often overlooks their intentional development. This case study explores a 5-week river field course where principles of outdoor experiential education were integrated to explicitly cultivate these skills in a river-focused expedition-style field course. Activities focused on building connections among students and faculty within the unique riverine environment, enhancing comfort and self-efficacy specific to fieldwork, and providing tools to discuss belonging and group dynamics in this context. Student reflections from the river course indicated a positive relationship between increased belonging and team performance observed during the expedition. Furthermore, students perceived the experiential learning activities conducted on the river as significantly contributing to both their sense of belonging and their ability to collaborate effectively in the field. This work underscores the value of applying outdoor education pedagogy to enhance the social and collaborative learning dimensions of intensive river field courses. Fostering partnerships between STEM departments and university outdoor programs offers a scalable strategy to improve student outcomes and preparedness for collaborative work in challenging field environments. This project aligns with the goals of the NSF Belonging in Field Education and River Field Studies Network Communities of Practice.

The influence of hydroclimatic and water quality variability on benthic macroinvertebrate communities in mid-elevation Sierra Nevada streams; A case study from the Deer Creek Watershed

Presenting Author:	**Emma Walker,** Sierra Streams Institute
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Session:	**Water Quality I - Contributed Session**

Abstract

Climate change is expected to have profound impacts on the Sierra Nevada region, increasing the frequency and intensity of extreme conditions. In stream ecosystems, the alteration of the hydrological regime will have consequences for benthic macroinvertebrate communities. To further investigate these impacts, we leveraged community science data collected as part of a long-term bioassessment monitoring program of the Deer Creek watershed, a heavily managed system within the Sierra Nevada foothills. Between 2003 and 2022, volunteer field crews sampled benthic macroinvertebrates from eleven sites biannually. Samples were identified to family level and community counts were paired with water quality, PRISM climate, and USGS flow data averaged over 1-month, 3-month, 6-month, and 12-month intervals. We assessed community response using overall diversity and richness, as well as the diversity, richness, and abundance of EPT (Ephemeroptera, Plecoptera, Trichoptera) taxa. Using nonmetric multidimensional scaling (NMDS) ordinations, we identified hydroclimatic and water quality drivers of community shifts. Here we share insights into how benthic communities have responded to flow extremes, and how they may be expected to respond under future conditions. Understanding these biotic community responses to environmental changes is essential to watershed management and restoration initiatives in foothill Sierra Streams.

Regional and local synchrony of aquatic heatwaves in Western USA rivers

Presenting Author:	**Jonathan Walter,** University of California, Davis Center for Watershed Sciences
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Session:	**Disturbance & River Dynamics - Contributed Session**

Abstract

Aquatic heatwaves are prolonged periods of atypically warm water temperatures, which alter ecosystem function and threaten aquatic biota. The frequency of river heatwaves is increasing as a likely consequence of climate change and water development, but many aspects of spatiotemporal patterns of riverine heatwaves remain unknown. We examined whether riverine heatwaves co-occur regionally and within individual river networks (i.e., are spatially synchronous) in the Western USA, by analyzing long (≥15 yr) river temperature records. Riverine heatwave synchrony was prevalent at both spatial scales. The magnitude of region-wide synchrony correlated with climate variability, tending to increase when the Pacific Decadal Oscillation was in modes associated with warm air temperatures in the Western USA. Within river networks, synchrony tended to be inhibited by reservoirs, suggesting a potential role for dam management in mediating the spatial distribution of river temperature extremes. Riverine heatwave synchrony likely has substantial consequences for aquatic biota and ecosystem function given that it implies simultaneous high temperature extremes across broad spatial scales (10s to 100s of km).

The ripple effect of a community-based student project on the Reese River in the Shoshone Yomba Reservation, Nevada

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Session:	**Special Session 5 - Revitalizing Community & Landscape by Connecting Rivers, People, & Science Through Field Experiences**

Abstract

In the Reese River Valley, Nevada, members of the Shoshone Yomba tribe have reported noticeable changes to the landscape and water supply within one generation. Working together, we identified several needs: 1) assessment of resources; 2) evidence of water loss, and 3) means of educating and communicating with tribal members. We co-created one immediate undergraduate project (skill and timewise) and identified long-term goals. A lack of available data hinders research into key issues, primarily measuring water supply. For this, changes in river characteristics such as riparian coverage, sandbars, and the active water channel were used as proxies. In this project, we 1) mapped past and present resources; 2) calculated proxy areas along the river within the reservation (2010, 2013, 2016); and 3) created a StoryMap of the data for tribal use. Changes quantified along the river reflect tribal elder concerns about reduced water supply in the valley. From this project, several lessons stand out. First, academic schedules must be considered in planning timelines of community projects to achieve successful student and community outcomes. And importantly, community projects = relationship building. Thus, an iterative approach is essential to allow for continued learning on both sides throughout the process.

Multi-Objective Criteria for Floodplain Benefits on Working Lands Using a Hydrospatial Approach

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Session:	**Special Session 3 - Restoring & Revitalizing Large Alluvial Rivers & Their Floodplains to Support Biodiversity & Multiple Goals**

Abstract

Reconnecting rivers and their floodplains in highly modified and managed systems to reinstate physical and ecological processes that confer ecosystem resilience and species recovery is a global challenge. In the Central Valley of California, vast wetland flood basins along the Sacramento River were once part of a complex and dynamic river-wetland corridor, and recent efforts seek to increase functional connectivity while maintaining agricultural viability. Establishing pathways forward requires landscape-scale approaches that address multiple priorities, benefits, and tradeoffs playing out over space and time. This study - part of a larger participatory Floodplains Reimagined Program - established a suite of criteria, based on the scientific literature and technical experts, related to juvenile salmon floodplain rearing habitat, shorebird and waterfowl habitat, and secondary productivity (zooplankton production and export potential). These were applied to hydrodynamic modeling for five representative baseline water years covering a range of hydrologic conditions using a hydrospatial approach, a quantitative application of criteria varying in space and time depending on inundation characteristics such as depth, velocity, and duration. In addition to summary at the annual and landscape scale, this approach allows spatially- and temporally-resolved evaluation of benefits and trade-offs. This work demonstrates valuable tools for managing toward more ecologically functional floodplains.

Tracing the Development Path of a Regional Monitoring Program for the Russian River Watershed of California

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Session:	**Special Session 4 - Data to Decision: Who Governs Ecological Monitoring of the River Commons?**

Abstract

The Russian River Regional Monitoring Program (R3MP), established in 2019 by both the regulated and regulator community, aims to support coordinated monitoring and reporting of scientific information necessary for successful long-term management of watershed health. The nearly 1,500 square mile bi-county northern California watershed includes a mosaic of working lands, urban areas, natural vegetation communities, and stream habitat, with more than three dozen federally protected species. Management challenges in the watershed are amplifying due to rapid environmental change, exemplified by poor water quality, habitat degradation, and species population declines. The R3MP is taking a watershed-scale approach to monitoring ecological conditions of streams and riparian areas to help inform resource management decisions across the watershed. The R3MP is governed by the many management interests within the watershed including counties, municipalities, regulatory and other public agencies, Tribes, NGOs, and private interests that need a dependable source of high quality monitoring data and independent, scientific information to successfully address watershed health questions. The R3MP's experience establishing a governance structure, science framework, an initial coordinated monitoring plan, and data management process offers an example of successes and challenges associated with a coordinated and collaborative regional monitoring program that serves diverse interests.

Evaluating the use of cotton strips and leaf litter bags for assessing the impact of flow regulation on decomposition rates

Presenting Author:	**Ellie Williams,** University of Leeds
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Session:	**Special Session 7 - Advancing Environmental Flow Management: Holistic Approaches for Sustaining Aquatic Ecosystems**

Abstract

Functional processes including the decomposition of organic matter are key to evaluating the impact of flow regulation on rivers. Decomposition plays a vital role in nutrient cycling in freshwater ecosystems and leaf litter is one of the primary energy sources to rivers. Decomposition is affected by the microbial and macroinvertebrate community as well as the river's thermal and fluvial regime making it an effective indicator of the ecological health of the river without extensive biomonitoring. Traditionally leaf litter bags have been used to measure decomposition in rivers, however cotton strips have been suggested as a standardised alternative as unlike leaf litter, they are not affected by environmental conditions. Cotton strips are less commonly used, and to assess their viability, they must be tested under various environmental conditions. This study compares the use of cotton strips vs leaf litter bags to assess the impact of flow regulation on decomposition rates in four British upland rivers, each with a different flow regime. Accurate assessment of decomposition rates is crucial for developing appropriate environmental flow management strategies that maintain the integrity of freshwater ecosystems. We illustrate how these methods enable us to evaluate the impact of flow regulation on British upland rivers.

