Oral Abstracts

September 17-18,

2015

Abstracts for oral sessions presented at the 2015 State of the San Francisco Estuary Conference are compiled in this document. Abstracts are listed by Session Topic. Names of presenting authors are underlined.

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Zachary Wasserman, Chair, San Francisco Bay Conservation and Development Commission, zwasserman@wendel.com

Keywords: BCDC, Shorelines, Climate Change

Session Title: Day 1 Plenary Session

Speaker Biography: In 2012, Zack Wasserman was appointed by Governor Jerry Brown as Chair of the San Francisco Bay Conservation and Development Commission. As General Counsel to the East Bay Economic Development Alliance, Zack played an integral role negotiating with BCDC on the Bay Plan Amendment to address rising sea levels. He currently serves as vice-chair of the San Francisco Regional Center that coordinates regional policies of MTC, ABAG, BAAQMD and BCDC. He serves as general counsel to the Oakland Chamber of Commerce and the East Bay Economic Development Alliance, as well as to several non-profit corporations and foundations engaged in technology transfer and scientific development.

San Francisco Bay Year 2115: Three Science Fictions

Kim Stanley Robinson, Writer

Keywords: San Francisco Bay, Future, Science Fiction

Session Title: Day 1 Plenary Session

Speaker Biography: Kim Stanley Robinson is a science fiction writer who lives with his wife and sons in Davis, California. His first novel was published in 1984, and he has published about twenty novels since then. He was sent to the Antarctic by the NSF, and his books have been translated into 24 languages. His *Mars* trilogy is an international best-seller and recent novel *2312* was a New York Times bestseller. He was named a "Hero of the Environment" by Time magazine in 2008, and now works with the Sierra Nevada Research Institute.

Drought, Demography and Conservation – The Estuary and 21st Century California

Glen MacDonald, UCLA, macdonal@geog.ucla.edu

The San Francisco Estuary encapsulates environmental challenges of land-use, climate-change, declining governmental capacity and evolving public priorities faced by conservation efforts across the State. As population grows towards some 50-60 million by 2050 we are grappling with a climatic trajectory to hotter and more arid conditions. This is producing altered physical environments, disturbance regimes and ecosystems. Perhaps more fundamentally, the demography, life experiences and the very concept of nature itself are evolving in the State. With the largest proportion of urban dwellers in the United States in California, the experiencing and conceptualization of nature is as likely to be formed in the empty lot down the street as in the mountains of Yosemite. These trajectories of environmental, demographic and socioeconomic change are manifest and clear. They are trajectories that extend beyond California to the Southwest and in some cases nationwide. The current California drought and its impacts must be viewed in the wider context of these larger temporal and geographic patterns. This drought is not an end-state of these trajectories but rather a way-station that points to the future. The 21st century is a new world of considerable conservation challenges. Here then is the critical importance of the San Francisco Estuary and its terrestrial, marsh and aquatic habitat. As wrought as it is with conflicts over species and habitat protection, land usage, and the provision of water resources, being situated within an urban megalopolis of 7 million people the Estuary offers an opportunity to showcase resolve and success in grappling with the myriad environmental challenges afflicting many of the world's coastal metropolises. Just as importantly it provides a chance to engage this massive urban population with the diverse nature at their doorstep and develop conservation ethos in new generations of Californians for the benefit of the State and beyond.

Keywords: San Francisco Estuary, Conservation, Nature, Climate Change, Drought, Population, Cities

Session Title: Day 1 Plenary Session

Speaker Biography: Glen M. MacDonald is John Muir Memorial Chair of Geography and a UCLA Distinguished Professor. He is a Co-PI for the Department of the Interior's Southwest Climate Science Center. His research focuses on climate change, its causes and its impacts on the environment and society. A particular focus of his work has been water resources and society in western North America and the global semi-arid regions and the concept of the 'Perfect Drought'. He has over 150 scientific and popular press pieces and an award winning book on biogeography. He speaks widely to the public and policy makers and has provided presentations and testimony to a number of California state agencies and the US Senate Appropriations Committee. Glen MacDonald is a Member of the National Academy of Sciences, a Fellow of the American Geophysical Union, a Fellow of the American Association for the Advancement of Science, and a Guggenheim Fellow.

From American Samoa to California: Confronting the Environmental Challenges of the 21st Century

Jared Blumenfeld, Administrator for EPA's Pacific Southwest Region (Region 9),

San Francisco Bay is recognized around the world for its natural beauty and ecological significance. Jared Blumenfeld, EPA's regional administrator of the Pacific Southwest, will highlight EPA's work in identifying and addressing the threats to the Bay and Delta's ecological health. The Clean Water Act has enabled EPA to improve the Estuary's condition from 50 years ago by reducing legacy pollutants like PCBs and mercury, improving polluted stormwater, and supporting ecological restoration efforts. The current challenges of climate change, and expected 'mega droughts' for California, call for more engagement with EPA's partners at the state and local level, as well as with academia and innovators from across the globe in order to keep pace with new technology and approaches needed to sustain our communities and our environment.

Keywords: San Francisco Bay, Clean Water Act, climate, drought

Session Title: Day 1 Plenary Session

Speaker Biography: Jared Blumenfeld was appointed by President Barack Obama to serve as EPA Regional Administrator for the Pacific Southwest in November 2009. EPA Region 9 is home to more than 48 million people in California, Arizona, Hawaii, Nevada, the Pacific Islands, and 148 tribal nations. Mr. Blumenfeld priorities at EPA include strong enforcement, environmental justice, protecting and restoring our air, land and waters, building strong federal, state, local and tribal partnerships, and taking action on climate change. Before becoming Regional Administrator, Mr. Blumenfeld was the Director of the San Francisco Department of the Environment where he spent eight years as the primary environmental decision-maker for the city. Jared helped to initiate many landmark environmental laws that became part of the municipal Environment Code. These included San Francisco’s ban of plastic bags, a 2020 zero waste goal, LEED Gold building standards, and an overarching precautionary principle framework.

Surviving the Storm: The Bay Area Economy at Risk

Jim Wunderman, Bay Area Council, Jim@bayareacouncil.org
Jim Levine, Managing Partner, Montezuma Wetlands; Co-Chair, Bay Area Council Water Committee

California's climate is famously volatile, with winters of devastating floods separated by years of remorseless drought. Following recent mega storms in New York and New Orleans, the Bay Area Council Economic Institute, in partnership with AECOM, the Brattle Group, the California Coastal Conservancy, Gensler and the Gordon & Betty Moore Foundation, have produced *Surviving the Storm*, a report which models the potential economic impacts of a 150-year mega storm striking the Bay Area.

California is vulnerable to prolonged periods of heavy rainfall, elevated tides and gale force winds known as "atmospheric rivers." The great flood of 1862 brought rain to Northern California for 43 days straight, transforming the central valley into an inland sea, destroying Sacramento and bankrupting the state.

Surviving the Storm models a significantly smaller storm than 1862, but larger than anything seen since. Seven days of torrential rain would grind daily life to a halt. Local rivers and creeks would swell beyond anything seen since the Gold Rush. Air travel would stop and major roadways would be blocked. The San Francisco Bay, elevated by low barometric pressure, storm surge, and a king tide, would overtop local levees like a clogged sink, resulting in widespread flooding.

Silicon Valley, much of which is below sea level, is particularly vulnerable: over $7 billion worth of damage is expected to occur in San Mateo and Santa Clara counties alone. As we saw in New Orleans following Hurricane Katrina, businesses are only able to suspend operations for so long until they uproot and go elsewhere, sometimes never to return.

From wetland restoration to levee improvement, surviving the Storm examines policy opportunities for local, state and federal officials to greater investments in the Bay Area's flood protection infrastructure.

Keywords: flood, extreme weather, atmospheric river, economy, superstorm, levees, wetlands

Session Title: Day 1 Plenary Session

Speaker Biography: Jim Levine is a Bay Area entrepreneur with a graduate degree in environmental engineering from UC Berkeley. In 1998, Levine began the Montezuma Wetlands restoration project, helping to pioneer the use of dredged sediment to accelerate the restoration of tidal wetlands and other habitat, influencing federal policy on dredging and wetlands around the country. Montezuma launched its 1,800 acre tidal wetland restoration project site operations as part of the 2003 Port of Oakland's 50-foot dredging project, and has since received more than 6 million cubic yards of sediment while readying the first 500-acres of wetlands for full restoration. Prior to Montezuma, Levine founded and ran Levine*Fricke, a prominent environmental engineering and contracting firm that successfully remediated California's first Superfund site, and worked with the US Army and Navy to pioneer technologies to stabilize nuclear materials. Jim started his career as a staff engineer for the San Francisco Bay Regional Water Quality Control Board, and has previously served as a BCDC Commissioner, a Trustee for the Oakland Children's Hospital, a board member for organizations helping at-risk youth, and was a long-time advisory board member for UC Berkeley's College of Engineering.

How Healthy is Our Estuary?: The 2015 State of the Estuary Report

Letitia Grenier, San Francisco Estuary Institute, letitia@SFEI.org

The 2015 State of the Estuary Report, produced by the San Francisco Estuary Partnership, provides a broad-based, data-driven assessment of the health of estuarine ecosystems in the San Francisco Bay-Delta. The authors hope that this assessment will help natural resource managers and scientists make better decisions about how to best allocate resources to protect and restore the estuary, while informing a broader reading audience. A large team of scientists collaborated to provide data and interpret that data, and to create indicators of estuarine health within their area of expertise. These indicators of the health of the estuary fall into five attribute areas: Water, Habitat, Living Resources, Ecological Processes, and Stewardship.

The State of the Estuary Report 2015 is the latest in a series of analyses of estuarine health, most recently following the 2011 State of the Bay (also a San Francisco Estuary Partnership product) and earlier reports produced by The Bay Institute. The 2015 report expands greatly upon the 2011 report, principally by adding new indicators that address the health of Delta ecosystems. In addition to adding the Delta freshwater portion of the estuary, new information has also been added about the marine portion of the estuary—the Gulf of the Farallones. Also, several new indicators for the Habitat, Living Resources, and Ecological Processes are included, which reflect our greater scientific understanding of elements of the estuary that previously did not have enough data to be included in such a health assessment. Based on this suite of scientific information, a story is emerging about how anthropogenic stresses are impacting estuarine ecosystem function, to what degree restoration to date has lessened these stresses, and what areas need attention in the future in order to restore estuarine health in this era of rapid change.

Keywords: health assessment, Delta, subregions, habitat change, flows, ecological processes,

Session Title: Day 1 Plenary Session

Speaker Biography: Letitia Grenier co-directs SFEI's Resilient Landscapes Program. She is the science lead for the 2015 State of the Estuary Report (a SF Estuary Partnership project) and the 2015 update to the Baylands Ecosystem Habitat Goals (a California Coastal Conservancy project), heading a team of over 200 environmental scientists, managers, and regulators to develop sciencebased recommendations for restoring and maintaining the health the Bay's tidal wetlands in the face of rising sea levels and other stressors. Letitia holds a PhD in Conservation Biology from the University of California at Berkeley and has previously worked on investigating bioaccumulation of contaminants in estuarine food webs, the condition of California's wetlands, and other ecological questions about the Bay. Her focus now is to work with partners to conserve California's living resources by developing landscape-scale, collaborative, sciencebased visions and solutions.

The Bay and the Delta: Making Connections during Drought, a Scientific Update and Insights from Europe

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San Francisco Bay and the California Delta are connected by more than Suisun Bay and the Carquinez Strait. The severe ongoing drought highlights the hydrologic, chemical, biologic, and ecologic connections that exist between our estuaries and river networks. These interactions often take place in strongly human-modified estuaries and rivers. Some emerging research taking place in Europe on some of their more highly modified estuaries and rivers is germane to San Francisco Bay and the Delta. Four examples from Europe are 1) the increasing prevalence and impact of harmful algal blooms, 2) emerging anthropogenic organic contaminants and their impacts on aquatic food webs, 3) multiple stressors interacting in Mediterranean rivers and degrading biota in rivers and estuaries, and 4) the effects of intermittent rivers in the landscape on perennial waters and coastal ecosystems. Warming temperatures, increased carbon dioxide, altered hydrology, and nutrient loading all push the pendulum towards stronger, longer, and more prevalent harmful algal blooms in both estuaries and deltas. The broad spectrum of organic contaminants (e.g. pharmaceuticals, personal care products, and pesticides) found in natural waters in the parts per billion and parts per trillion levels are not always benign, and analytical chemical methods to measure these pollutants are improving. Mediterranean rivers and estuaries are particularly susceptible to these contaminants due to warming temperatures, enhanced residence times, and increased inputs. The role of multiple stressors has long been a topic of interest in San Francisco Bay and the Delta. This topic is an emerging research area in Europe with interactions between emerging pollutants, heavy metals, nutrients, and climate change on biofilms and aquatic food webs of particular interest. Finally, intermittent rivers, which make up more than half of river networks worldwide and more than two-thirds of river networks in California, have emerged as a fruitful area of research.

Keywords: Europe, harmful algal blooms, emerging contaminants, multiple stressors, intermittent rivers

Session Title: Day 1 Plenary Session

Speaker Biography: Dr. Cliff Dahm is recently professor emeritus (as of July) at the University of New Mexico, where he taught and carried out research for 31 years. His research interests are in the areas of ecosystem studies, biogeochemistry, aquatic ecology, ecosystem restoration and the science and policy interface. He served as lead scientist for the CALFED Bay-Delta Science Program that became the Delta Science Program after passage of the Delta Reform Act in 2009. He was lead scientist from July of 2008 through February of 2012. His current research activities are on the ecology and biogeochemistry of intermittent rivers, the use of continuous sensor devices to measure and understand water quality, and the impacts of forest fires on streams and rivers.

The Fruits of Our Labors: Progress in Restoration and the Challenges Ahead

John Bourgeois, California State Coastal Conservancy, John.Bourgeois@scc.ca.gov

San Francisco Bay has undergone numerous transformations throughout its long history. The Baylands were once viewed as wastelands, needing to be reclaimed for 'better' uses. The large degree of tidal wetland loss since the mid-1800's due to urbanization, agriculture and salt production has been well documented, and eventually resulted in major shifts in public policy and attitude toward the Bay. Following a period of conservation and protection, we now find ourselves in the era of large-scale habitat restoration. But even with numerous success stories surrounding us, our community is faced with a new and even more daunting challenge.

Climate change threatens the Baylands, their wildlife, and the ecosystem services they provide to human communities. This threat increases the magnitude and complexity of the challenges to achieving a healthy and sustainable Baylands ecosystem with continued threats from urbanization, pollution, and invasive species. A corresponding increase in our innovation, partnerships among stakeholders, and monetary investment is required to achieve the Baylands acreage goals and to maintain the ecosystem services the Baylands provide over the next century.

Keywords: restoration, Baylands Goals Update, climate change

Session Title: Day 1 Plenary Session

Speaker Biography: John is a wetland ecologist that has served as the Executive Project Manager for the South Bay Salt Pond Restoration Project since 2009. John has almost 20 years of experience working on large-scale wetland restoration projects from San Francisco Bay, to coastal Louisiana, to mangrove swamps in the central Pacific. He has an M.S. in biology from the University of Louisiana at Lafayette and a B.S. in biology from Tulane University.

State of the Estuary Report 2015: Freshwater Flows

Tina Swanson, Natural Resources Defense Council, cswanson@nrdc.org

In the San Francisco Bay estuary, the amounts, timing and patterns of freshwater inflows control the quality and quantity of estuarine habitat, drive key ecological processes, and significantly affect the abundance and survival of estuarine biota, from tiny planktonic plants and animals to shrimp and fish. The State of the Estuary report uses more than a dozen indicators to measure and evaluate the condition and trends over time of annual and seasonal inflows, the quality and quantity of open water habitat, and the frequency, magnitude and duration of flood-driven ecological processes. Indicator results were compared against benchmarks, or reference conditions, that were based on scientific literature on environmental flow requirements for riverine and estuarine ecosystems, statistical relationships between inflows and estuarine habitat and fish abundance and survival, the State Water Board's 2010 Flow Criteria report that identified flows needed to protect public trust resources, historical inflow conditions, and regulatory standards for inflows, Delta diversion levels, and water quality. The Freshwater Inflow indicators revealed that inflows have been substantially reduced, averaging just half of estimated unimpaired inflows and creating chronic, man-made drought conditions in the estuary. These lower inflows result in reduced frequency of occurrence and quality of open water habitat conditions in the Delta (upper estuary) and the Bay, and reduced frequency of occurrence, magnitude and duration of ecologically important high flow flood conditions. Since 1990, most of the Freshwater Inflow indicators show "poor" and deteriorating conditions, and the Open Water Habitat and Flood Events indicators show that these ecological attributes were in "poor" condition in most years and only rarely in "good" condition (20% of years or less). These results underscore the importance of improving freshwater inflow conditions to the estuary as an essential element of ecosystem protection and restoration efforts.

Keywords: freshwater inflow, open water habitat, flood events, indicators, Bay, Delta

Session Title: State of the Estuary Report 2015: How Healthy is Our Estuary?

Speaker Biography: Christina (Tina) Swanson, Ph.D., is Director of the Natural Resources Defense Council's Science Center, where she works to expand the organization's scientific capabilities and support its legal and policy work across a range of environmental, public health and sustainable management issues. Prior to joining NRDC in 2011, Tina worked with The Bay Institute, serving as the organization's fisheries scientist and, from 2008-2011, as Executive Director and Chief Scientist. She is an expert in biology, ecosystem protection and restoration, ecological indicators and water resource management. Much of her work has been in the San Francisco Bay-Delta, but she has also worked and conducted research in Hawaii and, as a Fulbright Scholar, in the Philippines. Tina received her B.A. from Cornell University, her doctorate from UCLA and conducted post-doctoral research at UC Davis. She was President of the Western Division of the American Fisheries Society in 2012-2013.

