



Sediment Dynamics in Restored Tidal Wetlands of San Francisco Bay

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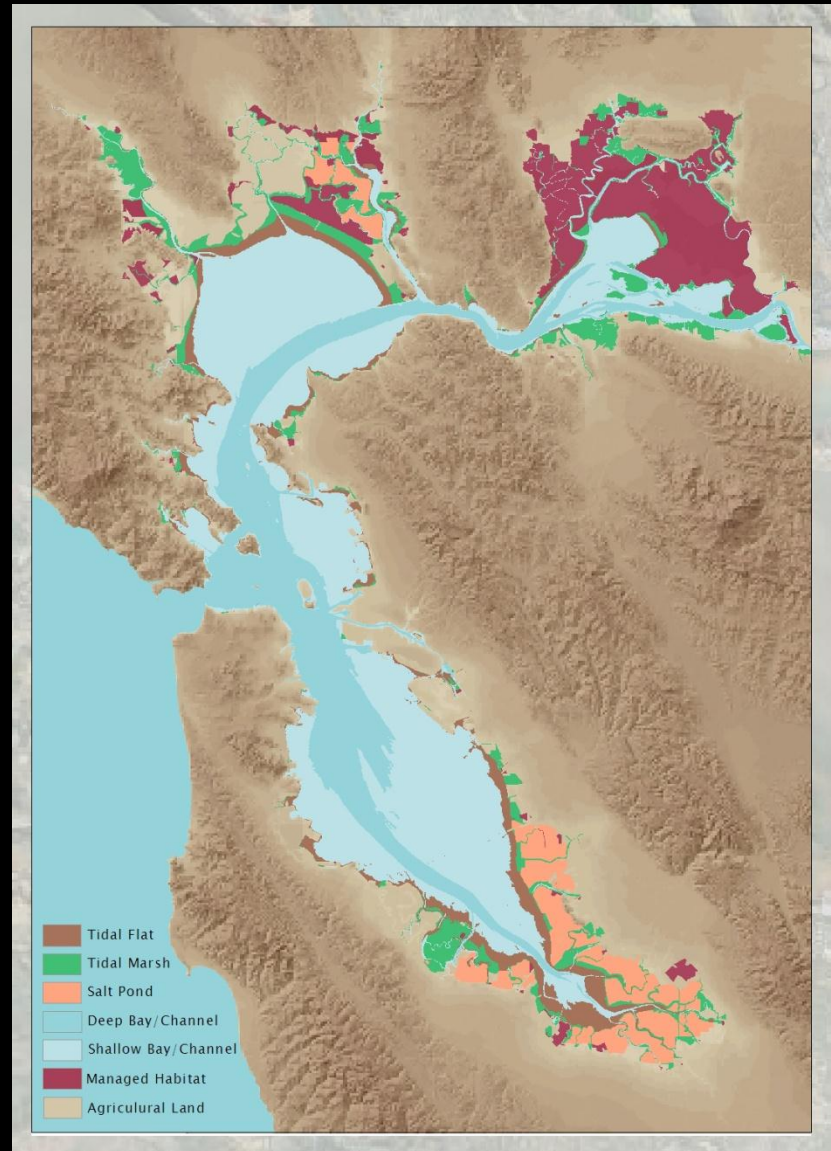
Evyan Borgnis & Tom Parker (SFSU)

Donna Ball (HT Harvey & Assoc.)

Gene Turner & Charlie Milan (LSU)



Past and Present Distribution of SF Bay Wetlands



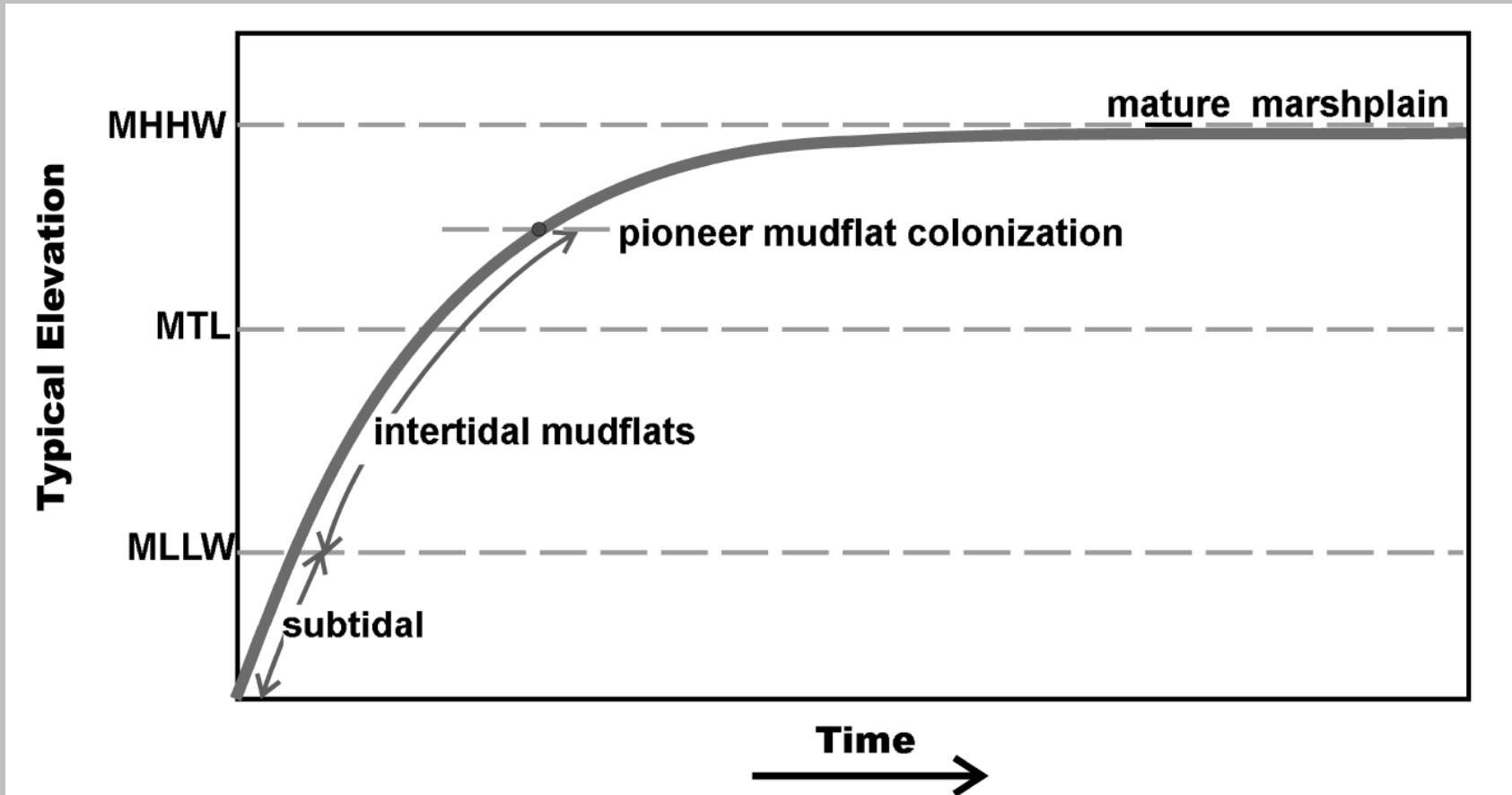
(from San Francisco Estuary Institute)

An aerial photograph showing a grid of dark, linear levees or ditches that divide a large area of reddish-brown, textured ground. The ground appears to be a wetland or salt flat, with some darker, possibly water-filled areas visible in the upper corners. The overall scene is a top-down view of a managed or restored landscape.

Huge interest in restoration in SF Bay, but ...