Evaluating salmon embryo survival for incorporation into flow management strategies

Presenting Author:	**Jasmine Williamshen,** Cramer Fish Sciences
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Session:	**Fish Conservation & Management - Contributed Session**

Abstract

Life cycle modeling is important for assessing the abundance and dynamics of imperiled species, but accuracy depends on underlying parameters and transition rates between life stages. In the case of oviparous fish such as Pacific salmon, the earliest life stages from egg fertilization to fry emergence are critical, yet they are also the most understudied. This knowledge gap is problematic because in California's regulated rivers there is a focus on the impacts of discharge on juvenile outmigration survival. However, impacts of dam construction and flow regulation in the tailwater also has significant impacts on the substate where salmonids deposit their eggs and the hyporheic environment where incubation occurs. It is paramount that the needs of early life history stages are considered when developing flow management strategies. Here, we present two case studies on embryo survival of Chinook Salmon (Oncorhynchus tshawytscha) and Steelhead (Oncorhynchus mykiss) in two regulated California rivers, the Sacramento River and Stanislaus River, respectively, with an emphasis on water temperature and substrate as factors impacting the survival of incubating salmon embryos. These case studies highlight the importance of monitoring all life stages to build upon the functional flows approach and develop a more holistic management strategy.

Science-Based Priority Setting for Fish Habitat Expansion in the Central Valley of California

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Session:	**Special Session 11 - Healthy Rivers & Landscapes**

Abstract

Reclamation & the Service use a Structured Decision Making process to set priorities for expanding salmonid and sturgeon habitats available to fish stocks in the Central Valley. We begin by separating fundamental objectives from means objectives. We then describe a conceptual life-cycle model of target salmonids and sturgeon species. We bound the set of management actions that we will simulate in the model. We set the scale and domain of the decision support model(s). We seed the models with three types of data: 1. Empirical or observed; 2. Synthesized by a process-based model; 3. Expert Elicitation. We develop alternatives to test in the model, ascertaining which alternatives best achieve our fundamental objectives. The Science Integration Team provides experience, expertise, and data to the decision making process. Through facilitated, iterative dialogues participants describe a set of management actions available to Reclamation. They also provide their opinions on both the formulation of the conceptual model and inputs, and the alternatives. They then discuss the model outputs, tempering the results based on their expertise and experience. Reclamation and the Service take their input and set priorities for on the ground actions, as well as directed studies that reduce key uncertainties in the process. Reclamation has used this science-based approach to competitively fund $190M in river restoration and science efforts over the past 10 years.

Vertical Wetlands as ecological stepping stones for urban waterways

Presenting Author:	**Christian Wolter,** Leibniz Institute of Freshwater Ecology and Inland Fisheries
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Session:	**Special Session 10 - Nature Based Solutions in River Restoration**

Abstract

Urban waterways belong to the most degraded ecosystems on Earth and opportunities for their ecological rehabilitation are particularly constrained. Embankments are often vertical, because of fairway dimensions and adjacent land use leaving very little space for improvements. Despite this, rehabilitation is needed to enhance habitat connectivity, but also to improve public perception of waters in the city.

To provide minimum habitats as stepping stones in heavily constrained urban canals, we developed a modular system of plant baskets that can be differently structured with semiaquatic and riparian plants and installed at mean water level to mimic shallow banks. A pilot site consisting of 78 modules has been installed in the canal Berlin-Spandauer-Schifffahrtskanal in Berlin, Germany, in April 2023 and ecologically monitored since.

Until June 2024 the reed plants had reached 3 m height and successfully served first waterfowl breeding. The stepping stone was used by various insects, birds, waterfowl and semiaquatic mammals for habitat, resting and feeding. The roots developed underwater provided additional habitats, which were extensively used by fish. In addition, the shading of the sheet pile wall by plants significantly reduced the heat input to the water.

Hydrogeomorphic Study of the Scott River Watershed, northern California, USA

Presenting Author:	**Scott Wright,** Verdantas
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Session:	**Disturbance & River Dynamics - Contributed Session**

Abstract

The Scott River is located within the Klamath River watershed in northern California, USA. Historically, the Klamath River was the third-largest salmon-producing river on the US west coast. As with many other west coast USA rivers, salmon runs on Scott have experienced declines in the past century: spring run chinook have been extirpated from the watershed; fall run chinook populations have declined substantially; and coho are listed as threatened under both the California and Federal Endangered Species Acts. The reasons for the declines are complex; however, previous work has identified habitat degradation as one of the primary factors. In this study, a comprehensive assessment of hydrogeomorphic processes at the watershed scale is being used to better understand the magnitude and spatial and temporal aspects of habitat degradation, and to develop plans for improving habitat. Study elements include documenting historical changes from aerial imagery, development and application of integrated surface-groundwater models, mapping geomorphic features that represent channel and habitat complexity, and constructing sediment budgets, culminating in an overall assessment of habitat conditions along the mainstem Scott River. Ultimately, these assessments will be used to identify and prioritize habitat restoration alternatives.

Reach-scale riverbed grain-size mapping with remote-sensing techniques

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Session:	**Physical Processes - Contributed Session**

Abstract

Riverbed substrate grain-size has important influences on aquatic ecosystem function. Habitat suitability for many fish species is a function of substrate grain-size and hydraulic conditions. While hydraulic conditions can be reliably predicted with numerical models, no comparable modeling techniques are available for predicting grain-size. Traditional field methods for grain-size, such as pebble counts and grab samples, are not feasible for reach-scale mapping because they require significant effort to make a single measurement. To address this need, a research study was conducted along the lower American River (LAR) to determine the most effective remote-sensing methods for mapping salmon-spawning-sized substrates. Testing of various methods indicated that multibeam sonar (MBS), combined with underwater imagery, shows promise for mapping the gravel and cobble substrates of the LAR. The high-resolution elevation point-cloud from MBS provides a measure of bed roughness, which can be converted to grain-size by calibrating to direct point measurements throughout the reach. Point measurements were collected with an underwater camera system with grain-size distributions extracted from the images using deep-learning segmentation techniques. The MBS and underwater camera system were used to comprehensively map grain-size along a 23 river-mile reach of the LAR from Nimbus Dam to the Sacramento River confluence.

Reservoir operation optimization accounting for socioeconomic, water quality and methane emission mitigation targets

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Session:	**Water Quality II - Contributed Session**

Abstract

Improving water quality and mitigating methane (CH 4) emissions are critical for the sustainable development of water conservancy and hydropower projects. Reservoir operations influence hydrodynamic and biogeochemical processes by regulating water storage and discharge, which significantly impact reservoir water quality and CH 4 emissions. However, existing operation optimization approaches have rarely considered CH 4 emission mitigation, and the relationships among CH 4 emission, water quality, and socioeconomic objectives remain unclear. This study proposes a multi-objective optimization approach for reservoir operations accounting for CH 4 mitigation, water quality, and socioeconomic objectives (i.e., water supply and hydropower generation) while exploring the relationships among these targets. A reservoir hydrodynamic-biogeochemical model is used to simulate CH 4 emissions and water quality under multiple reservoir operation scenarios. Machine learning (ML) models are trained to predict CH 4 emissions and water quality responses to reservoir operations, and these models are then incorporated into an operation optimization model. Using China's second largest reservoir (Danjiangkou Reservoir) as a case, results show that maintaining higher water levels mitigates CH 4 emissions and improves water quality. Under the optimized operation scheme, multi-year averaged annual CH 4 emission decreases by 12.2%, chlorophyll a (Chl-a) exceeding degree declines by 13.4%, hydropower generation increases by 3%, while water supply volume is slightly reduced by 0.4%. Pareto optimal solutions reveal a synergistic relationship between CH 4 mitigation and both water quality improvements and hydropower generation, while showing a tradeoff with water supply. This study provides a cleaner strategy for sustaining reservoir services and moving towards watershed C neutrality.

