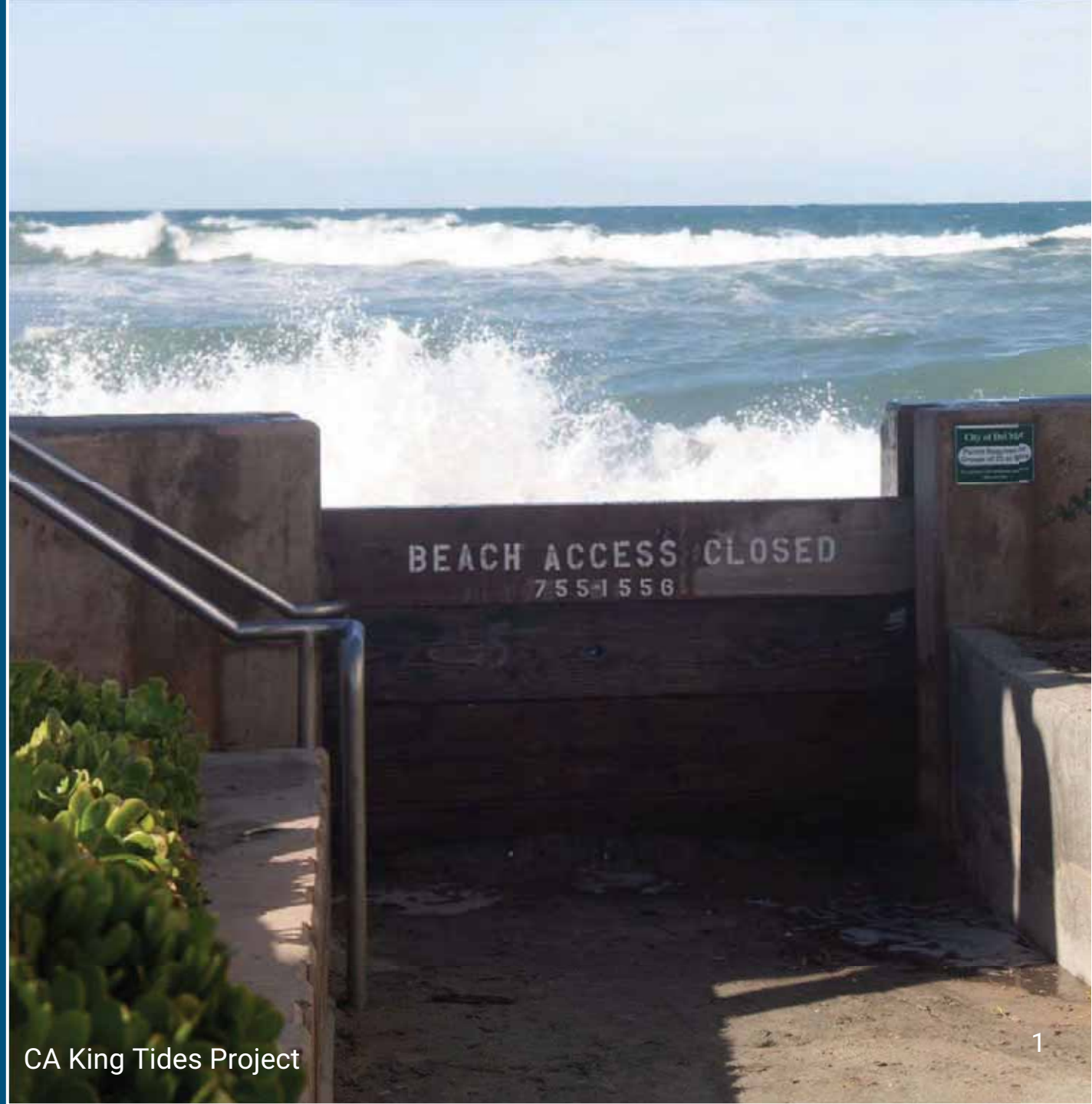
CSU Council on Ocean Affairs, Science & Technology

Sea-Level Rise Related Research

April 12, 2021



CA King Tides Project

California State University

>480,000 students

Largest and most diverse four-year public university system

CSU Council on Ocean Affairs, Science & Technology (COAST)

CSU's affinity group for marine, coastal, and coastal watershed related research.

COAST Goals

- Advance our knowledge of marine and coastal systems.
- Train the future workforce.
- Support informed decision-making and the development of responsible policy.

State Science Information Needs Program

- $3M one-time from FY 19-20 budget
- Directly and exclusively to support state needs
- Three SLR projects recently awarded for total of $1.1M (round 2 of funding)

Supporting informed decision-making

Equitable Coastal Access

SB 1--Atkins

Directs the CA Coastal Commission (CCC) to take SLR into account in its coastal planning, development, and mitigation efforts.

CCC Environmental Justice Policy

Guides CCC's permit and planning decisions to ensure that all Californians have equitable access to coastal natural resources.

Nature-Based Adaptation

LAO December 2019 report

Support coastal adaptation projects with widespread benefits (e.g. use of new techniques).

More efficient permitting processes.

AB 72--Petrie-Norris

Directs CNRA to create a more efficient regulatory review process for coastal adaptation projects.

Sea level rise adaptation: partnering with nature

Dr. Katharyn Boyer
Professor of Biology
Estuary & Ocean Science Center
San Francisco State University

Melissa Patten

Shoreline erosion

Up to 6 feet per year eroding away

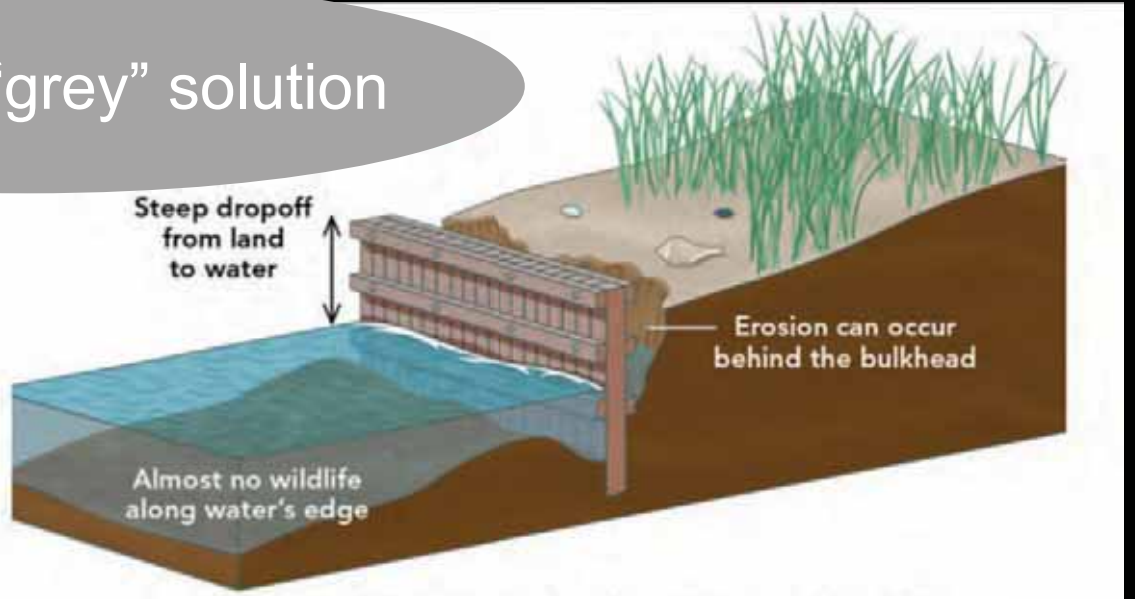
Muzzi Marsh, Corte Madera

~600’

Shoreline 1853

James Zoulas / SFEI

Traditional “grey” solution



Living shoreline

Illustration, Frank McShane

Restoration that enhances natural coastal habitats while protecting shores

Nature’s tool box

Working with key species and natural processes

Daniel Harris

Oyster reefs paired with eelgrass

Olympia oyster
(*Ostrea lurida*)

Eelgrass
(*Zostera marina*)

