Blue carbon challenges in a California coastal salt marsh

Monique Fountain, Tidal Wetland Program Director
Elkhorn Slough National Estuarine Research Reserve

ESNERR Team

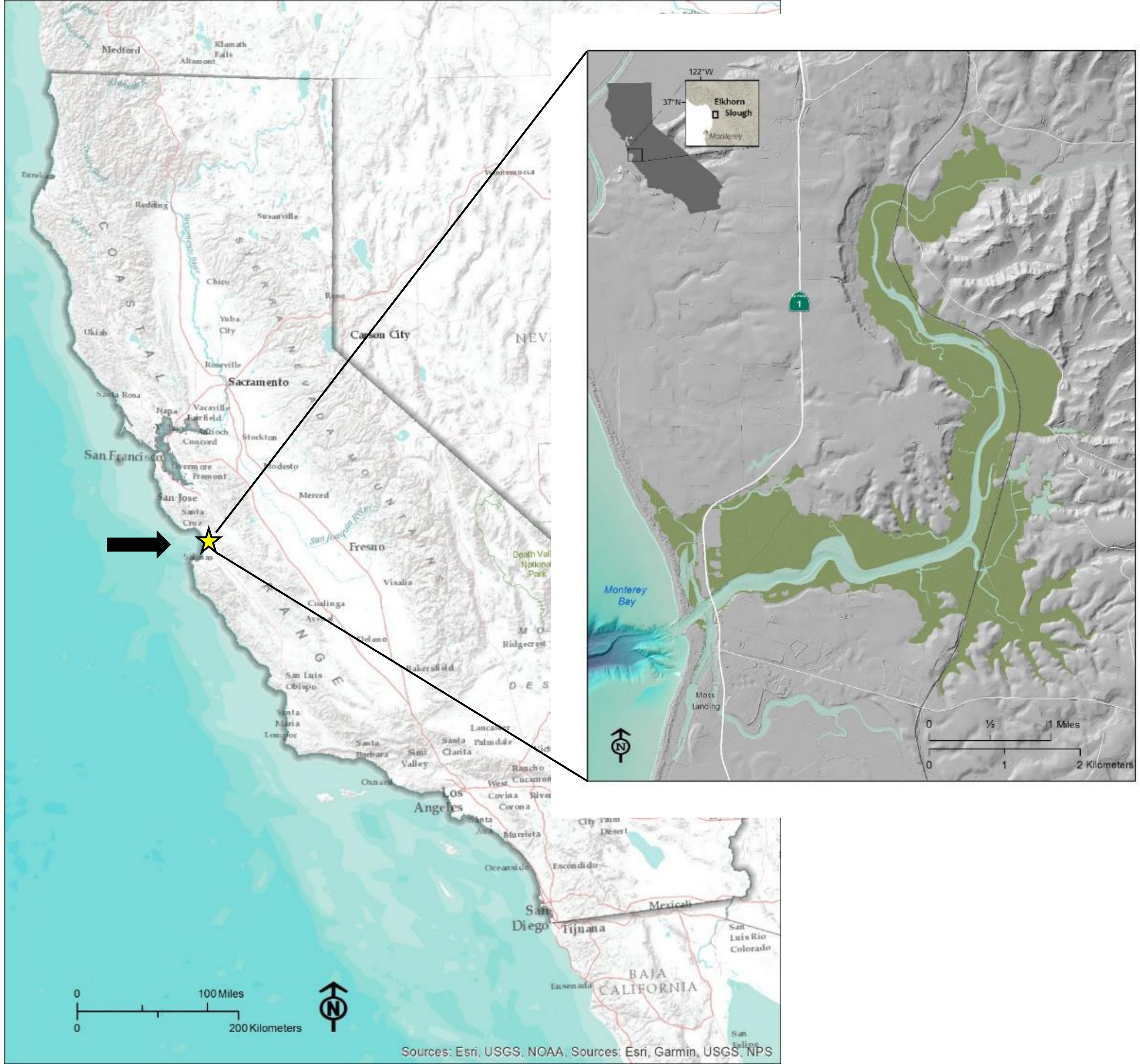
Dave Feliz
Susie Fork
Bill Fortner
Monique Fountain
John Haskins
Rikke Jeppesen
Kari Olsen
Mary Paul
Kerstin Wasson
Andrea Woolfolk

Collaborators

Beth Watson, Drexel University
Cathleen Wigand, US EPA, Narragansett, RI
Charlie Endris, Moss Landing Marine Labs
Ivano Aiello, Moss Landing Marine Laboratories

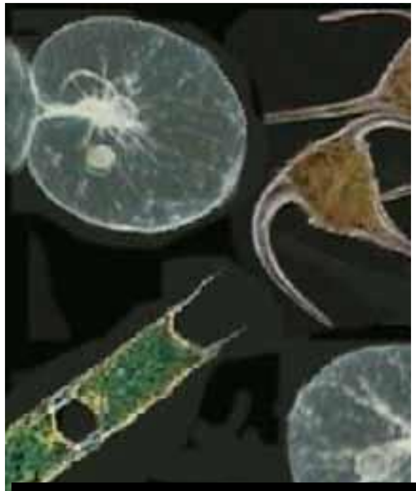
Funders

California Department of Fish and Wildlife
California Ocean Protection Council
California State Coastal Conservancy
California Wildlife Conservation Board
USFW National Coastal Wetlands Conservation

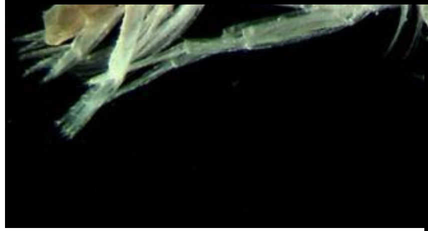


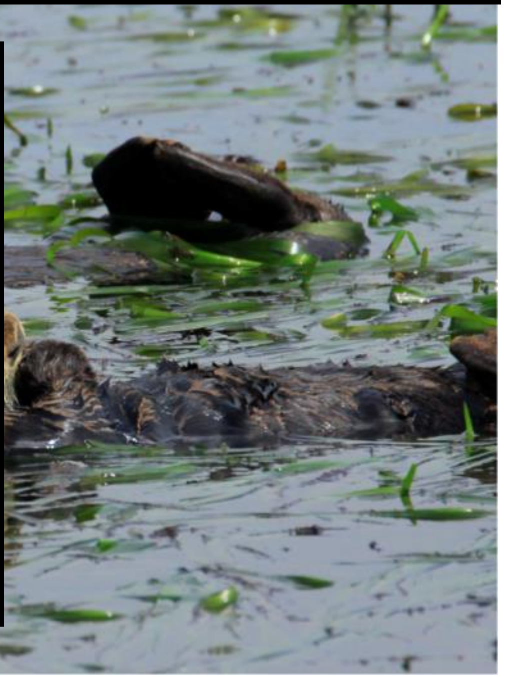
Medford
Klamath Falls
Altamont
Eureka
Redding
Susanville
Chico
Reno
Yuba City
Ukiah
Carson City
Roseville
Sacramento
Santa Rosa
Napa
Vacaville
Fairfield
Antioch
Concord
Stockton
San Francisco
Livermore
Fremont
Modesto
Merced
San Jose
Santa Cruz
Salinas
Fresno
Visalia
Coalinga
Delano
Ridgecrest
Bakersfield
San Luis Obispo
Santa Maria
Lompoc
Lancaster
Palmdale
Santa Barbara
Santa Clarita
Simi Valley
Oxnard
Los Angeles
Covina
Corona
Murrieta
Oceanside
Escondido
San Diego
Tijuana
Mexicali
San Luis Rio Colorado
Ensenada
BAJA CALIFORNIA
Death Valley National Park
0
100 Miles
0
200 Kilometers
Sources: Esri, USGS, NOAA, Sources: Esri, Garmin, USGS, NPS
122°W
37°N
Elkhorn Slough
Monterey
1
Monterey Bay
Moss Landing
0
½
1 Miles
0
1
2 Kilometers

