

The Sears Point Experience: Early Returns on a State-Of-The-Art Tidal Wetland Restoration Project

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The Sears Point tidal wetland restoration (SP) story played out over more than ten years and is both unconventional and inspiring. Led by the local Sonoma Land Trust (SLT), the project included acquisition of 2 farms and ranches in historic baylands, funding from dozens of private and public donors, and overcoming design and construction challenges. Ultimately, the San Francisco Estuary (SFE) community celebrated the breaching of the SP dike in October, 2015. End of story? For many, other than permit-required monitoring, yes. However, the SLT had other ideas. As part of the SF Bay Joint Venture, the SLT knew about a movement to establish a regional tidal wetland monitoring program in the SFE. One leader of this movement, the SF Bay National Estuarine Research Reserve (SF Bay NERR), made the case that the SP project could be an excellent project to pilot this concept. While monitoring would satisfy regulatory requirements, additional studies would focus on observations and hypothesis-testing that could lead to adaptive management and generate lessons learned for future tidal wetland restoration projects. The SLT agreed. The SF Bay NERR worked closely with a graduate student studying plantings to stabilize the mounds and test for mound erosion. It worked with a wetland restoration class taught by SFSU Professor Kathy Boyer to measure accretion patterns. Vegetation studies, aerial surveys – including LiDAR, and bathymetric studies have revealed several surprises concerning the biogeomorphic evolution of the site. Special studies on fish use and an innovative citizen science survey of bird use has added additional insights. This poster cluster describes the history of the project, thinking behind its design, challenges of implementation, preliminary observations on post-breach conditions, and how these may lead to future research and management activities on the SP project.

Keywords: Tidal, wetland, restoration, monitoring, citizen, science, adaptive, management, LiDAR, mounds

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Laying the Groundwork for Large-Scale Tidal Wetland Restoration at Sears Point, Sonoma County

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The Sonoma Baylands are a land in transition. The story begins with the Swampland Reclamation Act of 1850 which provided the incentive to reclaim 15,000 acres wetlands for farming to provide hay for the growing town of San Francisco. These farms still retain the signature of historic sloughs and wetlands and allow us to write the next chapter of this story —restoring these diked and drained lands back to marsh. Sonoma Land Trust (SLT) has been actively conserving the Sonoma Baylands since the 1980s. Early work often revolved around opportunistic property acquisitions but gradually led to far larger and more ambitious efforts. The Sears Point Wetland and Watershed Restoration Project began with the threat of casino development and concluded with the acquisition of more than 2,300 acres by SLT and restoration of 1,000 acres of tidal wetlands. Over more than a decade, SLT learned the value and challenges of engaging with the diverse hunting, scientific, agricultural, and tribal interests.

This poster describes and depicts the rich human and ecological history of the Sonoma Baylands and the myriad challenges of setting up and seeing through a project on a landscape scale.

Keywords: restoration, Sears Point, wetland, tidal wetland, acquisition

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Design Considerations of the Sears Point Tidal Marsh Restoration Project

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The 1,000-acre Sears Point Tidal Marsh restoration design combined well-established strategies with several innovative “pilot scale” approaches to address marsh resiliency under sea level rise conditions and within a highly constrained implementation budget. The Sears Point design needs were to (1) reverse historical subsidence to near-MLLW in an era of limited dredged material supply and declining regional (though locally-generated high) sediment loads, (2) protect adjacent diked lands and infrastructure (e.g., Highway 37) from tidal flooding, (3) innovate geotechnical engineering to reuse onsite materials for ecotone levee construction, (4) protect against shoreline erosion, (5) maintain watershed storm runoff to the bay, and (6) integrate with surrounding natural and restored tidal marshlands. A key design objective was to hasten the establishment of vegetated tidal marsh in the site interior, in contrast to the slow process of waiting for accretion to reach suitable vegetation elevations followed by new recruitment and vegetative expansion. The resulting design innovations included vegetated intertidal “marsh mounds” and supratidal sidecast ridges that would serve as interior nuclei for vegetation establishment, break up wind-wave energy to promote sediment deposition, and reduce erosion pressure on the flood protection levee. Numerous small pilot channels, in addition to the large “trunk” channels, aimed to promote formation of a high density, natural channel network. The ecotone flood protection levee includes 10:1 to 20:1 side slopes and several small panes to reduce erosion, provide estuarine-terrestrial transitional habitats now and with SLR, and provide panne habitat found historically at the marsh-upland edge. This design won the 2005 CCMP Outstanding Implementation Award.