+

=

Photos, Stephanie Kiriakopolos

Bay

Shore

Geana Ayala

Bay beaches

Coarse sediment: sand, gravel, shell beaches

Common historic features in SF Bay – still examples

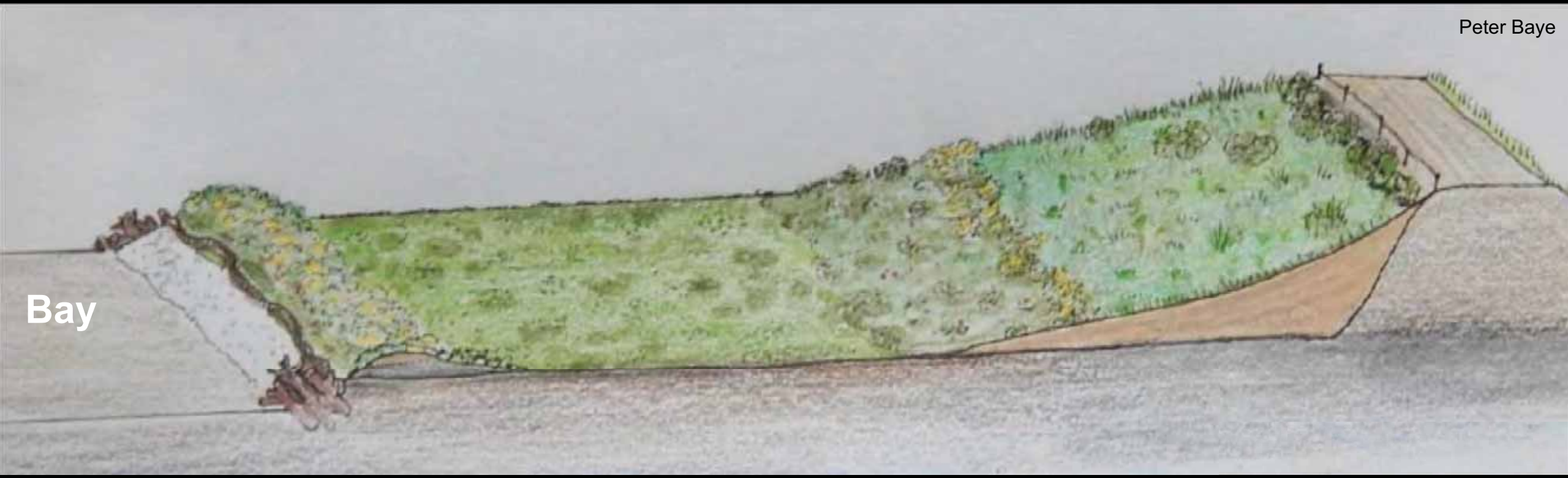
Protect tidal marshes and build elevation


