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Making Connections 8th Biennial Bay-Delta Science Conference

POSTER ABSTRACTS

2014 Bay-Delta Science Conference

Abstracts for Poster sessions presented at the 2014 State of the Bay-Delta Science Conference are compiled in this document. Abstracts are listed by Poster Topic and then sorted by the presenting author's last name. Though many posters have multiple authors, only the presenting author is listed in the table of contents. In the abstracts, names of presenting authors are underlined. Asterisks (*) indicate the poster is submitted by a student and eligible for the student poster awards competition.

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Hydrodynamic Modeling in the Yolo Bypass to Support Salmonid Habitat Restoration

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Significant modifications have been made to the historic floodplains of California's Central Valley for water supply and flood damage reduction purposes. The resulting losses of rearing habitat, migration corridors, and food web production for fish have significantly hindered native fish species that rely on floodplain habitat during part or all of their life history. To support the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project, a collaboration between the California Department of Water Resources and US Bureau of Reclamation, previous modeling efforts were improved with the development of a calibrated TUFLOW model of the Yolo Bypass and vicinity. The TUFLOW model analyzes multiple alternatives aimed at increasing seasonal floodplain inundation in the lower Sacramento River Basin and improving fish passage throughout the Yolo Bypass. The best available topographic and hydrologic information was used in preparing the model. The model was calibrated to a range of flow conditions representative of seasonal floodplain inundation as well as flood conditions. Hydrodynamic model outputs are being used to derive spatially explicit annual inundation footprints. These footprints are then used to assess the effects of increased frequency, depth, and duration of floodplain inundation on agriculture, fish, and waterbirds. The TUFLOW model will be an important planning tool as managers continue to try and find sustainable solutions for agriculture, fish, recreation, and terrestrial species in the Yolo Bypass.

Keywords: Yolo Bypass, Flood Control, Fish Passage, Fish Habitat, Ecology, Hydraulics

Poster cluster: Yolo Bypass: Connecting Science, Policy and Management

Uncharted Territory: Paving the Road for Future Large-Scale Restoration Projects

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Modern water delivery and flood control systems have virtually eliminated access to the vast majority of historic Central Valley floodplains. These floodplains once served as vital rearing habitat for native fish species. The Yolo Bypass presents an opportunity to provide juvenile salmonids with the rearing habitat critical to their growth and survival. Initially constructed as a flood control measure, the Bypass is not currently designed to optimize fish passage or juvenile rearing habitat requirements. The 2009 NMFS Biological Opinion on the Long-term Operations of the CVP and SWP prescribed the increase of seasonal floodplain habitat and improved fish passage in the Yolo Bypass. Currently, the Department of Water Resources and US Bureau of Reclamation are working to develop alternatives to comply with the Biological Opinion and minimize impacts to existing land uses in the Yolo Bypass. DWR and USBR are incorporating results from past and recent monitoring to help formulate and evaluate alternatives. Preliminary hydrologic and biological modeling results have helped form design and operational criteria required for fish passage and inundation structures. Developing design and operational criteria for salmonids and sturgeon in a flood bypass is a critical step towards the formation of a set of potential alternatives to be further examined as part of the EIR/EIS process. Fish passage structures on streams and rivers have been heavily studied on the west coast, but fish passage through a flood bypass coupled with increased access to rearing habitat of this scale has never been attempted. Every milestone reached in the development of this project will help pave the way for future large-scale floodplain restoration efforts.

Keywords: Yolo Bypass, Fremont Weir, fish passage, inundation, floodplain, salmon, sturgeon

Poster cluster: Yolo Bypass: Connecting Science, Policy and Management

Bloom or Bust: Fall Fish Food Trends in the Yolo Bypass

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The Yolo Bypass is a large, 59,000 acre engineered floodplain that, when inundated, becomes an important source of food for native fish species such as Sacramento Splittail and juvenile Chinook Salmon. This warm shallow habitat has long been valued by floodplain-adapted native fish, which rely on this environment for spawning, rearing, and foraging. Seasonal phytoplankton blooms, usually seen in winter and spring when inundation occurs, are important for the survival of many larval and juvenile fish species. Recent evidence has shown similar benefits can also be found during non-inundation periods, when agricultural discharge creates increased flows through the bypass. The increased availability of phytoplankton biomass has been linked to positive bottom up effect on the entire Delta ecosystem, leading to an increase in zooplankton. To investigate the role of this phytoplankton on zooplankton populations in the critical fall period, we examined zooplankton trends using data from the Yolo Bypass Fish Monitoring Program. A key motivator for this study is evidence from 2011 and 2012 that a phytoplankton bloom in the lower Sacramento River was seeded by contributions from the Yolo Bypass. Leading up to these fall blooms, increased flow pulses from the drainage of rice fields acted to transport high residence-time water out of the perennially wetted toe drain of the bypass into the delta. This transport has direct positive implications for the zooplankton and pelagic fish community downstream. Initial study results from 2012 and 2013 have shown that the phytoplankton species composition during the fall flow pulse is dominated by higher nutritional quality diatoms, which are a primary food for copepods and cladocerans. The benefit of these zooplankton species is significant as they comprise a substantial portion of the diet for larval and post-larval native fishes, including Delta smelt.

Keywords: Food webs, Floodplain, zooplankton, phytoplankton blooms, rice drainage, Yolo bypass

Poster cluster: Yolo Bypass: Connecting Science, Policy and Management

Conserving Terrestrial Species on the Yolo Bypass Floodplain

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The Yolo Bypass Fisheries Enhancement Conservation Measure (CM2) of the BDCP will increase the frequency, magnitude, and duration of floodplain inundation to benefit several native fish species. Increased floodplain inundation will periodically affect terrestrial species habitat in the bypass, including that of six vertebrate species covered by the BDCP: tricolored blackbird, Swainson's hawk, western burrowing owl, white-tailed kite, greater sandhill crane, and giant garter snake. These species occupy and utilize a combination of different habitat types (managed wetlands, cultivated lands, tidal and nontidal wetlands, and grasslands), requiring careful and strategic planning to develop a comprehensive conservation strategy that addresses the needs of both aquatic and terrestrial species, while also considering other land uses, such as agriculture and flood control. Yolo Bypass improvements presents a unique opportunity for local and regional landowners to partner on conservation actions for a multitude of species, while providing for the long-term protection of important cultural, economic, and biological resources. The conservation strategy for species occupying the Yolo Bypass was developed by a team of species, habitat, and flood control experts, including consultant and agency staff, and focuses on creating and protecting a mosaic of land types including large patches of nontidal and tidal wetland, cultivated land (primarily rice and pasture), and grassland. Lands created, restored, or protected within the Yolo Bypass will be enhanced and managed to benefit native species including BDCP covered species, waterfowl, and shorebirds. This poster will present the modeling and GIS approach used to craft the conservation strategy and effects analysis for the Yolo Bypass as well as a summary of the natural community and species-specific conservation strategies, and how they can be implemented in a way that is beneficial to land users and native species.

Keywords: Yolo Bypass, Terrestrial Conservation, Floodplain, BDCP

Poster cluster: Yolo Bypass: Connecting Science, Policy and Management

Presence of Juvenile Fishes in Yolo Bypass during Dry Years

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The Yolo Bypass is a 59,000 acre engineered floodplain that has been the focus of many ecological studies. Flooding in the Yolo Bypass occurs during years of heavy rainfall primarily when the Sacramento River overtops the Fremont and Sacramento Weirs. These flood events in the Bypass are able to convey up to 80% of the Sacramento River basin outflow, and it is now widely accepted that this engineered floodplain provides valuable habitat for many native fishes, especially Sacramento splittail and juvenile Chinook salmon. High productivity in the shallow, warm flood waters provide juvenile fish with abundant food sources, increasing their growth rates. However, the toe drain of the bypass, a perennial tidal channel that borders the east side, may be a perennial source of productivity, drawing juvenile fish up from the delta in response to high resource levels. The toe drain's primary source of water in dry years is irrigation water drained from agricultural fields, and it subsequently connects downstream with the Cache Slough Complex. We examined how the toe drain of the bypass may affect the presence or absence of juvenile fishes in non-flood years (years in which the Fremont Weir did not overtop). Even during extreme dry conditions, like the past water year (2013-2014), we observed a substantial number of juvenile fish, particularly Chinook salmon, in the Yolo Bypass toe drain. Documenting potential benefits of the Yolo Bypass to species of conservation concern during years without flooding is critical to understanding the role this important waterway plays in the ecology of the delta during all types of inflow scenarios.

Keywords: Chinook salmon, Yolo Bypass, non-flooded years, conservation

Poster cluster: Yolo Bypass: Connecting Science, Policy and Management

Yolo Bypass Fish Monitoring Program

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The Yolo Bypass is the primary floodplain of the Sacramento Valley. The Yolo Bypass Fish Monitoring Program has conducted studies and fisheries monitoring in the bypass continuously since 1997. This monitoring, primarily centered on the perennially wetted toe drain of the bypass, includes the operation of a rotary screw trap and fyke trap, biweekly beach seine surveys, zooplankton and drift invertebrate sampling, and water quality monitoring. Results from this monitoring have revealed that the Yolo Bypass is a major contributor to year class strength of Sacramento Splittail, a key migration corridor for adult fish of salmon and sturgeon, one of most important regional rearing areas for juvenile Chinook Salmon, a net source of phytoplankton to the food web of the San Francisco Estuary, and supports an endemic, floodplain dependent invertebrate. In particular, portions of the Yolo Bypass have been identified as key habitat for Delta Smelt and an important source of food for pelagic organisms, whose number have declined in recent years. The Yolo Bypass has been identified as a key area for future habitat restoration, and as such the Yolo Bypass Fish Monitoring Program provides for crucial baseline data and, moving forward, an important tool by which to gauge the success of any putative conservation measures.

Keywords: Yolo Bypass, Floodplain, RST, FYKE, Beach Seine, Lower Trophic

Poster cluster: Yolo Bypass: Connecting Science, Policy and Management

Utility of Passive Integrated Transponder (PIT) technology to examine juvenile salmon habitat preference on an agricultural floodplain

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The Yolo Bypass is an extensive 59,000 acre floodplain that is managed for farming, wildlife habitat, and flood control. When the Bypass floods (approximately 70% of years), it has been shown to provide quality habitat for juvenile salmon, enhancing growth and survival. Knaggs Ranch is an agricultural parcel within the Yolo Bypass that farmed for rice during the growing season, but is inundated along with other parts of the bypass during high water periods. As part of the larger 2013 Knaggs Ranch Experimental Floodplain project, we explored the feasibility of using passive integrated transponder (PIT) technology to examine individually-based growth, survival and habitat use across three basic agricultural land treatments: fallow, disked and rice stubble.

84 juvenile hatchery salmon 69 mm - 84 mm (FL) were implanted with either 8 mm or 12 mm PIT tags, and divided equally between experimental (fallow + disced + stubble) and control (disced only) enclosures along with non-tagged fish (including surgically treated fish). Approximately 2 million detections were recorded during the 2-week experimental period. Survival was high (~98%) and identical for both tag sizes. However, detectability of 8 mm tags was much lower than for 12 mm tags. Growth rate was very high, averaging over 1.1 mm per day for all habitats and tag sizes, and tagged fish & non-tagged fish alike. Detection patterns suggest that fish did not show a distinct preference for a specific habitat. Overall results indicate that PIT technology can be a useful tool to examine juvenile salmon movement in the open, shallow and non-linear (non-riverine) floodplain environment. However, the management of large resulting datasets and the limited detectability of the smaller tags are important considerations that should be taken into account during study planning.

Keywords: Yolo Bypass, Floodplain, Juvenile salmon, Agriculture, PIT tag, Habitat

Poster cluster: Yolo Bypass: Connecting Science, Policy and Management

Discovering the Flyway at the Yolo Bypass Wildlife Area

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Yolo Basin Foundation is training the next generation of Delta scientists and conservationists. The *Discover the Flyway* program for schools is a partnership between Yolo Basin Foundation and the CA Department of Fish and Wildlife at the 16,800-acre Yolo Bypass Wildlife Area. Over 50,000 K-12 students have participated in the *Discover the Flyway* program since its inception in 1997. The students come from more than 100 schools in Sacramento, Yolo, Solano, Placer and El Dorado Counties. This unique program provides students with a day of exciting hands-on, inquiry-based activities that are tied to the State Science and Social Studies Framework for each grade level. Students are able to see first hand how agriculture, flood protection and wetlands co-exist at the Wildlife Area, all within sight of the Sacramento skyline. For many of the students the *Discover the Flyway* field trip is their first opportunity to experience the excitement of seeing tens of thousands of migratory geese, ducks and swans, as well as otters and beavers. In order to enhance the grade-level curriculum needs of teachers, Yolo Basin Foundation provides them with a one-day workshop where they learn pre and post activities to supplement their *Discover the Flyway* field trip. Through fundraising in the private sector Yolo Basin Foundation is able to hire expert staff to train volunteers and teachers and provide grants to cover bus transportation costs for class visits from low-income neighborhood schools. Student to staff or volunteer ratios are 8:1 so that each child has a high quality experience. During the 2013-14 school year, 3,600 students and 1,000 parent chaperones spent an educational and memorable day at the Yolo Bypass Wildlife Area.

Keywords: Yolo Bypass students flood agriculture wetlands school partnership wildlife migratory

Poster cluster: Yolo Bypass: Connecting Science, Policy and Management

Resolving Stakeholder Concerns in the Name of Restoration: Case Study of the Yolo Bypass

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The Bay Delta Conservation Plans (BDCP) Conservation Measure 2 (CM2) is expected to contribute significantly to the achievement of the BDCP Biological Goals and Objectives for covered fish species including salmonids, Sacramento splittail, and sturgeon. The goal of CM2 is to improve fish passage through the Bypass and past Fremont Weir through modifications to the structure and increase the extent, frequency, depth, and duration of floodplain inundation to increase fish habitat quantity and quality. The scientific literature supports the assumption that implementation of CM2 will provide significant benefits for covered fish species including increased survival of juvenile salmonids and juvenile and adult sturgeon and increased splittail abundance. However, achieving these benefits will require accommodation by various stakeholders, including Wildlife Area land managers, local and regional agencies, and agriculture and flood control agencies. There will also be impacts to some wildlife species, including several BDCP covered species. Extensive coordination between various stakeholders is required to balance the needs of existing land users and the restoration and enhancement of floodplain habitat in Yolo Bypass. This poster outlines major stakeholder concerns and how the BDCP is proposing to address them, with emphasis on finding a sustainable balance between the biological benefit BDCP must achieve and the consequences of CM2 implementation on cultural, recreation, biological, and agricultural resources. The poster also highlights the science supporting the BDCP Biological Goals and Objectives for covered fish species, and the interconnectedness of the various regulatory and planning actions that all converge in Yolo Bypass.

Keywords: Yolo Bypass, Stakeholders, BDCP, Conservation Measure 2, Biological Goals Objectives

Poster cluster: Yolo Bypass: Connecting Science, Policy and Management

A New Method for Quantifying Flood Plain Habitat and Function

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Floodplains provide a variety of beneficial functions, but floodplain managers lack tools to systematically quantify these benefits. We have developed a new method and metric for quantifying the basic inundation characteristics that determine the value of a floodplain for a variety of functions and species (Matella and Jagt, 2013). The expected annual habitat (EAH) method relies on standard flood management planning tools and data to conduct (1) statistical analysis of the hydrologic record and (2) spatial analysis of hydraulic modeling results. Targeted queries of the hydrologic record using HEC-EFM determine how frequently an area is inundated for a specified duration and time and inform the creation of area-duration-frequency (ADF) curves for a river segment and floodplain. We combined hydraulic model output with topographic data to create flow versus inundated area curves or flow versus habitat curves where a habitat suitability curve incorporating timing, depth, or velocity is available. The primary innovation of the EAH method is combining inundated area with flow frequency to generate ADF curves that characterize areas of frequently inundated floodplain. The area under an ADF curve can be distilled to one number that represents the expected annual habitat for any species including agricultural crops.

Keywords: floodplain, habitat, hydrology, restoration planning

Poster cluster: Yolo Bypass: Connecting Science, Policy and Management

Recent Applications of the Estimated Annual Habitat method to measure, design, and evaluate floodplain habitat

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Until recently, the lack of replicable methods for measuring floodplain habitat has limited the ability of managers to evaluate historic changes in the quantity of floodplain habitat or plan and design floodplain restoration projects. The development of hydraulic models and high resolution topographic data developed as part of the Central Valley Flood Protection Plan has facilitated the development of the expected annual habitat (EAH) method (Matella and Jagt, 2013), which in turn has enabled managers to plan and evaluate a broad range of floodplain restoration projects.

The EAH method can quantify the floodplain habitat effects of any project that either modifies hydrology or floodway geometry. Aside from the data and hydraulic modeling issues that arise in any flood management study, the calculation of EAH is transparent and replicable. Calculation of inundated area and frequency of inundation is based solely on stage discharge relationships and standard frequency analysis statistics. EAH is therefore a replicable, scientific method that is not subject to distortions associated with weighting factors or professional opinion.

American Rivers, a national river conservation organization, has worked with scientists, engineers, and planners to develop the EAH for a range of applications across the Central Valley. These include use of the EAH to measure the existing area of floodplain habitat in the Central Valley, estimate the amount of floodplain habitat necessary to double anadromous fish populations, quantify the floodplain habitat characteristics of the Southport levee set-back project in West Sacramento, evaluate floodplain management conflicts in the Yolo bypass, plan floodplain and flow restoration on the Stanislaus River, measure the floodplain benefits of levee set-back and flow augmentation scenarios on the lower San Joaquin, and predict the agro-economic impacts of removing levees on the lower San Joaquin River.

Keywords: floodplain habitat, floodplain, restoration, hydrology, hydraulic model

Poster cluster: Yolo Bypass: Connecting Science, Policy and Management

Flood Management Planning – Drivers for Change in the Yolo Bypass

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The 2012 Central Valley Flood Protection Plan (CVFPP) focused on improving flood risk management for areas protected by the facilities of the State Plan of Flood Control (SPFC).

The Sacramento River Basin-Wide Feasibility Study (BWFS) is currently being prepared as part of the 2017 CVFPP Update. The BWFS focuses on evaluating system-scale improvements (bypasses) that reduce flood risk and provide multiple benefits.

The *systemwide approach to* flood risk reduction looks to provide:

- Reduction in the occurrence of flooding
- Reduction in damages when flooding does occur
- Increased flexibility of the system to accommodate increased flows in the future due to uncertainty in hydrologic conditions such as climate change
- Opportunities to achieve the CVFPP supporting goals of improving O&M, promoting ecosystem functions, and promoting multi-benefit projects
- A forum for coordinating with other planning efforts to leverage ongoing work efforts and identify synergistic actions and opportunities for alignment

The Yolo Bypass has significant potential to attenuate and convey large system flows from the entire Sacramento River basin and provide meaningful ecosystem restoration opportunities. The CVFPP poster will focus on describing the science, tools, and methods being applied to evaluate the flood risk drivers and benefits associated with potential improvements to the Yolo Bypass.

Keywords: CVFPP Flood Management Planning Climate Change Basin-wide Feasibility Study multi-benefit

Poster cluster: Yolo Bypass: Connecting Science, Policy and Management

Central Valley Flood System Conservation Strategy

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Central Valley Flood System Conservation Strategy
The Conservation Strategy is an integral part of the Central Valley Flood Protection Plan (CVFPP), an integrated approach to flood management that provides public safety, environmental stewardship, and economic stability. While improving flood risk management is the primary goal of the CVFPP, four secondary goals have been identified for this program. These include: improving operations and maintenance; promoting ecosystem functions; improving institutional support, and promoting multi-benefit projects. The Conservation Strategy supports these goals and provides more specific ecological goals including: improving and enhancing dynamic hydrologic and geomorphic processes; increasing and improving the quantity, diversity, quality, and connectivity of riverine aquatic and floodplain habitats; contributing to the recovery and sustainability of native species populations and overall biotic community diversity; and reducing stressors related to the development, operation, and maintenance of the flood management system that negatively affect at-risk species. The Conservation Strategy includes: improved science and planning information; a regional permitting approach; an improved approach to vegetation management; and ecological targets and measurable objectives. Implementation of the Conservation Strategy will be through multiple-benefit flood improvement projects, integrated planning, coordination with other conservation planning efforts, and agricultural stewardship. The Conservation Strategy builds upon the Conservation Framework that was adopted by the Central Valley Flood Protection Board as part of the 2012 CVFPP. A draft Conservation Strategy will be completed in December 2014 and integrated into the 2017 update of the CVFPP.

Keywords: conservation, flood management, integrative projects, planning, multi-benefit projects

Poster cluster: Yolo Bypass: Connecting Science, Policy and Management

Lower Putah Creek: Restoration Design within a Highly Managed Yolo Bypass

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Habitat and fisheries conditions in the reach of Lower Putah Creek within the Yolo Bypass have been shaped by agricultural activities, flood control, vegetation management practices, and construction and operation of the Solano Water Project. Hydrology and geomorphology in this reach continues to be dominated by its use as a 'reservoir' for irrigation of neighboring agricultural lands, and for flooding of the seasonal (managed) wetlands on the YBWA. The creek is seasonally dammed (from April 1 to December 1 each year).

The Lower Putah Creek Restoration Project must be designed within the context of maintaining current water management practices and legal mandates, flood conveyance capacity, Yolo Bypass inundation, and public uses including agricultural leases, managed wetlands, and hunting on the YBWA. Adequate conditions for passage of adult salmon must be achieved in a new stream channel which will travel over a distance of 4 to 5 miles with a fall in elevation of only 7 feet. The restoration will include creation of a new (fish friendly) diversion structure and new stream channel, connecting reaches of Putah Creek upstream of the Bypass, through previously restored tidal habitat (that will be enhanced as an element of the project), to the Toe Drain. This feature will allow adult salmon to enter the stream at least one month earlier than under current conditions. The new channel will bypass the last 2.3 miles of the existing Lower Putah Creek channel (a constructed irrigation ditch). The new channel design will include a series of shallow, seasonal wetlands to provide high quality rearing habitat.

Not unlike other restoration efforts planned in the Delta, implementation of this action presents considerable challenges related to reconciling the goals of restoration of habitats and ecological functions that support native species with the realities of working within a highly managed Delta system.

Keywords: Yolo Bypass, Putah Creek, fish passage, restoration, floodplain, salmonids

Poster cluster: Yolo Bypass: Connecting Science, Policy and Management

Permanent Wetlands Act as Polishing Ponds to Remove MeHg from Managed Freshwater Seasonal Wetland Tailwater in the Yolo Bypass Wildlife Area

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Managed freshwater seasonal wetlands often show patterns of elevated monomethylmercury (MMHg) concentrations and fluxes relative to other habitat types. Proposals to increase total acreage of seasonal wetlands in the Sacramento-San Joaquin Delta through restoration efforts may have unintended consequences of increasing MMHg in water, sediment, and biota. In this study, we investigated the potential for water quality improvement using permanent wetlands as treatment ponds. We utilized two existing permanent wetlands in the Yolo Bypass Wildlife Area in addition to constructing nine replicate large scale experimental permanent wetlands which allowed for controlled studies of mercury cycling. Weekly mass balance models for both the existing and experimental permanent wetlands were calculated. These models yield the net mass reductions of MeHg and relative importance of internal processes such as photodegradation, sediment water exchange, and particulate settling within the wetlands. Results indicate the permanent wetlands act as treatment ponds reducing levels of MeHg in drain water from managed seasonal wetlands. This information is useful to wetland restoration efforts and wetland managers as a way to mitigate MeHg loads from managed wetlands.

Keywords: Mercury cycling; Methylmercury; Wetlands; Seasonal Wetlands

Poster cluster: Yolo Bypass: Connecting Science, Policy and Management

How to Estimate Trophic Position of Fish from Lag in Contaminant Bioaccumulation

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For bioaccumulative contaminants, such as selenium, efforts to predict concentrations in organisms at upper trophic levels, based on measurements of environmental exposure, are confounded by the appreciable amount of time it may take for bioaccumulation to occur through various pathways and across several trophic transfers. Yet studies of bioaccumulation have hitherto generally overlooked this lag time, using temporally matched samples of water and tissue, effectively making the unrealistic assumption that bioaccumulation is instantaneous. The study summarized here offers a remedy for this deficiency, demonstrating a simple, objective method of automatically estimating the time required for bioaccumulation, and taking this lag into account to improve predictive modeling of bioaccumulation. This method uses a history of measurements of environmental exposure and tissue concentrations of a contaminant to systematically test a large array of potential lag characteristics, selecting the lag that provides the best regression. The method is demonstrated here using an unusually long-term data set of selenium measurements in water and aquatic organisms in sloughs in the San Joaquin Valley in California. Results indicate that, as expected, more time is required for selenium to bioaccumulate in organisms at higher trophic levels than in those at lower trophic levels. For example, the lag time for the piscivorous largemouth bass (*Micropterus salmoides*) may be more than one year, but only about one month for the filter-feeding threadfin shad (*Dorosoma petenense*). Also as expected, omnivorous organisms display a broader spread in lag time than more specialized feeders. Therefore, the method presented here not only provides a tool for improved prediction of contaminant effects and for more precise targeting of contaminant regulation, it also offers a novel means to estimate both the average trophic level of an organism and its trophic spread (degree of omnivory), when these characteristics are otherwise poorly known.

Keywords: bioaccumulation lag, trophic level, regression, computer program, selenium, trophic spread

Poster topic: Fish Biology, Ecology and Protection

Into the Belly of the Beast: Traditional and Genetic Prey Detection in Liberty Island's Mississippi Silversides

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Mississippi Silverside (*Menidia beryllina*) will feed on Delta Smelt (*Hypomesus transpacificus*) larvae in captivity (BM Schreier pers. comm.) and in the wild (Baerwald et al. 2012); however, the effects of predation on a population level are poorly understood. Identification of fish larvae in the stomach of predators is difficult as larvae are small and digest quickly. The purpose of this study was to utilize a novel approach of traditional visual processing followed by genetic testing of Mississippi Silverside stomach contents, with the goal of detecting and quantifying consumption of larval Delta Smelt.

Beach seine sampling was conducted by USFWS's Delta Juvenile Fish Monitoring Program's Liberty Island monitoring study. A total of 49 silversides were collected during March-May 2013. Size of fish ranged 45-89 mm FL (mean = 70 mm FL). Silversides collected in the field were preserved individually in 95% ETOH and stored at -20°C until their gut contents were visually analyzed.

Visual examination of stomach contents was conducted by CDFW Diet Study staff (Stockton, CA), which included removal and emptying of the stomach and identifying and enumerating all items to the lowest possible taxon. Lengths of larger prey items (larval fish, mysids, and amphipods) were recorded. DNA sterile techniques were used throughout the removal and stomach content identification process. The stomach contents and stomach (sans intestine) of each fish was subsequently collected into DNA extraction tubes and sent to Cramer Fish Sciences for genetic analysis using previously developed, species-specific TaqMan assays (Baerwald et al. 2011). Genetic analyses were carried out to determine the presence of Delta Smelt DNA.

The diet composition of silversides, by number, was primarily (95%) cladocerans and copepods. Other items included insects, amphipods, and mysids. Larval fish were not found in stomachs. Absence of Delta Smelt larvae in Mississippi Silverside stomachs was confirmed by DNA testing.

Keywords: Mississippi Silverside, Delta Smelt, Diet, DNA, TaqMan assays, Liberty Island

Poster topic: Fish Biology, Ecology and Protection

Inter-annual Variability of Delta Smelt Fall Growth in Association with the Fall Low-Salinity Habitat Study

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- Problem statement: Fall habitat condition in the Low-Salinity Zone of the upper San Francisco Estuary has deteriorated in recent years and has been associated delta smelt abundance. This study investigates the link between fall habitat and growth of delta smelt.
- Approach: We use the otolith increment widths as a proxy of growth during the fall for delta smelt collected in the Fall Midwater Trawl and Spring Kodiak Trawls in two consecutive years of wet and dry years (2005 Dry, 2006 Wet and 2010 Dry, 2011 Wet).
- Results: Fall growth varied considerably among years, with 2010 and 2011 exhibiting higher growth than either 2005 or 2006. Importantly, fall growth did correspond with the position of X2 in the months leading up to and including the fall period. Moreover, higher fall growth corresponded with better recruitment in the following spring.
- Conclusions/Relevance: This study supports adaptive management of fall habitat conditions through the manipulation of fall X2 via freshwater flow management for delta smelt. However, flow management in the fall must be followed by adequate spring habitat conditions to support the production of the next generation; otherwise any benefit provided by freshwater flows in the fall could be lost.

Keywords: FlaSH, Delta Smelt, Otoliths, Growth, X2, Freshwater Flows, Health, Abundance

Poster topic: Fish Biology, Ecology and Protection

Effects of Water Year Type on Juvenile Chinook Salmon Size at Emigration in the Lower Yuba River, California

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Most Central Valley rivers in California are regulated by large dams, altering the magnitude and frequency of flood events. Consequently, floodplain habitat is less frequently inundated, reducing the availability of an important habitat type for juvenile salmonids. Studies have shown that juvenile Chinook salmon (*Oncorhynchus tshawytscha*) rearing on floodplains may experience increased growth and survival compared to those rearing in-river. Floodplains can provide high quality food resources, which contribute to faster growth rates. Inundated floodplains and off-channel habitat may also improve survival by providing refuge from predators and increase the amount of available rearing habitat. Annual discharge in the lower Yuba River presently is based on the Water Year Type (WYT) designation from the North Yuba River Index described in the Yuba Accord. Implementation of the Yuba Accord began in 2007 and will continue until at least 2015. Significant differences in daily mean sizes of juvenile Chinook salmon exist across WYT in the lower Yuba River. In general, wet years tend to produce the largest juveniles whereas dry years produce the smallest fish. Increasing the amount of floodplain habitat available to juvenile salmon in the lower Yuba River at a variety of flow conditions could increase the overall size of juveniles. Larger smolts have been shown to have shorter travel times and higher survival through the Yolo Bypass and the Sacramento-San Joaquin Delta. Additionally, substantial scientific evidence for many species of salmonids indicates that the size of fish at ocean entry is an important, if not the primary, indicator of an individual's probability of returning to spawn.

Keywords: chinook, floodplain, rearing, Yuba

Poster topic: Fish Biology, Ecology and Protection

Use of *Menidia berylina* in Determining Impacts of Exposure to Endocrine Disrupting Chemicals in the SSJ Delta

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Populations of pelagic organisms in the Sacramento-San Joaquin (SSJ) Delta and other estuaries have been declining for several decades. We aimed to determine effects of endocrine disrupting chemicals (EDCs) on Inland Silverside, *Menidia berylina*, and further develop this species as a model molecular and genetic species for toxicological assessments. We have developed molecular and biochemical tools for assessing these impacts in *Menidia*. In this study we have monitored the changes in gene expression and protein translation in wild populations of *M. berylina* in the SSJ Delta, near Sacramento, CA over the course of 2 years. We also outplanted naive, lab-reared fish to sites in the SSJ Delta numerous times over the course of 1 year. Using a newly developed microarray for *Menidia,* as well as quantitative PCR on a suite of endocrine-related genes and ELISA to choriogenin protein, we have found that there are significant changes in hormonally regulated gene and protein expression in Silversides in the Delta, and that there is the potential for an impact on fish populations. Results indicate that rivers throughout the SSJ Delta elicited different responses, in terms of gene and protein expression, from each other as well as from control fish. Results were indicative of exposure to EDCs. There were impacts at all times of the year, but the greatest disturbance was observed in the winter months. This is likely due to increased influx of chemicals during the rainy season in that region. The incorporation of temporal aspects into the study was crucial to understanding the impacts of EDCs because the types of chemicals input into the Delta change as different crops are grown and as weather conditions vary throughout the year.

Keywords: endocrine disrupting chemicals, fish populations, toxicology, pelagic organism decline

Poster topic: Fish Biology, Ecology and Protection

Trophic Ecology of Larval Delta Smelt from Liberty Island, 2010-2012

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For this project we examined the diets of 212 larval delta smelt (*Hypomesus transpacificus*) containing prey that were captured within the Liberty Island/Cache Slough Complex as part of the Delta Juvenile Fish Monitoring Program. The primary goal was to identify the main prey taxa to compare to previous adult delta smelt diet results and to zooplankton assemblages present within Liberty Island. Diets of the Delta smelt analyzed were similar to those examined from the low salinity zone in the early 1990s and to diets collected more recently in the Liberty Island/Cache Slough Complex. Non-indigenous calanoid copepods dominated the diets in 2010 and 2011, with *Sinocalanus doerrii* more abundant early in the spring and *Pseudodiaptomus forbesi* more abundant later in the spring. In April and May 2012 the non-indigenous calanoids comprised much lower proportions of the diets and native cladocerans were more abundant.

Another goal of our study was to determine whether or not non-phytoplankton detrital material plays an important role in supporting larval delta smelt. Phytoplankton production has traditionally been regarded as the primary source of organic matter supporting these and other planktivorous fishes through pelagic zooplankton secondary production. However, recent food web research using a Bayesian mixing model and trophic enrichment-adjusted multiple stable isotope (MSI) signatures of delta smelt from Liberty Island suggested that the source of organic matter supporting their prey was a mixture of particulate organic matter (POM) from the surrounding Cache Slough Complex and POM and filamentous green algae originating within Liberty Island. We will present MSI results expected to be finalized in summer 2014, from both the larval delta smelt from Liberty Island and two major prey taxa, *Sinocalanus doerrii* and *Pseudodiaptomus forbesi.*

Keywords: larval delta smelt, diets, Liberty Island, stable isotopes

Poster topic: Fish Biology, Ecology and Protection

The Central Valley Spring-Run Chinook Life Cycle Model: A Tool to Evaluate the Impact of Water Project Operations and Habitat Restoration on the Population Dynamics of Threatened Salmon Populations

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The National Marine Fishery Service (NMFS) science center with support from the US Bureau of reclamation (USBR) has been developing a series of salmon life cycle models to predict the response of Central Valley Chinook salmon populations to water project operations and habitat restoration. They particularly aim at evaluating the effects of the Bay Delta Conservation Plan (BDCP) and the related operations of the Federal Central Valley Project (CVP) and California's State Water Project (SWP) on Chinook salmon populations. First developed for winter-run Chinook the model has been modified for spring-run Chinook salmons, which are listed as threatened under the Federal Endangered Species Act (ESA) since 1999. The differences between spring-run and winter-run Chinook life history are numerous and encompass dissimilarities in adult and juvenile migration timing, maturation strategy and spawning locations. As an example, spring-run adults are the unique one to leave the ocean as immature and hold in high elevation pools throughout the summer before spawning. They also have a specific juvenile life history strategy composed by both young-of-the-year fry that out-migrate soon after emergence and yearling fry that will stay in the Sacramento River Tributaries for a whole year before migrating to the Ocean.

