Nutrients & Dissolved Oxygen in Lower South Bay: Seasonal & Tidal influence

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Lower South Bay margins (sloughs and marshes) receive tidal water from the Bay, urban creeks, and treated effluent from the San Jose-Santa Clara Regional Wastewater Facility. The facility has studied this system for decades and recently increased focus on nutrient concentrations and ecosystem response to nutrient enrichment.

A nutrient concentration gradient from high to low with increasing distance from the RWF was established previously. To characterize responses to high nutrients, we present an analysis of nutrients and dissolved oxygen (DO) data collected monthly at 6 stations near the RWF discharge and continuous DO monitoring at one station in Coyote Creek near Drawbridge. Four continuous DO monitoring deployments were conducted during the year with each deployment spanning 2-weeks to capture spring and neap tides. The deployments coincided with solstices and equinoxes to characterize seasonality during some of the strongest and weakest tides of the year. Because deployments were timed with solstices and equinoxes, staff refer to the project informally as project Stonehenge.

Continuous DO from Project Stonehenge is highly variable with diurnal, tidal, and seasonal effects. Daily oscillations of DO follow a typical diurnal pattern: higher DO in late day, lower DO in early morning. This pattern reflects daily photosynthesis while respiration exerts a constant oxygen demand. Coupling tidal and diurnal changes shows higher DO during late day ebb tides, and lower DO during early morning ebbs. Influence by adjacent marsh water likely accounts for this and the magnitude tracks high and low mixing volumes associated with spring and neap tides.

Seasonal DO concentrations were lower during summer and fall ebb tides compared to flood, indicating higher oxygen demand in shallow marsh with increased temperature and light. Conversely, DO was higher during winter and spring ebb tides, likely due to stable phytoplankton and lower respiration rates.

Keywords: Nutrients, Dissolved Oxygen, Phytoplankton, Nitrogen

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Benthic Invertebrate Composition & Abundance in Lower South San Francisco Bay Margins

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San Jose-Santa Clara Regional Wastewater Facility discharges roughly 80 million gallons per day of tertiary treated wastewater to Artesian Slough and Lower Coyote Creek. To assess aquatic and benthic communities near the RWF discharge area, the facility began a pilot monitoring program in 2016. This program collects baseline information on the aquatic and benthic ecosystem in Alviso Slough, Coyote Creek, and Artesian Slough.

Benthic invertebrate grabs and zooplankton tows were taken bi-monthly at six stations to capture seasonal variability while nutrients and phytoplankton were collected on a monthly to bi-weekly basis at the same stations. This poster represents one of a cluster explaining results from facility Lower South Bay biological monitoring efforts. Results for benthic species community composition and abundance from March 2016 to March 2017 are presented and compared with results from a previous studies in 2014 and 2005.

A total of 45 distinct taxa were identified. The most abundant species included amphipods *Americorophium spinicorne* and *Grandidierella japonica*, clams *Gemma gemma* and *Potamocorbula amurensis*, and annelids *Streblospio benediciti* and oligochaetes. Annelid worms and arthropods were the most abundant groups at all stations while bivalves (clams, mussels and snails) were less abundant throughout the system. Of six stations sampled, the location in Artesian slough had the highest abundance of benthic invertebrates with a mean of over 20,000 individuals per m^2 over the sampling period (7 sampling events). Invertebrate abundance at the Mud Slough station in Coyote Creek was the lowest (14,093 individuals per m^2) and was dominated by *P. amurensis*, *S. benedicti* and oligochaetes.

Keywords: Benthos, benthic, clams, worms, amphipods

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Phytoplankton Community in Lower Coyote Creek a tributary of Lower South San Francisco Bay

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High nutrient concentrations (nitrogen and phosphorus) have contributed to eutrophication in many estuaries. The San Francisco Estuary is nutrient-enriched, particularly in the Lower South Bay (LSB) where the hydraulic residence time is relatively high and receives treated wastewater effluent from the San Jose-Santa Clara Regional Wastewater Facility (SJ-SC RWF).

