Tidal Wetlands & Climate Change

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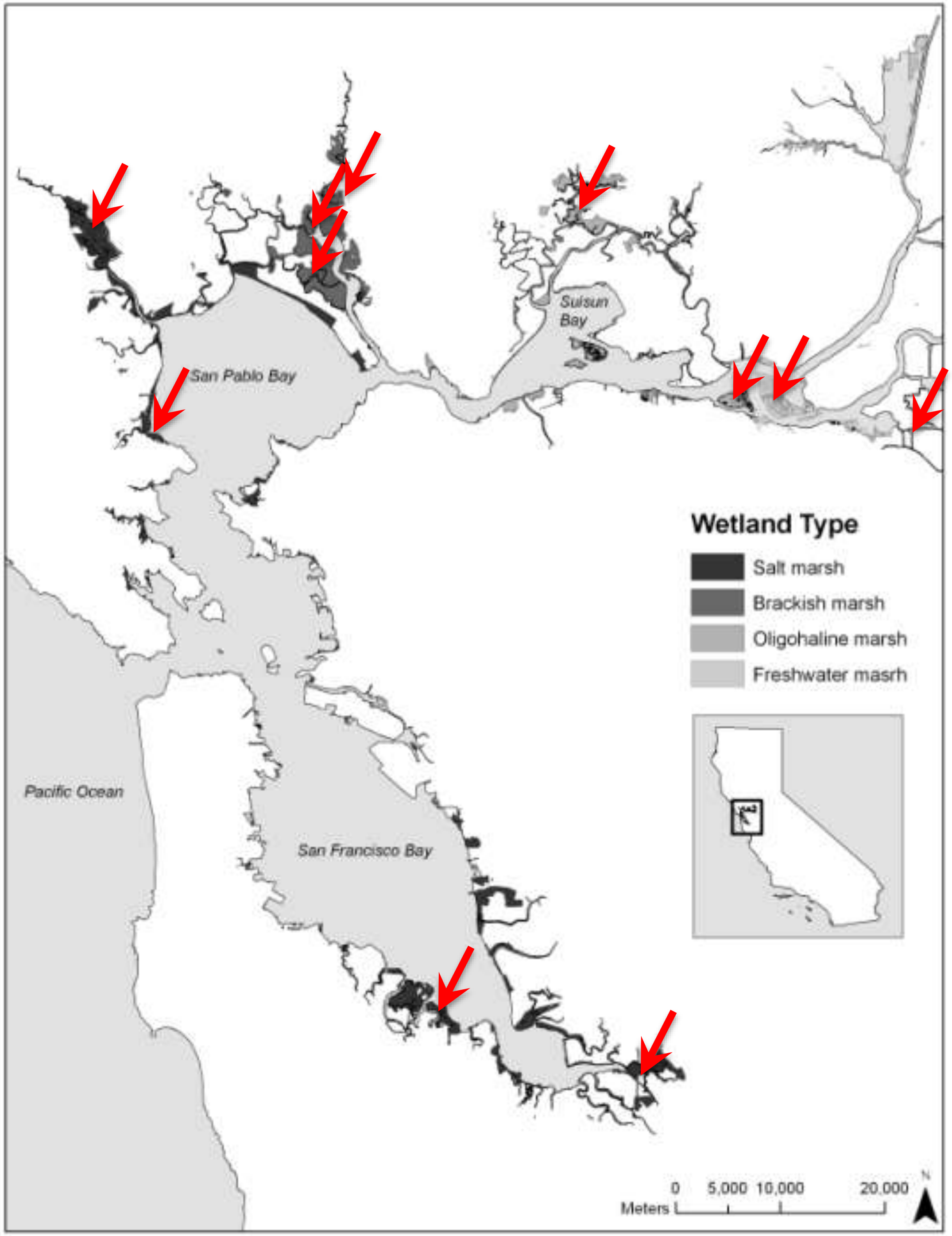
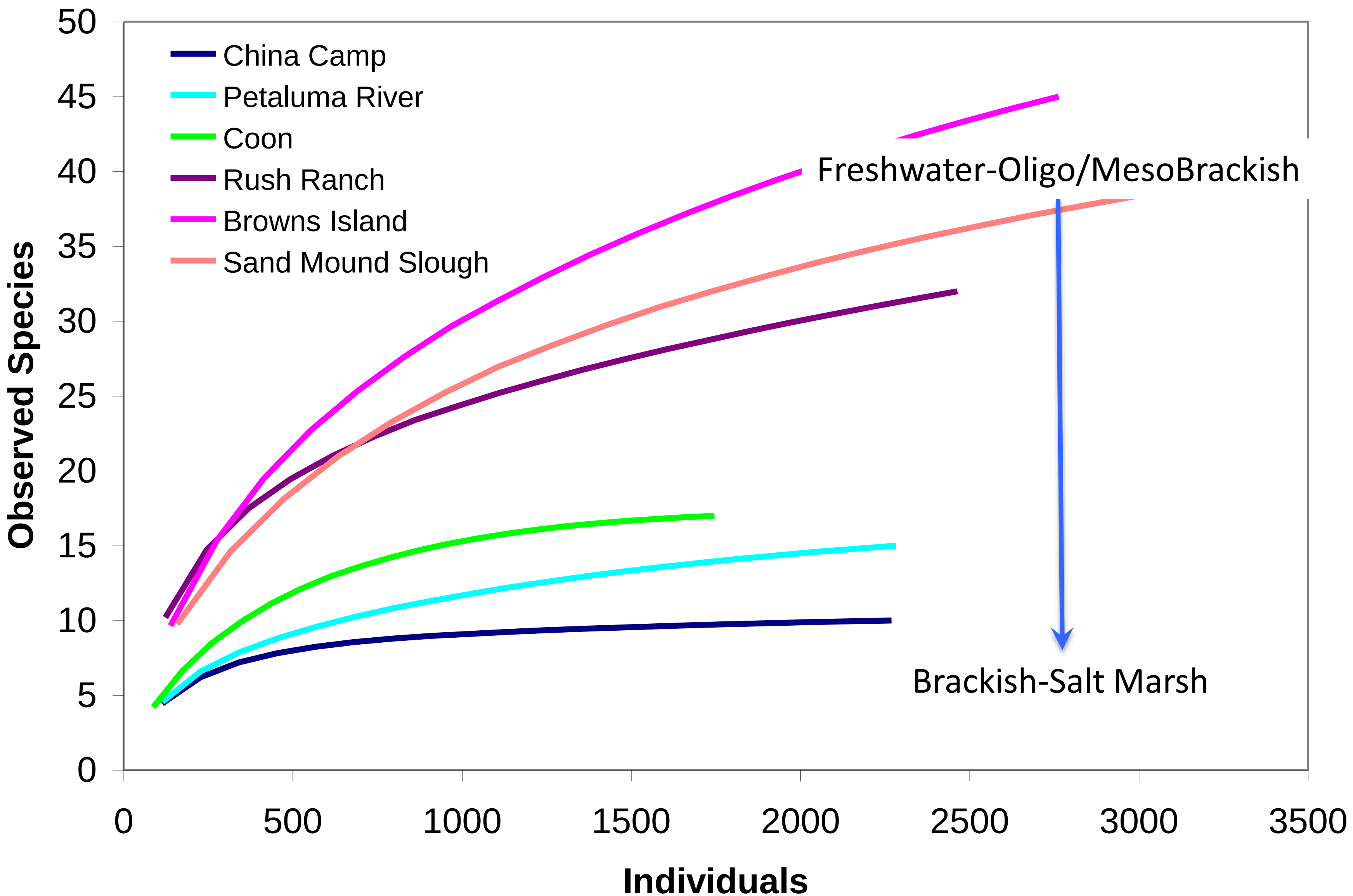
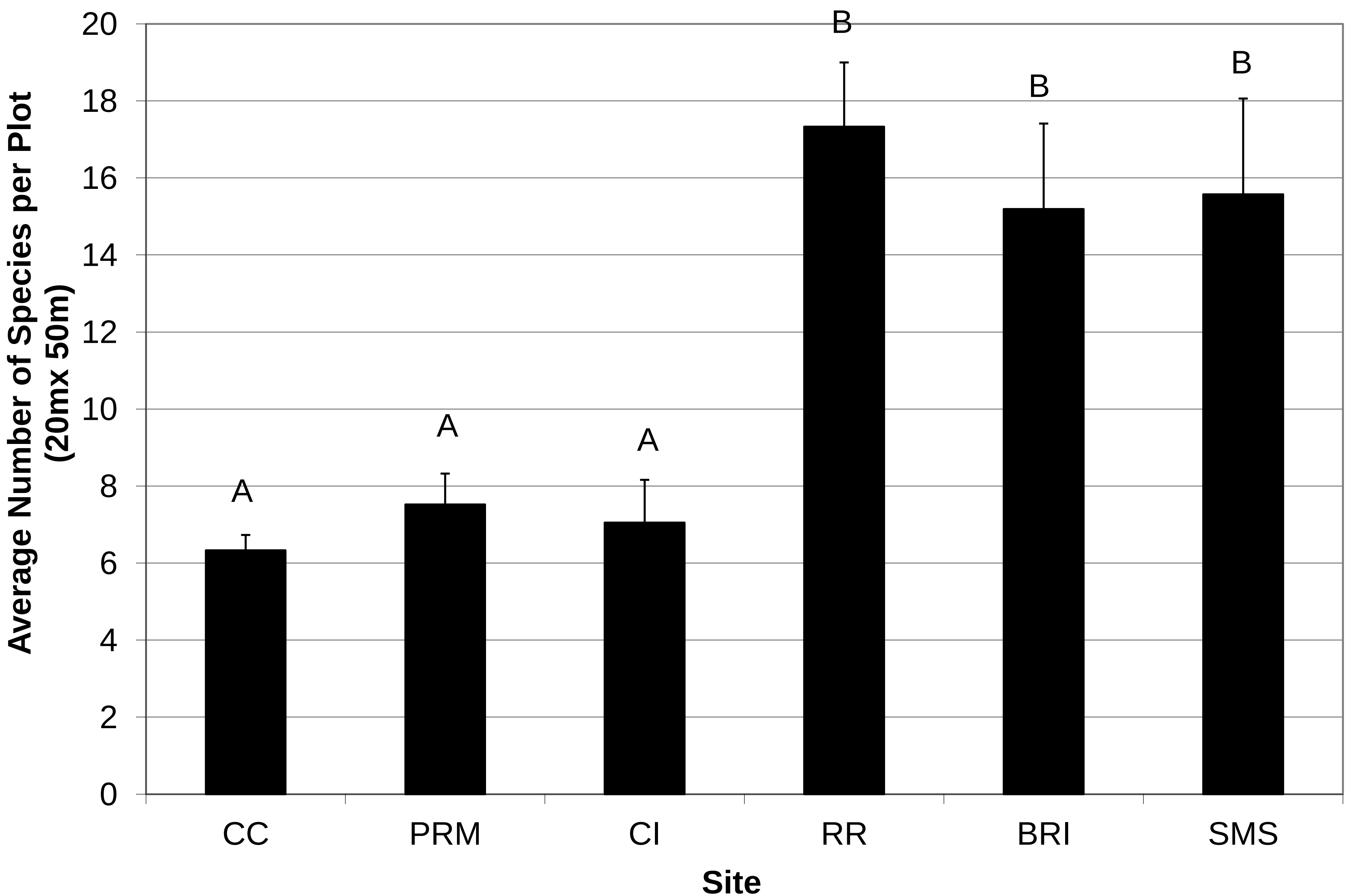