Keywords: spring-run Chinook salmon, threatened, life cycle model, Bay-Delta Conservation Plan

Poster topic: Fish Biology, Ecology and Protection

Tidal Marsh Restoration Attracts Longfin Smelt

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- Problem statement: The Bay-Delta Conservation Plan will seek to restore tens of thousands of acres of tidal marsh habitat with the goal of increasing the abundance of declining native species including the longfin smelt. However; considerable scientific uncertainty surrounds the link between tidal wetland habitat and smelt.
- Approach: This study has been monitoring fish and macro-invertebrate abundance in several restored tidal salt pond habitats in Lower South San Francisco Bay in the Alviso Marsh area since July 2010.
- Results: Monthly otter trawling was conducted from July 2010 to present. In 4-years of monitoring, we counted 218 individuals from YOY to age 2+. Fall and winter months, we persistently found longfin smelt inside restored habitats. Moreover, restored tidal ponds exhibited high abundance of mysid shrimp, the preferred prey for longfin smelt.
- Conclusions/Relevance: This study supports the Bay-Delta Conservation Plans hypothesis that tidal marsh restoration will provide a benefit to longfin smelt. Over a 4-year period longfin smelt utilized restore habitats by migrating from the bay into the restoration ponds to forage. The tremendous productivity of tidal pond habitats will attract native species and support growth of threatened and endangered species.

Keywords: Tidal marsh restoration Longfin Smelt Mysid Shrimp Abundance

Poster topic: Fish Biology, Ecology and Protection

San Joaquin River White Sturgeon Telemetry Study

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White Sturgeon (*Acipenser transmontanus*) migration and spawning in California's Sacramento River has been well documented. Less is known about the migration and behavior of sturgeon within the San Joaquin River system. The use of acoustic telemetry provides an opportunity to gather information on White Sturgeon captured in the San Joaquin River over a wide geographical area and long time span. The information collected from this type of sampling can help determine fish habitat use outside of the capture area, evaluate spawning frequency, spawning site fidelity, and length of stay within a spawning area. White Sturgeon (n = 43) were captured with gill or trammel nets and implanted with acoustic transmitters (10 year tag life) during three sampling seasons (2012 – 2014). Most but not all sturgeon that were captured and tagged displayed post-surgery behavior indicating that they were not severely affected by the procedure. Seven of the fish implanted with acoustic transmitters have returned to the study area in subsequent years which shows that at least a portion of the White Sturgeon found in the San Joaquin appear to display site fidelity. Six fish have been detected in the lower Stanislaus River but the intent of their occupancy is not clear (spawning vs. exploratory behavior). During 2013, five fish over-summered in the study area and outmigrated during a pulse flow in September. The movement of fish into the Stanislaus River during the spring and out of the San Joaquin during the fall coincided with water releases for other purposes. Reservoir releases in the spring that are designed to promote the outmigration of juvenile salmonids may also benefit spawning White Sturgeon.

Keywords: White Sturgeon, San Joaquin River, Telemetry

Poster topic: Fish Biology, Ecology and Protection

Survival and initial feeding response of Delta Smelt larvae (Hypomesus transpacificus) exposed to Sacramento- San Joaquin Delta water, April – June 2012 to 2014.

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The endemic delta smelt is a threatened species (USFWS 1993) with potential population stressors including reduced freshwater flows, entrainment losses, inadequate food base and competition for food from exotic species, predation by exotic fishes and environmental contaminants. It is difficult to evaluate survival of the small (5-8 µm) pelagic larvae in the Sacramento River system. The USFWS Livingston Stone National Fish Hatchery maintains a refugial broodstock backup to the UC Davis Byron facility but cannot hold multiple generations due to resource limitations. We used excess newly hatched larvae to investigate the effects of delta water quality on 6 day survival and initial feeding response. Due to permit limitations, replicate groups were exposed *in-vitro* to water collected from the Sacramento River near the confluence of Cache slough and deep water shipping channel. Water was analyzed for pesticides and monitored (ºC, DO, pH, EC, NH_4, NTU) over the 6d trials. In comparison to control water, delta water exposure was associated with reduced survival and / or feeding response in **four** of eleven groups during 2012 and 2013. A similar trend has been observed in the spring 2014 trials however analysis is on-going. No difference in pooled whole body acetylcholinesterase activity was observed between exposure groups in 2013. Four fungicides and organophosphate pesticides as well as 2 pyrethroid pesticides were detected in the 2012 and 2013 water samples. No consistent pesticide or elevated ammonia level was associated with impaired survival in 2012 or 2013. This work indicates that delta water quality can have adverse effects on delta smelt larvae. A key question is to determine both the causes and mechanisms of this effect. Excess captive eggs could be used for an in-situ monitoring program to evaluate larval survival each spring.

Keywords: Delta smelt, pesticide, water quality, larval survival

Poster topic: Fish Biology, Ecology and Protection

Age-0 Striped Bass Regional Prey Consumption in the Fall (2011)

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Striped Bass (*Morone saxatilis*) is one of several pelagic fishes in the San Francisco Estuary that has suffered a severe decline since the early 2000s. The estuary serves as an important nursery for Striped Bass and monitoring the species has proven valuable in gauging the health of the Delta. There is little recent information on Striped Bass feeding habits during early life stages, when individuals are subject to varying prey availability and possible food limitation. This poster will present age-0 Striped Bass' regional use of prey that occurred during fall 2011.

Age-0 Striped Bass (n=243) collected during August-December of 2011 as part of the Fall Low Salinity Habitat Studies (FLaSH), were examined for stomach contents and fullness. Fish were collected by California Department of Fish and Wildlife (CDFW) surveys Summer Townet and Fall Midwater Trawl from Cache Slough (CS), the Sacramento River Deep Water Ship Channel (SRDWSC), and at stations assigned to regions based on surface water salinity (<6, 1-6, and <1 ppt) at time of sampling. Age-0 Striped Bass consumed a diverse group of prey types, the majority as diet by weight being amphipods, mysids, and juvenile fish. Furthermore, occurrence of prey was highly variable among months and regions. For example, Gammarus body type amphipods made up the majority of food found in >6 ppt through <1 ppt, while Corophium body type amphipods dominated stomach contents of fish in the CS-SRDWSC. Fish found in stomachs of age-0 Striped Bass contributed to a large portion of diet by weight due to their size. Additional prey types found in stomachs included the calanoid copepod *Pseudodiaptomus forbesi,* isopods, and insects. Age-0 Striped Bass diet composition during fall 2011 differed considerably from the diet of another FLaSH study species, Delta Smelt (*Hypomesus transpacificus*), which consumed mostly copepods (Slater 2012).

Keywords: Striped Bass, Diet, Mysids, Amphipods, FLaSH, Cache Slough, SRDWSC

Poster topic Area: Fish Biology, Ecology and Protection

The Role of Visual Stimuli and Flow in Green Sturgeon Rheotaxis Behavior

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Green sturgeon in the San Francisco Estuary have been observed utilizing current in an energy-efficient way by "riding" flow in high current areas, and subsequently moving independently of, or even into, the flow of slower currents. The ability to detect direction of flow (rheotaxis) is important when we consider the complex localized movements and migration patterns of green sturgeon. Here, we asked whether or not visual stimuli play a significant role in green sturgeon rheotaxis behavior. Twenty-three juvenile green sturgeon (49 to 59cm in length) were placed in a large tank and exposed to four unique conditions: flow in a dark environment, flow in a lit environment, visual stimuli above the subject, and visual stimuli below the subject. The visual stimuli consisted of a large belt with alternating black and white bands that would run the length of the tank and move at the researchers' discretion. Each fish was exposed to a condition for an average of 12 minutes. The trials started with the flow or belt moving at 1m/s and increase in increments of 0.1m/s every 15 seconds until a maximum flow of 5m/s was reached. We recorded the amount of time each fish spent either positively, negatively, or neutrally oriented with respect to the presented stimulus. Rheotaxis response to each treatment is presented here.

Keywords: sturgeon, rheotaxis, behavior, orientation, flow, experiment, visual

Poster topic Area: Fish Biology, Ecology and Protection

Combining Acoustic Tag and Hydrodynamic Data to Assess Velocity Habitat Suitability for Predatory Fishes in the Sacramento-San Joaquin Delta, California

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Predation of juvenile salmonids within the Sacramento-San Joaquin Delta is a major fish management concern. An important component of habitat for predatory fishes is water velocity. Infrastructure projects (e.g., for water supply) may change river flows and water velocity, but assessing the significance of the changes during planning can be challenging because information on the velocity range occupied by predatory fishes is limited. The present study assessed the velocity range occupied by predatory fishes at the San Joaquin River/Old River junction during April/May 2012. Captured predatory fishes were fitted with acoustic tags and their locations following release were estimated with a hydrophone array. Near-surface hydrodynamic data were collected with side-looking acoustic Doppler current profilers deployed near the river bank, and these data were interpolated to generate two-dimensional velocity fields for a 5-meter-by-5-meter set of grid points every 15 minutes. Each predatory fish tag detection was matched to the velocity estimate that was closest in space and time. Velocity data were binned into 0.05-meter-per-second categories and habitat suitability was evaluated as the number of detections in each velocity category divided by the total number of velocity observations within that velocity category. Channel catfish (n = 5) velocity habitat suitability was greatest at 0-0.05 m/s, intermediate at 0.1-0.25 m/s, and low at >0.3 m/s. Largemouth bass (n = 7) velocity habitat suitability was greatest at 0 m/s and declined rapidly to almost zero at velocity >0.1 m/s, which generally is consistent with published habitat suitability indices. Striped bass (n = 4) velocity habitat suitability was quite uniform across the range of velocity (0-0.45 m/s) encountered, reflecting the species' wide-ranging behavior. Results from this study can be used to give quantitative biological context to modeled velocity changes (e.g., from infrastructure projects) and will be augmented by study of additional species and locations.

Keywords: habitat suitability, predator, acoustic tag, velocity, salmonid

Poster topic: Fish Biology, Ecology and Protection

Determination of Optimal Fish Density in Experimental Systems using Physiological Stress Responses

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Fish density in holding systems can elicit stress responses that can greatly affect experimental signal-to-noise ratios, which are crucial in determining and interpreting significance in experiments related to physiological response. Optimal fish densities depend on the species, size and age, and can influence fish growth, behavior, and ultimately survival. Thus prior determination of optimal densities is important for both successful experimentation and aquaculture alike. Density determination is especially crucial for non-model species such as the endangered Delta Smelt (*Hypomesus transpacificus*), for which little-to-no density dependence information is available. The aim of this study was to determine the optimal density ranges for specific experimental vessels routinely used for delta smelt exposures. We maintained juvenile Delta Smelt (60 dph) for a period of 24 h, at five different densities: 7, 14, 28, 42, and 56 fish per 8 L circular fish tanks, at temperatures (15.8°C) and light (40.3 lux) regimes consistent with culture conditions. We assessed whole body cortisol, and transcriptomic biomarkers leading to cortisol production, via the Hypothalamus-Pituitary-Interrenal (HPI) axis. Stress levels (cortisol and change in gene expression) were lowest at densities of 28 and 42 fish per vessel whereas elevated stress levels were observed in lower densities 7 and 14 fish per vessel and highest densities of 56, suggesting an optimal juvenile Delta Smelt density in the range of 28-42 juveniles per vessels. This test further supports anecdotal observations that juvenile Delta Smelt do best when acclimated and cultured in groups rather than individually. We will present this simple but important experimental design for addressing fish densities, utilizing molecular and biochemical endpoints that are easily applicable to a broad range of fish species and exposure vessels.

Keywords: Optimal Fish Density, Stress Response, Cortisol, Molecular Biomarkers, Experimental Biology

Poster topic: Fish Biology, Ecology and Protection

Stress Response to Turbidity and Salinity utilizing Feeding Performance, Biochemical, and Molecular Biomarkers in Delta Smelt (*Hypomesus transpacificus)*

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Estuaries are amongst the most threatened and impacted ecosystems in the world and provide a unique habitat for numerous species. Turbidity and salinity are important parameters that play key roles for fish species such as the endangered Delta Smelt. We investigated turbidity (NTU) and salinity (ppt) requirements of Delta Smelt by assessing food intake, whole body cortisol and using a suite of molecular biomarkers involved in cortisol production, specific responses to salinity acclimation, and extreme turbidity (e.g. sodium potassium ATPase and glutathione-*S*-transferase). Physiological data were directly compared to feeding potential, and used towards defining the fundamental niche for delta smelt at adult, juvenile, larval stages. Endpoints indicated that the optimal salinity range for adults was above 0.2 and up to 12 ppt, and for the juvenile life stage from 2 to 6 ppt. Feeding was highly variable in adult Delta Smelt, but was not turbidity dependent. Juvenile feeding was relatively constant between 12 and 120 NTU declining significantly at 250 NTU, while larval fish showed optimal feeding performance between 25 and 50 NTU, with peak ingestion at 35 NTU. No statistical interactions were found between turbidity and salinity. Overall, turbidity affected feeding, likely by impacting the fish`s ability to visualize prey at both high and low turbidity extremes, rather than the measured physiological stress response. Salinity had a stronger effect on the physiological responses and only a minor effect on feeding performance. All life stages responded differently to turbidity and salinity exposure, indicating that the fundamental niche of Delta Smelt is life stage specific. Extrapolation of these findings to field observations could help with ecosystem management decisions in favor of the conservation of this sensitive fish species.
Keywords: Delta smelt, Turbidity, Salinity, Stress Response, Fundamental Niche

Poster topic: Fish Biology, Ecology and Protection

The Toxic Effects of Two New Herbicides on Early Life Stages of Delta Smelt (Hypomesus transpacificus)

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The control of invasive aquatic weeds in the Sacramento/San Joaquin River Delta is necessary for the protection of the environment and its beneficial uses; however safe herbicide use for non-target species must also be established. Two new herbicides, penoxsulam and imazamox, are proposed for use under the water hyacinth, *Egeria densa* and spongeplant pest control programs. Neither chemical has been extensively field tested, so there is some uncertainty regarding their effects on non-target aquatic organisms including the endangered delta smelt, *Hypomesus transpacificus*. Other current use herbicides and adjuvants have been implicated for developmental and endocrine effects in fish. This study assessed the toxicity of penoxsulam and imazamox and the adjuvant, Agridex, on delta smelt embryos and newly hatched larvae. Five replicates of twenty larvae or thirty embryos were tested, and mortality or hatching success was assessed upon test termination after 96-hour exposures and a clean water recovery period of three days (larvae) or until hatched (embryos). Results were analyzed for significant toxicant effects and interactions using generalized linear model statistics. Hatching success was not significantly affected by either of the herbicides or the adjuvant, individually, but there was a significant mixture interaction between imazamox and Agridex causing reduced hatching success at the highest mixture concentrations. Larval survival was affected by Agridex and imazamox alone (but not penoxsulam) after the 96-hour exposure and recovery period, however there was a low magnitude negative interaction between imazamox or penoxsulam in mixtures with Agridex. Results indicate that imazamox and Agridex are toxic to larval delta smelt at high concentrations, while their mixture is antagonistic. On the other hand, high concentration mixtures of imazamox and Agridex impair hatching success in delta smelt embryos, and are synergistic on this endpoint.

Keywords: imazamox, penoxsulam, Agridex, delta smelt, toxicity, hatching, mixture, herbicide, adjuvant

Poster topic: Fish Biology, Ecology and Protection

San Joaquin River White Sturgeon Spawning Survey

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The primary focus of this study was to determine if sturgeon (genus Acipenser) are spawning in the San Joaquin River in various water-year types by collecting fertilized sturgeon eggs with artificial substrate samplers. Anglers have reported capturing both White Sturgeon (*Acipenser transmontanus*) and Green Sturgeon (*A. medirostris*) in the San Joaquin River upstream from Highway 140. Several researchers have suggested that sturgeon may spawn occasionally in the San Joaquin River during high-water years but this has not been confirmed until recently. Initial documentation of White Sturgeon spawning in the San Joaquin River system occurred in 2011 (wet year type) when fertilized eggs were collected near Grayson, CA. In 2012 (dry year type), a total of 65 eggs were collected from four sites within a 24-km reach from Grayson downstream to near the confluence of the Stanislaus River. However, in both 2013 and 2014 (both critical year types) no eggs were detected within the study area. In addition, larval sampling with a benthic D-net was conducted during 2013 and resulted in no catch of larval sturgeon. Findings to date indicate that White Sturgeon spawn in the San Joaquin River in both wet and dry but not critical years. Although in both 2013 and 2014 it is possible that sturgeon spawned outside the area sampled or spawned in very low numbers that were not detected by our sampling methods. The area surveyed during our study may be an important source of production for the White Sturgeon population in the Sacramento-San Joaquin river system during some years. Understanding the spatial and temporal distribution of sturgeon in the San Joaquin River is vital for the management and recovery of this important species. Further, understanding the physical characteristics of the areas being used by sturgeon will help identify potential restoration actions.

Keywords: White Sturgeon, San Joaquin River, Spawning

Poster topic: Fish Biology, Ecology and Protection

The Sublethal Effects of Chronic Ammonia Exposure in Larval and Embryonic Delta Smelt (*Hypomesus transpacificus*)

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The Delta Smelt *(DS) Hypomesus transpacificus* is an endangered species endemic to the San Francisco Bay Delta-Estuary (SFBDE). The ammonia contamination of SFBDE occurring from wastewater treatment plants and agriculture runoff may play a role in *DS* population decline. In order to investigate the sublethal effects of environmentally relevant ammonia concentrations on embryonic and newly hatched larval *DS,* 3-day old embryos were exposed to six different concentrations of unionized ammonia (UIA) at a pH of 7.8. Control was set at 0.76µg/L, while treatments were 9.76, 37.39, 47.42, 90.74 and 115.20 µg/L. Ammonia exposure continued for 14 days, with embryos hatching at day 8 and larval exposure continuing through day 14. Larvae were euthanized on day 14 and fixed in 10% buffered formalin. The condition index and the yolk oil globule area were determined. Significant decreases were evident in both the condition index from the control starting at the highest UIA concentration of 115.20 µg/L and in the yolk oil globule area starting at the lowest concentration 9.76 µg/L. The yolk is separated into a lipoprotein yolk, used for energy and structural development during embryogenesis, and the oil globule, which acts as an energy reserve of calories during larval development. The decrease in oil globule area implies that there is an increase in energy requirements when exposed to UIA. Similar studies on the topic have exhibited an increase in expression of sodium/potassium (NK)-ATPase on gill epithelium in fish that have been exposed to UIA. The up-regulation of NK-ATPase due to increase UIA may be the cause for increased energy use, resulting in decreased oil globule size and decreased condition index. To further investigate, staining for increased expression of NK-ATPase on fixed samples of larvae is planned for the next phase of this study.

Keywords: Sublethal effects of chronic ammonia exposure on Delta Smelt

Poster topic: Fish Biology, Ecology and Protection

Physiological Responses of Delta Smelt to Low Salinity Acclimation

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The influence of freshwater (FW) diversion and global climate change reduce Delta outflows in the San Francisco Bay-Delta (SFBD) resulting in decreased size of the low salinity zone (LSZ) and its movement upstream. Decreased LSZ and entrainment as it approaches Delta export facilities is a problem facing pelagic fishes; Delta smelt (DS) is endangered. DS distribute throughout the LSZ and are spawning in FW. To determine salinity effects on DS as they move through the LSZ, we exposed adult DS (3.16±0.36 g, 78.42±2.74mm), fed 2% body mass per day, to salinities 0 to 10 parts per thousand (ppt) increased incrementally at 4 ppt/week over 19 days relative to FW controls. DS (n= 4/tank for 3 tanks/treatment) were weighed, measured, and sampled for analysis of hematocrit and plasma osmolality, gill chloride cell (CC) Na^+/K^+-ATPase (NKA) and apoptosis, and muscle water content at 1, 3, and 4 days post-salinity increase in both treatments. No apparent increase in length ($p=0.466$) or weight ($p=0.397$) occurred, nor did a difference in survival ($p=0.859$) between treatments over time. However, blood hematocrit ($p<0.05$) and plasma osmolality ($p<0.001$) became elevated just after increases in salinity and then decreased back to near FW after 4 days. Likewise, CCs showed increased apoptosis ($p<0.05$), NKA ($p<0.005$), and cell size ($p<0.005$) over time, indicating that renewal to salinity-tolerant CCs occurs. Muscle water content also increased by 3 days post-salinity increase ($p=0.015$), though was not different from FW by 4 days ($p>0.05$), indicating like hematological data, that osmoregulatory changes in CCs regulate DS's transition to brackish water. The process takes days at this rate, and likely comes at an energetic cost. While there are many stressors DS encounter in the SFBD, our data shows that utilization of biomarkers developed in this study have potential for long-term monitoring of DS in response to salinity.

Keywords: Delta smelt, salinity, physiological responses, environmental stressors, low salinity zone

Poster topic: Fish Biology, Ecology and Protection

Screening of Infectious Pathogens in Wild Striped Bass and Delta Smelt Populations using Next Generation Sequencing Technology

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Understanding the prevalence and pathogenicity of infectious agents are important for the protection of wild and captive fish populations. Cell-based screening is traditionally used for virus detection, however this method is not always practical due to the requirement for stable cell lines specific to the host species. The affinity between virus and cell type is another factor for successful virus replication. Although various types of pathogens are likely affecting wild fishes in the San Francisco Estuary (SFE), few infectious agents have been identified. To overcome the difficulties associated with specific identification of fish pathogens, we applied a cutting edge sequencing technology for pathogen screening. Genomic DNA from striped bass and delta smelt caught in the SFE were pooled and used for shotgun sequencing using the MiSeq System (Illumina) at UC Davis Sequencing Core. Over 10 million sequences were generated and processed using various bioinformatics programs for the assessment of sequence quality and assembly, and BLAST similarity search. We successfully obtained DNA fragments showing similarity to infectious fish pathogens such as *Mycobacterium marinum*, herpesviruses, and other environmental isolates. The fish used in this study did not show any clinical signs suggesting they harbored latent infections. Our results suggest that the Next Generation Sequencing Technology will benefit ongoing fish health surveys and the Delta Smelt Conservation Program by providing a tool for quantifying pathogen gene copies as indicators of prior exposure to the pathogen. The latent state (non–lethal DNA carriers) and active infections (overt diseases) are potential risk factors that may alter the health of wild and captive fish populations in the SFE. Pathogens are among the least studied stressors affecting the health of aquatic species with declining populations in the SFE; fits the goal of the Ecosystem Restoration Program.

Keywords: Next Generation Sequencing Technology, striped bass, delta smelt, Mycobacterium, herpesviruses

Poster topic: Fish Biology, Ecology and Protection

Reproductive Biology of Female Delta Smelt and Their Life History Model in the San Francisco Delta

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Problem Statement: Delta smelt (*Hypomesus transpacificus*) is a pelagic fish species endemic to the San Francisco Delta, which has been listed as endangered under Federal and State regulations. Understanding reproductive biology is critically important for protection of the endangered fish species.
Approach: In this study, we established accurate scoring criteria for female maturity levels based on histological changes in ovary and analyzed the reproductive status for the 2011 cohort, caught from December 2010 through April 2011.
Results: Staging based on histological examination revealed that 1) delta smelt oocytes underwent dramatic maturation changes in late February through April, and 2) delta smelt migrate towards low salinity zones (< 1 PSU) for spawning. The presence of postovulatory follicles and various stages of immature oocytes (Stage 2 to 3) in the ovary suggest that delta smelt are multi-spawning species, capable of reproducing several times over the course of their lives. Results indicate that our method provides a powerful approach to evaluate reproductive fitness of delta smelt. Furthermore, we will attempt to consolidate findings from the past scientific publications and propose a delta smelt life history model for their migration pattern and reproductive fitness in the San Francisco Delta.
Conclusion/Relevance: Information presented in this study enhances understanding of delta smelt's reproductive biology, migration pattern, and possible spawning ground, which can be further used to support management programs to protect their wild populations.

Keywords: Delta Smelt, Reproductive Biology, Migration Pattern

Poster topic: Fish Biology, Ecology and Protection

Use of Video Cameras in Monitoring

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Video cameras are commonly used as a tool to monitor organism behavior; however, the use of underwater video has become more prevalent in recent years for fisheries applications as video cameras have become smaller, higher resolution, more cost-effective, and more customizable. Stationary video cameras coupled with other passive monitoring equipment (i.e., infrared, sonar, electronic counters, etc.) have become commonplace for use at resistance board weirs, passageways, and fish ladders. Sites with direct power have the luxury of connecting high-resolution video cameras to computers, digital video recorders (DVR), and motion detection software to reduce user review time.

This poster describes applications, and challenges, of underwater video as a technique to quantify and observe aquatic organisms in riverine habitats. We describe several studies that have used video technology to quantify salmonids and non-native predators, document spawning activity of an endangered fish species, and experimentally test utilization of habitat structures by juvenile salmonids within habitat restoration sites. These studies have implications for both short- and long-term monitoring efforts and for habitat restoration project design.

Keywords: Restoration, monitoring, video, central valley, salmon

Poster topic: Fish Biology, Ecology and Protection

Employing Multiple Strategies to Restore Connectivity, Fish Populations and Aquatic Habitat in the Cosumnes, Mokelumne and Calaveras Rivers

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The Cosumnes, Mokelumne and Calaveras rivers differ significantly in many respects yet are all uniquely tied to conditions in the Sacramento – San Joaquin Delta due to their close proximity and relatively short anadromous reaches. A combination of habitat improvements, aquatic passage projects and water management operations has been employed recently in these systems to improve connectivity and increase the production of salmonids within each system individually and all systems collectively. A review of ongoing and planned future projects and efforts to address limiting factors to connectivity and production in these three rivers will be presented. In the Cosumnes River, upstream passage of adult salmonids was viewed as the highest priority limiting factor and the last two non-natural barriers in the system were addressed in 2010 and 2011. In the Mokelumne River, spawning and rearing habitat limitation and inadequate migration flows are currently being addressed via habitat restoration projects and adaptive management of water releases and facility operations within the river and beyond. On the Calaveras River, adult and juvenile passage and limiting migration flows are being addressed through fish passage improvements and coordinated flow releases when possible. In addition to the efforts on individual systems, opportunities to restore floodplain habitats that will benefit juveniles from these three systems and other Central Valley rivers are being developed. These efforts shown positive results in fish populations and significantly increased the ability to accomplish challenging projects. While an ever increasing set of demands is placed on these systems that make fisheries and aquatic habitat management challenging, collaborative efforts to manage each system individually and all systems collectively shows great promise to protect and enhance important aquatic resources. These improvements will be an important part of the success of larger-scale efforts to restore and manage resources throughout the Bay-Delta system.

Keywords: Cosumnes, Mokelumne, Calaveras, Connectivity, Passage, Flow Management, Collaboration

Poster topic: Fish Biology, Ecology and Protection

2014 Georgiana Slough Floating Fish Guidance Structure Performance Evaluation

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In response to a 2009 NMFS Biological and Conference Opinion for the Long-Term Operations of the Central Valley Project and State Water Project, DWR has been investigating engineering optionsto reduce the diversion of juvenile salmonids into the interior and southern Delta where survival is lower. In 2011 and 2012 DWR led an evaluation of a non-physical barrier using Bio-Acoustic Fish Fence™ (BAFF) technology at the divergence of Georgiana Slough and the Sacramento River. During these studies, it was observed that the probability of outmigrating salmonid entrainment into Georgiana Slough was significantly reduced; and that the observed entrainment probability was dependent on salmonid cross-stream distribution with or without the barrier. It was hypothesized that similar or improved entrainment reduction could be achieved by simply re-distributing a portion of the fish away from Georgiana Slough. Based on this hypothesis, DWR conducted a study in 2014 utilizing a simpler technology —a floating fish guidance structure (FFGS). A primary component of the 2014study experimental design was to release uniquely tagged (acoustic tags) juvenile late fall–run Chinook salmon into the Sacramento River near the City of Sacramento, approximately 33 miles upstream of Georgiana Slough and track their movements near the FFGS and throughout the larger Delta system. The study design included a total of 25 hypotheses that were formulated to inform the following study objectives: assess reach-scale route selection and survival of juvenile Chinook salmon; assess temporal distribution of juvenile Chinook salmon at arrival in FFGS area; assess predation and predatory fish behavior in the vicinity of the FFGS; assess far-field movements of predatory fishes and Chinook salmon juveniles; assess alternative hypotheses specific to barrier function; and compare effectiveness of the FFGS and the BAFF technologies and between years. The poster presentation will provide preliminary results of the study as well as future management directions.

Keywords: acoustic tag, salmonid, Georgiana Slough, fish barrier

Poster topic: Fish Biology, Ecology and Protection

Identifying When Tagged Fishes Have Been Consumed By Piscivorous Predators: Application of Multivariate Mixture Models to Movement Parameters of Telemetered Fishes

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Consumption of telemetered fishes by piscivores is problematic for telemetry studies because tag detections from the piscivore could introduce bias into the analysis of telemetry data. We illustrate the use of multivariate mixture models to estimate group membership (smolt or predator) of telemetered juvenile Chinook salmon (*Oncorhynchus tshawytscha*), juvenile steelhead trout (*O. mykiss*), striped bass (*Morone saxatilis*), smallmouth bass (*Micropterus dolomieu*) and spotted bass (*M. punctulatus*) in the Sacramento River, CA, USA. First, we estimated two types of track statistics from spatially explicit two-dimensional movement tracks of telemetered fishes: the Lévy exponent (b) and tortuosity (τ). Second, we hypothesized that the distribution of each track statistic would differ between predators and smolts. To estimate the distribution of track statistics for putative predators and smolts, we fitted a bivariate normal mixture model to the mixed distribution of track statistics. Lastly, we classified each track as a smolt or predator using parameter estimates from the mixture model to estimate the probability that each track was that of a predator or smolt. Tracks classified as predators exhibited movement that was tortuous and consistent with prey searching tactics, whereas tracks classified as smolts were characterized by directed, linear downstream movement. We correctly classified 90% of the *Micropterus* species and 72% of the striped bass as predators. For tagged smolts, 80% of Chinook salmon and 74% of steelhead trout were not classified as predators. Mixture models proved valuable as a means to differentiate between salmonid smolts and predators that consumed salmonid smolts. However, successful application of this method requires that telemetered fishes and their predators exhibit measurable differences in movement behavior. Our approach is flexible, allows inclusion of multiple track statistics and improves upon rule-based manual classification methods.

Keywords: Telemetry, predation, Striped bass, Micropterus, Chinook salmon smolt

Poster topic: Fish Biology, Ecology and Protection

Finding the Females: Developing a Novel Tool to Investigate the Skewed Bay Delta Striped Bass Sex Ratio

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Recruitment of Bay Delta Striped Bass (*Morone saxatilis*), an apex predator and economically important sport fish, has been decreasing despite a stable adult population. A trend in declining female abundance on the Sacramento River spawning grounds from 1970s - 2008 and decreases in female size and age suggests that reduced egg availability may have contributed to low recruitment. The cause of female decline is unknown, although it is hypothesized that environmental factors or sex specific behavioral differences may be responsible. We propose to develop a novel tool that will allow biologists to test alternative hypotheses about the decline in Striped Bass female spawners. Here, we provide updated sex ratio data for the 2014 Striped Bass spawning run and describe proposed research to design a genetic sex marker that will non-invasively determine the sex of Striped Bass of any size/age class using only a small tissue sample. Currently Striped Bass sex ratio data is collected through dissection of ripe adults harvested on the spawning grounds but a genetic sex marker would allow biologists to determine sex of immature individuals and pinpoint the spatial and temporal extent of the sex ratio skew. Once the cause of the female Striped Bass decline is determined, managers can develop strategies to increase female abundance and restore recruitment to preserve this popular sport fishery.

Keywords: Striped Bass, Recruitment, Sex Ratio, Sex-Specific Behavior

Poster topic: Fish Biology, Ecology and Protection

Juvenile Salmonid Utilization of Floodplain Rearing Habitat after Gravel Augmentation in a Regulated River

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Gravel augmentation is used in sediment-starved streams to improve salmonid spawning habitat. As gravel is added to river channels, water surface elevations rise in adjacent areas, activating floodplain habitat at lower flows and with greater frequency, potentially affecting the quantity and quality of juvenile salmonid rearing habitat. We analyzed five years of juvenile Chinook salmon *Oncorhynchus tschawytscha* and steelhead *O. mykiss* data from snorkel surveys before and after gravel augmentation in a regulated river in California's Central Valley. We measured the quality and quantity of rearing habitat (current velocity and areal extent of inundated riparian vegetation) following gravel placement and tested whether these factors affected juvenile abundance.

Gravel augmentation increased floodplain extent, and rearing habitat conditions (current velocity, vegetative cover) improved significantly. Juvenile abundance increased significantly for both species following augmentation; however, the strength of the relationship between abundance and habitat variables was greater for smaller fish. These results suggest that, in addition to enhancing salmonid spawning habitat, gravel augmentation can improve rearing habitat where channel incision and/or regulated hydrographs disconnect floodplains from main river channels.

Keywords: habitat improvement, fishery resources, restoration, rivers, salmon

Poster topic: Fish Biology, Ecology and Protection

Determining the Feasibility of Fish Passage, Calaveras Dam Replacement Project, California

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

Keywords: fish passage, Calaveras, Alameda Creek, steelhead, dam, watershed, permit, SFPUC

Poster topic: Fish Biology, Ecology and Protection

Does Gravel Size Influence Benthic Macroinvertebrate Density, Biomass and Feeding Guild Composition?

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There has been an increase in river restoration projects on regulated California Central Valley rivers due to undesired anthropogenic effects (e.g. dams, diversions, agriculture, levees and urban development). These effects interrupt and reduce the quantity and quality of bed sediment substrates necessary for anadromous salmonid spawning and also reduce essential ecosystem processes important to rearing juvenile salmonids. Aquatic macroinvertebrate production is an example of an ecosystem process that has been altered because assemblage richness and composition is generally influenced by substrate size. Aquatic macroinvertebrates play a pivotal role in river ecosystem functions including prey sources for juvenile anadromous salmonids. Gravel augmentation is a widely accepted technique for restoring anadromous salmonid spawning habitats throughout the Central Valley. We examined the effects of gravel augmentation on colonization and composition of aquatic macroinvertebrates by comparing density, biomass and community structure among three different substrate sizes (small, medium and large) in a gravel augmented area on the lower American River, a regulated Central Valley stream. Our observations show that large gravel produced significantly higher macroinvertebrate density than small and medium substrate which suggests that larger gravel may support increased forage production for juvenile salmonids. Large gravel has lower total surface area, but provides more stable substrate and interstitial spaces that are accessible to both macroinvertebrates and juvenile salmonids. Although larger sized gravel had a higher density of benthic macroinvertebrates, the biomass did not differ significantly between medium and large gravel. Therefore, because medium-sized gravel produces more optimal spawning habitat, it may ultimately be the most appropriate strategy for augmentation to simultaneously enhance habitat and prey productivity for multiple salmonid life stages.