Roberts Landing


South Bay Salt Pond


Outer Bair Island

Peter Baye



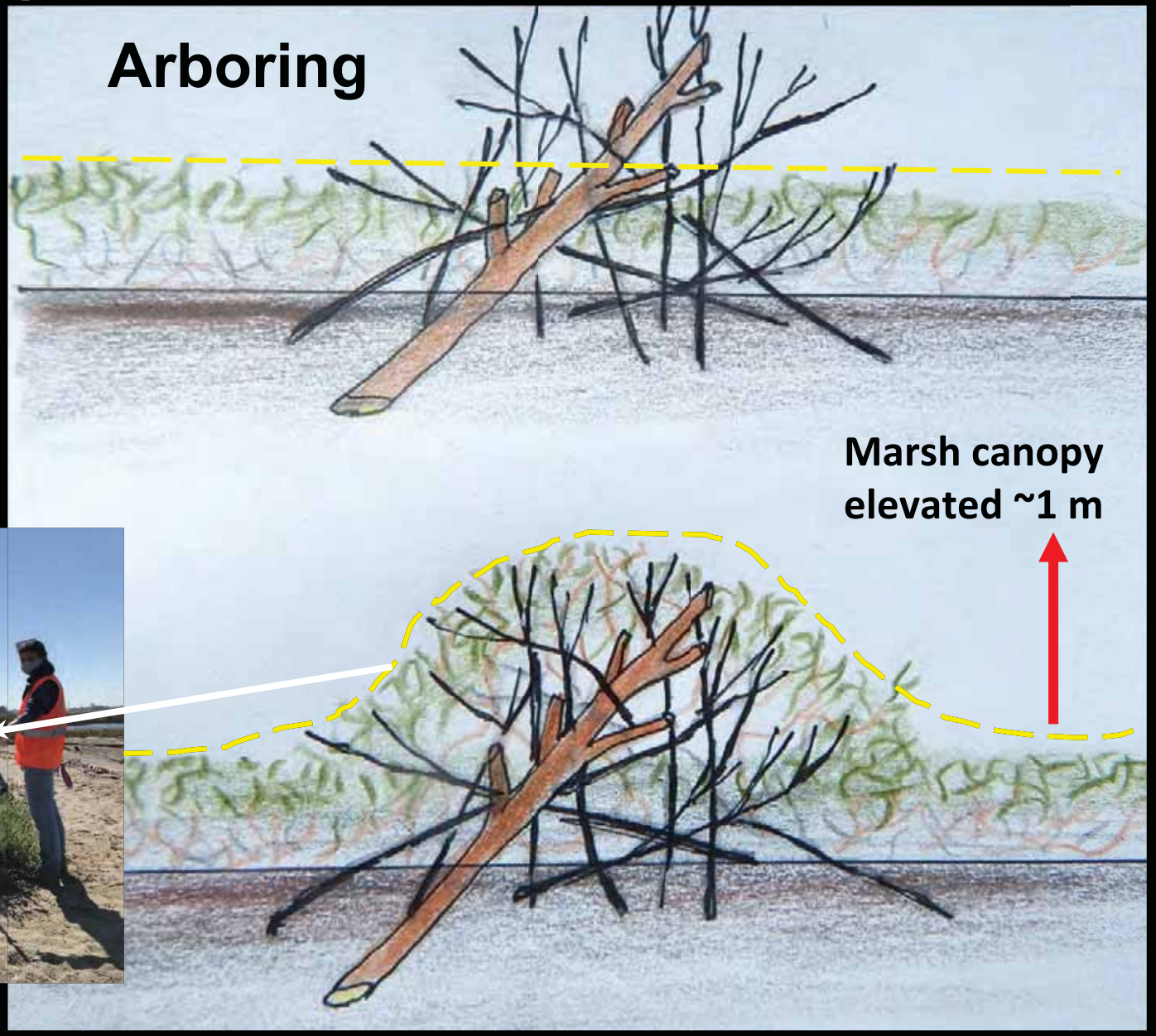
Coarse-grained beach

Tidal marsh

Room for upward shift

Levee

Growing high tide refuge



Concept, drawing & photos, Peter Baye

Adaptation requires resources…

Silicon Valley Community Foundation

Measure AA

…and support for greater community input

Bionic Team

…and trained scientists, engineers, and builders

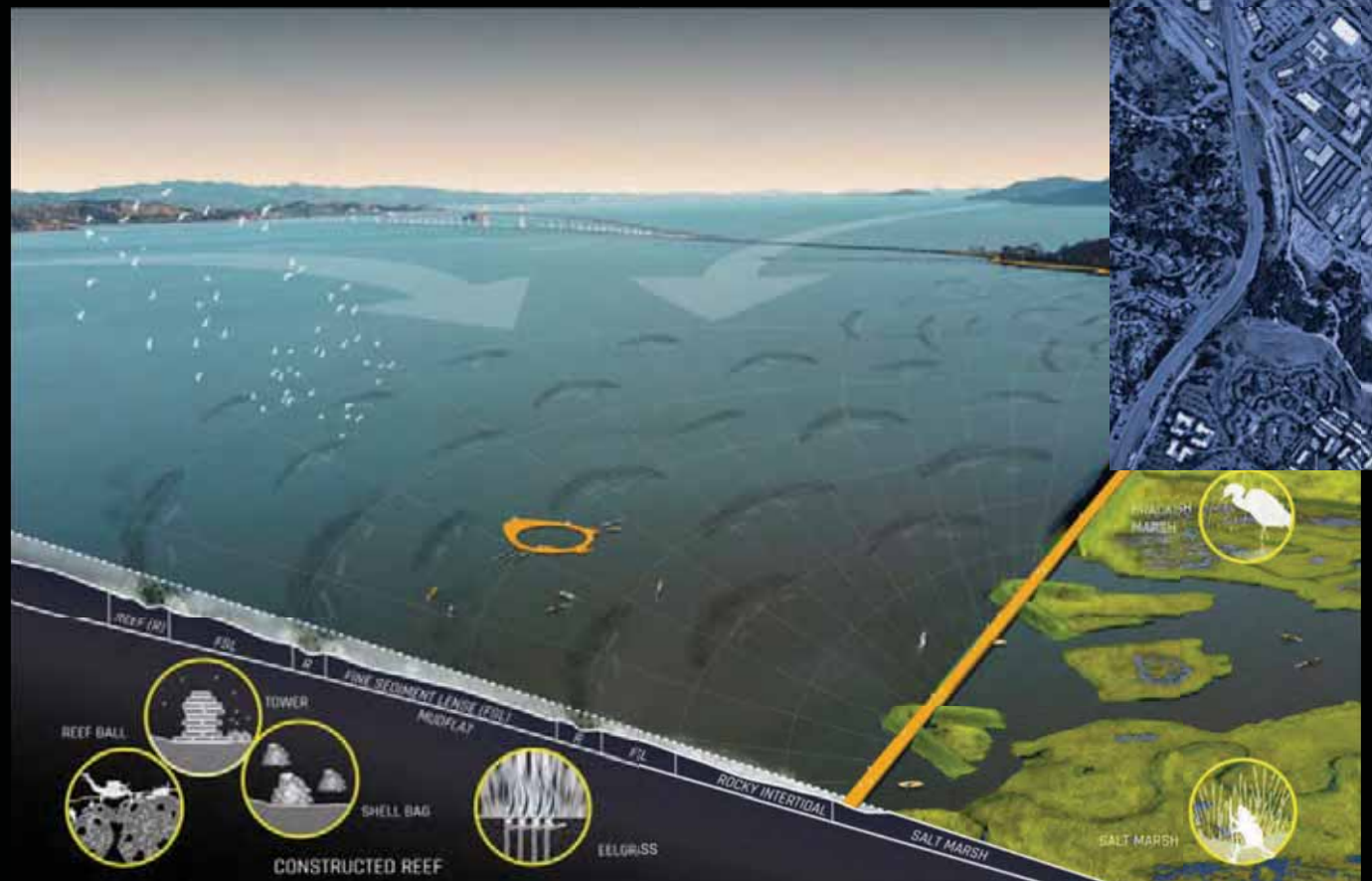

Melissa Patten


K. Boyer

...and partnership building

Stephanie Kiriakopolos

…to innovate, test, and scale up…

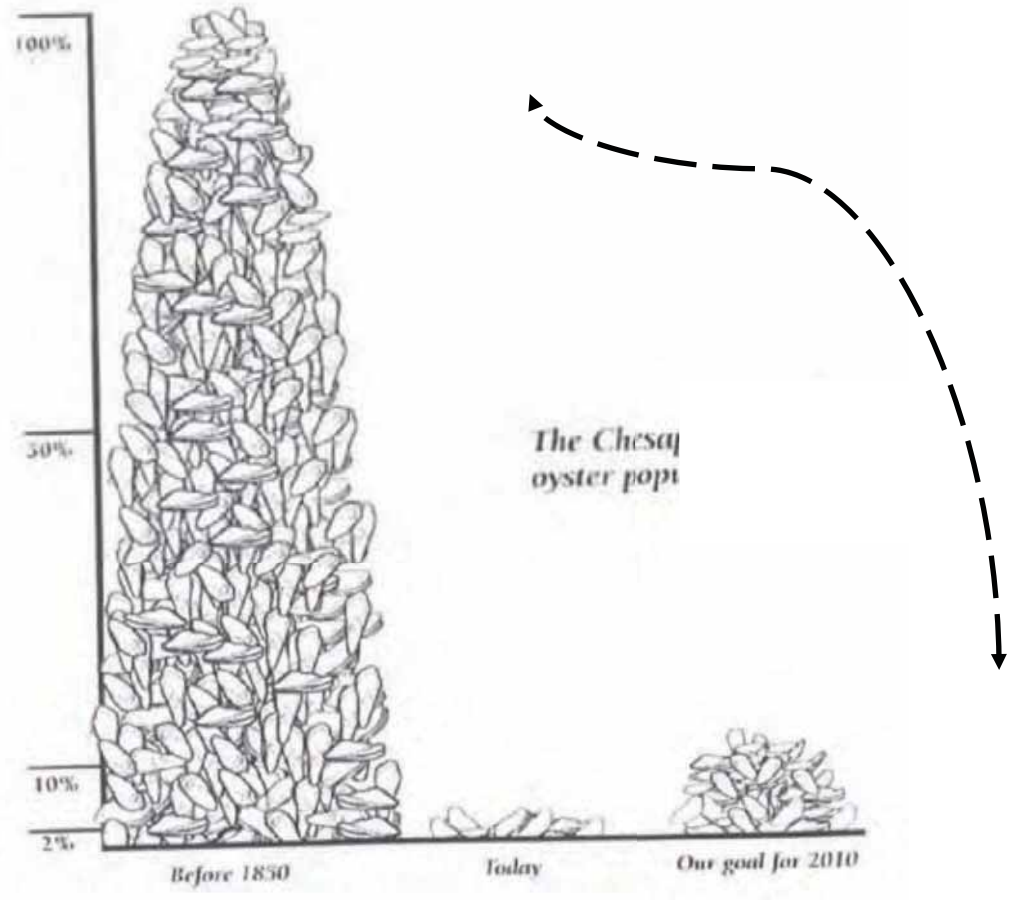


…and fast


Biological Sciences
Dr. Christine Whitcraft
Professor

Needs for scaling up restoration

- Funding
- Training & Education
  - Scientists
  - Community members
- Monitoring
  - Functions
  - Costs
- Community support

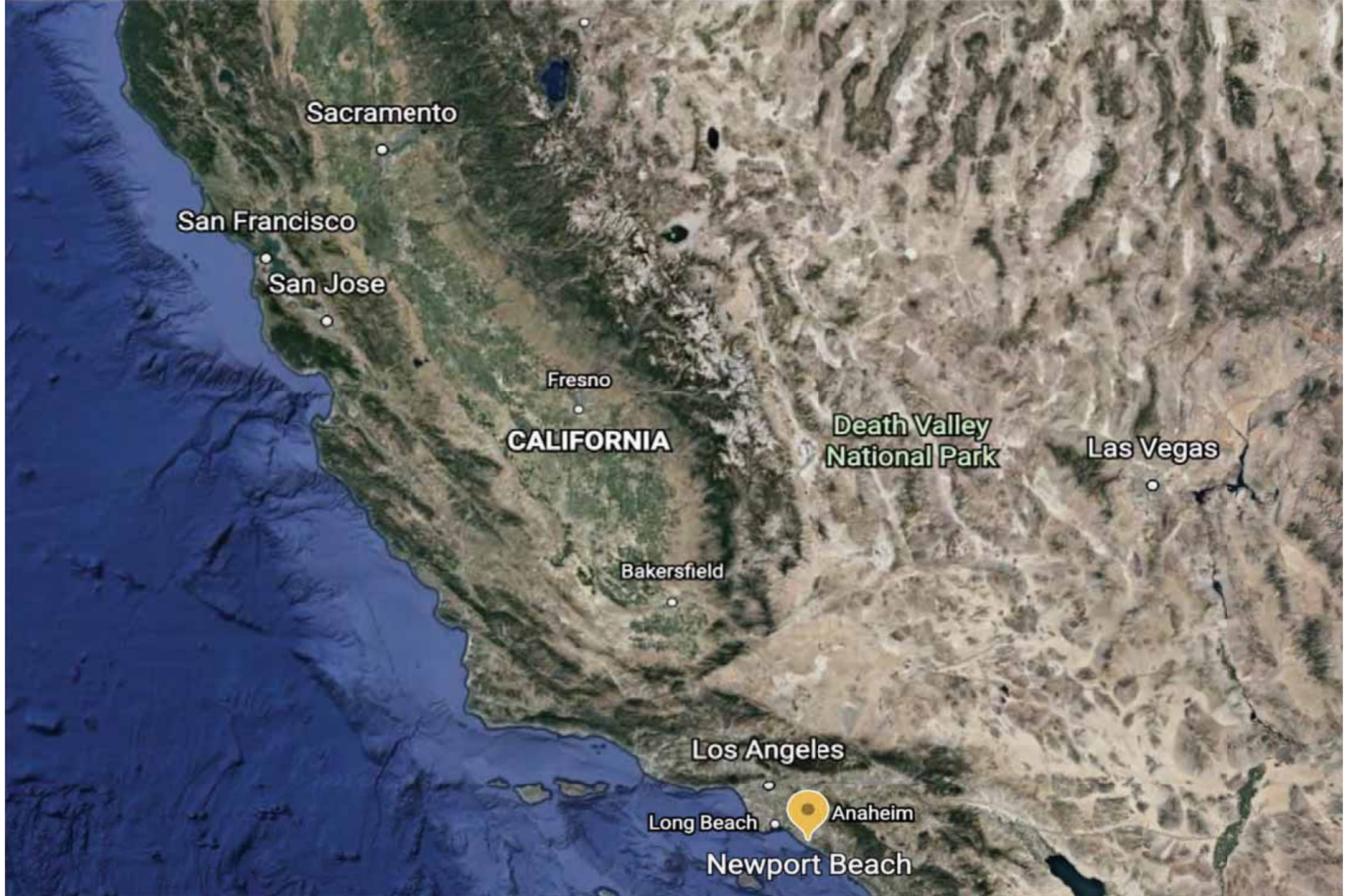


Not possible without….