Elkhorn Slough estuary – a gem in central California



High value system
both ecologically and economically



Elkhorn Slough marshes have sequestered a lot of carbon

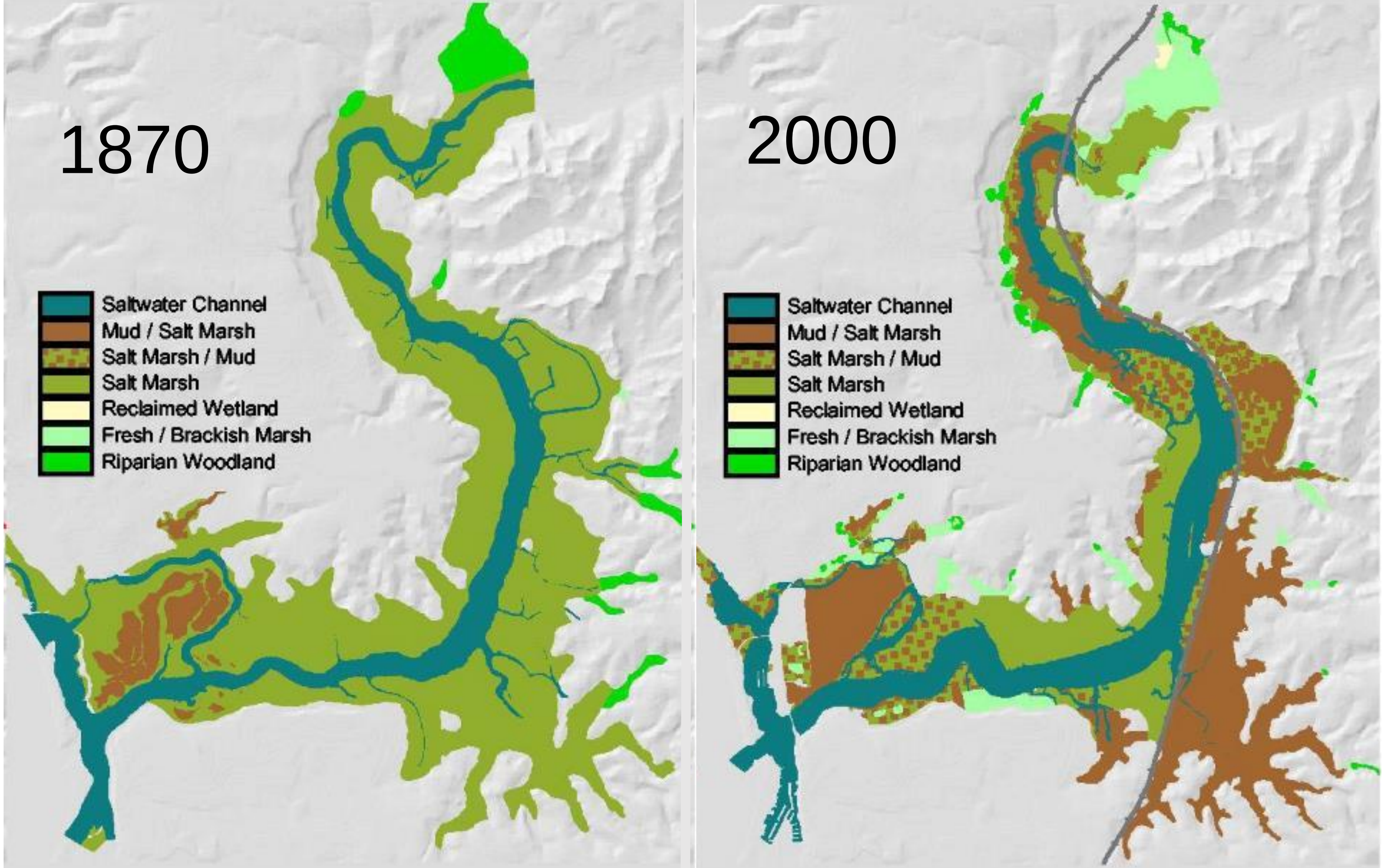
Restoration Ecology
THE JOURNAL OF THE SOCIETY FOR ECOLOGICAL RESTORATION INTERNATIONAL

RESEARCH ARTICLE

Applications from Paleoecology to Environmental Management and Restoration in a Dynamic Coastal Environment

Elizabeth B. Watson,[1,2,3] Kerstin Wasson,[2] Gregory B. Pasternack,[4] Andrea Woolfolk,[2] Eric Van Dyke,[2] Andrew B. Gray,[4] Anna Pakenham,[5] and Robert A. Wheatcroft[5]