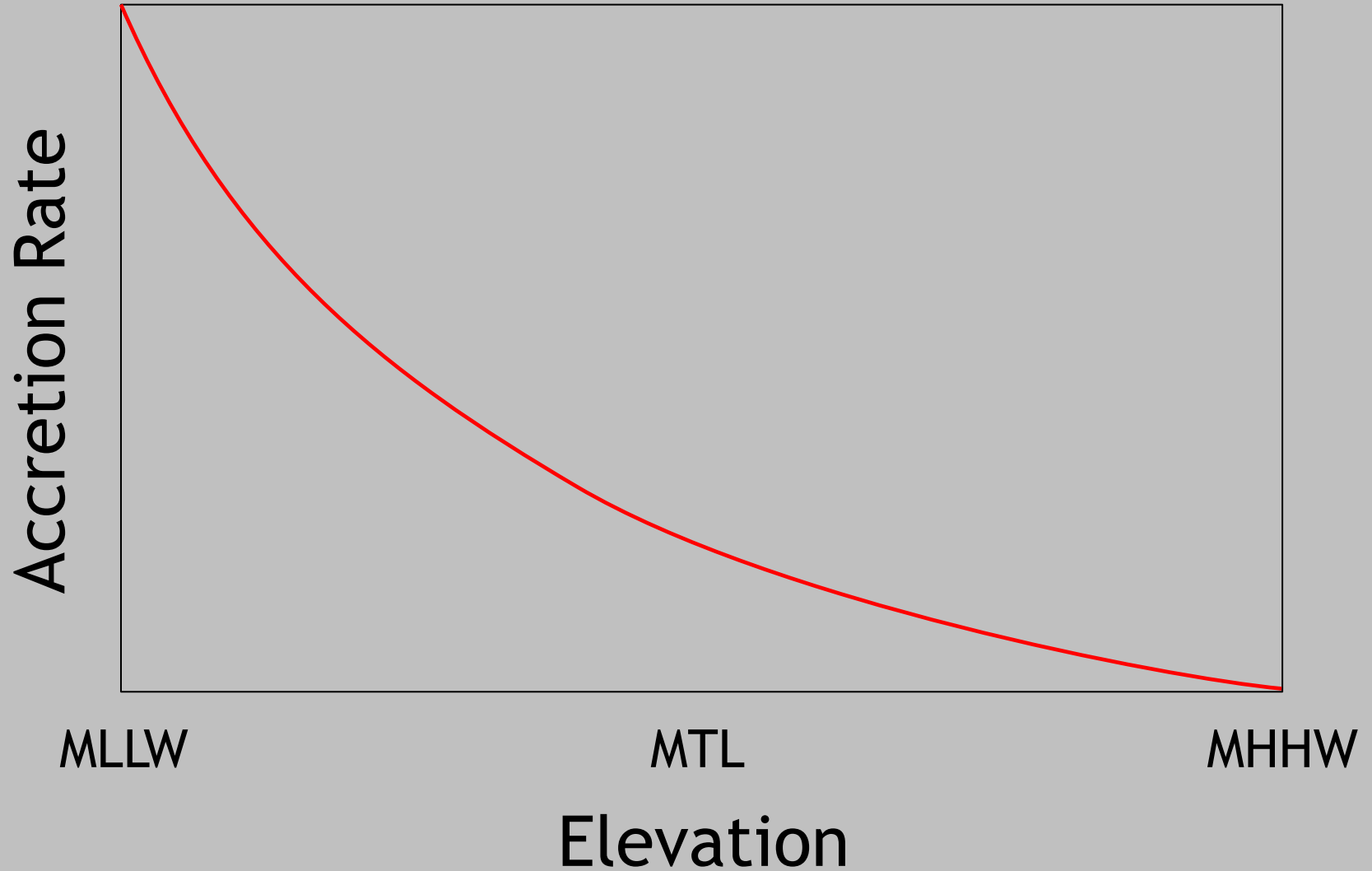
many potential restoration sites (including former salt ponds) have subsided substantially and need to increase elevation to reach threshold elevations for vegetation establishment

Theoretical Tidal Wetland Development



(from Williams and Orr 2002)

Theoretical Tidal Wetland Development





Muzzi Marsh

Crissy Field

Island Ponds / A21

Pond A6

South Bay Salt Pond Restoration Project

An aerial photograph of the South Bay Salt Pond Restoration Project. The image shows a large body of water on the left, with various land parcels and structures to the right. Red text and red circles highlight specific areas of interest. The text 'Island Ponds / A21 Breached in March 2006' is overlaid on the water area, and 'Pond A6 Breached in December 2010' is overlaid on a smaller pond area. Red circles and lines point to these specific locations.

Island Ponds / A21
Breached in March 2006

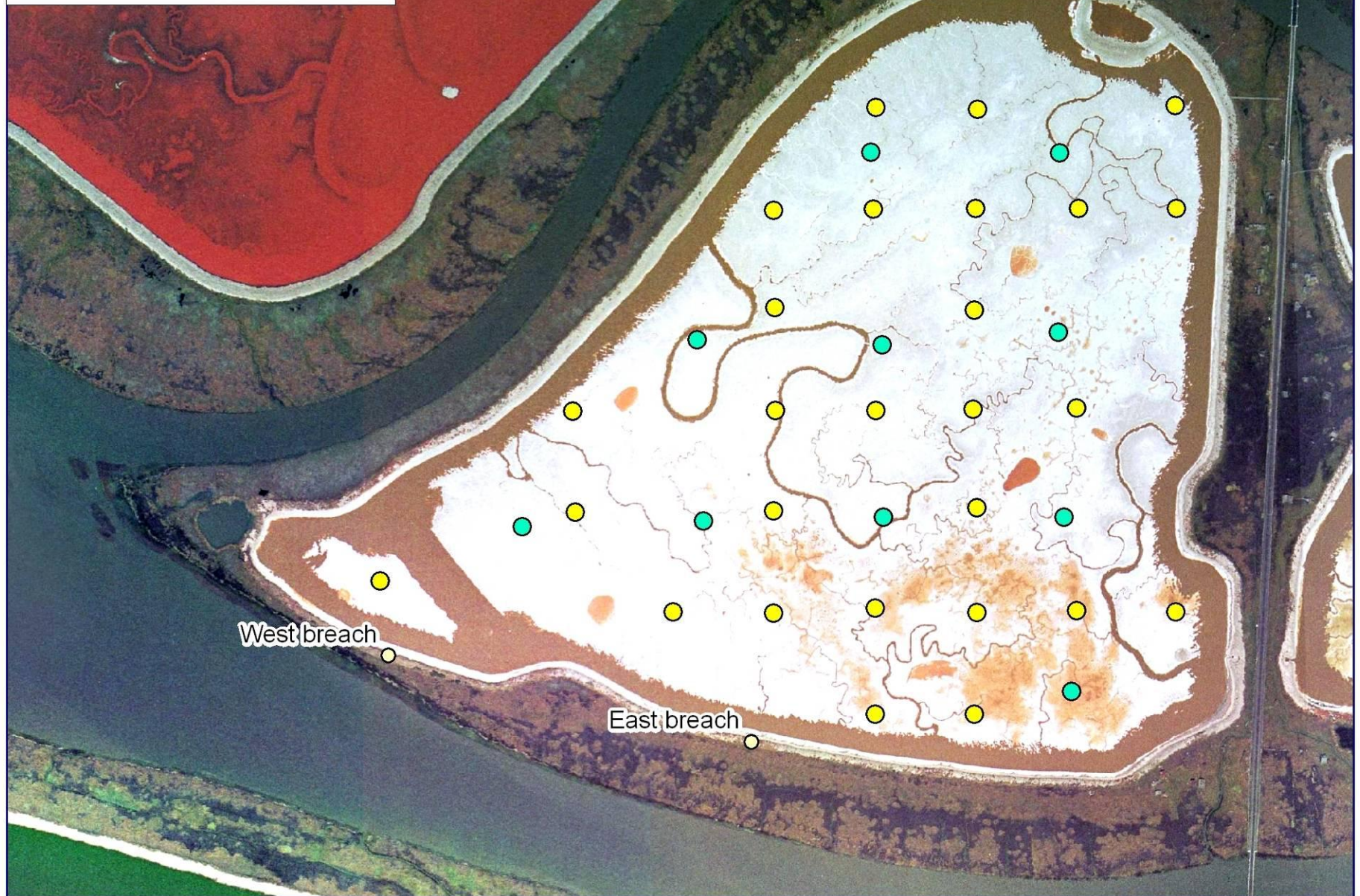
Pond A6

Breached in December 2010

A21 Sediment Pin Locations

- Sediment Pin
- SCVWD Sediment Pin

100 m





Pin Sediment Depth - 3 year data

sediment depth (mm)