State of the Estuary Report 2015: Habitat

Samuel Safran, San Francisco Estuary Institute, sams@sfei.org
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This two-part presentation covers three indicators of estuarine habitat health included in the State of the Estuary Report. The first part covers tidal marsh extent and patch size. Although the historical (pre-Euro-American) area of tidal marsh was greater in the Delta than the Bay, as of 2009 there were 12 and 70 mi^2 of the habitat in the two regions, respectively. Since then, an additional 0.4 and 10 mi^2 of diked areas have been restored to tidal action. The current proportion of Bay tidal marsh habitat arranged in patches large enough to support key native species, specifically rails, is comparable to historical levels. In the Delta, however, this proportion has been drastically reduced, further highlighting disparities between the two regions in the status of tidal marsh habitat. Given common assumptions of sea level rise and upstream salinity-shifts, these results signal the need for Estuary-wide habitat restoration goals. The second part of this presentation covers migration space, which is the area into which the rising Estuary could migrate. A basic approach to consistently characterize migration space has been tested, given four criteria: Bay-Delta applicability; reliance solely on public data; upgradability, and adjustability of key parameters. Based on a changeable definition of undeveloped lands, the approach reveals that, for a 2-ft rise in the Estuary, there is about 100 mi^2 of migration space, of which less than 30% is undeveloped. Only about 9% of the total migration space is both undeveloped and protected. In order of deceasing percentage of protected-undeveloped migration space, the sub-regions are: North Bay, Central Delta, Suisun, North Delta, South Bay, Central Bay, and South Delta. The North Delta, Central Delta, and South Bay have the three largest areas of unprotected-undeveloped migration space. Further analysis using local data in a regional context will facilitate migration space planning.

Keywords: tidal marsh, migration space, San Francisco Bay-Delta Estuary, SOTER

Session Title: State of the Estuary Report 2015: How Healthy is Our Estuary?

Speaker Biography: Sam Safran is an Environmental Analyst in the Resilient Landscapes Program of the San Francisco Estuary Institute. He is the author of the tidal marsh and woody riparian habitat sections of the 2015 State of the Estuary Report. He also carried out the spatial analyses of landscape change in the Sacramento-San Joaquin Delta that were recently published by SFEI in the report "A Delta Transformed."

State of the Estuary 2015: Living Resources and Food Web

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The San Francisco Estuary provides essential habitat for a diverse community of fish, wildlife, invertebrates, and plants that depend on the Estuary to complete all or part of their life cycles. In a comprehensive effort to assess the health of these populations in the Estuary, more than 30 Living Resources and Food Web indicators were developed for the State of the Estuary Report 2015. Results were evaluated with reference to benchmark conditions, which allowed assessment of current status and trends over time. Many indicators were updated from the 2011 Report and other indicators were added to extend the spatial coverage to include Suisun Marsh and the Delta, and to broaden ecological representation.

Status and trends differed regionally as well as among and within groups of organisms. The diversity of results reflects underlying differences in the ecology of estuarine species and their responses to ecological stressors. Fish indicators, including abundance of native fish, diversity, and community composition, suggested better conditions in the Central Bay, which is more influenced by ocean conditions, and poorer conditions in the upper Estuary region, which is more influenced by freshwater flows. Most of these fish indicators exhibited declining trends. The results for Delta and Suisun Marsh aquatic invertebrate and fish food web indicators were “good” to “poor,” with trends in overall and native species abundance varying among regions. Wintering and breeding waterfowl indicators were “good” to “poor” and showed mixed trends. Many of the bird and mammal indicators, such as harbor seals, herons and egrets, revealed relatively stable trends, though large shorebirds evidenced substantial declines. Some bird species (e.g., Brandt’s Cormorants) demonstrated recent recovery from earlier declines.

The Living Resources indicators set the stage for tracking ecosystem improvements as habitat restoration proceeds. In some cases (e.g., tidal marsh birds) they are already providing evidence of improvement.

Keywords: Fish, food web, birds, health, Delta, Bay, Suisun, indicators, wetlands

Session Title: State of the Estuary Report 2015: How Healthy is Our Estuary?

Speaker Biography: Nadav Nur is currently Quantitative Ecology Program Director at Point Blue. He has led the Bird and Mammal component of the 2015 State of the Estuary Report. **Hildie Spautz** is a Scientist with the California Department of Fish and Wildlife’s Watershed Restoration Grants Branch, where she participates in development of monitoring and adaptive management plans for restoration programs, primarily in Delta wetlands. As a scientist for the Rivers and Delta Program at The Bay Institute, **Alison Weber-Stover** collaborates on research projects aimed at understanding and improving ecosystem health of the San Francisco Estuary and its watershed.

State of the Estuary Report 2015: Water Use and Re-use

Peter Vorster, The Bay Institute, vorster@bay.org

WATER USE: This indicator measures the total volume of potable water annually used by municipalities in the Bay Area from 1986 to 2014 and the amount used per-person on an average daily basis (gallons per capita per day –gpcd) for the same period. Potable water use from 1986 to 2014 declined 24% or 266 thousand ac-ft from its near historical peak use of 1.1 million ac-ft. This is a remarkable achievement given that the population increased 26% during the same period. The per-person use declined by an even greater percentage - 40% down to 119 gpcd- because of the population increase. Residential use declined 16% or 93 thousand ac-ft (TAF) during this same period and the per-person use declined 33% to 72 gpcd by 2014. Data from 2014 and the first half of 2015 suggest that the region should be able to meet drought-induced mandatory use reductions imposed by the State and local agencies.

RECYCLED WATER: Recycled water is quantified with two metrics: 1) the total of the highly treated water distributed from wastewater treatment plants (WTPs) to provide a beneficial use, and 2) the surface and ground water supply that it potentially offsets, i.e. water that otherwise would be treated to potable (drinking water) standards and delivered by a municipal supplier or self-supplied groundwater or surface water that an agricultural or other commercial user would consume (potentially available for potable use). Recycled water use was quantified for 2001, 2005, 2010, and 2014. Total use steadily grew from 2001 to 2014 by 23 TAF, an 80% increase, to 52 TAF, which represents about 9% of the wastewater produced at WTP's. The amount that offsets potential potable water grew more - 26 TAF or a 158% increase- up to 42 TAF, which represents about 5% of the urban demand in 2014.

Keywords: potable water, recycled use, Bay Area per-capita, municipal beneficial wastewater

Session Title: State of the Estuary Report 2015: How Healthy is Our Estuary?

Speaker Biography: Peter Vorster has over 40 years of experience as a hydrogeographer, much of it focused on California's water resources. Peter has been at The Bay Institute since 1996, where he heads up the San Joaquin River Restoration Initiative and is a principal for the Ecological Scorecard project. Currently he is a senior adviser to the California Water Foundation on their Sustainable Water Management Profile project. Peter's expertise includes water management, water balance and system operations modeling, stream restoration, historical landscapes of California, and museum education. Peter is also a consultant to groups working on stream restoration and environmental flow management, primarily in the Eastern Sierra. He has an A.B. in geography and geology from UC Berkeley, an M.A. in geography from California State University East Bay, and completed Ph.D. coursework in environmental planning at UC Berkeley.

The Baylands and Climate Change: What We Can Do

Letitia Grenier, SFEI, letitia@SFEI.org

The Baylands and Climate Change: What We Can Do is an update to the 1999 Baylands Ecosystem Habitat Goals that synthesizes the latest science about the baylands and factors in projected future change through 2100 to outline new recommendations aimed at achieving healthy baylands ecosystems. Over 150 estuarine scientists, natural resource managers, and restoration practitioners collaborated to produce this report. The need for new recommendations was driven by advances in scientific understanding of drivers of change, particularly climate change and sediment supply, that will significantly impact the baylands by the end of this century. A long-term vision is crucial to prepare for climate change and to plan restoration actions decades in advance. The habitat acreage goals set in 1999 remain the same. However, new approaches need to be taken to achieve the goals, and these approaches are laid out in the updated recommendations. The following strategies are recommended to maintain healthy baylands and the benefits they provide:

> Restore complete baylands systems – both the habitats themselves and the processes that sustain the habitats.
>
> Accelerate restoration of complete baylands systems by 2030.
>
> Plan ahead for the dynamic future.
>
> Increase regional coordination and collaboration.

These recommendations will be the focus of the conference presentation. The recommendations must be integrated with social, civic, and economic planning to arrive at appropriate implementation strategies. This report provides technical information that policy makers and others can use in deciding how to take actions to maximize ecosystem health.

Keywords: baylands goals update, climate change, resilience strategies, ecosystem restoration, recommendations

Session Title: Baylands Ecosystem Habitat Goals Science Update 2015

Speaker Biography: Letitia Grenier co-directs SFEI's Resilient Landscapes Program. She is the science lead for the 2015 State of the Estuary Report (a SF Estuary Partnership project) and the 2015 update to the Baylands Ecosystem Habitat Goals (a California Coastal Conservancy project), heading a team of over 200 environmental scientists, managers, and regulators to develop science-based recommendations for restoring and maintaining the health the Bay's tidal wetlands in the face of rising sea levels and other stressors. Letitia holds a PhD in Conservation Biology from the University of California at Berkeley and has previously worked on investigating bioaccumulation of contaminants in estuarine food webs, the condition of California's wetlands, and other ecological questions about the Bay. Her focus now is to work with partners to conserve California's living resources by developing landscape-scale, collaborative, science-based visions and solutions.

Landscape Vision and Implementation Ideas for Suisun and North Bay

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Building on BEHGU's regional recommendations, subregional landscape visions have been developed that are place-specific and incorporate climate change. These provide a picture of how each subregion could look in the future if the recommendations are implemented. Suisun provides abundant opportunity to restore large patches of tidal marsh that adjoin broad areas of transition zone, while maintaining large tracts of diked marsh for intensive waterfowl management. The goal is to restore large connected areas of tidal habitat in Suisun Marsh and along the Contra Costa shore, to conserve and enhance adjacent terrestrial areas and associated seasonal wetlands, and to enhance remaining managed marsh habitat. The North Bay is similarly envisioned with restored large tidal marshes as part of a mosaic of dynamic, diverse, connected habitats from the Bay to the watersheds, and with enhanced managed ponds. Both visions face significant challenges of infrastructure, invasive species, subsidence, and the need to manage water levels and address flood management issues for adjacent lands.

To implement the subregional visions, BEHGU has developed actions grouped by shoreline segment based on the 1999 Habitat Goals. There are two groups of actions: (1) for habitats and the landscape in general that will benefit wildlife communities overall, and (2) for particular wildlife populations. For instance, restorations in Suisun should prioritize the areas that have naturally gentle slopes to maximize plant diversity in the transition zone and are ideal for landward marsh migration. Diked areas of Suisun Marsh that are not restored to tidal marsh should be enhanced to increase waterfowl diversity and carrying capacity, manage mosquitoes, reduce subsidence, and improve water quality. In the North Bay the focus is restoring a broad swath of tidal marsh along the shore as soon as possible and restoring riparian corridors, including floodplains, to connect the Baylands to the lower watersheds.

Keywords: Bayland Goals Update, Suisun Bay, San Pablo Bay, North Bay

Session Title: Baylands Ecosystem Habitat Goals Science Update 2015

Speaker Biography: Jeremy Lowe is a coastal and estuarine geomorphologist with over 30 years' experience in Europe and the US, the last 15 years on the West Coast with PWA, then ESA and now SFEI. His work has included the design of sea defenses in Venice, Italy and the planning of wetland restoration at Ballona Wetlands in Venice, California. Jeremy is the author of tidal wetland design guidelines for San Francisco Bay and a chapter author for the San Francisco Baylands Ecosystem Habitat Goals Update. He is working on a number of projects in the Bay designed to investigate the integration of ecosystem restoration, water quality and flood risk management in a more resilient shoreline.

Landscape Vision and Implementation Ideas for Central and South Bay

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Just as in the previous presentation, BEHGU subregional landscape visions have been developed for Central and the South Bay. These provide a picture of what each of these subregions could look like in the future if the recommendations were implemented successfully. The Central Bay is the region's most intensively developed shoreline, yet it is home to critical Bayland resources and is the visible center of the urban Bay Area. There are limited opportunities for large-scale restoration, yet there are opportunities for small-scale restoration projects with co-objectives of generating new knowledge and new public-private partnerships and community involvement. The vision for the Central Bay is to protect and enhance marshes and mudflats, while connecting urban residents to the Baylands with restoration projects that demonstrate how climate change adaptation can provide vital services while improving ecological health. In contrast, the South Bay provides some of the most extensive opportunities in the region to restore the Baylands. The vision for South Bay is to restore large tidal marshes as soon as possible. Given the large areas available for restoration and generally high sedimentation rates, tidal marsh restoration (including transition zones) to increase long-term shoreline resilience should be emphasized.

Within each subregion, the BEHGU team has developed implementation actions grouped by segment, following the layout of the 1999 Habitat Goals. There are two groups of actions: (1) for habitats and the landscape in general that will benefit overall Baylands communities, and (2) for particular wildlife populations that need extra attention. Examples of implementation actions range from large-scale restoration of former salt ponds (including creating large upland transition zones) in the South Bay, to multiple smaller-scale efforts in the Central Bay, including restoration of subtidal habitats such as eelgrass and oyster beds, and utilizing living shoreline techniques to protect more urbanized shorelines.

Keywords: Baylands Goals Update, marsh restoration, subtidal, central bay, south bay

Session Title: Baylands Ecosystem Habitat Goals Science Update 2015

Speaker Biography: Marilyn Latta is a Project Manager at the California State Coastal Conservancy. She manages the SF Bay Living Shorelines Project, Invasive Spartina Project, and additional regional projects and collaborative planning efforts in San Francisco Bay. She studied Marine Biology/Zoology at Humboldt State University, and prior to joining the Conservancy she worked for a variety of non-profit organizations to educate and involve the public in the protection and restoration of ocean and estuarine resources.

Flood Protection Meets Climate Change

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Scott Dusterhoff, San Francisco Estuary Institute
Julie Beagle, San Francisco Estuary Institute

Climate change – along with regulatory trends and shifts in public expectations – is one of several drivers leading flood protection agencies to more aggressively pursue nature-based flood management approaches. Projections for more intense and/or unpredictable storms, greater proportions of rain falling as precipitation on snowmelt systems – as well as increasing recognition of the potential for "atmospheric rivers" – are necessitating the consideration of higher flows. At the same time, the current drought and projections of future water shortages are increasing pressure to shift the design of our flood protection systems from maximizing drainage towards emphasizing capture of local stormwater. Finally, we are beginning to recognize how the design of our flood protection systems has diminished the resilience of the associated riverine ecosystems to climate change and other stressors.

These pressures are leading communities to more seriously consider how natural processes may be substantially re-integrated into our flood protection and stormwater systems to increase resilience to climate change. Many of our cities lie above natural aquifers that were recharged through stream floodplains and distributaries, reducing flood peaks while capturing winter flows. Efforts are underway to analyze how these natural buffers to flood and drought can be recovered through distributed systems of recharge, re-established floodplains, tree cover, and other elements. These changes will be challenging to design and implement but may be essential to making our communities less vulnerable to climate change. Fortunately, many of these innovations that can increase the resilience of flood protection systems can also improve the resilience of the associated riverine ecosystems, by reducing excessive flood scour of riparian habitats and maintaining groundwater levels and base flows during drought. As aging infrastructure is replaced in the coming decades, the next generation of flood protection can contribute to groundwater recharge, ecosystem resilience, and more sustainable flood management.

Keywords: Natural flood protection, ecosystem resilience, climate change

Session Title: Critters and Communities: New Approaches to Flood Management I

Speaker Biography: Robin Grossinger is a Senior Scientist at the San Francisco Estuary Institute, where he directs SFEI's Resilient Landscapes program. For over twenty years, Robin has analyzed how California landscapes have changed since European contact, using these data to guide landscape-scale restoration strategies. Robin and his team lead efforts throughout the state to reintegrate natural processes within our highly modified landscapes, creating healthier and more adaptive neighborhoods, cities, and surrounding landscapes. Robin's many publications include the Napa Valley Historical Ecology Atlas, released by the University of California Press in 2012, and his work has been featured by NPR, KQED's QUEST, Saving the Bay, and The New York Times. He has been recognized with a Local Hero award from Bay Nature magazine and the Carla Bard Bay Education Award from The Bay Institute.

Flood Protection Meets Ecosystem Restoration: A New Vision for Managing Channels at the Bay Margin

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Throughout the San Francisco Bay region, flood control channels at the Bay margin are aging and in need of replacement. Many of these channels do not pass flood waters and sediment loads effectively because they were designed decades ago when watersheds were less developed and the Bay elevation was lower. In addition, the building of these channels often resulted in the fragmentation, disturbance, or complete destruction of important bayland habitats as well as disruption of the physical processes that maintained these habitats over time. Flood control managers currently have a rare opportunity to redesign new flood control projects at the Bay margin that can help meet current and future flood control needs and improve bayland habitat conditions, provided they have the right tools and knowledge base to develop resilient, multi-benefit designs.

Flood Control 2.0 is an EPA-funded project involving several agency partners that is aimed at developing tools and providing information that can be used in designing multi-benefit flood control channels at the Bay margin. This presentation will provide an overview of the technical work being done under Flood Control 2.0 to assist the flood control management community, including the development of a regional channel morphology and sediment delivery synthesis, a management concept framework for flood control channels at the Bay margin, and a long-term, landscape scale management "vision" for a single flood control channel at the Bay margin.

Keywords: flood control, bayland habitat resilience, multi-benefit management tools, design

Session Title: Critters and Communities: New Approaches to Flood Management I

Speaker Biography: Scott Dusterhoff is a geomorphologist at the San Francisco Estuary Institute with a background in fluvial geomorphology, watershed hydrology, and estuarine/tidal wetland dynamics. For two decades, Scott has been working in coastal and upland watersheds throughout California, Oregon, and Washington, as well as in the Mid-Atlantic, on projects that use in-depth scientific investigations to inform sustainable ecosystem management approaches. He specializes in understanding the impacts of land disturbance and flow regulation on geomorphic processes and aquatic habitat for a variety of endangered species. He has extensive experience using a combination of field-based data, numerical modeling, and geospatial tools to characterize fluvial and coastal sediment transport dynamics, assess hydrologic/hydraulic processes in watershed and estuarine environments, and construct watershed and estuary water and sediment budgets.