Keywords: tidal marsh, restoration, design, SLR, San Pablo Bay

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Construction Challenges of Translating the Sears Point Restoration Design from Paper to Mud

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San Francisco Bay Estuary is experiencing an unprecedented level of restoration, and more restoration acreage must be completed on a vastly accelerated timeline to achieve agreed upon conservation objectives and to give restoring marshes the opportunity to keep pace. The Sears Point Restoration Project comprises one of several large-scale tidal restoration projects implemented in recent years. Ducks Unlimited carried the preliminary design forward to implementation in partnership with Sonoma Land Trust and US Fish and Wildlife Service. The project design integrated lessons learned from previous smaller-scale projects, including the adjacent Sonoma Baylands, and incorporated a number of specialty habitat features, including root wads, marsh mounds, side cast ridges, miles of channel excavation, marsh pannes, and construction of a large flood control levee with a variable slope designed to provide marsh to upland transition habitat, as well as construction of a large channel linking the primary breach to the Petaluma River Navigation Channel. Earthwork including building a 1 million cubic yard levee – that is a quantity of earth sufficient to fill enough dump trucks to reach from Sears Point to San Diego when lined up end to end. We will share challenges and lessons learned during construction with the hope of informing future implementation efforts. Marsh pannes constructed on the habitat levee did not have a compacted or vegetated edge, and several experienced drainage through low erosive places in the panne rim. Dredging the connector channel in potential endangered species habitat required extensive monitoring and clearance surveys, as well as flexibility to redirect work. Nesting bird avoidance meant clearing much of the site and created a trade-off between giving the construction contractor the capacity to have a longer construction season to reduce overall construction timeline and cost, versus the desire to keep surface roughness.

Keywords: Sears Point, Levee, restoration, accretion, sediment, tidal marsh

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Strategies and Early Outcomes of Revegetating Marsh Mounds at the Sears Point Tidal Wetland Restoration Project

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The Sears Point salt marsh restoration project, located in the San Pablo Bay National Wildlife Refuge, utilizes a novel method of building sediment to accelerate marsh plain development. 500 earthen 'marsh mounds' have been built across the 955-acre site that are intended to lower erosion, promote sedimentation and serve as nuclei for the colonization of marsh vegetation. The levee was breached in October 2015 following construction of the mounds, returning tidal flow to the site. Early monitoring of the marsh mounds indicated that they were rapidly eroding, thus limiting their ability to achieve these goals. This project seeks to determine whether protecting marsh mounds through vegetative plantings and physical protective barriers is an effective method to reduce erosion and potentially promote sediment accretion. Additionally, the study addresses whether active plantings of foundation species can induce more rapid recovery of invertebrate communities. We installed experimental treatments containing plots of native *Spartina foliosa* and coir erosion logs alone and in combination on mounds in the spring of 2016. Plots have been monitored quarterly during the growing season for sediment quality and accretion, infaunal communities and benthic epifauna. Early results show no differences between treatments for sediment quality or accretion in the first year, but a correlation between higher *Spartina* density and lower erosion of mounds. Additionally, benthic epifaunal communities showed a trend towards an immediate response in the first season following planting, with more individuals present on *Spartina* mounds. We discuss the implications of using active revegetation as a strategy for habitat creation in restoration sites, and future planting strategies to maximize ecological recovery at Sears Point.

Student Award Competition: Yes

Keywords: tidal marsh, restoration, *Spartina foliosa*, invertebrate community, sediment, erosion

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Preliminary Findings on Vegetation, Hydrology, and Geomorphic Processes at the Sears Point Tidal Wetland Restoration Project

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The SF Bay National Estuarine Research Reserve (NERR) is conducting a five-year post-breach monitoring and coordinating across other monitoring entities for reporting purposes. The NERR is monitoring vegetation dynamics, geomorphology, and hydrology. A SFSU graduate student is testing techniques for stabilizing and planting the marsh mounds. The Sonoma Land Trust is actively managing invasive plants. Baseline topography by the Corps and mound studies began in 2015, aerial photography and bird studies started in 2016, and fish monitoring, bathymetry, LiDAR, and vegetation studies took place in 2017. Heavy wind events in spring and summer of 2016 and extreme high tides and storms during winter 2017 all exerted tremendous physical forcing on this young restoration site and will influence its long-term restoration trajectory. The unvegetated mounds have sustained erosion of 30-60cm with coarse eroded material deposited nearby. Little natural vegetation recruitment has occurred so far on mounds. However, natural tidal marsh plant recruitment in the intertidal zone of the transition levees has occurred, especially in wind protected areas. Accretion overall has been very high, ranging from 30-80 cm in the northwest over 1.5 years especially in the mound “flow shadows.” Natural vegetation recruitment in constructed marsh pannes has been robust. Considerable settling and scour of the levee separating Sears Point from Sonoma Baylands has occurred whereas the northern flood control and habitat levee has held up well. The rapid accretion and mound surface erosion is building a more uniform future marsh plain. Native *Spartina* success on the planted mounds and natural recruitment on the levees has raised Sears Point as a candidate for active ISP *Spartina* revegetation through adaptive management. Sears Point demonstrates that wind flow shadows of mounds and a good supply of suspended sediment can result in rapid marsh plain development despite extreme weather events.