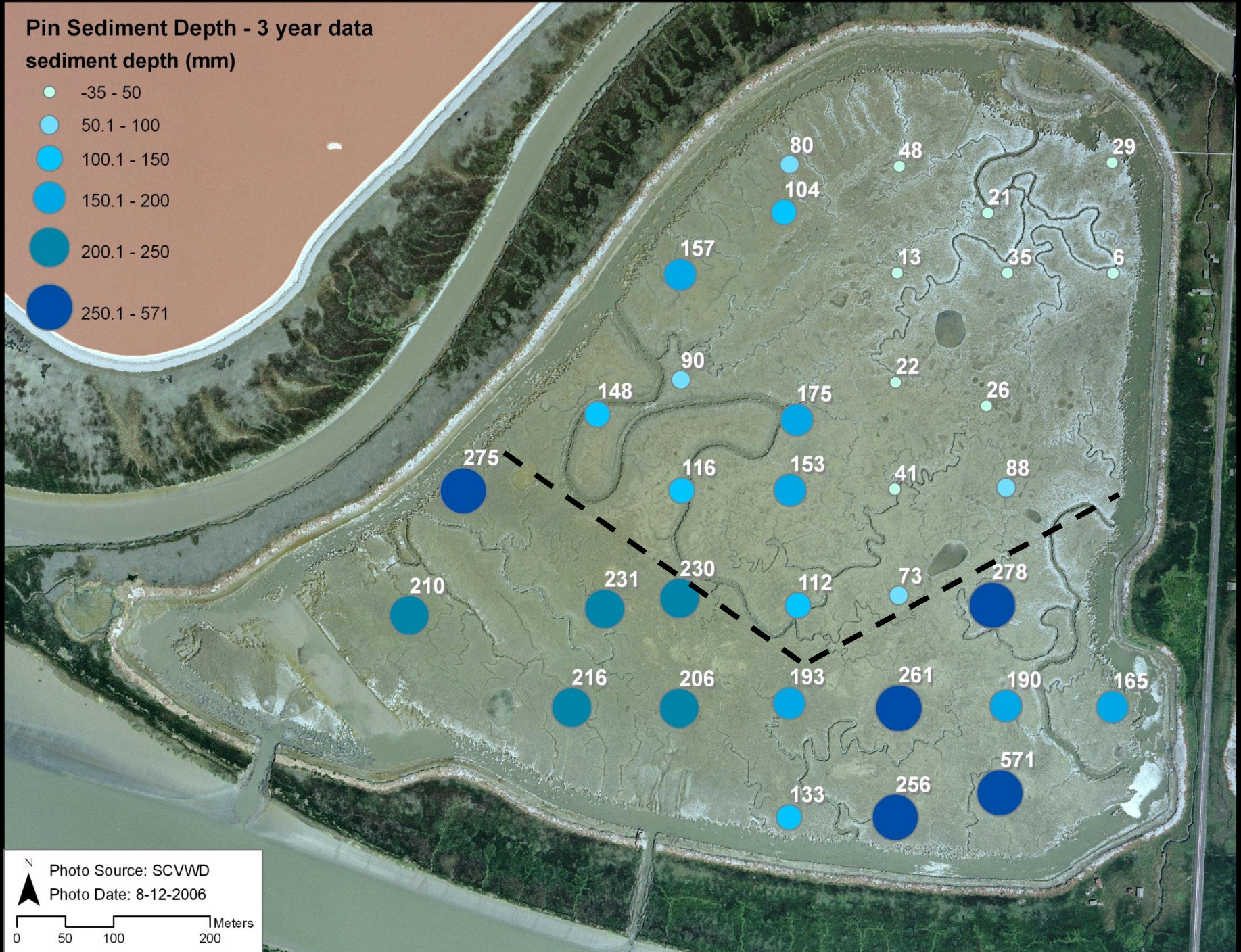
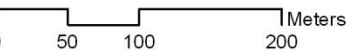
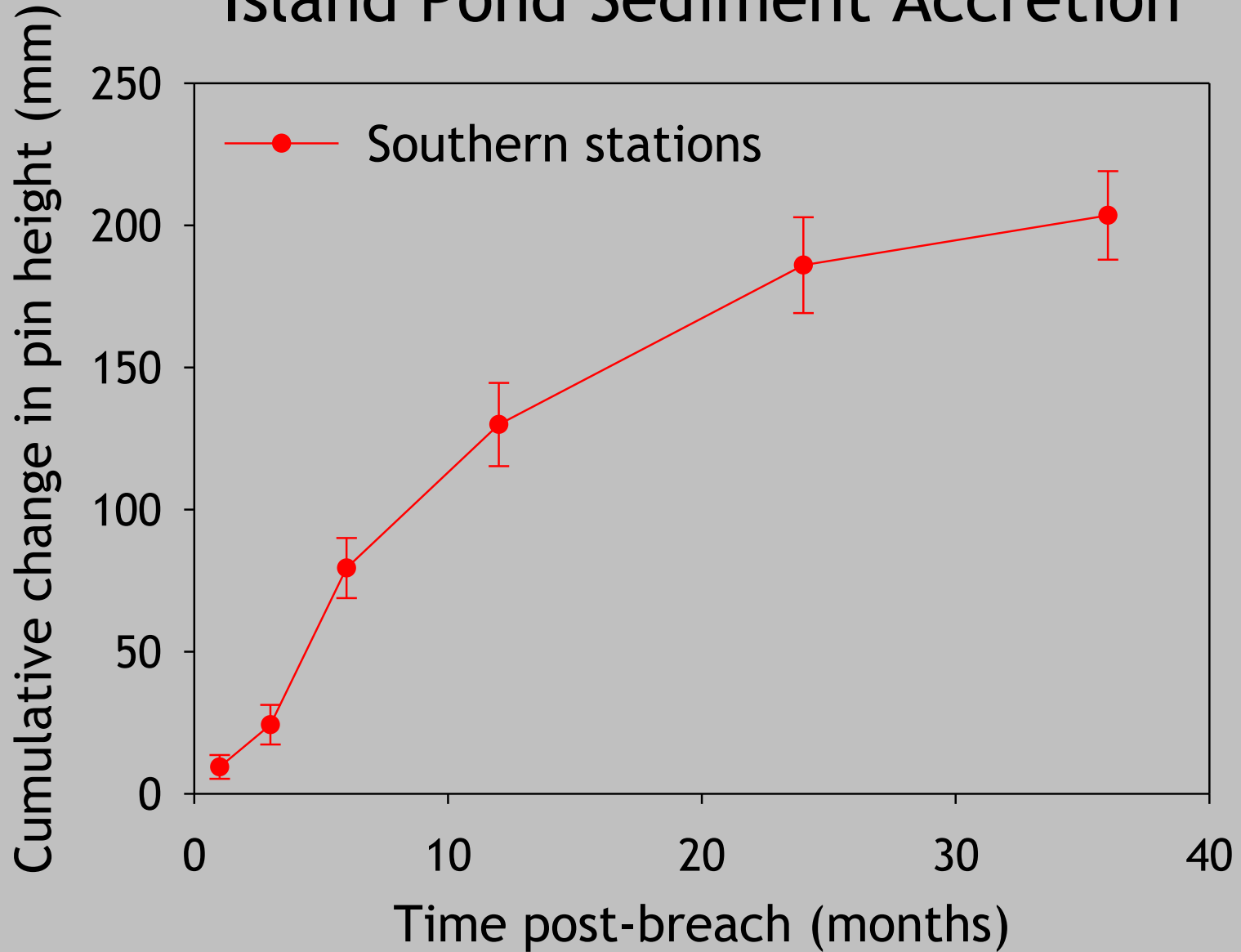