Funding and Partners

Undergrads & Graduate students

- Terry Champieux
- Chloe Van Grootheest
- Nick DaSilva
- Kenneth McCune
- Madison Thomas
- Marjorie Howard*
- Victoria Wood*
- Cody Fees*
- Elishebah Tate-Pulliam*
- Aaron Sugimoto*
- Amanda Russell*
- Anita Arenas
- Tania Asef


Sacramento
San Francisco
San Jose
Fresno
CALIFORNIA
Death Valley
National Park
Las Vegas
Bakersfield
Los Angeles
Long Beach
Anaheim
Newport Beach

ack Bay of Newport Beach CA by D Ramey Logan.jpg from Wikimedia CC-BY-SA 4.0

https://sites.uci.edu/energyobserver/2012/11/05/sea-level-rise-risks-in-newport-beach-new-york-and-some-other-cities/

Olympia oysters

(Ostrea lurida)

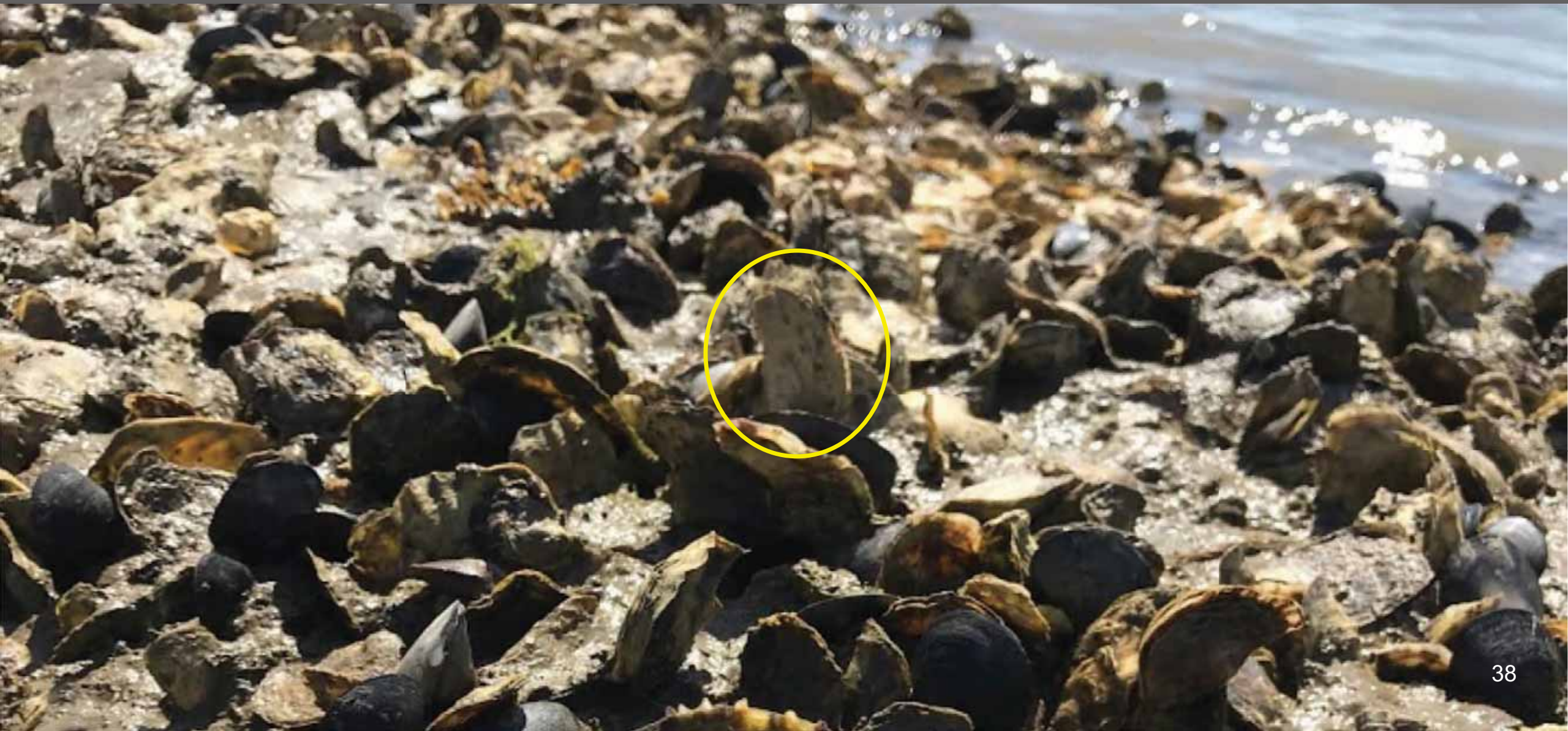
- **90% loss in CA**
- **Depleted due to a combination of anthropogenic causes:**
  - **Overharvesting, dredging, pollution**
- **Restoration underway along the coast**
- **Remnant populations on human-introduced substrates in southern CA**


Pre-restoration

O.C. Register

O.C. Register

After 2 years, native oyster density increased 10x pre-restoration levels!