Flood Protection Meets Ecosystem Restoration: A New Approach to Regional Planning in the Delta

Campbell Ingram, Sacramento-San Joaquin Delta Conservancy, cingram@deltaconservancy.ca.gov

California Eco Restore creates an expectation of at least 30,000 acres of habitat restoration be completed within the next 5 years. It also directs the Delta Conservancy to facilitate locally led regional planning processes to identify priority projects. Working with large partnership of restoration experts we have developed a three step process, to be piloted this fall and winter called the Northeast Delta Landscape Restoration Framework. It aims to engage the best available science for restoration design by connecting science and stakeholder experts to advanced analytical tools in a real-time analysis and decision support environment. The Framework helps scientists, stakeholders, and agencies envision how complex ecosystem restoration alternatives can be integrated with flood protection, the agricultural economy, and heritage values of the Delta. ***Step 1. Implement Data, Modeling, and Decision-Support Tools.*** First, the Framework integrates diverse data from physical and ecological processes to economics and demographics within an advanced data analytics and visualization platform. The goal is to produce modeling, data, visualization and decision-support tools that can be used in real-time by stakeholders and system experts alike as alternative futures are deliberated. ***Step 2. Develop a Vision of Regional Ecological Potential.*** Second, using the data and modeling tools, the Framework will produce a science-based vision of northeast Delta ecological potential as a guide to assure that individual restoration actions yield high-functioning landscapes in the future. The vision will represent our best data-driven current understanding of ecosystem function and potential while providing an overarching reference tool to guide restoration actions. ***Step 3. Develop Multi-Benefit Alternatives and Facilitate Decisions***. The Framework ultimately supports co-development of broadly acceptable landscape restoration strategies using the best available tools and scientific understanding. Moreover, the Framework provides a decision support environment that facilitates clarification of tradeoffs between alternatives to promote informed decisions among all stakeholders.

Keywords: Ecosystem Restoration Planning, Data Analytics, Data Visualization, Interoperable Models, Collaboration

Session Title: Critters and Communities: New Approaches to Flood Management I

Speaker Biography: Campbell Ingram became the first Executive Officer of the Sacramento-San Joaquin Delta Conservancy in March of 2011. The Conservancy is tasked with being a lead agency for ecosystem restoration in the Delta and supporting efforts that advance environmental protection and the economic well-being of Delta residents. Previously, Campbell was an Associate Director of The Nature Conservancy's California Water Program where he participated in the Bay-Delta Conservation Plan effort as a Steering Committee member. Campbell previously worked for the U.S. Fish and Wildlife Service where he was responsible for implementing several CVPIA restoration programs and the CALFED Environmental Water Program; and prior to that was employed by the U.S. Bureau of Reclamation working directly for the CALFED Ecosystem Restoration Program.

Levees Meet Habitat Creation: A New Strategy for the Delta

Cindy Messer, Delta Stewardship Council, cindy.messer@deltacouncil.ca.gov

The Delta Stewardship Council is leading the development of a new levee strategy to guide state investments that reduce flood risk while contributing to long-term improvement of river corridors that provide for fish and wildlife migration.This investment strategy will be developed in collaboration with state agencies, local reclamation districts, Delta landowners and businesses, and other important stakeholders. It will be based on the best available data, research, and lessons learned from other state and local programs and planning efforts. This presentation will focus on the Council's efforts to ensure that levee investments result in net benefits for channel-margin, floodplain and wetland habitats.

Keywords: floodplain, flood management, habitat, restoration, enhancement, investment, levees

Session Title: Critters and Communities: New Approaches to Flood Management I

Speaker Biography: Cindy Messer serves as the Deputy Executive Officer for Planning at the Delta Stewardship Council. She previously served as Interim Executive Officer of the Delta Conservancy. Prior to that, Cindy worked for several years at the Department of Water Resources.

Delta Case Study: Integrating Flood Protection, Habitat Enhancement, and Agriculture in the Yolo Bypass

Kris Tjernell, California Natural Resources Agency, Kristopher.Tjernell@resources.ca.gov

A new task force of wildlife agencies, flood planners, and local governments has come together to develop a common project that integrates multiple goals in the Yolo Bypass. This new partnership is attempting to integrate state flood protection objectives, which include a potential 10,000 to 18,000-acre expansion of the Yolo Bypass; ecological restoration objectives, which include improved fish passage and enhanced floodplain habitat for salmon; and local and regional objectives, which include maintaining agricultural productivity and waterfowl habitat. The Yolo Bypass Partnership is seeking accelerated permitting and broader sources of financing for this integrated multi-benefit project.

Keywords: floodplain, integrated, multi-benefit, Yolo Bypass, salmon, habitat, restoration

Session Title: Critters and Communities: New Approaches to Flood Management II

Speaker Biography: Kris Tjernell is the Special Assistant for Water Policy at the California Natural Resources Agency. Tjernell previously served as a policy consultant at the Conservation Strategy Group from 2007 to 2014, in the areas of integrated water management, water supply, ecosystem conflict resolution and public finance.

Bay Case Study: Integrating Flood Protection, Habitat Enhancement, and Groundwater Recharge in an Urbanized Watershed

Norma Camacho, Santa Clara Valley Water District, ncamacho@valleywater.org

The Santa Clara Valley Water District has operated under a guiding principle of using an integrated and balanced approach in managing a sustainable water supply, effective natural flood protection, and healthy watersheds.

Santa Clara County's shoreline is at great risk from flooding due to extreme storm events combined with high tides, and sea level rise. To address this risk, the Santa Clara Valley Water District has been working with the U.S. Army Corps of Engineers, the Coastal Conservancy, and the U.S. Fish and Wildlife Service on the South San Francisco Bay Shoreline Study. The purpose of this multi-objective study is to provide one-percent tidal flood protection, restore and enhance tidal marsh and related habitats, and provide recreational and public access opportunities for the Santa Clara County shoreline area. The Shoreline Study takes into consideration the potential need for adaption resulting from climate change, the primary consideration being sea level rise.

The current phase of the Shoreline Study is focusing on the San Jose shoreline area located between Alviso Slough and Coyote Creek. The recommended project includes a horizontal levee feature, which would be constructed bayside to the proposed flood risk management levee. Although this design approach increases fill in the waters of the U.S., it creates habitat connection between the tidal marsh and upland levee, buffers the flood risk management levee from wave action, and provides areas for restored marsh to retreat as sea levels rise. Because the federal civil works design and construction approach as well as the state and federal regulatory framework were both developed from a single-purpose project lens, many issues such as the calculation of project benefits, mitigation for temporal losses, and current policies prohibiting bay fill needed to be re-examined under this new multi-purpose project paradigm.

Keywords: Shoreline Study, multi-benefit, flood control

Session Title: Critters and Communities: New Approaches to Flood Management II

Speaker Biography: Norma Camacho is the Chief Operating Officer of Watersheds Operations for the Santa Clara Valley Water District. She joined the district in March 2012. As COO, Ms. Camacho is responsible for an operational and capital program at the District of over $200 million in FY15. She has more than 25 years of long-range planning, program development, finance, and capital projects experience. She previously worked as the Director of the Ventura County Watershed Protection District and prior to that position she served in the Ventura County Executive Office as deputy executive officer for finance and budgets. Ms. Camacho holds a bachelor's degree in civil engineering (structural) from Stanford University. She currently serves on the Board of Directors for the National Association of Flood & Stormwater Management Agencies and is a Board member of the American Red Cross of Silicon Valley. She was also co-chair of the 2014 Annual Floodplain Management Conference.

Below the Surface: Fish Response to Hamilton Restoration

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The Hamilton Wetland Restoration Project, located in Marin County, California, restores a former Army airfield (648 acres) to a mix of tidal and seasonal wetland, transitional ecotone and upland habitats. The project is being implemented by the U.S. Army Corps of Engineers (USACE), San Francisco District, in partnership with the California State Coastal Conservancy (Conservancy). The site was constructed and opened to tidal inundation in the spring of 2014. The USACE and Conservancy are monitoring a variety of physical and biological parameters to provide information on the development of the project. Fish species assemblages were surveyed in the spring of 2015 utilizing a combination of otter trawl and beach seine techniques at multiple sample sites to assess the distribution and relative abundance of juvenile and adult fish species in the restored marshes, mudflats, and associated unvegetated shallow water areas. Captured fish were identified to species and statistical summaries were generated to document species diversity and relative abundance by sample site. A total of 20 different fish species were captured; 70% were species native to the Bay and 30% nonnative. Relative abundance of native species was dominated by Northern anchovy (*Engraulis mordax*) and topsmelt (*Atherinops affinis*); relative abundance of nonnative species was dominated by Shokihaze goby (*Tridentiger barbatus*). Additionally, Olympia oysters (*Ostrea lurida*), at least three species of shrimp (*Crangon* spp.), two species of crab, and copepods were observed in the catch. These encouraging results represent the first year monitoring and document initial fish response to the very young restoration site. Additional sampling will be carried out each year for the first five years of the restoration and then every other year for the remainder of the 13 year monitoring period to document fish response trends to the evolving site over time.

Keywords: Hamilton restoration, fish, monitor, wetland, tidal, native oyster, USACE, Conservancy

Session Title: Wildlife Responses to Change

Speaker Biography: Chris Fitzer is a senior aquatic ecologist and fisheries program manager with Environmental Science Associates. Chris has over 18 years of experience in working on a diverse range of projects involving fisheries and aquatic ecology, aquatic ecosystem assessment, restoration, and enhancement, and comprehensive water resource planning and management for local, state, and federal agencies. He received a Bachelor's degree from Texas Tech University and Master's degree from University of Colorado.

Below the Surface: Bugs and Fish in the South Bay

Jim Ervin, San Jose-Santa Clara Regional Wastewater Facility, james.ervin@sanjoseca.gov

The Lower South San Francisco Bay, the portion of the Bay south of the Dumbarton Bridge, started a significant salt pond circulation and restoration process in 2004. Since then, the South Bay Salt Pond Restoration Project has opened at least 16 former salt ponds in the Alviso Complex to circulate Bay water in over 3500 acres of recovered shallow water, including 1200 acres under full tidal, or managed, restoration. How has this changed the Lower South Bay ecology?

It is easiest to observe the apex of the eco system, the top predators and birds. But the food web is built from bottom up. The animals we can't easily see are the most important units: plankton, benthic invertebrates, shrimp, and fish. The strange and slimy things that people usually don't want to think about are food to many of the fish, mammals and birds we do like. How do we observe the underwater ecology? And, what are we seeing as a result of a decade of salt pond restoration?

This presentation will provide a synopsis of benthic studies and fish research efforts currently under way in the Lower South Bay. Results from this work will be summarized along with some comparison to other results from similar work in other parts of the Bay.

The opened ponds have become habitat to an increasing abundance of invertebrates which in turn is food for fish. Diversity of fish populations appear to be increasing, albeit based on comparison to sparse historical data sets. Anecdotal and systematic surveys of migratory bird populations additionally suggest that restored and recovering marshes are providing a lot of food for birds. So, far, the Alviso Complex appears to be transitioning into a healthy estuarine system.

Keywords: San Francisco Bay Salt Pond Restoration Fish Benthos Mysids

Session Title: Wildlife Responses to Change

Speaker Biography: Jim Ervin is the Compliance Manager for the San Jose-Santa Clara Regional Wastewater Facility, the largest wastewater facility in the San Francisco Bay area. He has worked for the Facility for 20+ years on wastewater analysis, collection system and stormwater protection, and, over the past decade in research and evaluation of past and present impact of treated wastewater on Bay marshes. Jim also represents the City of San Jose and the Facility as an executive board member to the Bay Area Clean Water Agencies (BACWA).

Up in the Air: Bird Response to Restoration

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The urbanized San Francisco Bay (SFB) is a critically important wintering and stop-over area for migratory waterbirds. Federal and state agencies in SFB are working together to restore 50 to 90% of former salt production ponds to tidal marsh while maintaining the rest as foraging and roosting areas for migratory birds. Since 1999, the USGS Western Ecological Research Center has evaluated migratory waterbird use of pre and post-restoration salt ponds in both North and South SFB. Our approach has been to use monthly surveys, applied studies and modeling to evaluate avian response to this changing habitat. To date, tidal flow has been restored to over 2,000 ha of ponds across SFB. In the North Bay prior to breaching, ponds were unoccupied by shorebirds at low tide, but annually supported tens of thousands of shorebirds, dabbling and diving ducks at high tide. Post-restoration, high tide water levels within the ponds have displaced roosting shorebirds; however, waterfowl densities have increased or remained similar to pre-breach values. In the South Bay, small shorebird and dabbling duck densities increased significantly in restoration pond complexes from 2003-2013. Dabbling duck increases corresponded strongly with salinity declines and this guild had significantly higher densities in low salinity circulation ponds and breached ponds compared with other pond management types. Small shorebirds had highest densities in shallow ponds managed as seasonal wetlands. Preliminary results from on-going modeling and applied studies suggest that the importance of different habitat features varies among waterbird guilds, indicating that a suite of management methods may be needed to maintain species diversity. Transitional post-breach habitat appears to provide important foraging and roosting areas for some waterbird guilds; however, continued efforts to optimize the performance of managed ponds will be imperative to maintain migratory bird numbers as breached habitats transition to tidal marsh.

Keywords: salt ponds, shorebirds, waterfowl, transitional habitats, migratory bird conservation, monitoring

Session Title: Wildlife Responses to Change

Speaker Biography: Susan De La Cruz has over 20 years of wildlife research experience in San Francisco Bay Delta and along the Pacific and Central Flyways. As a senior researcher, she directs research priorities and direction at the San Francisco Bay Estuary Field Station. With Federal, State, University, non-profit, and local partners, Susan conducts research on foraging and migration ecology, responses to habitat restoration, climate change effects, winter habitat use, and survival and contaminant effects in nearshore avian species. Susan has a B.S. in Biological Sciences from University of California, Davis, an M.S. in Wildlife and Fisheries Sciences from Texas A&M University, and Ph.D. in Ecology from University of California-Davis.

River Otters: Back on the Bay Area Map

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The River Otter Ecology project launched in 2012 to address a critical data gap in the understanding of North American River Otter (*Lontra canadensis*) population abundance, range, prey species, migration corridors and health issues in the SF Bay Area.

Historically extirpated from the region, wild populations of this sentinel carnivore appear to have made a recovery in recent years. Utilizing a citizen-science network paired with field investigations in 2012 and 2013, we documented 1374 River Otter observations across 8 of 9 San Francisco Bay Area counties. We found that River Otters are reproducing, and reported on the first sightings in decades in Alameda, San Francisco, and Santa Clara counties, indicating a possible gradual expansion of the species' range southward.

Within our Intensive Study Area in coastal Marin County, conservatively estimated densities ranged from 0.21 to 0.32 River Otters/km, with otters inhabiting a range of habitats from freshwater to marine. A pilot assessment of disease and mortality indicates that otters are being exposed to pathogens such as Vibrio and that observable mortality was largely due to car-strikes.

Despite large-scale ecosystem restoration actions underway across the San Francisco Bay Area, River Otters have been overlooked by resource managers. Because they not only benefit from restoration actions but also may play a significant role in the outcome of recovery actions focused on endangered salmonids and waterfowl, we recommend attention to their potential role as a keystone species in the San Francisco Bay Area.

River otters, as highly charismatic predators, make ideal ambassadors for public interest in and support for watershed restoration and conservation. Their return to the SF Bay Area can be seen as a hopeful result of restoration efforts.

Keywords: citizen science, ecosystem restoration, Lontra canadensis, SF Bay Area, sentinel species

Session Title: Wildlife Responses to Change

Speaker Biography: Megan Isadore is the Co-founder and Executive Director of the River Otter Ecology Project. Little did she know that her degree in English and Philosophy was the precursor to a career in science. She began her study of ecology 17 years ago, working on recovery of the critically endangered salmon of Lagunitas Creek. There she saw her first river otters, was smitten and was moved to found ROEP. Her passions also include environmental education, writing and painting. For her work with the River Otter Ecology Project, she was honored with a Congressional Certificate of Excellence, Gold Medal Environmental Leader of Marin Award and the John Muir Nonprofit Award in 2014. "Watersheds, with their complicated constancy, fascinate and inspire me every day," according to Megan.

Data and Tools: Modern Information-Sharing to Promote Beneficial Resource Outcomes

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In agency circles, scientists and managers voice many questions and concerns about data sharing. How do natural resource managers leverage tools to communicate not just data but other useful information? And how do they ensure that their data-sharing practices conform to current user needs and expectations? What does effective collaboration look like in the context of environmental information management?

This panel will chart some examples of successful information-sharing projects serving the Estuary. Panelists will demonstrate recent strides in the use of tools to inform management decisions, illustrating how advances in information-sharing have also advanced our ability to manage our resources more insightfully. For instance, the Delta Conservancy and Delta Stewardship Council have partnered with nonprofits such as San Francisco Estuary Institute, The Nature Conservancy, and New Fields to promote open data, harness information for regional insights, and aggregate restoration project tracking. Point Blue, the State Coastal Conservancy's San Francisco Estuary Invasive *Spartina* Project, and USFWS have partnered to track endangered Ridgeway's rails in the Bay and share related information on a broad scale. Meanwhile, the Exploratorium serves as a convener of data providers and consumers, while working with NOAA and USGS to track sea-level rise at their Bay Observatory. The Exploratorium, an educational, publically focused organization, both contributes and distributes information.

The panel will begin with a live-narrated video highlighting some of the panelists' recent advances in environmental information-sharing and collaboration. Panelists not featured in the video presentation will then introduce a recent project emblematic of open data sharing. We then anticipate the panel to conduct a lively conversation among the gathered experts to probe not only the successes but continuing challenges to well-integrated information technology.

Following the panel, during the poster session, we will feature the "Tech Section." This multimedia, information-rich innovation center will afford an opportunity for attendees to continue the discussion started during the panel session, while watching interactive demonstrations of the highlighted tools.

Keywords: collaborative data-sharing practices, environmental information management

Session Title: Data and Tools: Modern Information-Sharing to Promote Beneficial Resource Outcomes

GreenPlan-IT 101 - Where to Improve Water Quality in Your Watershed

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Addressing stormwater runoff and pollution challenges associated with urbanization is complex and relies on costly engineering, especially in highly-developed urban environments. Increasingly, distributed management of stormwater runoff using Green infrastructure (GI) is emerging as a multi-benefit solution that can address both stormwater quality and quantity concerns. Consistent with this trend and under the NPDES Stormwater Municipal Regional Permit (MRP), many local municipalities are required to develop and implement watershed-scale green infrastructure plans to cost effectively achieve quantitative water quality improvements and provide reasonable assurance that GI will achieve the desired load reductions.

GreenPlan-IT, a watershed planning level tool, was developed to support the cost-effective selection and placement of GI in urban watersheds. The GreenPlan-IT ToolKit is comprised of three Modules: a GIS-based Site Locator Tool, a Modeling Tool, and an Optimization Tool. The Site Locator Tool works with ESRI Arc-GIS software to produce customizable, practical, and useful planning-level maps that identify and rank the best locations to implement GI. The Modeling Tool is built on a spatially distributed hydrologic and water quality model to establish baseline conditions; identify high-yield runoff and pollution areas; and quantify any reduction made from GI implementation across a watershed. The Optimization Tool was developed to determine GI scenarios (locations, types, and design configurations) that minimize the total implementation cost while satisfying water quality and quantity objectives and constraints.