Photo Source: SCVWD

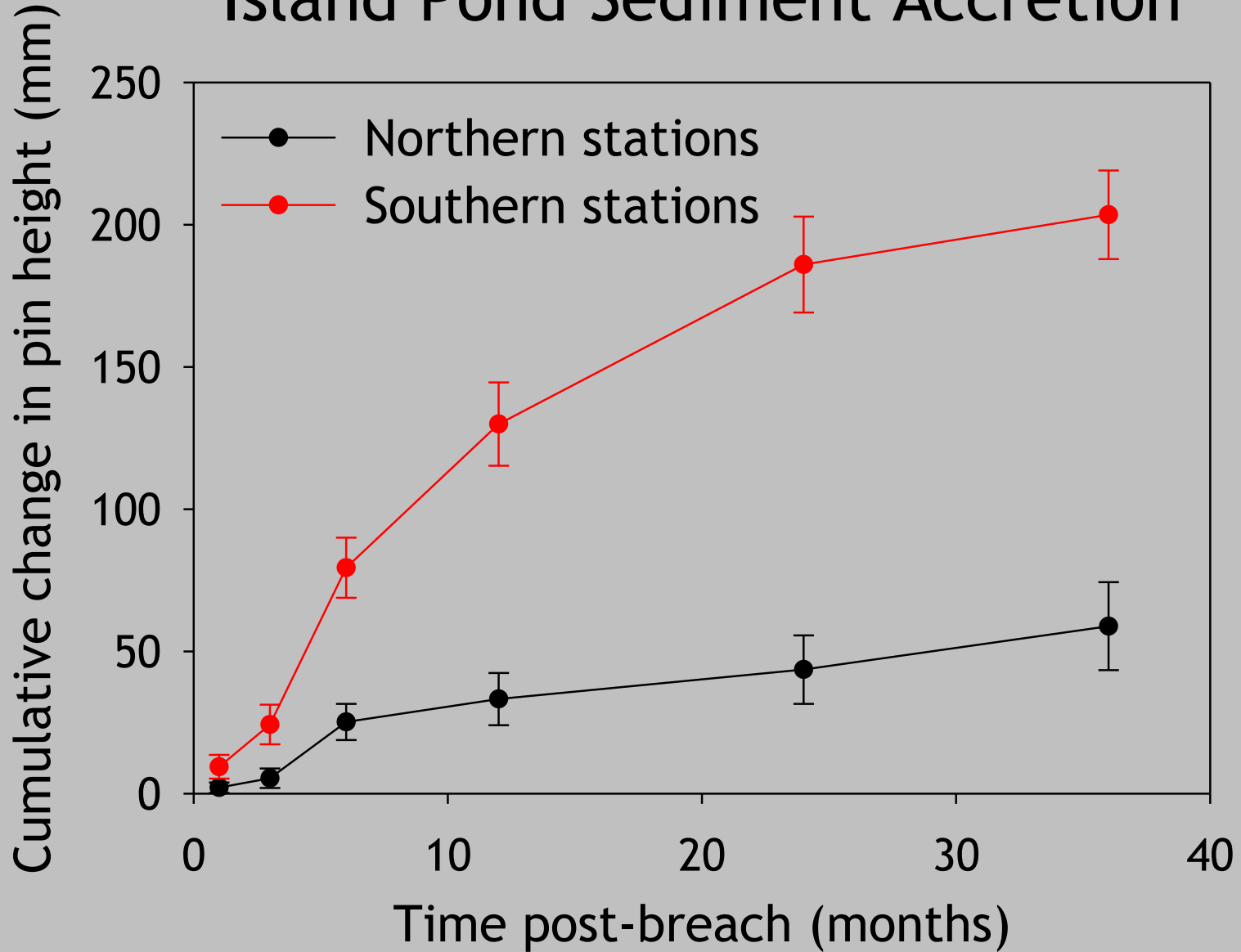
Photo Date: 8-12-2006



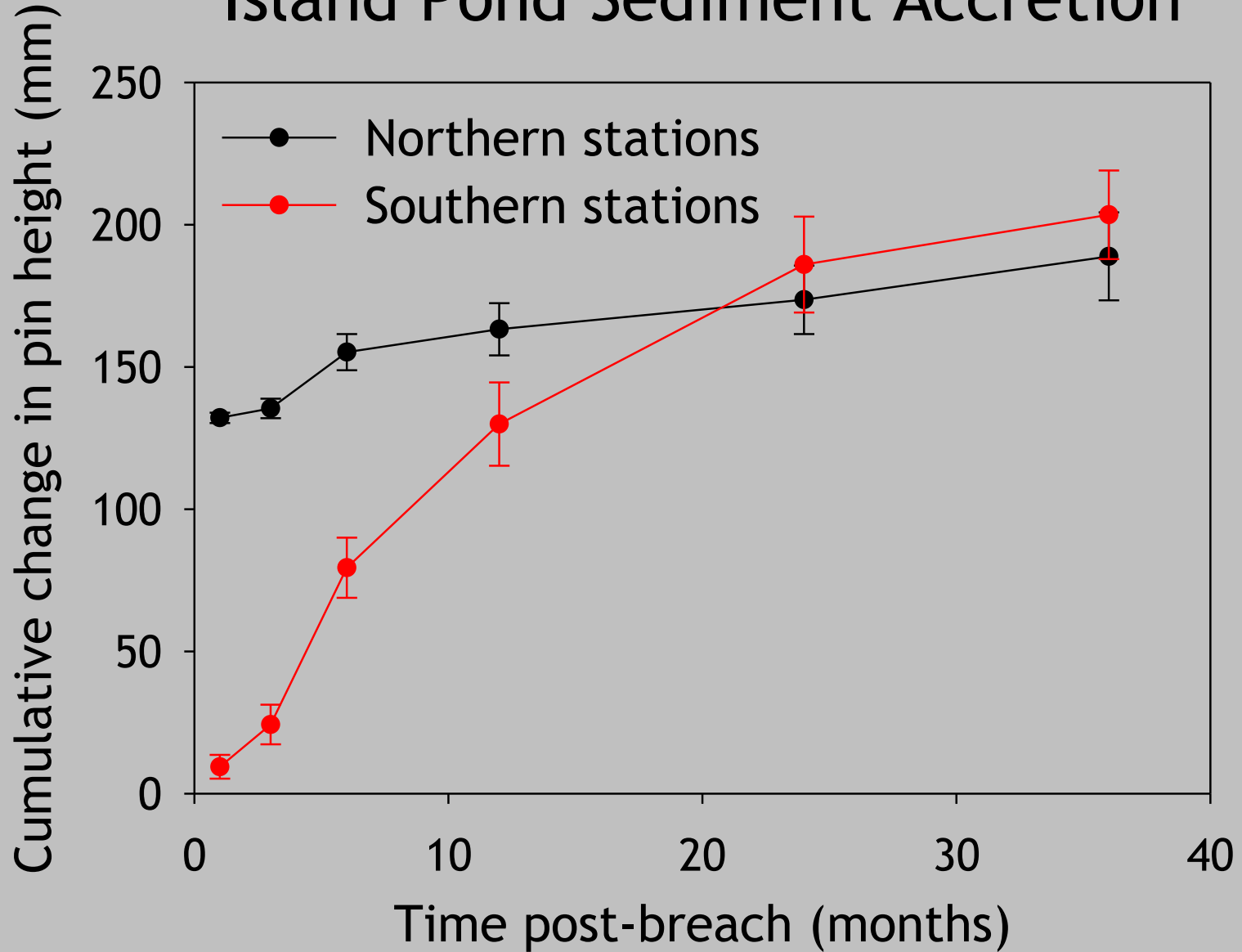
Island Pond Sediment Accretion



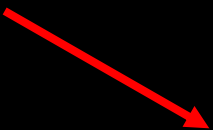
Island Pond Sediment Accretion



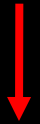
Island Pond Sediment Accretion



6 months



pre-restoration



36 months



24 months





April 2008



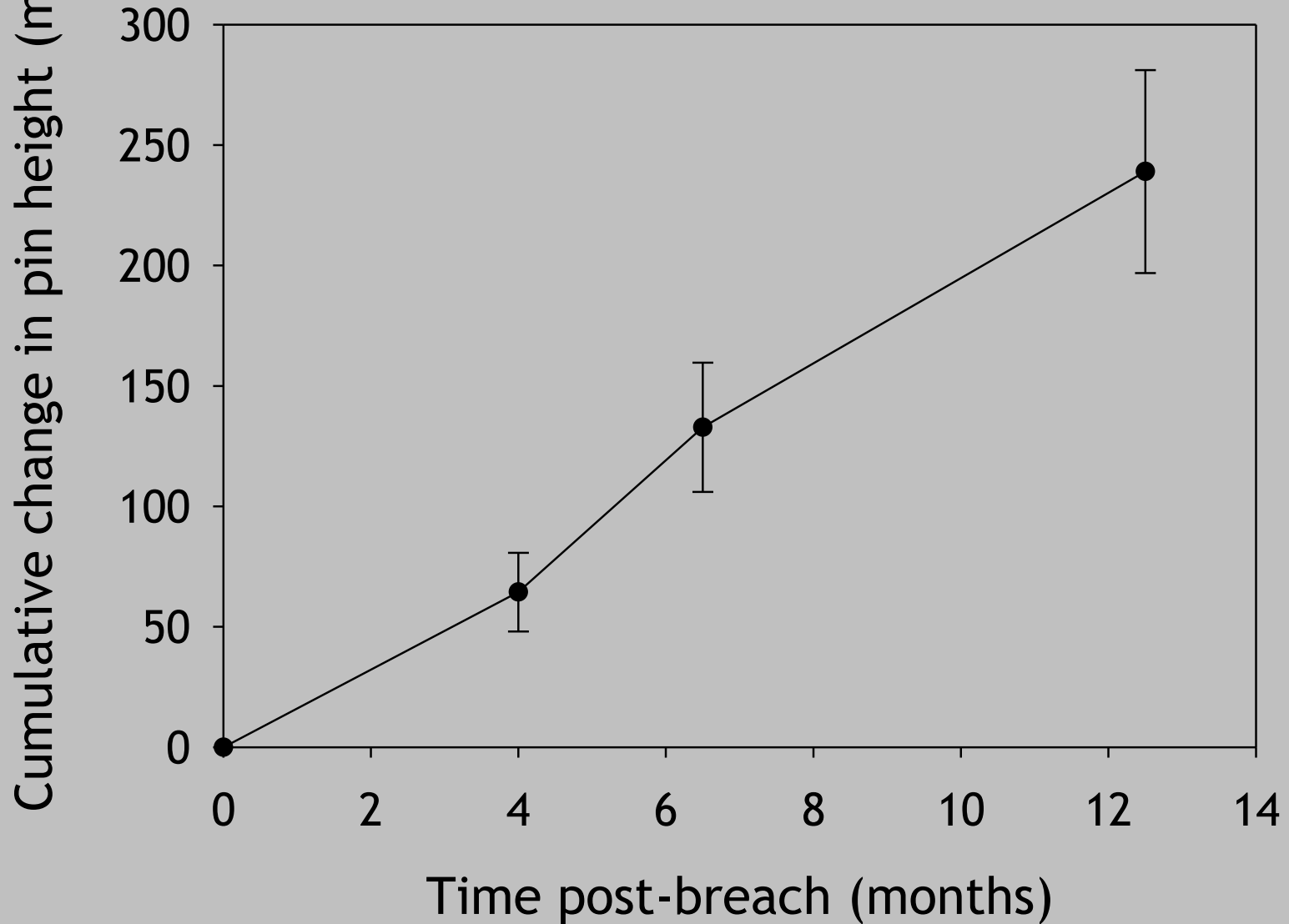
September 2009