A novel framework for retrieving total Nitrogen concentrations in Large Basin Scales using Multi-source data and novelty detection method, a case study in Pearl River Basin, China

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Session:	**Water Quality I - Contributed Session**

Abstract

We present a novel big earth data based approach for estimating riverine total nitrogen (TN), addressing the challenge of accurate, large-scale water quality mapping in rivers. Utilizing multi-source data, our approach significantly enhances accuracy and reliability over traditional methods. Applied to the Pearl River Basin, our technique demonstrates two main advantages: a substantial improvement in accuracy, evidenced by an 86% increase in the r 2 -score of the validation set, and a 10% enhancement in model prediction accuracy through the identification of out-of-distribution data. The technique results in a continuous riverine TN estimation dataset from 2015 to 2024, with a spatial resolution of 5 km and temporal resolution of ~1 day. Our method offers a scalable and accurate tool for monitoring riverine nitrogen concentrations, improving the ability to track and manage water quality on a basin-wide scale. By providing detailed insights into the drivers of total nitrogen concentration in the Pearl River Basin, this study also supports further research on water pollution and ecosystem management.

Evaluating Environmental Flows in the Central Valley Under Various Management Scenarios

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Session:	**Special Session 7 - Advancing Environmental Flow Management: Holistic Approaches for Sustaining Aquatic Ecosystems**

Abstract

The natural seasonal flow patterns of Central Valley rivers in California's Sacramento–San Joaquin Delta watershed have been significantly disrupted by dams, conveyance infrastructure, and land use changes. These widespread modifications have degraded aquatic habitats, diminished fish populations, and reduced critical ecosystem services. Environmental flows—the quantity and quality of water needed to sustain healthy ecosystems—are key to restoring ecological function, but their implementation may require substantial changes in water management, with uncertain consequences for other water users. As part of the publicly funded COllaboratory for EQuity in Water Allocations (COEQWAL) initiative, this work explores how water operations and climate change scenarios influence the ability to meet environmental flow needs, using Functional Flows as ecological targets. Functional Flows represent components of the natural flow regime that support key ecosystem processes. Results show that monthly environmental water budgets, tailored to basin-specific and water-year conditions, can meet these targets under certain scenarios. Additionally, projected climate warming is assessed for its impact on flow regime performance under alternative water management approaches. This analysis provides insight into the feasibility and trade-offs of meeting environmental flow requirements in the Central Valley, offering a foundation for more equitable and ecologically informed water management.

Carbon Dioxide Emission Prediction for Large Reservoirs in China

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Session:	**Water Quality II - Contributed Session**

Abstract

Based on CO_2 flux data of 5143 large Chinese reservoirs, this study explores national - scale CO_2 flux distribution and spatiotemporal changes, and analyzes influencing factors. Data shows southern low - latitude reservoirs have higher CO_2 flux than northern high - latitude ones; Yangtze and Pearl River basins > Yellow and Songhua River basins. CO_2 flux correlates significantly with reservoir age, latitude, and total phosphorus, declining exponentially with increasing age and longitude. Water environment parameters like area, pre - impoundment proportion, and average depth show insignificant correlation nationally. Neural network analysis ranks factor importance: total phosphorus > latitude > reservoir age > cumulative radiation > soil organic matter density.

All Forward: Watershed Education on the Tuolumne River, A Decade After the Rim Fire

Presenting Author:	**Kira Zalis Waldman,** University of California Davis
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Session:	**Special Session 5 - Revitalizing Community & Landscape by Connecting Rivers, People, & Science Through Field Experiences**

Abstract

As wildfires, drought, and infrastructure reshape our watersheds, how do we prepare future leaders to engage with landscapes that were severely altered by humans — yet dynamic, and very much alive? This presentation explores the potential of immersive, place-based education to inspire connection, using the Tuolumne River and Rim Fire burn scar as a case study. In the UC Water Academy's "Wildfire and Water" course, graduate students rafted the Wild & Scenic Tuolumne River, camped along its banks, and engaged directly with fire-impacted ecosystems, hydropower infrastructure, and restoration sites, exactly a decade after the Rim Fire scorched over 250,000 acres of the watershed. Along the way, students developed a systems-based understanding of watershed change grounded in lived experience. Building from this immersive foundation, students transformed field insights into science-based policy pitches and presented those pitches to a panel of mentors, agency staff, and community leaders. This integration of experience and civic engagement prepares students not just to study watersheds, but to advocate for them. We offer this course as one model for revitalizing watershed education to center place, embrace complexity, and empower students to engage meaningfully with the beauty and challenges of rivers.

Monitoring a threatened fish population with multiple life history strategies: *Oncorhynchus mykiss* in the Stanislaus River, USA

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Session:	**Fish Conservation & Management - Contributed Session**

Abstract

Monitoring *Oncorhynchus mykiss* populations in anadromous waters is complicated by plasticity in their life history expression. This species is facultatively anadromous comprised of resident and migratory individuals. Yet monitoring is often limited to migratory individuals captured incidentally in programs deployed for commercially important Pacific salmon. We designed a monitoring plan specifically for *O. mykiss* in the Stanislaus River, California and worked with state, federal, and private partners to implement the plan. Our goal was to estimate the abundance of key *O. mykiss* life stages, transition rates between life stages, and migratory decisions. Using a combination of molecular methods and traditional fisheries techniques, we generated inference on multiple population attributes including, spawner abundance, age and size at maturation, annual growth rates, migration frequency, rate of iteroparity, and egg-to-fry survival. These data revealed a diverse range of life history strategies, and linkages between resident and migratory individuals, that have implications for which individuals have protected status. Over time, these metrics can be linked with water operations and environmental data to inform actions that could affect life history expression and abundance. The methods employed and analysis strategy provide a framework for future monitoring of *O. mykiss* and other species with variable life histories.

Coupled hydrological-biogeochemical shifts shape N2O emission patterns along a river-estuary continuum

Presenting Author:	**Sibo Zhang,** Guangdong University of Technology
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Session:	**Water Quality I - Contributed Session**

Abstract

Riverine N2O and N2 fluxes, key components of the global nitrogen budget, are known to be influenced by river size, yet the specific mechanisms behind these effects remain unclear. This study examined how environmental and microbial factors influence sediment N2O and N2 fluxes across rivers with varying widths in China. Sediment acted as sources of both N2O and N2 emissions, with both N2 fluxes and N2O fluxes decreasing significantly as river width increased. Water physicochemical factors, particularly temperature and nitrate, were more important drivers of these fluxes than sediment factors. Nitrate significantly increased denitrifying bacterial abundance, whereas higher temperatures enhanced cell-specific activity. Lower N2O and N2 emissions in wider rivers were attributed to decreased denitrifying microbial abundance and lower denitrification rates, in addition to the commonly assumed reduction in exogenous N2O and N2 inputs. Nitrate concentration had a stronger effect on sediment N2O and N2 fluxes in narrower rivers, whereas temperature was more influential in wider rivers. This difference is attributed to more stable nitrate concentrations and decreased nitrogen removal efficiency in wider rivers, while temperature variation remained consistent across all river widths. This study provides new biogeochemical insights into how river width influences sediment N2O and N2 fluxes.

Poster Session Abstracts

Smart applications of artificial intelligence and machine learning for water, community, and crisis management during mass gathering events in Ganges River

Presenting Author:	**Rawi Abdullah,** Universit of California-Davis
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Session:	**Poster Session**

Abstract

Many civilizations have grown and disintegrated along the Ganges River, which is more than 2,525 km long, and it flows down from its glacial source located in the high Himalayas to the Gangetic plain. The Ganges River is the most important river system in India, and its basin (area of 860,000 sq km) is the world's most populous river basin, which supports more than 600 million people. Because the Ganges River is India's the holiest river with cultural and spiritual significance, Kumbha Mela, a festival is held on the banks of the Ganges and Yamuna Rivers in North India every twelve lunar years. This is the world's largest festival, which brings more than 400 million people, and the applications of artificial intelligence and machine learning provides significant information in terms of understanding the crowd behaviors, transportation, river water flow and quality, security, and crowd management. This study provides insights into the difficulties and challenges during such a large event, and describes relatively new application of the artificial intelligence and machine learning for determining crowd density and crisis management along the Ganges River.