Data comes from these wetlands

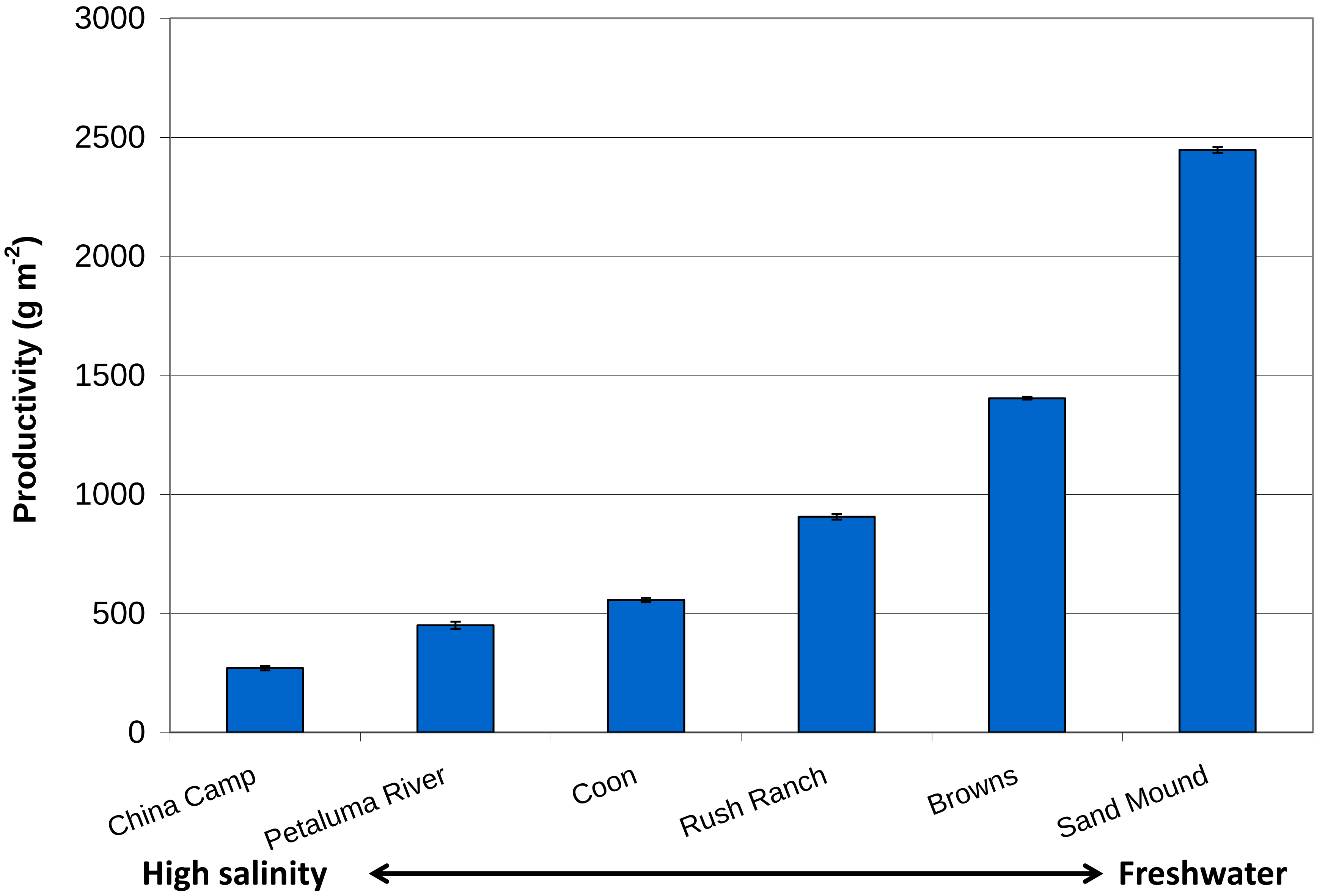
What do we know?