Salt Pond A21

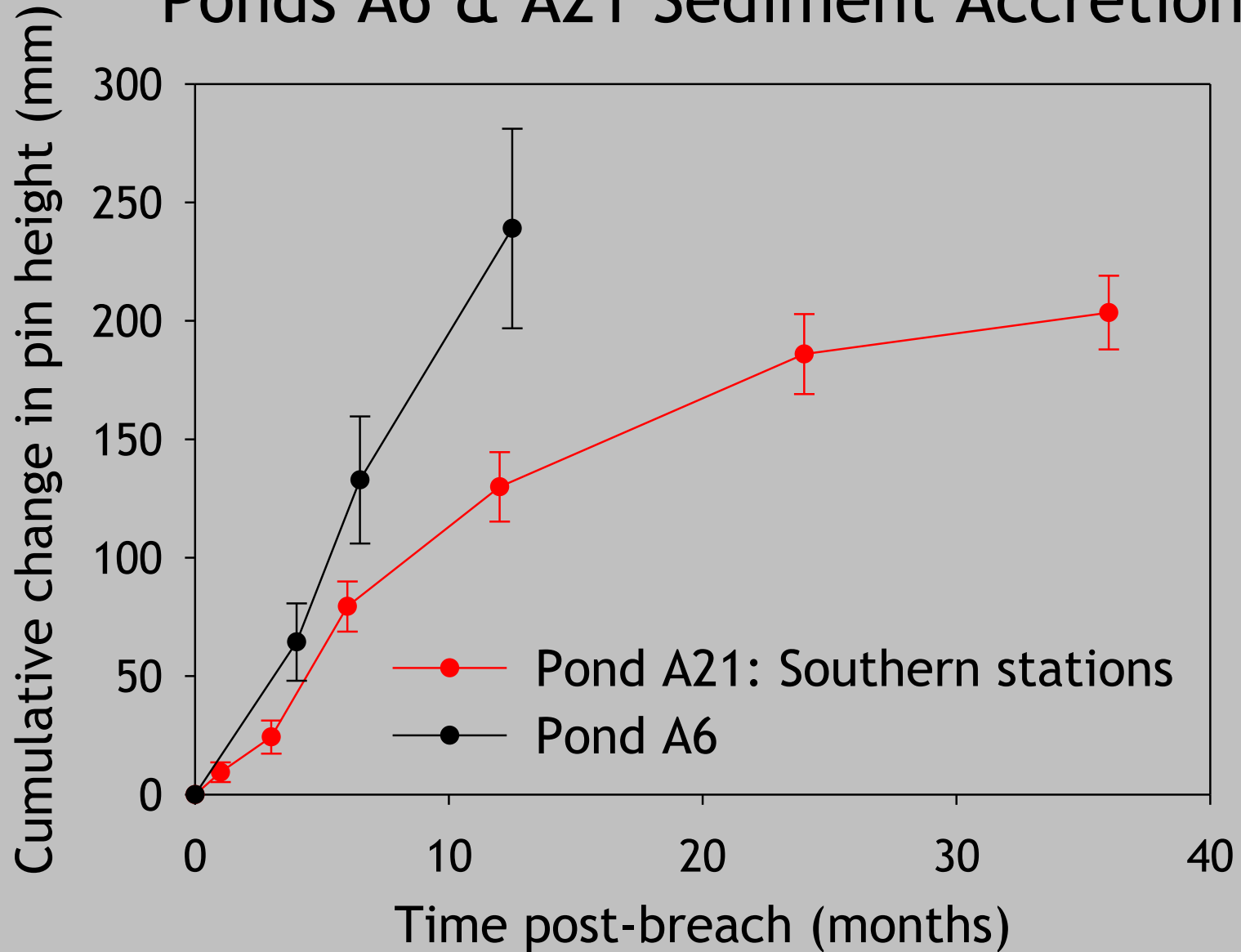
Pond A6: Breached December 2010



Pond A6 Sediment Accretion



Ponds A6 & A21 Sediment Accretion





Muzzi Marsh

Crissy Field

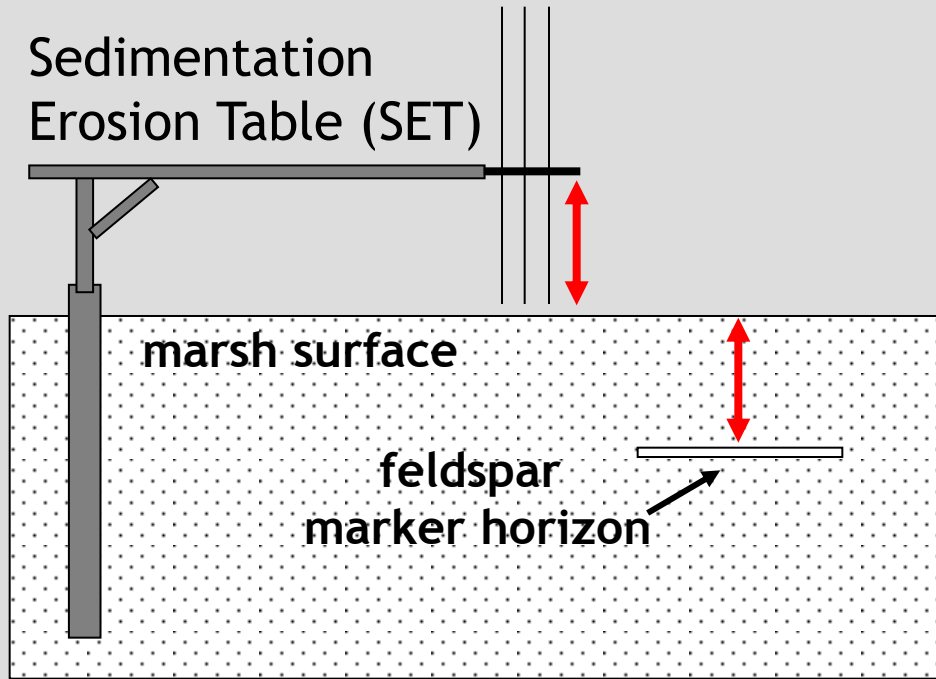
Island Ponds / A21

Pond A6

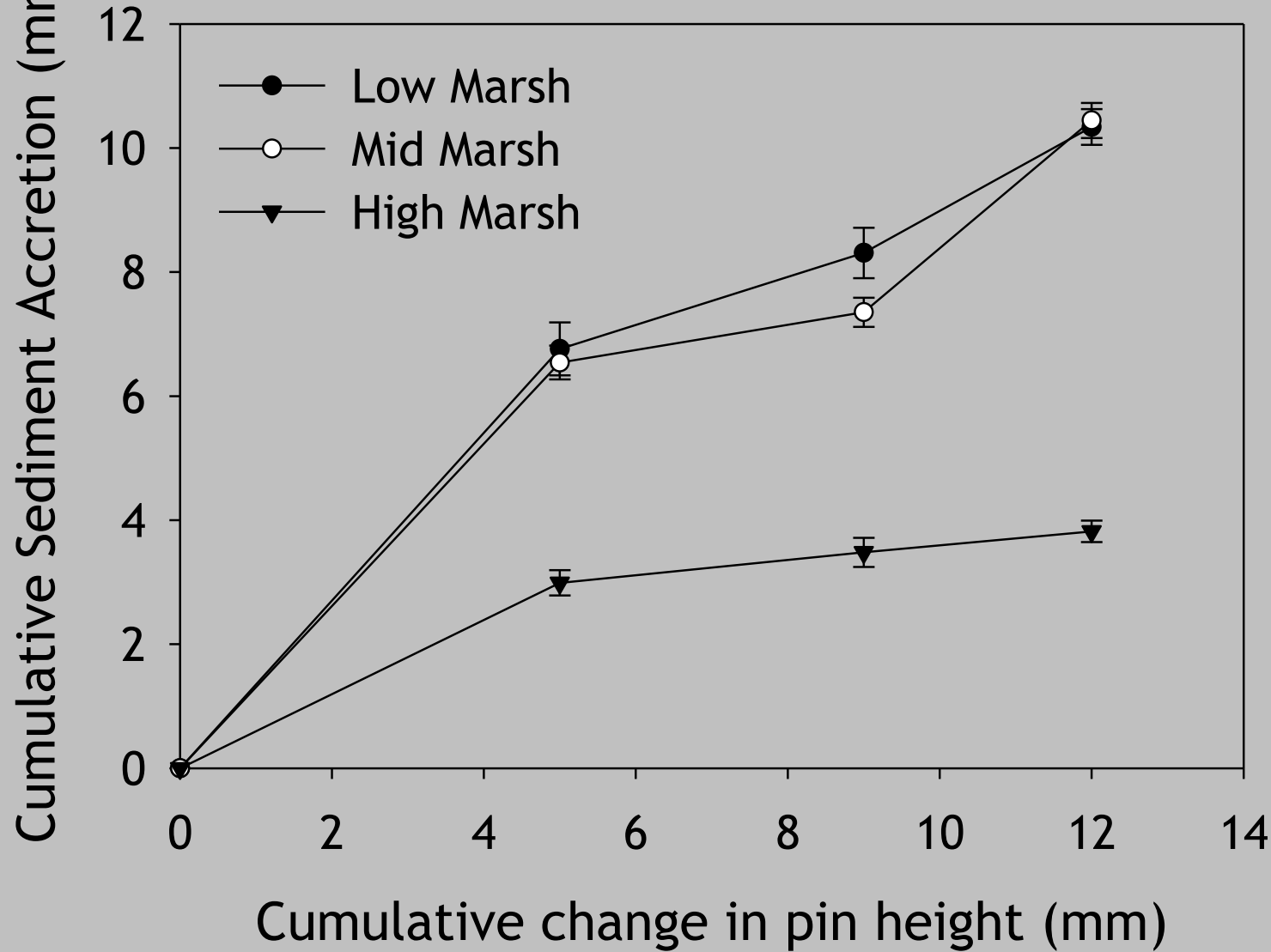
Muzzi Marsh: Restored 1976



SETs & Markers



Muzzi Marsh Sediment Accretion

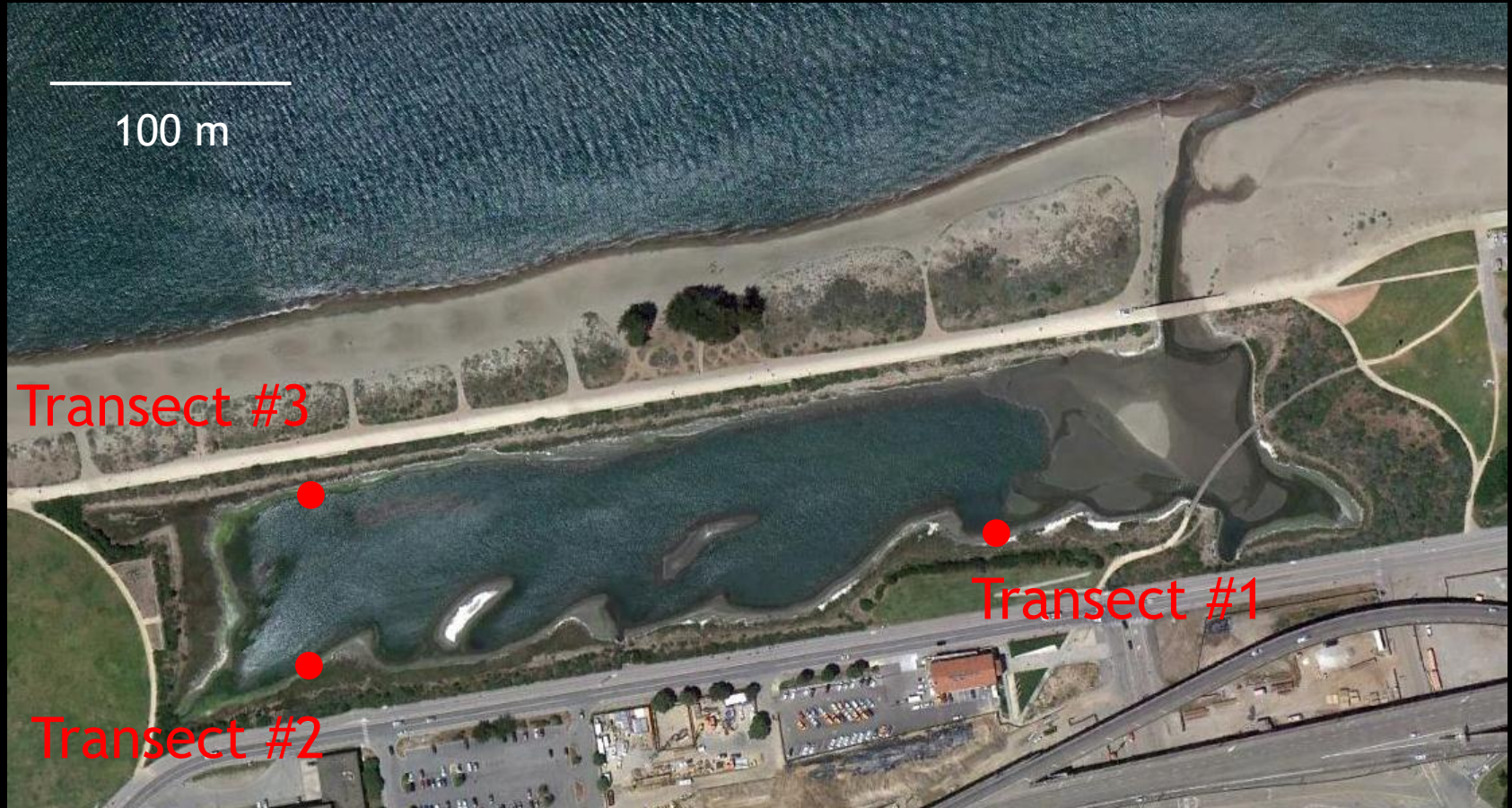


Crissy Field Marsh Restoration Project