The GreenPlan-IT Toolkit has been piloted with the City of San Mateo and the City of San Jose. The City of San Mateo incorporated map outputs into their Sustainable Streets plan. The City of San Jose utilized all three Toolkit modules to support a cost-benefit evaluation of stormwater runoff control. The tool combines the best available science with the best available local and regional data and can be applied to other municipalities throughout the region.

Keywords: Green Infrastructure, Watershed Planning, GIS, Water Quality,

Session Title: Urban Greening of the Bay Area

Speaker Biography: Pete Kauhanen is a GIS Specialist and Project Manager at SFEI with over 6 years' experience generating, obtaining, and analyzing GIS data for environmental projects. Pete has a background in watershed ecology, green infrastructure planning, habitat mapping, fire management, utilizing indigenous knowledge to achieve conservation goals, projects and initiatives. Pete has a BA and MA from Stanford University where he focused on ecology, behavioral ecology and environmental anthropology. **Lester McKee** is a Senior Scientist at SFEI, specializing in design and implementation of studies on the sources, transport, transformation, and loadings of sediments, nutrients and trace contaminants in Bay Area watersheds. He also studies hydrology, water quality, geomorphic processes, and resource mapping using geographic information systems (GIS). Dr. McKee has a BSc. in Geology from the University of Canterbury in New Zealand. He conducted his Ph.D. hydrology and nutrient biogeochemistry research at Southern Cross University in Australia.

Stormwater Infrastructure Funding

Mitch Avalon, County Engineers Association of California, maval@pw.cccounty.us

The total water portfolio in California is divided into three sectors, drinking water, wastewater, and stormwater. The stormwater sector includes four service centers: groundwater recharge through infiltration of stormwater, stormwater quality improvement by removing pollutants, local-scale drainage facilities operated by cities and counties, and regional-scale flood protection systems often operated by Flood Control Districts. The stormwater sector has been underfunded for decades and if this disinvestment continues there will be far-reaching consequences. Fortunately, there is an effort underway that could turn around this cycle of disinvestment.

Last year, a coalition of statewide organizations came together to develop a Constitutional Amendment and ballot measure to help fund stormwater services. Currently, the California Constitution (Proposition 218) requires stormwater agencies to receive voter approval to establish or increase "rates" to fund capital and operational needs. Water districts and wastewater districts are able to fund their services with a different public involvement process. The ballot measure would establish a process to raise revenue for stormwater services similar to the process used by water districts and wastewater districts. In the context of this legislative effort, "stormwater" includes all four elements described above: groundwater supply, stormwater quality, local and regional drainage.

The way we manage water today in California and the management tools we will need to manage our water resources in the future are described in various state publications including the California Water Plan. It is a different world today than when Proposition 218 was passed in 1996. A coalition is working to clarify Proposition 218 requirements so all sectors of water are funded through a similar process, to help provide funding for stormwater services.

This presentation will describe the way stormwater services are funded, what's needed for sustainable funding, and the legislative effort to help provide that funding.

Keywords: Stormwater, Funding

Session Title: Urban Greening of the Bay Area

Speaker Biography: Mitch Avalon graduated from the University of California, Berkeley, with a degree in Civil Engineering. He worked for the Contra Costa County Public Works Department for 35 years, the last 15 years as the Deputy Chief Engineer for the Flood Control and Water Conservation District, where he developed the "50 Year Plan", a policy to convert traditional concrete flood control channels into natural stream systems. Mitch retired in 2011 and established his own company. He currently does special projects for Contra Costa County Flood Control District and County Engineers Association of California. Mitch has been chair of the Alhambra Watershed Council since its founding in 1997, is on the Board of Directors of the San Francisco Estuary Institute, and was the founding Chair of the Bay Area Flood Protection Agencies Association. In his free time, Mitch enjoys carpentry, wilderness camping, hiking, and kayaking.

Greening Oakland: Plans & Projects

Kristin Hathaway, City of Oakland, khathaway@oaklandnet.com
Rebecca Tuden, City of Oakland, rtuden@oaklandnet.com

This presentation will highlight how the City of Oakland is helping to improve water quality and watershed health through the implementation of green infrastructure projects and will describe its planning efforts for future opportunities. Case studies will illustrate several recently-completed projects including the retrofit of a parking lot in downtown Oakland that will reduce stormwater runoff volumes and capture runoff from fire truck washing, and a tree well project in West Oakland designed to help reduce the volume of stormwater and pollutants flowing into San Francisco Bay, specifically legacy PCBs. The presentation will also showcase several larger green infrastructure projects currently in design.

The presentation will discuss lessons learned in planning green infrastructure with an emphasis on implementation and design challenges at the local level. Oakland's development of an urban greening plan and recent efforts to incorporate green infrastructure into transportation programs will also be highlighted.

Keywords: Green Infrastructure, Lessons Learned, Stormwater, Urban Greening, Transportation

Session Title: Urban Greening of the Bay Area

Speaker Biography: Rebecca Tuden works for the City of Oakland Watershed and Stormwater Management Program on implementing water quality programs and managing green infrastructure projects. Previously she worked as a professional facilitator in environmental dispute issues and worked for the US EPA on watershed management, wetland regulatory issues and a coordinator on states' clean water programs.

Beyond Demonstrations: Making Green Streets a Reality

Jennifer Krebs, San Francisco Estuary Partnership, jkrebs@waterboards.ca.gov
Joshua Bradt, San Francisco Estuary Partnership, Jbradt@waterboards.ca.gov

Green Streets are locations where Green Infrastructure/Low Impact Development practices are applied to the public right-of-way (i.e. streets & sidewalks). When widely implemented within a watershed, Green Streets can address water quality, local flooding, and climate change resiliency challenges, while providing a host of community and environmental benefits. Although Bay Area municipalities have implemented a handful of opportunistic, demonstration projects, more effort is needed to make Green Streets a standard practice throughout the region. The San Francisco Estuary Partnership collaborates with local governments, the scientific community, and the regulatory community to identify and help resolve the many barriers to achieving a new standard paradigm. Our presentation will cover our on-going, multi-pronged efforts to increase local governmental capacity for Green Streets. These include: watershed-based planning and tracking tools, inter-departmental coordination, lessons from implemented projects, hydrologic and water quality monitoring, cost controls, and financing mechanisms for Green Street life-cycle costs.

Keywords: Green Infrastructure, Green Streets, Stormwater, Urban Greening, Transportation, Funding, GreenPlan-IT

Session Title: Urban Greening of the Bay Area

Speaker Biography: Jennifer Krebs is a Principal Environmental Planner with San Francisco Estuary Partnership. She works with local governments and water agencies throughout the Bay Area to plan, design, and build green infrastructure projects. She helped design and implement the EcoWise Certified Program, the Joint Aquatic Resources Permit Application (JARPA), the Bay Area Dioxins Project, and the Bay Area Green Business Program. She has a B.S.F.S. in International Affairs and an M.A. in Geography.

Josh Bradt is an SFEP Project Manager, working on Green Streets projects in seven cities along San Pablo Ave in the East Bay. Prior to this, Josh spearheaded the creation of City of Berkeley's Citywide Watershed Management Plan, which informed local Measure M—formally integrating LID into a $30M pavement improvement program. Josh was the Executive Director of the Urban Creeks Council and a Watershed Specialist at the Contra Costa Countywide Clean Water Program.

Nutrients in the Bay: Science to Inform Management Decisions

David Senn, San Francisco Estuary Institute, davids@sfei.org
Emily Novick, San Francisco Estuary Institute, davids@sfei.org

San Francisco Bay (SFB) has higher concentrations of the nutrients nitrogen and phosphorous than many US estuaries due to large inputs from treated wastewater effluent and nonpoint source runoff from the Sacramento and San Joaquin Rivers. Despite its abundant nutrient supply, SFB has exhibited resistance to classic symptoms of nutrient over-enrichment observed in other estuaries, such as large phytoplankton (i.e., algae) blooms and low dissolved oxygen. Beginning in the late 1990s, however, phytoplankton levels began increasing sharply in South Bay, raising concerns that SFB's resistance to high nutrient loads was weakening. In response to those concerns, regulators and stakeholders collaboratively launched the SFB Nutrient Management Strategy (NMS), a multi-year science and monitoring program that will build the scientific foundation to inform major nutrient management decisions for the Bay Area. This presentation will discuss recent results from NMS science activities. One high-priority NMS initiative focuses on harmful algae blooms and the toxins they produce, with studies measuring toxin levels in water and biota throughout SFB, and investigations into toxin sources and conditions that encourage their production, including the potential role played by nutrients. A second major initiative focuses on phytoplankton growth, dissolved oxygen levels, and nutrient cycling, with a geographic focus in the sloughs and tidal creeks of Lower South Bay.

Keywords: nutrients, dissolved oxygen, HABs

Session Title: Nutrients in the Bay-Delta

Speaker Biography: David Senn is a Senior Scientist at SFEI, Co-Director of SFEI's Clean Water program, and Lead Scientist for the Bay Area Nutrient Management Strategy. He received his PhD in civil and environmental engineering from MIT, where he studied the interactions between nitrogen pollution and iron and arsenic cycling in contaminated urban lakes. Subsequently, as a researcher at the Harvard School of Public Health, he conducted contaminant fate, transport, and exposure studies, including investigating mercury cycling, bioaccumulation, and human exposure in the Gulf of Mexico. Prior to joining SFEI, from 2007-2011, he worked at the Swiss Federal Institute of Aquatic Science and Technology coordinating an interdisciplinary project studying the ecological impacts of large dams in the Zambezi River Basin in southern Africa.

Future Nutrient Loads to the Estuary and Approaches for Monitoring

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Shih Jhish-Shyang, Resources for the Future, Reston VA, shih@rff.org
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Nutrient delivery to the San Francisco Estuary (SFE) and California coastal waters already have been significantly altered by changes in population and land use resulting in, for example, changes to the timing and location of phytoplankton blooms and the extent of aquatic vegetation. Continued population growth and anticipated changes in agricultural practices and intensity are expected to accelerate these changes. As a community, we must anticipate and plan for these changes.

Using a novel modeling approach, the USGS LandCarbon project generated prospective annual future land use and land cover maps using a range of population and development scenarios (IPCC scenarios A1, A1b, and B1) to the year 2100. These projected land cover and land use maps allowed us to assess the potential for changes in the delivery of nutrients and sediments from upstream areas to estuaries and coastal waters for the continental United States using the SPARROW model, calibrated on historical water quality measurements.

Model results suggest that we should anticipate significantly greater fluxes of nutrients to the San Francisco Estuary. For example, nitrate loading to SFE is projected to increase up to 50% by 2050, depending on the development scenario. Anticipating such increases should be part of the ongoing environmental planning, data collection, and restoration activities in SFE. The results for the different scenarios and opportunities for appropriate monitoring of these changes will be discussed.

Keywords: nutrients, nitrate, phosphate, eutrophication, land-use change, population change, climate change

Session Title: Nutrients in the Bay-Delta

Speaker Biography: Dr. Brian Bergamaschi is a research biogeochemist with the USGS California Water Science Center and adjunct Faculty at California State University Sacramento. He received a Ph.D. in Chemical Oceanography from the University of Washington, in Seattle, WA, where he specialized in analyzing the sources and fates of natural organic material in the environment. His main interests are in understanding processes of carbon cycling in aquatic environments and related biogeochemical processes. His particular emphasis is on developing methods for quantifying the interactions between physical and biogeochemical processes. His research ranges in scale from light-mediated molecular transformations, to tidally-driven wetland fluxes, to effects of changing continental-scale fluxes on coastal carbon processes. His current projects largely focus on the effects of wetland restoration on aquatic habitat quality and carbon cycling.

Adaptive Management of Nutrients in the Delta: Integrating Science and Policy

Lisa Thompson, Sacramento Regional County Sanitation District, thompsonlis@sacsewer.com
Timothy Mussen, Sacramento Regional County Sanitation District, mussent@sacsewer.com

The mission of Sacramento Regional County Sanitation District (Regional San) is to serve its approximately 1.4 million customers by protecting public health and the environment through reliable and safe conveyance, treatment, and disposal of wastewater from residential, industrial, and commercial sources throughout the greater Sacramento metropolitan area in the most cost effective manner, now and in the future. The wastewater travels through 169 miles of interceptor pipelines to the Sacramento Regional Wastewater Treatment Plant near Elk Grove, where approximately 150 million gallons of wastewater are treated daily, as permitted by the Central Valley Regional Water Quality Control Board, prior to discharge into the Sacramento River. Regional San is conducting the EchoWater project, a greater than $1.5 B upgrade to the treatment plant. EchoWater responds to recent changes to Regional San's National Pollutant Discharge Elimination System permit, and involves an accelerated construction program that will result in new treatment processes being operational for ammonia removal by 2021, and for filtration and enhanced disinfection by 2023. The project will produce improved discharged water quality, and increased volumes of recycled water for reuse. Regional San staffs participate in numerous water management forums and science/policy work groups in the Delta and San Francisco Bay areas, promoting the application of sound science to management decisions. We encourage the integration of science and policy to inform management actions that are outcome-based. In 2013-2014 Regional San helped fund and participated in a large-scale adaptive management experiment to test the potential effects of discharged, treated wastewater on phytoplankton community health in the Sacramento River. This multi-day experiment tested how phytoplankton could respond to the massive reduction in dissolved ammonia concentrations that will result from EchoWater. We consider adaptive management to be a powerful scientific and policy approach for testing a spectrum of future management actions in the Delta.

Keywords: Wastewater treatment, nutrients, adaptive management, science, policy, outcome-based policy

Session Title: Nutrients in the Bay-Delta

Speaker Biography: Lisa Thompson was appointed Chief Scientist for both Regional San and Sacramento Area Sewer District in 2014. As Chief Scientist, she leads and supports Regional San's efforts regarding complying with permit related studies, Delta research, and she also serves as a technical resource for all scientific research needs for both Districts. Thompson was previously employed by the University of California, Davis for 13 years, where she served in various positions including Specialist in Cooperative Extension in the Wildlife, Fish, and Conservation Biology Department, and as Director of the Center for Aquatic Biology and Aquaculture. Thompson holds a Bachelor of Science degree in Zoology from the University of Toronto, a Master of Science degree in Biology from McGill University, in Montreal, Canada, and a Doctorate degree in Zoology from the University of British Columbia.

POTWs' Role in the Nutrient Management Strategy for San Francisco Bay

Laura Pagano, San Francisco Public Utilities Commission, LPagano@sfwater.org

San Francisco Bay is a nutrient-enriched estuary. Nonetheless, dissolved oxygen concentrations found in the Bay's subtidal habitats are much higher and phytoplankton biomass and productivity are substantially lower than expected in an estuary with such high nutrient enrichment. This implies that eutrophication is potentially controlled by processes other than straightforward nutrient-limitation of primary production. However some evidence suggests the historic resilience of San Francisco Bay to the harmful effects of nutrient enrichment is weakening. If true, management actions may be needed to reduce the nutrient loadings to the Bay. In response, the Water Board has developed a Nutrient Management Strategy (NMS) which is now being implemented.

Studies estimate that two third of nutrient loads to the Bay are from POTW discharges. Since most wastewater treatment plants are not designed to remove nutrients, regulations mandating nutrient removal would result in large capital improvement programs by many POTWs. It is therefore very important to conduct the needed scientific studies to understand if the Bay is heading towards impairment and if so what should be done. To this end POTWs in the Bay Area are supporting a robust science program as part of the NMS that will help determine if impairment is imminent and if management actions are required to limit the amount of discharges of nutrients.

Through their regional coalition, the Bay Area Clean Water Agencies (BACWA), POTWs have negotiated a nutrient watershed permit, are providing funds to further the scientific studies, and are participating in the governing body overseeing the NMS. This presentation discusses the role of Bay Area POTWs in the regulatory, technical and governance aspects of the NMS and describes investigations being conducted that will provide insight into how POTWs could reduce nutrients if such requirements are ultimately needed.

Keywords: nutrient management strategy, nutrient loadings, POTW, BACWA, nutrient regulations, permit

Session Title: Nutrients in the Bay-Delta

Speaker Biography: Laura Pagano is the Regulatory Program Manager (Wastewater) for the San Francisco Public Utilities within the City and County of San Francisco. She is also the Chair of the Bay Area Clean Water Agencies (BACWA) a Joint Powers Agreement among the major Publicly Owned Treatment Works (POTW) in the nine county Bay Area. BACWA represents 46 POTWs in the Bay Area under the regulatory jurisdiction of the San Francisco Bay Regional Water Quality Control Board.

Can We Get There from Here? – Water, Energy, Climate, and Resilience, What the SF Bay Could Teach the World

Bob Perciasepe, Center for Climate and Energy Solutions (C2ES),

Although climate change is global, the impacts are local. Each city, state and region has to adapt to a changing environment, whether it's drought affecting water supplies, more frequent flooding damaging infrastructure, or extreme temperatures endangering health.

It will be up to local communities to deal with the impacts of climate change.

In many cases, we're already seeing action at the state and local level on two fronts: building resilience to climate impacts and also reducing the emissions causing the problem.

Last year, the White House named 16 local and tribal communities as Climate Action Champions for steps such as creating climate-smart building codes, installing green infrastructure, and setting targets to reduce energy use. San Francisco is one of those communities. If most major cities around the world pursued these kinds of policies, they could cut emissions by 8 gigatons by 2050.

While there is still much to be done, even in California and the Bay Area, forward-leaning efforts here can help the rest of the country make progress.

C2ES takes a pragmatic, nonpartisan approach to being a bridge between diverse interests and a catalyst of constructive business engagement.

Oftentimes, the risks cities, states and companies face are the same – loss of power and water services, flooding, damaged facilities, people unable to get to work, loss of revenue, and rising costs for insurance. The unique partnerships that continue to evolve here in San Francisco can grow and demonstrate success.

Cities, states and businesses can learn a lot from one another. And they will play a key role in this pivotal year for advancing the climate effort both at home and internationally.

Keywords: Climate change, global, local, resilience.