Keywords: Restoration, ecology, habitat, salmon, macroinvertebrate communities, density, Central Valley

Poster topic: Fish Biology, Ecology and Protection

An Integrated Approach for Health Assessment of the Endangered Delta Smelt (*Hypomesus transpacificus*)

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Biological monitoring of the health of wild fish populations is challenging, especially when dealing with a small and sensitive fish such as the endangered delta smelt (*Hypomesus transpacificus*), a species of management concern and an important indicator species of the health of San Francisco Estuary ecosystem. To maximize the range of health information for smelt, we conducted multiple tissue collections and bioassays from individual fish, which from a large number of fish was a huge task to accomplish in field and laboratory settings and required enormous time and manpower. Here, in contrast with the traditional approach, we report an integrated approach of establishing the health status of an individual smelt by assessing a large suite of biological endpoints using a liquid nitrogen preservation method. Fish were obtained from the long-term monitoring surveys in collaboration with the California Department of Fish and Wildlife. Individual fish wrapped in a pre-labeled aluminum foil was immediately flash-frozen in liquid nitrogen and transported to UC Davis at the end of each field day. Flash-frozen fish were stored in liquid nitrogen to accommodate weekly necropsy schedules where multiple organs of individual fish were processed for aging, body and organ conditions, diseases, enzymes, histopathology, nutrition, and reproduction. Parallel tissues (fresh vs. frozen) were compared for each biological endpoints to evaluate the diagnostic accuracy of our method. Integrating multiple biological endpoints from a single fish will improve our understanding of fish health following exposure to multiple environmental stressors and if the cumulative responses may provide insights to vita functions such as growth, survival, and reproduction. Research to develop a qualitative understanding of physicochemical and contaminants stressors directly affecting the growth, survival, and reproduction of delta smelt fits the goal of the Ecosystem Restoration Program.

Keywords: Delta Smelt, Indicator Species, Flash-Frozen, Individual Health Assessment

Poster topic: Fish Biology, Ecology and Protection

Health of Juvenile Delta Smelt (*Hypomesus transpacificus*) in Summer 2012 and 2013

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This one-year study examines the health status of juvenile delta smelt (*Hypomesus transpacificus* sampled from the 2012 and 2013 Summer Townet Survey of the California Department of Fish and Wildlife from certain regions of interest: Suisun Bay, Sacramento and San Joaquin river confluence, and the Cache slough/Sacramento Deep Water Ship Channel (CS/SDWSC). Water temperature during fish collection (June and August) was higher in 2012 than in 2013. Compared to 2013, juvenile smelt in 2012 were relatively: 1) smaller, weighed less, and have lower hepatosomatic and condition indices), 2) lower in primary long-term reserve energy (muscle triglyceride) for growth and maturation, 3) lower in secondary short-term reserve energy (liver glycogen) for tissue repairs and growth, and 4) lower in stomach fullness, sum of prey wet weight, and %stomach body weight. When juveniles are separated by size, fish with 26-34 mm total length (TL) showed lower stomach fullness, sum of prey wet weight and muscle triglyceride in 2012 than 2013. Although fish at the 35-55 mm TL range had lower stomach fullness and sum of prey wet weight, they exhibited a higher muscle triglyceride in 2012 than 2013. Across regions, juveniles capture at CS/SDWSC had relatively lower stomach fullness, sum of prey wet weight, and muscle triglyceride in 2012 than 2013, regardless of size. As water temperature has a significant effect on fish metabolism, the lower temperature may have provided better habitats or potentially more food resources for juvenile smelt. Although multi-stressors generally impacted the health of juvenile smelt in the summer of both years, the fish showed greater nutritional capacity (in terms of energy reserve and stomach fullness) in 2013. These results suggest that the state of nutritional health may alter the severity of stressor effects, overall contributing to a relatively healthier juvenile smelt in summer of 2013 than in 2012.

Keywords: Juvenile delta smelt, summer townet, triglyceride, stomach, temperature

Poster topic: Fish Biology, Ecology and Protection

Warming Water Temperatures in California's Central Valley: Potential Effects on Upstream Salmonid Habitat Conditions

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Elevated water temperature associated with future climate change has the potential to become a major stressor for Central Valley salmonids with restricted access to cooler historical spawning and rearing habitat. In this study, we assessed effects of water temperature increases due to climate change over the next 50 years on threatened and endangered salmonids in the upper Sacramento, Feather, and American rivers. To assess effects, we employed a novel "degree-day/degree-month" technique that combines both the frequency and magnitude of exceedance of modeled water temperatures above regulatory water temperature thresholds under current and future climate conditions. Our analysis predicts that salmonids will experience a consistent two- to three-fold increase in suboptimal temperature conditions during much of their upstream freshwater residence within the next 50 years. We offer potential management solutions for improving the likelihood of sustaining Central Valley salmonid fisheries in the future, including expanding upstream habitat, promoting life history diversity, and altering water management strategies. We found that our analytical technique could be an effective screening tool for biological evaluation because of similarities in results to more elaborate biological models, but without the additional effort needed to run those models.

Keywords: climate change, salmonids, water temperature, modeling, threshold, degree-day

Poster topic: Fish Biology, Ecology and Protection

Tidal Habitat Restoration and Regional Flood Protection Nexus: Planning for Multiple-Benefits in the Lower Sacramento North Delta Region

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Problem: Two concurrent goals, regional planning for flood risk reduction and flood plain and tidal habitat restoration efforts, are planned for the Lower Sacramento River/North Delta Region. Effective inter- and intra-agency coordination, communication, and collaboration will be fundamental to the success of meeting both goals in a region where land available to achieve these goals is limited.

Approach: DWR funds locally driven efforts to develop flood management plans. FloodProtect, in the Lower Sacramento North Delta Region, seeks to coordinate flood planning efforts with stakeholders and present a landscape level regional flood management plan to DWR. The Fish Restoration Program (FRP), a joint effort by DWR and CDFW, must restore 8,000 acres of intertidal and associated subtidal habitat and a minimum of 17,000 acres of flood plain habitat by 2018 to meet specific State and Federal restoration requirements. There is great potential to achieve the goals of these two compatible efforts through close coordination between programs, departments, and agencies.

Results: Close collaboration has already begun between CDFW and DWR through the FRP and FloodSAFE Environmental Stewardship and Statewide Resources Office. Bit by bit, lines of communication between the agency silos are being formed, regional planning for multiple-benefits is taking shape, and these collaborative efforts are identifying where the opportunities exist in the system.

Conclusions: Multiple-benefit projects, that meet ecological, flood safety, and agricultural needs in a finite landscape, where the land is already performing multiple functions, will require continued close collaboration for planning operations and maintenance of the system.

Keywords: Tidal Habitats, Lower-Sacramento, North-Delta, collaboration, Yolo Bypass, Flood Protection, Multiple-Benefit

Poster topic: Flood Management

The AFRI Rice Project: Benefits of Nitrogen Fertilizer Treatment in Rice Planting on the Sacramento-San Joaquin Delta to Encourage Subsidence Prevention, Sustainability of Soil Conditions & Water Management Effects on GHG Emissions

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About two-thirds of the Sacramento-San Joaquin Delta (Delta) islands are agriculture lands. The drained peat soils of the Delta have provided fertile soils for agriculture since the late 1800s. Unfortunately during that time, the environment in the Delta island region has dramatically deteriorated as evidenced by subsidence. On many of the Delta islands peat soil has oxidized causing subsidence of up to 20 feet, or more, below sea level.

Subsidence is responsible for severe consequences including extensive greenhouse gas emissions, construction of a 110-mile levee network, risks to California's water supply and the degradation of water quality. If current agricultural practices remain unchanged, things will only get worse.

As a partner in a UC Davis and UC Berkeley study, East Contra Costa County high school students are participating in the AFRI Rice Culture Mitigation Study to determine if growing rice, as opposed to other Delta crops, would help in mitigating subsidence and concurrently mitigating GHG emissions and soil loss; reducing risks to California water supply, including the agricultural users throughout the San Joaquin Valley downstream of the Delta; and protecting water quality.

In this study, conducted in a Learning Lab rice field on Jersey Island, the main focus is the effect of fertilizers on rice as related to yield and environmental effects. A number of hypotheses will be tested: nitrogen is a limiting nutrient in the Delta for rice; soil under treatments with nitrogen fertilizer additions will contain higher concentrations of extractable NO3 during the growing season compared to treatments lacking nitrogen; GHG emissions are affected by water management and rice developmental stages; rice fields are sources of NO3 and PO4 in water.

Through soil, water and air quality samplings students hope to use examples of soil nitrogen levels, N_2O and CH_4 emissions and chloride changes to prove hypotheses.

Keywords: Island Subsidence, Levee, GHG, Greenhouse Gas, Carbon Emissions, Rice, Peat

Poster topic: Flood Management

Lower Food Web Dynamics of the Sacramento-San Joaquin Delta

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The highly studied lower food web in the Sacramento-San Joaquin Delta involves many complex relationships and dynamics across its constituents (Bennett et al. 1995, Kimmerer 2004, Lehman 2004, Glibert 2010). Large shifts of both phytoplankton and zooplankton abundance and species composition have occurred over the last few decades (Lehman 1996, Jassby et al. 2002, Bollens et al. 2011, Winder and Jassby 2011). Declines of phytoplankton have occurred, as well as a shift from a largely diatom-dominated system to non-diatom species (Lehman 1996, Lehman 2000, Kimmerer 2004). Declines of many zooplankton species and the invasion of new species have greatly altered lower food web dynamics (Kimmerer 2004, Winder and Jassby 2011). These relationships are strongly influenced by various regulating factors that facilitate changes in the lower food web such as hydrodynamic transport mechanisms, light limitation, nutrient concentration, toxicity, and grazing by invasive clams (Lisa Lucas, workshop presentation, Alex Parker, workshop presentation, Jan Thompson, workshop presentation). The intense modification of the entire Delta system has also greatly influenced the lower food web of the ecosystem (Nichols 1986, Kimmerer 2004, Whipple et al. 2012). Understanding lower food web dynamics is crucial to providing insights regarding the overall functioning of the entire system. To synthesize our current knowledge on this topic, a symposium, *Lower Foodweb Dynamics in California's Bay-Delta Ecosystem: Current Understanding and Future Interactions with a Changing Landscape,* was held at the University of California, Davis, on February 18th, 2013. The purpose of this symposium was to provide recent scientific results that further inform the current state of knowledge regarding lower food web dynamics in the Bay-Delta system. The poster will summarize the results of this symposium.

Keywords: food webs, physical dynamics, zooplankton, phytoplankton

Poster topic: Food Webs

Impacts of Population Growth on the San Francisco Bay and Delta Ecosystem (SFE)

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One challenge facing Earth system science is to understand and quantify the impacts and feedbacks of human influences on rivers and estuaries and coastal zone biology and ecology. This collective system has important interplay with human population and economics, especially in regions of high population density like the San Francisco Bay and Delta Ecosystem (SFE). The goal of this recently funded NASA Interdisciplinary Science project is to put in place an approach and modeling framework for the scientific basis of an ecosystem approach to the stewardship of the SFE including freshwater and marine resources within the SFE and adjacent ocean ecosystems. Our SFE project combines four components: (1) satellite observations, (MODIS, MERIS, HICO on the international space station, LDCM-OLI and in the future Sentinel-3 OLCI); (2) field observations (nutrients, phytoplankton, suspended sediments, CDOM and optical properties); (3) the CoSiNE ecological model integrated with (4) a SELFE hydrological model of SFE. This project builds upon long established remote sensing and field programs in the SFE and on the physical and biological models of the SFE being developed as part of the current NASA Interdisciplinary Science SESAME project to understand and predict variations in central California salmon populations. Our measurements and models will encompass the dynamics of the SFE in order to determine how increasing population density and demand for fresh water can affect this watershed including human impacts from its upper reaches to the continental shelf. We will explicitly include water diversion and flow management, nutrient inputs from sewage plants and other sources and the effects of the mix of nutrients on the phytoplankton populations in the SFE. Throughout this project we will share our data, model results and insights with SFE agency leaders responsible for managing this complex system.

Keywords: physical models, remote sensing, ecosystem modeling, nutrients, phytoplankton, water diversions

Poster topic: Food Webs

What Would Fish be without Food? How Herbicides Affect Aquatic Communities from Bottom-Up

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Herbicides, used in both agricultural and urban areas, are found in the Sacramento-San Joaquin Delta watershed at concentrations that are potentially toxic to phytoplankton. Furthermore, herbicides are directly applied to control invasive aquatic vegetation. Consequently, there is increasing concern over direct effects on primary production, and indirect effects on zooplankton and other aquatic invertebrates. Here we evaluate the effects of herbicides commonly detected in the Delta; diuron and hexazinone, as well as their degradates, on the algal species *Pseudokirchneriella subcapitata*, as well as on naturally developed invertebrate communities.

We first conducted laboratory exposures on *P. subcapitata* to determine effective concentrations for the herbicides, applied both individually and in mixtures, over 96h. We then assessed effects of environmentally relevant concentrations, as well as toxic concentrations determined in the study above, over a period of four months in outdoor mesocosms. Phytoplankton and periphyton growth, chlorophyll-α, zooplankton and macroinvertebrate communities were monitored.

Concentrations that are commonly detected in the Delta caused a significant decrease in growth of *P. subcapitata* in both single and mixture exposures. In the mesocosm study, chlorophyll-α was significantly decreased, associated with a negative trend in the abundance of aquatic invertebrates.

We present information on the impact of herbicide mixtures to both algal and aquatic invertebrate communities, as well as their interactions as important components of food web dynamics in the Delta. The information obtained is a valuable resource for future watershed management towards the protection of the fragile delta ecosystem.

Keywords: herbicides, algal species, mixture toxicity, aquatic communities, mesocosms

Poster topic: Food Webs

Analysis of Nutrient Mitigation and Organic Matter Production in Waters of Liberty Island

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Shallow, flooded and tidally influenced areas of the Sacramento-San Joaquin Delta are sites of increased water residence time compared to the faster flowing adjacent river ecosystem, thus providing the opportunity for phytoplankton nutrient uptake and growth. As such, flooded islands are thought to provide particulate organic carbon in the form of phytoplankton to support food webs of surrounding waters as a bottom-up influence (the outwelling hypothesis) and may serve as a sink for anthropogenic nutrients via phytoplankton uptake. One such flooded area, Liberty Island in the Cache Slough Complex, was monitored in spring 2014 in locations with a range of nutrient and chlorophyll concentrations. To observe phytoplankton response to the varying conditions, water for 10 L enclosure experiments was collected from three areas and monitored over a six-day period. As nitrogen concentrations and speciation (i.e. ammonium and nitrate) were spatially variable across the wetland, the phytoplankton communities showed different growth potentials when drawing down nitrogen in the enclosures. Nutrient and chlorophyll concentration data were compared between enclosures and the water column to assess the primary production and nutrient uptake in the absence of advective processes. Our analysis provides insight into how Liberty Island could be used as a model for management of flooded areas and development of restored wetland areas in the Delta to support organic carbon production and nutrient mitigation.

Keywords: Nutrients, Phytoplankton, Wetlands, Particulate Organic Material Production

Poster topic: Food Webs

Spatial and Temporal Variation in Aquatic Plant and Invertebrate Communities in Suisun Bay and the Sacramento-San Joaquin Delta

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Having documented >1100 acres of native *Stuckenia* spp. (pondweeds) in Suisun Bay and west Delta, we conducted a survey to document patterns in plant and invertebrate assemblages along a salinity gradient from brackish to fresh. At 8 sites (4 in the Delta and 4 in Suisun Bay) we collected quarterly samples for 1 year of all plants and macro- and epiphytic algae present; extracted, identified, and counted all invertebrate species from these samples. We found Delta sites to be dominated by non-native *Egeria densa* in spring and summer, with a transition to higher species diversity by late summer/fall. This compares to the brackish Suisun sites being dominated mainly by *Stuckenia* spp. (*S. filiformis* and *S. pectinata*). We also found a wide range of spatial and seasonal variation in invertebrate species composition and abundance. In particular, we observed a large decline in abundance of all invertebrate species during winter in Suisun Bay, coinciding with the senescence of vegetation. Additionally, summer collections indicated dominance of gastropod species, and fall collections showed the greatest abundance and diversity of invertebrate and plant species. We also observed consistent spatial differences in invertebrate species composition, relating to the salinity gradient of our 8 sites from the fresh Delta to the saltier Suisun Bay. The most central site, which has intermediate salinity (Sherman Lake), hosts a mixture of the species residing in nearby sites. These results indicate relationships between salinities, season and both abundance and species composition of invertebrate species inhabiting submerged vegetation in the Delta and Suisun Bay. These findings may help predict subsequent invertebrate community diversity shifts and changes in abundance with foreseen climatic changes including increased salinity associated with sea level rise. The findings may also elucidate seasonal and spatial food source fluctuations for fish species of concern thought to feed on these invertebrates.

Keywords: Salinity, invertebrates, SAV, Stuckenia, Food webs, adaptation, habitat

Poster topic: Food Webs

Effect of a Diet Devoid of Docosahexaenoic Acid on Fish Larval Vision

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Diets containing omega-3 highly unsaturated fatty acids (HUFAs) such as docosahexaenoic acid (DHA) are essential for eye development and growth of fish. A laboratory study using larval medaka, *Oryzias latipes* was carried out to test the effect of early HUFA supplementation and deprivation on larval vision when their parents were fed a diet either supplemented (DHA+) or devoid (DHA-) of HUFA. Larvae from breeders given the DHA- diet improved their visual acuity when given the DHA+ diet after eight days of treatment. In contrast, the larvae from breeders given the DHA+ diet decreased their visual acuity when given the DHA- diet after sixteen days of diet treatment. Levels of Arachidonic acid (ARA) in the eye did not vary across the diet treatments and larval age. Linoleic acid (LA) was only greater in larvae given the DHA+ diet from breeders given the DHA+ diet 16 dph than in larvae given the DHA- diet from breeders given the DHA- diet 0 dph. Enzyme activity expressed as product-to-precursor ratios for delta6-desaturase and elongase-5 was greater in the eyes of larvae given a DHA- diet whose parents received a DHA- diet, than in eyes of larvae that received a DHA+ diet whose parents received a DHA+ diet. However, there was no difference for the ratio elongase-5 and delta5-desaturase. The high enzymatic activity in eyes of larvae that received the DHA- diet may be explained as a metabolic response to synthesize the deficient dietary DHA in retina required for vision from the predominant dietary essential fatty acid, LA. These results suggest that larvae require exogenous food of high quality and that it is possible that larval vision may be compromised when they prey on items low on DHA. These findings may apply to larval delta smelt but studies are needed to confirm this hypothesis.

Keywords: Docosahexaenoic acid, Fatty acid, composition, Optokinetic response, apparatus, Enzyme activity

Poster topic: Food Webs

Limiting the Impact of Benthic Grazers and Maximizing Foodweb Enhancements under BDCP

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The BDCP proposes 65,000 acres of tidal natural community restoration in the Delta, which is intended, in part, to alter the supply of food necessary for the maintenance and conservation of native fishes. Restoration of these marsh and tidal habitats may greatly increase phytoplankton growth with a potential for large positive effect on the food-limited pelagic ecosystem. However, benthic grazing could offset these gains on local and regional scales. Field observation and analysis show that benthic grazing rates can limit the food production and value of delta restoration for foodweb enhancement. In some cases benthic grazing could result in shallow habitat zones acting as sinks for phytoplankton rather than sources of growth, but the magnitude of these impacts is highly uncertain. Negative phytoplankton growth in shallow regions can outstrip positive phytoplankton growth in deeper, sub-tidal habitat. Restoration of tidal habitat can provide significant foodweb enhancements if benthic grazing in shallow water habitats is limited. Habitat restoration should be carefully designed to limit colonization by benthic grazers and to maximize transport of phytoplankton from highly productive shallow areas to deep habitats where benthic grazing effectiveness is limited in order to maximize the positive benefit to the foodweb. Salinity, depth, and hydrologic connectivity all play a role in determining the relative strength of potential phytoplankton growth and grazing. These physical habitat characteristics can be used to guide restoration design to maximize phytoplankton growth such that benthic grazer colonization is impeded or phytoplankton is transported away from areas rapidly cleared by bivalves.

Keywords: foodweb, phytoplankton growth, bivalve grazing, restoration, BDCP

Poster topic: Food Webs

Are There Phytoplankton Blooms and Elevated Primary Productivity in the Fall in the Northern Estuary? (Fall Habitat Study)

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Most efforts to understand the low salinity zone (LSZ; salinity 0.5 to 5) and upstream freshwater habitats of the San Francisco Estuary have focused on studies in spring. We measured conditions including phytoplankton standing stocks, community composition and primary production rates in the Sacramento and San Joaquin rivers and the LSZ each fall from 2010 to 2013. In fall 2010 chlorophyll in all regions was low (< 4 µg/L) compared to spring of the same year. In fall 2011 there was excess freshwater, a more seaward location of the LSZ and in late October a phytoplankton bloom (chlorophyll ~30 µg/L) was observed in the lower Sacramento River. The bloom was dominated by the diatom *Aulacoseira* that had long chains, typically 15-20 cells per chain. At these stations, nutrients were lower with ammonium concentrations < 2 µM and nitrate ~15 µM. In fall 2012, a similar bloom was observed in the lower Sacramento River in October (40 µg/L) and into Suisun Bay (14 µg/L) accompanied by lower nutrients, especially ammonium concentrations. Primary production was also measured and showed elevated C uptake rates in 2011 and 2012 contributing to the bloom development. These fall phytoplankton blooms have not been previously recognized and represent an important feature of the fall habitat in the LSZ. A better understanding of the causes of these fall blooms could be used in adaptive management of fall outflow for delta smelt protection

Keywords: nutrients, primary productivity, phytoplankton, low salinity zone, fall bloom

Poster topic: Food Webs

Recent Progress of the Sacramento-San Joaquin Delta and Suisun Bay Ecopath Model

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Improvements are being made to the Ecopath with Ecosim* (EwE) Sacramento-San Joaquin Delta and Suisun Bay (herein referred to as the Delta) ecosystem model so that it will be useful as a decision support tool for resource management. To date, we have developed a biomass-based fish food web model of the Delta with Ecopath and initiated hypothesis exploration using temporal simulations of the modeled food web via Ecosim. The current model parameterization of decreased primary productivity and increased submerged aquatic vegetation (SAV) are the best drivers for improving the simulation model's fit to data (relative abundance indices for the pelagic organism decline (POD) species and largemouth bass (*Micropterus salmoides*)). These results support the idea that the Delta has shifted from a pelagic food web to a SAV-associated food web. This initial model is limited because it does not incorporate spatial heterogeneity within the model domain. We are currently developing a spatial component of the EwE model using Ecospace that will allow us to explore how freshwater-pelagic, low-salinity pelagic, and freshwater-littoral food webs interact within the Delta. Spatial modeling is accomplished by identifying foraging, dispersion, and predator avoidance parameters for each functional group (a species or group of species) relative to the range of defined habitats. With completion of the spatial model, we will have a working model of the system that can be used in conjunction with time-dynamic Monte Carlo simulations to explore the possible effects of resource management decisions on the food web dynamics within the Delta ecosystem. This information can be used to help evaluate and optimize the utility and outcomes of such decisions.

* *Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government*

Keywords: Food web, Ecopath with Ecosim, pelagic organism decline, largemouth bass

Poster topic: Food Webs

Planning Treatment Plant Infrastructure for Sea Level Rise

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The San José-Santa Clara Regional Wastewater Facility (Facility) is located in the Lower South San Francisco Bay. The oldest structures were constructed in 1956, and structures that control outfall to San Francisco Bay were constructed in the 1970s. Typical of wastewater treatment plants, the Facility is located at low elevation close to the shoreline. The Fifth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC) projects sea level rise between 1 to 3 feet by year 2100. Will Facility structures be threatened by rising seas over the next century?

Original elevations of the Facility outfall structure, and pre-existing sewage outfall structures from the 1950s and early 1900s, were recorded with respect to Mean Sea Level (MSL). Past MSL values can be correlated to National Geodetic Vertical Datum (NGVD) elevations. Comparison of sea level to existing facilities is complicated by the effects of land subsidence which occurred over the past century. Poland and Ireland (1982) documented land subsidence in the vicinity of these structures: 1 foot from 1960 to 1967, and between 1.5 to 2.5 feet of subsidence from 1934 to 1960. Changes to nearby levees and land use also complicate the picture.

Current survey results compared to historical elevations are surprising. Despite 3 to 4 inches of known sea level rise and 1 to over 3 feet of subsidence, existing structures do not appear threatened. Also, land use practices over decades have raised surrounding landscape by up to several feet. Over the same 3 to 6 decades, Facility infrastructure has deteriorated and is now scheduled for replacement or rehabilitation.

Results indicate that 1 to 3 feet of relative sea level rise over 30 to 60 years has had negligible effect on Facility infrastructure.

Keywords: sea level rise, wastewater treatment, land subsidence, infrastructure

Poster topic: Global Perspectives

The Behavior of and Benefits to Researchers Using Open Access Electronic Journals

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Publishers began to provide online access to articles in scholarly journals just over a decade ago. Numerous studies have shown how much researchers have welcomed enhanced and easy access to unprecedented numbers of journals. Downloads of journal articles are rising faster that the worldwide growth in the number of articles published each year. *San Francisco Estuary and Watershed Science* -- an open access scholarly journal -- began publishing research 11 years ago and has remained a steadfast outlet for research on California's Bay-Delta region. Until recently there has been little detailed evidence about how researchers have changed their behaviors in response to this revolution in access, about how they make use of online journals, or about the benefits that flow from that use. What connections can be made by investigating how researchers use and benefit from online journals? This poster presentation presents key findings from a worldwide perspective and a regional focus to give an overview of the behavior of and benefits to researchers using online journals in an open access platform.

Keywords: open access, scholarly referencing, online journal, research publications

Poster topic: Global Perspectives

The Use of Antifouling Coatings to Deter Biofouling on Commercial Ships Arriving to San Francisco Bay-Delta Ports

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Biofouling consists of aquatic organisms attached to or associated with submerged or wetted hard surfaces. Biofouling on commercial ships has negative impacts to both the shipping industry and the environment. Organisms attached to the hull create drag when the vessel is moving leading to an overall increase in fuel consumption and resulting air emissions. Furthermore, vessel biofouling has been identified as one of the most important vectors of nonindigenous species (NIS) introductions, likely contributing up to 60% of all established aquatic NIS in California.
To prevent biofouling, commercial vessels currently use antifouling coatings on wetted surfaces. These coatings may contain biocides, such as copper and zinc, to deter organism attachment and survival. Antifouling coatings are developed for specific vessel operational profiles, making the careful selection of the coating, its proper application, and vessel operation in accordance with the coating's recommendations critical to the performance of the coating.
The California State Lands Commission Marine Invasive Species Program (MISP) collected annual hull husbandry data from all vessels calling to California ports from 2008 to 2013. An analysis of the vessel arrival patterns and the different coating types used by vessels calling ports in the San Francisco Bay-Delta (SFBD) was conducted. The majority of coatings used by the commercial fleet operating in SFBD are biocide-based with copper as the most common biocide. The use of biocide-free coatings also emerged as a strategy to prevent biofouling.
Tracking the use of antifouling coatings and their alignment with the vessel's operational profile can provide a better insight into the development of effective biofouling management strategies to prevent biofouling accumulation on commercial vessels.

Keywords: biofouling, biocide, commercial ships, copper, nonindigenous species

Poster topic: Global Perspectives

Rainwater Storage for Evaporative Air Cooling

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Evaporative cooling systems are an energy efficient cooling solution for hot, arid climates. While evaporative cooling systems have a large potential to reduce both the peak electricity demand and the energy use associated with cooling, water management for evaporative cooling systems is essential and particular care must be taken to reduce the effects of hard water and overall water consumption of the system. Evaporative processes lead to accumulation of mineral scale on the heat exchanger, whose performance thereby degrades over time. Several strategies have been put forward to improve water-use efficiency and/or minimize scale formation in evaporative cooling systems, however no cost effective solution has been found that enables long-term use of these systems in hard water areas.

My project investigates the benefits and feasibility of using harvested rainwater as a strategy to reduce tap water consumption and extend equipment life. It is expected that the small amount of hardness in rainwater compared to municipal tap water minimizes scale formation, which extends the system life and increases the system efficiency. This results in reduced consumption of water, electricity, and chemicals, and reduced water treatment needs (e.g. water softening).

For the first part of the project, the 2500 gallon tank was filled with rainwater collected from a residential composite shingle roof. The rainwater was stored for summer when cooling is needed and the water quality was examined on a weekly basis. According to the conducted field experiment, stored rainwater would not need any complex treatment to meet the minimum non-potable water quality guidelines developed by US EPA. This study suggests that the disinfection of stored rainwater before usage, as a relatively simple method, could result in a safe and reliable approach for use in an evaporative cooling system.

Keywords: Rainwater harvesting, Roof-runoff, Water quality, Microbial growth

Poster topic: Global Perspectives

Preliminary Review of the Relative Effectiveness of Ballast Water Management in Preventing New Introduction of Non-Native Zooplankton in the San Francisco Estuary

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Non-native species are moved around the world through the activities of humans, and once established these species can impact the environment, economy, human culture, and human health. One such human activity (i.e. vector) involves the ocean-based shipment of cargo around the world. Ships uptake ballast water to maintain stability and trim, and this water also acts as a vector for the transportation of non-native species. Local, state and federal laws have been implemented to prevent and respond to the introduction of non-native species. At the state and federal level, legislation has been adopted to manage the discharge of ballast water in order to prevent new species introductions. Ships arriving at ports within the United States typically comply with these laws by retaining all ballast water onboard or by conducting an open ocean exchange of ballast water prior to discharge. Zooplankton are one group of organisms that are likely to have been transported via ballast water and introduced to California's coastal waters. A preliminary review of the data on vessel compliance with ballast management requirements coupled with the data from the California Department of Fish and Wildlife's monthly zooplankton survey of the San Francisco Estuary was conducted. This cursory review represents an attempt to characterize the relative effectiveness of the prevention of new introductions of non-native zooplankton through the management of ballast water. This glimpse at the connections between a management action and biological survey results can inform invasive species detection techniques and prevention policy decisions in the future.

Keywords: Invasive Species, Non-native, prevention, management, ballast

Poster topic: Global Perspectives

Sacramento District Regulatory in the Sacramento San Joaquin Delta

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The Regulatory Division of the Sacramento Corps of Engineers evaluates permit applications underSection 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act. The former is intended primarily to ensure navigability; the purpose of the latter is to "restore and maintain the chemical, physical and biological integrity" of waters of the United States. Section 10 authority extends to all tidal waters, thus includes the entire Sacramento-San Joaquin Delta – and all navigable waters are waters of the U.S. All work in navigable waters is regulated under Section 10, whereas Section 404 regulates discharges into waters.

In the past five years, the Sacramento District has issued over 300 authorizations, permit modifications and extensions in the Delta. Moreover, the District has investigated numerous un-permitted activities and compliance issues throughout our area of responsibility in the Delta. Authorized projects have included roads and bridges, residential development, dredging of ports and marinas, mitigation and conservation banks, pipelines, bank stabilization, maintenance activities, monitoring and geotechnical surveys, scientific research, emergency work and restoration activities. Currently under evaluation by the District are substantial and controversial proposals such as the Bay Delta Conservation Plan Delta barriers, as are relatively minor activities like private recreational docks and bank stabilization.

The Corps has two different types of permit authorizations – individual (standard and "letters of permission") and general (nationwide and regional) permits. The Corps Regulatory's goal is protect the Nation's aquatic resources, while allowing reasonable development, through fair, flexible and balanced permit decisions. We look forward to working with applicants, the fish resources agencies (USFWS and NMFS), the State Historic Preservation Office and Regional Water Quality Control Boards to ensure sustainable projects. Talk with us.

Keywords: Regulatory, Clean Water Act, Wetlands

Poster topic: Human Consequences

Improving Communication of Fish Consumption Advisories in the Bay Delta System

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Human exposure to mercury from consumption of contaminated fish is a significant problem in the Bay-Delta system. Due to historic mercury and gold mining, some fish contain high levels of mercury, a neurodevelopmental toxin. Yet fishing for consumption is popular throughout the watershed. The fishing populations are highly diverse and include immigrants and non-English speakers. Fish consumption advisories have been issued for many water bodies in the watershed. While the advisories provide important information on the species and quantities that are safe to eat, the information is often complex and difficult for some fish consumers to understand. As a result, they may lack the information they need to follow the advisories and protect their health.

The goal of this project is to improve comprehension of advisories by designing and testing educational materials that can be understood by low-literacy audiences. Our approach is to conduct in-depth interviews in English as well as other languages with ethnically diverse fish consumers with recruitment assistance from community-based organizations in the Bay-Delta region. Using qualitative analysis of interview responses, we are identifying common themes among responses and developing recommendations for improving the effectiveness of the materials. Preliminary results show that fish consumers have difficulty identifying the correct advice for their own population group (advisories for children and women 18-45 are more restrictive than advisories for men and older women). New formats are being tested to help fish consumers identify their population group.

Our findings aim to improve comprehension of advisories by low-literacy fish consumers in order to reduce their exposure to contaminants from Bay-Delta fish. The new formats will be used by state agencies and other organizations to improve communication of fish consumption advisories in the Bay-Delta system to affected populations.

Keywords: Fish Advisories, Mercury, Communication

Poster topic: Human Consequences

Local Ballot Measures Provide Opportunities for Funding Multiple Stressors Management

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The Bay-Delta ecosystem is in a state of serious decline due to multiple stressors such as flow regime change, physical alterations, invasive species, poor fish management, and pollutant discharges. Effective, integrated, and sustainable management of these stressors is costly and will require funding from diverse sources beyond state and federal dollars. Local ballot measures provide an opportunity to raise funds that address these challenges, but they often face significant hurdles in obtaining voter approval. A recent PPIC report, "Paying for Water in California", found that 84% of funding for the water system (including water supply, wastewater, flood protection, stormwater management, and aquatic ecosystem management) comes from local entities. State law requires that local funding in some of these areas (floods, stormwater, and most ecosystem spending) be submitted to voters for approval. We analyzed measure content, geographical and temporal patterns, type of funding mechanisms, and passage rates for local water-related ballot measures from 1995 to today. Measures that combined funding for issues like street maintenance or police services, in addition to water, have a higher passage rate (89%) than those focused more narrowly on water issues only (65%). These multi-issue measures have increased in recent years, which has improved chances of passage, but perhaps with less money designated specifically for water needs. The Bay-Delta region had a higher number of measures proposed and a higher passage rate (82%) relative to the state as a whole (72%). Our findings suggest that obtaining local or regional funds for stressor management in the Bay-Delta – especially stormwater and habitat restoration – remains challenging.

Keywords: stressors, funding, ballot, local management, water finance, Bay-Delta, stormwater, habitat

Poster topic: Human Consequences

Fishing for the Right Message: Community Involvement in Reducing Human Exposure to Mercury in Delta fish

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Due to historic mercury and gold-mining activities, elevated levels of mercury in fish are present throughout the Sacramento-San Joaquin Delta, where fishing is common. Delta fish consumers are a diverse multilingual population that may be exposed to harmful levels of mercury by consuming contaminated catch. Fish consumption advisories detailing the specific types and amounts of Delta fish that can be safely eaten have been issued, but disseminating the advice so that it is understandable by the diverse communities in the Delta requires focused efforts.

Because it will take many years to reach the mercury clean-up goals, the Central Valley Regional Water Quality Control Board is initiating the Delta Mercury Exposure Reduction Program (Delta MERP), a multi-agency effort over several years to reduce human exposure to mercury from eating fish caught in this area. The Delta MERP will raise awareness about fish contamination in the Delta and encourage actions that will reduce mercury exposure in affected communities.

For 2014-15, Delta MERP activities will include convening a stakeholder advisory group to solicit input on project activities; implementing a small grants program to fund community-based education projects aimed at reaching affected populations; developing and distributing multilingual educational materials; conducting training to raise awareness and understanding of fish contamination issues in the Delta to local groups; and promoting collaboration with local programs to include messages and activities on fish contamination.

