Effects of regional wetland restoration on the Alviso Shoals of the South San Francisco Bay: migratory bird ecology, food webs, and sediment supply

Phase I Data Summary Update

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Introduction

The ongoing restoration of salt ponds in the South Bay Salt Pond Restoration Project, the largest tidal marsh restoration on the Pacific coast, will increase sediment demand to the ponds, but the effect of that change on the adjacent shoals is unknown. The shoals are very sensitive habitats that drive regional primary productivity and are used as the principal foraging resource by over a million migratory birds. If sediment supply is insufficient, erosion of existing mud flat habitats may result in changes in food webs, reducing their value for the migratory birds. Based on previous studies, we expect that sediment will deposit on mud flats during the wet season when supply from the watershed is the greatest, and mud flats will erode during the dry season, mostly due to wind-wave resuspension.

In the lower South Bay, the relative contribution of sediment coming from the watershed or from San Francisco Bay through the Dumbarton Narrows is unknown. Sediment supply and the response of migratory birds are the top key uncertainties identified for the South Bay Salt Pond Restoration Project. Phase I restoration projects will include restoring Ponds A6 and A8 in

FY2010-FY2011, and our studies are focused on the shoals adjacent to these restoring ponds to collect baseline information and post-restoration data. This project will examine the bird population and benthic invertebrate densities on the Alviso Shoals immediately adjacent to A6 which separates Alviso and Guadalupe Sloughs. The studies will directly

address the largest uncertainty facing the SBSP restoration program: sediment supply and migratory bird response.

Objectives

1. Document seasonal changes in the benthic macroinvertebrate community and their relationship to elevation, inundation, and slope on the Alviso Shoals.

2. Determine the response of migratory birds to the mud flat food resources through monthly surveys and behavior observations.

Site Establishment and Avian Data Collection

In June 2010, we conducted surveys to establish the Alviso Site for sampling the spatial distribution of avian densities and avian behavior. Sampling locations were based on areas: (1) most likely affected by Phase I restorations, (2) overlapping previous bird sampling, (3) observable from shore, (4) where bathymetry was being measured (B. Jaffe, USGS, unpubl. data), and (5) encompassing the zone where a shallow-water package will measure flows (D. Schoellhamer, USGS, unpubl.data). A total of 38, 1" PVC poles at 100-m intervals were installed on the mud flat for visual reference.

Our first goal was to utilize an existing dataset (supported with USGS funding) to gain as much pre-restoration data as possible. As such, we incorporated the 16 existing poles that captured the elevation gradient extending from the edge of Ponds AB1 and AB2 (see figure below). On each of two transects located 400 m apart, 8 poles were located separated by 100 m that extended perpendicular to the shoreline approximately 800 meters into the bay. These two transects signify the outer boundaries of our AB1 study mud flat. Previous to this project, monthly avian surveys were initiated on these outer transects beginning in November 2008 and included (1) counts of total number of birds present on the shoals in relation to tideline and (2) one minute long observations of individual birds from two foraging guilds (shallow probers: western sandpiper or dunlin;

and deep probers: long-billed curlews or marbled godwits) where all behaviors observers were recorded

Beginning in June 2010, we supplemented the existing study area with 22 additional 1" PVC poles on the adjacent mud flat (see adjacent figure). Our primary goal for placement of the poles was to capture the spatial area that was expected to have the greatest effect from the restoration activities in Phase I restored ponds, especially Ponds A6 and A8. The larger study area now consists of the original study mud flat extending from the area north of the Moffett ponds and south of Coyote Creek to an area east of the original study mud flat ending at the power towers intersecting the mud flat just north of A6. When we surveyed the area, the larger extent was found to be too large to be handled by one observer during the low tide. Thus, we added an additional experienced observer for the survey to complete the count and behavior observations during the available tide windows.

Avian surveys on the additional mud flat areas supplement the original dataset were conducted monthly from June to November 2010. Surveys included (1) counts of total number of birds present on the shoals in relation to tideline and (2) one-minute observations of individual birds from two foraging guilds (shallow probers: western sandpiper and dunlin; and deep probers: long-billed curlews and marbled Godwits) where all behaviors observers were recorded. These data have been entered, and are pending analysis as part of the Phase II effort to indicate how the mud flat has been used pre-restoration.

Site Establishment for Invertebrate Data Collection:

Following field reconnaissance visits in early June, we set up final locations for invertebrate sampling locations on the Alviso site on June 17-19. We set up 36 invertebrate sampling locations (see figure below) to capture the avian sampling locations and the areas where the largest sediment changes were expected to occur following restoration activities at Ponds A6 and A8. We took at GPS coordinate of each invertebrate location that we programmed into the GPS unit for subsequent monthly sampling efforts. We used a boat acquired specifically for shallow-water sampling of mud flats, a "flats" boat known as a Flatscat® that is a tunnel-hulled motorboat that is able to travel in less than 15 cm of water.