Session Title: Day 2 Plenary Session

Speaker Biography: Bob Perciasepe is President of the Center for Climate and Energy Solutions, a leading, independent voice for practical policy and action to address the twin challenges of energy and climate change. Mr. Perciasepe has been an environmental policy leader in and outside government for more than 30 years, most recently as Deputy Administrator of the U.S. Environmental Protection Agency (EPA). Previously, he served as chief operating officer of the National Audubon Society, Secretary of the Environment for the state of Maryland and as a senior planning official for the city of Baltimore.

Coping with Year 4 – How are We Doing and What's Needed Next

Jay Lund, Professor of Civil and Environmental Engineering, UC Davis, jrlund@ucdavis.edu

The presentation reviews the development of the drought and some implications for current and future management. Effects on agriculture, urban, and ecosystem objectives are reviewed, as well as management innovations, particularly regarding groundwater, water conservation, and water trading. Remaining problems and promising innovations for future drought years also are presented.

Keywords: Drought, Management, Ecosystem Objectives

Session Title: Day 2 Plenary Session: Water and Drought Panel

Speaker Biography: Dr. Jay Lund is Director of the Center for Watershed Sciences and Professor of Civil and Environmental Engineering at University of California, Davis. His research and teaching interests focus on applying systems analysis and economic methods to infrastructure and environmental problems, including policy, planning, and management studies. His work is primarily in water resources and environmental system engineering, but with substantial past work in solid and hazardous waste management, dredging and coastal zone management, and urban, regional, and transportation planning. He received his B.Sc. in Civil Engineering, M.A. in Geography, and Ph.D. in Civil Engineering from the University of Washington. Dr. Lund has been honored with the following awards: Julian Hinds Award, American Society of Civil Engineers/Environment and Water Resources Institute, Hugo B. Fischer Award, California Water and Environmental Modeling Forum, ASCE/EWRI Planning and Management Council Service to the Profession Award, Boggess Award for best paper in the Journal of the American Water Resources Association, and California Water and Environment Modeling Forum Service Award.

Economic Impacts – Facts, Fiction and Uncertainty

Jeffrey Michael, University of the Pacific, jmichael@pacific.edu

There are many claims made about the drought related economic impacts to our farming communities, urban areas, fishing communities from low water availability. Even the data seems to conflict sometimes. For example, agricultural employment and revenue is at or near record highs even as hundreds of thousands of acres have been fallowed and economic models estimate thousands of jobs have been lost. How should we interpret the information and put it into context? Is the drought an economic crisis? How does it compare to other natural disasters?

The drought provides an important opportunity for researchers, policy-makers, and the public to gain a better understanding of the links between water and the modern economy. For example, research on the 2009 drought has already had positive effects on our understanding of the effects of a much more severe drought today. While misinformation such as endangered minnows creating 40% unemployment can still be found in the media, the amount of misinformation and uncritical reporting is notably lower today.

This improved understanding of economic impacts also informs long-term policy debates in California that are too often driven by fear rather than facts. The drought can help us better understand the real costs of transitioning to sustainable groundwater management, and the critical importance of doing so. The drought helps us understand the real economic impacts of water shortages that could result from an earthquake in the Delta, and the wisdom of investing in twin tunnels to protect against that risk.

Keywords: Drought, Jobs, Agriculture, Economic Impact

Session Title: Day 2 Plenary Session: Water and Drought Panel

Speaker Biography: Dr. Jeffrey Michael is Director of the Center for the Business and Policy Research at the University of the Pacific's Sacramento and Stockton campuses. Jeff's areas of expertise include regional economic forecasting and environmental economics including work on water resources, the Endangered Species Act, climate change, and regulation on land use, property values and employment growth. His research has been published in scholarly journals and books such as the Journal of Law and Economics, Energy Policy, and Ecological Economics, and he has been a principal investigator on numerous grants including the Delta Protection Commission's Economic Sustainability Plan. Jeff is cited over 100 times per year in the local and national press including the Wall Street Journal, New York Times, San Francisco Chronicle, Los Angeles Times, NBC, NPR, and PBS. Jeff received his Ph.D. from North Carolina State University, M.S. from the University of Maine, and B.A. from Hamilton College.

Drought Impacts on Native Fishes of the Delta and Central California

Peter Moyle, Department of Wildlife, Fish, and Conservation Biology, UC Davis, pbmoyle@ucdavis.edu

Most native fishes of California need cool flowing water to survive. During drought, the streams and rivers of Central California become very low and warm, a process exacerbated by human removal of most of the water. Most native fishes have been living in a state of human-created drought even without natural drought, so the present severe drought is pushing them to their ecological limits. Several species, most conspicuously delta smelt, are facing extinction in the wild as a consequence. Species persistence seems to depend on 'luck of the drought' until a systematic drought and climate change protection strategy is in place.

Keywords: Native Fish, Delta, Drought, Extinction

Session Title: Day 2 Plenary Session: Water and Drought Panel

Speaker Biography: Peter Moyle is Professor and former Chair of the Department of Wildlife, Fish and Conservation Biology at University of California, Davis. He is the author or co-author of more than 170 publications, including the definitive Inland Fishes of California (2002). He has served on numerous advisory bodies, including the Ecosystem Restoration Program Science Board of the California Bay-Delta Authority and the National Research Council Panel on the Klamath River. His research interests include conservation of aquatic species, habitats, and ecosystems, including salmon; ecology of fishes of the San Francisco Estuary; ecology of California stream fishes; impact of introduced aquatic organisms; use of flood plains by fish. He has long-term research projects in the Suisun Marsh, Putah Creek, Sierra Nevada streams and the Cosumnes River.

The End of Wastewater: Sustainable Infrastructure for an Urban Estuary

David Sedlak, UC Berkeley, sedlak@berkeley.edu

Our municipal wastewater infrastructure was designed to reduce the amount of pollution released to the San Francisco Bay. Over the past forty years, increasing demands for water and recognition of the effects of climate change have led to a greater appreciation of the value of municipal wastewater as a source of water, resources and energy. Coincident with this change in attitude, much of the region's wastewater infrastructure has reached the end of its useful life. It is also becoming clear that many existing treatment plants are situated in locations that are vulnerable to sea level rise. As a result, it is likely that wastewater treatment plants will be replaced by resource recovery facilities that will extract water, energy and fertilizer from sewage. Although this new approach is well aligned with societal objectives of sustainability and resilience, its effect on the San Francisco Bay is uncertain. For example, potable water recycling often produces a waste stream that contains all of the metals, nutrients and organic chemicals that were originally present in the wastewater. Disposal of this concentrated waste stream without adequate treatment or dilution could be deleterious to aquatic life. Wastewater effluent discharges that have the potential to create climate-ready habitat along the margins of the Bay may disappear as water recycling becomes more popular. By anticipating the inevitable changes in our municipal wastewater infrastructure, it will be possible to create a new system that benefits our community and protects the San Francisco Bay.

Keywords: Urban water infrastructure, water reuse, nutrients, contaminants, climate change adaptation

Session Title: Day 2 Plenary Session: Future Visions for Estuary Water Quality

Speaker Biography: David Sedlak is the Malozemoff Professor in the Department of Civil & Environmental Engineering at UC Berkeley, Co-Director of the Berkeley Water Center and Deputy Director of the NSF engineering research center for Reinventing the Nation's Urban Water Infrastructure (ReNUWIt). Professor Sedlak's research addresses the use of natural and engineered systems to improve water quality and new approaches for increasing the sustainability and resiliency of urban water systems. He is a recipient of the NSF CAREER Award, the Paul Busch Award for Innovation in Applied Water Quality Research and the Clarke Prize for Excellence in Water Research. Sedlak is the author of Water 4.0: The Past, Present and Future of the World's Most Vital Resource and serves as editor-in-chief of the ACS journal, Environmental Science & Technology.

The Future of Green Infrastructure for Stormwater Management and Climate Resilience

Andy Lipkis, TreePeople, alipkis@treepeople.org

Andy Lipkis plans to take us back to the future. With climate change and severe weather increasingly stressing and overwhelming the capacity of infrastructure to protect public health and safety and reliably meet our needs; and costs dramatically mounting for upgrading and maintaining separate water quality, water supply, and flood protection systems, it is increasingly difficult to secure public support to pay for all the separate requests. But retrofitting the urban landscape with distributed multi-purpose smart green infrastructure—a combination of natural urban watershed practices, fully integrated with technology that *biomimics* and greatly enhances the performance of natural systems, may be the quickest, most cost effective and politically palatable pathway to sustainability and resilience.

Andy will describe how multiple diverse infrastructure agencies in Los Angeles are collaborating to co-create, finance, pilot test, and maintain these new intelligent landscape retrofit... on the pathway to scaling and accelerating wide scale adoption across the region. *Helping Nature Heal our Cities.*

Keywords: Rainwater Harvesting, Cisterns, Green Infrastructure, Multi-Agency Collaboration, Biomimicry

Session Title: Day 2 Plenary Session: Future Visions for Estuary Water Quality

Speaker Biography: Andy Lipkis founded the non-profit organization TreePeople at age 18 in 1973, and serves as its President today. Under Andy's leadership, TreePeople brings together people, trees, and forest-inspired infrastructure to protect cities against droughts and floods, prevent water and air pollution, and mitigate and adapt to climate change. Andy has received numerous awards, and in 2008 was named an Ashoka Fellow in recognition of his achievements as a social entrepreneur. Andy has been featured in numerous documentaries including the PBS series Visionaries, Dirt the Movie, and Rock the Boat. In 2014, Andy was named to the EPA's Green Infrastructure Collaborative, where he is representing L.A.'s Multi-Agency Collaborative, a group of three of the region's largest water agencies. Andy recently presented at TEDxUCLA, and speaks regularly to business, government, civic leaders and community organizations around the United States, Europe and Asia.

Greener Products for Bluer Waters: California's Safer Consumer Products Regulations

Meredith Williams, California Department of Toxic Substances Control, meredith.williams@dtsc.ca.gov

Many common products can impact water quality. There have been past successes in reducing such impacts by regulating products with bans or registration. New regulations in California and Washington are expected to reduce copper loads to water bodies through management of brake pad metals content. New standards for upholstered furniture will reduce the need for flame retardants, and, in turn, the amount of these substances in water bodies and aquatic species. Nevertheless, challenges remain for reducing impacts from consumer products with regulation. Even successful regulation has had unintended consequences in cases where hazardous chemicals were replaced with other chemicals with unanticipated hazards.

California's Safer Consumer Product (SCP) regulations use a new approach for chemicals regulation. The regulations identify a list of Candidate Chemicals with known human health or environmental hazards. Products containing Candidate Chemicals may be designated as Priority Products by DTSC if the product may cause harm. Manufacturers who wish to sell Priority Products into California must determine whether or not the chemical is truly necessary in the product or whether a safer alternative exists using a rigorous Alternatives Analysis. One strength of the regulations is that a thorough Alternative Analysis can avoid "regrettable substitutes" of one problematic chemical for another. Based on the outcome of the Alternatives Analysis, DTSC may regulate the product through a variety of regulatory responses.

The authorizing statute explicitly calls for consideration of water quality impacts in the Alternative Analysis. DTSC's three year Priority Products Work Plan established aquatic impacts as a policy priority and is currently evaluating product-chemical combinations. DTSC can use water quality monitoring data, bioaccumulation data, biosolids analysis, and source identification to inform its decisions about potential products.

This presentation will provide a regulations overview and discuss how a focus on consumer products can contribute to improvements in California water quality.

Keywords: source identification, pollution prevention, safer consumer products, regulation,

Session Title: Day 2 Plenary Session: Future Visions for Estuary Water Quality

Speaker Biography: Meredith Williams joined the Department of Toxic Substances Control in 2013 to lead California's new Safer Consumer Products program. She has expertise in research and development and product management for consumer product and chemical companies including Applied Materials and 3M. After nearly 20 years of corporate work, she joined the San Francisco Estuary Institute (SFEI). Among other positions, she served as SFEI's interim Executive Director. She works to ensure the SCP regulations are implemented using robust decision making processes, stakeholder engagement, and strong science. She holds B.S. from Yale University and a Ph.D. in physics from North Carolina State University.

Futuristic Water Quality Management in the Bay Area is Happening Now

Thomas Mumley, SF Bay Water Board, tmumley@waterboards.ca.gov

Our vision of future water quality in the Bay is one wherein there is no pollutant caused water quality impairment except for lingering but managed effects of legacy contamination, Water quality management will be integrated with habitat, flood, water supply, and land-use management. That means greening of infrastructure, less and less direct runoff to creeks and the Bay from hardscape areas, beneficial reuse of wastewater including habitat enhancement and purification for potable water use, and natural creek-system flood management. It also means adequate surveillance to identify emerging contaminants and initiate preventive actions before they become a problem. An ever increasing number of these actions are happening now throughout the Bay Area and green infrastructure and integrated water and habitat management planning is becoming the norm not the exception. Inadequate funding is an obvious barrier to increased and faster implementation, but fortunately, there are also efforts in play to provide new and improved funding mechanisms. Public support is key, and should be forthcoming given that the Bay Area quality of life and economy are dependent on the Bay and the quality of its water and habitat.

Keywords: water quality management, green infrastructure, funding, integrated management

Session Title: Day 2 Plenary Session: Future Visions for Estuary Water Quality

Speaker Biography: Thomas Mumley, Ph.D., has been an Assistant Executive Officer at the San Francisco Bay Water Board since 2007 and is Vice Chair of the San Francisco Estuary Partnership Implementation Committee. He has worked at the San Francisco Bay Regional Water Quality Control Board for over 30 years with experience in nearly all program areas of the Water Board including development and implementation of water quality standards, development and implementation of Total Maximum Daily Loads to fix impaired waters, NPDES wastewater and stormwater permits, nonpoint source control and watershed management. He received his BS degree in Chemical Engineering from the University of Massachusetts, Amherst in 1976 and his Ph.D. in Chemical Engineering from the University of California, Berkeley in 1983.

A Return to Restoration: Species Coming Back to the Bay

Cheryl Strong, USFWS, cheryl_strong@fws.gov

For decades the San Francisco Bay estuary was the dumping grounds of unwanted items: everything from tires and trash to raw sewage were dropped into the “useless” wetlands and waters. A 1959 study recommended filling most of the Bay in order to accommodate future growth. While this may have reduced our housing prices, it would have been disastrous in terms of water quality, flood protection, and species diversity. However, beginning in the 1960’s - 1970’s, grass roots actions and subsequent legislation helped to establish our now very robust restoration community. Literally dozens of wetlands are now being restored and improved around the estuary, in projects from small to enormous. These improvements have helped encourage some of our scaled, furred, and feathered friends to return to the Bay. The return of large, top level predators such as sharks, otters, and osprey signal cleaner waters, increased prey availability, and overall improved wetland habitats. While major issues such as reduced funding and impending sea level rise may cause us to lose sleep at night, let’s not forget the progress that has been made in just 50 years. Let's celebrate these accomplishments, enjoy the return of porpoises, black rails, and Point Reyes bird's beak even as we look forward to new challenges.

Keywords: restoration, wetlands, estuary, river otters, leopard sharks, osprey, predators, endangered

Session Title: Responses to a Changing Bay

Speaker Biography: Cheryl M. Strong is a wildlife biologist with the Don Edwards San Francisco Bay National Wildlife Refuge where she focuses on managed pond and tidal marsh restoration as part of the South Bay Salt Pond Restoration Project, with an emphasis on waterfowl and shorebird conservation, endangered species, and adaptive management. One of Cheryl’s main objectives regarding this restoration effort is to balance the needs of endangered species such as the marsh-loving Ridgway’s rail and the dry salt-panne loving western snowy plover with the tens of thousands of waterfowl and shorebirds that utilize the ponds during the winter and migratory months.

Mystery Goo: An Investigation of Unknown Pollutants and Wildlife Losses

Daniel Orr, California Department of Fish and Wildlife, daniel.orr@wildlife.ca.gov

The investigation of pollution and resulting wildlife losses is a continuing challenge. The diversity of potential inputs into natural systems and high environmental consciousness make this task uniquely complex in industrialized regions of California's coast. This case study will discuss investigation of a reported "mystery goo", an unknown contaminant that impacted more than 500 seabirds in East San Francisco Bay in January 2015. Multidisciplinary and interagency techniques including necropsies, histopathology, chemical analyses and public outreach were used to guide the investigation. Cooperative agreements and volunteer efforts by local, state, and federal agency, domestic and international academic, and industry scientists were essential to testing. Chemical analyses indicate the "mystery goo" is a complex mixture containing non-petroleum oils. Laboratory results suggest the polymers have a molecular mass greater than 1500 Daltons and are likely to consist of linked fatty acids and triglycerides of plant origin. The size distribution of the polymeric material and the source of the contaminant have not been determined. As this case demonstrates clear communication, continued partnerships between law enforcement and scientific staff, coordination and open sharing among agencies, rapid availability of resources, and a spirit of volunteerism are essential for successful resource protection in complex pollution events.

Keywords: pollution, chemical, wildlife, investigation, unknown

Session Title: Responses to a Changing Bay

Speaker Biography: Daniel Orr is a Senior Environmental Scientist (Specialist) with the California Department of Fish and Wildlife (CDFW) Office of Spill Prevention and Response. Daniel received his master's degree in analytical chemistry at the University of California, Riverside and bachelor's degrees in chemistry and biology from the University of Redlands. His analytical methods have been published in Plant Chemical Genomics and the Journal of Analytical and Bioanalytical Chemistry. Daniel joined CDFW in 2011 and spent three years working with the Habitat Conservation and Water Quality programs, he then embraced his incurable chemical curiosity and transferred to the Water Pollution Control Laboratory. He currently serves as the Inland Spill Scientific Coordinator for statewide spill response and focuses on improving methods for algal toxins, pesticides, and other pollutants in the laboratory. He can be reached at daniel.orr@wildlife.ca.gov.