Estimating Actual Evaportranspiration (Eta) Estimation for Major Crops of Mahanadi River Canal Command Using CROPWAT 8.0 Model

Presenting Author:	**Pakzadeh Behrooz**, University of California, Davis
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Session:	**Poster Session**

Abstract

The paper aims to estimate Actual Evapotranspiration of major crops using CROPWAT 8.0 in 2A canal command of Mahanadi river of Dhamtari district in Chhattisgarh, India. Long term daily meteorological data including rainfall, maximum temperature, minimum temperature, relative humidity, wind speed and sunshine hours of IMD station data were used as input data in modified Penman method and CROPWAT 8.0 model. The crop stage data, including the value of Kc in, Kc mid, Kc end for the selected crops were obtained from the Department of Irrigation,and rooting depth, critical depletion and crop height of different crops were taken from Food and Agriculture Organization (FAO) Irrigation and Drainage Database. The major crops in 2A canal command area are Paddy, Wheat, Chickpea,Summer Paddy. Daily meteorological weather data for the period of 2007 to 2021 were used for analysis.This researchconcluded that Penman–Montieth method found to be among the best method to estimate Actual Evapotranspiration of major crops of 2A canal command of MahanadiRiver, and estimated new values agrees within acceptable limits of accuracy for this site. The model also provided information on crop water requirement, irrigation requirement based on soil, climate, and crop data.

Building a toolkit to manage water for the environment; a case-study from the Goulburn River, Australia

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Session:	**Poster Session**

Abstract

The Murray Darling Basin (MDB) is Australia's largest river catchment, with significant ecological, cultural and economic importance. These facets all have been impacted by human interventions that disrupt where, when, and how much water is available for ecosystems throughout the Basin. To alleviate these impacts, the Commonwealth Environmental Water Holder (Australian Government) delivers water for the environment to meet key environmental and social objectives.

For more than 10 years the Flow MER (Monitoring, Evaluation, Research) program has conducted monitoring to inform adaptive management of environmental watering actions across seven Areas within the MDB. We reflect on key learnings from one Area, the Lower Goulburn River Area in Victoria, which is characterised by a simplified channel morphology and operational restrictions that prohibit delivery of overbank flows.

A collaborative team spanning science, water delivery, and policy disciplines have developed and continuously refine a flow-management "toolkit" – a suite of targeted water releases that are timed throughout the year to promote: bankside vegetation (seed deposition, recruitment, establishment, growth); native fish (flows to cue spawning and fish movement); river metabolism; bank condition (erosion mitigation) and more.

Key features of the flow management toolkit are presented, including targeted ecological outcomes and tradeoffs between ecological responses to different watering actions.

Optimizing Reservoir Release Decisions for a Simulated Environmentally Significant Floodplain

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Session:	**Poster Session**

Abstract

This project aims to explore high-level biophysical relationships in ephemeral floodplains related to water release regimes in scarcity scenarios. Ephemeral floodplains are a complex and dynamic habitats crucial for migratory fish and birds, and amphibians. However, due to their dynamic nature, outcomes of management decisions can be unclear. The conceptual framework in this paper aims to organize the problem for the purpose of making more informed management decisions and posing better questions about these environments. By coupling hydrologic and bioproductivity models, the effects of bathymetry, climate, water quality, and release regimes on habitat creation and primary productivity will be explored. These factors will then be run through an optimization framework and sensitivity analysis to create a decision support system for floodplains under varying physical, ecological, and chemical states. These results will be verified by matching the conditions of the simulation to an existing floodplain data set. Exploring this simulated decision space will be beneficial for moving future real world management decisions in the direction of Pareto optimal for both reliable delivery and habitat creation.

Economic Analysis of Just Land Use Transitions in the California's Sacramento San Joaquin Delta

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Session:	**Poster Session**

Abstract

The Sacramento–San Joaquin Delta (SSJD) in California serves as a central hub for the state's intertied water supply system while supporting agriculture, communities, and a fragile ecosystem under multiple stressors. Chronic upstream water overextraction, declining water quality affecting native species and human use, and land use practices contributing to subsidence and flood risk have intensified the region's vulnerability. These challenges underscore the need for a systems-based approach that moves beyond unsustainable practices to ensure long-term benefits for all Delta stakeholders. While scientific modeling and participatory planning have progressed, economic considerations are often introduced too late, limiting the assessment of trade-offs across outcomes. The region's complexity stems not only from physical and institutional interactions but also from fragmented governance that hinders coordinated, multi-benefit strategies. This study evaluates the economic implications of equitable transition scenarios for the SSJD using an integrated suite of economic, ecological, hydrologic, and hydrodynamic models. Scenarios incorporate tiered thresholds to assess changes in water availability, salinity, and land use, helping to identify points where impacts on productivity, reliability, and ecosystem function become significant. Hosted on OpenDAP, a web-based open-access platform, the framework enables stakeholders to explore outcomes across indicators such as gross domestic product, income, employment, water quality, and habitat condition. Preliminary results suggest that land repurposing guided by threshold-based planning can enhance systemwide resilience without substantial economic losses. These insights support integrated policies that promote a sustainable and balanced Delta future.

Modeling the Impact of Friant Dam Releases on San Joaquin River Temperatures: Implications for Chinook Salmon

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Session:	**Poster Session**

Abstract

Hydrologic modeling is an effective tool in managing California's water resources, enabling predictions of streamflow, water temperature, and quality under various scenarios. These models are useful in riverine systems affected by dams, where controlled releases influence downstream river temperatures, a key factor in aquatic ecosystem health. The San Joaquin River downstream of Friant Dam experiences river temperature fluctuations that disrupt aquatic ecosystems. The extent of coldwater habitat for the native Chinook salmon (Oncorhynchus tshawytscha) has been reduced by dams and water regulation practices, leading to river temperature variations that severely impact river life stages.

We investigate the effects of controlled water releases from Friant Dam on the San Joaquin River's thermal regime and its implications for Chinook salmon populations by modeling heat fluxes and river temperature. This study utilizes the Fluvial Energy Balance Model (FLUVIAL-EB), a physically based numerical energy balance model that simulates the spatially distributed energy balance and river temperature continuously over river distance and over time. Simulations are conducted at 100-meter spatial resolution and 30-minute timesteps along a 150-kilometer reach of the San Joaquin River. We focus on critical periods of the salmon lifecycle, including months associated with egg incubation and smolt migration, and compare modeled river temperatures for Water Year 2021 (a drought year) and Water Year 2023 (a wet year).

This study aims to provide a more comprehensive understanding of river temperature dynamics in a regulated system, offering insights for optimizing water management practices to support the ecological health of the San Joaquin River and the greater Bay-Delta system.

Water on the Margins: Water Hauling and Climate Resilience in Northern New Mexico

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Session:	**Poster Session**

Abstract

In the U.S. Southwest, decentralized water users—those relying on domestic wells or hauled water—are among the most vulnerable to climate change, yet remain largely invisible in research and policy. As wells dry up or become contaminated, many households shift to bottled or hauled water, often at high financial, logistical, and health costs. In Santa Fe County, New Mexico—a state where 14% of residents self-supply—some haul water due to well failure, while others cite PFAS contamination in the Santa Fe River linked to nearby aviation activity. These overlapping surface and groundwater challenges illustrate how rivers, aquifers, and human systems are deeply interconnected—and how these linkages must be reimagined to ensure water justice in an era of accelerating aridification. While similar vulnerabilities have been documented in places like California's Central Valley and the Navajo Nation, limited research has been conducted in other contexts, such as northern New Mexico. This study draws on anthropological fieldwork and interviews with water haulers and public works staff to examine household water needs, hauling burdens, and institutional trust. By centering the lived experiences of federally unregulated water users, this research identifies systemic gaps in household water security and aims to inform more equitable, climate-resilient water management.