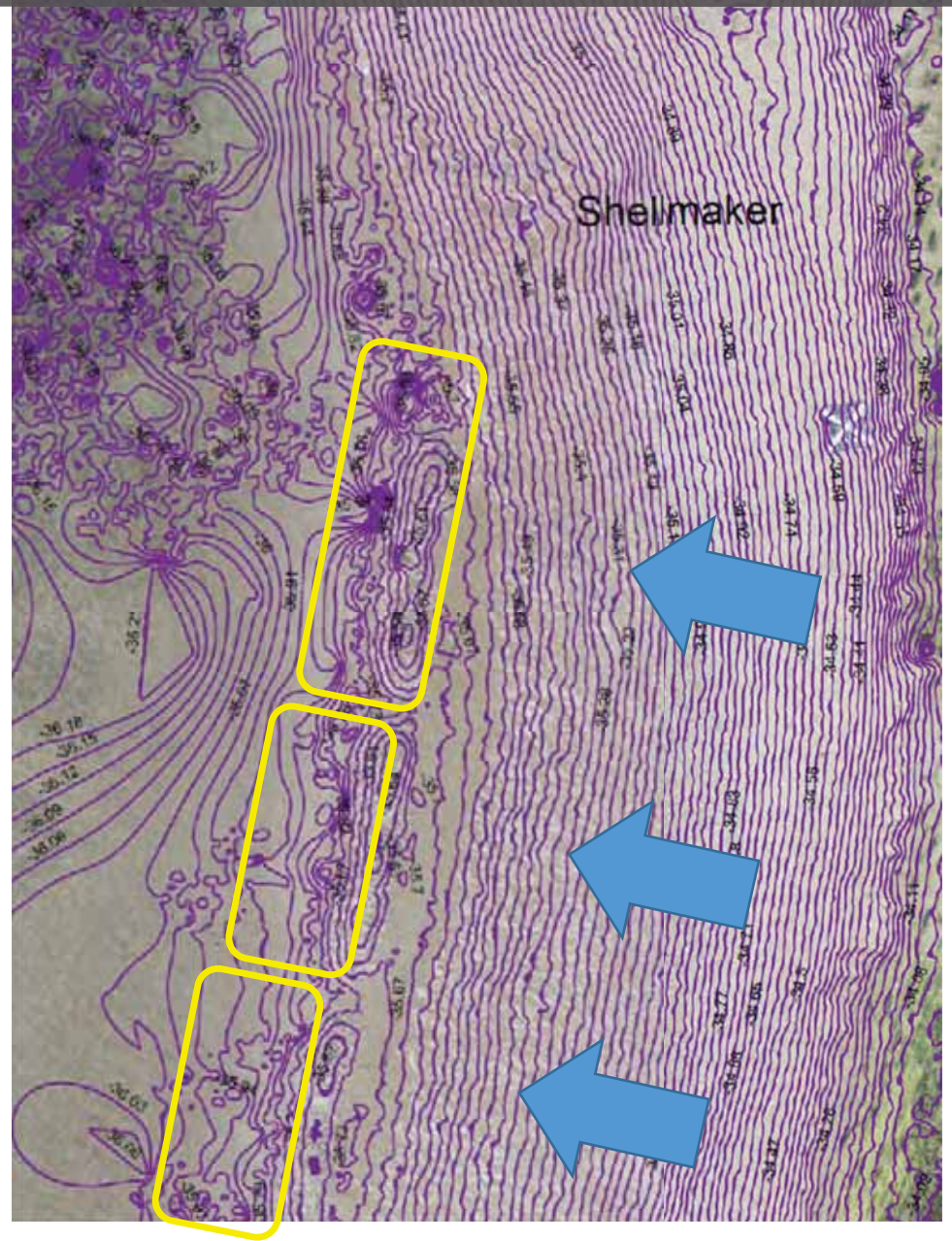


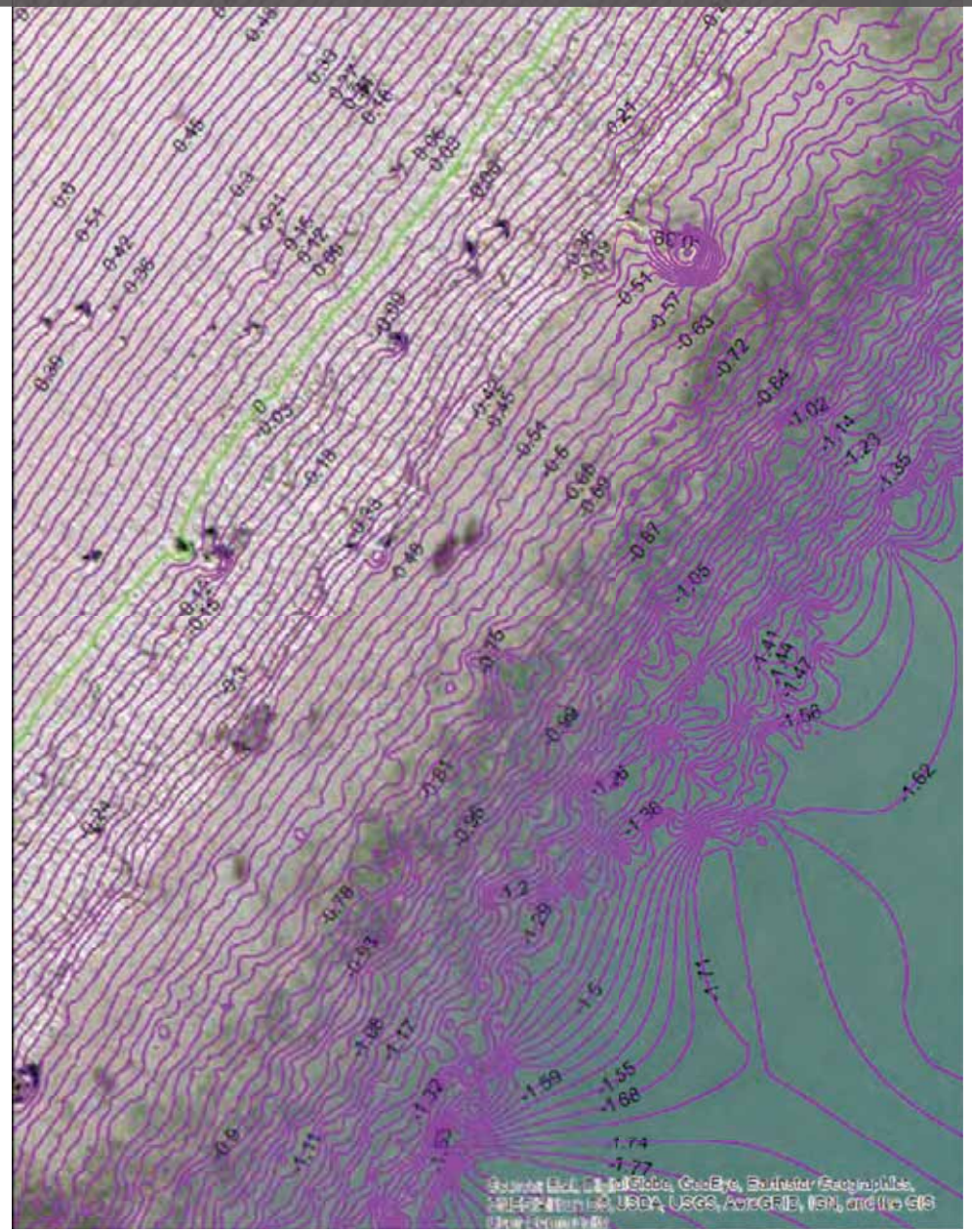
Fish, invertebrate & bird use of restored beds increased

O.C. Register

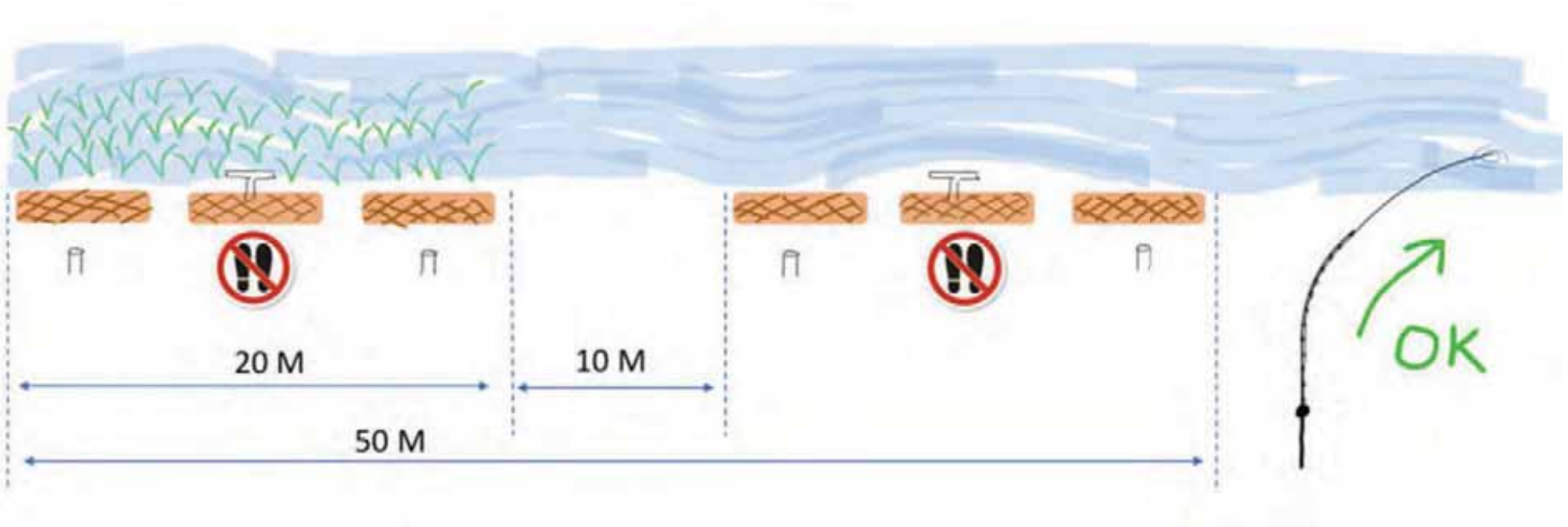
Imagery flights

Sediment retention greater upshore of beds





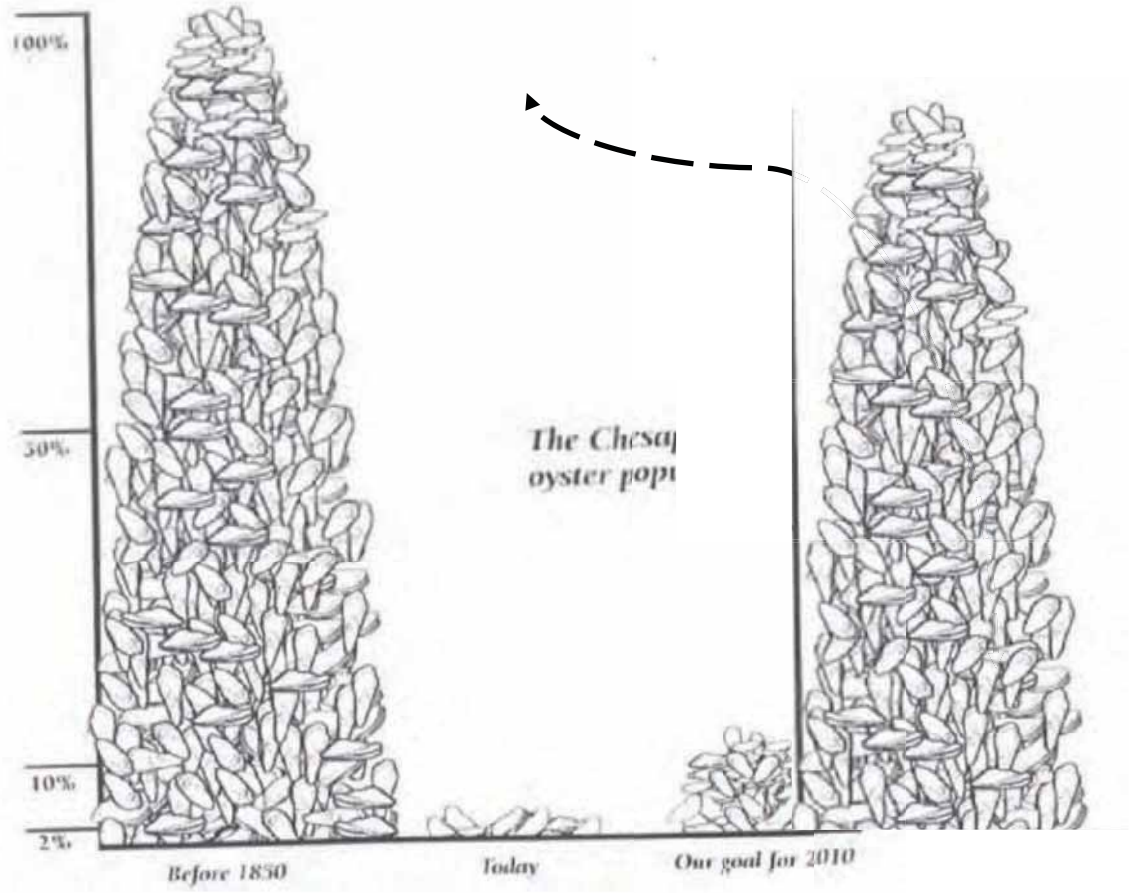
Strategies -- Những bị đựng vỏ con Hào là gì?