We conducted benthic invertebrate collection monthly from June to November, 2010 by taking a single, 10 cm mud core at each of the 36 unique locations. The final number of samples was chosen based on statistical discussions that examined variation in results from the Dumbarton Shoals (J. Yee, USGS statistician). We also collected a smaller sample from the top 1-2cm of the core for sediment analysis (B. Jaffe, USGS, unpubl. Data).
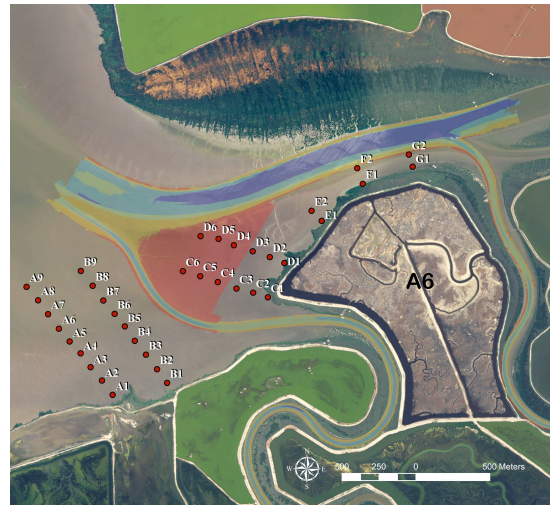
Spring and early summer conditions in this part of the South Bay result in heavy wind-waves during the afternoon to early evening; thus, we had to adjust sampling to the period just before sunset to obtain the samples at this mud flat. This data collection is ongoing and will occur monthly to provide comparison with the USGS-funded studies occurring at the Dumbarton mud flat. The two sample areas will provide an important comparison on effects of restoration to mud flats adjacent to managed ponds (SF2:

opened in August) and the planned breached pond (A6: proposed to open in October). This will be the first opportunity for the SBSP restoration project to obtain scientific information on this key uncertainty, and it will provide the basis for future phases of the restoration program.

Progress on invertebrate processing:

The most costly and time consuming aspect of our study is the processing of invertebrate samples. After the field data collection is completed, processing steps include careful sieving of each sample in an external area to separate invertebrates from the Bay mud through a screen of 0.5mm, staining and storage in sample bottles, sorting of invertebrates from other matter to prepare them for analysis, identification of each invertebrate with keys to the lowest taxonomic level, subsampling some of the invertebrates for quality assurance and quality control sampling at an outside laboratory, wet weight of samples, morphological measurement of samples, oven drying for dry weight of samples, developing equations to estimate ash-free dry weight, and entry and error-checking of the data. To accomplish this work, we use the Invertebrate Sorting Facility (ISF) at the San Francisco Bay Estuary Field Station.

In the early summer, we renovated space to provide exterior areas for sieving by 2-4 staff, interior space for 4 staff at 4 sorting stations as well as a sink and areas for sample storage, measurement and high accuracy (0.0001g) weighing stations for 1-2 staff, and office space for data entry by 1-2 staff. Our progress thus far includes: 36 samples were sieved, sorted, identified, and entered for June to August 2010; 36 samples were sieved and sorted for September to November 2010. All samples are stored at the USGS Field Station to complete identification efforts required prior to data analysis as part of the Phase II effort.

Future Work:

The main goal of sampling the Alviso Shoals before October 2010 was to capture the nature of the physical properties of the mud flat, the invertebrate community, and bird foraging activity before restoration of A6 in October 2010. Unfortunately, we missed the sampling of the Alviso Shoals in the winter of 2009-2010 because although we had planned to undertake this research, USGS funding was diverted from this critical objective too late to obtain other funding. Supplemental funds (RLF) for Alviso Shoals was not obtained until the spring of 2010 after the migratory birds had departed, and the actual final transfer was not completed until 15 September 2010. We have been promised added support ($30K) to complete the invertebrate identification, and the analysis and writing of a data summary report for the bird and invertebrate data, but that funding has not yet become available. With Phase II funding, the analysis will be completed for a data summary report in September 2011.

The primary point of the mud flat studies is to better understand the most important uncertainties in the SBSP restoration program – how does restoration affect the ecology of adjacent mud flats that supports the majority of vertebrate diversity in the Bay? A before- and after-restoration comparison is essential to learn from this Phase I restoration and is the basis of adaptive restoration within the SBSP program for the following decades. If sampling does not occur past the completion of A6 restoration, there will be little relevance to the findings. Thus, one of the key goals of our program is to secure funding for continued sampling after construction has been completed, to determine how such restorations affect the critical shoals habitats adjacent to their boundaries. In addition, the findings from the mud flat studies will be the key to better understanding the likelihood that climate change effects and sea level rise in particular will negate the value of the SBSP restoration efforts.