Projected Climate Change Impacts to the San Francisco Bay-Delta Ecosystem and Region

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The San Francisco Bay region, and specifically the Bay-Delta system is being and will continue to be impacted by global climate change on a local scale. We are already experiencing extreme variability in weather and can expect further increases in air and sea temperatures, increased storm frequency and intensity resulting in greater precipitation and flooding events, increased frequency and intensity of El Niño events (which also reduce upwelling and dramatically decrease coastal ecosystem productivity), extended droughts, continued sea level rise, increased ocean acidification, and ultimately dramatic changes in and loss of shoreline habitats. This is overlain onto a system that is already impacted by ongoing land use changes, invasive species and contaminants. What will the Bay-Delta system look like in 20/50/100 years? How can we address changes that will continue to threaten endemic and listed species? What mitigation strategies can we implement to help deal with some of these risks? What timeframe do we have to start taking corrective or remedial actions? These questions and more will be addressed by referencing ongoing research by numerous organizations in the Bay Area.

Keywords: Climate change, extreme weather/variability, sea level rise, El Niño events

Thursday, October 18, 2012: Room 314, Global Perspectives– Order 1

Stemming the Tide of Ballast Water Invasions? Geographic Patterns of Ballast Water Exchange and Discharge to the San Francisco Bay-Delta Region

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Marine invasive species have negatively impacted public health, coastal environments, and the economy of California. To address this ongoing threat, the State of California has adopted laws and regulations aimed at controlling the influx of invasive species via ballast water discharges. Current regulations require that ships exchange waters taken up for ballast in coastal environments with open ocean waters at least 50 or 200 nautical miles off any coast, depending on where the water was sourced and where the vessel is arriving from, before discharging ballast water in California ports.

This talk will present an analysis of ballast water discharged to San Francisco Bay and the Sacramento-San Joaquin River Delta region for the past two years, in the context of a changing regulatory landscape. Under current regulations, the California State Lands Commission (Commission) collects and manages ballast water management reporting forms from vessels arriving in California. These forms contain a rich data source regarding ballast water management practices, including ballast water exchange locations, for vessels arriving to the San Francisco Bay region. Data collected from these forms will be presented regarding where and when ballast water has been taken up, exchanged, and eventually discharged within the waters of San Francisco Bay and the Delta. Patterns regarding vessel compliance with exchange requirements will also be presented. This information is a powerful tool for retrospective and predictive analyses of marine invasion patterns in the San Francisco Bay region.

Keywords: Invasive species, vector management, ballast water, open-ocean exchange

Thursday, October 18, 2012: Room 314, Global Perspectives– Order 2

Atmospheric Rivers, Levees and Floodplain Ecology in the Bay-Delta System

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Atmospheric rivers (ARs) are narrow, transient corridors of strong water-vapor transport in midlatitude winter storms, corridors of intense winds and moist air roughly 400-500 km across and thousands of km long. First recognized in 1998, ARs are increasingly understood to play crucial roles in flooding and water resources in California. ARs routinely transport water vapor at rates equivalent to 7-15 times the average daily discharge of the Mississippi River, and the half dozen or so ARs per year that make landfall in California contribute an average of one third to one half of all the State's precipitation, thereby supplying much of the State's water resources. Meanwhile, AR storms also have been the sources of many (and in some rivers, most) floods in the State. Floods arising from AR storms have been the dominant historical cause of levee breaks in the Central Valley and Delta (>80% of the breaks) since 1951. AR storms have also been the primary initiators (also about 80% of the time) of flood flows and the ecologically beneficial inundations of the Yolo Bypass floodplains in that era. Thus, ARs are an important part of the hydroclimatic variability to which the ecologies and life histories of many of the region's aquatic and riparian habitats and species are adapted. Understanding and prediction of future AR conditions could be a particularly important contribution from the climate sciences to environmental restoration activities, and to the enhancement of water-supply reliability, in the Bay-Delta system.

Keywords: Climate Climate Change Floods Floodplain ecosystems Levee Breaks Atmospheric Rivers

Thursday, October 18, 2012: Room 314, Global Perspectives– Order 3

Enhancement of the Sacramento-San Joaquin Delta Island Consumptive Use Estimates and Water Quality Predictions

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Continuous water diversions, water operations, and land-use changes in the Sacramento-San Joaquin Delta have impaired the Delta's water flows, quality, and suitability for fish species. A thorough knowledge and understanding of the flow features in Delta rivers and streams is crucial for a solution of these problems. In an on-going effort to better understand and manage the Delta, a collaborative, integrated approach was used to better predict Delta Island Consumptive Use of water (DICU) flows and water quality variables on a higher temporal resolution and actual diversion and return locations on topography rather than simple geographical approximation. The Island known as Fabian Tract was selected for this proof-of-concept study based on available data and island accessibility. A combination of historical diversion and return location data, water rights claims, and LIDAR digital elevation model data were used to predict diversion and return locations on the island. The accuracy of the predicted diversion and return locations was analyzed through ground-truthing. To calculate water requirements and runoff returns from agricultural land-use, incorporating soil and land-use characteristics as well as weather data, the IWFM Demand Calculator (IDC) was selected based on model capabilities, ease of use, applicability, and recommendations. As input to the IDC model, the Fabian Tract was divided into grid cells forming subregions, representing fields, levees, ditches, and roads. The subregions were joined to form diversion and return watersheds representing the total area supplied by a given water source or the total drainage area for a given return. Model results provide daily estimates of the volume of water diverted and returned from actual diversion and return locations, lending insight into daily agricultural diversion and return operations within the Delta that are missed in current DICU models and contributing to sustainable solutions to the problems faced by the Delta.

Keywords: Sacramento-San Joaquin Delta, Consumptive Use, DICU, IDC, IWFM, Modeling

Thursday, October 18, 2012: Room 314, Global Perspectives– Order 4

Global Perspectives Q & A

Thursday, October 18, 2012: Room 314, Global Perspectives– Order 5