Graphic: Althea Marks

Needs for scaling up restoration

- Funding
- Training & Education
  - Scientists
  - Community members
- Monitoring
  - Functions
    - Native biodiversity
    - Food web support
    - Coastal resilience
    - Erosion control
  - Costs
- Community support



@whitcraftmudlab, www.csulb.edu/~cwhitcra

Community Capacity Building

SB 1--Atkins

Assists local governments to build capacity by providing financial support

Other bills largely aimed at capacity building:

AB 11 (Ward)

AB 897 (Mullin)

AB 1384 (Gabriel)

Centering 'Community' in Sea-level Rise Research and Planning

Dr. Laurie Richmond and Collaborators

Dept. of Environmental Science & Management, Humboldt State University

April 12, 2021

Humboldt Bay or *Wigi*: Ancestral Territory of the Wiyot People

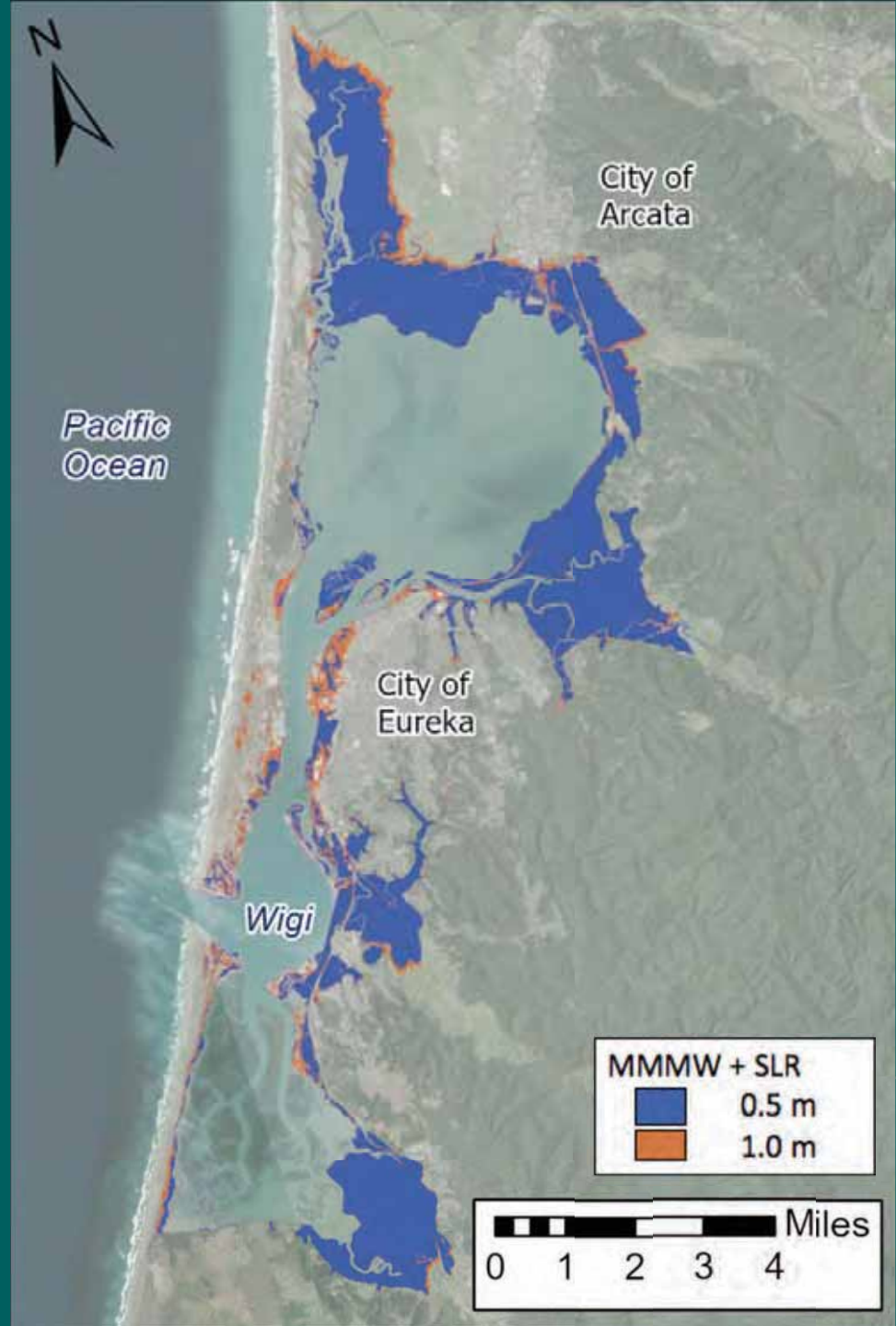
Sea-level Rise in HB

- Residential areas
- Culturally significant areas
- Transportation infrastructure
- Utilities Systems
- Agricultural lands
- Ecological & recreation areas

King Salmon, CA
Kunkel 2019

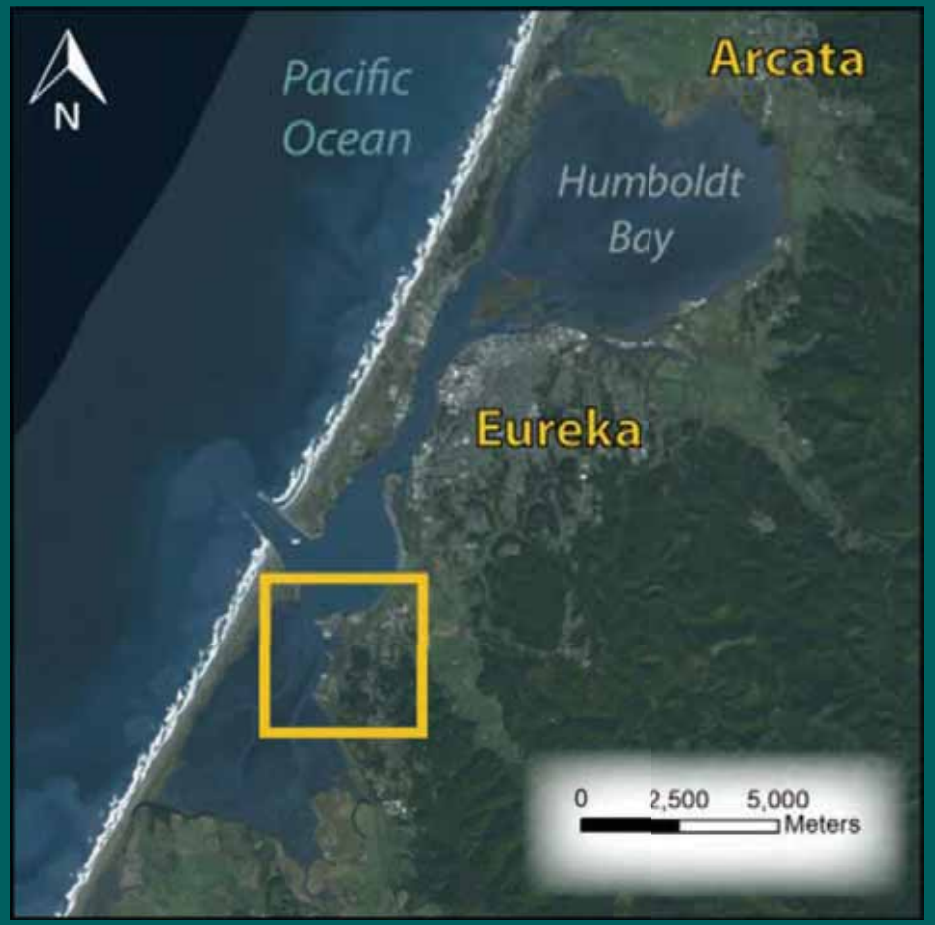
Hwy 101 Corridor
Eureka - Arcata
HumCo 2021

Agricultural Lands,
Arcata Bottoms
Richmond 2020



"We envision a diverse network of collaborators working together across disciplines, sectors, and ways of knowing to develop sea level rise research and planning that informs equitable and community-centered local climate action."

King Salmon, CA



King Salmon, projected Mean Monthly Maximum Water, Year 2100 – Medium-High Risk Aversion, RCP 8.5 (2.3 meters of SLR) (Source: Kunkel 2020)

King Salmon Research

- Community already lives with flooding
- Sense of place
  - One of the few cheaper places to live on the coast in CA
- Generational differences
  - Older respondents less concerned about SLR
- Unincorporated, lower income
- Need and desire for more engagement and capacity-building

King Salmon during king tides: Kunkel 2019

Source: Kunkel, K. (2019) Exploring community knowledge and perceptions of flooding and sea-level rise in King Salmon, California. HSU Masters Thesis

HB Regional Coordination Research

- Coordination is essential but a challenge
  - What is the best structure?
- Existing regulations potential barrier
- Need to include community and public perspectives
- Need for funding/resources to support coordination
  - Now it's no one's full time job
  - Facilitation support

Source: Ongoing Research: Kristen Orth-Gordinier, HSU Masters Student

Take-home Messages

- Contributions of Social Science Research
  - Just, equitable, and effective planning and adaptation
- Need for funding to support community capacity building and engagement
  - 50% of budget for climate adaptation projects (Chang 2018)
- Investment in Coordination
  - State coordination efforts should work with current initiatives rather than add a new layer
- Role of Academia and the CSU
  - Research institutes can play a unique role, especially in rural areas
  - Training the next generation of climate leaders
  - Funding to support SLR research groups
- Humboldt Bay and the North Coast
  - Experiencing effects soonest
  - Potential to develop and pilot adaptation approaches

www.humboldtslri.org

Acknowledgements:

- Interview Participants
- SLRI Members
  - Co-chair, Adam Canter, Wiyot Tribe NR Program
- SLR Students
  - Kristen Orth-Gordinier
  - Kristina Kunkel
  - Nayre Herrera
  - Bente Jansen
  - Thomas Premo
- Funders of HSU SLRI Projects Including:

Rising Groundwater and Mobilization of Contaminants

OPC Strategic Plan

Target 1.1.3 “Provide scientific guidance to partner agencies on the potential impacts of sea-level rise on contaminated sites and how current models could be used to inform site-specific decision-making.”