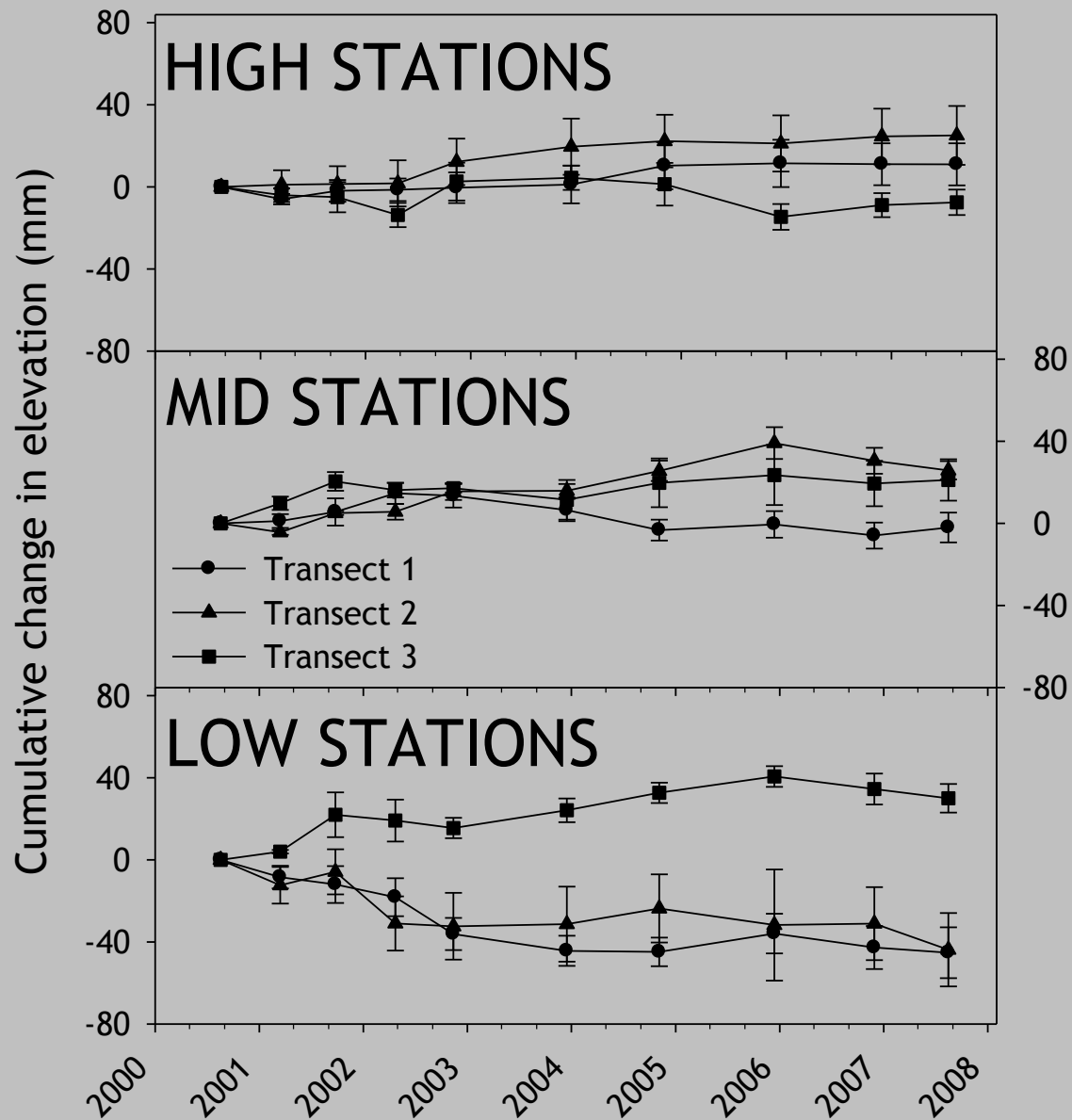


(from Robert Campbell Photography)

Crissy Field Marsh: Restored 1999



Crissy Field Marsh Sediment Accretion



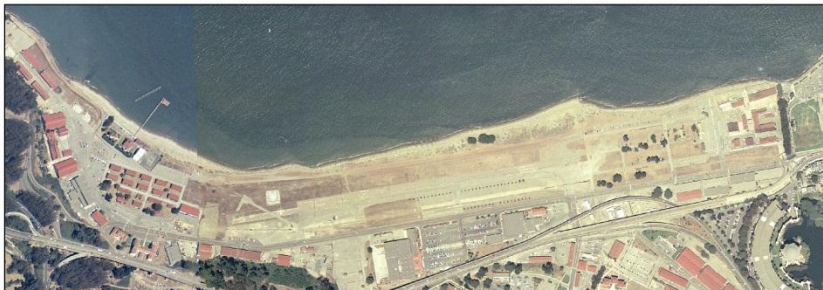
Crissy Field Marsh and Shoreline (1993-2005)



1993



2002



1995



2003



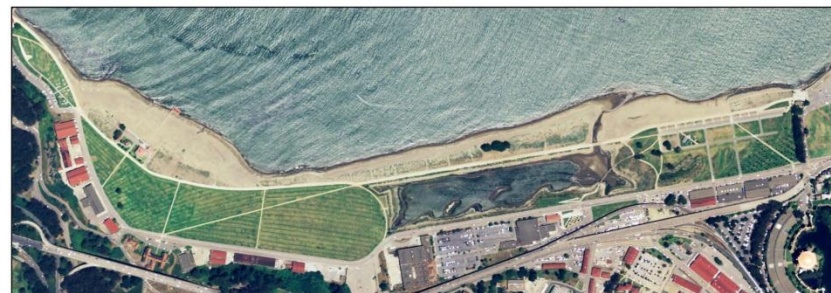
2000



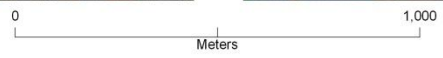
2004



2001



2005





(from Kristen Ward, NPS)