Diversity Increases as Salinity Decreases

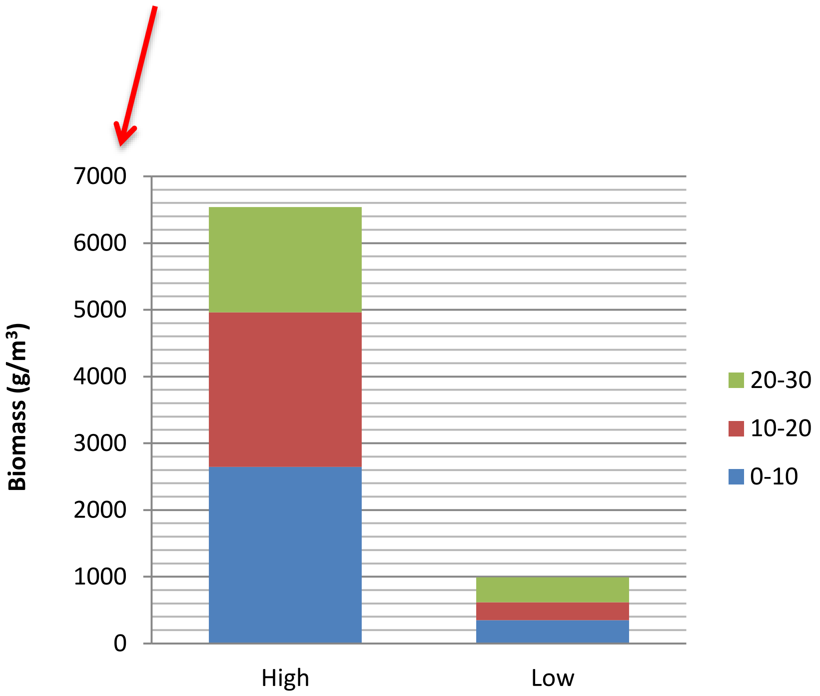



Average Number of Species per Plot
(20mx 50m)
20
18
16
14
12
10
8
6
4
2
0
A
A
A
B
B
B
CC
PRM
CI
RR
BRI
SMS
Site

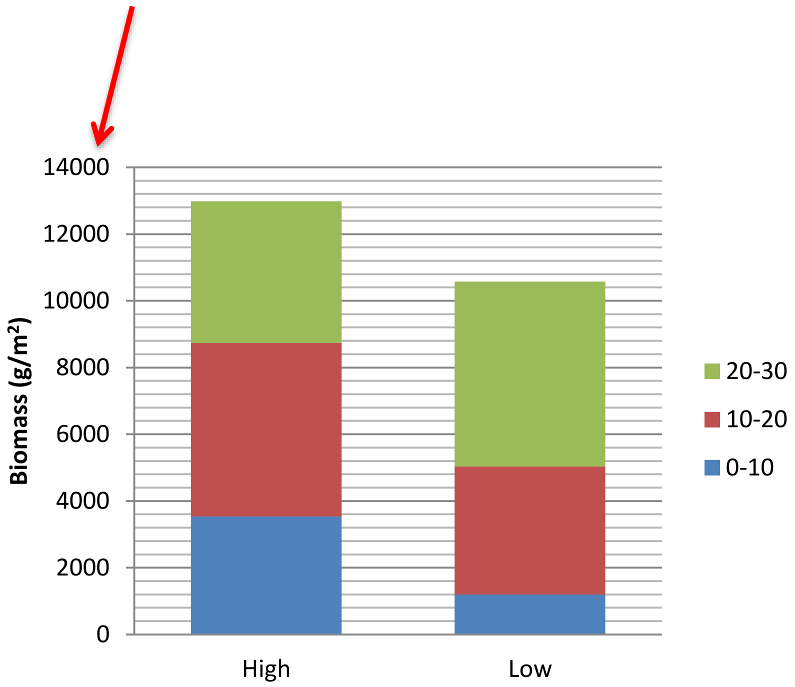
Productivity in strongly reduced by salinity



Belowground biomass is also quite high



Petaluma River Marsh



Browns Island

Inundation reduces productivity when interacting with salinity.

