CUIMR-X-02-001 C2

Slough Channel Network and Marsh Plain Morphodynamics in a Rapidly Accreting Tidal Marsh Restoration on Diked, Subsided Baylands San Francisco Estuary, California

by

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B.A. (University of California, Berkeley) 1986
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M.A. (University of California, Berkeley) 1993

A dissertation submitted in partial satisfaction of the

requirements for the degree of

Doctor of Philosophy
in

Geography

in the

GRADUATE DIVISION

of the

UNIVERSITY OF CALIFORNIA, BERKELEY

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Spring 2002

Abstract

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Since 1850, nearly 90% (about 60,000 hectares) of San Francisco Estuary tidal marshlands have been diked and drained for agriculture, salt production, waterfowl management, and development. Resource managers envision restoring 22,000 to 27,000 hectares of these "diked baylands" for natural resource conservation purposes. These lands have subsidence below marsh plain elevations, between 0.3-3m, presenting challenges for successful marsh restoration because tidal marsh elevations

must be restored to provide target ecological functions. When opened to the tides, these sites become intertidal "basins" with net accretion rates strongly influenced by incoming sediment concentrations, wind fetch, storms, tidal currents, runoff, salinity, existing site landforms, baseline elevations, consolidation, compaction, desiccation, and biomass accumulation.

Past restoration efforts have been mixed in meeting ecological goals, often due to channel networks inadequate to provide full circulation and elevations and substrate poorly suited for tidal marsh establishment. Resolving these problems is essential to meet the Estuary's restoration goals.

This research examined temporal and spatial net sediment accretion patterns and the role of pilot channels and berms in controlling channel network evolution. This research used the Petaluma River Marsh restoration project, a 19-hectare diked bayland in the northwest corner of San Pablo Bay (subsided to local mean lower low water elevation) restored August 1994.

Small parallel berms spaced at 20m-intervals doubled channel density by promoting natural channel formation within the multiple small "watersheds" they create. Confounding site factors limit evaluating 35m spacing effects. Berms oriented across high velocity flow paths erode and thus do not promote channel formation. Pilot channels maintained planform position even while accreting sediment throughout their length. Minimal lateral migration occurred.

Accretion before vegetation colonization created gradients sloped away from the levee breach, controlled by the inverse relationship between elevation and accretion rates, velocity drops inside the breach, and within-tide variability in suspended sediment concentration. Once accreted to the distal reaches, elevations leveled out about 0.2m below mean high water. Subsequent static elevations with continued net sediment influx require similar magnitudes of competing processes that raise versus lower elevations. Summer low-tide exposure coincides with greatest winds, sunlight, and temperature that maximize elevation-lowering desiccation and consolidation processes.

ACKNOWLEDGEMENTS

This dissertation is funded in part by a grant from the National Sea Grant College Program, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, under grant number NA66RG0477, project number R/CZ-139 through the California Sea Grant College System. The views expressed herein are those of the author and do not necessarily reflect the views of NOAA or any of its sub-agencies. The U.S. Government is authorized to reproduce and distribute for governmental purposes.

This dissertation is also funded in part by grants from the San Francisco Bay Regional Water Quality Control Board; U.S. Fish and Wildlife Service, Division of Ecological Services, Coastal Ecosystem Program – San Francisco Bay Program Order No. 11420-0-M065A; U.S. Geological Survey, Western Coastal and Marine Geology Section, Menlo Park; and the Sonoma Land Trust. In-kind services were provided by Hammon, Jensen, Wallen and NASA Jet Propulsion Laboratory, Visualization and Earth Science Applications Group. The views expressed herein are those of the author and do not necessarily reflect the views of the RWQCB, USFWS, Sonoma Land Trust, HJW, or NASA.

The author would like to thank several people for their field and other assistance and support during conduct of this research: Douglas Allen, Paul Amato, Alan Ambacher, Peter Ashley, Philip Bachand, Bob Batha, Peter Baye, Chicory Bechtel, Andree Breaux, Paul Buchanan, Dave Cacchione, Richard Charter, Josh Collins, Bill Dietrich, John Dingler, Eric Edlund, Wendy Eliot, Jules Evens, Sergio Fagherazzi, Steve Goldbeck, Jon French, John Hacker, Jeff Hall, Cathy Hieb, Eric Jolliffe, Paul Jones, Durrell Kapan, Wyndham Kapan, David Katz, Maggi Kelly, Jimmy Kulpa, Eric Larson, Jim Levine, Karl Malamud-Roam, Jill Marshall, Vir McCoy, Brian Moody, Rick Morat, Dan Plumlee, David Schoellhamer, Jake Schweitzer, David Stoddart, Andrea Taylor, Kim Taylor, Charles Thompson, John Vollmar, Allen Wicks, and Carl Wilcox.