Exposure reduction activities that are guided and carried out by local groups in the Delta are integral in the overall picture of Bay-Delta management. These activities, in addition to the mercury clean-up efforts, create a well-rounded approach for protecting public health immediately and in the future. Challenges and successes experienced in the Delta MERP activities will provide guidance to future exposure reduction efforts.

Keywords: Mercury, Fish, consumers, Community involvement, Public health, Delta, MERP

Poster topic: Human Consequences

Novel Technique for Assessing Ammonium Utilization by Phytoplankton in the San Francisco Bay-Delta Estuary

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High concentrations of NH_4^+ in the San Francisco Bay-Delta Estuary (SFE) have been hypothesized to inhibit the growth of phytoplankton, which are an important food source to zooplankton at the base of the pelagic food web. The primary goal of this research is to use stable isotope approaches to distinguish $NH_4^+$and NO_3^- assimilation at the base of the food web in a portion of the Sacramento River where NH_4^+ concentration is elevated downstream of the Sacramento Regional Wastewater Treatment Plant (SRWTP). To examine the form of nitrogen assimilated by phytoplankton *in situ,* a novel method has been developed to isolate algae from bulk particulate organic matter using flow cytometry prior to isotopic analysis. Modifications were made to a Carlo Erba 1108 Elemental analyzer to allow measurement of $d^{15}N$ of samples containing as little as 0.5 µg N with an analytical precision of 0.2 ‰ (determined from replicate analysis of standards). Using this new method requires sorting approximately ten million phytoplankton cells from one to two liters of river water. Replicate analysis of $d^{15}N$ of sorted phytoplankton samples indicates that analytical precision for the entire protocol is 0.3 ‰ for samples with a final N content between 0.5 -1.0 µg N. Preliminary results suggest that that the $d^{15}N$ of isolated phytoplankton differs by 1-3 ‰ from the detrital fraction of bulk POM. Work is ongoing to establish a relationship between $d^{15}N$- POM_{bulk} and $d^{15}N$ of isolated algal samples. A better understanding of this relationship will potentially allow use of a bulk POM isotope record (collected over the past 10 years in the SFE) to understand potential links between historical changes in phytoplankton nutrient utilization and Delta POD.

Keywords: nutrients, ammonium, nitrate, phytoplankton, stable isotopes

Poster topic: Human Consequences

Effects of Nitrogen Fertilization and Soil Carbon Variables on CH_4 and N_2O Emissions from Rice Fields

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Reclamation of the Sacramento-San Joaquin Delta's peatlands provided fertile soils for agriculture, but resulted in the oxidation of peat soils, large greenhouse gas (GHG) emissions, and subsidence. Rice cultivation has been proposed as a regional solution to mitigate ongoing agricultural impacts. In the present study, we investigate the influence of nutrient management and soil carbon (C) content on methane (CH_4) and nitrous oxide (N_2O) emissions from peat soils under rice cultivation. The experiment was conducted in rice fields at Twitchell Island, California including 4 soil C contents (5%, 10%, 20%, and 25%) in combination with 2 nitrogen (N) fertilization rates (0 and 80 kg N ha^{-1} as urea). We determined CH_4 and N_2O emissions with a typical closed chamber method during the growing season of 2013. In general, CH_4 emissions varied considerably across the soil C gradient, but were not affected by N fertilization. Methane emissions peaked during the drainage event, averaging 48.3, 17.2, 5.2, and 11.4 mg CH_4 hr^{-1} m^{-2} for 5%, 10%, 20%, and 25% C fields, respectively. Total CH_4 emissions degreased gradually as soil C increased from 5% to 25%, suggesting higher C turnover in the lower soil C fields. N fertilization influenced N_2O emissions rates, however, the effects depended on soil C and crop growth. N_2O emissions were low during the flooding period and negative emissions (sink) were frequently observed in all fields. The highest emissions were observed in all fields right after the drainage, except for the 25% C field where the emission was largely negative. Our results suggest that, in addition to C quantity, soil C quality is likely controlling GHGs emissions. Furthermore, N management is not as effective as water management to mitigate GHGs emissions from the rice fields with high organic matter soils.

Keywords: Greenhouse gas, Nitrogen fertilization, soil carbon content, rice field

Poster topic: Human Consequences

Updating the State of Bay-Delta Science to Reflect Findings Learned about the System Since 2008

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The State of Bay-Delta Science, 2008 (SBDS, 2008), a synthesis of the scientific knowledge of the Bay-Delta system, is currently being updated by the Delta Science Program (DSP). The update to *SBDS, 2008* will be written for a broad audience with different sections of the report addressing diverse needs. The executive summary will target high-level decision-makers, including the Governor, agency secretaries, the legislature, and Congress, while the main document will target decision-makers and agency managers who are familiar with the system, as well as technical specialists and scientists. The key questions to be addressed revolve around the state of scientific knowledge, including changes throughout the system, insights from an integrated synthesis of data and analyses, and prevailing certainties and uncertainties. This living document, which will be revised by scientific experts every four years, will include future web-based updates as new information arises.

Topics may include: a brief summary of *SBDS, 2008*; defining a new baseline for the big issues of water quality, aquatic ecosystems, levee system fragility, water supply and climate change; a systems-scale view; alternative futures; the role of science and other social science perspectives; and the way forward.

Future updates to the document will complement the DSP Science Action Agenda by identifying actions necessary to fill knowledge gaps and address uncertainties of the system. In turn, this document will be shaped by information gleaned from actions performed under the Science Action Agenda. The next update to *SBDS* is scheduled for completion in 2015.

Keywords: SBDS, State of Bay-Delta Science

Poster topic: Integrative Applied Science

California Estuaries Portal: Bringing Science to the Public

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The California Estuary Monitoring Workgroup (CEMW) continues to refine the recently released California Estuary Portal, improve web-based collaboration tools, enhance access to environmental monitoring data, and identify ecosystem health indicators for the Delta that complement those used in the San Francisco Bay as part of the 2015 State of the Estuary report. The Estuary Portal continues to strive to meet the Delta Science Plan's call to "build on existing data management systems to enable the regions' environmental and project-implementation data to be easily accessed, visualized, and processed." The portal continues to focus on the visualization of data that will help inform stakeholder about trends in living resources populations. By incorporating new data sets and query capability the Estuary Portal plays a multifaceted roll in providing the public with detailed and digestible information about the Bay-Delta ecosystem and satisfying state and federal agency reporting requirements. Learn why you should, and how you can, be part of this collaborative effort, involving multiple government agencies and non-governmental organizations, working toward improved estuarine science, restoration, and protection of beneficial uses.

Keywords: Estuary, Data Visualization, Health Indicators, Web Portal

Poster topic: Integrative Applied Science

Enhancing Capacity for Habitat Restoration Project Tracking, Assessment and Reporting

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Currently, evaluating the effects of restoration projects on the extent and conditions of Bay-Delta and Central Valley wetlands is extraordinarily difficult because restoration projects are not tracked in a consistent manner across programs. The Sacramento-San Joaquin Delta Conservancy (Conservancy), in partnership with the State Water Resources Control Board (Water Board), San Francisco Bay Joint Venture, Central Valley Joint Venture and San Francisco Estuary Institute/Aquatic Science Center (SFEI/ASC), is expanding current wetland project tracking capabilities of EcoAtlas to meet the project tracking, assessment, and reporting needs for current and planned habitat restoration in the San Francisco Bay-Delta and Central Valley. An online visualization and data management tool, EcoAtlas was created under the auspices of the California Wetland Monitoring Workgroup, to provide free access to information about the condition and extent of California wetlands, as well as wetland restoration project tracking information. The Conservancy and project partners have met with entities working in the Delta to develop new functionality, which includes a data entry tool, additional information fields, expanded mapping tools, data queries and reporting summaries. SFEI/ASC will soon begin incorporating new features into EcoAtlas with forthcoming interim products for review. In the upcoming months, the Conservancy's database of current and planned restoration projects in the Delta, a product of the Department of Water Resources, FloodSAFE Environmental Stewardship and Statewide Resources Office efforts will be made available through these enhancements to EcoAtlas. The intent of this project is to enable better analyses of changes in wetland extent and condition; landscape-scale conservation planning efforts; prioritization of restoration areas; evaluation of progress toward meeting conservation objectives; increasing coordination among restoration entities; and leveraging of restoration resources on a regional and statewide scale.

Keywords: Habitat restoration, tracking, assessment, monitoring, mapping, database

Poster topic: Integrative Applied Science

New Insights on Measuring and Up-Scaling Wetland Canopy Leaf Area Index in the Sacramento-San Joaquin Delta

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Canopy leaf area index (LAI; one-sided leaf area per unit ground area) is a key instrumental variable used in models of plant-atmosphere carbon and water exchange, greenhouse gas and energy budgets and canopy-based habitats. Multiple studies have measured LAI in upland terrestrial landscapes and explored methods to up-scale field values to regional extents using remote sensing data. However, in wetland ecosystems globally, much uncertainty still exists on magnitude of LAI, its spatial and temporal variation and on robust approaches to measure this index in the field or from remote sensing. We assessed LAI in natural and man-made wetlands of the Sacramento-San Joaquin Delta, California, USA (the Delta) during the growing seasons of 2013-2014 and tested its empirical relationships with spectral indices of vegetation function derived from Landsat satellite imagery. Peak-season site-average LAI ranged from $3.3m^2m^{-2}$ in a diked marsh to $6.5m^2m^{-2}$ in a young engineered wetland. Results also indicate high within-site dispersion of LAI (coefficient of variation from 0.13 in rice to >0.5 in engineered marshes) attributed to complex surface composition, variable canopy height and non-uniform contribution of litter. Field LAI significantly correlated ($p<0.001$) with several Landsat-based indicators of vegetation greenness; however, the strongest univariate relationships explained only 45-50% of LAI variance due to variable canopy characteristics and sub-pixel wetland complexity. Improving model strength requires use of multiple variables and corrections for non-green biomass and sub-pixel green canopy fraction. Results indicate that, unlike in terrestrial biome-scale studies, single "mean" LAI values may not sufficiently characterize complex Delta wetland canopies, and models of wetland ecosystem function and greenhouse gas fluxes must incorporate within-site spatial variation in canopy properties. Landsat satellite imagery is very promising for regional-scale modeling of LAI, however, instead of simple univariate relationships with spectral indices, multivariate spatial models should be employed with sub-pixel corrections for site heterogeneity.

Keywords: wetland, LAI, canopy, vegetation, carbon, remote sensing, leaf area index

Poster topic: Integrative Applied Science

Optimizing Secondary Treatment for Energy Savings & Nutrient Removal

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At the San José-Santa Clara Regional Wastewater Facility (Facility) power generation and reducing energy demand have been issues of concern since nitrification and filtration were installed in 1979. In 1997, the Facility began configuring its secondary treatment process to Biological Nutrient Removal (BNR). It was known at the time that BNR treatment should reduce energy demand compared to sequential secondary and nitrification treatment steps. Over subsequent years, the facility additionally experimented and adapted aeration enhancements that reduced energy demand and continued to provide effective nutrient removal. This poster attempts to quantify the energy savings that were gained since major Facility expansion in 1979.

Since electric and engine driven blowers consume most of the energy in the secondary wastewater treatment process, the number of blowers operating at any given time is the simplest, albeit crude, method of quantifying changes to energy consumption. Measurement of electricity in kilowatt hours (kWh) and methane gas in British thermal units (Btu) is accurate, but limited by availability of data over the decades. Pump replacements with newer more efficient models require consideration of their specific energy use. The analysis of overall energy savings is further complicated by seasonal wastewater loads and constant changes in numbers of on-line aeration basins and clarifiers.

Overall, several changes to the secondary wastewater process at the Facility appear to have shaved off almost a megawatt (MW) of peak demand. The typical number of on-line blowers during peak times has dropped from 6 to 8 down to 2 to 3 today. Over the same period, the facility has increased the percentage of nutrients removed.

These findings demonstrate that denitrification can be added to an existing secondary-nitrification treatment process and still result in energy savings.

Keywords: Secondary Wastewater Treatment, Energy, Sustainability, Nitrification, Nutrients

Poster topic: Integrative Applied Science

Subsidence Reversal through Marsh Re-establishment on Twitchell Island

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Worldwide, freshwater marshes and their rich peat soils have been lost as a result of the conversion to agriculture. In the Sacramento-San Joaquin Delta the converted land has since subsided due to peat oxidation, requiring maintenance of perimeter levees to prevent flooding. Marsh re-establishment through gradual flooding is one restoration strategy that has shown great potential for reversing this subsidence and transforming current carbon sources into carbon sinks. This technique involves flooding the land to a level suitable for marsh vegetation and allowing the biomass to naturally accrete over time. As the main metric for these systems, vertical accretion is essential to evaluating the success of this strategy.

In this study, we updated previous measurements of accretion in the west wetland of Twitchell Island; the west wetland is a 3-hectare re-established marsh built by the USGS in 1997. The area was extensively studied and managed from 1997 to 2008 and continues to be used for research, but there are no other known accretion measurements since 2008. One sediment elevation table (SET) benchmark out of the original eight was located and measured in October 2013. Results from Miller et al. 2008 report an accretion rate of 4.18 cm/yr from 1997 to 2005 at this location. Our results show an increased rate of 7.96 ± 1.1 cm/yr from 2005 to 2013. Throughout the original study period, water levels were maintained at 25 cm; however, data since that time shows variable levels. Thus, even without strict management, high rates of accretion continued. These results help inform carbon balance models and future restoration efforts.

Miller RL, Fram MS, Fujii R, Wheeler G. 2008. Subsidence reversal in a re-established wetland in the Sacramento-San Joaquin Delta, California, USA. San Francisco Estuary and Watershed Science 6(3): article 1.

Keywords: wetland restoration, carbon sequestration, subsidence reversal, Twitchell Island, freshwater marsh

Poster topic: Integrative Applied Science

Assessing Regional Digital Elevation Model Suitability for Tidal Wetland Restoration Planning in Suisun Marsh

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Tidal wetland restoration planning requires accurate ground elevation data for proposed sites, as elevation in relation to the tides determines the habitats that would be created following restoration (subtidal, intertidal, supratidal). Regional-scale efforts require reasonably approximate topographic data to support site selection and make predictions of restoration outcome. Site-scale efforts require more accurate data to support design and outcome projections. Prior to using a regional digital elevation model (DEM) for regional or site-specific restoration planning, DEM suitability for that use must be assessed. In Suisun, two marsh-wide DEMs are available, both derived from Light Detection and Ranging (LiDAR) data collected by: (1) the Department of Water Resources in 2005 (2005 DEM - currently in use), and (2) the California Coastal Conservancy from 2009-2011 (2011 DEM) covering much, but not all of Suisun. Tall, dense wetland vegetation and standing water, common in Suisun Marsh, interfere with LiDAR return signals, yielding inaccuracies up to several feet.

We developed a methodology for quantitatively assessing DEM suitability for regional and site-scale tidal wetland restoration planning in Suisun Marsh, using limited ground-based topographic survey data, statistical analyses of elevation differences, and a set of suitability criteria. We applied this methodology to six properties across Suisun Marsh to assess suitability of the 2005 and 2011 DEMs. The 2011 DEM better represented elevations at all sites. Where vegetation was less dense, the 2011 DEM was within acceptable tolerances. For sites with more dense vegetation and/or extensive standing water, neither DEM was within tolerance. Results indicate the 2011 DEM is better suited for regional planning and should be used, where coverage exists, in place of the 2005 DEM. Individual restoration projects should assess DEM suitability with this method, and sites flooded during LiDAR data acquisition, or covered in dense, tall wetland vegetation will likely require additional topographic data.

Keywords: Wetland Restoration, topography, DEM, LiDAR

Poster topic: Integrative Applied Science

The Bay Delta Science Conference Interacts with a Conceptual Model of Sacramento River Salmonid Biology and Management- Make Your Connection!

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Conceptual models are a great tool for collaborative brainstorming of linkages between physical and management drivers and biological outcomes. Recent interagency efforts through the Management Assessment and Synthesis Team and the South Delta Salmon Research Collaborative work teams have focused on developing conceptual models to construct and evaluate hypotheses relevant to management, prioritize and document critical data gaps, and guide adaptive management. We drafted a conceptual model which nests a generalized salmon life cycle within tiered levels that promote explicit attributes that influence and/or drive transitions within the life cycle. Such a model may be useful for water management over appropriate time and spatial scales for aforementioned reasons, but requires iterative brainstorming, review, and revision to achieve collective agreement on its functionality. This poster provides an opportunity for conference participants to make their own connection with the ideas through use of interactive materials that allow participants to suggest changes and make comments. To interact with the conceptual model, we recommend people record their responses to the following questions at this poster:

1. Do the model's tiers provide sufficient specificity to capture fish and water management drivers on life stage biological responses and transition drivers? What drivers would you add?

2. Do the model's salmonid responses reflect the ontogenic processes influenced by life history and water management drivers? What responses would you add?

3. Do the model's habitat attributes reflect the elements influencing salmonid life stages and responses? What habitat attributes would you add?

4. Are the life stages too specific? Should parr and smolt be combined? What distinguishes these stages?

5. Would this conceptual model be useful in any fish and water management efforts you participate in?

We hope to present a next iteration of the model and review of input received at an upcoming science workshop or meeting.

Keywords: conceptual model, salmonid, driver-linkage-outcome, transition drivers, interactive
Poster topic: Integrative Applied Science

Regional Data Exchange: From Concept to End User Data Tools

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How data exchanges and presentation can be leveraged to demonstrate the efficacy of key analyses; tools to make the data more understandable to target audiences, and using good design in fostering information consumption.

A partnership between Portland State University and Oregon Department of Environmental Quality was formed to develop a web based data system for both surface water and lake data through a single web portal. Disparate systems housing water quality and lakes data was evaluated to provide the end user a 'one stop shop' to access multiple data systems. Using new technologies, such as data exchanges, web services and geo databases were incorporated to create the Atlas of Oregon Lakes data exchange.

In addition to merging disparate data sets, statistical coding was embedded to allow real time metrics for the end user. This step allows the data user quick access to statistical results based on a customized query. The final results include access to databases from different organizations, real time metric calculations, web services to communicate data efficiently and a map based web site.

Keywords: Data exhchanges

Poster topic: Integrative Applied Science

Where Are Our Wetlands and How Are They Doing?

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The California Water Quality Monitoring Council recently released a completely redesigned internet portal to connect decision makers and the public with ecosystem health information. The theme of this new portal is "Are Our Wetland Ecosystems Healthy?" Go to California's "My Water Quality" website (www.MyWaterQuality.ca.gov) and click on "Are Our Aquatic Ecosystems Healthy?" The California Wetlands Portal includes interactive graphics, maps and monitoring data that focus on the location, extent and health of our state's wetland resources. A home page photo carousel provides insight into the many types of wetlands found around California. The goal is to make this information as timely and user-friendly as possible. Data presented in the portal are housed in another new web-based tool called EcoAtlas (www.ecoatlas.org), which provides an online resource for compiling maps and data about wetlands produced by numerous state and federal agencies and non-governmental organizations.

Formed in 2007 through cooperative agreement between California's Environmental Protection and Natural Resources Agencies, the California Water Quality Monitoring Council brings together water quality and ecosystem health information from a variety of organizations with special expertise in wetland monitoring and assessment, coordinated through the California Wetland Monitoring Workgroup. This collaborative workgroup facilitates dialogue and coordination among twenty-four state, federal, and local agencies and non-governmental organizations that monitor and assess our state's wetlands. Their portal provides a way to make the information more readily accessible so that it can inform policies and management decisions. Furthermore, it allows the general public to access information about local and statewide resources that were compiled by public agencies with public resources.

Wetlands are an important component of the San Francisco Bay-Delta ecosystem. The California Wetlands Portal and EcoAtlas make wetland information relevant to scientists, decision makers and the general public, improving accessibility while increasing the transparency and accountability of monitoring and assessment programs.

Keywords: internet portal, wetlands, data management, Monitoring Council, Wetland Workgroup, EcoAtlas

Poster topic: Integrative Applied Science

What Does a Pigment-Based Analysis Tell us about the Phytoplankton Community Composition in San Francisco Bay?

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San Francisco Bay is a nutrient-enriched estuary, but has not shown the typical symptoms of nutrient overenrichment, such as high phytoplankton biomass and low dissolved oxygen. However, excess nutrients can also adversely affect estuaries by supporting increases in the abundance of harmful algal species, and can lead to other potential shifts in community composition such as changes causing altered or reduced food quality. Developing an improved understanding of the phytoplankton community-nutrient linkage is among the highest priority nutrient management issues for the Bay, but will require a substantial increase in the spatial and temporal resolution of phytoplankton community data collection. Microscopy is the classic method for phytoplankton taxonomy and biomass quantification, but it is labor-intensive and cost-prohibitive. An alternate method to quantify phytoplankton uses high-performance liquid chromatography (HPLC) pigment analysis, an objective and fast method for identifying the composition of phytoplankton communities, albeit at reduced taxonomic resolution. We present HPLC pigment analysis of approximately bi-monthly samples collected throughout San Francisco Bay from November 2011 - December 2013, and describe spatial, seasonal, and interannual variability of phytoplankton composition using CHEMTAX (a factor analysis program using chemical markers to estimate phytoplankton class abundance) and biomass phytoplankton proportion factors. The pigment-based abundance estimates compared well with parallel microscopy biovolume class abundance measurements. In addition, from the pigment analyses, we were able to infer seasonal and inter-subembayment variability in community composition, and capture small or rare phytoplankton classes commonly missed by microscopy. Initial work suggests that the pigment-based approach provides a cost-effective yet sensitive method to monitor and explore factors regulating phytoplankton composition for the purpose of environmental management strategies.

Keywords: pigments, HPLC, CHEMTAX, phytoplankton community composition, nutrients

Poster topic: Integrative Applied Science

Understanding Stem Strength and Flood Tolerance of *Schoenoplectus californicus* for Enhanced Restoration Success

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Schoenoplectus acutus and *S. californicus* are freshwater macrophytes that are native to California and commonly utilized in wetland restoration efforts due to their ability to encourage sediment accretion, stabilize sediment, and provide faunal habitat. Despite their prominence in portions of the Sacramento-San Joaquin Bay Delta, limited information is available on the environmental tolerances of these species. Results from a tidal mesocosm study on the responses of *S. acutus* and *S. californicus* adults and seedlings to a variety of flooding regimes revealed that longer durations of flooding significantly reduced survival of seedlings of both species and adults of *S. acutus*, but not *S. californicus*. Longer durations of flooding significantly reduced biomass production, reproductive capacity, and stem strength of *S. acutus* adults. However, *S. californicus* adults maintained stem strength across flooding treatments and displayed greater biomass production with increased flooding. These findings help to explain vegetation patterns at a freshwater tidal restoration site (Liberty Island, CA) that is dominated by expanding stands of *S. californicus*. A field study conducted at Liberty Island examined *S. californicus* expansion and stem strength in a variety of zones that differed in elevation, edaphic properties, hydrology, and wave energy. In zones characterized by longer durations of flooding and higher wave energy, *S. californicus* exhibited slower rates of expansion, shorter stem heights, and lower stem density. However, differences in stem strength of *S. californicus* were minor regardless of environmental conditions, indicating that *S. californicus* is an excellent species for establishment in these high energy environments. These results demonstrate the influence of multiple factors on vegetation colonization and expansion, which should be considered in the context of informing management decisions and ecosystem restoration. Additionally, this research may have implications for improving the science and practice of mitigating wave erosion of earthen levees with vegetation that also provides marsh habitat.
Keywords: Hydrology, Restoration, Schoenoplectus spp., Stem Strength, Wave Attenuation

Poster topic: Integrative Applied Science

Integrating Surface and Shallow Subsurface Hydrologic and Water Quality Interactions for Developing Management Practices for Rice in the Sacramento-San Joaquin Delta, CA

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The Sacramento-San Joaquin Delta conveys water to over 25 million Californians and three million agricultural acres in California's Central Valley. Throughout the Delta, subsidence from peat oxidation, over 7 meters in some areas, threatens water delivery because of increasing failure risks to levees. Strategic implementation of rice fields in the Delta is being proposed to create a more sustainable environment with regards to water conveyance and its agrarian culture. Water quality indicator dynamics (e.g. dissolved organic carbon, disinfection byproduct precursors, mercury, and nutrients) are an important consideration because rice fields export greater constituent loads due to continuous discharges during the irrigation season and greater subsurface flows. Understanding constituent transport and potential management opportunities requires an understanding of surface and shallow subsurface flow pathways. Surface and shallow subsurface interactions were modeled on two subsided Delta islands and six rice fields using a Plug Flow Reactor (PFR) model, separating evaporation and transpiration from evapotranspiration. Rice transpiration demand was met by surface irrigation and ground water. Transpiration played a dominant role in subsurface solute transport during summer irrigation. A mass balance was conducted to test drain ditch level effects on drainage ditch water quality and flow. High-managed ditches reduced total seepage by 95% compared to low-managed ditches, and significantly changed the drain water source. High managed ditches received 15% of their water from groundwater seepage in comparison to 56% for low-managed ditches. These results suggest high-managed ditches reduce surface water demand, flow and constituent exports. Constituent loads were consistent with these hydrologic trends. Ditch management is thus one tool that can be implemented to manage potential water quality impacts from rice. These findings are being integrated into recommendations for strategic implementation of rice to create a more sustainable Delta and protect California's water security.

Keywords: Water Quality, Hydrology, Subsidence, Rice, Wetlands, BMPs, Budget, Transpiration, Seepage

Poster topic: Integrative Applied Science

Effectiveness Monitoring for Adaptive Management of the Lower Yolo Restoration Project

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Large-scale restoration of tidal wetlands is planned for the Delta and Suisun Marsh, and is an important component of the current Biological Opinions and proposed Bay Delta Conservation Plan. Monitoring at multiple spatial and temporal scales will be necessary to evaluate the effectiveness of these projects and their contribution to the Delta ecosystem and recovery of protected fish species. The Lower Yolo Restoration Project will restore and enhance approximately 1,749 acres of tidal wetlands in the southern Yolo Bypass. The Project, by the State and Federal Water Contractors Agency, is designed to provide foodweb support for delta smelt and rearing habitat for juvenile salmonids. Projects such as the Lower Yolo provide opportunities for collaborative study to reduce uncertainty and test restoration techniques. Tide gates will allow managers to test the effect of residence time and tidal pumping on productivity and food export. We defined a suite of physical and biological indicators to measure restoration outputs and ecological outcomes. Some metrics can be readily measured on site, such as vegetation and water level in the wetlands. Other metrics are more difficult to sample, such as export of productivity from the site, and fish sampling that requires permits. The proposed sampling program will include continuous monitoring of selected hydrological parameters, with intensive sampling of water quality and foodweb elements (nutrients, chlorophyll a, phytoplankton, zooplankton) that is timed seasonally with spring tides. Consistent methods and integration among restoration projects will be necessary in order to put these results in a regional context. We are coordinating with regional initiatives such as the California Wetland Monitoring Workgroup, the IEP Monitoring Workgroup, the Fish Restoration Program, and studies by USGS and UC Davis.

Keywords: adaptive management, indicators, monitoring, foodweb, wetlands

Poster topic: Integrative Applied Science

Response of Sacramento River Phytoplankton Community Composition to Ammonium-Rich Effluent in Mesocosms

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Concentration and form of nitrogen can influence the composition of phytoplankton communities. In the lower Sacramento River, a notable source of nitrogen comes from ammonium (NH_4)-rich effluent released by a large municipal wastewater treatment plant (WWTP). Excess nitrogen has been associated with nuisance phytoplankton blooms and eutrophication in estuaries. Long-term monitoring in the upper San Francisco estuary where NH_4 is elevated has shown decreased primary productivity and low chlorophyll concentrations and some studies suggest that the NH_4 supply has shifted the community from diatoms to flagellates. Our aim was to understand how NH_4-rich effluent influences the development of phytoplankton communities in the Sacramento River.

Mesocosm (10 L enclosure) experiments were conducted in conjunction with the USGS California Water Science Center study (Nitrogen Dynamics along the Sacramento River and Links to Phytoplankton Dynamics), a large scale field manipulation in which WWTP effluent discharge was halted for extended periods (15-20 hours) in October 2013 and May of 2014. Mesocosm treatments included varieties of nitrogen sources (effluent-NH_4, NH_4Cl and NO_3) that were incubated directly in the river to ensure natural light conditions and water temperatures. Development of phytoplankton communities in each mesocosm treatment was monitored by measuring Chlorophyll-a biomass, and nutrient draw-down. Major phytoplankton groups were identified using microscopy and flow cytometry.

This project is highly relevant to water quality stakeholders in the San Francisco Bay Delta because it aims to understand the impacts of NH_4-rich effluent on phytoplankton communities. Effluent manipulation experiments on this scale are rare, and provide an opportunity to study whole river processes, including the response of phytoplankton in situ. Corresponding mesocosm experiments allow for more controlled conditions, yet remain coupled with river measurements.

Keywords: phytoplankton, ammonium, effluent, mesocosm

Poster topic: Integrative Applied Science

Communicating Science: The South Bay Salt Pond Restoration Project

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The South Bay Salt Pond Restoration Project (www.southbayrestoration.org) is unique not only for its size-- over 15,000 acres—but 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.

An Adaptive Management Plan has guided the Project Science Program since its inception. To date, 10 years after the acquisition, the Project has spent $11.7 million on research and applied studies covering topics as diverse as sediment dynamics, habitat evolution, water quality, nesting birds, wintering and migratory birds, response of birds to human activity, impacts of legacy mercury, and response of fish communities to the restoration. Over 20 principal investigators from diverse disciplines representing academic, government, and private, and non-profit organizations have contributed to the knowledge base of the project.

One of the challenges of the project is how to communicate these varied and often complex results to managers, among scientists, to stakeholders, and to the general public. This talk will describe how the largest wetland restoration project on the West Coast of the U.S. establishes and maintains communications and connections between scientists, managers, and the public.

Keywords: Adaptive Management, Communicating Science, Outreach

Poster topic: Integrative Applied Science

Modeling the Influence of Fall Outflow and Community Structure on the Delta Smelt Population

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The ecological significance of the low salinity habitat (LSH, 1-6 psu) in controlling the distribution and abundance of Delta Smelt is increasingly recognized. The response of the Delta Smelt to fall outflows is an area of significant interest in terms of adaptive management. Modeling the complex mechanisms operating in the LSH may contribute to better understanding its underlying ecological processes. The objectives of this study were to model both community structure under 3 outflow scenarios and the effect of outflow on species/trophic levels. The response of the Delta Smelt population was then compared between model predictions and field data. Qualitative and quantitative species interaction models were used to evaluate the response of the community and its stability under 3 fall outflow levels: low (5,000 cfs), intermediate (8,000 cfs) and high (11,400 cfs), where the near-bottom 2 psu salinity position in the estuary (X2), corresponded respectively to X2 of 85, 81 and 74 km. Community composition for each outflow scenario included species/trophic groups relevant to the Delta Smelt subsystem at each X2 level (class I models). Class II models further included outflow and unlike class I models, sustained outflow disturbances (press perturbations) were assumed to transfer indirectly from outflow to other community variables. Both classes I and II models showed the predicted population response of the Delta Smelt were: 1) consistently positive and certain under the high outflow community scenario, 2) generally positive but very ambiguous under the intermediate and low outflow community scenarios. Quantitative simulation models further showed community stability tended to decline from high outflow scenarios to intermediate and low outflow scenarios. Model predictions were consistent with the observed Delta Smelt response and support the hypothesis that the fall outflow action has a positive population level effect on Delta Smelt by shifting the LSH towards X2 = 74 km.

Keywords: delta smelt, flow, management, species interactions, X2, stability, community, model

Poster topic: Modeling

Modeling the Bay-Delta Circulation and Ecosystem

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Coupled physical and biological models are an effective way to address complex resource management questions in dynamic systems such as the San Francisco Bay/Estuary and Sacramento-San Joaquin River Delta (Bay-Delta). An unstructured grid model known as SELFE (Semi-implicit Eulerian-Lagrangian Finite Element) is used to model the 3-dimensional circulation of this system and is coupled to the CoSiNE ecosystem model to study the nutrient and biomass cycle. The CoSiNE ecosystem model consists of 13 tracers (Nitrate, Silicate, Ammonium, Small Phytoplankton, Diatoms, Micro-Zooplankton, Meso-Zooplankton, detrital Nitrogen, detrital Silicate, Phosphate, Dissolved Oxygen, Total CO2 and Total Alkalinity). The air-sea fluxes are provided by a high-resolution (3-km) mesoscale atmospheric model (COAMPS). The river discharge data are used as the lateral boundary condition upstream. The coastal ocean boundary condition is derived from a structured grid California coastal ocean model (ROMS). The coupled circulation-ecosystem model is tested and refined during June-July 2009 against a number of observational data sets. The validated model is then used to make a 10-year hindcast during 2004-2013 with a goal to describe, understand and ultimately predict the influence of climate change scenarios on the nutrient and biomass cycles in the Bay-Delta. Results from the June-July 2009 test run as well as the 10-year hindcast will be presented. Possible ways in which this coupled circulation-ecosystem model can be used to study and manage the Sacramento River Fall Chinook Salmon will be discussed.

Keywords: modeling, circulation, ecosystem, climate, Salmon, prediction, nutrient, biomass, unstructured, grid

Poster topic: Modeling

Sacramento River Chinook: A Statistical Model for Evaluating the Influence of Environmental Variability and Competition on Survival

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Chinook salmon (*Oncorhynchus tshawytscha*) populations spawning in the Sacramento River, CA and its tributaries have demonstrated high variability, and in some cases significant declines in spawning abundance during the past 40 years. The purpose of this research is to provide a quantitative framework for assessing the influence of both environmental and anthropogenic factors on the survival of Chinook populations in the Central Valley during both freshwater and marine portions of the lifecycle. We employ a stage-structured population dynamics model to evaluate the influence these factors on productivity and capacity limitations during specific life stages, and those resulting from an interaction among co-migrating CV Chinook natural populations and hatchery reared stocks. The stage transitions are modeled using Beverton-Holt functions, in which the productivity and capacity parameters are modeled as a function of the hypothesized factors and abundances of co-migrating populations. The population dynamics model generates predicted abundance for returning spawners and out-migrating juveniles in each year as a function of the hypothesized factors and their associated coefficients which describe their influence. The coefficients are subsequently estimated by using a statistical fitting algorithm that minimizes the error between model predictions and observed adult abundances, and juvenile abundances where available. Alternative models (hypotheses incorporating different combinations of factors) are compared using the Akaike Information criterion (AICc) and a cross-validation approach to balance model complexity with ability to explain historical data. In this analysis we focus primarily on Sacramento River Fall and Spring-run Chinook populations given the potential for interaction throughout the lower Sacramento River, delta and estuary during rearing and outmigration.