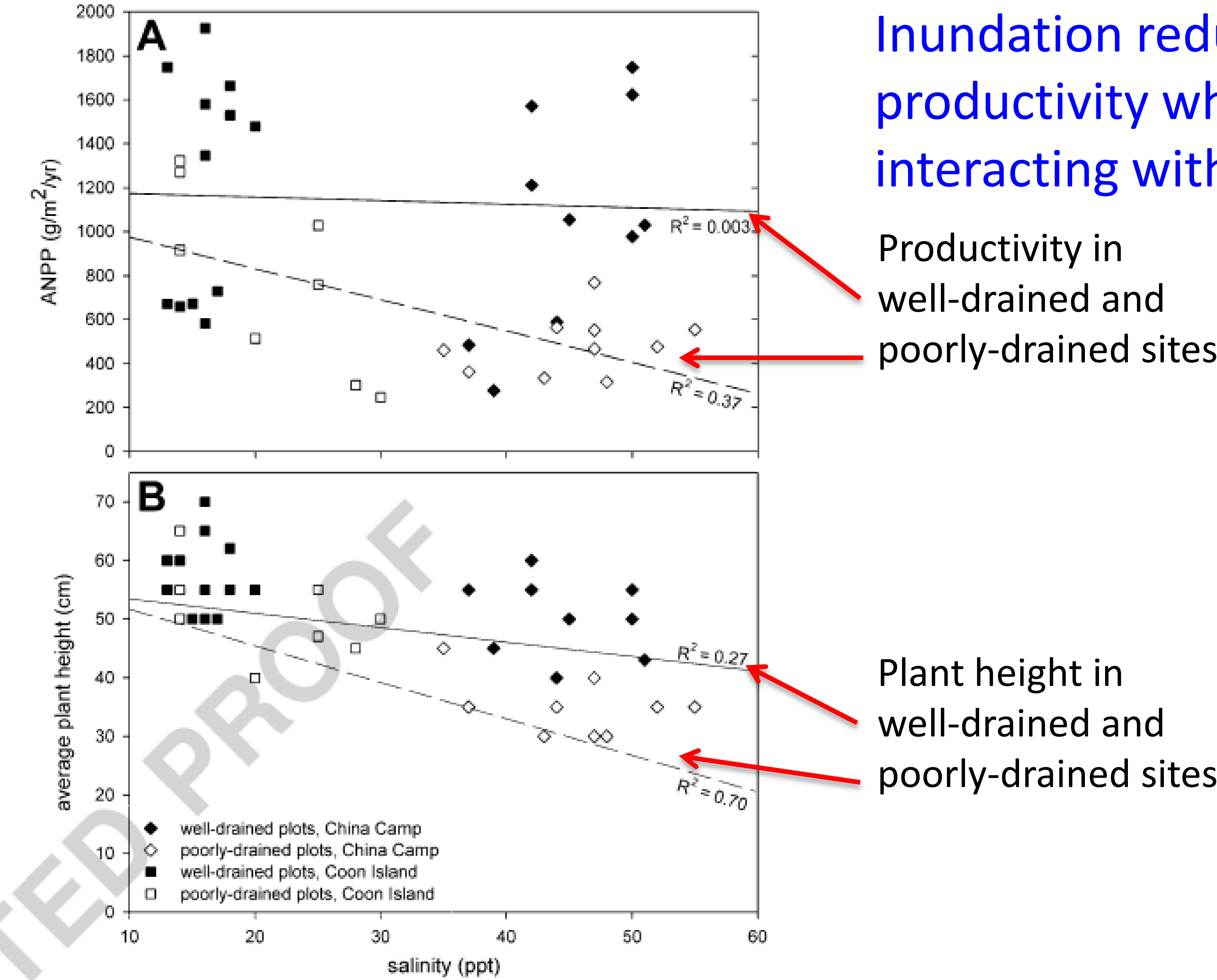


Fig. 5 **a** Aboveground annual net primary production of *S. pacifica* and **b** average plant height in relation to soil salinity in poorly-drained areas (- - -) versus well-drained areas (—) at China Camp and Coon Island

Schile et al. Wetlands *in press*

What aspects of climate change will impact SF Bay-Delta tidal wetlands?