Governor’s Budget

$300M in GF for toxic site clean up

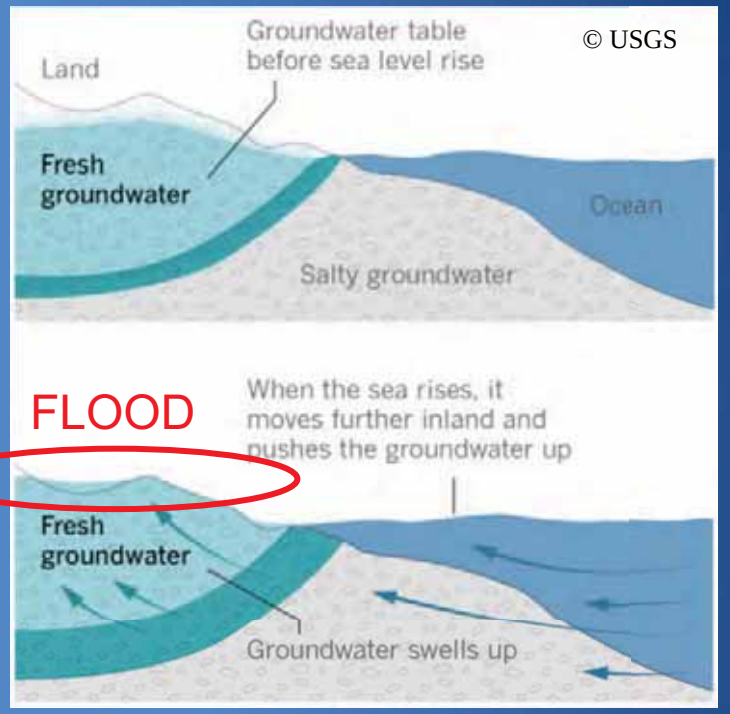
Impact of Sea-Level Rise on Groundwater Pollution Vulnerability in Shallow Coastal Aquifers

Ben Hagedorn, Matt Becker and Danielle Bram

The Problem

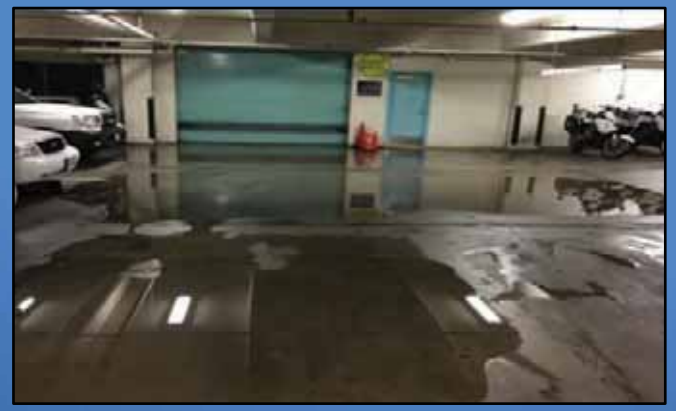
- Because fresh groundwater floats atop seawater, SLR will increase ***groundwater flooding*** risks

- Consequences: beach erosion and degradation of coastal habitats and infrastructure



Drainage backflow

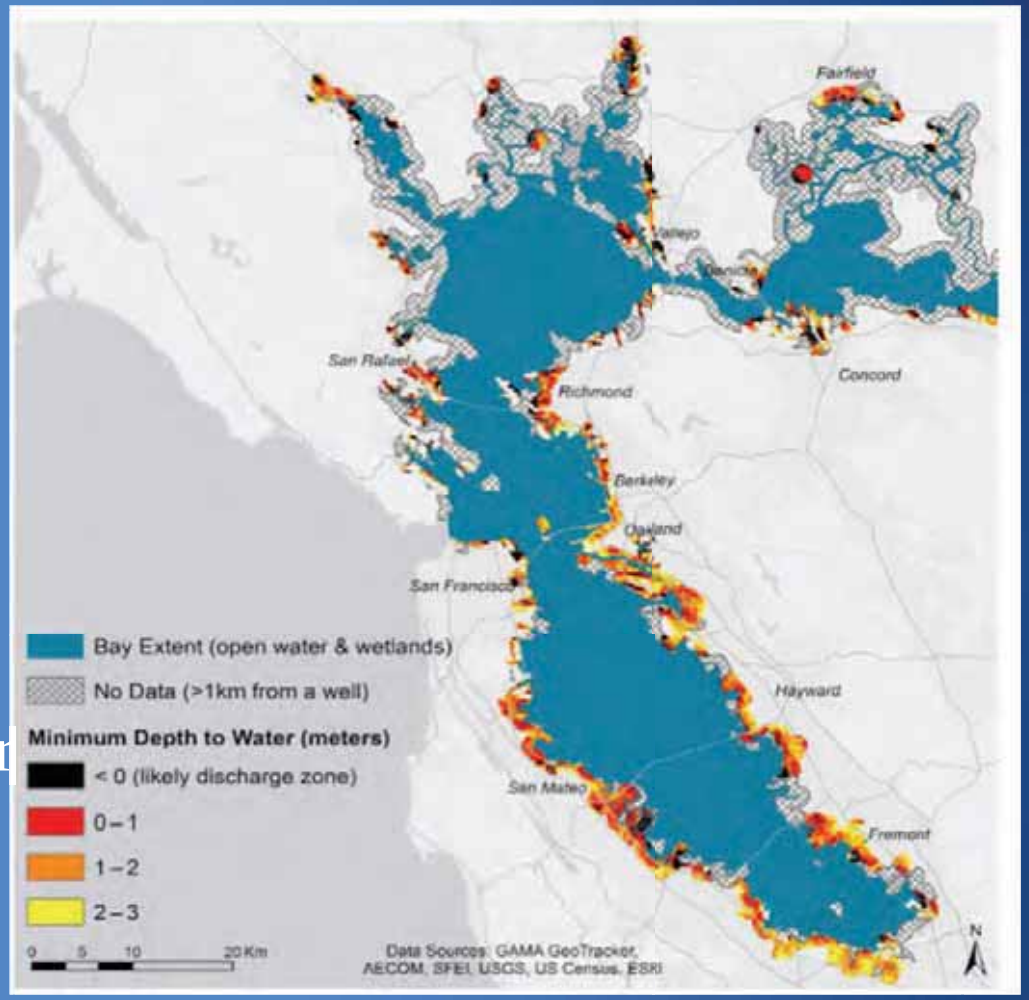
Inundation



Flooding of hazardous sites

The Problem

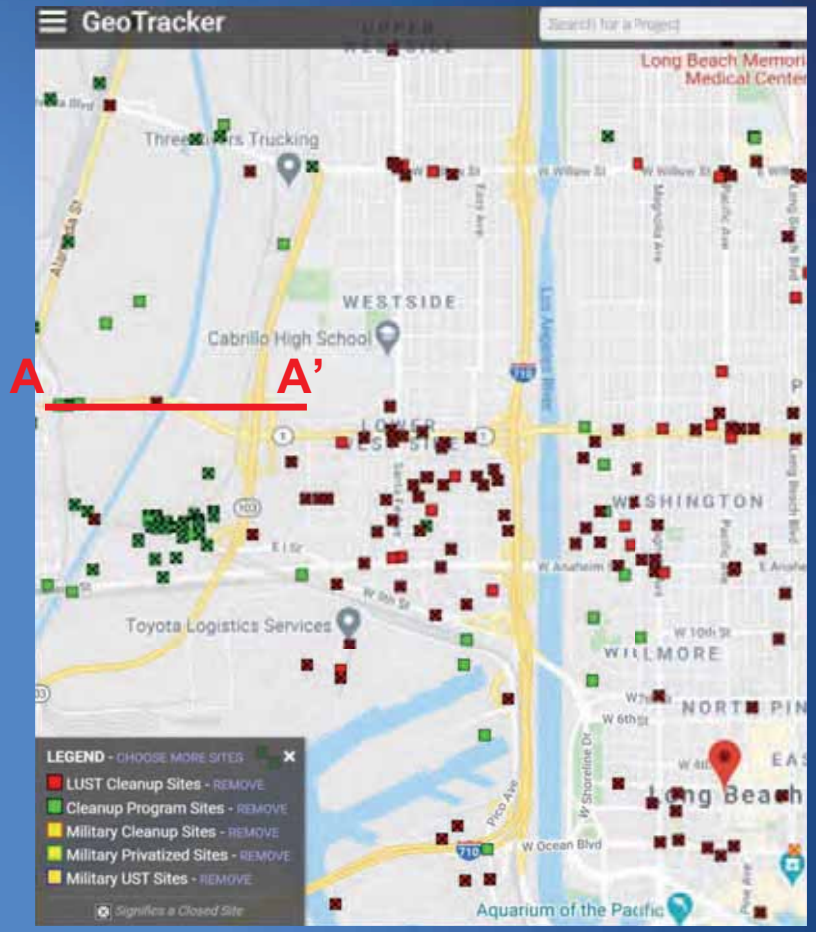
- Previous research focused on ***mapping*** of SLR-driven groundwater inundation areas
- SLR effects of ***groundwater quality*** are not fully explored
- There is a need for ***risk index maps*** to identify localized vulnerability to SLR-induced groundwater contamination