Keywords: Chinook, Population dynamics, Survival, Simulation testing, Statistical model

Poster topic: Modeling

SF Estuary Salinity Field and Fish Abundance and Distribution Visualization

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The relationship between the salinity gradient and the abundance and distribution of several species of SF Bay Delta fishes and other aquatic life is important for managing freshwater flows through the estuary but the causes of the relationship are poorly understood. We are developing a visualization of the long-term changes in the salinity field and the abundance and distribution of several SF Bay Delta Estuary fishes to improve our understanding. The visualization tool is produced using ArcMap (a GIS program) which imports 30 years of salinity field predictions developed using a coarse-grid version of the UnTRIM San Francisco Bay-Delta Model, which incorporates complex bathymetry at a sub-grid scale and runs more than 1200 times faster than real-time. Fish monitoring data from California Department of Fish and Wildlife are mapped on a seasonally averaged salinity gradient to produce a 30-year time series that illustrates the long-term changes in abundance and distribution of fishes relevant to the salinity field. The poster summarizes our initial results reviewing Longfin smelt monitoring data changes over the last 30 years mapped on the seasonally averaged salinity gradient. This work is intended to improve our understanding of how the salinity field and abundance and distribution of several estuarine fishes has changed over long time periods and provides a spatial framework to further explore the relationship between salinity gradient and fish abundance.

Keywords: salinity, fish, abundance, distribution, modeling

Poster topic: Modeling

Comparison of Mixing at a Junction Computed With Two- and Three-Dimensional Models to the Simple Flow-Weighting Scheme Used in One-Dimensional Models

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Models that approximate complex channel networks like the Sacrament-San Joaquin Delta with one-dimensional interconnected channels (such as DSM2; Delta Simulation Model II) can be run much faster than their two- and three-dimensional counterparts (such as UnTRIM, Delft3D, SUNTANS). However, calculation of transport in one-dimensional channel networks requires numerous assumptions about dispersion and mixing within the flow, particularly at junctions. The simplest approximation for the mixing at a junction is to assume that scalar mass is partitioned based on flow weighting, whereby the percentage of mass entering a particular channel is given identically by the fraction of flow volume entering that channel. Although this approximation ignores complex three-dimensional flow features at a junction that may significantly affect mixing, we demonstrate that in many circumstances it is reasonable. The three-dimensional SUNTANS model is employed to simulate flow at a junction in the Delta, and we compare direct calculations of flow and mixing at the junction with the SUNTANS model to the simple flow-weighting scheme. The results indicate that the three-dimensional model differs from the simple flow-weighting scheme only in the presence of large and persistent recirculation regions, justifying the use of the flow-weighting scheme for most junctions of interest.

Keywords: Mixing, Junctions, 1D modeling, 3D modeling, Secondary circulation, SUNTANS, DSM2

Poster topic: Modeling

Habitat Restoration and Water Diversion Effects of the Proposed Bay Delta Conservation Plan on the Hydrodynamics of a Key River Junction within the Sacramento-San Joaquin Delta, California

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Field studies have shown that the survival probability of outmigrating juvenile salmonids in the Sacramento-San Joaquin Delta is markedly lower for fish entering the interior Delta through Georgiana Slough than for fish remaining in the main stem Sacramento River. The likelihood of fish entering Georgiana Slough is a function of flow entering the junction, which reflects the interaction of river flow entering the Delta and tides. Under the proposed Bay Delta Conservation Plan (BDCP), a portion of Sacramento River flow would be diverted by three intakes between Clarksburg and Courtland, which has raised management concern because of the potential for a greater proportion of flow, and therefore fish, to enter Georgiana Slough should less river flow lead to stronger tidal influence and an increased frequency of upstream (reverse) flows. The BDCP proposes criteria for flows bypassing the intakes to limit such negative effects, and also proposes extensive tidal habitat restoration, which would result in wide-ranging changes in Delta hydrodynamics. Outputs from the California Department of Water Resources' Delta Simulation Model II suggested that the incidence of reverse flows and the proportion of flow entering Georgiana Slough within the main salmonid migration period (December-June) were similar or slightly lower under various BDCP scenarios, relative to base scenarios with the existing configuration of the Delta and existing water operations. Proposed tidal habitat restoration greatly affected hydrodynamics at the river junction, reflecting assumptions about habitat restoration extent in the Cache Slough complex that would draw tidal energy away from the main stem Sacramento River at Georgiana Slough; this was confirmed by sensitivity analyses of scenarios with proposed BDCP operations but without tidal habitat restoration. It is concluded that proposed BDCP water operations and habitat restoration would not result in an increase in flow and fish entering Georgiana Slough from the Sacramento River.

Keywords: Bay Delta Conservation Plan, Georgiana Slough, Sacramento River, flow, restoration

Poster topic: Modeling

Enhancing the Vision for Managing California's Environmental Information: A Vision Document

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This poster describes the features, impact, and future outreach plans for a "vision document" that has emerged from the Environmental Data Summit, which was convened in June 2014. The product of a collective effort, the vision document reflects the ideas of technologists, data specialists, and scientists who gathered together with a common interest to characterize the opportunities for contemporary data management, to envision how we might identify the obstacles before us, and to chart a path toward an open community of information sharing.

The challenges facing California's Delta are not new, but they are underscored by the urgencies of the moment. Pressing matters such as climate change, an aging water infrastructure, and a deep drought force all Californians to recognize the fragile balance between our natural resources and their competing uses across the state but nowhere so poignantly as in the Delta. There, natural resource decisions must accommodate both the rate of environmental change and the fast pace of intervention efforts.

To be effective under these circumstances, agencies, organizations, and public interests must make use of today's innovations with an equally fast rate of adoption. And they must share the information and data produced through these innovations across conventional jurisdictions and agency boundaries. In short, the need for transparency and sharing of data demands an open community of science with interoperability standards, state-of-the-art data exchange and access tools. Decision makers, analysts, and public interests recognize the need for such a sharing initiative. With the world's most advanced technology resources located here in California, how do we apply our intellectual resources to this problem, to ensure that sharing information becomes the norm for natural resource management rather than the exception? And how do we best complement and build upon on our past technology investments?

Keywords: Big Data, Data Intergration, Knowledge discovery, Data Mining

Poster topic: Modeling

Projecting Boundary Conditions for a Hydrodynamic Model of the Bay-Delta under Scenarios of Climate Change

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The CASCaDE project, funded by the U.S. Geological Survey and the Delta Science Program, was developed to bring together scientists from multiple disciplines to conduct coordinated assessments of the potential effects of climate and infrastructure changes on the Bay-Delta aquatic ecosystem. At the core of this effort are simulations of the response of the estuary to scenarios of change using the Delft 3D Flexible Mesh (D3DFM) hydrodynamic model, which integrates a variety of hydrodynamic, water quality, and biological responses into a single model.

D3DFM is driven at its horizontal boundaries by flow rate, water temperature, salinity and sediment flux, and at the water surface by air temperature, precipitation, wind speed, surface pressure, humidity and cloudiness. Translating GCM outputs into these quantities at the appropriate spatial and temporal scales in a manner that is consistent with real-world behavior has entailed the development of new models and techniques.

In this poster, methods for deriving climate-change time series for several of the D3DFM boundary forcings will be summarized briefly. These time series are all ultimately derived from GCM outputs, with corrections based on relevant historical observations applied to obtain realistic behavior.

One of the more complex sets of time series to derive--river flows at the model's upstream boundaries--will be addressed in more detail. The sequence of models and techniques used in this derivation include downscaling and bias correction (using the LOCA method, development of which was sponsored by the California Energy Commission and other agencies) of GCM daily meteorological outputs over California, propagation of these signals through hydrological (VIC) and management (CALSIM II) models, and application of a new method to disaggregate monthly CALSIM flows to the daily time scale. Preliminary results will be presented.

Keywords: climate change, warming, modeling, watershed, snowpack, streamflows, floods, droughts, reservoirs

Poster topic: Modeling

The Calibration of a 3D Hydrodynamic Model for the Assessment of Water Quality Indicators in the San Francisco Bay-Delta System

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The USGS-led CASCaDE II project aims to understand the potential effects of changes in climate and physical configuration on water quality, ecosystem processes, and key species in the San Francisco Bay and Delta through the application of a series of linked models of climate, hydrology, hydrodynamics, sediment, geomorphology, phytoplankton, bivalves, contaminants, marsh accretion, and fish. CASCaDE II extends the work of CASCaDE I in part through the depiction of the Bay-Delta in one continuous domain, allowing for more interaction of hydrodynamics and water quality between the Bay and Delta.

The 3D hydrodynamic model Delft3D-Flexible Mesh (DFM), developed by Deltares, is applied as a foundation for exploring linkages between ecologically relevant processes in the Bay-Delta System, and has been calibrated for water flow, salinity and temperature. The model domain encompasses the coastal ocean, estuary, and lower watershed, and is driven by tidal forcing along the Pacific Ocean boundary in the west, and freshwater inflows from rivers in the North Bay and Delta. The model also includes freshwater withdrawal at major local, state, and federal sites, and the effects of temporary barriers and gates. DFM's combined curvilinear and unstructured grid provides both improved alignment along main flow directions and more natural depictions of irregular shorelines and allows for the flooding of below-sea-level leveed islands. The model is suitable for running on distributed-memory clusters, as well as multi-core local workstations.

The model has shown good agreement with measurements of the aforementioned parameters, and model performance, shown through numerous statistical metrics, is shown to be good for many locations throughout the Bay-Delta. Early results indicate that DFM is a useful tool to improve understanding of the effects of changes in regional climate and infrastructure on Bay-Delta hydrodynamics. Ultimately, through linkages with other models, DFM will shed light on likely resulting ecosystem change.

Keywords: Hydrodynamics, Three-dimensional modeling, Unstructured meshes, salinity, temperature, tidal processes, rivers

Poster topic: Modeling

Airborne Surface Water Elevation Observation for Hydrodynamic Modeling in the Sacramento-San Joaquin Delta

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Hydrodynamic processes in complex environments such as deltas are highly spatially heterogeneous and this spatial variability cannot be fully represented by traditional hydrological monitoring which relies on frequent water level measurements at discrete locations. Remote sensing on the other hand, whether air-or spaceborne, allows for spatially distributed measurements but the frequency of data acquisition is typically too low for the data to be immediately useful in hydrological applications. Because of this, remote sensing data are often used in conjunction with hydrological or hydrodynamic models.

The new AirSWOT instrument provides spatially distributed measurements of water surface elevation from an airborne platform and the Sacramento-San Joaquin Delta is one of its test areas. In order to assess the value of such measurements to hydrodynamic modeling in the Delta, a synthetic data assimilation experiment was designed. A hydrodynamic model of the Delta was set up and run using in situ observations as input to produce a “true” run. Sets of synthetic AirSWOT measurements, covering different locations and at different times, were then generated based this “true” run and expected measurement errors. An ensemble of perturbed runs was generated by perturbing the boundary conditions (upstream inflows, downstream tidal levels and export pumping) and the synthetic data sets were assimilated using the ensemble Kalman Filter. The impact of the assimilation on the hydrodynamic model performance was studied for the different sets of synthetic data to identify the most sensitive measurement times and locations in order to help improve the design of future measurement campaigns.

The research described here was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

Keywords: hydrodynamic modeling, remote sensing, data assimilation

Poster topic: Modeling

Lessons Applicable to the Bay-Delta Nutrients Program from a Nutrient TMDL Developed for a Polluted Urban Watershed

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Lessons learnt from a nutrient total maximum daily load (TMDL) allocation study for a historically eutrophic urban lake are presented in the context of the numeric nutrient endpoint program that is underway for the San Francisco Bay and Delta. Even though the TMDL was developed for a lacustrine system the technical and regulatory challenges provided unique insights that are relevant to the Bay-Delta. Onondaga Lake, a dimictic, water body located in central New York, has a 100-year history of legacy municipal and industrial pollution. The lake drains into Seneca River in which navigable water levels are maintained by the operation of a series of locks. Filter feeding dreissenid mussels have played a major role in affecting the water quality of the Seneca River, and to a lesser extent in Onondaga Lake. The development of the TMDL follows a 1998 Consent Judgment that required an extensive monitoring program, and the development of a series of mathematical models of the lake, its watershed, and the Seneca River to provide an integrated assessment of potential point and non-point nutrient loading mitigation measures. Ongoing improvements to point sources and implementation of gray and green infrastructure programs (e.g., Save the Rain program) have resulted in a remarkable improvement in water quality. Additional mitigation measures were put into context through two bounding scenarios: the lake under pre-colonial conditions; the lake with loadings continued before the ACJ was passed. Model projections showed only modest improvements in lake water quality with inter-annual variability far greater than the improvements simulated between scenarios, and that anoxic conditions likely existed even under pre-colonial conditions. Paleolimniological evidence derived from the lake's sediments independently confirmed the model findings. NYSDEC used these results in developing phosphorus TMDL allocation for the lake, which was approved by U.S. EPA in 2012.

Keywords: TMDL, Eutrophication, Food web, Water Quality Modeling, Point/Non-Point source control

Poster topic: Modeling

Improving Process Based Modeling of CO_2 and CH_4 from Managed Wetland and Rice Systems in the Delta

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Under California's Cap-and-Trade program, companies are looking to invest in land use practices that will reduce greenhouse gases (GHG). Restoring drained cultivated peatlands to flooded conditions in the Sacramento-San Joaquin River Delta may significantly reduce GHG emissions. However, in order for land owners to participate in the Cap-and-Trade program, we need a reliable method for quantifying the GHG emissions associated with flooding cultivated peatlands. Process-based biogeochemical modeling can provide a cheap and rigorous method for calculating GHG reductions associated with land use change. The goal of our research is to contribute to emission protocol development by provideing accurate biogeochemical models calibrated to diverse land uses in the Delta. We took a hierarchical modeling approach to develop and test a soil CO_2 and CH_4 emission model in the Delta. First we adapted the Dual Arrhenius Michaelis-Menten kinetics model (DAMM) to predict soil surface CO_2 and CH_4 emissions using temperature, plant productivity, soil C substrates, and water table depth. The modified DAMM model was integrated with a simple light use efficiency model. This allowed not only accurate simulation of gross primary productivity but also the influence of plant productivity on microbial production of CO_2 and CH_4. The modified DAMM model has 2 C pools differing in lability and inputs including a labile soil C pool (associated with plant photosynthetic C) and a recalcitrant C pool (associated with soil organic matter). Water table depth allowed accurate simulation of inhibited soil respiration and enhanced methanogenesis during inundated conditions. The modified DAMM and plant productivity model was then parameterized in both restored wetland and rice systems using net ecosystem exchange of CO_2 and CH_4 measured with the eddy covariance technique. This ecosystem model will advance understanding of biogeochemisty in managed peatland systems as well as aid the development of a GHG protocol in the Delta.

Keywords: Rice, Managed wetlands, biogeochemical modeling, light use, efficiency, methane, emission

Poster topic: Modeling

Modeling Selenium Biogeochemistry in the Delta and San Francisco Bay

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San Francisco Bay is the subject of a total maximum daily load (TMDL) evaluation for selenium given elevated tissue concentrations in some species. Selenium is present at background levels in the Sacramento River and Pacific Ocean, at elevated levels in the San Joaquin River and certain tributaries, and is also discharged through refinery and other point sources in the Bay. Selenium exists in multiple oxidation states and in different dissolved and particulate forms that are relevant to its biological uptake. Here we present the results of modeling of different selenium species through the Delta (using the Delta Simulation Model, DSM2), and the in the bay using an estuary biogeochemistry model (ECoS). The model is calibrated and validated with speciated selenium transect data across the estuary collected in 1999-2000 and in 2000-2012, as well as data from tributaries, the major rivers, and point sources collected over the last 5 years. The modeling shows the changing contribution of Delta loads to the bay by water year type and season, with varying San Joaquin inflow volumes. The resulting effects in the bay water column selenium species, both dissolved and particulate, are well represented through the modeling framework. The model is used to evaluate the bay-wide impacts of changing specific selenium loads, such as refinery loads and riverine loads, and large scale changes such as the implementation of selected alternatives envisioned as part of the Bay Delta Conservation Plan.

Keywords: selenium, DSM2, biogeochemistry, speciation

Poster topic: Modeling

How Much Floodplain Habitat is in the Central Valley and How Much Do We Need to Achieve the AFRP Chinook Salmon Doubling Goal?

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We applied best available tools and data to quantify the area of all types of existing Central Valley floodplain habitat and to estimate the amount of additional floodplain rearing habitat that would be needed in each of the Central Valley Flood Protection Plan (CVFPP) Conservation Planning Areas (CPAs) to achieve the Anadromous Fish Restoration Program (AFRP) "doubling goal" for Central Valley Chinook salmon populations. Historical and existing salmonid rearing habitat acreages were determined using an Estimated Annual Habitat (EAH)-based approach (Matella and Jagt 2013) that considers current and historical (i.e., before construction of Central Valley dams and levees) hydrology together with pre-levee and leveed flow-area relationships to calculate the area of rearing habitat historically and presently inundated with timing, duration, and frequency meaningful to juvenile Chinook salmon. Rearing habitat needed to support the doubling goal populations was estimated using the Emigrating Salmonid Habitat Estimation (ESHE) model, a territory size-based model that uses empirically-derived salmonid survival rates, growth rates, and migration rates to determine habitat area needs. Initial results from this investigation provide spatial and quantitative information to guide identification and prioritization of floodplain reconnection or restoration areas that could contribute to satisfying the AFRP Doubling Goal. Additional ongoing work is refining the spatial scale of the initial analysis to support site-specific levee configuration evaluations for floodplain habitat reconnection and restoration throughout the Sacramento and San Joaquin River watersheds.

Keywords: Floodplain, Doubling Goal, Estimated Annual Habitat, Emigrating Salmonid Habitat Estimation

Poster topic: Modeling

Building a Public Community around the D3D-FM San Francisco Bay-Delta Model

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The San Francisco Bay-Delta system is complex in its physical and environmental dynamics. Modeling tools that integrate hydrodynamics and water quality dynamics are essential to unravel the governing processes on various spatial and temporal scales and assess potential developments due to climate change and adapting management strategies. There is a need for open access, publicly available, integrated modeling platforms to facilitate and enhance interdisciplinary and interagency scientific communication, collaboration, and understanding.

Cascade project partners (http://cascade.wr.usgs.gov/) currently develop a 3D hydrodynamic surface water flow model applying the Delft3D FM (flexible mesh) Deltares software. The domain covers an area from Point Reyes up to the tidal limits near Sacramento and Vernalis (http://san-francisco-bay-delta-model.unesco-ihe.org/). A high resolution mesh allows for detailed computations of flow and water quality including turbidity, phytoplankton, nutrients, and contaminants. The Bay Nutrient Strategy also recently adopted this model to inform nutrient management decisions.

We aim to present a web-based infrastructure around this SF Bay Delta model to stimulate and enhance knowledge and understanding of the Bay-Delta system. The SF Bay Delta community model is open access (publicly available, but only 2D in first instance) and the modeling software (Delft3D FM) will be released as open source. The web-based infrastructure will support other open-source implementations of the SF Bay-Delta system, such as SUNTANS, ROMS, UNTRIM, which are also under active development. Ultimately, the platform will enable community involvement in the development and comparison of modeling systems.

It is our hope that the SF Bay-Delta community model will stimulate scientific co-operation and knowledge sharing by providing a sound and continuous basis for future scientific or operational projects. We intend for both users and developers to contribute to further optimization of model performance in multidisciplinary studies related to salinity intrusion, water quality, contaminants, morphodynamics, flooding and interaction with groundwater flow.

Keywords: process-based modeling, community, model, open source, scientific co-operation

Poster topic: Modeling

San Francisco Bay Sediment Dynamics in Low Energy Turbulence

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Sediment dynamics in San Francisco Bay control whether the Bay floor and surrounding marshes are growing or eroding, dictate how sediment-associated contaminants spread, and determine the amount of light available for primary production through turbidity levels. In San Francisco Bay, much of the actively transported sediment is cohesive, and can flocculate when suspended. Changes to the composition of the sediment and waters, the suspended sediment concentration, and the turbulence can all affect the flocculation of suspended sediment. In turn, flocculation controls the particle diameter, settling velocity, density, and particle inertia. These sediment properties have a large impact on the vertical distribution of sediment in the water column, which strongly affect the way sediment is transported through the estuary by fluid flow.

We isolated the effect of turbulence on particle characteristics by measuring the concentration gradient, settling velocity, and turbulent diffusivity in homogeneous, isotropic turbulence in a controlled laboratory setting. We compared the behavior of well-defined particles: a) sorted, fine-grained, non-flocculating sediment and b) synthetic flocs produced in the laboratory, with c) real mud from San Francisco Bay.

These results will make numerical models of sediment transport in San Francisco Bay more accurate, enabling managers to make better predictions of contaminant transport and sediment accumulation or erosion within the Bay. The Bay Margins are considered a management priority, since they have some of the highest concentrations of contaminated sediments in the Bay and are affected by current discharges. Increasing our mechanistic understanding of sediment transport directly improves our ability to make effective management decisions.

Keywords: suspended sediment, settling velocity, turbulence, diffusivity

Poster topic: Physical Processes

Daily Tracking and Evaluation of Effective Delta Outflow and Delta Salinity (EC) During the 2014 Drought

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The 2014 Drought Management Plan (DWR and Reclamation) described several possible changes in the D-1641 objectives to reduce the minimum required Delta outflow so that upstream reservoir releases could be reduced and to allow Delta exports for minimum "health and safety" water supply needs. The effects of relatively low Delta outflow on seawater intrusion were tracked and evaluated using daily Delta operations data from Central Valley Operations (CVO) and daily EC data from USGS, DWR and Reclamation monitoring stations (from CDEC). A daily model was developed to allow forecasted and measured Delta outflow and EC conditions to be compared and evaluated. The daily average salinity at Suisun Bay and western Delta stations was calculated using the "effective Delta outflow", based on the G-model formulation (volumetric moving-average) developed by CCWD. One challenge for tracking Delta salinity is that the daily Delta outflow must be estimated from the Delta inflows with assumed channel depletions, or from the USGS tidal flow measurements with assumed "tidal filling" effects. Once the effective outflow was calculated, the effects on salinity at each station were well-described with a unique outflow-EC relationship (e.g., negative exponential). The calculated EC generally matched the measured EC for the historical conditions. The increased runoff from moderate storms in February, March, and April had a dramatic effect on EC that extended into May and June. The daily model was used to evaluate future conditions with alternative Delta operations (outflows). For example, the projected effects of D-1641 outflow objectives and reduced outflow objectives (3,000 cfs) were compared. The benefits from the proposed drought barriers on south Delta EC conditions were also evaluated, although the drought barriers were not installed. The daily model provided an accurate evaluation of alternative Delta operations effects on salinity.

Keywords: Delta outflow, Salinity, Seawater Intrusion, Drought Barriers, EC measurements

Poster topic: Physical Processes

Blacklock Restoration Project in Suisun Marsh - Changes to Marsh Plain Elevations and Channel Network Evolution Over Five Years

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The Blacklock Restoration Project in Suisun Marsh is a 70 acre site in which tidal flow was restored to managed wetlands by the Department of Water Resources. The objectives of this project are to increase the amount of tidal brackish wetlands to aid in the recovery of listed species and to improve the understanding of tidal marsh restoration through collaborative science. There is a 10 year monitoring period following breaching of the levee in 2006. Data on 15 parameters was collected and analyzed to evaluate progress towards meeting these objectives. This poster will focus on 4 interrelated parameters: channel network evolution and accretion measurements through surface elevation tables (SET), cryogenic core samples, and topographic surveys. Channel network evolution results include: total channel length increased by 26%; channels in the 5 to 10 ft wide classification increased by 112%; and there is not a need to conduct actions to foster channel development. Elevation change results include: accretion was not uniform across the site; topographic survey transects showed an average elevation increase of 0.3 ft; SET and cryogenic core sampling were found to be ineffective ways to measure accretion in highly subsided unvegetated areas due to scour. Overall, geomorphology of the site is progressing toward a complex dendritic channel system in a high intertidal marsh plain.

Keywords: Suisun Marsh, Blacklock, tidal restoration, subsided, accretion, sedimentation, channel formation

Poster topic: Physical Processes

Evaluating the Measured Effects of Delta Outflow on San Francisco Estuary Salinity in WY 2011

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Data collected by the USGS, DWR, and USBR in the Delta and San Francisco Bay during water year 2011 were evaluated to better understand the effects of outflow on seawater intrusion in the Delta and on the longitudinal salinity gradient, vertical salinity stratification, and the upstream edge of the salinity gradient (X2). Water year 2011 was selected because Delta outflow varied widely from approximately 2,500 cfs to 225,000 cfs. Electrical conductivity (EC), tidal elevation, flow and velocity data collected every 15 minutes at multiple locations, as well as USGS boat survey data were integrated and evaluated. The data show how salinity varies longitudinally and vertically through the SF Estuary as well as how the salinity gradients vary in response to tidal flow and net Delta outflow. At any given location, the daily range of EC values (caused by tidal excursion) is much greater than vertical EC stratification. Delta outflow is the primary control for seawater intrusion. Other factors such as tidal strength and gravitational circulation play a secondary role. Effective outflow (described with the G-model by CCWD) was used to estimate the daily EC at each monitoring location and to estimate the daily X2 position more accurately than the daily X2 equation. Adding a term representing the variation in high tides (caused by the spring-neap tidal cycle) improved the daily EC and daily X2 estimates. Although outflow, X2 and daily average EC values provide an accurate summary of the SF Estuary salinity gradients, the 15-minute data reveal many more interesting hydrodynamic events and processes. The integration of the salinity data from the entire SF Estuary provides a more complete understanding of the outflow-salinity relationships.

Keywords: Delta outflow, salinity gradients, seawater intrusion, EC monitoring, X2

Poster topic: Physical Processes

Floc Depositional Characteristics within the Sacramento–San Joaquin River Delta, Northern California, USA

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Deposited sediment helps create and sustain the landscape in the Sacramento–San Joaquin River Delta (Delta), including desirable habitats such as tidal marsh, shoals, and floodplains. A key management question is whether the existing Delta landscape can be sustained as sea level rises. The erosion and deposition processes are strongly dependent on the local sediment properties, particularly when cohesion and flocculation are important, as they are in the Delta.
The U.S. Geological Survey collects data that support the development, calibration, and validation of numerical models of sediment transport and turbidity in the Delta. Research questions include: How much flocculation of sediment particles occurs in the Delta, and what are the settling velocities of the flocs? How do floc settling properties vary spatially and temporally? To address these questions, a Co-operative Agreement was established between the USGS and HR Wallingford (UK).
This abstract presents preliminary findings from measurements of floc depositional properties throughout the Delta, 2010-2011. Individual floc properties and dynamics were measured with the LabSFLOC-1 instrument; a high resolution video-based device. Thirty-one floc population samples were obtained from 21 sites within the Delta. Flocculated particles were observed throughout the Delta including in freshwater. Suspended-sediment concentrations in the near-bed region ranged from 4-52 $mg.l^{-1}$. A combined total of more than 2,200 individual flocs were measured. Floc sizes (D) ranged from 27 micron microflocs (D < 160 microns) to macroflocs of 500 microns. Macrofloc settling velocities (Ws) were 0.7-5 mm/s (mean 2.25 mm/s) and macroflocs comprised 1-56% (mean 24%) of the suspended mass. Microfloc Ws was smaller (0.3-4.0 mm/s, mean 1.63 mm/s), but comprised more (44-99%, mean 76%) of the suspended mass and thus, mass settling fluxes (spanning 0.1-80 $mg.m^{-2}s^{-1}$) were dominated by microflocs, albeit an order of magnitude less than depositional fluxes within San Francisco Bay.

Keywords: Flocculation, Flocs, Settling Velocity, Depositional Flux, River Delta, Suspended Sediment

Poster topic: Physical Processes

Comparison of Downscaled CMIP5 Precipitation Datasets for Projecting Changes in Extreme Precipitation in the San Francisco Bay Area

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Water resource managers planning for the adaptation to future events of extreme precipitation now have access to high resolution downscaled daily projections derived from statistical bias correction and constructed analogs. We also show that along the Pacific Coast the Northern Oscillation Index (NOI) is a reliable predictor of storm likelihood, and therefore a predictor of seasonal precipitation totals and likelihood of extremely intense precipitation. Such time series can be used to project intensity duration curves into the future or input into stormwater models. However, few climate projection studies have explored the impact of the type of downscaling method used on the range and uncertainty of predictions for local flood protection studies.

Here we present a study of the future climate flood risk at NASA Ames Research Center, located in South Bay Area, by comparing the range of predictions in extreme precipitation events calculated from three sets of time series downscaled from CMIP5 data: 1) the Bias Correction Constructed Analogs method dataset downscaled to a 1/8 degree grid (12km); 2) the Bias Correction Spatial Disaggregation method downscaled to a 1km grid; 3) a statistical model of extreme daily precipitation events and projected NOI from CMIP5 models. In addition, predicted years of extreme precipitation are used to estimate the risk of overtopping of the retention pond located on the site through simulations of the EPA SWMM hydrologic model.

Preliminary results indicate that the intensity of extreme precipitation events is expected to increase and flood the NASA Ames retention pond. The results from these estimations will assist flood protection managers in planning for infrastructure adaptations.

Keywords: Precipitation extremes, statistical downscaling, empirical downscaling, NOI, flooding, stormwater

Poster topic: Physical Processes

Influence of Wind, Wind Waves, and Tidal Forcing on Sediment Resuspension, Liberty Island, CA

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Liberty Island is an abandoned agricultural land in the Northern Sacramento-San Joaquin Delta at the south end of the Yolo Bypass. The North Delta around Liberty Island is a region known to have elevated turbidity compared to other Delta regions and currently sustains a functioning Delta smelt habitat. The island flooded when the south levee failed in 1998 due to a large winter flood and was not repaired. It is now a shallow, tidally forced embayment, approximately 2.5 by 8.5 km, surrounded by levees with multiple breaches, especially on the east side, and hydrodynamic interaction with the surrounding sloughs. Since 2010, USGS researchers have measured turbidity, water temperature, salt and wind waves within the embayment, flow, turbidity, suspended-sediment concentrations (SSC), salt, water temperature, and SSC flux at the south breach. The focus of this poster is the relationship between wind-driven and tidally-driven hydrodynamics, turbidity, suspended-sediment concentrations, and how the sediment exchanges with the Liberty Island/Cache Slough complex. The spatial and temporal turbidity distributions are a critical aspect of Delta smelt habitat.

The bed sediments within the Cache Slough complex are finer than elsewhere in the delta with median diameter less than 0.1 mm. These fine sediments are easily re-suspended by tidal currents and wind-driven near-bed orbital motions, enhancing turbidity throughout the area. Preliminary results demonstrate a large seaward sediment flux through the breach when the Yolo Bypass floods, a landward sediment flux during low flows and elevated turbidity during spring and summer winds. The majority of the winds are from the southwest, however, at similar wind speeds, significantly higher wave heights occur during northwesterly winds. This information will help resource managers plan future habitat restoration efforts throughout the Delta.

Keywords: wind induced turbidity, wind-waves, sediment resuspension, turbidity, Liberty Island

Poster topic: Physical Processes

Beyond the 10% Rule: A New Method for Predicting Salmon Spawning Potential from Substrate Grain Size and Fish Length

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We describe a new approach to assessing the amount of salmon spawning habitat in coarse-bedded rivers. The approach is based on a recently developed model that predicts the reproductive potential of coarse-bedded rivers as a continuous function of grain size and salmon length. It incorporates empirical relationships between fish length, redd area, and the size of the largest particles that female fish can move when building redds. Estimates of this threshold particle size are incorporated into a mechanistic model for the amount of spawning habitat in riverbeds where grain-size distributions have been measured. Model inputs are the grain size indices D50 and D84 and an estimate of fish length. Outputs include predictions of the fraction of the bed that the fish can use for redd building and also the number of redds that they can build within the useable area. We cast the model into a variety of easy-to-use tools, including look-up tables, charts, an Excel worksheet, a MatLab user interface, and a Java web applet. We discuss how these tools can be used as part of a new, mechanistic approach to assessing spawning substrates and optimizing gravel augmentation in coarse-bedded rivers.

Keywords: Pacific salmon, gravel augmentation, grain-size distributions, population diversity, river restoration

Poster topic: Physical Processes

Evaluation of Junction Hydrodynamics in the Sacramento-San Joaquin Delta

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The understanding of junction hydrodynamics in the Delta is critical to determine survival pathways of out-migrating salmon. This is the first in a series of four presentations that collectively investigate the relationship between water velocities and fish entrainment in these junctions. Specifically, we investigated methods to quantify junction scale hydrodynamics focusing on accurately describing the surface currents with two-dimensional (2D) velocity interpolation, and simplified metrics such as discharge ratio and critical streakline. Continuous measurements with side-looking acoustic Doppler current profilers (SL-ADCP's) were collected at six junctions in the Delta over a period of two to five months to provide baseline detailed hydrodynamic information. The SL-ADCP profile data at the junctions were used to provide accurate velocity field interpolations using a mass balance Lagrangian particle tracking and inverse path-length weighted algorithms. The profile data was extrapolated in the horizontal and vertical, and cross-sectional area were integrated to determine accurate discharge estimations with the Velocity Profile Method. These results are validated with down-looking (DL)-ADCP measurements and Lagrangian drifter tracks.

Our preliminary results show, junction scale hydrodynamics vary considerably depending on the phase of the tide and river inflows. The time scale of entrainment and the amount of water entrainment is dependent on location. Since these investigations occur over a short time scale, we compared the 2D velocity and discharge measurements to long term discharge monitoring stations in order to evaluate water entrainment on longer time scales. These results show that site specific studies are needed to effectively understand junction hydrodynamics for the design and placement of fish diversion structures.

Keywords: Junction Hydrodynamics, ADCP. Velocity Interpolation, Ecohydraulics

Poster topic: Physical Processes

Central Valley Outflow over Time: Water Budgets and Other Estimates

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The Bay Institute's 1998 publication, From the Sierra to the Sea: the Ecological History of the San Francisco Bay-Delta Watershed (STS) (http://bay.org/publications/from-the-sierra-to-the-sea-the-ecological-history-of-the-san-francisco-baydelta-watershed), examined multiple estimates of Central Valley outflow prior to large-scale water development. STS was a consensus effort with public water agencies to develop a common understanding of the natural functioning of the Bay-Delta-River ecosystem.

These previous estimates used a variety of approaches:

- sediment cores and correlations by academic researchers

- Gaging and correlations from 1879-1885 by the State Engineer

- Gaging and correlations in early 20th century by State Public Works Department

- Water budget calculations of average annual "natural" outflow with the 20th century unimpaired hydrology and precipitation as inflow and estimated natural vegetation acreage and evapotranspiration (ET) rates for outflow, developed by competing parties to the 1987 Water Board hearings. USGS developed an annual natural groundwater budget for its 1989 Central Valley groundwater study.

STS also developed an average annual "natural" outflow using a water budget approach. Although these water budget estimates were formulated similarly and used the same unimpaired runoff data sets, their results vary from 11 MAF to 24 MAF per year. The variation in these estimates is attributable to differences in the reconstructions of natural vegetation types, acreage and ET rates, as well differences in the extent of the inflow watersheds. The monthly outflow estimates derived in the 19th century and early 20th century are closer to or exceed the higher end of the 20th century water budget estimates.

To gain further insight into how the Central Valley pre-disturbance landscape may have functioned hydrologically and ecologically STS also began development of a monthly natural water budget, which required monthly estimates of groundwater inflow, groundwater storage changes and surface water storage changes in the Sacramento Valley flood basins.