The Forgotten Habitats: Re-envisioning the Bay's Urban Edge

Marilyn Latta, State Coastal Conservancy, marilyn.latta@scc.ca.gov

The State Coastal Conservancy and our partners are implementing several experimental restoration projects to reconnect shorelines with the hidden and often forgotten subtidal and intertidal habitats of the bay. This shoreline-bay interface is an active edge zone that contributes to habitat and food resources as well as shoreline protection- which is increasingly important in light of climate changes such as sea level rise. The 2010 Subtidal Habitat Goals Report recommended integration of multiple habitat types to improve linkages and promote synergistic effects of habitat features on each other as well as on associated fauna. There is a critical need to get started early on pilot projects which test new integrative design concepts and adaptive approaches. In 2011, the Conservancy and USFWS established a five-year program to implement rapid intensive revegetation to enhance habitat for California Ridgway's rails and other species. In 2012, the Conservancy constructed the SF Bay Living Shorelines Project, a multi-objective habitat restoration project with the overarching goal to create biologically rich and diverse subtidal and low intertidal habitats, including eelgrass and oyster reefs, that is resilient to changing environmental conditions. Phase two planning for living shorelines is currently underway and includes a focus on integration of tidal marshes and mudflats with oyster and eelgrass beds across the tidal frame in order to promote and increase habitat connectivity, native species habitat and foraging opportunities, high tide refugia, and wave attenuation. In 2014, the Conservancy and the National Fish and Wildlife Foundation began to plan for removal of two derelict creosote wharfs and replace the lost physical structure with native habitats that will benefit Pacific herring and improve the shoreline. This presentation will focus on sharing key values of forgotten habitats, preliminary results to date, permitting considerations, and lessons learned that can be applied to additional habitat integration efforts.

Keywords: shoreline, subtidal, wetlands, climate adaptation, eelgrass, oyster, creosote, integrated restoration

Session Title: Responses to a Changing Bay

Speaker Biography: Marilyn Latta is a Project Manager at the California State Coastal Conservancy. She manages the SF Bay Living Shorelines Project, Invasive Spartina Project, and additional regional projects and collaborative planning efforts in San Francisco Bay. She studied Marine Biology/Zoology at Humboldt State University, and prior to joining the Conservancy she worked for a variety of non-profit organizations to educate and involve the public in the protection and restoration of ocean and estuarine resources.

Invasive Spartina Project Update and the Case for Active Restoration

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In 2011, the California Coastal Conservancy's San Francisco Estuary Invasive *Spartina* Project (ISP) implemented a five-year program to rapidly enhance habitat for California Ridgway's rail in areas impacted by the invasion and removal of non-native *Spartina*. To date, ISP has planted over 300,000 plants in 40 restoration sites. This project provided an opportunity to study factors that limit plant establishment in saltmarsh. The reintroduction of Pacific cordgrass, *Spartina foliosa*, was a particularly complex component of ISP's effort. Challenges to restoration included grazing pressure by herbivores, highly variable restoration sites, limited restoration literature for native cordgrass, and the continued presence of non-native hybrid *Spartina* in the estuary. To address challenges, ISP, in partnership with researchers at San Francisco State's Romberg Tiburon Center, implemented replicated planting designs that tested multiple restoration techniques across different sites and habitat types. Experimentation helped to develop methods that promoted successful restoration under the varying environmental conditions at any given site. We have concluded that: 1) our early focus on testing restoration methods has likely improved project success; 2) our research partnerships have helped us to understand variability in success of planting efforts; 3) our findings from one site should not be generalized to all sites-survivorship varies greatly by year and site, and; 4) even common baywide species such as *Grindelia stricta* and *Spartina foliosa* are recruitment limited. We contend that that active restoration efforts should be expanded to include other marsh species. A study with RTC partners found that that some marsh species are common to natural marshes, but absent in restoration marshes (*i.e., Triglochin coccinna/maritima, Plantago maritima, and Chloropyron maritima)*. It may be that these plants are recruitment limited. Expanding planting palettes such that a diversity of desired species are outplanted has the potential to both speed up restoration trajectories and create diverse healthy marshes.

Keywords: Active restoration, Spartina, cordgrass, Ridgeway's Rail, Gumplant, saltmarsh, planting,

Session Title: Responses to a Changing Bay

Speaker Biography: Whitney Thornton has extensive field work experience in salt marshes, fresh water wetlands, and intertidal zones throughout the San Francisco Estuary. Her knowledge and interest in marsh plant ecology and restoration history has led to a co-authored UC Press book chapter that looks at differences between natural and restored marshes in the San Francisco Bay. Ms. Thornton is happiest designing an experiment, planning restoration, and keying out plants. For her master's thesis under Kathy Boyer at San Francisco State University Romberg Tiburon Center, she developed methods for native cordgrass restoration, Spartina foliosa, to areas of San Francisco Bay where it has been extirpated. Over a period of four planting seasons, Ms. Thornton designed studies to test different environmental variables on restoration success.

Guiding the Future of Restoration – Overview

Beth Huning, San Francisco Bay Joint Venture, bhuning@sfbayjv.org

Since the publication of the Baylands Ecosystem Habitat Goals in 1999 and the subsequent Joint Venture Implementation Plan, more than 50,000 acres of tidal wetlands have been protected, restored, or enhanced in the San Francisco Estuary. The original focus was to restore historic tidal marsh to provide habitat for threatened and endangered species and restore ecological function to tidal systems.

A decade-and-a-half later, many lessons have been learned, the importance of sub-tidal and transitional habitats has been acknowledged, and projects are designed and constructed for multi-species and multi-habitats. Restoration sites are evolving and wildlife is returning and other species are occupying new habitats.

Dynamic ecosystems require a dynamic approach to planning and restoration. The urgency to address the impacts of climate change and other environmental stressors will require managers and regulators to respond rapidly with management and policy changes as new information is forthcoming. This session will reflect on lessons learned and look forward to how we can adaptively make decisions and manage for change.

Keywords: Restoration, Future, Climate Change, Adaptive Management, Infrastructure, Policy

Session Title: Guiding the Future of Restoration

Speaker Biography: Beth Huning is the Coordinator of the San Francisco Bay Joint Venture, a public-private partnership for wetlands protection and restoration. She has been actively involved in wetlands conservation in the Bay Area over 30 years, including 18 years with the National Audubon Society in various capacities and as the director of Richardson Bay Audubon Center & Sanctuary when she helped found and chair the Joint Venture. She holds a BA in geography and was honored in 2001 as a Fellow by the Stanford Graduate School of Business Center for Social Innovation for non-profit management. In her free time, she hikes, kayaks, photographs, travels the world and is the 2011 recipient of the North American Nature Photography Association's Philip Hyde Grant award for conservation photography.

South Bay Salt Pond Restoration Project: Adaptive Management in Action

Laura Valoppi, U.S. Geological Survey, Laura_Valoppi@usgs.gov

The South Bay Salt Pond Restoration Project (www.southbayrestoration.org) is the largest wetlands restoration project on the West coast of the United States. It is unique not only for its size— over 15,000 acres— but also for its location adjacent to one of the nation's largest urban areas, home to over 3 million people. The Project is intended to restore and enhance wetlands in South San Francisco Bay while providing for flood management and wildlife-oriented public access and recreation.

We have identified long-term alternatives for the Project, each representing a continuum toward different end-states: one end-state represents 50% of existing ponds converted to managed ponds for waterbirds and 50% restored to salt marsh habitat, and the other end-state represents 10% of the existing ponds converted to managed ponds and 90% restored to marsh habitat. The final ratio of managed ponds to salt marsh habitat will depend on the outcome of the Adaptive Management Plan, which will be implemented over the next 50 years. The Plan will allow for scientific information gained from earlier phases and applied studies to be incorporated as management objectives and designs of future actions are revised and implemented.

The Project has completed most of the Phase 1 studies, and much has been learned about key uncertainties. This presentation will summarize the results of some key studies and how managers have revised management actions and restoration designs in response to scientific research.

Keywords: wetlands, restoration, adaptive management, waterfowl, shorebirds, saltmarsh, restoration design, sediment

Session Title: Guiding the Future of Restoration

Speaker Biography: Laura Valoppi, of the U.S. Geological Survey, has been the Lead Scientist for the South Bay Salt Pond Restoration Project since May 2009. The SBSPRP is restoring 15,000 acres in South San Francisco Bay to a mixture of salt marsh and pond habitat. She is the primary science representative of the restoration project and oversees an $8 million multi-disciplinary research program conducted by teams of researchers from USGS, universities, non-profits and consultants. This is a long-term project requiring the consideration of many aspects of San Francisco Bay geomorphology, geology, water use and quality, chemistry, toxicology, and ecology. Laura has over 27 years of experience in restoration, natural resources, water quality, wildlife toxicology, risk assessment, and endangered species in California.

Restoring Ecosystems as Sustainable Infrastructure in a Changing World

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Climate change and the reduced inflow of sediment to the estuary are examples of the increasingly dynamic nature of the Bay Area's future. Our public infrastructure will need to account for these dynamic future conditions in its design and construction in order to continue to function effectively. Sustained function as conditions change is a useful definition of resilience.

The capacity of ecosystems to be resilient to stress while providing multiple benefits suggests that integrating ecosystem restoration into infrastructure planning is a valuable strategy to create more sustainable infrastructure in the future. Successfully envisioning and implementing this strategy requires understanding the biogeochemical processes operating in the landscape, the influence of these processes on valuable attributes of the landscape, and how these processes will change in our more dynamic future. While it is clear that some locations are more likely than others to benefit from ecosystem restoration, it also appears that restoration of ecosystems can provide benefits regionally.

By building our understanding of ecosystem function and applying this to infrastructure design and construction, we can develop cost-effective approaches for enhancing regional resilience to our dynamic future. However, ecosystem restoration takes time, and given the expected acceleration of sea level rise and other climatic changes in coming decades, now is the time to be restoring regional ecosystems to build resilience. Our ability to accelerate this development now will enhance the benefit/cost ratio for future infrastructure projects while continuing to maintain the natural beauty that is an integral part of the economy and quality of life of the Bay Area.

Keywords: ecosystems, restoration, shoreline, natural infrastructure, climate change, sea level rise

Session Title: Guiding the Future of Restoration

Speaker Biography: Dr. Andrew Gunther received his Ph.D. in Energy and Resources from the UC Berkeley in 1987, and has worked at the intersection of environmental science and policy since 1979. He is currently serving as the Executive Coordinator of the Bay Area Ecosystems Climate Change Consortium under contract to the California State Coastal Conservancy. He has worked on developing ecological indicators for the Bay Area since 2001, and he was the project leader for the State of San Francisco Bay in 2011 for the San Francisco Estuary Partnership. Dr. Gunther previously served (1991-2001) as the Assistant Chief Scientist for the Exxon Valdez Oil Spill Restoration Program, where he helped coordinate development of the restoration science program. Dr. Gunther was the original manager (1993-1997) of the Regional Monitoring Program for Toxic Contaminants in the San Francisco Estuary, and is a member of the Board of Directors of the Union of Concerned Scientists.

Climate Change: Policy Challenges for Restoration

Stuart Siegel, Siegel Environmental, San Francisco Bay National Estuarine Research Reserve, stuart@swampthing.org

Our current policy framework in the face of climate change pressures has many gaps and obstacles to the successful planning, implementation, and achieving outcomes of ecosystem restoration in the San Francisco Estuary. All the laws we rely on to guide us – Endangered Species Acts, Clean Water Act, McAteer-Petris Act, CEQA, NEPA, and many more – were established in response to pressures entirely other than climate change. Climate change will exert pressures that bridge across these vital yet often insular policy mandates. The core of our policy challenge, then, is to protect their underlying intents while evolving them to be responsive to climate change's multi-faceted ramifications. What are some examples of these policy challenges? Allowing boldness in action and time for results where certainty of outcome is not high. Allowing some impacts now from actions that will, we hope, give us "resiliency". Preserving landscapes that later will be essential to continued ecological functions and ecosystem services. Choosing between investments in "holding the line" vs. "managed retreat" in shorelines, levees, flood management, and more. Treating sediment as the critical commodity that it is. Accommodating seemingly "novel" approaches. Supporting long-term analytical foundations essential for informed decision-making especially in the face of political and economic pressures. Moving restoration efforts expeditiously through regulatory approvals without burdensome requirements so that we shave years and decades off taking action. Bringing to bear the fiscal resources early on when costs are less for the same results. Flexibility and responsiveness in climate change projections. Funding and allowing landscape-scale adaptive management. Recognizing that inaction will not preserve the status quo. And all the while, human society will be exerting a wide range of other pressures, natural disasters may well reorder our natural and human systems, species invasions will continue, and our knowledge and skills will continue to grow.

Keywords: climate change, restoration, policy, wetlands, sea level rise, resiliency

Session Title: Guiding the Future of Restoration

Speaker Biography: Dr. Stuart Siegel is Principal of Siegel Environmental and Coastal Resilience Specialist for the San Francisco Bay National Estuarine Research Reserve. He focuses on the intersections of climate change, natural resources resiliency, ecosystem restoration, management-relevant science, and regional planning. He has been at the forefront of ecosystem restoration before it gained its modern name, and has worked on climate change-driven projects for several years. Dr. Siegel has lead design teams for several wetland restoration projects responsive to climate change, including Aramburu Island, Sonoma Creek, and Sears Point. He was a co-lead scientist for DRERIP, technical lead for the Delta Vision Ecosystem Workgroup, Suisun Marsh Plan Science Advisor, and lead PI for the Integrated Regional Wetland Monitoring Pilot Project. He co-authored the Wetland Carbon Sequestration Road Map to Implementation, authored the climate change chapter of the Moyle Suisun Marsh book, and served on technical advisory panels for large restoration projects.

Policy, Regulatory, and Management Challenges to Science in the Anthropocene

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This 5-minute Session introduction will highlight chapter topics from *The State of Bay-Delta Science* report integrated with relevant key themes from the chapter on "Delta Challenges."

Keywords: Session introduction, The State of Bay-Delta Science report, Delta Challenges

Session Title: A Preview of the State of Bay-Delta Science, 2015

Speaker Biography: Dr. Peter Goodwin is the DeVlieg Presidential Professor in Ecohydraulics and Professor of Civil Engineering at the University of Idaho. He also is the founding and current director of the Center for Ecohydraulics Research. He is recognized internationally for his research with important contributions in the field of modeling flows, sediment transport, and river channel evolution. Dr. Goodwin is also the director of Idaho's Experimental Program to Stimulate Competitive Research (EPSCoR), a federal-state partnership to enhance the science and engineering research, education, and technology capabilities of states that traditionally have received smaller amounts of federal R&D funds. He earned his B.Sc. in civil engineering from Southampton University, England, his M.S.C.E in Hydraulic and Coastal Engineering and Ph.D. in Hydraulic Engineering from UC Berkeley.

Challenges of Building the "One Delta-One Science" Approach

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How science and policy come together in the Delta is undergoing a cultural change. Competing demands on California's scarce water and environmental resources and the socio-political calls for science to guide decision-making about California's water and environmental resources have forged new opportunities for improving science-policy interactions. These cultural changes follow fatigue over tiresome litigation and new requirements for the use of science in Delta decision-making. The culture is being defined by policy-makers, managers, and scientists who have worked together to develop and begin implementing a Delta Science Plan that envisions 'One Delta, One Science' – an open science community that works collaboratively to build a shared body of scientific knowledge with the capacity to adapt and inform future water and environmental decisions. This chapter summarizes what we have learned about the need for 'One Delta, One Science', progress made to transform the Delta's science-policy interface, and recommendations for overcoming the remaining challenges to achieving the Delta Science Plan's vision.

Keywords: One Delta-One Science, decision-making, management, science communication, science-policy interface

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Speaker Biography: Dr. Peter Goodwin is the DeVlieg Presidential Professor in Ecohydraulics and Professor of Civil Engineering at the University of Idaho. He also is the founding and current director of the Center for Ecohydraulics Research. He is recognized internationally for his research with important contributions in the field of modeling flows, sediment transport, and river channel evolution. Dr. Goodwin is also the director of Idaho's Experimental Program to Stimulate Competitive Research (EPSCoR), a federal-state partnership to enhance the science and engineering research, education, and technology capabilities of states that traditionally have received smaller amounts of federal R&D funds. He earned his B.Sc. in civil engineering from Southampton University, England, his M.S.C.E in Hydraulic and Coastal Engineering and Ph.D. in Hydraulic Engineering from UC Berkeley.

Climate Change and the Bay-Delta: Bounding the Uncertainties of Sea-level Rise and Changes in Precipitation

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In response to increasing atmospheric greenhouse-gas (GHG), California is warming and is projected with a high degree of certainty to continue warming this century. Our ability to predict future climate is limited by several sources of uncertainty that will be discussed as applied to sea-level rise (SLR) and precipitation projections: 1) uncertain future rates of GHG emission; 2) uncertain climate responses to changing GHG concentrations (essentially, climate-model differences); and 3) natural climate variability. Twentieth century SLR was ~0.5 foot. SLR projections are for >3 times as much this century in response to increasing ocean warming and melting land ice. However, some projections reach as much as 5 feet, leaving a wide range of possible outcomes. SLR, along with subsidence of Delta islands, will combine to make many Delta landscapes more vulnerable to inundation. Extreme sea levels from El Niños, storms, and wind waves, together with floods, will be primary occasions when SLR impacts will be felt. However, gradual SLR may drive more ocean salinity into the Bay-Delta, affecting brackish and freshwater habitats and potentially threatening water supplies.

For some time, projections of future precipitation have included nearly equal numbers of projections of wetter conditions as drier for northern California. Although most projections are within 10-15% of historical norms, we remain unable to determine whether the future will provide that much more precipitation or that much less. Despite this we know that California's precipitation will continue to vary widely from year to year and longer, and because a warmer atmosphere holds more moisture, when rain does fall, it will produce more intense downpours. Simultaneously, more dry days are projected over California, and warmer temperatures will likely enhance evaporative demands, reducing runoff per unit of precipitation. Consequently, climate change is expected to yield more extreme flood risks and more extreme drought risks.

Keywords: climate change, uncertainty, sea-level rise, precipitation, Bay-Delta

Session Title: A Preview of the State of Bay-Delta Science, 2015

Speaker Biography: Dr. Michael Dettinger is a research hydrologist for the U.S. Geological Survey, Branch of Western Regional Research, and a research associate at Scripps Institution of Oceanography, La Jolla, California. Dr. Dettinger has researched the hydrology, climate, and water resources of the West for over 30 years, focusing on regional surface water and groundwater resources and modeling, hydroclimatic variability, and climate-change impacts. He was physical sciences team leader for DOI-DOD ecosystem planning in the Mojave Desert, founding member of the CIRMONT Western Mountain Climate Sciences Consortium, climate advisor to the CALFED Bay-Delta Restoration Program, research advisor for USGS Surface-Water Discipline, member of the USGS Global Change Science Strategic Planning Team, and lead author of the Water Resources chapter of the 2013 National Climate Assessment. Dettinger earned his B.A. in Physics from UC San Diego, M.S.C.E from Massachusetts Institute of Technology, M.S. in Atmospheric Sciences and Ph.D. in Atmospheric Sciences from UCLA.