Keywords: Tidal, Wetland, Restoration, Vegetation, Hydrology, Geomorphology, Accretion, LiDAR, Mounds, Pannes

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Documenting Increased Avian Richness and Abundance at the Sears Point Wetland Restoration Project Based on Point County Surveys that Include Citizen Science Monitoring

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To improve the understanding of avian richness and abundance as they forage and nest in restored tidal marsh habitat, eight annual point-count surveys at 12 point-count stations are coordinated by a consulting avian biologist and supported by more than 40 citizen-scientists who have documented the presence of eight avian guilds corresponding to diverse habitat types. Foraging and nesting occurs within diverse habitats such as tidal marsh, tidal mud flat, upland levee, beach, rocky shoreline, open water, and tidal panne. Shorebirds represented 36% of the total observations, followed by diving ducks 17%; dabbling ducks 14%; gulls, 11%; raptors, 11%; grebes 5%; rails 3%; and American Avocet/Black-necked Stilt, 3%. Notable differences in richness and abundance varied by season and shifts in habitat-type among points. Mudflats at low tide yielded greater richness among shorebirds, with Western and Least Sandpiper present at the majority of the 12 points for every survey, along with fewer numbers of Dunlin. Open water habitat at high tide yielded large numbers of diving ducks, with Greater Scaup and Canvasback most commonly recorded, in addition to one stiff-tailed duck guild member: Ruddy Duck. Puddle/dabbling duck guild members documented in the greatest abundance were Gadwall and American Wigeon. Preliminary results suggest that the restoration area provides multiple habitat types for resting and foraging bird species that utilize it within the Pacific Flyway migration corridor and it also serves as valuable stopover/"wayside" habitat. Created habitat at the site includes upland "islands" and emergent vegetation that promises to further increase foraging and nesting success among these species, in addition to potentially attracting listed resident species such as Ridgway's and California Black Rail that occur nearby. Valuable, ongoing citizen science participation for surveys in 2018 will continue to increase managers' insights into design strategies, with results again added to the California Avian Database Center.

Keywords: Avian, citizen science, restoration, point counts

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Fish Habitat Use and Insights from a Paired Sampling Strategy at Sears Point Tidal Wetland Restoration Project

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To improve the understanding of fish habitat use within a newly restored tidal marsh, an Adaptive Resolution Imaging Sonar (ARIS) was paired with traditional sampling gear (i.e., beach seine and otter trawl) to examine the fish community at the Sears Point Wetland Restoration Area (breached in Oct. 2015). Specific objectives of the study included examining fish use of several different habitat types within the restored tidal marsh and identifying the species using the habitats across multiple guilds. During sampling conducted in May 2017, a total of 24 paired transects and 18 paired beach seine hauls were completed. A total of 1,592 fish observations were made with the ARIS (1,018 during trawling and 574 during seining) and 591 individuals were captured with traditional sampling gear (441 by seine and 150 by trawl). Fish sampling resulted in high totals for both observed catch and species diversity (16 species), indicating extensive use of the newly restored habitat by a variety of fish species. Nearly 75 percent of the total fish catch was comprised of native species, with Bay Goby totaling nearly 40 percent of the catch. Differences in relative fish abundance between various habitat types were minimal, potentially due to the proximity and uniformity of many of the sampling sites as well as fluctuating tidal conditions. Notable avoidance behaviors of both beach seines and trawls, particularly among larger fish, were frequently observed after review of the ARIS footage, thus limiting comparisons of the data between the ARIS and each active sampling method. However, utilizing dual sampling methods allowed for a more in-depth examination of the fish fauna in a variety of habitats. More broadly, pairing an ARIS camera with conventional sampling gear that is used extensively throughout the estuary and Delta may yield important information about detection rates of larger, more mobile fishes.

Keywords: Fish Community, Fish Habitat Use, Tidal Marsh Restoration, Paired Sampling,

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