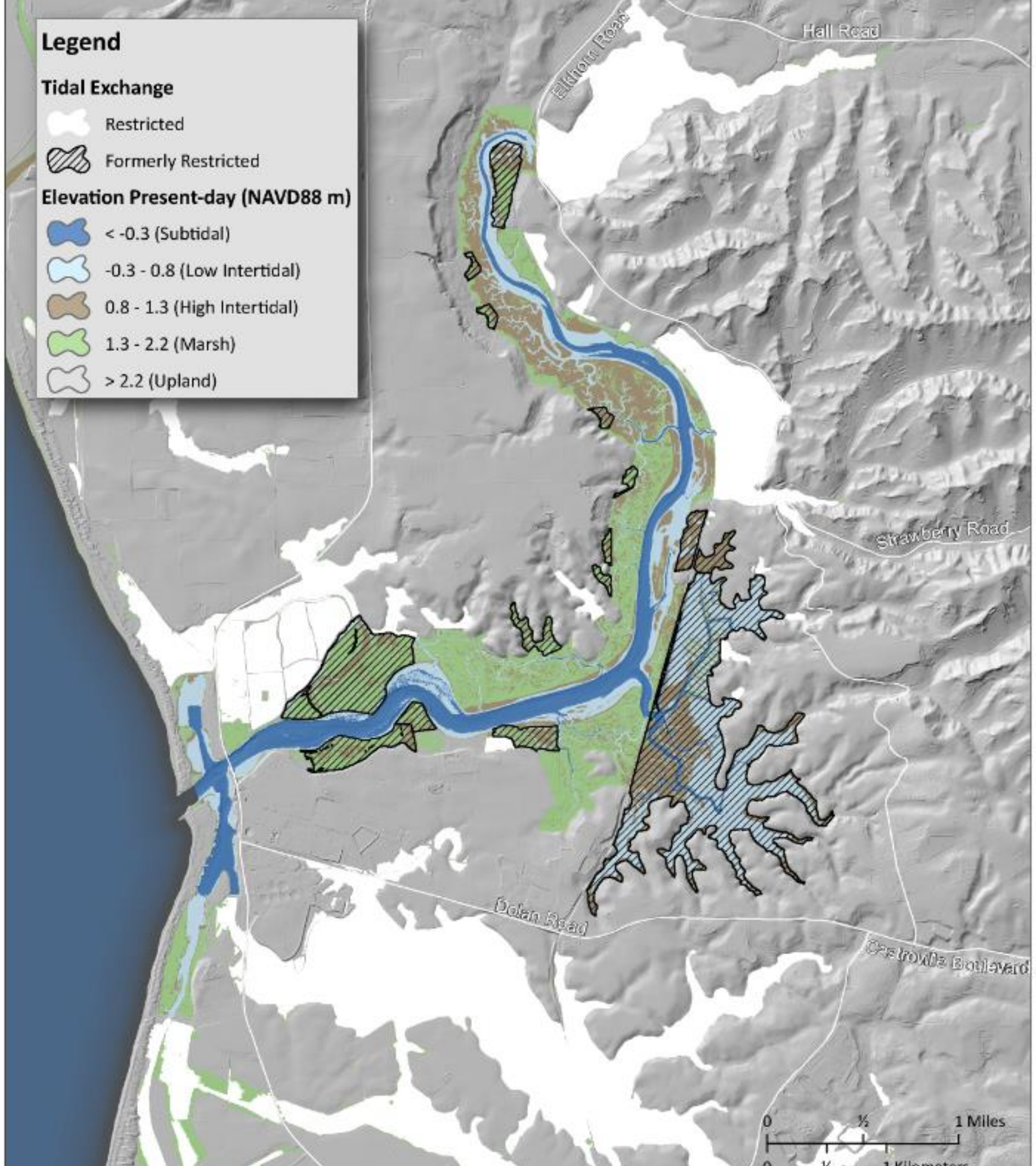
50% of Slough marshes lost to diking

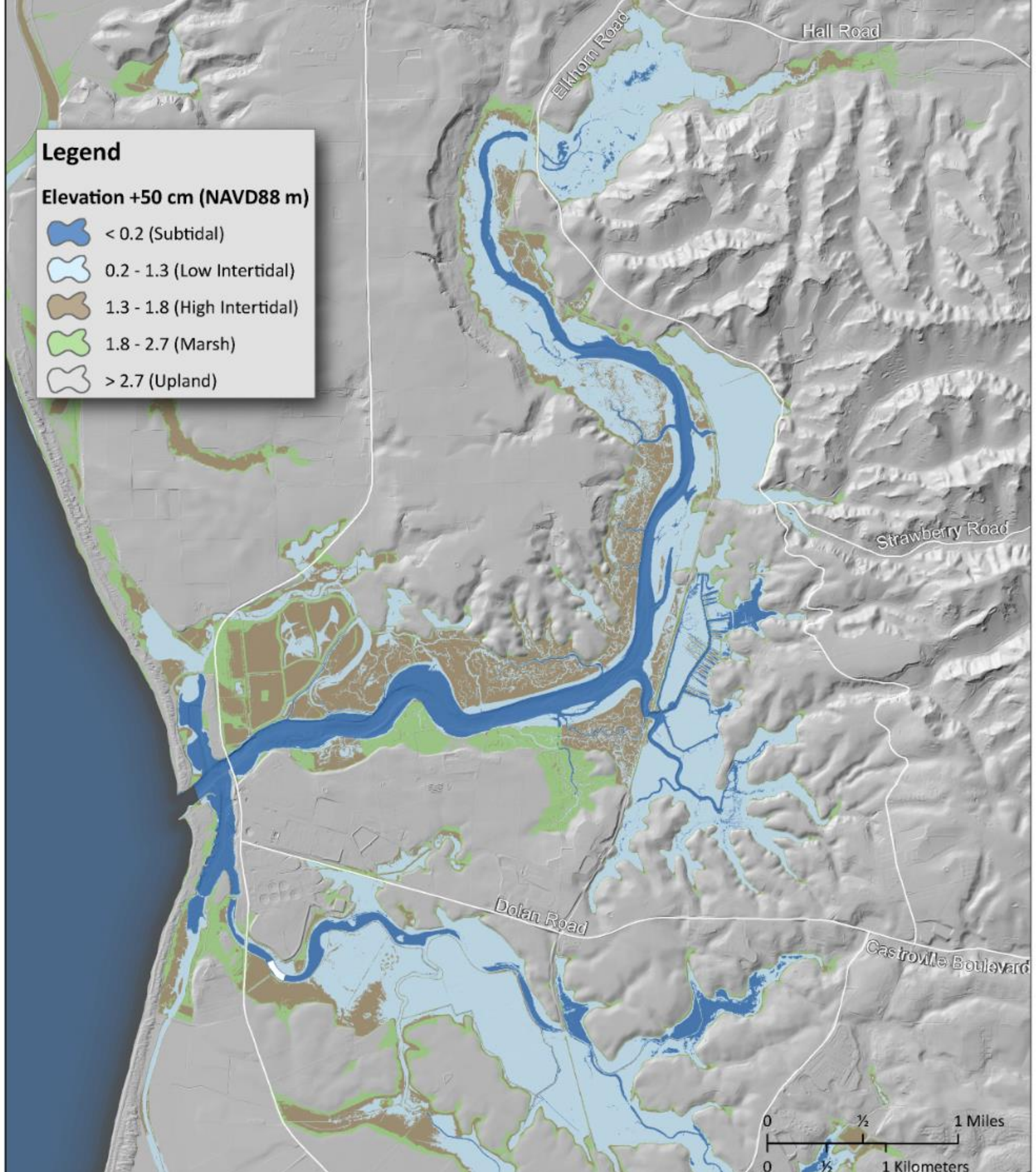


From Van Dyke & Wasson 2005

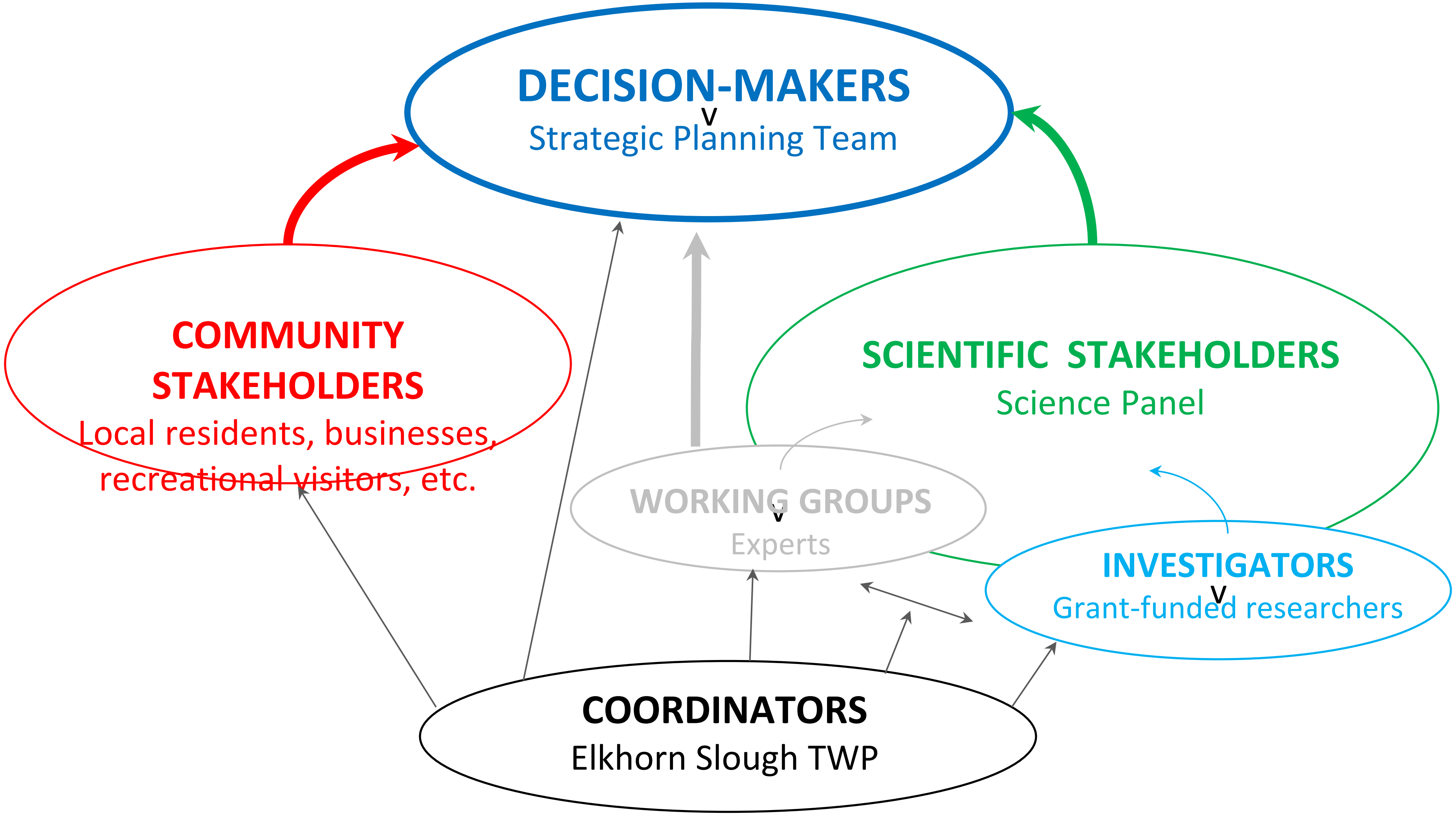
Legacy of diking persists in system with low sediment supply and subsidence