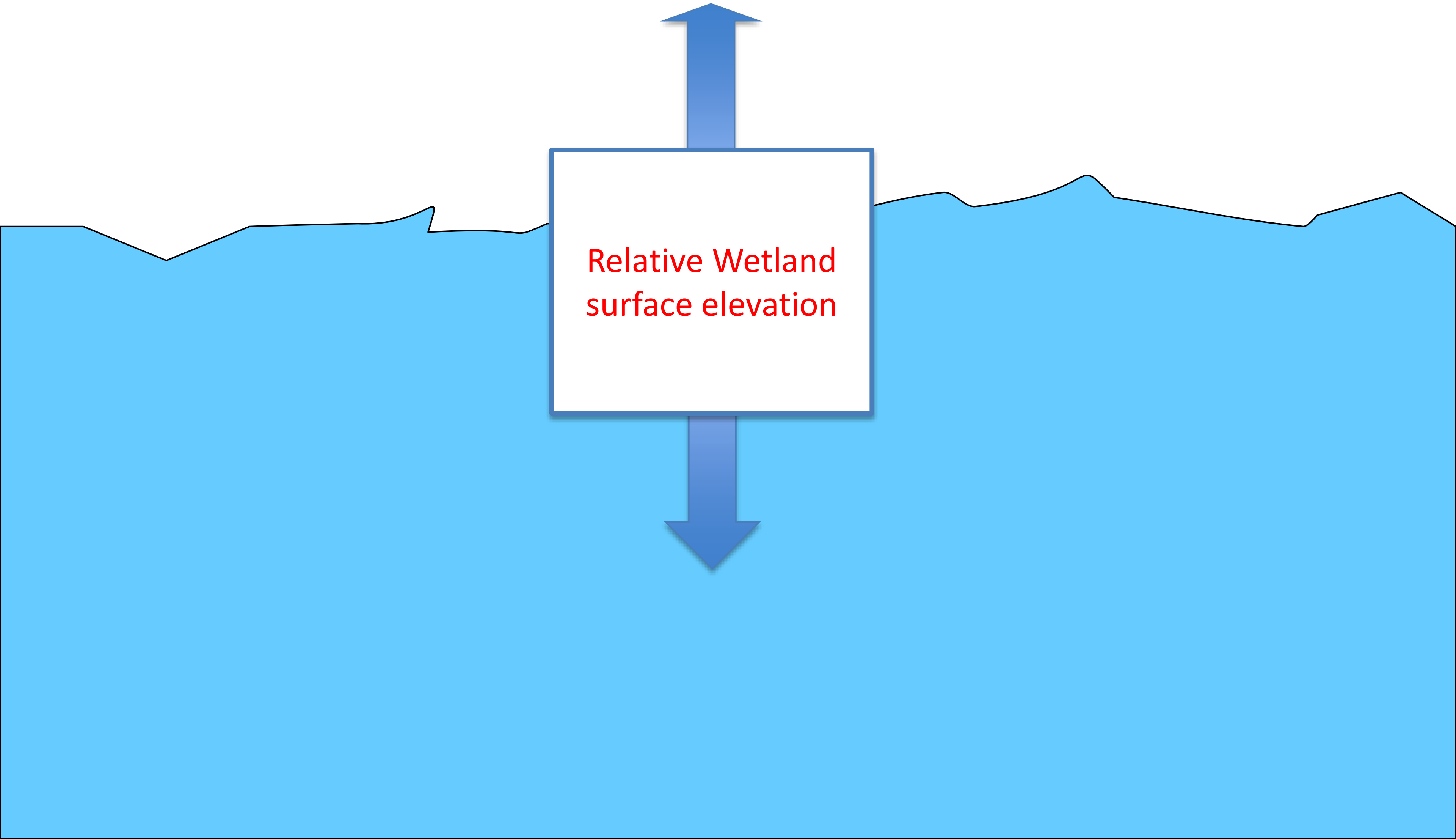
Climate change and tidal wetlands

- Increased CO_2
- Increased temperatures during growing season
- Increased rate of sea level rise
- Increased salinity in brackish and freshwater tidal areas
- Decreased freshwater flows in summer and fall
- Salinity stress increases due to summer evapotranspiration

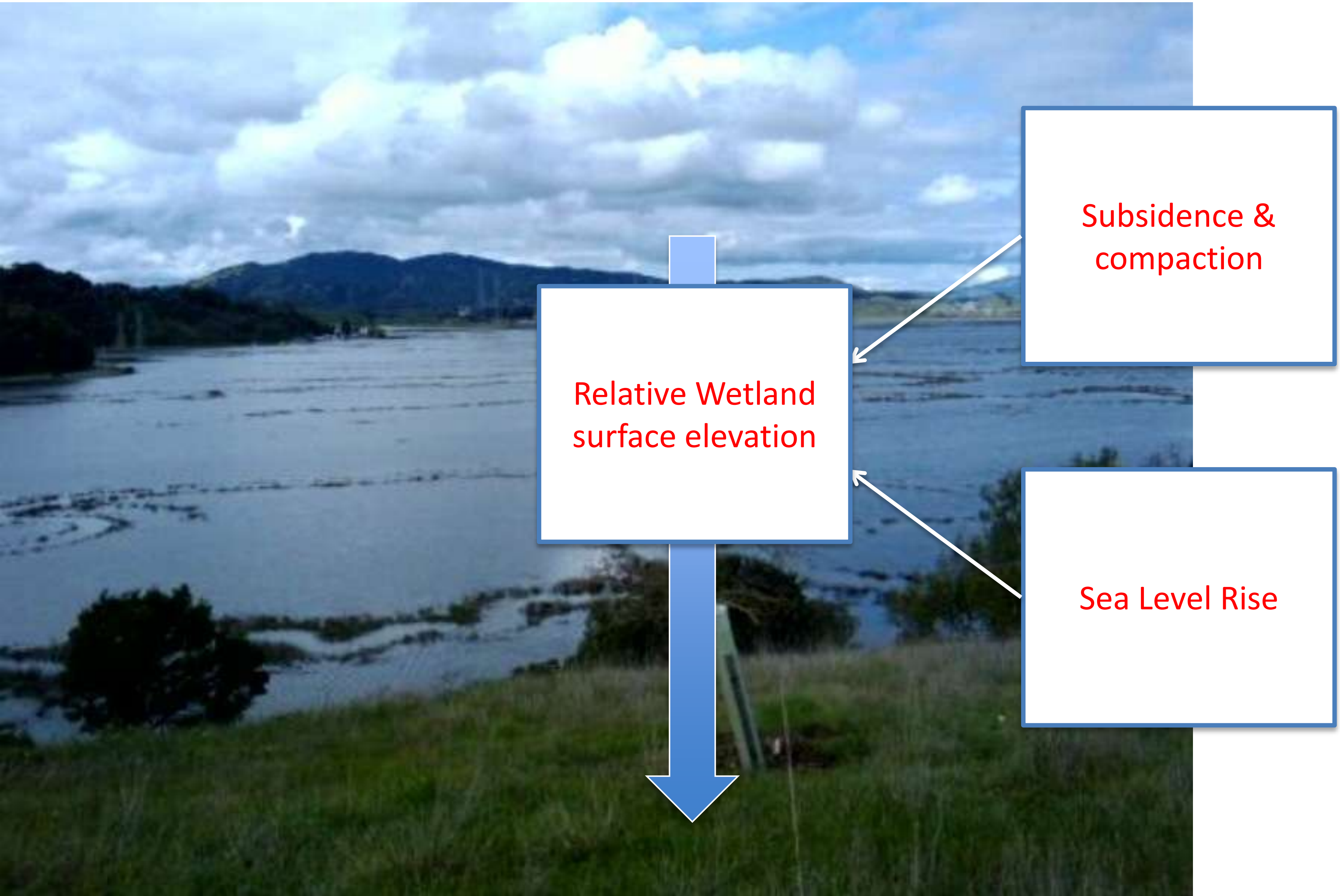
What are we sure about?