To address concerns about potential eutrophication from nutrient enrichment, SJ-SC RWF performed monthly and quarterly monitoring of nutrients in water column at several stations downstream of facility discharge into Artesian Slough and Lower Coyote Creek. In 2016, monthly monitoring of phytoplankton species composition at six stations was added, alternating between spring and neap ebb tides. The objective of this monitoring is to characterize the phytoplankton community in proximity to SJ-SC RWF effluent discharge and look for the presence of Harmful Algal Bloom (HAB) species.

Over the 1-year study period, 105 Genera from 7 divisions were identified. Diatoms made up of the majority of species encountered (87.5%), followed by Cryptophytes (3.5%), Chrysophytes (2.5%), Dinoflagellates (2.3%), Cyanobacteria (2.2%), Chlorophytes (1.9%), and Euglenophytes (0.2%). Presence of HAB species was marginal with one occurrence of the dinoflagellate *Karenia mikimotoi*, at a very low density, and 27 detections of the cyanobacteria Planktothrix.

The Alviso slough station tended to have the highest overall phytoplankton densities, likely due to substantial input from managed pond A8, which has very high densities of phytoplankton. It is important to characterize both phytoplankton overall abundance and community composition because very little is known about specific phytoplankton community variability in South San Francisco Bay and the community response to high nutrient concentrations.

Keywords: Phytoplankton, Diatoms, Eutrophication, HAB

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Fish Populations in Artesian Slough and Lower Coyote Creek

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San Jose-Santa Clara Regional Wastewater Facility collaborated with University of California, Davis, to continue monthly fish population surveys in tidal marsh habitats of Lower South Bay, including Artesian Slough and Lower Coyote Creek. Surveys were performed using 10-minute Otter Trawls at several creek, slough, and Bay stations representing a range of habitats from restored intertidal ponds, subtidal creeks, and outer Bay.

From 2014 to present show presence and seasonal variability of 40+ species of fishes and macro-invertebrates. Species exhibited distributions along the tidal gradient, from predominantly fresh-treated wastewater effluent and creek water to saline Bay water. Surprising year-to-year population variations were documented for some species known to be local slough year-round-residents, such as Three-spined Stickleback, Pacific Staghorn Sculpin and Prickly Sculpin. Fish assemblages varied in response to freshwater supply with higher marine fish abundance and species richness during drought (2014-2015) and more freshwater species during an extreme wet year (2017).

Importantly, tidal marsh functioned as nursery habitat for many species as seasonal presence corresponded to reproductive behavior (e.g. adult Leopard Shark and Bat Ray arrived in spring to give birth), or were “young of year,” arriving as larvae from outside the marsh. Surveys document that restored ponds and adjacent sloughs in Lower South Bay provide spawning and rearing habitat for fishes known to be forage for birds (Northern Anchovies, Pacific Herring, Inland Silversides), recreationally important species (California Halibut, Starry Flounder, Striped Bass) and many native species (Prickly Sculpin, Bay Pipefish and others). Most notably, successful spawning of State-Threatened Longfin Smelt was documented for the first time in March and April 2017 as extreme precipitation and outflows in spring 2017 created a large area of rearing habitat. Results document importance and rewards of CCMP Blueprint Goal #4: “Improve water quality and increase quantity of fresh water available to the estuary.”

Keywords: Fish, Freshwater, Habitat, Restoration, Artesian Slough, Coyote Creek

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Bald Eagle Nesting in Lower South San Francisco Bay

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One highly celebrated outcome of the South Bay Salt Pond Restoration Project in 2017 has been the first documented Bald Eagle nesting and rearing of young in the City of Milpitas in 2017. This event signifies the convergence of at least three long-term trends: chlorinated pesticide bans since the 1970s, Bald Eagle species reintroduction to Central California and recovery since the 1980s, and local habitat restoration in the 2000's. The Milpitas eagle pair is one of seven pairs of bald eagles now nesting in the greater Bay Area. This is an unexpectedly dramatic recovery for a species that was practically extirpated from the United States, apart from Alaska, in the 1970s.

This poster tracks observations from fall 2016, first sighting of the male, through mid-2017, eagle courtship, feeding, nest-building, and rearing and fledging of one chick. The first-ever documented nesting of Bald Eagles in lower Santa Clara Valley was unexpectedly facilitated by nearby salt marsh habitat restoration starting in 2005, and more significant bird habitat management since 2013. Increasing populations of American Coot and wider range of striped bass fishing grounds were specifically observed to be supporting new resident bald eagles as apex predators.