Remaining marshes are drowning already now, and will not survive much sea-level rise


Legend
Tidal Exchange
Restricted
Formerly Restricted
Elevation Present-day (NAVD88 m)
< -0.3 (Subtidal)
-0.3 - 0.8 (Low Intertidal)
0.8 - 1.3 (High Intertidal)
1.3 - 2.2 (Marsh)
> 2.2 (Upland)
Hall Road
Elkhorn Road
Strawberry Road
Dolan Road
Castroville Boulevard
0
½
1 Miles


Legend
Elevation +50 cm (NAVD88 m)
< 0.2 (Subtidal)
0.2 - 1.3 (Low Intertidal)
1.3 - 1.8 (High Intertidal)
1.8 - 2.7 (Marsh)
> 2.7 (Upland)
Hall Road
Elkhorn Road
Strawberry Road
Dolan Road
Castroville Boulevard
0
½
1 Miles
0
½
1 Kilometers

ESNERR TIDAL WETLAND PROGRAM: strategic planning for the estuary



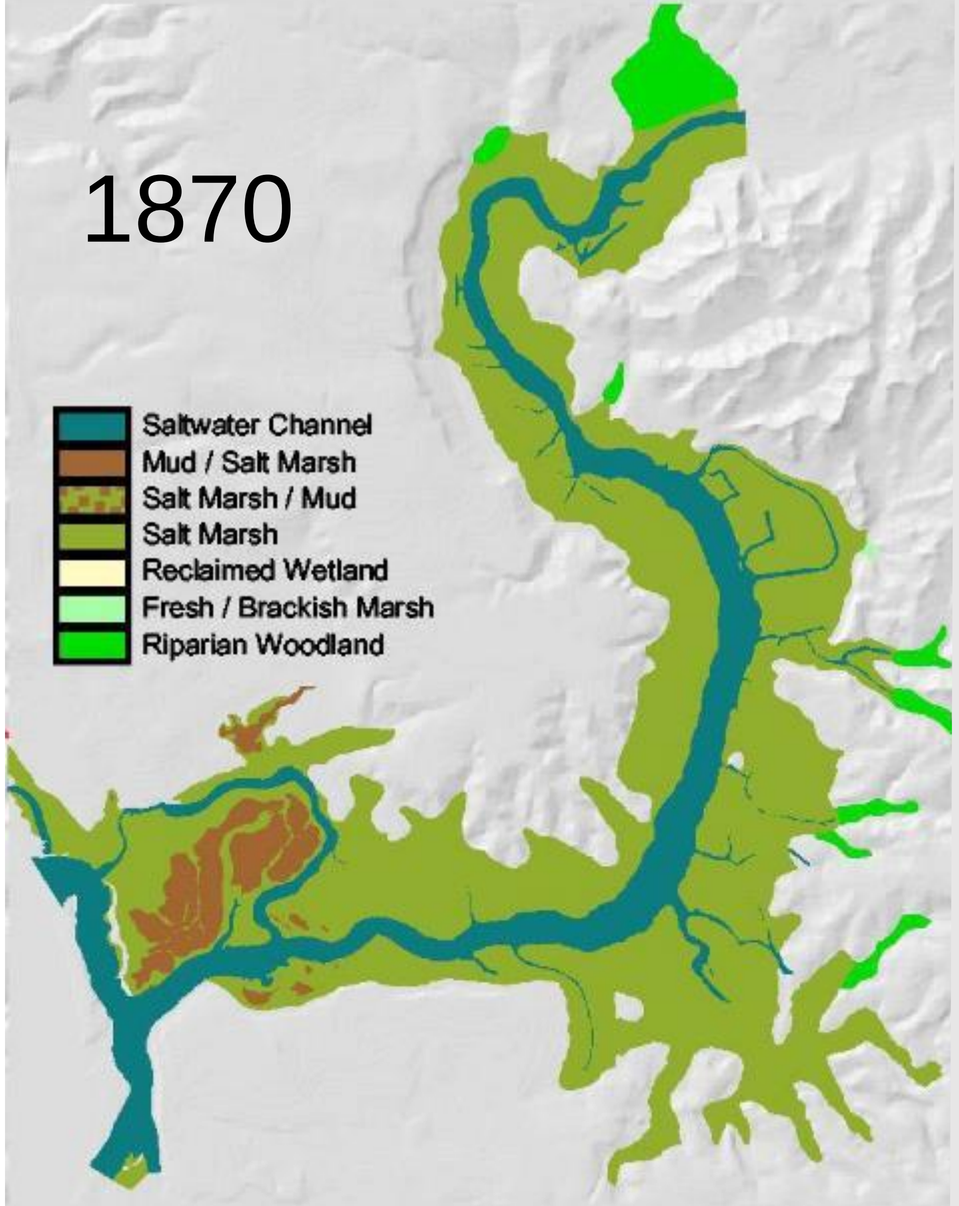
Option 1: Conserve existing tidal marshes

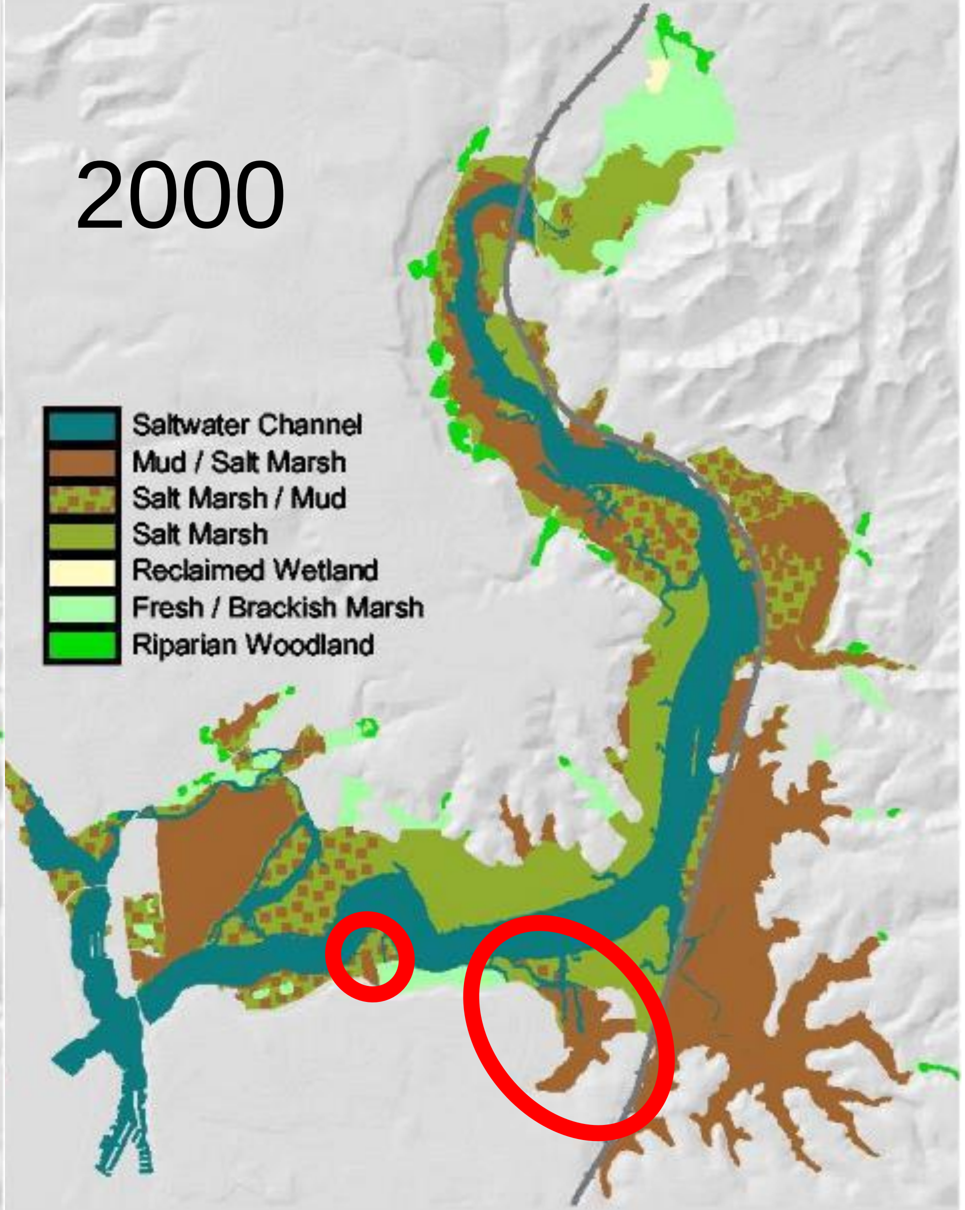
Option 2: Facilitate migration to higher ground