Science for Water Management: Advances, Challenges, and Implications for California's Future

Jay Lund, UC Davis, jrlund@ucdavis.edu
Roger Bales, UC Merced

Much of California relies on the Sacramento-San Joaquin Delta directly or indirectly, for some or all of its water supply. The reliability of Delta water supplies is threatened by drought, climate change, earthquakes, endangered species, and changing ecosystems. Recent years have brought a fuller understanding of how management of the Delta ties together the quantity and quality of water available statewide in California. These ties run from the Sierra mountains and coastal streams, through the Central Valley, to the Bay Areas, and then over the Tehachapi Mountains to southern California. This chapter reviews issues in water supply reliability, and the costs of unreliability in quantity and quality.

Keywords: water supply reliability, water management

Session Title: A Preview of the State of Bay-Delta Science, 2015

Speaker Biography: Dr. Jay Lund is Director of the Center for Watershed Sciences and Professor of Civil and Environmental Engineering at University of California, Davis. His research and teaching interests focus on applying systems analysis and economic methods to infrastructure and environmental problems, including policy, planning, and management studies. His work is primarily in water resources and environmental system engineering, but with substantial past work in solid and hazardous waste management, dredging and coastal zone management, and urban, regional, and transportation planning. He received his B.Sc. in Civil Engineering, M.A. in Geography, and Ph.D. in Civil Engineering from the University of Washington. Dr. Lund has been honored with the following awards: Julian Hinds Award, American Society of Civil Engineers/Environment and Water Resources Institute, Hugo B. Fischer Award, California Water and Environmental Modeling Forum, ASCE/EWRI Planning and Management Council Service to the Profession Award, Boggess Award for best paper in the Journal of the American Water Resources Association, and California Water and Environment Modeling Forum Service Award.

Beyond Fishable and Swimmable: Water Quality and Contaminant Effects on Species and Water Supply

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Contaminants in the Delta affect water quality, impact associated species, and potentially impact drinking water supply. They originate from agricultural and urban runoff, wastewater treatment effluent discharge, industrial waste, and atmospheric deposition, as well as being applied directly to surface waters. There is also a legacy of contaminants such as persistent organic compounds, mercury, and selenium, which can accumulate through the food chain leading to health risks for humans and wildlife.

Although the Bay-Delta is one of the most studied surface water systems in the world, the ecological impacts of contaminants remain unquantified, and their effects poorly understood. Fish kills that were a common occurrence in past decades are now confined to spills or first flush events, however, sublethal effects of significant concern have been reported. In fish for example, contaminants can negatively affect the immune system, impact growth and development, directly alter behavior, and have detrimental impacts on sensory systems that affect the ability to avoid predators, recognize kin, find spawning grounds, and reproduce successfully. These sublethal impairments are often difficult to measure and to attribute to specific contaminant classes, because contaminants co-occur in space and time and can interact additively, synergistically, and antagonistically.

Standard bioassay methods that are based on acute toxicity of select species are not sufficient to adequately address the impact of contaminants on aquatic life. Bioassay endpoints that are currently used to evaluate contaminant impacts for regulatory purposes thus need to be enhanced. Contaminants are also a concern in regard to the Delta as a source for drinking water. Drinking water agencies that rely on the Delta have invested in upgrades to water treatment processes over the last decade, and have also implemented an integrated system of monitoring and forecasting tools to inform water treatment operations.

Keywords: contaminants, water quality, drinking water, toxicity

Session Title: A Preview of the State of Bay-Delta Science, 2015

Speaker Biography: Stephanie Fong is the Acting Science Program Manager of the State and Federal Contractors Water Agency (SFCWA). She earned her B.S. at UC San Diego before accepting a position at UC Davis, where she worked for 6 years. During that time, she led research studies and monitoring of surface waters across CA. She focused in particular on environmental toxicology and method development. Stephanie's desire to apply environmental toxicology to resource management and policy then led her to work for the Water Boards in 2005, and then SFCWA in 2012. Her projects mainly focus on the Delta and its tributaries, aimed at providing resource managers with the science they need to make informed decisions. Stephanie has served on various planning committees and on the Board of Directors for the Northern California Chapter of the Society of Environmental Toxicology and Chemistry, and believes in advancing science through communication, collaboration, and multidisciplinary contributions.

Communicating at the Science-Policy Interface in the Bay and Delta

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This 5-minute Session introduction will highlight chapter topics from *The State of Bay-Delta Science* report integrated with relevant key themes from the chapter on "Delta Challenges."

Keywords: Session introduction, The State of Bay-Delta Science report, Delta Challenges

Session Title: A Preview of the State of Bay-Delta Science, 2015

Speaker Biography: Dr. Jay Lund is Director of the Center for Watershed Sciences and Professor of Civil and Environmental Engineering at University of California, Davis. His research and teaching interests focus on applying systems analysis and economic methods to infrastructure and environmental problems, including policy, planning, and management studies. His work is primarily in water resources and environmental system engineering, but with substantial past work in solid and hazardous waste management, dredging and coastal zone management, and urban, regional, and transportation planning. He received his B.Sc. in Civil Engineering, M.A. in Geography, and Ph.D. in Civil Engineering from the University of Washington. Dr. Lund has been honored with the following awards: Julian Hinds Award, American Society of Civil Engineers/Environment and Water Resources Institute, Hugo B. Fischer Award, California Water and Environmental Modeling Forum, ASCE/EWRI Planning and Management Council Service to the Profession Award, Boggess Award for best paper in the Journal of the American Water Resources Association, and California Water and Environment Modeling Forum Service Award.

The Bay-Delta Food Web: Why We Care about the Dynamics of Sustaining Native Species

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We examine what has been learned recently about foodwebs of the upper San Francisco Estuary including the Delta, and identify key topics requiring additional research. Substantial new knowledge has been developed on lower trophic levels of various estuarine habitats, and we focus on a few key topics. The current foodweb of the open waters of the main branch of the estuary are unproductive and dependent on spatial subsidies of organic matter, phytoplankton, and zooplankton; small isolated channels and sloughs seem more productive. Zooplankton and fish species have spatial-temporal patterns of abundance that appear adapted to low productivity through shifts in spatial distribution (striped bass, anchovy, longfin smelt, delta smelt) or temporal abundance patterns (*Eurytemora affinis*), and introduced species of copepod have spatial or temporal patterns or feeding niches that minimize effects of low productivity. *Microcystis aeruginosa* forms blooms in the Delta during warm years that have detectable negative effects on zooplankton reproduction and abundance. In contrast to open waters, vegetated beds in the Delta (SAV) appear to be thriving and supporting a vibrant assemblage of invertebrates and fish that are largely non-native. The SAV beds and marshes have distinct isotopic signatures from open water, indicating alternative pathways for energy and nutrients.

Several large-scale, important questions need to be addressed. First, is it possible to increase subsidies of zooplankton through habitat restoration in the Delta? Existing information does not support this idea but cannot be used to rule it out. Second, would reducing the ammonium discharge to the estuary improve conditions, and how? Third, how do spatial connections affect the productivity of heterogeneous habitats? And fourth, will it ever be possible to use an experimental approach to management and restoration, so we can fill in the huge gaps in our knowledge?

Keywords: Bay-Delta, food web, productivity, phytoplankton, zooplankton

Session Title: A Preview of the State of Bay-Delta Science, 2015

Speaker Biography: Dr. Wim Kimmerer is a Research Professor of Biology at the Romberg Tiburon Center for Environmental Studies of San Francisco State University. He is an honorary Fellow of the California Academy of Sciences who studies how estuarine ecosystems function, with particular emphasis on human effects. For over 25 years he and his associates have conducted studies in the San Francisco estuary on effects of freshwater and tidal flow on habitat, abundance, and movement of plankton and fish; the influence of introduced species; and population dynamics, reproduction, growth, and mortality of fish and food web organisms. He has participated in modeling studies on topics, such as delta smelt population dynamics and hydrodynamics. Dr. Kimmerer earned a B.S. in Chemistry from Purdue University, and his Ph.D. in Biological Oceanography from University of Hawaii.

Delta Landscapes: Translating the Findings of Historical Ecology to Inform Ecological Restoration

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The Delta is many places, with many uses, values and functions to many users, both people and wildlife. These do not occur as separate, independent entities, although they are often treated or managed as such. A landscape perspective is important for several reasons. People live in landscapes. Consequently, landscapes are where they raise crops and families and where they experience the environment and nature. Landscapes are the scale at which people and the Delta intersect. A landscape perspective also enables one to step back and take a broad view, somewhere between a single place and the Delta as a whole. Focusing conservation or management on a single place isolates the place from its surroundings, while attempting to deal with the entire Delta in all its complexity is overwhelming. The former may lead to ineffective management, the latter to inefficient and superficial management. While local or Delta-scale issues should not be ignored, a landscape perspective provides a workable scale for Delta management as well as an interface that allows the small and the large to be seen in context.

Landscape ecology has the power to integrate land with water, as well as places, habitat, species, stakeholders, policy, agencies, and scales. It draws attention to entire landscapes and considers how multiple features interact in space and time. By considering the structure and function of entire landscapes rather than their individual parts, the broad-scale patterns and processes that determine how Delta ecosystems function emerge. This integrated landscape perspective provides the foundation for managing or restoring ecological connectivity, habitat diversity, landscape adaptability, and resilience to change—all of which are critically important as the Delta is exposed to the forces of climate change and sea-level rise.

Keywords: landscape ecology, historical ecology, habitat, conservation, management

Session Title: A Preview of the State of Bay-Delta Science, 2015

Speaker Biography: Dr. John Wiens is a leader in the field of landscape ecology. An Emeritus University Distinguished Professor at Colorado State University, Winthrop Research Professor at the University of Western Australia, and Chief Scientist at PRBO Conservation Science (Point Reyes Bird Observatory), he grew up in Oklahoma as an avid birdwatcher. This led to degrees from the University of Oklahoma and the University of Wisconsin-Madison (M.S., Ph.D.). He served on the faculties of Oregon State University, the University of New Mexico, and Colorado State University, where he was a Professor of Ecology. In 2001 he left academia to join The Nature Conservancy as Lead/Chief Scientist, working to integrate scientific research into conservation practice. His research, which has emphasized landscape ecology and the ecology of birds, has led to over 200 scientific papers and seven books.

Translating Science for Management: The Art of Decision-Making Frameworks

Richard Norgaard, UC Berkeley, Emeritus, norgaard@berkeley.edu

Providing policy-makers and managers with pertinent information for making decisions is often a struggle for scientists working on complex science in a dynamic system like the Bay-Delta. Improving our scientific communication will require a shift in our thinking and approaches to solving resource management and ecological problems, possible shifts in culture, and the ways scientists communicate to policy-makers. One way of communicating complex science in a way that is helpful for policy-makers is through decision-support tools and frameworks.

Decision-support tools and frameworks provide a way of reaching standard, reproducible, transparent approaches to making decisions. They integrate knowledge from many disciplines and provide context by incorporating broader perspectives, and non-scientific values and information. They allow users to explore the solution space, which provides a way of dealing with uncertainty and multiple and often conflicting objectives. They can highlight multiple approaches as well as tradeoffs among those approaches. Strengths of decision-support tools and frameworks include: providing transparency in decision-making; discerning key information from basic information; integrating information into a coherent structure; and identifying realistic management choices. Techniques can be document-driven, model-driven or data-driven and include cost-benefit analyses, structured decision making, adaptive management, organizational restructuring, and the use of facilitators and facilitation techniques. We explore how to organize our science tools to better inform policy-makers.

Keywords: decision-support, decision-making, science communication

Session Title: A Preview of the State of Bay-Delta Science, 2015

Speaker Biography: A pioneer in the field of ecological economics, Dr. Norgaard's recent research addresses how complex environmental problems challenge disciplinary scientific understanding and the policy process. He serves on the Fifth Assessment of the Intergovernmental Panel on Climate Change and as a member of UNEP's International Panel on Sustainable Resource Management. He was a member of the Environmental Economics Advisory Committee of the Science Advisory Board of the U.S. Environmental Protection Agency. He has served on the Board of the American Institute of Biological Sciences and as President of the International Society for Ecological Economics. Dr. Norgaard was a member of the CALFED Independent Science Board, and before that the Water Management Science Board. He earned his doctorate in economics from the University of Chicago. Currently, he works as a Professor, Energy and Resources Group, University of California, Berkeley.

Rising Waters: Rethinking Our Shoreline

Zachary Wasserman, Chair of BCDC, zwasserman@wendel.com
John Gioia, Contra Costa Supervisor & BCDC Commissioner
JR DeLaRosa, California Natural Resources Agency
Kristina Hill, PhD, Associate Professor, U.C. Berkeley College of Environmental Design

The rising Bay will drive a transformation of the Bay shoreline and force us to reconsider Bay fill, public access and development patterns. Our panel will address this from a local, state and regional perspective.

Keywords: decision-support, decision-making, science communication

Session Title: Rising Waters: Rethinking Our Shoreline

Speaker Biographies: In 2012, **Zack Wasserman** was appointed by Governor Jerry Brown as Chair of the San Francisco Bay Conservation and Development Commission. As General Counsel to the East Bay Economic Development Alliance, Zack played an integral role negotiating with BCDC on the Bay Plan Amendment to address rising sea levels. He currently serves as vice-chair of the San Francisco Regional Center that coordinates regional policies of MTC, ABAG, BAAQMD and BCDC. He serves as general counsel to the Oakland Chamber of Commerce and the East Bay Economic Development Alliance, as well as to several non-profit corporations and foundations engaged in technology transfer and scientific development. **John Gioia** is the Chair for the Contra Costa Board of supervisors, elected in 1998 and re-elected four times. Recognized as a leader on air quality issues, he was appointed by Governor Brown to serve on the California Air Resources Board and has served on the BAAQMD since 2006. Through these roles John is helping to lead the state's ground breaking efforts on climate change and air quality. John also advocates on behalf of our county government as an officer of the California State Association of Counties and serves as Vice Chair of the San Francisco Restoration Authority and serves on the San Francisco BCDC and a number of other commissions and advisory boards as well. John holds a B.A. in Political Science and a law degree from University of California, Berkeley. **JR DeLaRosa** is the special assistant for climate change at the California Natural Resources Agency. He has served as a researcher at the Governor's Office of Planning and Research since 2011. He was an executive fellow in the California Governor's Office from 2010 to 2011 and a field representative for California State Assemblymember Anna Caballero from 2008 to 2010. DeLaRosa was an intern at the Office of Assemblymember Joe Coto from 2006 to 2007. **Kristina Hill** is an urban designer and planner who specializes in the application of ecological and geomorphological principles in urban adaptation to sea level rise and other climate change trends. She has worked on major adaptation plans for New Orleans, the mid-Atlantic coast, and Seattle. Her current work is on understanding adaptation opportunities in the San Francisco Bay Area, with a focus on biodiversity, infrastructure costs, and social justice. Hill was a co-author and editor of Ecology and Design, published by Island Press, and is guest editor for the 100th anniversary issue of Frontiers in Ecology and Environment, published by the Ecological Society of America. She lectures internationally on urban infrastructure and adaptation, and received her PhD from Harvard University. Hill is a professor at UC Berkeley in environmental planning.

Slope Response to Drought and Fire: Possible Parallels

Reid Fisher, Cal Engineering & Geology, rfisher@caleng.com

Both fire and drought appear to prime slopes and watersheds for failure and erosion, which could deliver sediment pulses to the estuary. Comparing fire and drought effects on mass wasting and slope stability is centered on the amount, distribution, and movement of water -- a key factor in slope instability --across and through a slope. The primary means by which fire affects the amount/distribution/movement of water (and thus slope instability) is by reducing biomass and making the slope more vulnerable to water once it returns. Drought has some broadly similar effects:

- Fire reduces protective soil cover (alive and dead), leading to more raindrop impacts, more energy per impact, and greater potential for dislodging any single particle. Drought over time reduces this same cover, promoting similar effects.
- Fire indirectly can kill off the root mat; as this mat loses strength, there is greater potential for shallow landslides, ravelling and erosion. Drought over time can weaken this same mat, promoting similar effects.
- Fire and drought both reduce the capacity of a slope to store sediment; they both enhance the delivery of sediment to the local drainage axis, where it is either eroded, awaits erosion, or awaits mobilization as debris flow.

Some slope processes are slowed by drought, whereas fire often has little effect below ground (except for generating hydrophobic layers):

- Clays stay dry, hard, and strong under drought conditions, inhibiting sliding; fire has little effect.
- The effective (grain-to-grain) pressure is high under drought conditions, inhibiting sliding; fire has no effect.
- The soil mass is less dense under drought conditions, inhibiting sliding; fire has no effect.
- Soil creep is slowed under drought conditions; fire has little effect.
- Rock creep may be slowed under drought conditions; fire has little effect.

Post-fire and post-drought sediment pulses are a serious cumulative challenge to the estuary.

Keywords: Fire, drought, sediment, pulse, landslide, slope stability, erosion, mass wasting

Session Title: “End of Drought” – NOT so fast…

Speaker Biography: G. Reid Fisher, PhD, PG, CEG is Principal Geologist for Cal Engineering & Geology. He oversees and performs geologic and geohazard investigations, primarily for agency and public works projects in the greater San Francisco/Monterey Bay Area. His experience includes serving as geomorphologist for contract archeological excavations; Research Geologist for the USGS; and consulting engineering geologist. His main professional interests are in slope stability and earthquake hazards.

Sediment, Salts, and Bed Mobility: Movement Spikes Following Droughts

Barry Hecht, Balance Hydrologics, bhecht@balancehydro.com

Sediment loads will remain elevated or temporarily increase following the end of a drought in many of California's rainfall-dominated watersheds. Salinity and nutrient loads may also discernibly spike as rising groundwater levels mobilize salts and nitrogen compounds from the vadose zone, and deliver them to streams, ponds, springs and seeps once surface/groundwater connections are restored following the drought. These residual trailing effects of drought are thought to be due to:

a. Diminished bank stability, as riparian woodlands die back, leading to continuity gaps and bank erosion.
b. Streams draining riparian woodlands mobilize and "float out" substantial volumes of limbs, snags or trunks, and then erode around the expanded logjams.
c. Rising groundwater tables mobilize salts which have accumulated in the vadose zone; salts in streams can spike 10 to 20 percent during the first wet year or two following droughts, while higher percentages can be observed in off-channel wetlands
d. High nutrient loads that have accumulated in the vadose zone during the drought.

