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