Hydropower diversions in mountain streams: ecohydraulics alterations and sediment connectivity in a relicensing perspective

Presenting Author:	**Matteo Dal Santo,** University of Trento
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Session:	**Poster Session**

Abstract

Hydropower water diversions can significantly alter the hydrology, morphology and habitat in mountain streams. This study presents a multidimensional ecohydraulic and sediment connectivity analysis of two water diversion schemes in the NE European Alps, aimed at supporting improved future water diversion management in the perspective that the related hydropower schemes will undergo a relicensing process in the coming years. The Ala and Leno streams flow through two mountain catchments in the province of Trento, Italy. The Ala stream was formerly affected by a run-of-river hydropower diversion, dismantled in 2004, whereas the Leno stream is regulated by a hydropower system where the storage is constituted by two dams. Hydrological alterations and habitat availability at two diversions were assessed using the IARI hydrological alteration Index, which is largely based on the well known IHA (Indicators of Hydrologic Alteration; Richter et al., 1996) and a mesoscale hydraulic-habitat index based on the MesoHABSIM methodology (Parasiewicz, 2007; Vezza et al., 2014), comparing multiple flow-release scenarios. These scenarios were developed through a hydrologic balance at the diversion node, and testing the effectiveness of both ecological flow releases based on constant monthly or seasonal flow rates and of proportional releases, which consisted of a fixed contribution plus a variable contribution, computed as linearly proportional to the upstream flow rate. The analysis allowed to highlight that these proportional-flow release scenarios offer a much more favourable balance between environmental and productive water needs, when compared to the more traditional fixed-rate releases. Sediment connectivity and production in the Leno catchment were evaluated using empirical models originally calibrated in another Alpine region (Morel et al., 2023). This enabled quantification of sediment yield from individual sub-catchments, both on an annual basis and for extreme events with return periods of 10 and 100 years. The availability of multi-temporal bathymetric data from the hydropower reservoirs allowed for validation of sediment transport estimates, particularly for the annual yield and the 100-year event. The findings allow support to targeted sediment management, specifically, to improve future sediment connectivity in the catchment.

The Influence of Wastewater Effluent on Water Quality in Suisun Marsh, San Francisco Estuary, CA

Presenting Author:	**Abigale Deen,** University of California, Davis Center for Watershed Sciences
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Session:	**Poster Session**

Abstract

The Fairfield-Suisun Wastewater Treatment Plant (FSWTP) cleans sewer water from public sewers of Fairfield, Suisun City, and Travis Air Force Base. The treated water is pumped into Boynton Slough in Suisun Marsh in the San Francisco Estuary. Suisun Marsh is a region of high importance for native biota and contains much of the remaining wetland habitat in Northern California. Through water quality analysis and stable isotopic ratios, we will determine the effluent uptake of carbon, nitrogen, and sulfur in Boynton Slough. Water samples were taken throughout nearby sloughs and biota were collected in one sampling session and analyzed at the University of California, Davis Stable Isotope Facility. Carbon ratios found in biota were not unique to the region with values averaging -26VPDB while nitrogen ratios averaged 15VPDB. The nitrogen values in the water were lower than in biota collected. The results from this study show that the effect of the FSWTP on C-N ratios is inconsequential. Suisun Marsh is more influenced by inputs from the San Francisco Bay, tidal creeks, and runoff rather than the treated water that is deposited in Boynton Slough. More sampling occasions or seasonal sampling could shed light on the exact nature of the influence of effluent.

Fish as Indicators of Change: Long Term Community Dynamics in the Suisun Marsh

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Session:	**Poster Session**

Abstract

Suisun Marsh, the largest tidal wetland on the west coast of North America, provides a model system to understand the effects of major environmental changes. Suisun Marsh primarily consists of wetlands managed for waterfowl, where human influence is a major driver for the present conditions (salinity control gate, water treatment plant, etc). The management and diversion of freshwater flows from the Delta additionally determines species distributions and downstream management rights. Given these complex influences, my research addresses how fishes may serve as important indicators of ecological change within the Suisun Marsh.

We observe how environmental change and human influence have driven yearly trends in fish community composition and abundance over 45 years (1980 - 2024). We have consistently collected trawling data once a month from ~20 sites, in addition to water clarity measurements and freshwater outflow calculations into the Marsh. Preliminary results show that there may be a differential response to these changing conditions even between species with similar life histories, like the native Sacramento Splittail and nonnative Common Carp. This work will continue to compare differential responses to flood-drought cycles to determine the impact on California fishes.

Does beaver dam analog restoration alter prey availability for stream-dwelling salmonids?

Presenting Author:	**Jaya Hanning,** University of California, Davis
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Session:	**Poster Session**

Abstract

Food availability is a primary constraint on the survival and growth of animals. In stream ecosystems, salmonid fishes are thought to gain most of their energy by foraging on invertebrates suspended in the water column or on the waters' surface. The availability of invertebrate prey in streams is influenced by a multitude of factors and can differ between habitat patches at relatively small spatial scales. As such, changes to instream physical habitat characteristics may alter the density food resources for stream-dwelling salmonids; however, evaluations into how habitat restoration practices influence food resources for fishes are rare. Here, we assess invertebrate drift abundance in habitats created by beaver dam analog (BDA) restoration and compare to natural stream habitats. To do so, we collected invertebrate drift samples from BDA and natural habitats across four headwater streams between June and October 2025. We compare drift and energy availability across habitat types to evaluate whether BDA restoration alters food and energy availability for salmonid fishes. This study will aid managers and biologists seeking to improve habitat quality for salmonid fishes by identifying whether changing physical habitat features influence the production and availability of food resources.

The significant impacts of Tribal Ecological Knowledge on fisheries technology

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Session:	**Poster Session**

Abstract

The McCloud River is a dynamic ecosystem with a deep cultural legacy. Partnering with the Winnemem Wintu Tribe to reintroduce the historic winter-run Chinook salmon has fostered an ideal environment for advancing fisheries field technology—innovations that boost performance and efficiency while honoring traditional values by minimizing impacts on fish and the environment. University of California, Davis has developed a "fish viewer," a non-invasive apparatus that allows fish to be measured without removal from the water or human handling—reducing stress and enabling the collection of morphometric data not possible through standard Western techniques. In collaboration with the Monterey Bay Aquarium Research Institute, University of California, Davis has implemented an automated water sampler for eDNA collection, delivering consistent, fine-resolution data on pathogen presence with minimal ecological disturbance. These advancements exemplify how blending cutting-edge science with Indigenous knowledge can elevate fisheries conservation and monitoring. The future of fisheries research lies in such interagency and tribal collaboration—where innovation and tradition work in concert to restore and protect our rivers.

Streamlining the technical evaluation of flow enhancement projects proposed under the North Coast Instream Flow Policy using web-based analytical tools

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Session:	**Poster Session**

Abstract

The North Coast Instream Flow Policy governs new applications for water diversions in the North Coast region of California. The policy defines a series of analyses that must be undertaken towards developing a Water Supply Report, which evaluates the gross availability of water, and a Cumulative Diversion Analysis, which subsequently evaluates the deliverability or reliability of supply. For conservation groups looking to complete flow enhancement projects, such as working with summertime irrigators to acquire new water rights that would allow them to divert during the winter and irrigate from storage, the time and effort required to conduct these analyses creates a significant bottleneck in identifying and evaluating potential projects.

With support from the Wildlife Conservation Board, Foundry Spatial, The Nature Conservancy, and Trout Unlimited have developed a web-based decision-support tool designed to help practitioners with the technical evaluation of projects. Released in the summer of 2025, this tool enables users to define their proposed point of diversion, season of diversion, and withdrawal rates and amounts, which are then evaluated against the water supply at that location and pre-existing water demand from senior diverters. The tool produces the full set of tables, graphs, and maps required, which can be assembled by an applicant alongside their project description and objectives, for submission to the regulator.

Evaluation of student learning from a stream-based field lesson

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Session:	**Poster Session**

Abstract

First-year nonmajor students were led on stream-based field lessons on two Southern California streams, Eaton Creek and the Kern River, during October 2024 and September 2025, respectively. The field lesson, titled Hydrology Scavenger Hunt: A Streamside Lesson to Identify Hydrological Features in General, Whitewater, and Waterfall Settings, supports the identification of hydrological features and the development of hydrological vocabulary; the lesson has been published online at the Quantitative Undergraduate Biology Education and Synthesis (QUBES) educational resources website, doi:10.25334/M3XW-PD87.

The success of student learning from the field lessons was evaluated based on post-trip student surveys, as well as submitted student work: pre- and post-field assignments and field journals. The rubric will be shared for the evaluation of the field journals.