Watershed planning should include provisions for sustaining aquatic and riparian biotic communities both during droughts, and 3 to 4 years after the drought has ended. In watersheds of the San Francisco Estuary (among others), habitat conservation plans may benefit from provisions which help sustain sensitive organisms through a reasonably predictable post-drought period. In rainfall-based watersheds, habitat and recovery planning should be able to draw upon drought-year funding to implement post-drought measures needed to sustain individual species or reaches of particular concern.

Keywords: post-drought recovery, bedload, salinity, salts, nutrients, episodicity, recovery plans,

Session Title: "End of Drought" – NOT so fast…

Speaker Biography: Barry Hecht, Senior Principal at Balance Hydrologics, has been practicing habitat hydrology since the 1970s. He is a proponent of balanced, integrated consideration of surface and groundwater flows, and for concurrent analysis of sediment transport and water quality, in managing and restoring streams. He often advocates for an episodic consideration of restoration evaluation and design, such that the effects of storms, wildfires, landslides, droughts, and seismic events can be functionally incorporated in channel planning. Mr. Hecht began his career as Santa Cruz County's first Geologist, and then worked under Luna Leopold at the USGS National Bedload Transport Research Facility in Pinedale, Wyoming. Prior to helping establish Balance in 1988, he served as Chief Geologist and Hydrologist for Kleinfelder. He is a registered as a professional geologist, certified engineering geologist, and certified hydrogeologist in California and several other western states.

What Every Resource Plan Should Include Following Droughts

Rich Casale, USDA Natural Resources Conservation Service, richard.casale@ca.usda.gov

I believe that the majority of people impacted by California's drought think that when it starts raining again the drought will be over. I certainly wish that were the case but there are some underlying consequences of our State's historic drought that will likely delay the declaration of an official end for some time. This presentation will explore both the positive (yes, positive) and negative effects of long-term drought and what every resource/restoration plan should address for the years ahead specifically in terms of residual impacts on natural resources, ecosystems, private and public properties, local communities, water supply and the San Francisco Bay Estuary.

In order to gain a wider awareness of the long-term effects of prolonged drought it is important to understand the full extent of damages that have occurred and why it will take time and a community-wide planning effort to restore the natural resources that have suffered. Higher runoff volumes, increased erosion and sediment rates and subsequent damages to water quality are expected following drought because of the loss or damage to soil/slope protecting vegetation. It could also take a decade or more for groundwater levels to be restored. Additionally, the hazard/occurrence of wildfire is higher following drought (sometimes for several years) because of excessive buildup of dead or dying vegetation in the landscape.

Individual and community based drought restoration plans should consider such things as: strategies to conserve, reuse/recycle water from existing supplies; development of new and innovative water supplies; groundwater recharge; use of drought tolerant vegetation and lower water using agricultural crops; irrigation water management and monitoring; soil health practices; infrastructure modifications; and other practices that can help prevent damage to natural resources, surface and groundwater supplies, water quality, wildlife and local ecosystems. Sources of information, technical and financial assistance will also be discussed.

Keywords: Response following drought, Resource Plan Restoration Planning, Drought Long-Term effects

Session Title: “End of Drought” – NOT so fast…

Speaker Biography: Rich Casale has over 41 years of experience with NRCS in the Monterey and San Francisco Bay area. He currently serves as District Conservationist for this USDA agency in Santa Cruz County. He helps agricultural producers and other land users address natural resource issues on properties they own and/or manage and by providing technical advice and services to conservation partners, units of government and others upon their request. He has also helped forward erosion control and conservation programs at the local, state and national level. Rich is a Certified Professional Erosion and Sediment Control Specialist, an international program he co-founded back in 1981. To date, nearly, 10,000 professionals in 13 countries worldwide have become certified. Rich has a Bachelor of Science degree in Natural Resource Management from Humboldt State University. He also owns, manages and practices conservation on his own small ranch in Aptos.

Big Plans for Improving Wastewater Infrastructure in San Francisco

Michael Carlin, SFPUC, mcarlin@sfwater.org

Keywords: Wastewater Infrastructure; San Francisco

Session Title: Bay Area Water Infrastructure Planning and Implementation: The Future is Now

Speaker Biography: Michael Carlin was appointed as the Deputy General Manager and Chief Operating Officer of San Francisco Public Utilities Commission in 2009. In that role, Michael supervises the agency's efforts in capital planning, emergency response, asset management, and other functions across the three business lines – water, power and wastewater. Prior to this position, Michael serviced as the Assistant General Manager for Water where he led the effort to diversify the water supply portfolio. He continues in that role leading many of the environmental initiatives including addressing the impact of climate change on the organization.

Water Recycling Becomes Reality in the South Bay

Pamela John, Santa Clara Valley Water District, pjohn@valleywater.org

The Santa Clara Valley Water District (SCVWD), the water resources management agency in Santa Clara County, located in South San Francisco Bay, recently completed construction of an 8 million gallon per day (approximately 9,000 acre-feet per year) advanced recycled water treatment facility. This facility, named the Silicon Valley Advanced Water Purification Center (SVAWPC), has microfiltration (MF), reverse osmosis (RO) and ultraviolet (UV) disinfection treatment units. The SVAWPC became operational in March 2014 and blends its purified product water with disinfected tertiary recycled water from the South Bay Water Recycling (SBWR) system. SBWR, operated by the City of San Jose, serves non-potable water to approximately 800 customers for large-scale irrigation and industrial uses. In addition to enhancing the recycled water quality to improve recycled water marketability, the SVAWPC also serves as the SCVWD's demonstration facility for potable reuse testing and outreach ultimately leading to augmenting drinking water supplies with purified recycled water. The SVAWPC is a testament to the interagency cooperation and coordination between SCVWD and the City of San Jose.

The county is in the fourth successive year of an extreme drought and strategies are being formulated to expedite the construction of new recycled water and purified recycled water infrastructure. The SCVWD's long-term water supply plans identify purified recycled water as a significant water supply addition for the county. The SBWR master planning effort, a jointly funded effort by both agencies, was completed recently and it evaluated opportunities to maximize the use of recycled and purified water. This presentation will cover the SVAWPC, its capabilities and an overview of future opportunities to expand recycled and purified water.

Keywords: SCVWD; SVAWPC, purified water; Silicon Valley Advanced Water Purification Center

Session Title: Bay Area Water Infrastructure Planning and Implementation: The Future is Now

Speaker Biography: Pamela John, P.E., is the North Water Treatment Manager for the Santa Clara Valley Water District. She currently manages the Penitencia Water Treatment Plant, the Silicon Valley Advanced Water Purification Center and the SCVWD-SFPUC Intertie Facility. She achieved bachelor and master degrees in Civil Engineering and is a registered professional civil engineer in California. She has 20+ years water resources engineering experience which includes 12 years of recycled water-specific experience. Previously as senior engineer, she was on the planning team for the purification center and managed the potable reuse piloting and demonstration effort. She was the 2013-2014 Board Trustee on the California WateReuse Board. She is a committee member on the WateReuse Regulatory-Legislation Committee.

Challenges of Water Recycling

Ashwini Kantak, City of San Jose, ashwini.kantak@sanjoseca.gov

This presentation will describe the challenges of City of San José's South Bay Water Recycling (SBWR) program as it finds itself at a critical juncture, balancing the needs of demand for recycled water through purple pipe while continuing to support the expansion of purified recycled water for potable uses.

Established in 1998, the SBWR program stands among the largest recycled water programs in California, serving the cities of San José, Santa Clara and Milpitas and delivering 5 billion gallons of recycled to nearly 800 customers.

SBWR began as a regulatory compliance measure to limit the amount of treated wastewater discharged from the San José-Santa Clara Regional Wastewater Facility (RWF) into the southern San Francisco Bay. Since 1998, sewage flows have decreased significantly due to water conservation efforts, code changes, and a shift towards industries with lower wastewater discharges.

While wastewater flows have decreased, the benefits of recycled water as a drought-proof and sustainable water source have increased. This paradigm shift has provided exciting opportunities for SBWR to re-evaluate program goals and funding, and explore regional partnerships.

A recently completed strategic plan, done in partnership with the Santa Clara Valley Water District (SCVWD), recommended purified recycled water as the best investment for integrating recycled water into the regional water supply system. Recycled water distribution has become cost comparable to purified recycled water, and results in duplicative infrastructure while providing water with limited uses. With the success of the pilot Silicon Valley Advanced Water Purification Center and the increased need for drought-proof water supplies, regional leaders including Mayors, SCVWD, Silicon Valley Leadership Group, and Chambers of Commerce are now increasingly promoting purified recycled water and advocating for fast tracking of purified recycled water projects. SBWR is uniquely positioned to be an important part of this regional effort.

Keywords: Purple Pipe Purified Recycled Water, South Bay Water Recycling, SBWR

Session Title: Bay Area Water Infrastructure Planning and Implementation: The Future is Now

Speaker Biography: Ashwini Kantak is Assistant Director in the Environmental Services Department in the City of San Jose and oversees administrative services, the sustainability and compliance division, and a multi-billion dollar capital program for the San Jose/Santa Clara regional wastewater facility. Prior to this role, Ashwini was an Assistant to the City Manager and led the development and implementation of several citywide policies and programs related to infrastructure and environmental sustainability. Ashwini has an undergraduate degree in Architecture from Mumbai, India, a graduate degree in Architecture from Iowa State University, and a graduate degree in Public Policy and Administration from Northwestern University. She is a licensed architect in California since 1997 and a LEED Accredited professional. She enjoys combining her educational and professional training with her interest in sustainable communities to advance the City's goals of economic growth, environmental sustainability and a better quality of life for the residents of San Jose.

The Economics of Clean Water in San Francisco Bay

Ellen Hanak, Public Policy Institute of California, hanak@ppic.org

This talk takes a broad look at how economists can contribute to thinking about a broad spectrum of water-related environmental management issues in the San Francisco Bay. Despite People often think of economics as only measuring the directly observable costs and benefits of investments and regulatory actions. But in reality, economics can also tease out insights on issues for which the numbers are less obvious – such as the value of ecosystem services or the transactions costs of institutional arrangements. The talk will provide illustrations relating to the management of water quality (wastewater and stormwater) and riparian and coastal habitat in the region, with a nod to the broader issues of integrated water resource management that bring in supply and flood management considerations.

Keywords: Economics, water quality, ecosystem services, stormwater, wastewater, habitat, transactions costs

Session Title: Bay Area Water Infrastructure Planning and Implementation: The Future is Now

Speaker Biography: Ellen Hanak is director of the PPIC Water Policy Center and a senior fellow at the Public Policy Institute of California. Under her leadership, the center has become a critical source of information and guidance for natural resource management in California. She has authored dozens of reports, articles, and books on water policy, including Managing California's Water. Her research is frequently profiled in the national media, and she participates in briefings, conferences, and interviews throughout the nation and around the world. Her other areas of expertise include climate change and infrastructure finance. Previously, she served as research director at PPIC. Before joining PPIC, she held positions with the French agricultural research system, the President's Council of Economic Advisers, and the World Bank. She holds a PhD in economics from the University of Maryland.

The State of Estuary Water Quality: 2015 and 2065

Jay Davis, San Francisco Estuary Institute, jay@sfei.org

The state of Estuary water quality was evaluated as part of the 2015 State of the Estuary Report. The Report examined whether Estuary waters are clean enough to be safe for fishing, for swimming, and to provide healthy habitat for aquatic life.

The status for fishing is fair and there has been no indication of improvement since 1994. Limited consumption of most popular Estuary fish species is advised due to contamination from two legacy pollutants (mercury and PCBs).

Water quality is generally good for swimming. Conditions are excellent at most Bay beaches. However, conditions are poor at 7% of beaches in summer and 27% in wet weather.

The quality of Estuary habitat with regard to chemical contamination is fair. Hundreds of chemicals have been measured and are below thresholds for concern. Mercury, invasive species, and trash are persistent problems. Recent improvement has been achieved for PBDEs and copper and is expected for invasive species, trash, and PFOS. Many potentially harmful chemicals have yet to be assessed.

The Estuary is also a safe source of drinking water for over two-thirds of Californians. A quantitative assessment of drinking water quality was beyond the scope of the Report.

In 2065, it can be expected that sources of pollutants of concern will be under robust control and that major hotspots will have been cleaned up. Other changes that can be expected include significant reductions in water flows and contaminant loads as wastewater and stormwater are increasingly conserved and used as a water supply; alterations in flows into the Estuary, the spatial extent of the Estuary, water movement, and water chemistry due to climate change; and changes due to new technologies including enhancements in water quality monitoring but also threats posed by new materials used in energy generation, transportation, and other sectors.

Keywords: water quality, fishing, swimming, habitat, mercury, PCBs, PBDEs, trash

Session Title: Water Quality in the Bay-Delta Estuary: Now and in the Future

Speaker Biography: Dr. Davis grew up near the PCB-contaminated aquatic food web of Lake Michigan. He has worked on contaminant issues in San Francisco Bay since 1986. He received his Ph.D. in Ecology at the University of California, Davis in 1997. Dr. Davis is lead scientist of the Regional Monitoring Program for Water Quality in San Francisco Bay, a comprehensive water quality monitoring program for San Francisco Bay. He is also lead scientist for bioaccumulation element of the California State Water Resource Control Board's Surface Water Ambient Monitoring Program, which conducts statewide surveys of contaminants in aquatic food webs. Dr. Davis is also the co-lead of SFEI's Clean Water Program. His primary research interests are monitoring the accumulation of persistent contaminants in aquatic food webs of the Bay, its watershed, and aquatic ecosystems in California, and the work of John Lillison, England's greatest one-armed poet.

Emerging Contaminants: Tackling Tomorrow's Problems, Today

Rebecca Sutton, San Francisco Estuary Institute, RebeccaS@sfei.org

Emerging contaminants are broadly defined as chemicals that are not regulated or commonly monitored, but have the potential to contaminate the environment and harm ecological or human health. The Regional Monitoring Program for Water Quality in San Francisco Bay (Bay RMP) has developed an emerging contaminants strategy that guides decisions on monitoring and management. Early identification of problem pollutants and quick action to prevent their spread is an optimal and cost-effective strategy for protecting water quality. This is especially true in an ecosystem like the Bay, which can act as a long-term trap for persistent contaminants, with recovery taking decades or centuries when contamination is extensive.

Monitoring of flame retardants like PBDEs (polybrominated diphenyl ethers) and stain repellants like PFOS (perfluorooctane sulfonate) illustrate the critical role the Bay RMP plays in providing policymakers with data needed to protect this vital urban ecosystem. Recent monitoring of PBDEs and PFOS suggests that levels have been high enough to affect Bay wildlife, though they are now declining due to state and federal policies, some informed by Bay RMP data. However, a common theme that our studies highlight is that policy actions designed to limit use of one chemical of concern can lead to increased use of replacement chemicals that may also threaten water quality. The Bay RMP emerging contaminants strategy allows scientists and managers to stay ahead of the curve, by identifying problem pollutants *before* they can harm wildlife.

Keywords: Contaminants of emerging concern, CECs, monitoring, flame retardants, stain repellants

Session Title: Water Quality in the Bay-Delta Estuary: Now and in the Future

Speaker Biography: Dr. Rebecca Sutton joined SFEI-ASC in 2013 as a Senior Scientist for the Regional Monitoring Program for Water Quality in San Francisco (Bay RMP), where she conducts investigations of contaminants of emerging concern. She manages SFEI-ASC's Green Chemistry focus area, leading studies to inform policies designed to prevent pollution through reduced use of toxic chemicals. Dr. Sutton has been appointed to California's Green Ribbon Science Panel to aid in the implementation of the state's Safer Consumer Products Regulations. Dr. Sutton received her B.S. in Environmental Resource Science from the University of California, Davis and her Ph.D. in Environmental Chemistry from the University of California, Berkeley. Prior to joining SFEI-ASC, Dr. Sutton was a senior scientist with research and advocacy non-profit Environmental Working Group, where she conducted research on chemicals of concern in air, water, soil, consumer goods, and people.

Green Infrastructure in San Mateo: A Vision of the Future

Matthew Fabry, San Mateo Countywide Water Pollution Prevention Program, mfabry@smcgov.org

Green infrastructure – natural systems that use vegetation, soils, and natural processes to manage water and create healthier urban environments – is increasingly seen as a "magic bullet" solution that can simultaneously provide habitat, flood protection, cleaner air, and cleaner water. These systems capture and treat stormwater runoff, allowing it to filter through plants and soil and replenish underground supplies. Although green infrastructure is being implemented throughout the Bay Area as new and redevelopment projects comply with regional mandates to incorporate on-site stormwater management systems, local agencies are challenged to meet increasing regulatory demands for green infrastructure within the public realm, primarily due to obstacles unique to stormwater in obtaining funding. Municipalities are facing requirements to develop Green Infrastructure Plans intended to gradually transform storm drainage infrastructure from the traditional "gray" to "green." These Plans, when implemented over the coming decades, are expected to help achieve long-term load reductions for mercury and PCBs in urban runoff. Municipalities are struggling to generate the necessary revenue to develop and implement such plans, and are looking for cost-effective approaches for integrating landscape-based stormwater management with other planned investments. In the past five years, agencies in San Mateo County have gradually increased the number of public green infrastructure projects and shifted from opportunistic demonstration projects to integrated multi-benefit projects capitalizing on the region's focus on building Complete Streets – roadways that safely accommodate bikes, pedestrians, and transit, as well as cars – as a means of driving down the cost of green infrastructure implementation and meeting water quality requirements. The presentation will focus on regional requirements related to green infrastructure, funding challenges and opportunities, integration with climate change and transportation investments, and project examples from San Mateo County.

Keywords: stormwater, green infrastructure, complete streets, low impact development, green streets

Session Title: Water Quality in the Bay-Delta Estuary: Now and in the Future

Speaker Biography: Matthew Fabry serves as Program Manager for the San Mateo Countywide Water Pollution Prevention Program, a program of the City/County Association of Governments of San Mateo County, which assists the 21 San Mateo municipalities with stormwater compliance issues. He sits on the Boards of Directors for both the Bay Area Stormwater Management Agencies Association and the California Stormwater Quality Association and has over 20 years of experience in water quality and stormwater management. Matthew has worked in municipal, regulatory, and consultant capacities, holds degrees in environmental engineering and music, and is a registered civil engineer in the State of California.