Keywords: Natural Outflow, Unimpaired Runoff, Evapotranspiration, Landscape History

Poster topic: Physical Processes

Developing Tools for Endangered Salt Marsh Harvest Mouse Conservation: Genetic Identification of Species and Population Variation using Functional Loci

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The salt marsh harvest mouse (*Reithrodontomys raviventris*) is endemic to diked and tidal marshes of the San Francisco Bay Estuary and is endangered due to habitat limitation and disruption. Because the fate of *R. raviventris* is so closely tied to that of its habitat, its response to wetland management and restoration programs may be used as an indicator of ecosystem health. Conservation planning for *R. raviventris* is challenging because there are no data pertaining to current population sizes, gene flow, or selective pressures for this species. In addition, morphological species identification is problematic between the endangered species and another native and common *Reithrodontomys* species. This study addresses these challenges by genetically identifying sampled mice to species, characterizing genetic variation in populations across the range of *R. raviventris*, and examining genetic variation related to pathogens and habitat destruction. We are currently developing a more robust genetic protocol for species identification using 96 samples collected to date from a total of 10 populations in Suisun, San Pablo, and South San Francisco Bays. Thus far, we have sequenced 36 samples at the mitochondrial cytochrome b locus, confirming morphological species identity for 18, identifying 15 unknown, and correcting the identity of 3 individuals. Assessing genetic variation at functional loci contributes to our understanding of how endangered organisms adapt to a rapidly changing environment. In particular, adaptive immune system variation is frequently characterized in endangered species to assess the potential of limited populations to respond to disease. We have isolated the first functional genetic locus from *R. raviventris*, an adaptive immune system gene in the major histocompatibility complex (MHC, Class II DRB). Population studies using these loci will be used to estimate abundance, population connectivity, and selection, enabling effective management of *R. raviventris* genetic diversity as mandated by state and federal regulations.

Keywords: Reithrodontomys, genetic, species identification, MHC, habitat fragmentation, endangered, mice, population

Poster topic: Population Estimation and Viability

Mobile Acoustic Sampling to Quantify the Distributions and Behaviors of Salmon Smolt Predators in the San Joaquin River

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An array of sonars and echosounders was deployed from a vessel to survey non-native salmon-smolt predators (e.g. striped bass, largemouth bass, white catfish, and channel catfish) in the San Joaquin River. The surveys, conducted between March and May 2014, spanned nine reaches, defined as part of an associated predator density manipulation study. A 500-kHz multibeam sonar (Simrad M3) was deployed in two orientations, using profiling and imaging modes, to measure bathymetry and track fishes. A 120-kHz elliptical- split-beam sonar (EK60) was used to detect, track, and enumerate fishes to the side of the vessel. Two narrow bandwidth (70 EK60 and 200 kHz ES15) and one wide bandwidth (45-90 kHz EK80) echosounder were used to measure the frequency-dependent dorsal-aspect backscatter from fishes beneath the vessel. The acoustic data were geolocated using positions from a differential GPS receiver, and the bathymetry data were compensated for measured pitch, roll, heave, and tide. The interpretation of fish backscatter was aided by fish length and weight measurements, collected as part of the predator density manipulation study, and X-ray images taken from representative specimens of the dominant species and sizes. The shapes of the fishes and their swimbladders were input to a Kirchoff-Ray Mode model to estimate frequency-specific backscatter versus fish length and orientation. The latter is used to refine the acoustical survey detections of fishes and the estimations of their numbers and sizes. Preliminary results will be presented and future work will be outlined.

Keywords: non-native, fish, enumeration, multibeam, sonar, wide bandwidth, echosounder, survey, KRM

Poster topic: Sampling Methods and Design

Designing Passive, Baited, GPS Enabled Monitoring Buoys to Measure Juvenile Chinook Salmon Predation in a River Environment

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Acoustic tagging technology has revealed regions of high mortality for juvenile salmon in Central Valley Rivers. However, this technology is both expensive and limited in its ability to identify when/where/why mortality occurred, even with the potential application of new 'predation sensing tags'. We have been experimenting with live baited 'tethers' in various configurations as a method of assessing relative predation rates across habitats or temporal periods or between experimental and control sites. In one study a series of anchored moorings with surface floats were used. A magnetic-timer-activated stopwatch connected to a piece of fluorocarbon baited with a Chinook smolt, was triggered when a significant force was applied (e.g. predation event). This was used to compare predation around water diversions with that observed along bank and mid-channel habitats. To assess effect of flow on predation, the design was changed to free floating tethers baited with juvenile Chinook salmon for a study along the lower San Joaquin River. Tethers were constructed of a 75cm ballasted PVC pipe closed at both ends with only the top 10 cm exposed to minimize wind influence. A GPS transponder was affixed to the top and a hook timer at the base. In place of a hook, smolts were attached with a fluorocarbon loop threaded through the mouth, between the gill arch and out the gill. A GoPro® underwater camera was mounted to the bottom of tethers to document predation events, and identify the predator species. These baited tethers proved quite versatile at navigating over 1 km of river per study site while accurately recording both timing and location of predation events under varying flow conditions. Units are <$1000 and can be deployed repeatedly. A small boat 2-3 person team can manage ~15-30 tethers in a research session.

Keywords: Predation, Monitoring, GPS, Technology, Tether, Chinook, Salmon, San Joaquin, SWFSC

Poster topic: Sampling Methods and Design

Tidal Marsh Restoration under BDCP: Adapting to Uncertainty in Management and Environment

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The proposed Bay-Delta Conservation Plan (BDCP) proposes a rapid rate of tidal marsh restoration, targeting an average of over 1,000 acres per year over a 40-year period, and including adjacent uplands expected to be inundated by sea level rise during that period. There are several sources of uncertainty regarding the potential to achieve those acreage targets, and to achieve performance targets established by biological objectives for the restored lands. For example, there are risks that sufficient suitable lands may not be available to meet the restoration targets, that productivity and food webs on restored lands would be heavily altered by the presence of invasive species, and that benefits to covered species may not be of the types and magnitudes anticipated.

This presentation describes the evaluation and decision process for monitoring and management of tidal wetlands restored under BDCP. Examples of potential management problems are given, showing how monitoring would detect these problems, and describing the prescribed approach for a science-based management response. That response includes elements of research, experimentation, and independent scientific review, with the potential to modify restoration methods and objectives, or to reallocate resources to more productive forms of restoration. This approach to diagnosis and response of problems in tidal restoration is potentially useful to all organizations engaged in tidal wetland restoration in the Delta.

Keywords: adaptive management, monitoring, BDCP, collaboration, tidal marsh restoration, effectiveness

Poster topic: Sampling Methods and Design

Mud on the Move: Measuring Suspended Sediment Concentrations within Tidal Wetlands in the San Francisco Estuary

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Inputs of suspended sediments are critical for development and sustainability of tidal wetlands. Suspended sediment inputs are also a key parameter used in calibrating wetland accretion models, which aid in both understanding restoration dynamics and projecting resiliency with sea-level rise. Despite the importance of suspended sediments, few field studies have directly measured sediment concentrations within estuarine wetlands, relying instead on measurements in adjacent waters or focusing on long-term rates of sediment accumulation. We refined and tested a simple method for collecting samples of suspended sediment during an incoming high tide, using siphon collectors positioned at set distances above the wetland surface and in transects extending away from channels or from the lower boundary of the vegetated wetland. This sampling protocol was developed collaboratively, with substantial input from local wetland managers and other stakeholders. Field samples were collected from December 2013 to March 2014 within two San Francisco Bay National Estuarine Research Reserve (NERR) locations: China Camp State Park in San Pablo Bay and Rush Ranch Open Space Preserve in Suisun Marsh. Most suspended sediment concentrations ranged from 15-60 mg/l at Rush Ranch and 15-200 mg/l at China Camp, with highest concentrations measured at low elevations and adjacent to tidal channels. The same method was subsequently tested at two additional NERR sites: Grand Bay in Mississippi and North Inlet in South Carolina. The combined data inform our understanding of sediment delivery to tidal wetlands, including variation within a site, between salt and brackish wetlands in the San Francisco Estuary, and among different types of tidal wetlands nationwide. Future application of the sampling method will allow standardized comparison of suspended sediment inputs across a wide range of estuarine wetlands, and when coupled with other physical measurements will enable detailed investigation of sediment transport between wetlands and adjacent intertidal and subtidal areas.

Keywords: total suspended solids, marsh, resuspension, deposition, China Camp, Rush Ranch

Poster topic: Sampling Methods and Design

Method for Continuous In-situ Measurement of Phytoplankton Settling Rates Using Existing Flow-Through Fluorometers

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To better understand the effects of environmental factors on the health of phytoplankton in river and delta systems, it would be helpful to have the capability to continuously measure the natural settling rate of phytoplankton in situ, under field conditions and over long periods of time. However, inexpensive and easily deployable *in-situ* instruments for making this measurement are not available. As a result, we are seeking to develop a method of continuously measuring *in-situ* phytoplankton settling rates using existing chlorophyll-a flow-through fluorometers. Because these instruments are already widely available, the increased functionality that this new method would provide has the potential to greatly increase data gathering capabilities with minimal added cost. By measuring the change in fluorescent response over time as chlorophyll containing phytoplankton sink through an isolated water column, it is possible to characterize how the concentration profile within the instrument evolves. Based on this profile, it is possible to model the settling characteristics and calculate the mean settling rate of sinking phytoplankton. Preliminary lab tests were run using a monoculture of *Thalassiosira Weissflogii* as well as fluorescent polystyrene microspheres of known diameter and density. The resulting concentration profiles were consistent with that of particles settling out of suspension and calculated settling velocities were near expected values. We plan to continue to test this method in the lab using controlled homogeneous samples as well as in the field at an existing *in-situ* continuous monitoring stations. Field data collected in 2014 will allow us to evaluate the validity and application of this method.

Keywords: Phytoplankton, Fluorometer, Settling Rate

Poster topic: Sampling Methods and Design

The Tail of Two Marshes: A Case Study Comparing a "Designer" and "Self-Design" Marsh

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The Guadalcanal mitigation and the Tubbs Setback restoration sites represent two approaches to construction designs in tidalmarsh restoration. Guadalcanal, a 21-ha former housing development for the Mare Island Naval Base, was developed to mitigate the expansion of Hwy 37 by the California Department of Transportation (Caltrans). As part of the regulatory requirements, Guadalcanal was designed with geomorphic specifications (e.g., tidal channel excavation and specific elevation profiles) such that when tidal flow was reintroduced in 2001, there were appropriate physical conditions for vegetation colonization. Tubbs Setback, a 29-ha parcel, was diked in the 1900s and farmed until 1983. The construction design for the Tubbs Setback tidalmarsh restoration, involved fortifying critical levees and the construction of a levee bench to help minimize wind-wave erosion, which also served as vegetated habitat. The site interior was subsided and left to natural sedimentation processes to support plant establishment. The US Fish and Wildlife Service restored tidal flow to Tubbs Setback in 2002.

These two examples represent case studies that range from intensive construction design (Designer Marsh sensu Mitsch 1996) approach in Guadalcanal to a more self-design marsh in Tubbs Setback that is primarily left to natural processes and timelines to develop. USGS monitored both sites and compared sedimentation rates, vegetative development, and bathymetry in relation to wildlife (bird) trends. Sedimentation at Tubbs Setback over time resulted in a shift from deep water to mudflat habitat. The self-design nature of Tubbs Setback has resulted in the creation of mudflat and open water that has persisted longer than that at Guadalcanal, with additional value to waterbirds. The rapid establishment of tidalmarsh vegetation throughout the site ultimately reduced the amount of mudflat and subtidal habitat available for foraging waterbirds. Restoration planning should consider the landscape mosaic and restoration trajectories to help manage valuable mudflat habitat for foraging waterbirds.

Keywords: tidal marsh restoration, construction design, waterbird, trajectory

Poster topic: Sampling Methods and Design

Status and Trends of Fish and Invertebrate Assemblages in the South Bay Salt Pond Restoration Programs Restorations Ponds

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Problem statement: Greater than 90% of tidal wetland habitat was reclaimed for urban and agricultural uses in the San Francisco Bay Estuary. Significant efforts are underway to return 15,100 acres of industrial solar evaporation ponds in South San Francisco Bay to tidal wetlands for wildlife.

Approach: The objective of this study was to monitor the spatial and temporal variability of fish species composition and relative abundance in newly restored salt ponds and adjacent slough habitats using boat based trawling (otter trawl), Bimonthly to monthly monitoring was conducted from July 2010 up through March 2013, at 2-3 sites in Alviso Slough, 3-6 sites in Coyote Creek, and 3 sites in A21, and A19 and in 1 site in A6.

Results: For this summary we examined the seasonal variability of the 10 most abundant fish species and the most abundance invertebrates (mysid and Crangon shrimp). Distinct seasonal patterns fish assemblages were apparent with summer species assemblages comprised of juvenile Pacific staghorn Sculpin, Northern anchovies and English sole, while the winter assemblage included Pacific Herring, American Shad and the State threatened Longfin Smelt. The mysid shrimp (comprised of several species) was in greatest rank abundance during the winter and into the early summer, while Crangon shrimp were abundance year round; however a clear pattern of recruitment of juveniles occurred during the spring-summer months.

Conclusions/Relevance: These patterns highlight the value of the Alviso Marsh system as a vital nursery area for several key species of the nearshore marine food web the estuarine food web (Pacific Staghorn Sculpin and crangon shrimp) and winter feeding grounds for Longfin Smelt. This study also observed the greatest abundance of mysid shrimp in the estuary and documents the overall benefits of restoring former salt ponds to tidal marsh habitats.

Keywords: Restoration, longfin smelt, american shad, mysid shrimp South Bay

Poster topic: Species Communities

Summer vs. Winter: Estimating the Conservation Value of Riparian Habitat to Birds throughout the Annual Cycle

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The winter season plays a key role in regulating avian populations, and a large number of species spend the winter in riparian habitat, yet riparian habitat conservation plans remain focused on breeding bird communities. Because a significant proportion of winter bird communities are made up of boreal breeding birds, which are threatened by accelerating rates of development and climate change, there is an important research and conservation opportunity in creating and maintaining high quality riparian habitat for wintering birds. To examine the value of riparian habitat to wintering birds, we compared the species richness and phylogenetic diversity of the summer and winter riparian bird communities in the Cosumnes River and lower Putah Creek watersheds. We found that the winter bird communities were just as species rich and more phylogenetically diverse than the breeding bird communities, suggesting that the value of this riparian habitat is high throughout the year. Further, nearly all of the winter visitors are boreal breeding birds, 32% of which are significantly declining. Thus, the impact of one riparian habitat conservation project could be maximized by considering the needs of winter bird communities. Our results underscore the need for additional research on winter ecology and consideration of how to restore and manage riparian habitat for winter birds.

Keywords: Avian Populations, Winter Season, Riparian Habitat

Poster topic: Species Communities

San Francisco Estuary Invasive Spartina Project Tidal Marsh Restoration Program in Support of California Clapper Rail

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In 2011, the California Coastal Conservancy and U.S. Fish and Wildlife Service San Francisco Estuary Invasive *Spartina* Project (ISP) established a five-year program to rapidly improve habitat for California clapper rail (*Rallus longirostris obsoletus*) in tidal marshes of the San Francisco Estuary. Program goals include: (1) the rapid enhancement of California clapper rail habitat at locations where control of non-native *Spartina* has caused decreases in local populations and (2) the reintroduction of native *Spartina foliosa* (Pacific cordgrass) where locally extirpated or reduced by spread of non-native *Spartina*. The primary objective of the program is to intensively plant native marsh vegetation, primarily marsh gumplant (*Grindelia stricta*) and Pacific cordgrass, in strategic locations at invasive *Spartina* treatment sites to rapidly enhance cover, nesting, and high tide refuge habitat for rails. ISP treatment sites are selected for revegetation primarily where there are existing clapper rail populations that would benefit in the near term from habitat enhancement. As an additional enhancement at some sites, high tide refuge islands are being constructed and densely planted (H.T. Harvey). In the first three seasons the program has installed over 200,000 plants at 36 ISP treatment sites. The most recent monitoring results indicate mean survivorship for *G. stricta* and *S. foliosa* varied among sites. Overall *G. stricta* survivorship was 55% (high of 86%) which surpassed the target survivorship goal of 40%. *S. foliosa* mean survivorship was 36% (high of 66%). Monitoring results of the 2012-2013 plantings indicate higher overall survivorship than the first installation season (2011-2012). Planting designs continue to be adapted each season with the goal of improving overall plant survivorship and enhancing near term clapper rail habitat. Approximately 70,000 plants are being propagated for the 2014-2015 revegetation season.

Keywords: California clapper rail, restoration, revegetation, invasive species, Spartina

Poster topic: Species Communities

Response of Invasive Spartina to Suspended Treatment at 10 San Francisco Bay Marshes

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The State Coastal Conservancy's Invasive *Spartina* Project (ISP) was initiated in 2000 to address the threat of invasive species and hybrids of cordgrass (*Spartina* sp.) in the San Francisco Bay. Full-scale treatment with the herbicide imazapyr was permitted and began in 2005. Annual treatment took place at virtually all infested marshes until regulatory decisions required the discontinuation of treatment at 10 marshes from 2011 to present. Using the annual inventory and monitoring data collected by the ISP, we analyzed the response of the invasive *Spartina* populations in these 10 marshes and compared this to the trajectory of invasive *Spartina* populations treated with herbicide in all other marshes during the same time period. In those areas that have been subject to annual treatment, invasive *Spartina* populations have been reduced from their pre-treatment levels by 95-100%, and populations continue to decline. Our analysis shows that invasive *Spartina* populations in marshes where treatment was discontinued show the same rapid expansion documented by the pre-treatment (2001-2005) monitoring data, though they have not yet reached pre-treatment levels of infestation. Continued non-treatment at these marshes is predicted to result in the accelerated expansion of cover and extent of invasive *Spartina* within these marshes up to pre-treatment levels or beyond, accompanied by spread of pollen, seed, and propagules to other locations.

Keywords: Spartina, invasive, regulatory, marsh, San Francisco Bay, population, herbicide, hybrid

Poster topic: Species Communities

Variation in Oyster Performance between and within Two Restoration Sites in San Francisco Bay

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The native oyster *Ostrea lurida* is increasingly an important focus for shoreline restoration. Nearly all oyster restoration projects involve hard substrate addition, but few projects have quantitatively assessed the relative performance of oysters on different substrate types and configurations. We compared recruitment and percent cover of native oysters on five substrate types at two restoration sites (San Rafael and Hayward) in San Francisco Bay. Four of the five substrate types were constructed from "baycrete" (cement and locally dredged shell) and molded into either: 1) modular interlocking blocks, 2) stacks of small domes, 3) single large domes, or 4) large segmented domes. The fifth substrate type consisted of stacks of Pacific oyster shell in mesh bags. These substrates were deployed at our sites in summer 2012. We collected data on various oyster demographics three times a year from 2012 - 2014, measuring variables on north versus south facing surfaces, at three tidal elevations. We found large variation in oyster recruitment and percent cover between the two sites. However, within each site, oyster densities differed little by substrate type. At the San Rafael site, we found a significant effect of tidal elevation and aspect, oyster numbers were consistently highest on north and vertical faces and at lower tidal elevations, suggesting thermal stress as a factor in oyster recruitment and/or survival. Initial recruitment at the Hayward site also followed this general pattern, however oyster cover differed, with the greatest densities occurring at higher tidal elevations. This was likely the result of predation at lower elevations by the introduced oyster drill *Urosalpinx cinerea,* which was not present at the San Rafael site. These results suggest that key stressors for oysters vary between sites, even within the same estuary, and oyster performance could be enhanced by modifying the configuration and placement of restoration substrates.

Keywords: Oysters, Restoration, San Francisco Bay, Species Communities, Habitat, Ecosystems

Poster topic: Species Communities

Effect of Drought Conditions on the Distribution and Bioaccumulation of Selenium in Two Invasive Clam Species in North San Francisco Bay

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Tissue selenium (Se) concentrations in the invasive species *Potamocorbula amurensis* are the highest among bivalves in north San Francisco Bay (SFB), vary both spatially and seasonally, and often exceed the dietary thresholds for adverse reproductive effects established for surrogate predators. For this reason *P. amurensis* in SFB poses a potential threat to clam eating predators, including sturgeon, Sacramento splittail, Dungeness crab, and waterfowl. During years of low freshwater flow, the greatest Se concentrations are observed and the habitat of *P. amurensis* extends up estuary overlaping with another invasive species of clam, *Corbicula fluminea*. Although both of these clams process large volumes of water and particles, and serve as important food sources for benthivorous predators, they concentrate Se to different levels conferring different levels of risk to predators. During the historically low flow year of 2014, water and clam samples will be collected within and around the overlap zone to determine: 1) how far the overlap zone for these species extends; 2) compare Se concentrations between the two clam species and; 3) determine if there are differences in environmental exposures. Preliminary samples collected in the Fall of 2009 show that despite occupying the same habitat there are significant differences between *P. amurensis* and *C. fluminea* in both Se concentrations (seasonal means 8.0 µg/g and 5.6 µg/g respectively), and stable isotopic values of carbon and nitrogen. While physiological dissimilarities between the two species, such as ingestion rates, can explain some differences in Se concentrations, differences in the $\delta^{13}C$ may indicate the two species are exposed to different sources and environmental concentrations of Se. Information on the extent of the overlap zone, clam tissue Se concentrations, and potential differences in environmental Se exposures, will improve our understanding of the risks of Se exposures from clams to predators during periods of drought.

Keywords: Selenium, Drought, Invasive Species

Poster topic: Species Communities

Communities Of Nitrogen-Cycling Bacteria in the North and Central San Francisco Bay: How Salinity Determines Who's There

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Denitrifying bacteria respire nitrate to form dinitrogen gas. Their activity is one of the most important pathways determining the bioavailability of nitrogen in low-oxygen environments such as estuary sediments. Denitrifiers, like other microorganisms, are known to choose habitats based on salinity: the denitrifiers in the saline Central Bay are genetically more similar to denitrifiers in the open ocean than they are to the denitrifiers just a few miles away in the freshwater regions of the Delta. This community-level effect of salinity has been known for years; however, we know little about how quickly these community changes happen in locations, such as Suisun Bay, where salinity undergoes significant seasonal fluctuations.

This study explores the role that salinity plays in shaping communities of an important functional group of microorganisms—the denitrifying bacteria—across space and time in the sediments of North and Central San Francisco Bay. We used culture-independent sequencing of a specific marker gene, nitrite reductase, to examine the diversity and abundance of denitrifiers at 5 sites, every month for one year. In addition, we conducted laboratory incubations of sediment cores to examine the effect of water with different salinity levels on microbial communities. We found that all denitrifier taxa are essentially present everywhere in the bay, but the relative abundances of the taxa determine a unique community composition at each study site. Sites that see monthly salinity changes do see corresponding community shifts, but each site also maintains a distinctive population signature that remains robust in the face of seasonal fluctuations. We also identified other environmental factors, such as sediment nitrogen content, that contribute significantly to community composition. These results have implications for our understanding of the resilience of microbial communities to seasonal and long-term environmental changes, and to our ability to model ecosystem processes such as nitrogen cycling.

Keywords: nitrogen cycle, microbial ecology, salinity, denitrification

Poster topic: Species Communities

California Clapper Rail Survey Results at Spartina-Invaded Marshes from 2010 to 2014 and the Implications for Eradication of Invasive Spartina from the SF-Bay Estuary

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The State Coastal Conservancy's Invasive *Spartina* Project (ISP) reduced invasive *Spartina* in the San Francisco Estuary by 95% between 2005 and 2012. Also during this time, the number of endangered California clapper rail (*Rallus longirostris obsoletus)*, which uses invasive *Spartina* for cover and nesting substrate, declined substantially at these sites. By the end of 2010, most invasive *Spartina* populations in the Bay had been reduced to insignificant levels that no longer provided adequate cover for clapper rails. ISP evaluated 2010 *Spartina* cover and 2011 California clapper rail data, and identified a subset of marshes where continued removal of invasive *Spartina* would further diminish habitat for clapper rails. Beginning in the fall of 2011, USFWS suspended treatment of invasive *Spartina* at some of these marshes until the number of clapper rails detected bay-wide increased by an average of 80 over 2010 survey numbers for three consecutive years. To determine the 2010 baseline, we assessed available clapper rail survey results from 2010 at *Spartina* treatment sub-areas. Based on this data, we estimated that a minimum of 855 clapper rails were detected in 2010 at 189 sites. In order to meet the goal of an increase of 80 rails, an average of 935 clapper rails must be detected for three consecutive years at the same 189 sites included in the 2010 baseline summary. In 2011, this goal was nearly met when approximately 924 clapper rails were detected in the same survey area. This number has not been exceeded in subsequent years, and in 2013 and 2014, survey results fell below the 2010 baseline number. Because the first year of the required three-year increase has not yet been achieved, resuming full treatment of invasive *Spartina* in the Bay will not occur before 2018 at the earliest, greatly extending the timeline for eradicating non-native *Spartina*.

Keywords: invasive Spartina, California clapper rail

Poster topic: Species Communities

Biomass Distribution of *Potamocorbula amurensis* and *Corbicula fluminea* in the San Francisco Bay and Delta during Several Dry and One Wet Year

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The California Department of Water Resources (DWR) initiated the Generalized Random Tesselation Stratified (GRTS) study in 2007 to further examine the spatial distribution of *the benthic community* in San Francisco Bay and the Sacramento-San Joaquin River Delta. Spatially intensive samples were collected twice a year (May and October) from 2007 through 2012. The study area includes the Bay-Delta from San Pablo Bay in San Francisco Bay to Sacramento and Stockton and to the water pumping stations at Clifton Court in the Delta.

We focused this part of the study on the biomass of these two bivalves in the samples because *Potamocorbula amurensis* and *Corbicula fluminea* are very efficient filter feeders and have the potential to alter the availability of phytoplankton in the system. The biomass and distribution of *C. fluminea* and *P. amurensis* was determined from all GRTS samples collected from 2007 through 2012. We analyzed the spatial and temporal data for each species as well as areas of species overlap and the temporal progressions of the overlap areas. Several distribution patterns persisted through the years, which included both dry and wet hydrologic years: (1) The distributions of the two bivalves overlap in the ecologically sensitive low salinity zone, (2) The lowest total bivalve biomass occurs in this overlap region, (3) *P. amurensis* biomass is greater in fall than in spring and the opposite is true of C. fluminea and (4) *P. amurensis* biomass declined in Suisun Bay during the wet spring of 2011 but rebounded to near normal levels by fall 2011.

We show the spatial and temporal distribution of biomass for each species; and areas of species overlap and the temporal progressions of the overlap areas.

Keywords: Potamocorbula, Corbicula, Invasive Species, Bivlave Biomass

Poster topic: Species Communities

Native Plant Expansion: Historic Imagery Reveals Recent Spread of SAV in the Northern Estuary

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Extensive beds of the native submerged aquatic vegetation (SAV) species *Stuckenia pectinata* and *Stuckenia filiformis* have recently been mapped in the low-salinity regions of the San Francisco Estuary, but little is known about their history in the area. The first mapping effort took place in 2011-12, and found ~485 hectares (1200 acres) of plant coverage, but there was no data on the plants' extent and coverage before that time.

Stuckenia plants form canopies that fan out on the water surface in characteristic shapes, visible in aerial images. Mapping efforts in 2011-12 used aerial imagery combined with ground-truthing, and found that digitizing aerial images is an extremely accurate way to map *Stuckenia* beds. Using this technique on historic imagery, we mapped *Stuckenia* beds from past years.

Quality aerial images from US Geological Survey, accessed on Google Earth, were used to create historic *Stuckenia* coverage maps for 1993 and 2002, which were compared to 2012 maps in ArcMap. Our results show an increase in coverage from 1993-2012, both in total area, and in geographic extent. Some beds appear unchanged since 1993, but many areas (particularly in the western edges of current *Stuckenia* habitat at Ryer and Roe islands in Suisun Bay) had no beds in 1993, and have gained coverage around most shorelines since then. Overall, we mapped an increase of ~80 hectares (200 acres) of *Stuckenia*, with the highest gains from 2002-2012.

Submerged aquatic vegetation provides structure and habitat for many species, and we have found dense invertebrate populations on *Stuckenia* plant shoots. As high abundances of invertebrates on the plants are likely to provide food resources to native fish species of concern along their migratory paths, recent expansion of these beds, and the possibility of continued expansion with increases in salinity and water clarity, are of particular conservation interest.

Keywords: Submerged aquatic vegetation, pondweeds, GIS, historical ecology, Suisun Bay

Poster topic: Species Communities

Habitat Preferences of Fishes in the North Delta: An Electrofishing Study

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Problem. The Cache-Lindsey Complex located in the northern Sacramento San-Joaquin Delta has a high diversity of fish species, both natives and non-natives. *Approach.* To better understand distribution and habitat association of these fishes, an electrofishing study was designed to look at the association of fishes with specific habitats types within the upper and lower reaches of Cache and Lindsey Sloughs. Electrofishing was chosen as a sampling method because it is possible to effectively target near-shore habitats. With a specialized boat, scientists are able to focus efforts on short stretches of the bank categorized by different habitat types. We stratified our sampling based on dominant substrate and structural elements, such as mud and riprap, submerged aquatic vegetation, woody debris, and riparian vegetatin. Additionally, we sampled across diel & tidal cycles to gain more insight on how and when fish use these different habitats. *Results.* This poster summarizes data from our spring sampling bout. It is apparent that electrofishing near-shore habitats is an effective method for exploring fish-habitat relationships, and it resulted in high catch numbers and large sizes of native fish species, like Sacramento splittail and Hitch. Native fishes preferred shallow water, with structurally complex habitat. Many native fishes were more abundant in shallow-waters during the dusk and evening, while many nonnative fishes did not show the same diel patterns. *Conclusion.* A better understanding of fish habitat preferences will help to inform targeted restoration efforts in the Delta.

Keywords: Electrofishing, North Delta

Poster topic: Species Communities

Management Implications of the Diet of Barn Owls Foraging in San Pablo Bay Wetlands

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The San Pablo Bay has some on of the most intact wetland systems in the San Francisco Bay estuary and is home to many federally and California state listed species, including the salt marsh harvest mouse (*Reithrodontomys raviventris*) and Suisun shrew (*Sorex ornatus sinuosus*). Barn owls (*Tyto alba*) have been documented foraging in wetlands if roosting sites are available in nearby trees or human structures. There has been very limited documentation of nocturnal avian predation in San Francisco Bay wetlands. To assess the diet of barn owls foraging in San Pablo Bay wetlands we collected pellets beneath an occupied barn owl nest. Then using the published foraging range of the barn owl, we used aerial imagery to establish that 99% of the owl's foraging range was within wetlands. We assessed diet by identifying skulls found in the pellets. We dissected 117 owl pellets and identified 277 skulls. The following species were present; *Microtus californicus* (64%), *R. raviventris* (25%), *Avian* (4%), *S. ornatus sinuosus* (2%), *Peromyscus maniculatus* (1%), and *Rattus rattus* (1%). These findings highlight the importance owl predation on small mammal populations in marshes and have many management implications including the removal of structures in salt marsh harvest mouse habitat. They also improve upon the limited documentation of nocturnal avian predation in San Pablo Bay.

Keywords: salt marsh harvest mouse, barn owl, nocturnal avian predation

Poster topic: Species Communities

Preliminary Results of the Bobcat Flat Rehabilitation Project, Post-Implementation Monitoring Plan, Lower Tuolumne River, CA

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The downward trend in anadromous salmonid populations in California has been attributed to the loss and degradation of existing spawning and rearing habitat. In-channel habitat rehabilitation (gravel augmentation) targeting fall-run Chinook salmon spawning and rearing habitat enhancement was carried out in two phases (2005 and 2011) at river mile 43 ("Bobcat Flat") within the lower Tuolumne River below La Grange Dam. The Bobcat Flat Rehabilitation Project is authorized by the Central Valley Project Improvement Act (CVPIA; Public Law 102-575, 1992), funded by the United States Fish and Wildlife Service's (USFWS) Anadromous Fish Restoration Program (AFRP), and administered by the Friends of the Tuolumne (FOT). Two years (2013 and 2014) of a 3-5 year monitoring plan to evaluate post-rehabilitation effectiveness has been completed. Preliminary results from year 1 young-of-the-year (YOY) rearing surveys revealed that the restored reach supported higher numbers of rearing YOY fall-run Chinook salmon than unrestored reaches (restored = 58.9 fish/50 ft; unrestored = 51.0 and 34.3 fish/50 ft). However, variation in fish density increased when viewed at successively smaller scales (i.e. site, mesohabitat, and microhabitat). Mean combined habitat suitability index (HSI) scores (0-1.0) developed from observed depth, velocity, and cover data at 170 cfs, ranked the restored reach (0.17 median HSI; n=92) just below the upstream reference reach (0.20 median HSI; n=71) and higher than the downstream reach (0.13 median HSI; n=64). Overall, the HSI analysis revealed that fish utilized expected velocity ranges, though preferred a wide range of depths and demonstrated very high preference for instream woody cover. Interim interpretation of results suggest that: (1) rearing YOY fall-run Chinook salmon may be over-crowded within the selected study reaches; and (2) gravel augmentation projects should target sites having intact, quality riparian woody vegetation, as this can provide more suitable rearing habitat than sites lacking such conditions.

Keywords: Anadromous salmonids, rearing habitat rehabilitation/restoration, effectiveness monitoring, habitat suitability

Poster topic: Sustainable Habitats and Ecosystems

Habitat Restoration and Adaptive Management: How the Delta Plan Can Help

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Effective habitat restoration requires using the best available science and learning from project implementation by following a three-phase adaptive management cycle. To ensure continued public support for restoration, it is also essential to be able to show that the restoration community is using funds efficiently to meet short-term acreage targets while gaining knowledge that will lead to effective landscape-scale restoration in the future. Adaptive management includes setting clear restoration goals; conducting a baseline assessment to determine initial conditions and long-term monitoring to assess project effectiveness; and making management adjustments as needed. The Delta Stewardship Council is addressing this need in three main ways. First, the Council adopted the Delta Plan, which includes a policy (G P1) that requires significant habitat restoration projects to document the use of best available science, have an adaptive management plan, and document access to adequate resources and authority to implement the plan. Council staff has provided early consultation to restoration project managers to help them prepare to certify their projects as consistent with these Delta Plan requirements. Second, the Delta Science Program, a division of the Council, has developed the Delta Science Plan, which calls for a framework for more integrated restoration project monitoring, sharing of results, and translation of scientific information into knowledge that can inform management decisions. Finally, the Council, in partnership with other state and federal agencies, is required to track the Delta Plan's performance measures of progress toward restoration acreage targets and trends in the occurrence of native species in protected and restored habitats and migratory corridors. Over time, Council staff hopes to encourage the adoption of performance measures that include landscape metrics, such as such as connectivity among habitats, linked to expected ecological functions.