Valley Floor Delineation in Digital Elevation Models: Comparative analysis of methodologies applied to the SF Bay Area

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Session:	**Poster Session**

Abstract

Valleys exert fundamental control on the flux of water and sediment throughout drainage networks, serving as both repositories of Earth history and controllers of contemporary fluvial processes. Despite their ecological and geomorphic significance, there remains no consensus definition of "valley floor". As a result, there exist various computational methodologies for delineating valleys from digital elevation models; one might even wonder if it is appropriate to exclusively define it on a purely topographic basis without considering other genetic variables, such as geological structure, tectonics, stratigraphy, and land engineering. This study evaluates several prominent approaches to valley floor delineation—including flood-stage, connectivity-based, and landform classification methods—across the San Francisco Bay Area, a region characterized by diverse valley morphologies including large alluvial plains, narrow bedrock canyons, preserved terraces, and landscapes with significant anthropogenic modification through land use change and artificial channels. We discuss the explicit and implicit assumptions about landscapes inherent to each method and assess how they perform across this topographic diversity. By synthesizing these approaches, we identify critical knowledge gaps and methodological challenges as well as advance the theoretical foundations for valley floor mapping generally. This in turn provides practical insights for developers of valley mapping tools and users of valley mapping products across domains.

Have our lake and eat it too: Developing functional flows for Utah's Great Salt Lake Basin

Presenting Author:	**Belize Lane,** Utah State University
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Session:	**Poster Session**

Abstract

A functional flows approach to water management, focusing on seasonal elements of the natural flow regime known to sustain important ecosystem processes, offers a pathway for linking understanding of ecosystem processes with discrete, quantifiable measures of the flow regime for a broad range of species. Functional flows will be integral to the Great Salt Lake Basin Integrated Plan by quantifying when, where, and how much water is needed to maximize ecosystem and water quality benefits to upstream rivers and wetlands as well as the Great Salt Lake itself. Utah's Functional Flows Framework will include: 1. stakeholder-driven characterization of key functional flows for the GSL Basin rivers and wetlands, 2. prediction of functional flow metrics (e.g., flow magnitude, timing, duration, frequency, rate of change) for all streams in the basin for dry, moderate and wet years, 3. assessment of current hydromodification of functional flows, 4. linkages between functional flows and water quality and between functional flows and measurable ecological indicators, and 5. recommendations for using the functional flow framework to inform best management practices in the basin.

Leveraging river and reservoir forecasting tools to implement Environmental Flow releases on the Trinity River, CA

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Session:	**Poster Session**

Abstract

Large dams in California were constructed to capture winter precipitation for later conveyance to municipal and agricultural customers, with little to no consideration of consequences to ecosystems. Meeting demand for valuable and often overallocated water resources requires careful accounting of reservoir storage, forecasting future runoff, and a complex dance of conveyance, interbasin transfers, and downstream releases. As ecosystem recovery has become increasingly prioritized worldwide, flow releases have been recognized as a critical management tool. Since 2000, the Trinity River in Northwest California has been prescribed five different annual hydrographs for environmental benefit dependent on water year type. While this was a considerable improvement, elevated releases were delayed until spring, leaving winter releases low and static. Recent work leveraged improved forecasting tools to implement Environmental Flow releases realigning physical and biological phenologies that have been out of phase for decades. Short-term river forecasting tools trigger winter pulse flows synchronized to natural runoff events. Medium-term reservoir volume forecasting tools prescribe elevated and variable winter flows. Shifting water from summer to winter reduces thermal impacts from hypolimnetic reservoir releases during the critical rearing period for juvenile salmonids. Carefully constructed rulesets with pre-determined volumes, daily release schedules, and triggers based on in-season conditions set the stage for a new era of environmental flow management in dammed river systems.

Environmental Changes Structure Fish Communities in Marsh Creek

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Session:	**Poster Session**

Abstract

Marsh Creek in Oakley, CA was once a naturally, intermittent creek that ran from the foothills of Mt. Diablo to Dutch Slough and into the San Francisco Estuary. It contained several native fish species, whose ranges were dispersed across varying aquatic habitats. Over time, the creek has been dammed and diverted for agricultural and recreational purposes. Today, only a few sections of intermittent and small, perennial streams remain in the foothills. The lower section of the creek has become channelized and receives perennial flow from a wastewater treatment plant. These anthropogenic modifications have facilitated the creation of a novel ecosystem, where the remaining native aquatic community assembly blends with introduced, non-native species.

To determine how these changes have affected the aquatic community, we are conducting fish surveys, macroinvertebrate sampling, and characterizing physical variables of the stream. We assessed initial results of spatial and temporal changes within the aquatic community, along with the environmental factors that could influence species shifts. Many of California's native freshwater fish have been subjected to stress from the modification of habitat, increased drought frequency, and competition with non-native species. Despite being modified, we detected regional species of concern such as Sacramento Hitch (*Lavinia exilicauda*) and Chinook Salmon (*Oncorhynchus tshawytscha*) using Marsh Creek as habitat. Thus, this study seeks to provide insight into the persistence of native fish in novel ecosystems and the influence stream modification can have on aquatic communities in Central California.

Emigrating Salmon Habitat Estimator: An Interactive Tool to Predict Chinook Salmon Rearing Habitat Needs through Space and Time in the Lower American River

Presenting Author:	**Kiera McNeely,** Cramer Fish Sciences
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Session:	**Poster Session**

Abstract

Prioritizing and optimizing salmon habitat restoration is a key challenge in many regulated rivers where resources are overallocated and historical impacts challenge our assessment of salmon habitat use and predicting restoration outcomes. The Emigrating Salmon Habitat Estimator (ESHE) model is a spatially structured, deterministic model that simulates juvenile salmon emergence, growth, survival, and behavioral responses to habitat availability on a daily time step. The model leverages river-specific habitat and adult, egg, and juvenile data to identify reach-specific habitat needs over time. As fish move through the model space, they rear if suitable habitat is available; if not, they move downstream, capturing dynamic use of space often missed in static models. ESHE provides insight into how much habitat is needed to support different population targets, which river reaches have the highest need for restoration, and how these needs shift seasonally. By realistically modeling rearing and migrating fish behavior, ESHE equips managers with a predictive tool for prioritizing rearing habitat restoration and salmon management actions in a dynamic, human-influenced river system. We provide examples of the ESHE framework using the Lower American River (LAR), an urban California stream with severely limited juvenile Chinook salmon habitat caused by anthropogenic impacts.

Informing habitat management for an endangered salmonid: spawning conditions and hydraulic suitability for winter-run Chinook Salmon in the Sacramento River

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Session:	**Poster Session**

Abstract

The Sacramento River mainstem is the primary habitat for endangered winter-run Chinook Salmon (WRCS; *Oncorhynchus tshawytscha*) and will continue to be their most reliable spawning habitat for the foreseeable future. The reach between Keswick Dam and the Anderson-Cottonwood Irrigation District (ACID) Dam may be especially important for buffering against recruitment failure, as it consistently provides the coldest water temperatures for spawning WRCS, which is critical during drought conditions when warmer downstream reaches may exceed thresholds for successful embryo development. Following fish passage improvements at ACID Dam and the initiation of periodic gravel injections downstream of Keswick Dam, an increased number of WRCS have been observed spawning in the reach. However, many of these fish spawn in depths and velocities considered unsuitable for Chinook Salmon, raising concerns about their reproductive success. To evaluate this, we monitored Chinook Salmon embryo survival in artificial redds constructed downstream of Keswick Dam and used an Acoustic Doppler Current Profiler to measure the suitability of depths and velocities throughout the reach. Results from this study can be used to better understand hydrogeomorphic controls on habitat suitability in this critically important reach and inform actions to enhance existing habitat through maintenance and restoration.

Long-term change in zooplankton phenology: implications for anadromous fish recruitment in the Hudson River estuary

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Session:	**Poster Session**

Abstract

Rivers encompass a critical stage in the anadromous fish life cycle, as year-class strength is linked to juvenile survival and growth. Rivers are also undergoing significant changes from the effects of climate change and human alterations. Our ability to predict how these changes will affect year-class strength hinges on our understanding of the processes and drivers of juvenile population variability. One commonly hypothesized driver of variability is degree of overlap between prey production and critical juvenile growth periods, i.e., the match-mismatch hypothesis. In the Hudson River, New York, USA, zooplankton are a primary food source for numerous anadromous juveniles. To better understand anadromous population variability in the Hudson River, we investigate the relationship between zooplankton phenology and anadromous year-class strength in the context of the match-mismatch hypothesis using three decades of fish and zooplankton abundance data. Specifically, we address the question, does seasonal zooplankton abundance peak timing, duration, or magnitude of phenological overlap in relation to abundance during the planktivorous life stage influence year-class strength? Determining the relevance of the match-mismatch hypothesis to anadromous population dynamics can improve our ability to predict recruitment dynamics and tease apart the effects of a changing environment on the Hudson River.