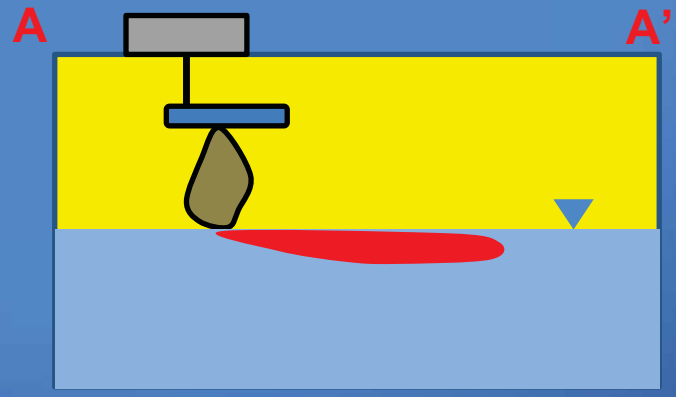
Plane et al., 2019

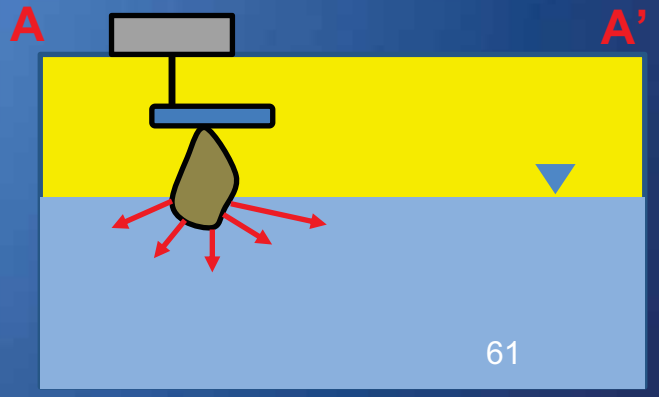
Study Purpose

- Collect ***contaminated sites*** and ***SLR*** datasets for coastal California
- Model the ***mobilization*** of chemicals of concern that may be impacted by SLR
- identify “hot spots” of imminent risk, especially in ***disadvantaged communities*** (DACs)



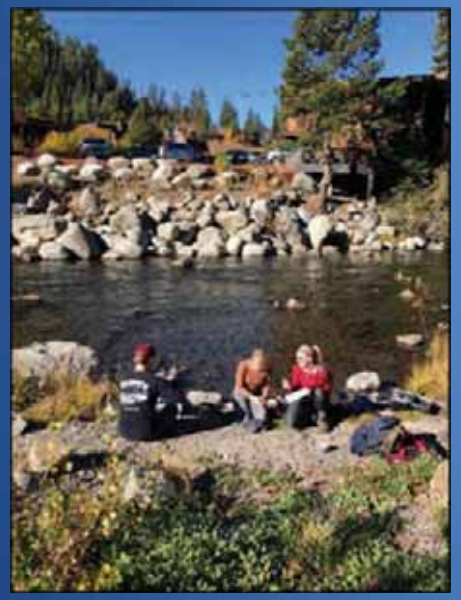
Source: CA Dept. of Public Health





Outcomes

- Refined groundwater level datasets using new modeling technology
- Models of contaminant mobilization from inundated LUSTs
- New risk maps of groundwater vulnerability
- Community engagement
- Student training



Thank you

Economics

AB 67--Petrie-Norris

OPC shall develop a standardized methodology and template for conducting economic analyses

SB 83--Allen

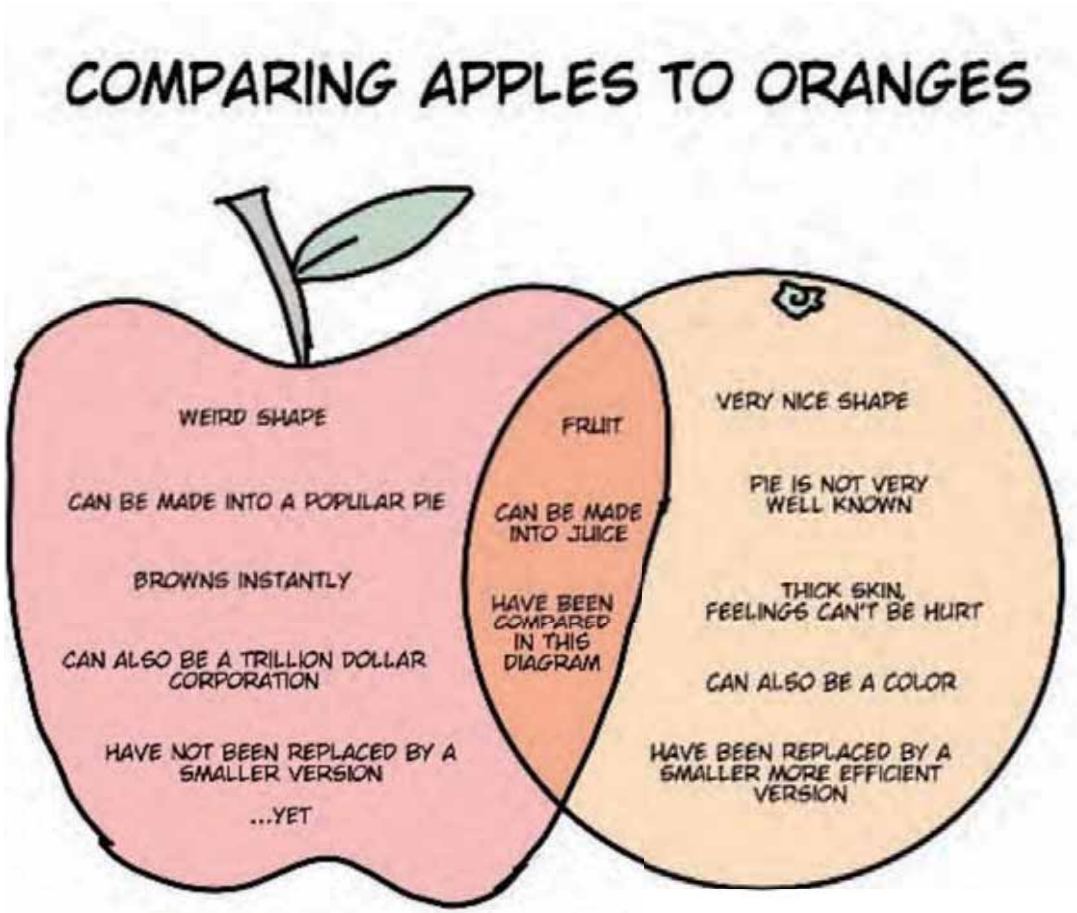
Provides low-interest loans to local jurisdictions so they can purchase vulnerable coastal properties; local jurisdictions could rent properties to recoup costs

Economic Issues Associated with Coastal Adaptation

Dr. Philip King

Advantages of Standardization: Consistency

- Economic analysis can help jurisdictions with timing and tradeoffs
  - Green vs grey
  - Trigger points
- Economic analysis can also help determine who pays
  - Should state subsidize local community?
  - CAFR integration



Challenges of Standardization: Valuing Ecosystems

- Valuing ecosystem services
  - CA policy favors green over grey
  - But ecosystem services often undervalued
  - Beaches provide >14 ecosystem services; we measured 2 in Pacifica
- State should consider using replacement cost

Challenges of Standardization: Equity

- Wealthy have disproportionate access
- Economic analysis needs to incorporate these concerns
  - *Access for All* to coast
  - Land values influenced by zoning laws
  - Account for challenges to low income communities

Pacifica: Sharp Park Golf Course

- Parts of Sharp Park Golf Course and trail will erode:
  - Historic park designed by Alister MacKenzie
  - Owned by City of San Francisco
  - Also home to sensitive species
- Solution:
  - City wants armoring to protect 18 holes
  - Retreat would allow beaches and species to survive

Imperial Beach: Lease Back Arrangements Can Work

- Analysis showed lease backs pay for themselves ~ 30 years
- Nature-based solutions generally “penciled out” in benefit cost analysis
- Low income communities impacted by flooding

Recommendations

- Jurisdictions need consistency
- Leasebacks can work given the timeframe of SLR in California
- Economic analysis must include:
  - Non-market value of natural infrastructure
  - Social justice considerations
- Incorporate with Comprehensive Annual Financial Reports (CAFRS)
  - LOWERS compliance costs
  - Consistent with capital planning

Q & A

Thank you!