Surprisingly, this pair of eagles chose to nest in a tree in front of an elementary school in a densely populated suburban neighborhood in Milpitas. Adult eagles were not disturbed by throngs of children arriving to school each day and clusters of amateur photographers lingering from morning till sunset. The Bald Eagle pair quickly inspired a dedicated fan club and Facebook group: originally called "Our Milpitas Eagles" now expanded and renamed as "Bay Area Birding and Wildlife." The human response to bald eagle arrival and nesting is as interesting and important to CCMP Blueprint Goal #4 "Champion the Estuary" as arrival of eagles alone.

Keywords: Restoration, Habitat, Bald Eagle, Raptor, Fish

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Pharmaceuticals in Wastewater at San Jose-Santa Clara Regional Wastewater Facility

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San Jose-Santa Clara Regional Wastewater Facility (SJ-SC RWF) participated in a study of Pharmaceuticals compounds in Wastewater in 2016 that was coordinated by the Regional Monitoring Program for Water Quality in San Francisco Bay (RMP). The SJ-SC RWF is one of the largest advanced wastewater treatment plants in Northern California and discharges to the ecological sensitive Lower South San Francisco Bay.

The facility had previously participated in a 2006 RMP study of pharmaceutical compounds in influent and effluent. In 2009, the facility conducted an environmental fate and transport study of Pharmaceutical compounds in influent, effluent, and solids. These previous studies showed that most quantified pharmaceutical compounds are removed from effluent, however there were a number of compounds (Carbamazepine, Azithromycin, Fluoxetine, Ofloxacin, Albuterol, Lincomycin, Erythromycin) that are not efficiently removed by the advanced treatment process.

As a follow-up to the 2006 and 2009 investigations, the facility collected three rounds of 24-hours composite wastewater samples from four process locations (influent, filter influent, filter effluent and final effluent) and reverse osmosis (RO) reject from Silicon Valley Advanced Water Purification Center (SVAWPC) which is discharged to final effluent. Samples were analyzed for 104 pharmaceutical compounds including antibiotics and antibacterial agents, steroids, analgesics, and other commonly prescribed medications. Out of 104 pharmaceutical compounds analyzed in the first round, 25 were not detected or quantified. The results from this study will be compared to previous studies.

Keywords: Pharmaceuticals, Wastewater Treatment, San Jose

Poster Cluster Title: San Jose-Santa Clara Regional Wastewater Facility: Sustaining & Improving Water Quality & Habitat of Lower South San Francisco Bay

Chronic Toxicity Testing at San Jose-Santa Clara Regional Wastewater Facility: a 25-year history

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The San Jose-Santa Clara Regional Wastewater Facility (SJ-SC RWF), the largest wastewater treatment plant in San Francisco Bay, treats wastewater from a customer base of 1.4 million people, or roughly one-fifth of the entire Bay Area population. Roughly 100 million gallons per day of facility freshwater effluent flows through 2-mile long Artesian Slough then into Lower Coyote Creek and out to the Bay. Adjacent to these same waterways, at least 3,000 acres of former salt ponds were opened to circulation from 2005 through 2013.

Posters in this cluster document results from several research projects that document biological response to water quality along roughly 8 linear miles of creek and pond complex to the confluence with Lower South San Francisco Bay. The main

Originally built in 1956 as a primary treatment facility, the wastewater treatment process has been expanded and improved. Since 1998, the SJ-SC RWF has been treating wastewater to tertiary level standards which result in very little BOD and TSS, virtually no ammonia, and low concentrations of nitrogen and phosphorus nutrients on a per capita service basis.

The SJ-SC RWF discharges treated effluent which flows to recently restored wetlands and Lower South San Francisco Bay. This cluster of posters describes environmental science projects to investigate and describe the aquatic ecosystem downstream of the facility. It is hoped that these investigations demonstrate that the facility is supporting all four goals stated in the 2016 CCMP “Estuary Blueprint.”

Keywords: Toxicity, Chronic Toxicity, *Ceriodaphnia*

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