- Increasing salinity strongly influences composition, and reduces diversity and productivity
- Inundation reduces diversity and productivity

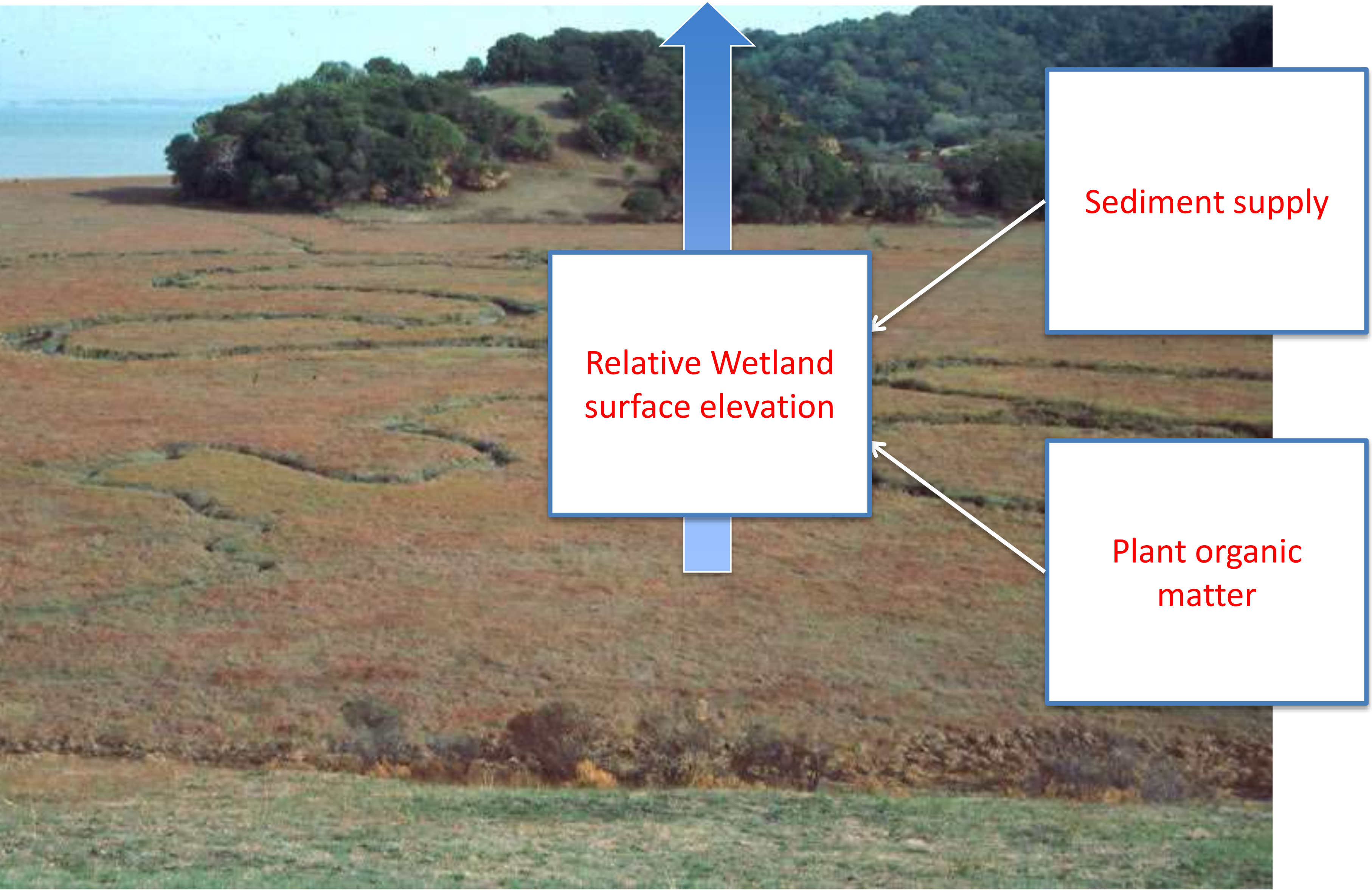
Can tidal wetlands keep up with sea level rise?