Avulsions, Channel Evolution and Groundwater Recovery in Restored Montane Meadows of California's Sierra Nevada

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Session: **Poster Session**

Abstract

Over half of riparian meadows in California's Sierra Nevada appear degraded. Incised channels can drain shallow aquifers, shifting groundwater-dependent ecosystems into dry terraces. "Pond and Plug" restoration fills sections of incised channels with meadow sediments, creating ponds as byproducts and allowing flows to spread across meadow floodplains. Introduced thirty years ago, the technique gained prominence after initial successes raising meadow groundwater levels and reviving hydrophytic riparian vegetation. Decades later, what can we learn from observations of how channels and groundwater levels evolved?

This field-based study tracks the multi-decadal hydrogeomorphic response to Pond and Plug restoration across eight meadow sites in the north-central Sierra. Geomorphic surveys of channel cross sections, long profiles, and sediment dynamics span from pre-restoration to at least fifteen years post-restoration. Channels avulsed at four sites. All reconnect to pre-restoration pathways, though flows remain bifurcated rather than fully abandoning their former path.

Restoration design, the natural instability of alluvial fans, varying sediment transport regimes, and beaver activity have influenced avulsion likelihood, location, and consequences. The potential for channel re-incision may depend on broader-scale drivers, such as major climate shifts, natural sediment supply, or human impacts on flows of water and sediment.

Monitoring dissolved oxygen in the Lower American River to inform real-time reservoir operations to support successful Chinook Salmon spawning

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Session:	**Poster Session**

Abstract

Dissolved oxygen (DO) is one of the most important indicators of biological health in rivers and can exhibit large fluctuations over a range of spatial and temporal scales. Salmonids are sensitive to low DO conditions, and at DO levels of 6.5 mg/L most salmonid species exhibit symptoms of oxygen distress. Salmonids are at risk of exposure to poor water quality (both high temperature and low dissolved oxygen) in the early fall when adults are immigrating into the river. In 2021 during a historic drought period, low dissolved oxygen levels (<5 mg/l) were documented in the lower American River at Nimbus Basin, which is at the base of Nimbus Dam. This area is the coolest portion of the river and upper point of anadromy, thus an area with disproportionately high Chinook Salmon holding and spawning activity. To better understand these water quality dynamics, in summer 2022 we installed dissolved oxygen loggers throughout the Lower American River. Throughout this monitoring, we consistently observed that when dissolved oxygen levels approached stressful levels in early fall, Nimbus Dam spill releases from dam gates (i.e., over the top of the dam as opposed to through the powerhouse) significantly improved dissolved oxygen levels in Nimbus Basin, even when DO levels within Folsom Dam were very low. This data was shared with the American River Group, and the Bureau of Reclamation was able to adaptively manage DO using continuous spill releases to maintain water quality for spawning Chinook salmon in 2023 and 2024. Leveraging real-time data to inform dam operations during this critical period in the Chinook salmon life cycle was a key strategy to improve in-river survival and spawning success on the American River.

Storage Hydropower in Alpine Catchment: exploring environmental strategies for heavily modified residual flow and hydropeaked reaches

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Session:	**Poster Session**

Abstract

The growing demand for renewable energy has driven the construction of dams worldwide, altering natural river regimes. Storage hydropower plants, while enabling flexible electricity generation, often create long stretches of residual flow downstream of dams and sudden hydropeaking events after water release, with significant impacts on river habitats and ecosystem functioning. The Noce River, a major tributary of the second-longest Italian river (the Adige), flows in the Trentino region of the NE Italian Alps, and is a striking example of such effects. This alpine river is regulated by two cascade storage hydropower plants, resulting in residual flow conditions for several kilometres immediately downstream of the dams, and intense hydropeaking patterns further downstream of the powerhouses. With the current hydropower concessions reaching the relicensing stage, strategies for mitigating residual flow deficits and hydropeaking disturbances are under discussion among stakeholders, including energy companies, environmental agencies, and local communities. Our study focuses on the lower Noce River and aims to support a multi-scale and multidisciplinary approach to propose improvements in the environmental management of the hydropower scheme. Hydrological analyses of sub-daily discharge time series, field surveys, and hydraulic-habitat modelling have been developed to quantify the present hydro-morphological conditions of the river reaches affected by hydropower operations. These preliminary results will be combined with ecological assessments to provide science-based recommendations to inform the relicensing process, offering practical flow management strategies that balance energy production needs with the protection and restoration of river ecosystems.

Identifying river channel features using high resolution topography

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Session:	**Poster Session**

Abstract

Topographic channel features such as bankfull level and floodplain terraces are functionally important features of rivers, yet remain difficult to quantify consistently. Recent acquisition of high-resolution lidar topography on a national scale makes topographic identification on the cross-section scale an increasingly accurate and reliable strategy to identify channel features such as bankfull and floodplain terraces. Using high-resolution topography and 2D hydraulic models, we present and test a new method for identifying channel features from topography (the Reach-Averaged Inflection Point Method) which utilizes the second derivative of channel width change to identify rapid channel expansions or constrictions indicative of prominent landscape features. The method includes averaging of cross-section results to produce results that represent reach conditions while moderating the effects of natural variation on the cross-section scale. The Reach-Averaged Inflection Point Method has been found to successfully identify bankfull and other channel features across a range of channel types, including both highly confined and open floodplain settings. Both alluvial and bedrock-controlled reaches have been tested, with the most consistent results found on alluvial reaches.

The UC Davis Arboretum - Experiential Learning on Water Quality and Restoration

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Session:	**Poster Session**

Abstract

This presentation will highlight the educational and science components of a first-year seminar offered at UC Davis that leveraged the restoration of the UC Davis Arboretum waterway. Prior to restoration of the waterway, a Course-Based Undergraduate Research Experience (CURE) seminar was offered during the 2023-2024 academic year, where first-year students collected data on biotic and abiotic components of water quality across established sampling sites of the arboretum waterway. Important educational components included the grading structure (specifications grading), use of "proficiencies" for skill development, and activities of data collection, management, analysis, and visualization. For the water quality data collected, students observed distinct spatial differences in water quality, with the east end experiencing stronger seasonality in dissolved oxygen, turbidity, and nitrate and higher levels of fecal coliform. In contrast, the west end exhibited consistent water quality across seasons and lower levels of fecal coliform, attributed to the effluent of the wastewater treatment plant. Following restoration, the course will be repeated and students will use the comprehensive dataset to evaluate how the restoration influenced water quality. This presentation will be co-delivered by an instructor and an original student of the course that has taken on a leadership role in the second offering

A Historical Perspective on Streamflow Capture in the Great Basin

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Session:	**Poster Session**

Abstract

The Humboldt River Basin is a critically important watershed for Nevada, the driest state in the nation. Its 16,840 square-mile drainage area supports ecosystems, rural communities and local economies. Its surface water flows are characterized by extreme variability, with 20th Century flows ranging from as low as 25,190 acre-feet (1934) to as high as 1,336,450 acre-feet (1984). Given the scarcity and significance of water in the basin, users have long fought in court over dividing the river. In recent decades, many lawsuits have focused on ways groundwater pumping for agricultural irrigation and mine dewatering has led to streamflow depletion, injuring priority surface water users. Drawing on historical research, this analysis examines how the law ignored the impacts of groundwater overuse in management frameworks, using the Humboldt River as a case study. From there, the analysis details contemporary efforts, driven by prolonged drought, to improve management, applying hydrologic science (i.e. capture zone models) to a legal system increasingly receptive to conjunctive management of surface and subsurface waters. Streamflow depletion is a prominent issue on the Humboldt River, but lessons learned could be applied in other arid watersheds, where river baseflows are threatened by overpumping.