Petaluma River Marsh

Coon Island

Rush Ranch

China Camp

Browns Island

Muzzi Marsh

Crissy Field

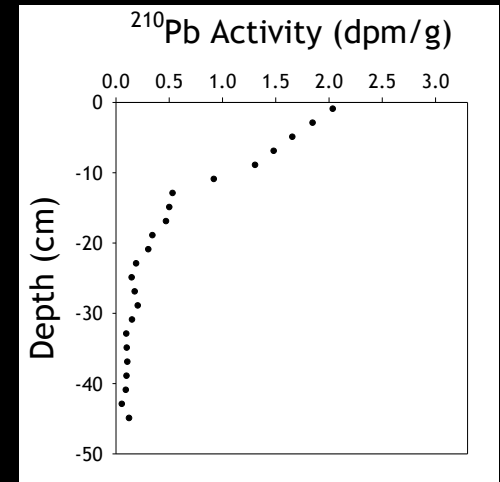
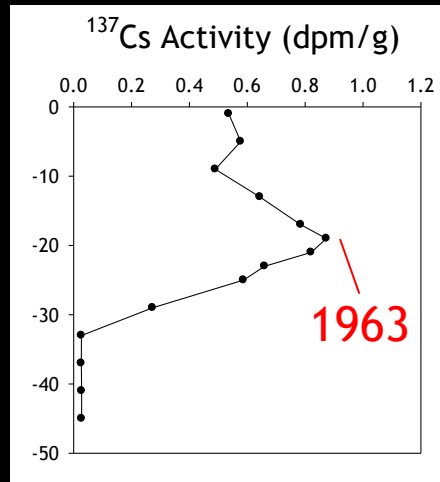
Whale's Tail Marsh

Island Ponds

Greco Island

Pond A6





100 m

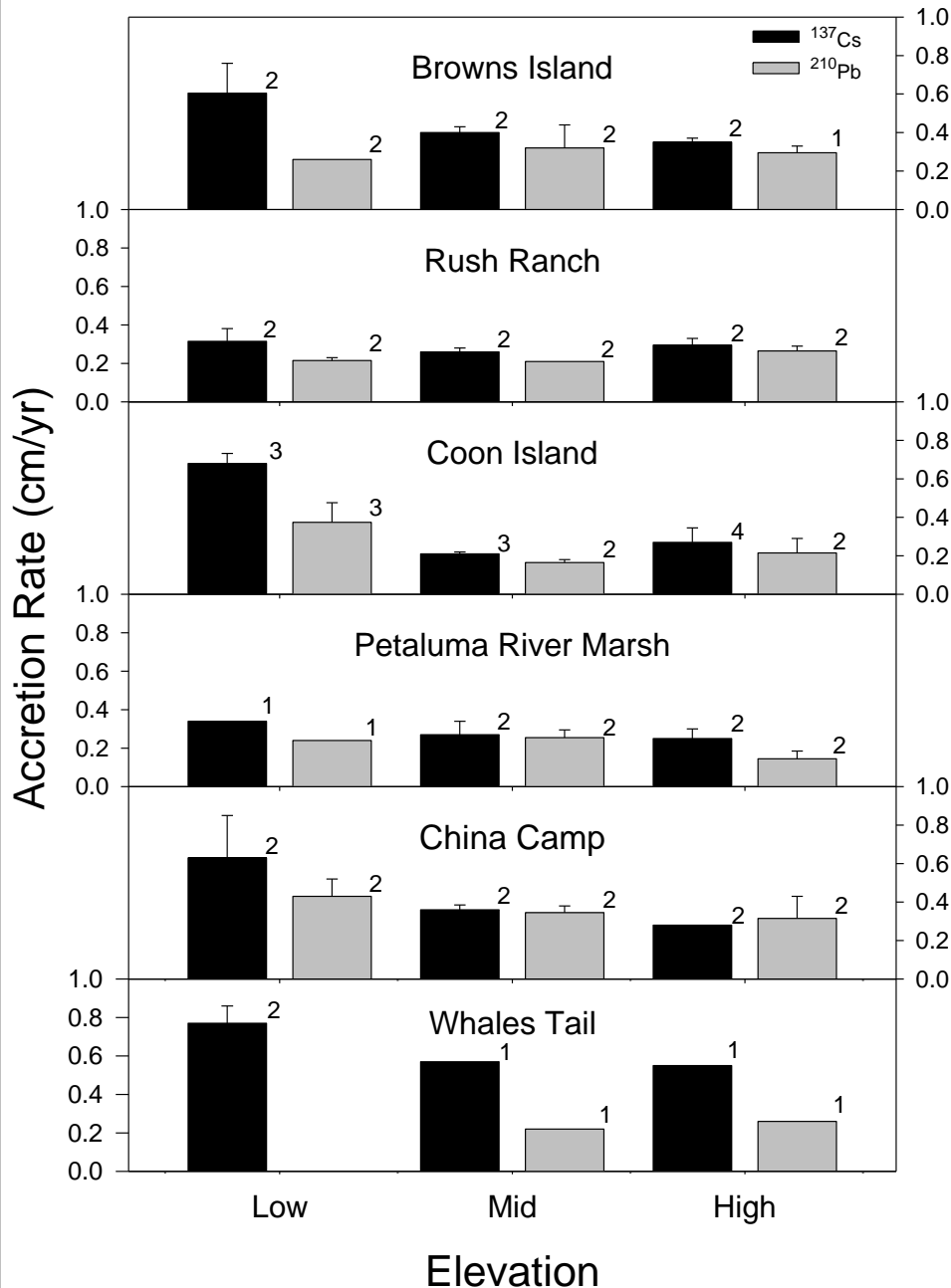
◆ Low station

◆ Mid station

◆ High station



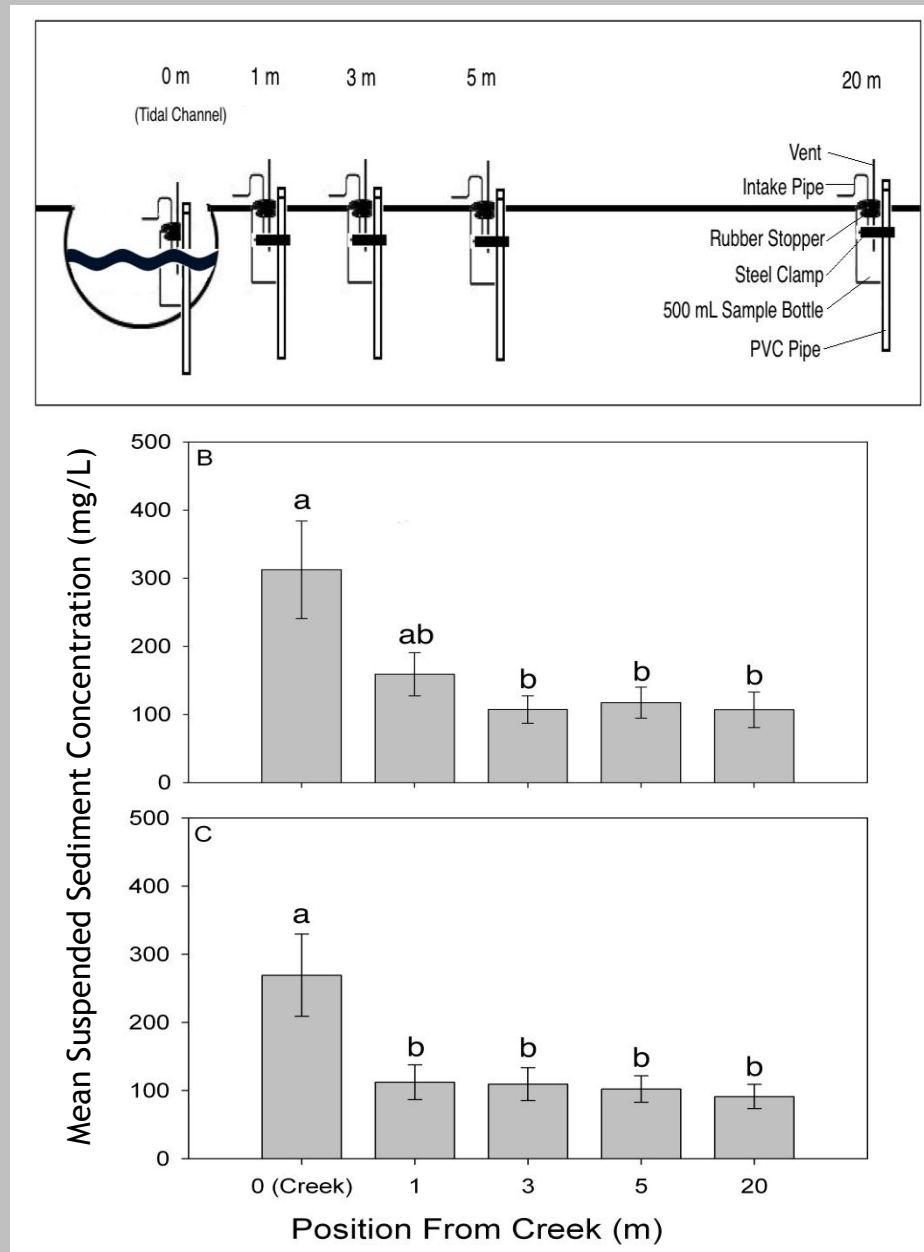
Natural Wetland Accretion Rates



- 37 dated cores using both ^{137}Cs and ^{210}Pb (out of 48 cores collected)!
- Very consistent rates of accretion in mid and high marsh: ~ 0.3 cm/yr
- Low marsh: four sites ~ 0.6 cm/yr using ^{137}Cs