Option 3: Thin-layer sediment addition

Option 4: Thick soil addition

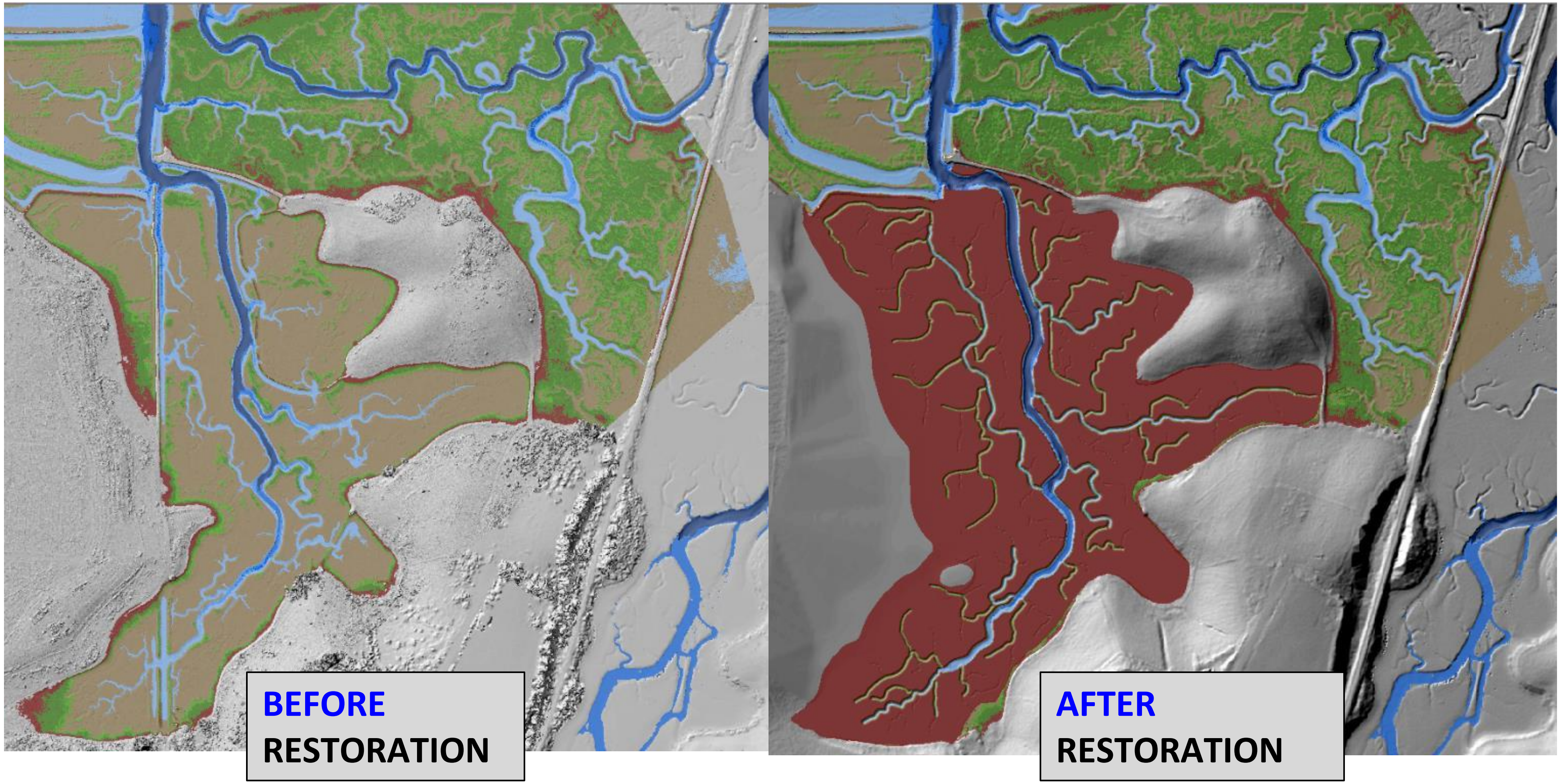
Hester marsh restoration

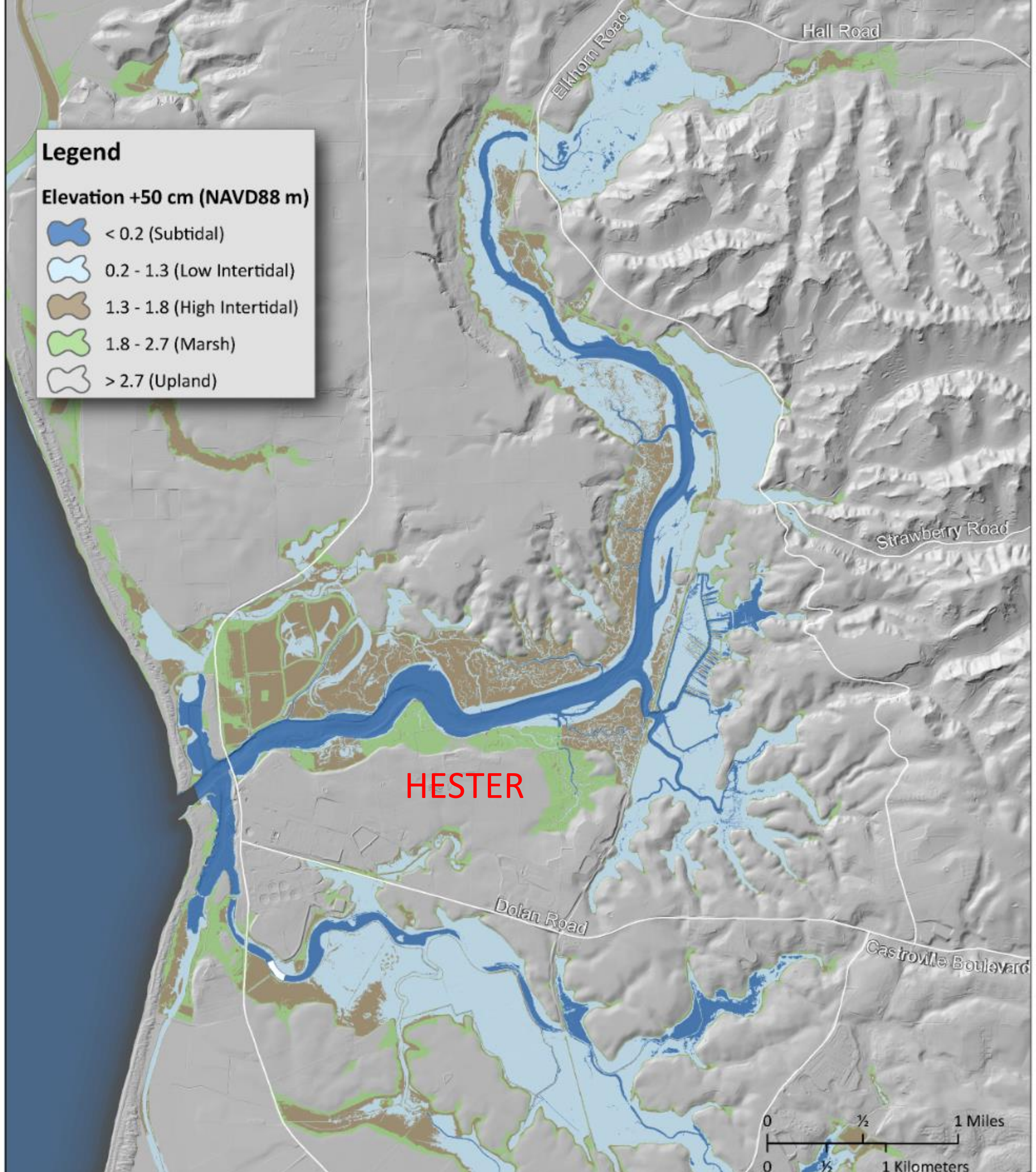




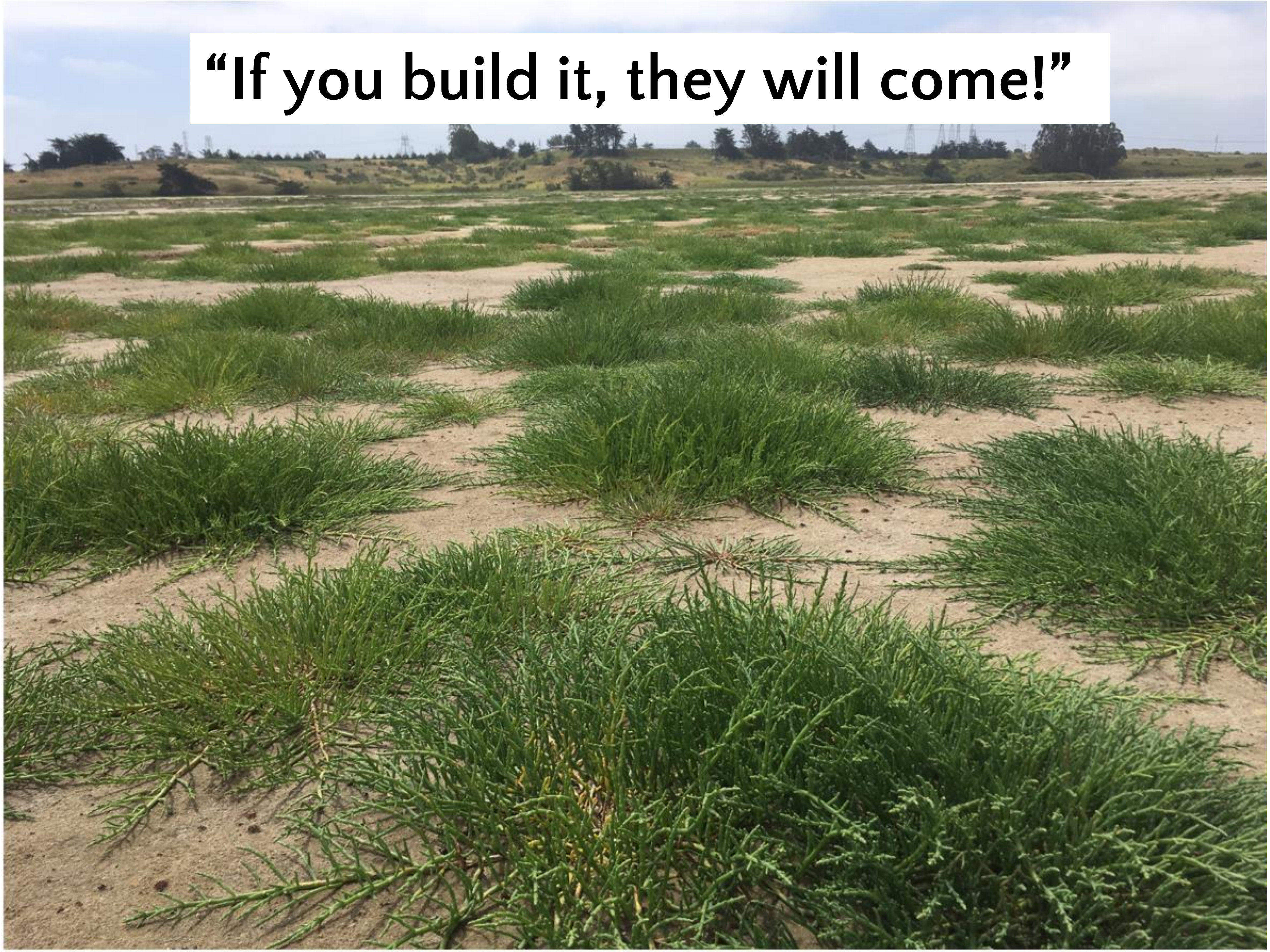
From Van Dyke & Wasson 2005

Transforming a formerly diked, degraded site to a high, climate-ready marsh




Legend
Elevation +50 cm (NAVD88 m)
