Restoring Ecologically Functional High Tide Refugia in San Francisco Bay Tidal Marshes

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I will discuss occupied indigenous lands stolen from the Ohlone, Coast Miwok, and Bay Miwok peoples.

Colonization is ongoing - few of these tribes are federally recognized.
San Francisco Estuary

- Watershed: Over 75,000 square miles
- Largest estuary on the Pacific Coast
- 50% of California’s freshwater
- Contains ~90% of California’s coastal wetlands
- Over 7 million people
SF Bay Regional Water Board

- San Francisco Bay
  - South Bay
  - Central Bay
  - North (San Pablo) Bay
- Suisun Marsh
- Pacific Coast from Walker Creek (Marin) to Pescadero Creek (San Mateo)
Wetland Loss in SF Estuary

- Salt ponds (40K ac)
- Farmland (50K ac)
- Managed wetlands (55K ac in Suisun)

~ 80% reduction in tidal marsh habitat since mid-1800s – 190,000 ac reduced to 40,000 ac
Subsidence of Diked Baylands

Elevations often subtidal or lower range of intertidal
Restoration Goals

- Mature tidal marsh plain (near or above MHHW)
- High tide refugia - Provided by vegetative canopy of specialists in the upper end of tidal range

Salt Marsh Harvest Mouse
*Reithrodontomys raviventris*

Ridgway’s Rail
*Rallus obsoletus*
Early Restoration Projects

Reclamation levees made of drained bay mud with steep side slopes → narrow “hedgerows” of gumplant

Tubbs Levee Setback

Sonoma Baylands
Later Restoration Projects

“Ecotone” levees with gentle side slopes to create transition zones & high tide refugia, and facilitate SLR-driven marsh transgression
Refuge at the Margins

- SMHM home ranges: about half an acre, can move 40 ft in 2 hours (Bias and Morrison 1999)
- Ridgway’s rails: tidal creeks are main movement corridors

Concentrating refugia at the margins can increase wildlife movement and predation risk during high tides, and increase the potential for conflict between wildlife and adjacent levee/land uses, especially w/ sea level rise!
So what does high tide refugia in natural marshes look like?
High Tide Refugia in Natural Marshes

- Marsh interior: tidal creek levees
- Marsh landward edge: grassland-marsh transition zones
- Marsh bayward edge: wave/debris deposits
Tidal Creek Levees

Sinuous, linear corridors of gumplant and pickleweed

China Camp, 2012

Newark Slough, 2014
Grassland-Marsh Transition Zones

Broad strips dominated by clonal perennial grasses, rushes, sedges, and forbs

Taller shrubs (gumplant, coyote bush) only in small patches
Bayward Debris Deposits

Debris often includes large wood, cattail wrack, and other materials
So how can we improve the quality and distribution of high tide refugia in restoring and downshifting tidal marshes?
Marsh Mounds

Excavated from local borrow sources, top elevations ≥ MHHW

Capped with locally transplanted high marsh sod/plantings
Thin-lift Placement

Use of sediment slurry (beneficial reuse!) to form naturally sorted deposits in existing marshes or future restoration sites, plant w/ native sods

Bothin Marsh (concept)

Graphic: Peter Baye

Novato Baylands
Woody Debris

Placement of logs/driftwood/etc. to create topographic variability & serve as trellises for climbing marsh species

San Rafael Bay

Sears Point
No, really, wood in marshes!

Salmon Creek Estuary Expansion, Humboldt Bay

Photos: Michael Love & Associates
And... trellises?!?

Pickleweed growing on an ornamental shrub

Check out Kelly Santos’s (SFSU) poster on *Suaeda californica* reintroduction to San Francisco Bay!
Beaches

Vegetative stabilization of placed sand, gravel, and shell hash

Geographic variation in San Francisco Bay beach forms, sediments, and processes: an overview

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State of the Sediment Workshop
April 19-20, 2010
San Francisco Bay Conservation and Development Commission
U.S. Geological Survey
Menlo Park, California
But... permits?!?

- CA Water Boards have independent authority under CA Water Code to regulate fill in wetlands (outside Corps)

- CA Wetlands Conservation Policy: “no net loss and a long term net gain in wetland acreage, functions, and values”

- Then: SF Bay’s post-colonial history → general prohibition on placement of fill in wetlands (or mitigate)

- Now: Effort by SF Bay Water Board to review and if necessary revise policies and regulations related to wetland fill to support long-term wetland resilience
Take-Home Messages

- High tide refugia (HTR) is provided by the canopy of plants at the upper end of the intertidal range – gumplant, pickleweed, maybe someday *Suaeda*?

- Tidal wetland wildlife have limited home ranges and need HTR in marsh interiors, not just the margins – see analogues in natural/ancient tidal marshes.

- Sea level rise threatens all landscape positions of HTR.

- Selective placement of sediment, wood, and other materials with proper revegetation can create HTR in marsh interiors, along channels, and along bayward margins.
Questions?

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