(Callaway et al., in press)

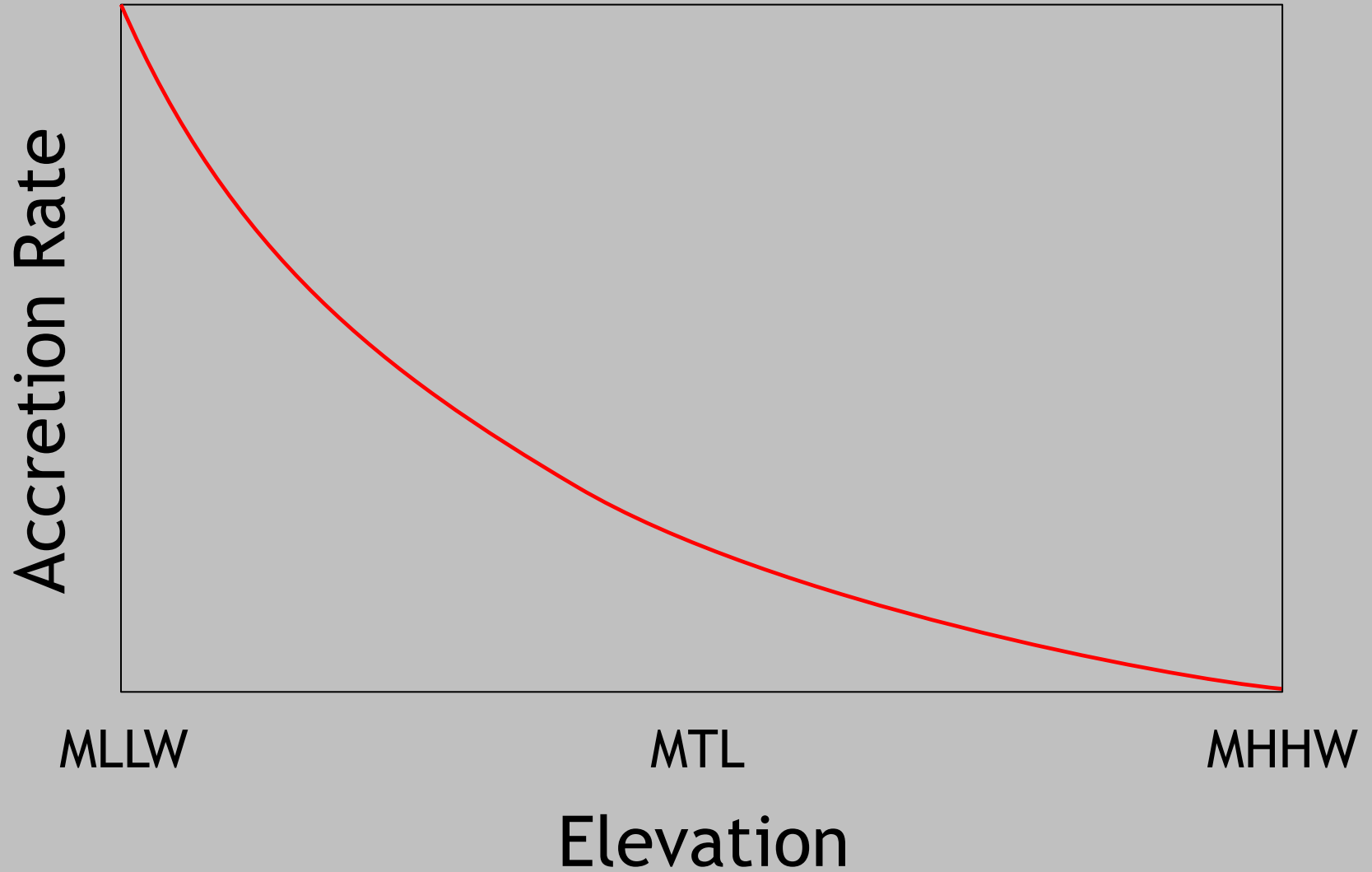
Marsh Suspended Sediment Concentrations



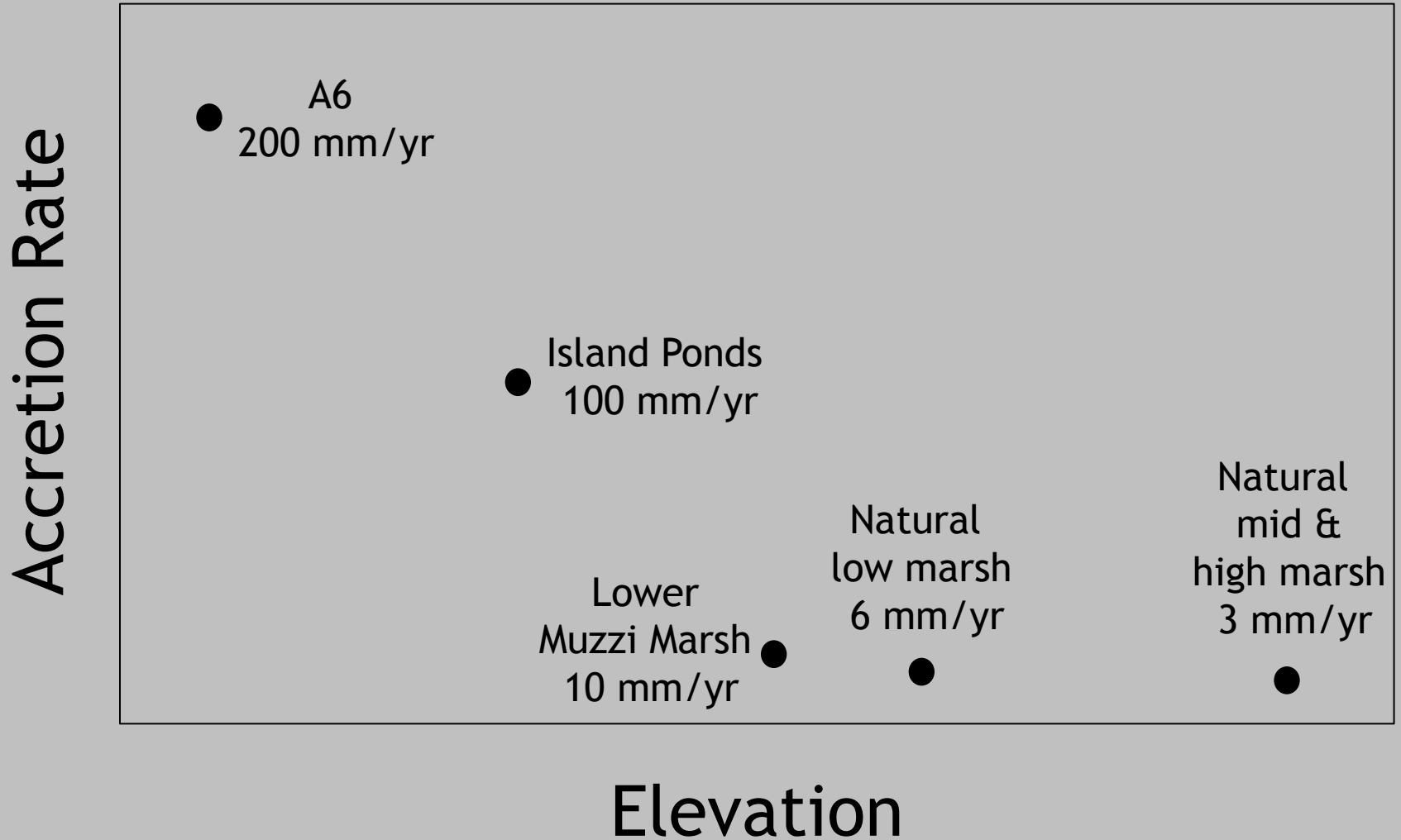
Summary of Accretion Rates across Sites

Sites	Range of accretion rates
Pond A6	> 200 mm/yr
Island Ponds	10 to 100 mm/yr
Muzzi Marsh	3 to 10 mm/yr
Crissy Field	-5 to 4 mm/yr
Low marsh (natural)	Up to 6 mm/yr
Mid and high marsh (natural)	3 mm/yr

Theoretical Tidal Wetland Development



Theoretical Tidal Wetland Development



Conclusions

- Rapid sediment accumulation at low elevations in most restored marshes
- Results closely match expectations of marsh development over time
- Natural wetlands are keeping pace with current rates of SLR
- High suspended sediment concentrations within SF Bay marshes

Acknowledgments

- Gordon and Betty Moore Foundation
- South Bay Salt Pond Project & the Resources Legacy Fund
- San Francisco Bay Conservation and Development Commission & US EPA
- Coastal Conservancy Association
- USF Faculty Development Fund
- Many USF and SFSU students