< 0.2 (Subtidal)
0.2 - 1.3 (Low Intertidal)
1.3 - 1.8 (High Intertidal)
1.8 - 2.7 (Marsh)
> 2.7 (Upland)
Hall Road
Elkhorn Road
Strawberry Road
HESTER
Dolan Road
Castroville Boulevard
0
½
1 Miles
0
½
1 Kilometers

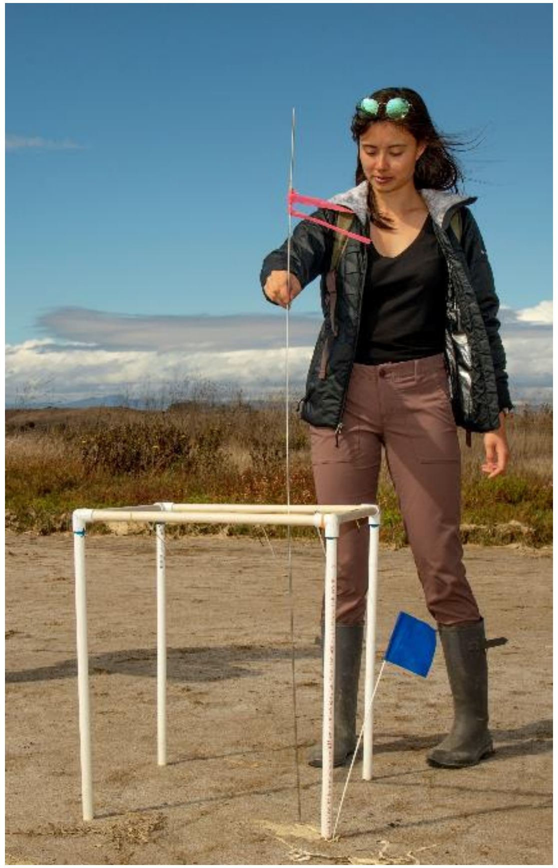
You can build a high marsh for tomorrow in place of yesterday's degraded wetland


“If you build it, they will come!”

