The Integrated Regional Wetland Monitoring Pilot Project: Program Introduction

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Regional tidal marsh restoration efforts aim to support and recover populations of plant, fish and wildlife species. These ecological functions follow successful establishment of a variety of ecological processes in restoration projects. In order to understand the effectiveness of tidal marsh restoration efforts regionally, we must determine which processes are in fact important to establish and the means by which we can measure and quantify these processes. The CALFED Science Program-funded Integrated Regional Wetland Monitoring Pilot Project (IRWM) utilized a four-element strategy: (1) multi-disciplinary, intensive monitoring program covering physical processes, landscape ecology, vegetation, birds, fish, invertebrates, primary production, and nutrients; (2) establish and apply conceptual models to establish hypotheses used to guide field data collection and analyses across these topic areas; (3) sample six sites (four restoration and two natural) intensively from 2003-2005, with sites spanning the estuarine salinity gradient from the western Delta to San Pablo Bay selected based on the conceptual models; and (4)integrate results across disciplines. To date, IRWM researchers have published10 journal manuscripts with another 20 at various states of preparation, and the work has been drawn upon for efforts such as the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP). The integrated publication of ecological functions for estuarine fishes will be completed late 2012. This Introduction poster presents information about the six study sites and will be accompanied by several posters focusing upon a range of the topics covered bythis applied research effort. IRWM is contributing essential knowledge to the regional efforts of species and natural community recovery through tidal restoration throughout the entire San Francisco Estuary and Delta.

Keywords: wetlands, monitoring, ecology, physical processes, restoration, fish, birds, plants

Poster Cluster Title: Integrated Regional Wetland Monitoring Pilot Project: New Findings 1

Ecosystem Scale Rates of Primary Production within Salt Marsh Habitats of the Northern San Francisco Estuary

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Salt marsh restoration is hypothesized to provide organic carbon subsidies for estuarine food webs. Organic carbon comes from diverse primary producers that differ in carbon fixation rates as well as areal extent within wetland systems. This study was designed to obtain some of the first estimates of relative contribution of different primary producers to total organic carbon production within a variety of salt marsh habitats in both natural and restoring wetlands of the northern San Francisco Estuary (SFE). We hypothesized that emergent plant production rates exceed those of microalgae (both pelagic and benthic), but overall microalgal contribution to wetland production is greater due to more extensive slough habitat and areal coverage of microphytobenthos. Carbon fixation rates of phytoplankton, benthic microalgae, and low marsh emergent vegetation were measured during the Integrated Regional Wetland Monitoring Project in two natural reference (Coon Island, Brown's Island), and four restoring (Bull Island, Pond 2A, Carl's Marsh, Sherman Lake) estuarine wetlands over the growing season in 2004. Areal (m^2) rates of production were the greatest for low marsh vegetation, while phytoplankton and benthic microalgae rates were one and two orders of magnitude lower, respectively. However, when areal production rates were scaled to the amount of habitat available for each primary producer group, the relative importance of each group varied by location. Given that each primary producer group supports a different subset of estuarine consumers, the type of food subsidy desired should influence the amount of slough, mudflat and low marsh area restored. The large scale wetland restoration activities proposed for the SFE should consider the types of primary producers likely to occupy restored habitats when estimating future foodweb impacts.

Keywords: salt marsh, microphytobenthos, carbon, primary productivity, marsh vegetation, phytoplankton, SAV

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Reassessment of the Role of Tidal Wetland Restoration in Enhancing Populations of Native Fishes

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In 2003, a series of papers was published in San Francisco Estuary and Watershed Sciences regarding the potential role of tidal wetland restoration in improving the ecological health and water management of the San Francisco Estuary. There was particular interest in the possibility that tidal wetland restoration could enhance populations of native fishes, particularly species of concern such as delta smelt *Hypomesus transpacificus*, longfin smelt *Spirinchus thaleichthys*, Sacramento splittail *Pogonichthys macrolepidotus*, and Chinook salmon *Oncorhynchus tshawytscha*. At that time, there were few studies evaluating the role of tidal wetlands with regard to fishes, and it was clear that new studies were needed to reduce uncertainties and quantify the response of fishes to tidal wetland restoration. Since the publication of the paper series, additional studies have been done and several large scale habitat restorations have occurred (e.g., flooding of Liberty Island) or are being implemented (e.g., South Bay salt ponds). We assess this new information and integrate it with the earlier papers to develop a more detailed understanding of the role of tidal wetland restoration in enhancing populations of native fishes. We specifically address studies conducted as part of the Integrated Regional Wetland Monitoring project, which was designed to monitor many aspects of tidal wetland structure and function and which included a two-year intensive field program at wetlands in the western Delta, Napa River, and Petaluma River. Isotope analyses conducted as part of this program demonstrated food web linkages between the tidal marshes and the fish sampled. The results of this reassessment will be of direct interest to resource managers, policy makers, and a variety of stakeholders who are involved in restoration of native fish populations and the functions of restored tidal wetlands.

Keywords: tidal wetlands, native fishes, restoration, San Francisco Estuary, Delta

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Invertebrate Assemblages and Fish Diets of Interior Tidal Marsh Channels in Relation to Environmental Variables and Restoration Status in the San Francisco Estuary

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Recent work in the San Francisco Estuary (SFE) indicates a variety of fish consume marsh-associated benthic, planktonic, and neustonic invertebrates. Stable isotopes and gut contents suggest that marsh-associated macro-invertebrates play a crucial role in translating marsh-derived detritus to higher trophic levels. Marsh ecosystems thus play a potentially critical role in sustaining many fish populations in the SFE. Unfortunately, little is known about how the macro-invertebrate community varies spatially and temporally in the SFE, or how this community responds to environmental variables and marsh restoration status. We address these issues by describing temporal and spatial variations in the assemblage structure and abundance of potential fish prey resources in northern SFE tidal marsh channels, specifically examining benthic and neustonic invertebrates. We also relate fish diets to prey availability, and macro-invertebrate community structure to environmental variables.

Preliminary results indicate that benthicmacro-invertebrates were most abundant in the Napa marshes, and lowest in the Delta. Natural reference marshes had slightly more taxa than restoring marshes. Temporal variability in benthic taxa richness was considerably lower than site variability. Neuston composition displayed a marked gradient from east to west, where the dominance of collembolans decreased from 70-85% in the west Delta, to 10% at Carl's Marsh. This coincided with an increase in dipterans and homopterans from east to west. Neuston abundance peaked in the summer, but abundance and community structure was extremely variable across sites and regions. Restoration status does not appear to affect neuston community abundance. Fish diets show considerable spatial and temporal variation, but little effect of restoration status. Our results indicate that community assemblages and fish diets respond more strongly to environmental variables operating at regional landscape scales, as well as seasonal variation, as compared to restoration status or age.

Keywords: tidal marsh, macro-invertebrate community, restoration, fish diet, environmental variables

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