Keywords: habitat restoration, Delta Plan, adaptive management, performance measures, implementation

Poster topic: Sustainable Habitats and Ecosystems

Interacting and Changing Ecological Constraints on Riparian Restoration Success: Insights from the Merced River

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The draft Bay Delta Conservation Plan calls for the restoration of 5,000 acres of riparian forest and scrub, but the complexity of Bay Delta conditions will limit the extent of process-based restoration, and the physical conditions upon which restoration will need to occur is likely to be uncertain in many instances. The long-term success of this riparian restoration will be controlled by both abiotic and biotic factors, and can be maximized by incorporating lessons from other riparian restorations in the region. We conducted an experiment on a floodplain along the Merced River that was degraded by gold mining dredge spoils but was slated for restorative recontouring, to test the influence of distance to groundwater, irrigation (two abiotic factors), initial plant size, and weed competition (two biotic factors) on seedling survival of four dominant native tree species: Fremont cottonwood (*Populus fremontii*), box elder (*Acer negundo*), Oregon ash (*Fraxinus latifolia*), and valley oak (*Quercus lobata*). The most important factor controlling tree survival shifted over time since planting, from initial plant size in the first year, irrigation duration in the second year, and distance to groundwater in the third year. These results indicate that the factors driving riparian restoration success can vary through time and can be used to improve the success of floodplain revegetation in degraded areas. The experiment is applicable to restoration efforts in the Bay Delta, and throughout much of arid west, where teasing apart multiple ecological constraints on vegetation establishment will be critical to restoration design and ultimate success.

Keywords: riparian, floodplain, restoration, tree survival, abiotic factors, biotic factors

Poster topic: Sustainable Habitats and Ecosystems

San Francisco Bay Transition Zone Conservation and Management Decision Support System

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A GIS based dcision support system (DSS) to identify and prioritize marsh-upland ecotonal habitats (transitions) to assist land managers in restoring and protecting San Francisco Bay's (estuary) tidal marsh ecosystem will be presented. The DSS takes a strategic approach towards decision support, by accounting for the landward migration of high marsh and other transitional habitats in response to predicted sea level rise (SLR). Current documents do not adequately describe ecotonal habitats, quantify the amount needed to aid listed species recovery while allowing for SLR, nor prioritize specific sites for protection and restoration. The DSS combines definitions bioassessment protocols, GIS models of the distribution of TZH using interpolated tidal data and Lidar, site specific criteria for ranking sites for restoration or protection, and parcels level maps for prioritizing TZH throughout the SF estuary. This toolkit will help managers allocate limited resources on site prioritization, alternative/scenario evaluation, and will include considerations for the influence of future climate change and land-use scenarios. Project findings will be made available on the web through an interactive mapping tool.

Keywords: Transition Zone, Sea Level Rise, GIS, tidal marsh, Decision Support

Poster topic: Sustainable Habitats and Ecosystems

The Effect of Stocking Density on Length and Gut Fullness of larval Delta Smelt Reared in Small Vessels

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Following the 2009 Endangered Species Act list - Delta Smelt (DS), a genetically monitored captive refuge population was established at the Fish Conservation and Culture Laboratory (FCCL), UC Davis. The refuge population serves as a genetic bank in case of species extinction in the wild and a source of DS for research purposes. In addition to large tanks (≥70 L) that the FCCL have been used to conduct research projects, we are developing a new recirculating system for larval and juvenile DS holding using small rearing vessels (18 L) to increase the flexibility and opportunity for more biological replications. To determine the fish stocking density level for the new system and its effect on growth and gut fullness, larvae are stocked in three densities: low, medium, and high (20, 40, and 60 larvae/L, respectively; n = 3). Larvae were sampled at 10 and 20 days post hatch (dph) and length and gut fullness were measured 15 minutes after feeding. A one-way ANOVA was used to test performance differences among fish stocking densities. At 10 dph, no significance differences of larval length (8.83, 8.88, and 8.62 mm, respectively) ($P>0.18$) and gut fullness (52.83, 41.04, 41.04 %, respectively) ($p>0.03$) was found among densities. Similarly, at 20 dph, no significance difference was found in larval length (10.5, 10.36, 10.20 mm, respectively) ($p>0.5$) and gut fullness (55.64, 58.22, 50.22%, respectively) ($p>0.6$) among densities. These results indicate that DS cultural density at their early stages (to 20 dph) doesn't have a significance effect on the growth and gut fullness. This finding ensures the feasibility in using small rearing vessels for future applications. The experiment will be extended to 40 dph, and the data of survival rate will be obtained at the end of the experiment.

Keywords: Delta Smelt, density, larvae, small rearing vessel

Poster topic: Sustainable Habitats and Ecosystems

CRAM: New Online Management Tools for Uploading and Accessing Wetland Condition Information

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The California Rapid Assessment Method (CRAM) is a cost-effective and scientifically proven tool for assessing the health of wetlands and riparian habitats. It is designed for assessing ambient conditions within watersheds, regions, and throughout the state. Adopted by state and federal agencies and NGOs, CRAM is actively in use to inform wetland condition. CRAM can also be used to assess compensatory mitigation and restoration projects, and to help evaluate the performance of wetland and riparian protection policies and programs.

Developed under the direction of the CRAM Steering Committee and California Wetland Monitoring Workgroup of the Water Quality Monitoring Council, the new online management tools include a robust database, improved data-entry functionality, multiple ways to access results, and a redesigned website. The new database was designed to store data from different versions of CRAM assessments, support future updates and changes to the methodology, track the various training courses and reference sites, and dynamically render the metric and attribute information in the data entry forms. In addition to being easier to maintain, the new entry forms enable better tracking of practitioners' assessments and uploads of photos and documents. The greatly improved mapper functionality allows for versatility in data entry. Practitioners can digitize a new polygon, upload a KML or shapefile, or edit an existing polygon. They can also access and download CRAM data in several ways: generate a pdf summary report for an assessment, download the individual metric and attribute scores, or view all public CRAM assessments in EcoAtlas. Additionally, the redesigned website provides training information, CRAM resources and documents, and the ability to search for trained practitioners.

The open source tools were developed with regular input from a large and multi-interest user group to ensure the developed functionality met the needs of users, while also focusing on easier tool maintenance.

Keywords: wetland condition, rapid assessment method, online data entry tools

Poster topic: Sustainable Habitats and Ecosystems

What Do We Have Now? Species Specific Floodplain Habitat in the Sacramento Basin

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There are particular reaches in the Sacramento system that, on average, have less than four feet of floodplain width on each side of the river channel. Meanwhile, the majority of the existing habitat for all species is believed to exist in the Yolo Bypass. We use the EAH method (Matella and Jagt, 2013) for measuring floodplain habitat to quantify the suitability of periodically inundated floodplains for nine riparian and aquatic species in the Sacramento Valley. The estimated annual habitat (EAH) method generates a single value that represents the long term average amount of periodically inundated floodplain that occurs (1) within the specific timing window that the species is present and (2) for the minimum length of time an individual needs to benefit. This talk will speak briefly about the relationships between the species and the physical and hydrologic components of the Sacramento system followed by reach by reach EAH values for the key species. The presentation will conclude with an analysis of the most vulnerable and robust parts of the system, and potential restoration strategies to increase values throughout the system.

Keywords: Floodplain Habitat, Baseline Conditions, Restoration Strategies, Estimated Annualized Habitat

Poster topic: Sustainable Habitats and Ecosystems

The 2015 State of the Estuary Report

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The San Francisco Estuary Partnership (SFEP) intends to produce a *2015 State of the Estuary Report*. The purpose of the report is to provide a well-reasoned synthesis of the ecological health of the Bay Delta system. SFEP sees this document as part of a series, as we completed our second *State of the Bay* report in 2011; the first health assessment was completed in 1992. SFEP is aiming for a document, like the 2011 report, that is built on a scientifically credible foundation that can continue to be reassessed and improved in coming years.

The findings will be synthesized and presented in a manner that is easily understood by the public and accessible to the mainstream media (such as a "report card"). The primary audience for this report will be the agency and organizational decision makers and managers who have a primary role in: 1) deciding what issues will receive time and money expenditures, and 2) in developing policy and programs that address the health of the Bay Delta. Secondarily, the audience is the general public and their elected representatives. The report is not intended to be of primary value to the scientific, engineering, or research community.

An effort will be made to include key ecological health indicators for the Delta – a new element for the 2015 report. This will require strong integration and assistance from the Delta scientific community, Delta Science Program, Delta Stewardship Council, Interagency Ecological Program, and the California Estuary Monitoring Workgroup to determine what indicators and benchmarks (publically or scientifically derived markers of progress toward a defined heath measurement) can be included in the 2015 Report. In addition, all 2011 report indicators and benchmarks are being reviewed, will be updated, revised or discarded depending on the outcome of the review.

Keywords: ecological report card, status and trends, indicators, benchmarks, ecosystem health

Poster topic: Sustainable Habitats and Ecosystems

Effect of Flow and Water Year (WY) Type on Nutrient and Organic Matter Sources and Biogeochemical Processes in the San Francisco Estuary: Use of a Multi-Isotope Fingerprinting Approach for Habitat Characterization during the Fall and Spring 2006-2014

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We have monthly or more frequent multi-isotope and chemistry data for 8 of the 9 falls 2006-2014 and 7 of the 8 spring/summers 2007-2014. The years with isotope data include 6 dry or critically dry WYs, 1 below normal WY, and 2 wet WYs. The entire dataset (projected through the end of 2014) consists of ~50 transects of the North Bay and Delta; ~40 transects of the Sacramento River, Delta, and Cache Slough region; ~20 transects of the lower SJR; and ~30 DFG "trawl" sample sets. The entire sample set has been analyzed for POM isotopes and most of the pre-2013 transect samples for nutrient isotopes. Hence, this dataset is ideal for an independent assessment of spatial and seasonal changes in characteristics and quality of the main fish habitats using our multi-isotope and multi-fingerprinting tools approach. For example, the C-N-S isotopes of the POM are sensitive to changes in salinity, nutrient sources, extent and type of C-N-S cycling, geographic sources of the POM, quality of the organic matter, etc. And nutrient isotopes are sensitive to changes in flow, effluent amount, nutrient ratios, extent of nitrification, etc. Hence, the isotopic and other data can be used to identify spring and fall fish habitat characteristics.

The average C-N-S isotopic compositions of POM and the N isotopes of nutrients from different seasons show relatively consistent trends with river mile. However, there often are large seasonal and downstream differences in POM sources and quality, and nutrient isotope trends, for different WYs with similar flows. Thus far, it appears that aggregating data by seasons and WY type is not a particularly useful way of evaluating controls on habitat quality. Instead, the specific flow of each transect usually appears to be the main control on isotopic compositions. This is a work in progress!

Keywords: LSZ, nutrients, habitat, organics, POD, isotopes

Poster topic: Sustainable Habitats and Ecosystems

Challenges and Approaches to Natural Resource Mitigation in a Changing Environment

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Current policies and practices address natural resource impact mitigation through replacement of lost services (including "take"), when impacts are unavoidable or deemed necessary. The approach has involved acquisition of "in-kind" services commensurate with anticipated losses, including measures intended to preserve the services "*in perpetuity*." In practice, these concepts are typically implemented via a service accounting scheme that quantifies the services lost, reconciles them with those acquired and ultimately generates or contributes to monetization of the transaction, sometimes including an "endowment" for long-term preservation. Various methodological tools/concepts have been employed to assess/quantify services and guide management (e.g., ecosystem service identification, habitat equivalency analysis, ecological and restoration risk assessment, net environmental benefit analysis, adaptive management, etc.). Monetization approaches have included direct restoration/replacement costing and mitigation credit transactions. The presumption that the ecology of such mitigation sites is always characterized by static processes (or "dynamic equilibria") is dubious and recent experience at some mitigation sites does not support such a presumption. Looming environmental alterations resulting from global climate change appear to be accelerating and are likely to further erode the validity of this presumption. Such changes likely would generate in the future qualities and quantities of services different from those envisioned under current conditions. This outcome would invalidate the concept of a site's current (or prospective) palette of service provision as existing "*in perpetuity.*" Substantial intellectual and financial capital is being invested in large-scale plans for mitigation of impacts in the Delta ecosystem. This presentation will discuss the inadequacies of current service accounting and propose adjustments (e.g., clarification of "*in perpetuity,"* linking monitoring results to services, use of a dynamic accounting system, etc.) that will facilitate responding to future conditions. Pro-actively addressing future variability and uncertainty will reduce investment risk and enhance our ability to achieve long-term sustainability of these biological systems.

Keywords: mitigation, compensation, HEA, NEBA, restoration, climate change, natural resource services

Poster topic: Sustainable Habitats and Ecosystems

Formation and Erosion of Tidal Wetland near Martinez from 1850 to Present

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In 2003, Solvay USA, launched the Peyton Slough Remediation and Restoration Project in Martinez to remedy legacy contamination and restore diked historic tidelands. Construction was completed in 2007. Shoreline erosion was noted during post-construction monitoring in 2011. To aid in the evaluation of whether the erosion is a long or short term condition, a review of historical information near the site was conducted including historic maps, aerial photographs, and estimates of historic sediment loading. Information was available from1860 to present including aerial photographs from 1928 to present. Each map or photo was geo-referenced relative to the shoreline. The first charts of the area showed that the embayment between Bulls Head Point and Point Edith was a large mud flat. By 1928, the shoreline had moved seaward about 2,000 feet compared with 1860 due to filling of the shallow mudflats. The shoreline continued to move outward, reaching its maximum extent between 1959 and 1980. This area probably filled in with sediment washed down from the Sierra Nevada as a result of hydraulic mining in the mid-1800s. The area became erosional between1951 to 1983, and since that time, the shoreline has retreated about 60 feet. The data on the change in shoreline was compared with U. S. Geological Survey estimates of sediment load to the Bay. A correlation between the decrease in sediment load and the reduction in rate of growth of the wetland was observed. By the mid-1900s, sediment load no longer seemed sufficient to maintain the wetland extent, and it started to contract. Recently, the sediment load seems to have stabilized, and as a consequence, shoreline erosion appears to have stabilized to a constant rate. If this trend continues there will be a conversion from wetland to mudflat in the study area.

Keywords: wetlands, erosion, sedimentation, hydraulic mining, historic

Poster topic: Sustainable Habitats and Ecosystems

McCormack Williamson Tract and Grizzly Slough: New Analyses for Floodplain and Tidal Marsh Restoration

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The North Delta Project focusses on flood control and habitat improvements where the Mokelumne River, Cosumnes River, Dry Creek, and Morrison Creek converge. Flood flows and high water conditions in this area threaten levees, bridges, railways, and roadways that affect human safety and the economy. The project will reduce flooding and provide contiguous aquatic and floodplain habitat along the downstream portion of the Cosumnes River Preserve by modifying levees on McCormack-Williamson Tract (MWT) and at Grizzly Slough (GS).

The MWT Element (1500 acres) provides flood flow and stage attenuation in the area of the tract by lowering the crest of selected levees. The reduction in crest height of some levees on the tract will allow flood flows to enter and then drain in a controlled manner, creating fresh water tidal wetlands and food production for native species. The GS Element (400 acres) will modify Grizzly and Bear Slough levees on DWR's Grizzly Slough property upstream of MWT to attenuate peak flood flows and create floodplain habitat to benefit native fish species.

The Department of Water Resources is funding and coordinating these independent planning processes with local Reclamation Districts and The Nature Conservancy. Building on existing conceptual models, preliminary designs, and hydrologic models for both sites, new analyses (GIS and modeling) are yielding important lessons, thoughts for streamlining planning/construction, and ways to ensure consistency with new planning processes including the Delta Plan, Bay Delta Conservation Plan and the Fish Restoration Program Agreement. Example analyses covering a wide range of restoration planning topics are presented: GIS analysis, land title analysis, environmental permitting, recreation planning, and tidal inundation modeling. These analyses illustrate how existing data sources can be combined to establish and connect restoration priorities, screen restoration sites, select appropriate restoration designs and reduce project costs.

Keywords: floodplain, riparian, tidal marsh, restoration, GIS, modeling, planning, permitting, Delta

Poster topic: Sustainable Habitats and Ecosystems

Delta Riparian Habitat Restoration on Rock Stabilized Levee Repair Sites

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Following the devastation to New Orleans caused by levee failure during Hurricane Katrina in 2005, California's levee system in the Sacramento-San Joaquin River Delta was closely scrutinized by the Department of Water Resources for similar weaknesses. The key obstacle that prevented an immediate engineered repair of the levees was the presence of valuable natural resources at the eroded sites. Because of the very high cost of mitigation land acquisition, and habitat creation, it was determined that repaired levee sites would be ecologically restored in place and in kind with similar habitats. This created an enormous challenge for the ecologists -- a viable, riparian ecosystem sustained by a high water table had to be re-created to accommodate phraetophytic vegetation on top of massive piles of large crushed rock. In response to this challenge, the URS Restoration Group developed an innovative soil-filled rock slope protection (RSP) technique. The soil-filled RSP guaranteed survival of riparian plants on heavily armored levee banks by providing capillary fringe via loamy soil fill. URS ecologists also eliminated a non-permeable geotextile from the design and replaced it with a more environmentally-friendly, well-graded, gravel filter to prevent piping of the erodible substrate (sugar sand) while maintaining an elevated water table. Restoration plans were developed for fifteen Delta levee repair sites on the banks of Sacramento and San Joaquin Rivers, and Steamboat, Sutter, and Cache Sloughs. URS worked closely with DWR experts and staff from other resource agencies (CDFW, NOAA NMFS, USFWS, and USACE) to meet the demanding Standard Assessment Methodology riparian restoration criteria. The key ecological goal to fully restore the sites and mitigate in-kind and in-place for any environmental impacts was deemed successful by the regulatory and permitting agencies two years after the planting was completed.

Keywords: riparian, restoration, levee, repair, phraetophytic, water table, piping, soi-filled RSP

Poster topic: Sustainable Habitats and Ecosystems

Effect of Light and Turbidity in Larval Delta Smelt Rearing Trials

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Understanding how environmental factors influence first feeding success is critical for the conservation-oriented larval culture of Delta Smelt (DS). We conducted 40-day rearing trials to investigate the effect of light intensity and algae concentration on the survival, feeding, and growth of cultured DS larvae. Turbidity, which is algae in this case, is thought to be a predictor of DS in the wild, and characterizing the interaction of these two factors may be important to managing smelt in the field, and may provide a practical reduction of algae for culture conditions.

The experiment was designed based on current rearing conditions (9 µmol m-2 s-1, PPF, @ 9 NTU) to test the effects of changing one or both parameters on the survival, feeding, and growth of the larvae. To complete the study two separate trials were run. Four replicates were done for each condition, and each trial included the current rearing condition as a control. In the first trial we looked at low turbidities (2 NTU) with both high-light (9 µmol) and low-light conditions (0.5 and 4.5 µmol). In the second trial higher turbidities were looked at (5.5 and 9 NTU) in low light conditions (6.5 and 2 µmol, respectively).

The results from the first trial show that the fish with low-light and low-algae did not start feeding on day five while fish under other two conditions started feeding on day three. The survival rates for control, low-light and high-algae, and low-light and low-algae are 71.4%, 51.4%, and 53.4%, respectively. The findings show that a significant percentage of larvae surviving with low turbidity, which may be relevant to the wild fish. In the field, and in the lab, it will be important to monitor both parameters and at several life stages to determine a more optimal habitat for feeding, growth, and survival.

Keywords: Delta Smelt, larvae, light, turbidity, algae

Poster topic: Sustainable Habitats and Ecosystems

Adaptive Management in Action: The South Bay Salt Pond Restoration Project

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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 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 at 50% of the existing ponds converted to managed ponds for waterbirds and 50% restored to salt marsh habitat, and the other end of the continuum at 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 lessons learned from earlier phases and applied studies to be incorporated into subsequent stages 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 poster will summarize the results of the studies on mercury bioaccumulation, steelhead smolt, Chinook salmon, and shallow mound habitat for foraging birds, and how managers have revised management actions and restoration designs in response to scientific research.

Keywords: Adaptive Management, wetland restoration, mercury, steelhead, Chinook salmon, birds

Poster topic: Sustainable Habitats and Ecosystems

Future San Francisco Bay Tidal Marshes: An Improved Climate Smart Planning Tool

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Unprecedented efforts to restore tidal marsh habitat in San Francisco Bay are being planned. To prioritize these and other conservation actions, decision-makers and resource managers need better information on the anticipated impacts of climate change on tidal marsh ecosystems. To address this need, Point Blue developed an innovative Decision Support Tool (DST) that synthesizes diverse information for evaluating the potential effectiveness of conservation actions. The Future San Francisco Bay Tidal Marshes Tool (Future Marshes Tool; www.pointblue.org/sfbayslr) is based on a mechanistic marsh accretion model and incorporates spatial variation at scales relevant to conservation and restoration decision-making to produce maps of current and future tidal marsh habitat. Models of current and projected bird distributions and abundance were developed by synthesizing the accretion modeling results with physical conditions at a fine scale (50 m). The user-friendly web-based DST was created to allow managers to examine scenarios of future marsh geomorphology and maps of modeled tidal marsh bird distribution, density, and conservation prioritization in relation to anticipated sea-level rise and marsh accretion. Point Blue has promoted the use of the Future Marshes Tool by conducting training workshops, demonstrations and presentations, and by working one-on-one with users. After synthesizing extensive feedback from land managers and decision-makers the tool has been improved with revised elevation projections based on a new Digital Elevation Model (compiled multibeam bathymetry and topographic LiDAR), updated organic accretion rates, site-specific summaries of projected habitat and bird population change, and conservation prioritization. The DST now provides enhanced information to guide restoration and management actions and the development of vulnerability assessments and adaptation plans aimed at maximizing tidal marsh resilience in the face of accelerating sea-level rise.

Keywords: Sea-level rise, resilience, vulnerability, bird abundance and distribution, accretion

Poster topic: Sustainable Habitats and Ecosystems

Seasonal, High Resolution Nutrient Dynamics in the Northern San Francisco Estuary under Varying Water Year Types

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Despite long-term monitoring efforts, nutrient dynamics, including loading and internal cycling, are not well constrained for the northern San Francisco estuary (SFE). In a system primarily influenced by anthropogenic point sources (i.e. municipal wastewater), it is suggested that improved management with respect to nutrients might achieve the goal of increasing pelagic fish populations through production of lower trophic levels. We hope to further elucidate the nutrient dynamics of the northern SFE through high-resolution spatial and temporal sampling in both spring and fall, with a focus on the amount, type and ratio of target nutrients. We conducted weekly cruises during fall of 2013 and spring of 2013 and 2014, occupying 15 stations between Isleton in the Sacramento River and the Benicia Bridge in Suisun Bay, including Grizzly and Honker (2014 only) Bays. Cruises spanned two drought years with the latter year more extreme. Nitrate (NO3) concentrations increased by 58% from spring 2013 to spring 2014 at the confluence of the San Joaquin and Sacramento rivers, by 55% in Grizzly Bay and by 46% in western Suisun Bay. Grizzly Bay also consistently had the highest measured NO3 concentrations throughout the spring 2014 sampling period (48-56µM). Ammonium concentrations also increased at Rio Vista Bridge (Sacramento River) by 19%. We hypothesize that the nutrient increases are a result of effluent discharge into an unusually low-flow river (i.e. reduced dilution), rather than increases from nonpoint sources via the watershed. The lack of rain during our study reduced the impact of nonpoint nutrient sources while also failing to dilute effluent nutrients to concentrations observed during pre-drought conditions.

Keywords: Nutrients, Phytoplankton, Nitrate, Ammonium, Wastewater, Suisun Bay, Sacramento River

Poster topic: Water and Sediment Quality

Evaluation of South Delta Salinity Sources and Alternatives for Improving EC Compliance

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Salinity (EC) monitoring since 2009 in Sugar Cut and Paradise Cut has documented many periods when the EC was greater than the EC objectives. Tidal elevation and flow measurements in the south Delta were used to calculate daily net channel flows and the daily salt loads added to Old River at Tracy Boulevard. The 15-minute tidal elevation, tidal flow and EC measurements in the South Delta were summarized in graphical "Data Atlas" documents for 2009-2013. The net flow in Old River at Tracy Boulevard is about 10% of the head of Old River flow, because most of the flow is diverted to Grant Line Canal through Doughty Cut. Because the mouth of Paradise Cut and Sugar Cut are downstream of Doughty Cut, the tidal exchange of salt could be increasing the EC in Old River at Tracy Boulevard (EC compliance station). Temporary barriers do not generally change the net flows, but they increase the minimum elevations, reduce the maximum elevations, reduce the tidal flows substantially (50%) and thereby reduce tidal exchange and flushing upstream of the barriers. Several alternatives for reducing the effects on the Old River at Tracy Boulevard EC increments were evaluated. Flushing of Paradise Cut and Sugar Cut with SJR water would not reduce the EC effects; pumping from Paradise Cut and Sugar Cut to the SJR or to Grant Line Canal would reduce the EC effects substantially. Increasing the net flow at Tracy Boulevard (with dredging or installing only the Grant Line Canal barrier) could reduce the EC effects. Relocating the mouth of Paradise Cut and Sugar Cut to Old River upstream of Doughty Cut would reduce the EC increments. Installing a tidal-gate in Old River (open during flood-tides) would provide a net upstream flow to transport all of the salt to Grant Line Canal.

Keywords: South Delta, Tidal Flows, Salinity Objectives, Salt Sources

Poster topic: Water and Sediment Quality

Multi-Purpose Planning Efforts for Phase II of the San Francisco Bay to Stockton Navigation Improvement Study

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The Port of Stockton, its partners Contra Costa County and the Western States Petroleum Association, and the U.S. Army Corps of Engineers (USACE) are leading the effort to develop an integrated, multi-purpose navigation and ecosystem restoration phase (known as Phase II) of the San Francisco Bay to Stockton Navigation Improvement Study. The Phase II project was initially envisioned to have a single purpose of navigation; however, by using dredged sediment to restore emergent marsh in subsided Delta islands, it would also achieve the regionally significant purpose of ecosystem restoration.

To understand potential changes to Delta salinity levels resulting from the project, a three-dimensional hydrodynamic and salinity model was used to simulate salt intrusion under future with- and without-project conditions. The initial modeling effort confirmed that restoration of Big Break would most effectively reduce the salinity impacts associated with channel deepening**.** The second modeling scenarios combined the multi-purpose project (marsh restoration and deepening to -40 and -38 feet mean lower low water in the channel's western and eastern reaches, respectively) with construction of an underwater sill at Dillon Point in Carquinez Strait as a salinity mitigation measure. These scenarios indicated that the sill would effectively offset all of the X2 impacts associated with the multi-purpose project during the period of the year that X2 is greater than 65, and that it would reduce the average predicted chloride concentrations between July 1 and February 1 at all five of the south Delta exports as compared to baseline conditions.

The results of this evaluation indicate that a multi-purpose Phase II project would accomplish project objectives, be economically justified, result in minimal residual salinity impacts, and create vital emergent marsh habitat. Accordingly, the Port, its partners, and USACE are continuing to move forward with multi-purpose planning efforts for the Phase II project.

Keywords: multi-purpose navigation, ecosystem restoration, salinity, X2

Poster topic: Water and Sediment Quality

Can San Francisco Bay "Filter" Nitrogen Between the Land and the Sea? The Microbiology and Biogeochemistry of Nitrification in Estuary Waters

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Ammonia oxidation, the first step of nitrification, is the critical link between nitrogen inputs and losses in coastal ecosystems. Since the discovery of ammonia-oxidizing archaea (AOA), research on the microbial ecology of this process has been prolific. AOA, rather than ammonia-oxidizing bacteria (AOB), appear to drive ammonia oxidation in many systems. Some estuaries, however, harbor thriving AOB communities, while AOA outnumber AOB in others. Although understanding their roles in estuarine N cycling is crucial for understanding the effects of coastal nutrient pollution, few studies have investigated these microbes in estuary waters. We determined the role of pelagic nitrification in oxidizing ammonium throughout San Francisco Bay, and characterized the microbial communities responsible for this process, using a combination of stable isotope tracer incubations and functional gene analyses, respectively. Data from one year of monthly measurements at 5 stations along the salinity gradient suggested nitrification was an active but variable process, with rates spanning over two orders of magnitude. Generally, Sacramento River waters and turbid bottom waters in Suisun Bay had the highest rates. Nitrification was generally greater in bottom waters, and was always faster when dark incubation bottles were used. AOA outnumbered AOB in the water column at most stations, and were present in high abundance at both the marine and freshwater ends of the estuary, suggesting multiple sources of microbes to the bay. Our data suggest a fraction of ammonium introduced into the bay is oxidized in the water column, likely by AOA. Interestingly, nitrification in bottom waters of the deeper channels may oxidize a substantial fraction of ammonium released by sediments. This work helps to assess the ability of ammonia-oxidizing microbes in anthropogenically impacted estuaries to transform nitrogen prior to discharge into the ocean, and furthers our understanding of the roles of these microbes in estuary waters in general.

Keywords: nitrogen, archaea, bacteria, nitrification, ammonium, biogeochemistry, microbiology, isotopes, nutrients

Poster topic: Water and Sediment Quality

Relationships between Water Quality Constituents in the Delta and the Influence of Different Sources of Water

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Bay-Delta salinity is generally measured in the field as specific conductance, loosely referred to as electrical conductivity (EC). However, drinking water and other beneficial uses are often best measured in terms of other constituents such as chloride, bromide, sodium, and total dissolved solids. Computer simulations of Delta water quality typically report Delta salinity predictions as EC or practical salinity units, which then requires conversion to the water quality constituent of concern. Water quality grab samples have been used to develop conversion relationships between the key indicators of salinity. These conversion relationships vary spatially throughout the Delta depending on the site-specific contributions from seawater intrusion, San Joaquin inflow or other sources of water. The site-specific contributions to EC from these different water sources vary by water year type and season, but can be quantified as a function of salinity in the western Delta which is strongly dependent on Delta outflow.

A general conversion approach has been developed that first calculates the contribution to EC from seawater using measured or simulated EC at Jersey Point. The seawater EC is then converted to other constituents using conversion relationships developed from Chipps Island grab sample data. EC originating from non-seawater sources is converted using a conversion relationship representative of agricultural drainage water quality. This new approach allows accurate estimation of salinity constituent concentrations from both continuous field EC measurements and computer simulations of EC. The grab sample analysis also gives insights into the influences of seawater intrusion and agricultural drainage within the Delta and how these influences have changed historically and might change in the future. These findings will help scientists and engineers better understand how flows and water quality influence beneficial uses of Delta water.

Keywords: Bay-Delta, salinity, seawater intrusion, agricultural drainage, water quality, chloride, bromide

Poster topic: Water and Sediment Quality

Toward the Remote Sensing of Water Quality and Contaminants in the California Delta

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The California Delta is a highly altered ecosystem largely reclaimed from wetlands for agriculture, and millions of acres of farmland and Californians rely on the Delta for their water supply. The Delta also harbors important habitats for many organisms, including commercial and endangered species. Recently, the Delta Stewardship Council developed a two component mission (coequal goals) to 1) provide a more reliable water supply for California while 2) protecting, restoring, and enhancing the Delta ecosystem. Dissolved organic carbon, turbidity, and contaminants such as methylmercury represent important water quality issues in the context of wetland restoration in the Delta and can threaten the achievement of the coequal goals. Here, we use field measurements of optical properties, chemical analyses, and remotely sensed data acquired with the airborne Portable Remote Imaging SpectroMeter (PRISM ; http://prism.jpl.nasa.gov/index.html) to demonstrate these water quality parameters and the study of their dynamics in the Delta are amenable to remote sensing. PRISM provides high signal-to-noise, high spatial resolution (~2 m), hyperspectral measurements of remote-sensing reflectance in the 350-1050 nm range, and therefore has the adequate resolutions for water quality monitoring in inland, optically complex waters. Remote sensing of water quality will represent a valuable complement to existing in situ water quality monitoring programs in this region and will help with decision-making to achieve the co-equal goals.

Keywords: Remote sensing, water quality, contaminants, dissolved organic carbon, methylmercury, turbidity

Poster topic: Water and Sediment Quality

Mapping Bathymetric Change as Alviso Salt Pond Restoration Projects Progress

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The potential for localized and regional erosion of sloughs, intertidal mudflats, and channels is a major concern associated with salt pond restoration activities in South San Francisco Bay. In 2010 the USGS collected bathymetry of the far South Bay in the vicinity of the Alviso pond complex to establish baseline bathymetry prior to the breaching of Pond A6 levees and opening of gates at Pond A8 (Foxgrover *et al.,* 2014). Interferometric sidescan swath mapping was used to generate high resolution (1 m cell size) bathymetric grids of the far South Bay extending east of Calaveras Point to where Coyote Creek meets the railroad bridge, and down Alviso Slough to just past the A8 gates. Between October 2011 and November 2013 we have conducted six additional surveys to monitor bathymetric changes in this region as restoration progresses. Thus far, the greatest erosion has occurred within Alviso and Guadalupe Sloughs bay-ward of the southern A6 breaches and significant erosion of the nearby intertidal mudflats has not occurred. These data are critical to the adaptive management of phased restoration plans and have played a key role in determining the configuration and seasonal operation of flood control gates at Pond A8. Our measurements of bathymetric change within Alviso Slough, in combination with analyses of sediment cores by Marvin-DiPasquale and Cox (2007) have enabled a quantification of legacy mercury released by restoration-associated scour (see poster by Fregoso *et al.*), and provide insight into morphological evolution of slough/intertidal mudflat/bay systems as levees are breached and the tidal prism increased.

Foxgrover, A.C., Finlayson, D.P., Jaffe, B.E., and Fregoso, T.A., 2014, Bathymetry and Digital Elevation Models of Coyote Creek and Alviso Slough, South San Francisco Bay, California (ver. 2, March, 2014): U.S. Geological Survey Open-File Report 2011-1315, 20 p.,

http://pubs.usgs.gov/of/2011/1315/

Keywords: bathymetry, salt pond restoration, South San Francisco Bay

Poster topic: Water and Sediment Quality

Using Bathymetric Surveys to Estimate Mercury Mobilization from Scour within Alviso Slough

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A major concern for restoration of the salt ponds bordering Alviso Slough is mercury (Hg) mobilization from the scouring of buried sediments, a legacy contaminant of the New Almaden Quicksilver mines that were active from 1847 to 1976. The breaching of the Pond A6 levees on December 2010 and the opening and closing of adjustable flood control structures at Pond A8 (June – December 2011, 2012, and 2013), have increased flow velocities in Alviso Slough resulting in sediment scour. The combination of bathymetric change measurements and Hg concentration data allows us to estimate the volume of Hg remobilized. We calculate the spatial distribution and volume of eroded sediment by differencing interferometric swath bathymetric surveys taken from 2011 to 2013 with one taken in 2010 before the levees were breached and A8 gates opened. This data is coupled with total Hg concentrations measured from 200-cm long sediment cores to track the progression of Hg remobilization since initiation of restoration. This study uses three different methods to estimate the total Hg mobilized by sediment scour. Method A divides the length of the slough into four zones, assigns depth-averaged Hg value to each zone and multiplies this by the observed volume of erosion in each zone. Method B uses zone averaged Hg values for each 20 cm sediment depth interval down core and multiplies this concentration by the corresponding observed volume of erosion for each depth interval. Method C uses interpolated values of Hg for each 20 cm depth interval and multiplies each interval by its corresponding observed volume of erosion. Interestingly, there is close agreement between the three methods. The question remains on whether scour, and the accompanying mercury remobilization, will continue at the same rate or slow through time.