Intensive blue carbon monitoring: management history

Pre-restoration

Post-restoration

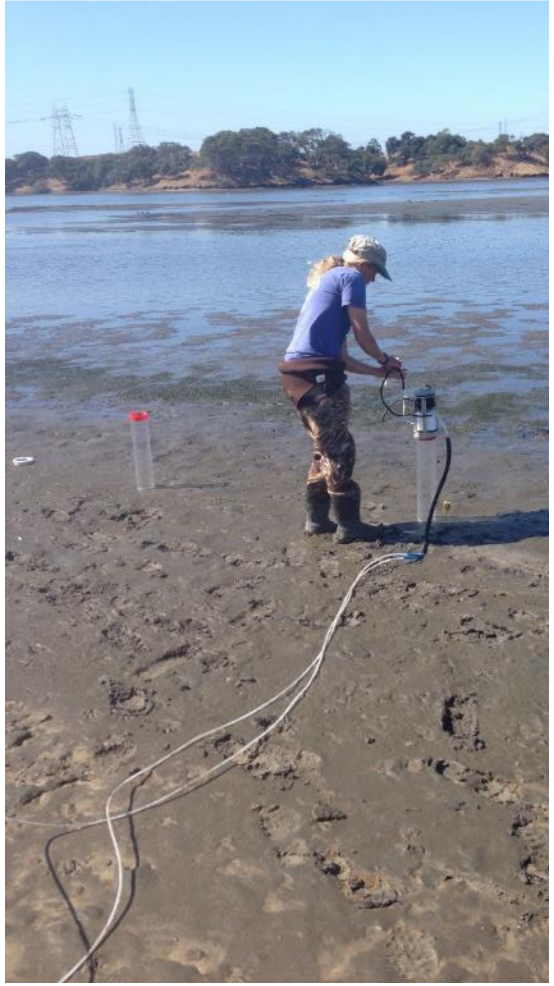


Degraded control

Reference

Intensive blue carbon monitoring: across habitat types

mudflat



salt marsh

grassland

Intensive blue carbon monitoring: multiple metrics

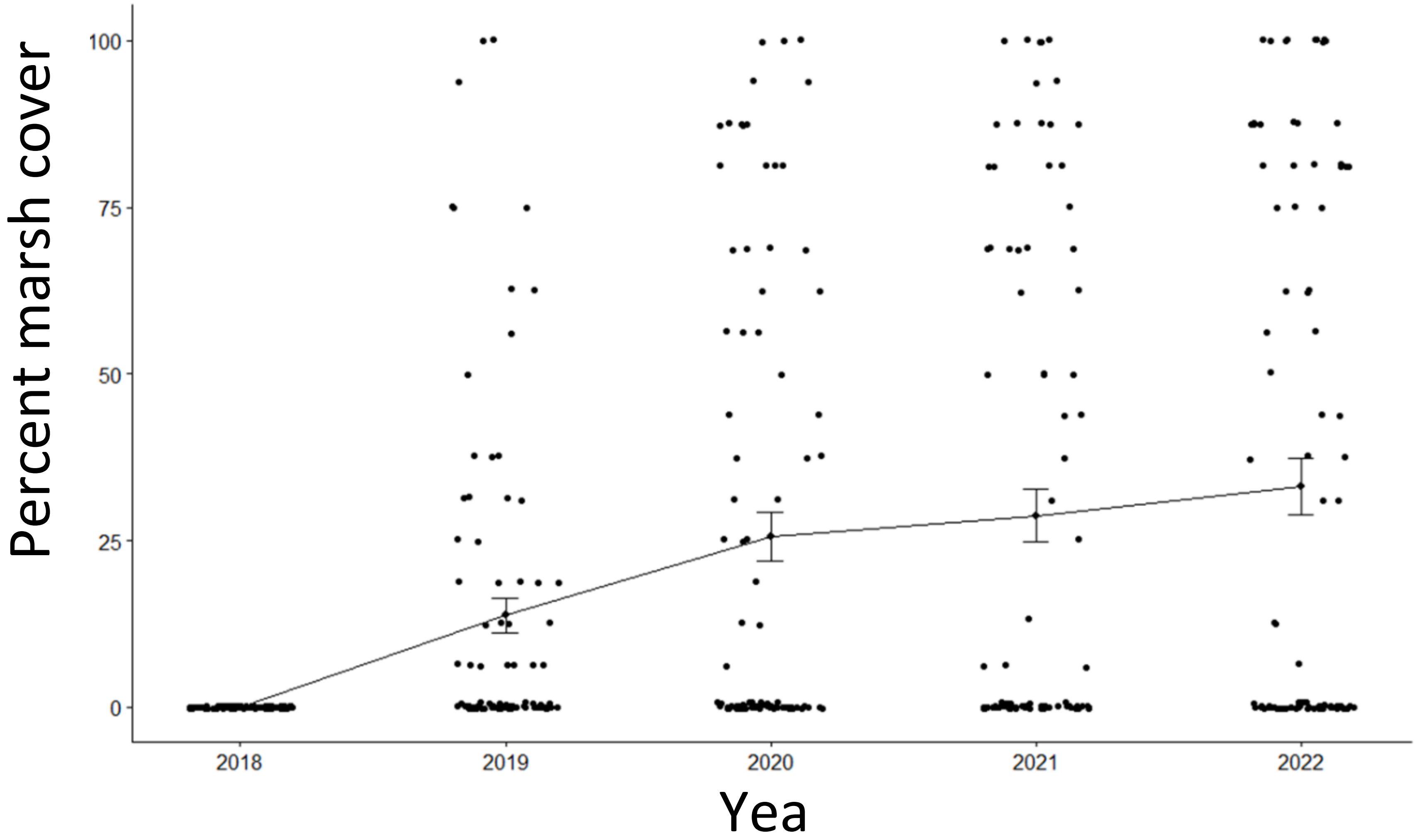
Above-ground C
in plants, sediment

Below-ground
in plants, sediment,
production/decomposition

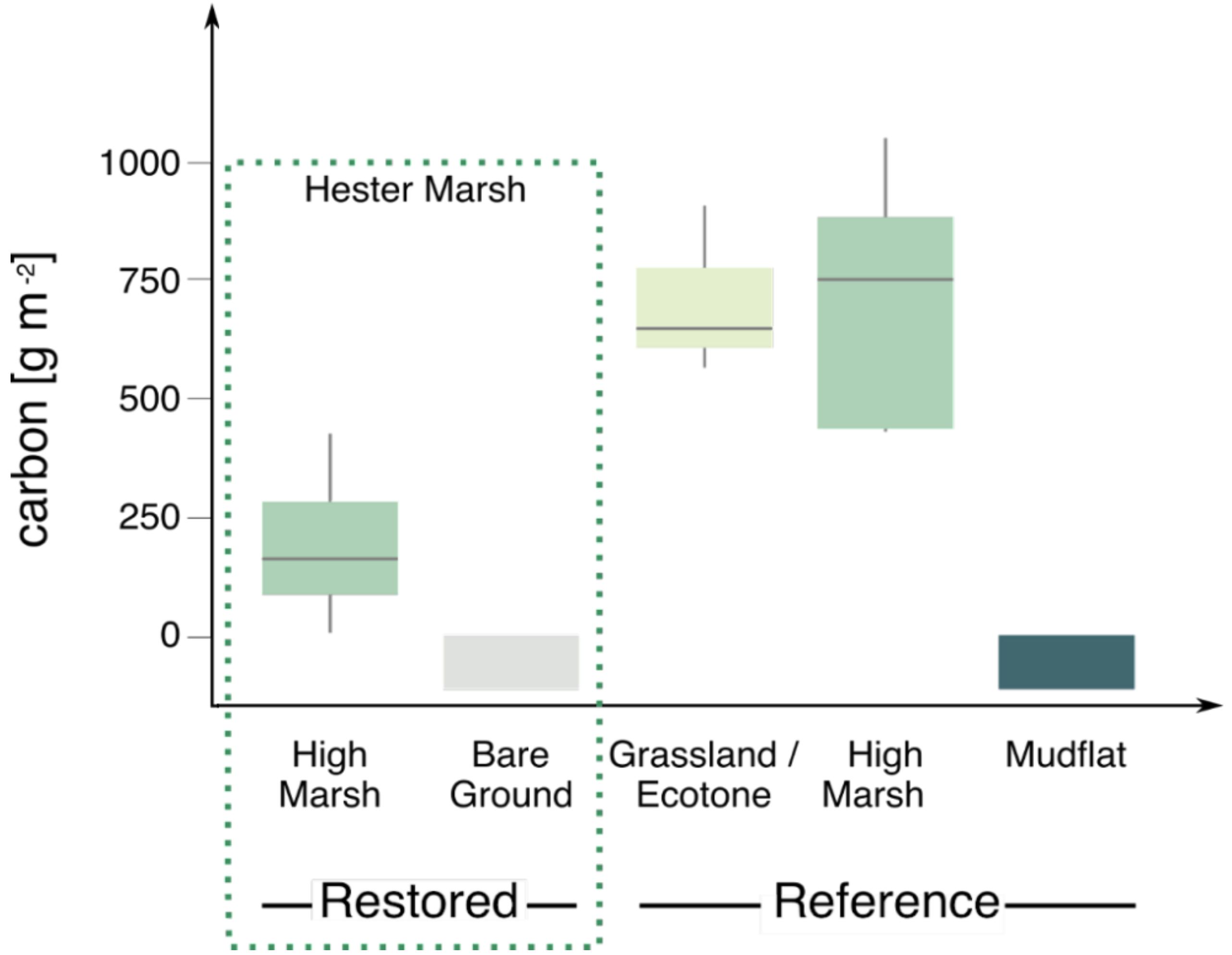
Gas flux

Colonization by vegetation takes time

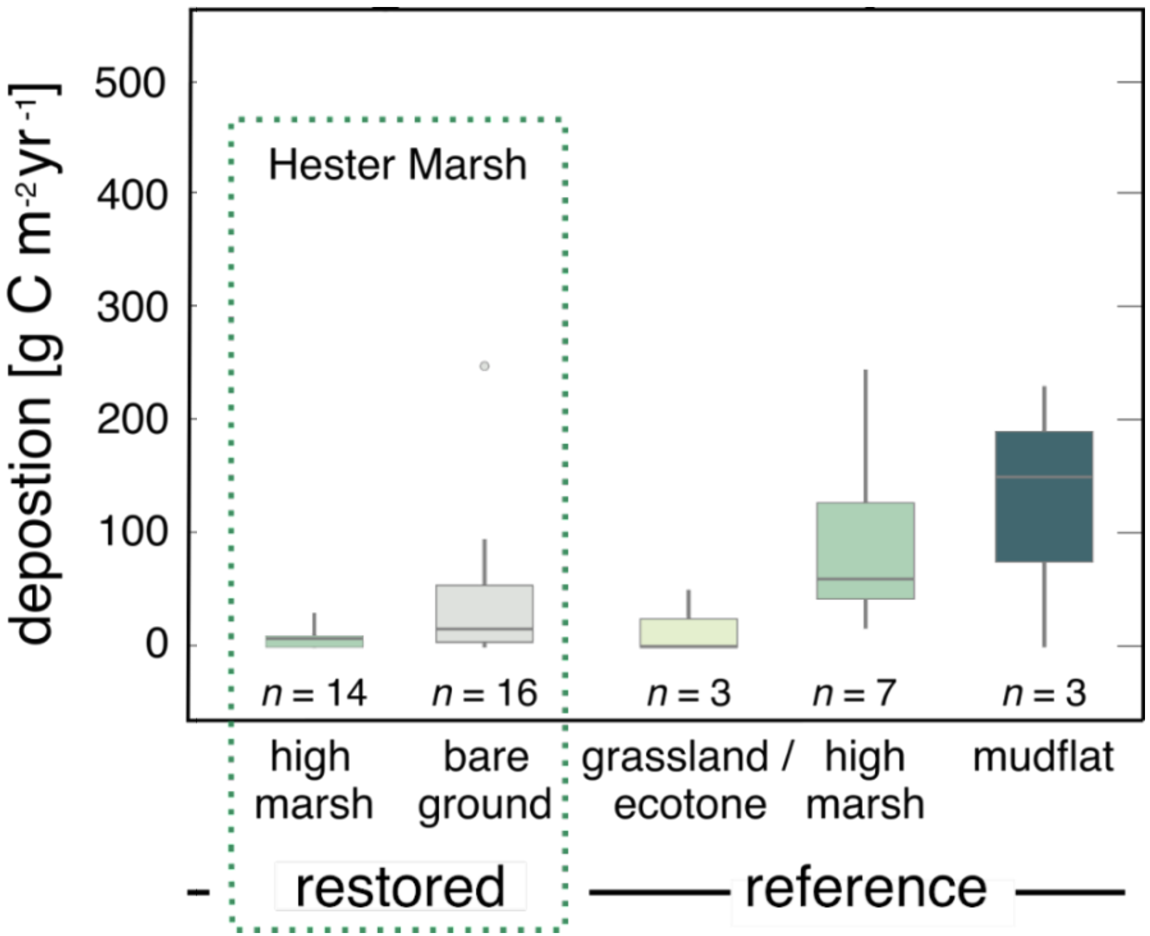
Have patience and plan far ahead, when building tomorrow's marshes



Above-ground carbon storage will be lower at restoration site than reference site for a while



Mudflats can have high carbon sequestration rate due to high accretion rates on surface