Fire Regimes in the Idaho Salmon River Watershed Across Time and Ecoregions

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Session:	**Poster Session**

Abstract

As a consequence of modern fire suppression strategies and the onset of anthropogenic climate change, fire regimes in the Western United States have shifted to become more frequent and intense. Many studies have been conducted on this phenomenon, however, there is limited literature on fire regime trends in specific ecoregions within single states. We investigated wildfire trends in Idaho's Salmon River Watershed. Based on previous research, we hypothesized that both fire frequency and intensity would show an increasing trend over time and across all ecoregions. Using Idaho's distinct ecoregions, we established ten burn regions from which we collected wildfire data, including area burned and the frequency of fires per year from 1985 to 2023. We found that no burn regions showed a statistically significant change in fire frequency over time. However, we found that two burn regions, the Alpine Zone/Subalpine Zone/Barren Mountains (AZ/SZ/BM) and the Dry Partly Wooded Mountains (DPWM), showed a statistically significant increase in fire intensity over time. The significant increase in fire intensity observed in the two burn regions is likely attributable to the relatively low number of fires historically and substantial anthropogenic change. These findings identify the characteristics of an ecoregion in the Salmon River Watershed that contribute to increasing fire intensity. Using this process to determine the characteristics of fire frequency and intensity trends in other ecoregions can enable a more efficient allocation of resources for fire research and management.

RekaScan: A Multimodal Machine Learning Framework for Automated River Feature Mapping from Ultra-High-Resolution Drone Imagery

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Session:	**Poster Session**

Abstract

Alpine rivers are dynamic ecosystems increasingly affected by anthropogenic pressures. Yet current monitoring techniques remain slow, subjective, and insufficiently detailed to capture the spatial and temporal variability of key ecological features. RekaScan introduces a new approach to river monitoring, combining ultra-high-resolution (UHR) drone imagery with advanced machine learning (ML) to enable automated classification of hydromorphological, sediment, and riparian vegetation features across diverse fluvial environments. By integrating multimodal data, such as RGB orthophotos and elevation models, within a hierarchical classification pipeline, the project leverages recent advances in computer vision to support both coarse compartment segmentation (e.g. water, sediment, vegetation) and fine-grained feature extraction (e.g. geomorphic units, wood, boulders, substrate class). A core element of this project is river.features, an open-access, crowdsourced database of annotated UHR aerial river imagery designed to support reproducibility and generalization across river types. While the project is in its initial phase, this abstract outlines the rationale, system design, and expected data architecture, establishing a foundation for future empirical work and inviting collaboration. RekaScan is funded by the European Union's Horizon Europe research and innovation programme under the Marie Skłodowska-Curie COFUND SMASH initiative (grant agreement No. 101081355), hosted by the Faculty of Computer and Information Science of the University of Ljubljana, and will begin in fall 2025.

SED: Sediment Trapping Estimation Behind Dams

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Session:	**Poster Session**

Abstract

Dams trap all bedload and a fraction of suspended sediments and nutrients, creating discontinuity in river networks. As dams age it is important to have a better estimation of their usable water storage capacity. Since 2010, new methods have been developed to account for impacts of dams in a river network at the watershed scale. The SED model accounts for the volume of sediment trapped behind each individual dam in the system and reduces sediment loads to downstream reaches accordingly. The steps are to first build a geo-dataset of hydrological and sediment information. Then, delineate watersheds to estimate sediment yields, especially at dam sites. If reservoir capacity is not available, we used a global database to estimate it as a function of power capacity. The volume of sediment trapped is calculated as a function of stream flow and reservoir volume. As sediment builds up, reservoir capacity decreases. On each time step sediment trapped is calculated for all dams in the river network. It is possible to run scenarios for planned projects. Results are presented in maps with the localized sediment load and its reduction. Also, reservoir transects are presented with the sediment build up layers and projections.

Expedición Río Usumacinta: An Interdisciplinary Approach to Understanding a Threatened Landscape

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Session:	**Poster Session**

Abstract

The Usumacinta River is the largest in Mesoamerica, flowing 1,000 kilometers from Guatemala to the Gulf of Mexico. For a significant portion, it forms the border between Chiapas, Mexico, and Peten, Guatemala. This border segment bisects the culturally and biologically rich tropical rainforest, a heartland of the Mayan civilization. However, this biodiversity hotspot faces significant threats. A proposed hydroelectric dam threatened the region, but recent Mexican water laws prioritizing environmental flows appear to have lessened this concern. Currently, the most pressing threats are increased settlement in protected areas and forest conversion for cattle ranching, sometimes linked to illegal cartel border activities. To better understand these challenges, a joint project involving Virginia Commonwealth University (USA) and El Colegio de la Frontera Sur (Mexico) was conducted from September 2023 to May 2024. A key component was an expedition planning course (Fall 2023) focusing on place-based learning, expedition development, and field project design. Students and researchers collaborated to develop observational projects on five key topics: land-use change, fluvial geomorphology, avian diversity, crocodile abundance, and team dynamics. These plans were implemented as a non-credit VCU Outdoor Adventure Program expedition (January 2024) – an 8-day, 200-kilometer whitewater rafting trip on the Usumacinta with support from Sierra Rios, a river conservation organization. Following the expedition, a student-faculty seminar (Spring 2024) focused on data analysis and stakeholder communication in both the US and Mexico.

Thermal regime diversity in the Klamath Basin post dam-removal

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Session:	**Poster Session**

Abstract

Temperature drives many ecosystem processes and is increasingly-recognized as an important focus for river restoration. Dams alter water temperatures directly through reservoirs and managed flows, but also indirectly by limiting access of migratory fish to upstream habitats with distinct regimes. Questions remain around how dam removals can help restore natural temperature regimes as well as the portfolio of conditions accessible to migratory fish. The largest dam removal project in history was completed in August 2024 in the Klamath Basin (California and Oregon, USA). We are using time-series methods to understand the effects of dam removal on temperature regimes by analyzing long-term, high-frequency temperature data from 31 sites located on the mainstem, in tributaries, and in off-channel ponds throughout the Klamath Basin. Specifically, we are using multivariate autoregressive models to determine long-term temperature trajectories and seasonality, as well as the unique effects of dam removal. Multivariate wavelets also show to what extent the dominant frequencies of temperature variation are synchronized across the watershed, and which sites contribute the most to thermal diversity. Because water temperature largely controls primary and secondary production, restoring and expanding the diversity of thermal regimes may have strong cascading effects on culturally-important species such as Pacific salmon.

Waterbird Community Assemblages and Behavioral Ecology in Managed Wetlands and Tidal Restorations in Suisun Marsh, CA

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Abstract

Suisun Marsh, located in the San Francisco Estuary, is at the confluence of the Sacramento and San Joaquin Rivers and has a mosaic of wetland types that create habitat for migratory birds and fishes. Managed wetlands, with a controlled hydrologic regime, are being replaced with passive tidal restorations due to interest in increased fish habitat. We surveyed waterbirds, habitat structure, and macroinvertebrates in tidal and managed wetlands to assess how bird communities and benthic foraging opportunities can be expected to shift when managed wetlands are converted to tidal wetlands. We also recorded the behaviors of waterbirds in the different wetland types. We found that tidal cycles in tidal wetlands allowed for consistent habitat for migratory waterbirds, while flood cycling in managed wetlands, when aligned with migration, showed high waterbird use. Foraging occurred at a higher rate in tidal wetlands, while roosting was more prevalent in managed wetlands, suggesting a temporal division in habitat use. Waterfowl showed significant relationships with managed wetlands, while larger shorebirds showed a significant relationship with tidal wetlands. This study helps inform how landscape conversion in systems downstream of major rivers may impact waterbird community assemblage and behavior through creation of a habitat mosaic.

Finding the Right Flows: How Hydropower Facilities Alter Streamflows in Watersheds Throughout California

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Session:	**Poster Session**

Abstract

California has more than 300 hydropower facilities operating in stream systems throughout the state, making it the fourth largest hydropower producer in the U.S. These hydropower facilities provide a myriad of benefits to support societal activities, ranging from renewable energy production to agriculture irrigation. At the same time, infrastructure from these facilities can largely disrupt the natural behavior and functionality of streamflow patterns, which consequently undermine biological processes like fish migration and spawning. As climate change is expected to bring hotter temperatures and longer drought events in the imminent future, the functionality of streamflows will be further limited to meet the increasing water needs for ecological resilience and various stakeholders. This research project assesses the ecological impacts of 126 federally-regulated hydropower projects on flow regimes and fish population health in stream systems throughout California. Using functional flow components to quantitatively characterize streamflow regimes, this research evaluates the extent to which all 126 hydropower projects have historically and contemporarily complied with minimum streamflow requirements issued by the Federal Energy Regulatory Commision (FERC) throughout their license timelines in order to provide more informed water management recommendations that optimally support aquatic ecosystem health and various societal needs.