Keywords: Mercury, Hg, Alviso Slough, interpolation

Poster topic: Water and Sediment Quality

Changes in Total and Methyl Mercury Concentrations in Water, Sediment, and Biota Resulting from Connectivity of a Post Restoration Tidal Marsh to a Tidal Slough

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From mid-1800's to early 1900's, over 90% of Suisun Bay tidal marsh were reclaimed for agriculture and subsequently have been managed as seasonal wetlands for waterfowl hunting. Currently, planning efforts to restore 65,000 acres of Delta and Suisun tidal habitat are in final stages of development. The 70-acre Blacklock tidal marsh restoration site, located in northeast Suisun Marsh, was restored by the California Department of Water Resources. This study is the first effort at estimating the impact on mercury cycling of converting a diked, managed wetland with seasonal water exchange to tidal marsh with unrestricted daily tidal inundations. The goals of this study were to estimate changes in total mercury and methyl mercury concentrations in fish, sediment and water before and after restoration. Field sampling took place January, 2005 to September, 2009. Unfiltered aqueous methylmercury post breach (0.101 to 0.768 ng L^{-1}) were significantly lower ($t_{(2), 8} = 6.19$; $p < 0.05$) than pre-breach (1.03 to 1.67 ng L^{-1}). Unfiltered aqueous total mercury were similar pre and post-breach (5.18 to 13.5 ng L^{-1}). Methylmercury sediment were higher and more variability between sample locations within the restoration site during year one post-breach (2.42 to 3.69 ng g^{-1} dry) relative to years 2 and 3 post-breach (1.48 to 1.85 ng g^{-1} d/w). Mercury in Inland Silverside (*Menidia beryllina*) post-breach decreased significantly from 0.163 ± 0.039 ug g^{-1} w/w to 0.038 ± 0.023 ug g^{-1} w/w. Greater connectivity of tidal wetlands with surrounding tidal sloughs resulted in decreased methylmercury concentrations in water, sediment, and fish. Wetland biogeochemistry in a daily inundated tidal regime did not support mercury methylation at levels observed for the site when it had a seasonal wetland inundation regime. It is hoped that scientific knowledge gained as a result of this restoration will aid future restoration efforts in the Bay-Delta.

Keywords: Mercury cycling, Wetlands, Mercury, Methylmercury, Wetland Restoration

Poster topic: Water and Sediment Quality

Using Mesocosms to Test the Effect of Land Management Practices on Monomethylmercury Production in Freshwater Seasonal Wetlands

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Managed freshwater seasonal wetlands are well suited for the production of monomethylmercury (MMHg). Wetting and drying cycles created by water management promote growth of wetland vegetation for waterfowl food during the summer growing season. After fall floodup of the fields this vegetation decomposes creating anoxic conditions and an abundant carbon source utilized by MMHg producing microbes. This results in hot moments of MMHg production after floodup and increased MMHg loads from seasonal wetlands. In this work, we determine the effect land management practices have on MMHg production. A manipulative study was conducted during the fall (October-November) of 2012 in a 20 hectacre seasonally flooded wetland located in Yolo Wildlife Area, CA. Polycarbonate cylindrical mesocosms (0.75 m diameter, 0.6 m tall), were placed over 6 differing land management treatment types: disc, simulated cattle grazed, mowed with vegetation removed, mowed with vegetation left in place, scraped with all vegetation removed, and natural undisturbed. Each treatment had n = 5 replicates. Samples were collected for determination of mercury speciation and ancillary measurements. Sampling occurred bi-weekly or weekly over a period of thirty days. Dissolved MMHg concentrations peaked in all treatments by day 16 of the experiment. Comparison of treatments was done on a mass dissolved MMHg basis. Natural and mowed treatments were similar (2.2 and 2.1 µg MMHg respectively). Simulated grazing treatments (1.4 µg MMHg) resulted in 36% reduction in MMHg relative to the natural treatment. Cleared (0.36 µg MMHg), disced (0.51 µg MMHg), and mowed with vegetation removed (0.88 µg MMHg) produced significantly less MMHg than the natural undisturbed treatment. Our results indicate specific management practices of seasonally flooded freshwater wetlands can reduce the net production of MMHg and potentially reduce loads to surrounding water.

Keywords: mercury, wetlands, methylmercury, wetland management

Poster topic: Water and Sediment Quality

The Delta Regional Monitoring Program: Connecting Water Quality Management and Science in the Delta

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The severity and complexity of the Delta's ecosystem management challenges have highlighted the importance of comprehensive information on its condition. The Delta Regional Monitoring Program (RMP) is intended to help address this need by better defining water quality issues of regional concern. The successful implementation of the Delta RMP is based on several key factors. The current Delta RMP has focused on a bottom-up structure, working with regulated stakeholders to improve the coordination among Water Board-mandated monitoring efforts and to identify efficiencies in existing monitoring requirements to support regional collaborative monitoring. A second key aspect was collaboratively defining water quality management questions that would be supported by all program participants. Starting small and focused, and building the program in several consecutive phases is another key factor to successful implementation. Therefore, initial priorities of the program were narrowed to improve the understanding of the spatial and temporal distribution of prioritized water quality constituents (i.e. mercury, nutrients, pathogens, and pesticides). The Delta RMP program structure has evolved from an ad-hoc participatory process to a more formal representative committee process that underscores the program's potential to serve as an effective forum for collaboratively defining and solving water quality issues in the Delta. Monitoring is expected to begin in 2015. We describe 1) the program structure as the result of a collaborative effort of regulators, the regulated community, and other agencies and organizations based on shared management questions; and 2) the monitoring implementation plan, including how the proposed monitoring approaches and sites were selected, plans for sharing information, and possible avenues for future coordination with additional partners.

Keywords: Beneficial uses, Status and trends, Regional water quality, conditions, Toxicity

Poster topic: Water and Sediment Quality

Ibuprofen Exposure Reduced Reproductive Output in Adult Inland Silversides

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Ibuprofen is a nonsteroidal anti-inflammatory drug (NSAID) that is has been detected in surface waters at concentrations up to 2.5 mg/L. Ibuprofen has a relatively short half-life and therefore is not persistent in the environment; however its continual introduction into the aquatic environment via municipal wastewater effluent can lead to some fishes experiencing chronic exposures in areas affected by wastewater. Ibuprofen has previously been shown to affect fecundity in both vertebrate and invertebrate species, and is therefore a contaminant of concern that is ubiquitous within the Sacramento-San Joaquin Delta. In this study, we used inland silversides (*Menidia beryllina*; 66 days old), a fish species that is a useful indicator of contaminant exposure in estuaries throughout North America, and for which we have a recently-sequenced transcriptome. We determined physiological effects of sublethal, chronic exposure to ibuprofen on gene expression and reproductive output. Acute 96-hr exposures were used to identify the effects of ibuprofen on survival, which was 98-100% after 96 hr for concentrations as high as 18.8 mg/L and subsequently decreased at higher concentrations. Juvenile fish were then exposed to one of three ibuprofen exposure treatments (0.025, 0.25 and 2.5 mg/L), along with an experimental control group, for 14 days. Genomic assessments used to determine the effects of ibuprofen, identified impacts on reproductive pathways, the immune system, and osmoregulation. Additionally, expression of hormone receptors was non-monotonic, with greater effects at the lowest exposure concentration. Our results show that at relatively low concentrations, chronic exposure to ibuprofen induces detrimental cellular responses in *M. beryllina*. We detected these cellular responses at concentrations that resulted in reduced reproductive output in adult *M. beryllina*, which suggests a potential link to whole organismal impacts from exposure to ibuprofen.

Keywords: Inland Silverside, Ibuprofen, Water Quality, Sewage

Poster topic: Water and Sediment Quality

Potential for In Situ Coagulation in Conjunction with Constructed Wetlands to Reduce Total and Methyl Mercury Concentrations, Loads and Bioavailability

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With the recent passage of the Delta methylmercury (MeHg) surface water TMDL, there is a need to develop management practices that will reduce the export of MeHg from both point and non-point sources. Coagulation with metal based salts is a practice commonly employed by drinking water utilities to remove particles and dissolved organic matter (DOM) from solution. Because dissolved Hg is associated with particles and DOM, it follows that Hg should also be removed during the coagulation process and end up associated with the organo-metal precipitate, termed floc. The effectiveness of iron- and aluminum-based coagulants for removing both inorganic and methyl mercury (IHg and MeHg, respectively) from solution was demonstrated in laboratory studies conducted on agricultural drainage waters of the Sacramento-San Joaquin Delta: dissolved concentrations of MeHg decreased by 80% while IHg decreased by 97% following coagulation. To test the field application of this technology, nine wetland treatment cells were constructed in the central Delta. This replicated field experiment includes three inflow waters treatments: (1) iron sulfate addition, (2) polyaluminum chloride addition, and (3) untreated controls. Water entering and exiting these treatment cells was sampled monthly over a 1-year period for total Hg and MeHg in both the dissolved and particulate aqueous phases. Initial results confirmed that coagulant addition is removing Hg (total and methyl, particulate and dissolved) from solution and sequestering it in the floc. Seasonal effects on DOM concentration and other factors appear to effect whether passage through the wetland cells alters surface water Hg concentrations. Related studies will examine whether the presence of the floc affects the production and fate of MeHg within the wetland cells. If proven effective, coagulation–either alone or in association with constructed wetlands–may be a feasible technique to reduce surface water Hg and MeHg concentrations and bioavailability.

Keywords: mercury, dissolved organic carbon, coagulation, constructed wetlands, TMDL

Poster topic: Water and Sediment Quality

Sacramento-San Joaquin Delta Improved Continuous Monitoring Network for Water and Habitat Quality

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Monitoring and observing factors such as nutrient availability, mixing and other biogeochemical parameters contributing to the overall habitat conditions in the Delta are essential for understanding the conditions under which pelagic organism recovery might become favorable. Water quality and nutrient supply dynamics are influenced by many very complex physical and biogeochemical factors. Thus, nutrient cycling (e.g., nitrogen and phosphorous) interactions are generally influenced by other factors such as suspended sediment and plankton dynamics. Our monitoring system allows the simultaneous measurement and assessment of these types of habitat factors and processes with physically descriptive properties such as flow, atmospheric pressure, wind speed, slope, and position in the Delta.

Currently, five continuous water-quality monitoring sites are located in the northern Delta on the lower Sacramento River. These sites are co-located with existing flow monitoring stations. The water-quality monitoring sites provide a flow network that monitors pH, temperature, dissolved oxygen, conductivity, nitrate, dissolved organic material, chloropyhll-a, phycocyanin and turbidity. These water-quality measurements, taken every 15 minutes, are telemetered in real-time to USGS data servers. The quality controlled data are then made publicly available via the USGS NWIS Web: http://waterdata.usgs.gov/ca/nwis/uv/.

Stations are maintained and serviced at regular intervals at which time sensors are cleaned and checked against calibration standards. Data from the sensor network are verified against discrete samples taken both monthly and intensively over periodic ebb to flood tidal cycles.

These data are useful for understanding nutrient supply dynamics and provide valuable information on algal productivity food web dynamics and other aspects of pelagic habitat quality.

Statement of Relevance to water and environmental policy and management: The sensor network continuously monitors nutrients (nitrate, phosphate), algal pigments, dissolved oxygen, turbidity and DOM continuously, allow for developing, testing and refining hypotheses related Bay-Delta management.

Keywords: Continuous monitoring, habitat network integration, water quality

Poster topic: Water and Sediment Quality

In Stream Nitrate Dynamics in the Presence and Absence of Effluent in the Sacramento River, CA

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Research suggests that both the amount and form of dissolved inorganic nitrogen (nitrate versus ammonium) in water affects the abundance, health, and species of phytoplankton in the Bay-Delta, which subsequently impacts food stocks for pelagic organisms. Effluent releases from the Sacramento Regional Wastewater Treatment Plant (SRWWTP) contribute high concentrations of ammonium to the Sacramento River just downstream of Freeport Bridge. Understanding the rate at which this ammonium is converted to nitrate (nitrification) may help us unravel controls on phytoplankton health. Data for this study were collected from in-situ monitoring stations at Freeport Bridge, located 0.2 km upstream of SRWWTP's effluent outflow, and at Walnut Grove, located just upstream of the Delta Cross Channel. Both stations report river velocity and nitrate every 15 minutes, along with standard water-quality measurements. Effluent flow data were provided by SRWWTP. These data allow us to model net nitrification rates in the Sacramento River along this 29-km stretch between the two stations. Based on the period of record to date (September 2013 to June 2014), we calculated water travel times between monitoring stations and net changes in nitrate concentration. We assumed that effluent contained negligible amounts of nitrate and that there were no other nitrate inputs along this river reach. Additionally, four wastewater holds by SRWWTP occurred during the study, allowing for evaluation of changes in nitrate concentration in the absence of wastewater. Preliminary results demonstrate that due to biogeochemical transformations that occur during travel, wastewater is an important source of nitrate to the Delta.

Keywords: nutrients, ammonium, nitrogen, nitrate, ammonia, effluent, wastewater

Poster topic: Water and Sediment Quality

Water Quality Monitoring in the Cache Slough Complex

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The Sacramento – San Joaquin Delta is a major water conveyance hub for both the State Water Project and Central Valley Project. Biological Opinions for both projects have called for the restoration of 8,000 acres of tidal wetlands to protect Delta Smelt. Furthermore, mitigation efforts as part of the Bay Delta Conservation Plan are proposing 60,000 acres of wetland restoration. Much of this restoration is likely to occur within the Cache Slough Complex because (i) Delta Smelt already exist within the Complex, (ii) the area is the best preserved part of the Delta, and (iii) ground elevations are favorable for tidal wetland restoration even with sea level rise. However, with these large land use changes being proposed, no pre-restoration baseline water quality data exists.

To help address this issue, the Department of Water Resources (DWR) in cooperation with the Solano County Water Agency began to look at what existing monitoring was being done in the Cache Slough Complex and what areas are most likely to be restored. DWR began an adaptive biweekly monitoring program for the Cache Slough Complex starting in September 2013. The main goal of the monitoring program is to document baseline water quality conditions, including drinking water constituents within the Cache Slough Complex.

While the study is still ongoing, preliminary results show that local and regional tributaries to Cache Slough are an important source of nutrients, organic carbon, and phytoplankton to the system. However, in dry years such as Water Year 2014, these nutrients are often short lived. Both the data and results of this study will help to document baseline conditions within the Cache Slough Complex, and provide an important source of data for water managers, scientists, and engineers.

Keywords: Water Quality, Cache Slough Complex, Wetland Restoration

Poster topic: Water and Sediment Quality

Nutrient Trends in the Sacramento and San Joaquin Basins: A Comparison to State and Regional Water-Quality Policies

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Non-point source (NPS) control strategies were initiated in California in the late 1980's under the authority of the Porter-Cologne Act and eventually for the development of total maximum daily load (TMDL) plans. Most of the NPS TMDLs developed for California's Central Valley region (CV) were related to pesticides. Efforts to reduce pesticide loads and concentrations began in earnest around 1990. The NPS control strategies either encouraged or mandated the use of best management practices (BMPs). Although TMDLs were largely developed for pesticides, the resultant BMPs would likely have affected the runoff of other potential pollutants (specifically, nutrients). This study evaluates the effectiveness of agricultural NPS control strategies implemented in California's CV between 1990 and 2013 by comparing surface-water nutrient concentration and load trends between two periods. In general, use of BMPs was encouraged during a "voluntary" period (1990 to 2004) and mandated during an "enforcement" period (2004 to 2013). Nutrient water-quality data were obtained from U.S. Geological Survey National Water Inventory System (NWIS) and the California Environmental Data Exchange Network (CEDEN). Nutrient concentrations, loads, and trends were estimated by using the recently developed Weighted Regressions on Time Discharge and Season (WRTDS) model. Sufficient total phosphorus (TP) and nitrate (NO3) data were available to compare the voluntary and enforcement periods for seven selected CV sites within the lower Sacramento and San Joaquin River basins. For six of the seven sites, flow-normalized mean annual concentrations of TP and NO3 decreased at a faster rate during the enforcement period than during the voluntary period. Concentration changes during similar years and ranges of flow conditions suggest that BMP's designed for pesticides, reduced nutrient loads. Results show that enforceable NPS policies, such as for pesticides, and accelerated BMP implementation, have also resulted in reduced loads of nutrients in Central valley rivers.

Keywords: nutrients, modeling, nitrogen, phosphorus, BMP's, trends

Poster topic: Water and Sediment Quality

Potential Benefits of C-N-S Isotopes of Dissolved Organic Matter (DOM) for Pelagic Organism Decline (POD) and Habitat Studies in the San Francisco Estuary (SFE)

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The current IEP conceptual model for POD recognizes that multiple environmental drivers and ecological processes contribute to habitat degradation and POD. Our recent SFE studies have investigated sources of nutrients and organic matter, linkages between nutrients and algae, and their effects on habitat quality. However, our OM characterization has focused almost exclusively on causes of spatial and temporal changes in POM (as a proxy for algae), not DOM, sources and quality. But from a broader foodweb perspective, the bioavailable POC and DOC pools are similar -- and the N concentrations of DON, NH4, and NO3 are roughly sub-equal – in the SFE. Hence, DOM may be an important but largely overlooked source of energy supplying estuary heterotrophic demand.

C-N-S isotope values of POM samples across the SFE suggest huge differences in sources and quality of the OM, with S and N isotopes especially useful for quantifying OM from Cache Slough. We hypothesize that analysis of DOM for C-N-S isotopes will prove similarly useful as a tracer of sources and processes. Hence, we propose to add C-N-S isotopes of DOM to our isotope toolbox for addressing various POD and habitat quality-oriented questions in the SFE. DOM isotopes have proved extremely useful for quantifying DOM from different Delta habitats in our previous drinking water quality projects where DOM was extracted with XAD resins. We have recently developed a new and easier PPL resin method for extracting and analyzing DOM samples for C-N-S isotopes to facilitate routine collection and analysis of DOM isotopes as part of aquatic monitoring programs. In anticipation of this method development, we have archived water from most SFE samples collected for isotopic analysis since 2005. This poster will briefly describe the new method and present examples of environmental puzzles where C-N-S analysis of archived DOM samples might prove illuminating.

Keywords: DOM, organics, isotopes, POD, foodweb, WWTP, PPL extraction

Poster topic: Water and Sediment Quality

Putah Creek Watershed Mercury Project

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This study was designed to determine the relative contribution of total mercury and methylmercury from upstream historical mining districts to the impairment of Lake Berryessa. The third and fourth historically largest mercury-producing mining districts in California are located within three tributary watersheds north and west of Lake Berryessa. Downstream of the lake, Putah Creek drains into the Yolo Bypass, tributary to the Sacramento-San Joaquin Delta. Lake Berryessa and the Delta are water bodies listed as impaired by mercury through Section 303(d) of the Clean Water Act. Water and sediment samples were collected October 2012 through May 2014, when precipitation was lower than the long-term average. Primary findings include: (a) Each tributary contributes total mercury (in water and sediment) and/or methylmercury (in water) to Lake Berryessa; (b) Tributary reaches with elevated mercury concentrations ("hot spots") are near or downstream of historic mercury mines; (c) Non-anthropogenic contributors, including geothermal springs and groundwater influx from shallow aquifers, may contribute a substantial percentage of mercury and methylmercury to surface water. Implications of relevant scientific findings for Bay-Delta management include: (a) The Putah Creek Watershed has elevated total mercury and methylmercury concentrations that originate upstream of Lake Berryessa; (b) Putah Creek, through its connectivity with the Yolo Bypass, is a contributing source of mercury and/or methylmercury loads to the Bay-Delta; (c) Identification of hot spots will assist in the prioritization of abandoned mine cleanups to reduce mercury impacts to the Delta; (d) Data collected on mercury and methylmercury in water and sediment contribute to the larger data pool for developing mercury TMDLs and Coast Range watershed characterizations; and (e) Better insight into mercury sources and transport in the Putah Creek Watershed will be helpful to Bay-Delta managers working to balance multiple habitat and water-quality concerns in the Yolo Bypass and Delta.

Keywords: Putah Creek Watershed, Lake Berryessa, mercury, methylmercury, Yolo Bypass, Delta

Poster topic: Water and Sediment Quality

Assessing Habitat Quality using New Optical Methods Developed for In-Situ, Real-Time Detection of Habitat Quality Indicators

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Aquatic habitat quality in the Sacramento Delta is a function of many biogeochemical and hydrologic processes involving nutrients, suspended sediment, temperature, pH, dissolved oxygen, light attenuation and physical attributes such as type of substrate, water depth and current velocity. Together, these habitat attributes can affect the aquatic food web. For example, algal dynamics affects: trophic structure, community structure, fish abundance, and other habitat features.

In conjunction with the California Department of Fish and Wildlife's (CDFW) fish collection programs in the Delta, we collected water samples and made in-situ measurements of turbidity, conductivity, pH, dissolved oxygen, temperature, Chlorophyll and FDOM at 73 stations including stations at Suisun Bay, Grizzly Bay, Montezuma Slough, Cache Slough, Sacramento River and the Deep Water Ship Channel. Sampling and measuring of in-situ parameters were done at the same time of day and same location as CDFW's fish sampling programs. Preliminary analysis of data has shown spatial and interannual variability, as well as a large tidal dependency of important water quality variables. We will present initial results from these studies that analyzed and compared water quality parameters over time and space in the Delta.

Keywords: Water quality, delta

Poster topic: Water and Sediment Quality

Understanding the Relationships Between TKN, SKN, NH3, and NO3 Discharged into San Francisco Bay

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In order to better understand nutrient loading into San Francisco Bay, the San Francisco Bay Region of the California Water Quality Control Board required dischargers under NPDES permits to collect effluent samples for nutrient (N and P) analyses. During the two year study, some discrepancies were observed between Total and Soluble Kjeldahl Nitrogen (TKN, SKN) analyses, with SKN>TKN. To provide our clients with the best expected data possible, contradictory results were re-analyzed. In most cases, the re-analysis did not support the original analysis, with TKN results increasing and SKN results decreasing in concentration from the original analysis. A common factor observed among these samples was NO_3 concentrations >10 mg/L. This TKN<SKN result discrepancy was commonly observed (>30% sampling events received per client) at seven out of 27 clients whom submitted samples to Caltest for analysis. Concentrations of NO_3 >10 mg/L was observed in other samples; however, nitrogen speciation was as expected (TKN>SKN and TKN>NH3). Re-analysis of unorthodox samples, on average, occurred about 24 days after initial collection, suggesting a change in the acid (H_2SO_4) preserved matrix. High nitrate (>10 mg/L), inorganic salts and solids, as well as organic matter are known interferences for kjeldahl digestion; however, due to the nature of this study, NO_3 was the only interferent analyzed. Additional studies/analyses would be necessary to determine other interfering compounds in order to improve the kjeldahl digestion and provide better data to the Regional Board regarding nitrogen speciation input into SF Bay.

Keywords: Nutrients, Nitrogen, Speciation, Wastewater

Poster topic: Water and Sediment Quality

Developmental Effects of Fipronil on Japanese Medaka (*Oryzias latipes*) Embryos using a 96-Well Plate Exposure Method

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Fipronil, a phenylpyrazole insecticide found in common-use household products, has been detected at levels of 0.13-12.6 µg/L in urban runoff. A high-throughput 96-well plate developmental toxicity bioassay was developed to evaluate toxicity of fipronil. Japanese Qurt Medaka (*Oryzias latipes*) embryos (<24 hour old) were exposed to 0.1, 1, 10, 100, and 1000 µg/L fipronil. All embryos were initially exposed in beakers containing various pesticide solutions then moved to a 96-well plate on day 3 of the exposure where they were separated by sex. Embryos were continuously exposed for 16 days or until hatching. Exposure to fipronil decreased hatching success. An analysis of hatching date comparing sexes revealed that both sexes experienced delayed time to hatching. Pericardial edema, a sublethal endpoint, was observed in larvae as low as 10 µg/L. These results suggest that sublethal effects can occur in developing aquatic vertebrates following exposure to environmentally relevant concentrations of fipronil. Fipronil and its degradates were some of the most commonly detected pesticides in a 2008-2011 Sacramento, San Francisco Bay, and Orange County surface water survey. Detections of fipronil in all water samples were above the lowest US EPA aquatic benchmark. Such detections paired with data from this study mark fipronil as a contaminant of concern for the San Francisco Bay and Sacramento-San Joaquin River Delta.

Keywords: Fipronil, Japanese medaka embryos, hatching success, pericardial edema, hatching time

Poster topic: Water and Sediment Quality

Hydraulic Modeling of an Upstream Passage Barrier for Adult Spring-Run Chinook Salmon on Butte Creek

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River2D was used to develop a hydraulic model of an upstream passage barrier for adult spring-run Chinook salmon on Butte Creek. Topographic data were collected using total station, survey-grade RTK GPS and terrestrial LIDAR. Stage-discharge relationships were developed at the upstream and downstream ends of the site to use as boundary conditions and to calibrate the 2D model. A pressure transducer was installed at the downstream boundary of the model to provide a time series of flow and water temperatures. Parameters of the hydraulic model that will be examined to assess upstream passage include minimum thalweg depth, depths, velocities and water surface elevations above and below a jump, and the flow split between the two main flow paths through the site. These hydraulic parameters for the time series of flows, together with recorded water temperatures, will be compared to passage data from a VAKI unit located just upstream of the site to evaluate how hydraulic conditions affect upstream passage of adult spring-run Chinook salmon, for the purpose of assessing what flows are needed for upstream passage. The topographic dataset can also be used to develop potential structural solutions for upstream fish passage.

Keywords: River2D, upstream, passage, Chinook salmon, hydraulic model

Poster topic: Water Supplies and Instream flows

Are Mid-Winter Droughts in Northern California Increasing?

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The major portion of northern California annual precipitation comes during the winter. Mid-winter dry spells can lead to problems in snowpack and water supply. Recent decades have led to questions about a possible change in patterns leading to more drought years. In this paper two widely used mountain precipitation indexes are examined to see if a trend for increasing winter dry months is shown. There does seem to be evidence for some increased risk of a dry month in the past 30 years, more so in the northern Sierra than in the south. Results will be presented in the paper.

Keywords: Drought, precipitation patterns, possible climate change

Poster topic: Water Supplies and Instream flows

Development of a Quality Assurance System for the California Department of Fish and Wildlife Instream Flow Program

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Instream flow measurements and data reports are vitally important to water management policies related to fish and wildlife habitat protection. This creates a challenge to agencies as instream flow reports may be highly variable in their approach to planning, study design, data collection, and reporting formats. The absence of established quality assurance (QA) systems has often left few mechanisms to asses if instream flow data were produced in a credible, comparable, coordinated, and scientifically-defensible manner.

In 2012, the California Department of Fish and Wildlife (CDFW) Water Branch's Instream Flow Program began a partnership with the QA Team from the Moss Landing Marine Laboratories to develop QA systems for instream flow measurements. The QA Team has decades of experience developing novel approaches to the design and implementation of quality management on large-scale applications, including the CalFED Bay-Delta Mercury Projects and the State Water Resource Control Board's (SWRCB) Surface Water Ambient Monitoring Program. Already, this partnership has developed peer-reviewed standard operating procedures, fact sheets, reporting templates, and guidance for instream flow studies. Proposed enhancements include a QA program plan, database structure, meta-data, electronic data capture, training, intercalibration exercises, and field audits.

The CDFW Instream Flow Program standard operating procedures are being used in tributaries of the Sacramento-San Joaquin River Delta to determine flow needs for fish and wildlife with ultimate consideration by the SWRCB. As the QA systems continue to grow within the CDFW, they are expected to become the basis for external partnerships with other agencies. A significant effort is underway to make connections through outreach to other agencies in the form of training, presentations, and maintenance of quality assurance web site. It is anticipated that these efforts will increase comparability between instream flow measurements within the State of California, extend limited resources, and boost efforts in production of scientifically-defensible reporting.

Keywords: Quality assurance, instream flow, methods, standard operating procedures, outreach, training

Poster topic: Water Supplies and Instream flows

Phase 4: Development and Implementation of Flow Objectives for Priority Bay-Delta Tributaries

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The Public Trust Unit in the Division of Water Rights at the State Water Resources Control Board (State Water Board) is currently working on the development of policies and flow objectives for priority tributaries to the Bay-Delta, with a focus on the Sacramento River. Often referred to as Phase 4 of the Bay-Delta effort, this work includes: 1) development of non-binding flow criteria; 2) development of flow objectives with regulatory effect; 3) programs of implementation to achieve flow objectives, including use of adaptive management; and 4) implementation of flows through conditioning of water rights and other measures, as appropriate.

Flow objectives will consider all competing uses for water, and will be tailored to each individual tributary to address the unique hydraulic/geomorphic characteristics, public trust resource considerations, and beneficial uses of water. Adaptive management plans will be used to establish a flexible framework that can accommodate future conditions, including new information, watershed changes, stakeholder agreements, and climate change.

Flow criteria will provide the technical basis for the development of flow objectives, but do not have regulatory effect. In July 2013, the State Water Board submitted a document to the Delta Science Program (DSP) to request assistance in identifying scientifically defensible methods to develop flow criteria for priority tributaries to the Bay-Delta. In response, DSP convened an expert panel that evaluated a variety of methods, and provided recommendations to the State Water Board. The recommendation was a seven-step hybrid approach using stream classification, hydrologic analyses, site-specific information where available or essential, extrapolating the understanding of flow-ecology relationships from other sites to the study catchment or segment, development of an environmental flow regime, interaction between scientist and stakeholders, and adaptive management. These recommendations, as well as public comments received, will inform the Phase 4 process of developing flow criteria.

Keywords: Policy, flow objective, flow criteria, instream flows

Poster topic: Water Supplies and Instream flows

Connecting Bay Area Students to the San Francisco Bay-Delta Watershed

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Every year more than 2,000 middle and high school students are inspired to become the next generation of Bay stewards through Save The Bay's Restoration Education Programs**.** Many students are not familiar with the San Francisco Bay, its connections to the Bay-Delta watershed, and how their own actions have effects upon this ecosystem. Save The Bay aims to help remedy this disconnect by leading community based restoration programs for Bay Area youth. Save The Bay's Bay Discovery program is a day-long restoration education field trip that engages students with the San Francisco Bay estuary and critical tidal marsh restoration. These introductory programs help students gain an understanding of the local watershed, drawing on the connections between human actions and a healthy environment. Water conservation is one component of Save The Bay's education programs, bringing attention to the high demand for fresh water and the need to treat it as a valuable resource. Through hands on restoration and educational activities students better understand the pathway of connected waterways and consequences of pollution entering our watershed from all sources ranging from headwaters in the Sierra Nevada mountain range down to the San Francisco Bay and Pacific Ocean. Students that participate in our shoreline clean-ups gain first-hand experience with human impacts on our watershed as they collect littered items they make use of everyday, such as fast food containers, straws, plastic wrappers, and drink containers. Save The Bay's Restoration Education Programs strive to connect students to water conservation and pollution prevention in the San Francisco Bay-Delta watershed to ensure better health and stewardship of this valuable ecosystem and resource.

Keywords: watershed, students, pollution, trash, education, environment impacts, stewardship, youth, restoration

Poster topic: Watersheds

GIS-Based Decision Support Tool for Estimating Riparian Zones at the Watershed and/or Project Scale

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The loss of riparian areas throughout the Bay-Delta region has affected water quality and habitat conditions and presented a number of challenges for resource managers related to water management and land use planning. Current approaches for restoring and protecting riparian areas are starting to focus on appropriate riparian functions or ecological services, including stream shading, bank stabilization, organic and inorganic material input, runoff filtration, floodwater storage, and groundwater recharge. Land-use planners therefore need tools to help delineate and map the extent of "functional riparian width" as a means of ensuring appropriate riparian width in developed stream reaches targeted for restoration and relatively undisturbed stream reaches targeted for development.

The Riparian Zone Estimator Tool (RipZET) is a GIS-based decision support tool under development that estimates functional riparian width based on channel type and associated appropriate functions. The tool provides reach-scale functional riparian width estimates based on average height of mature riparian vegetation, the steepness of hillslopes adjacent to the channel, and the floodplain inundation extent for large storm events. The appropriate width estimate for a reach is then determined based on the riparian functions associated with different channel types, which range from steep headwater channels to low-gradient, meandering channels with broad floodplains.

RipZET has been tested to date in the San Francisco Bay Area, as well as in the Tahoe Basin and Central Coast, and has been reviewed by regional science and management experts. This presentation will provide examples of tool applications around the state, with an emphasis on the Bay Area applications using floodplain inundation extents to determine riparian functional width. Once finalized, RipZET will provide watershed management communities with a robust tool that can be used to size riparian areas to achieve needed levels of selected riparian functions.

Keywords: watersheds, water management, land use planning, riparian, restoration, GIS

Poster topic: Watersheds

The Delta Watershed Initiative Network (Delta WIN)

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The Sacramento-San Joaquin Delta (Delta) is home to more than 55 species of fish and 750 species of plants, and provides irreplaceable habitat for numerous species of migratory birds. Delta waterways are identified as threatened and are listed on the Clean Water Act Section 303(d) List as impaired by multiple pollutants. The current drought and projected impacts of climate change are expected to exacerbate existing water quality problems. Many water quality and ecosystem problems have multiple causes and are best addressed using an integrated and coordinated approach to protect natural resources at the watershed level. At this critical junction, a platform is needed to connect people, resources, organizations, and programs, and to facilitate a regional network of locally initiated projects in a comprehensive approach. Such an approach supports sound science, informs adaptive management, uses innovative thinking, and implements best management practices. Using this approach, the Delta Watershed Initiative Network (Delta WIN) is a voluntary initiative that integrates multiple efforts at the local level to improve water quality and ecosystem health while providing regional benefits. Delta WIN focuses on water quality assessment, examining and emerging data, implementing best management practices, and education and outreach. Data collection and synthesis will identify data gaps and establish baselines for understanding watershed conditions, screen for potential pollution problems, and inform adaptive management decisions and best management practices. By leveraging and coordinating resources, Delta WIN will enhance, expand, and create opportunities for greater watershed health.

Keywords: water quality, monitoring, data, watershed, waterways, pollutants, adaptive management

Poster topic: Watersheds

Characterization of the Mass Flux of Salts, Nutrients, and Oxygen-Demanding Substances from the San Joaquin River to the Estuary

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A total maximum daily load (TMDL) for oxygen demanding substances in the San Joaquin River (SJR) in California is under development due to frequently occurring hypoxic conditions. Here, we present a mass balance analysis that was developed to identify the sources of oxygen-demanding substances and nutrients in the upstream portion of the SJR and to characterize the mass flux of these materials from the SJR to the Delta estuary. These studies were conducted to provide a scientific basis for management actions to be taken to meet TMDL requirements. Data was collected for flow and ten water quality constituents at locations within the main-stem of the SJR, major river inputs (tributaries), and major diversions for the 60 mile portion of the SJR included in the study area. The mass balance analysis was performed by calculating mass loads of all tributaries entering the SJR within the study area for a single year. Tributary flows and mass load inputs were compared and considered in the determination of their relative impacts on the SJR and the identification of best targets for water quality improvement efforts. Additionally, all mass loads were summed (tributary inputs minus diversions) and compared with observed mass loads in the SJR at the downstream limit of the study area. Discrepancies in summed and observed surface flows and mass loads are consistent with previous studies and explained by estimations of groundwater contributions, nitrate uptake by algal growth, denitrification by anoxic soils, and precipitation and evapotranspiration. These efforts are supportive of the TMDL process where load allocation is being performed and where determining the best locations for implementation of improvement projects is critical for improving the overall health of the river.

Keywords: Nitrogen, ammonia, phosphorous, salinity, irrigated agriculture, Central Valley, monitoring

Poster topic: Watersheds