Calculating net blue carbon function integrating multiple metrics over time

Recognize value of mudflats for blue carbon function

Reference marshes outperform restoration site: when possible, conserve rather than restore

Plan far ahead for tomorrow's blue carbon function

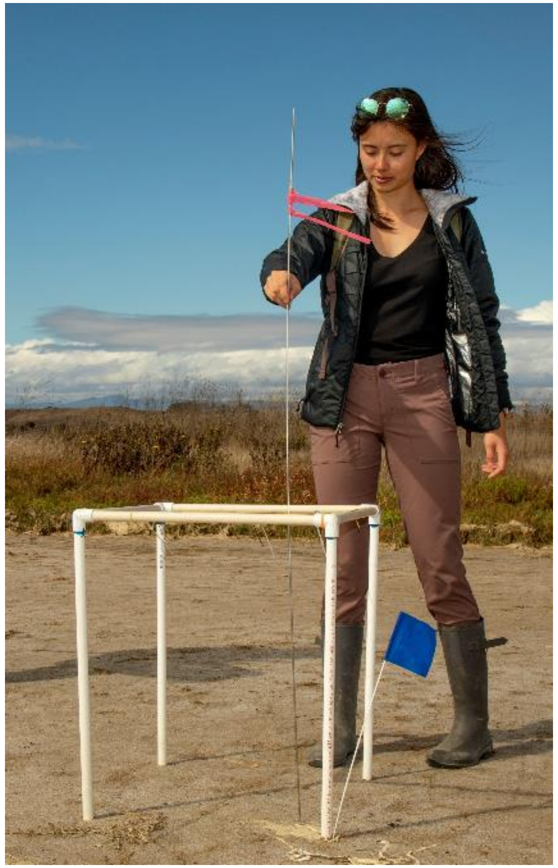
Trade-offs between blue carbon function now vs. future climate resilience of restoration site

Recap of key lessons learned

Diking led to extensive loss of marshes and decrease (but not total loss) of blue carbon function

You can build a high marsh for tomorrow in place of yesterday’s degraded wetland

Blue carbon monitoring should include multiple metrics, habitat types, and management histories



Plan ahead and be patient, and take care of existing marshes, because it will be a long time until restored marshes achieve their blue carbon function