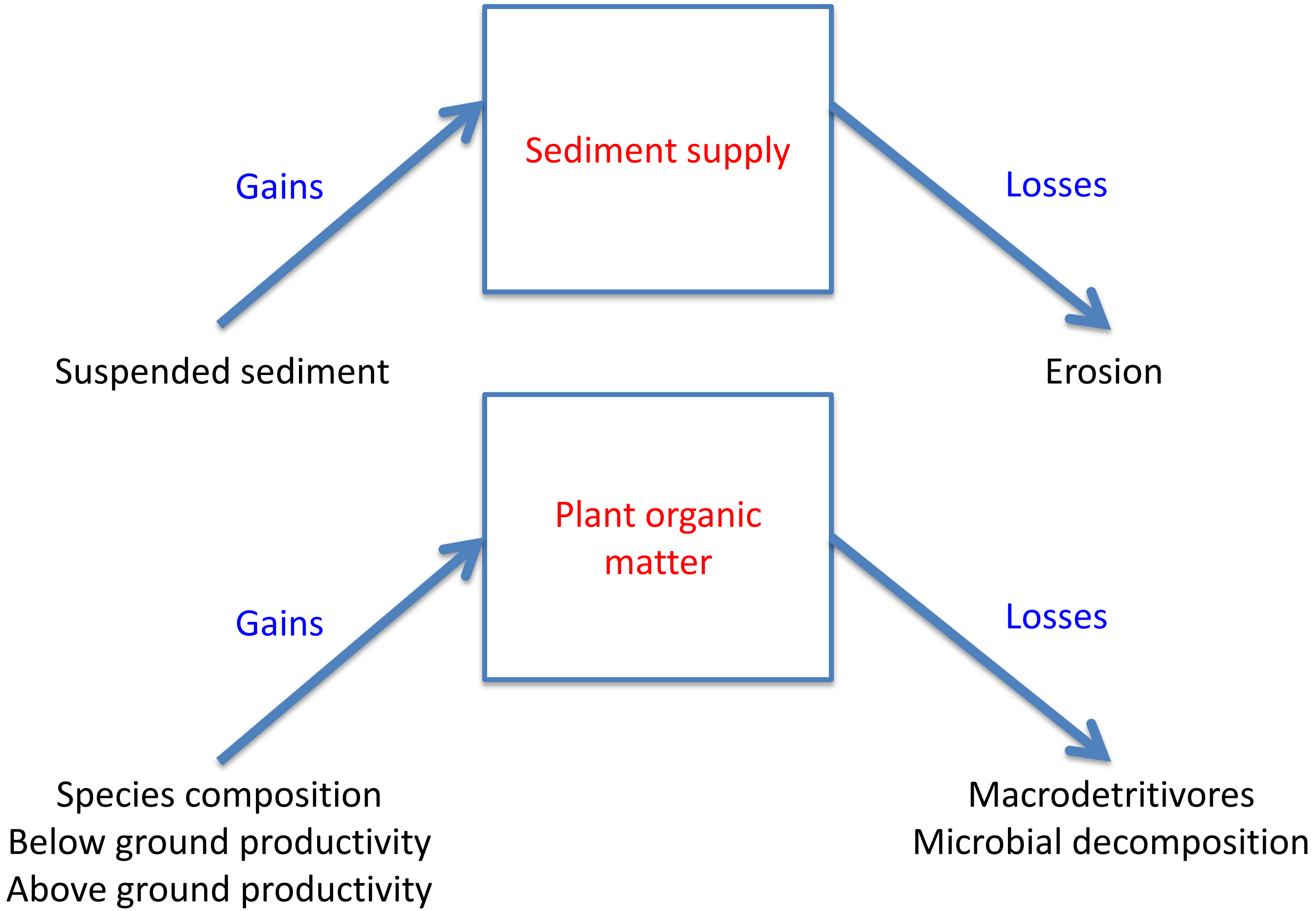
Processes contributing to elevation decline

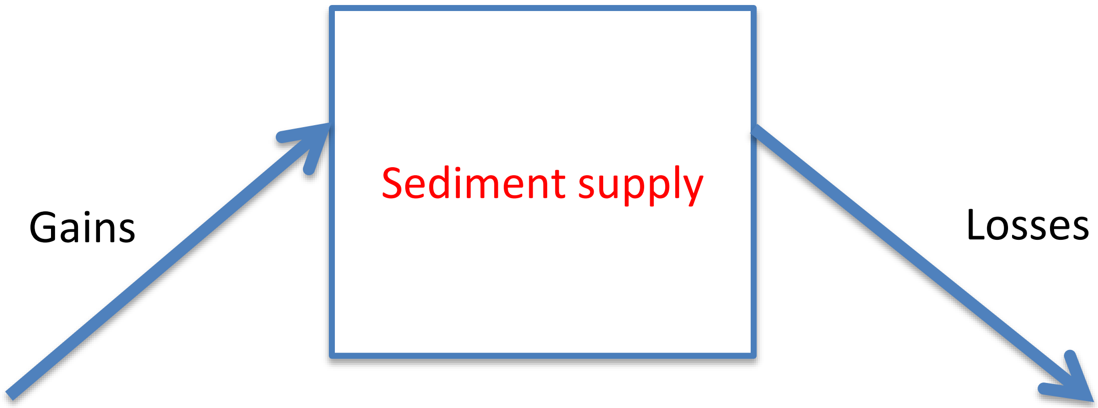


Processes contributing to elevation increase



Processes that promote accretion





Suspended sediment

Erosion

SET- Sediment Erosion Tables

Feldspar-
marker horizons

Plant organic matter

Gains

Losses

Species composition
Below ground productivity
Above ground productivity

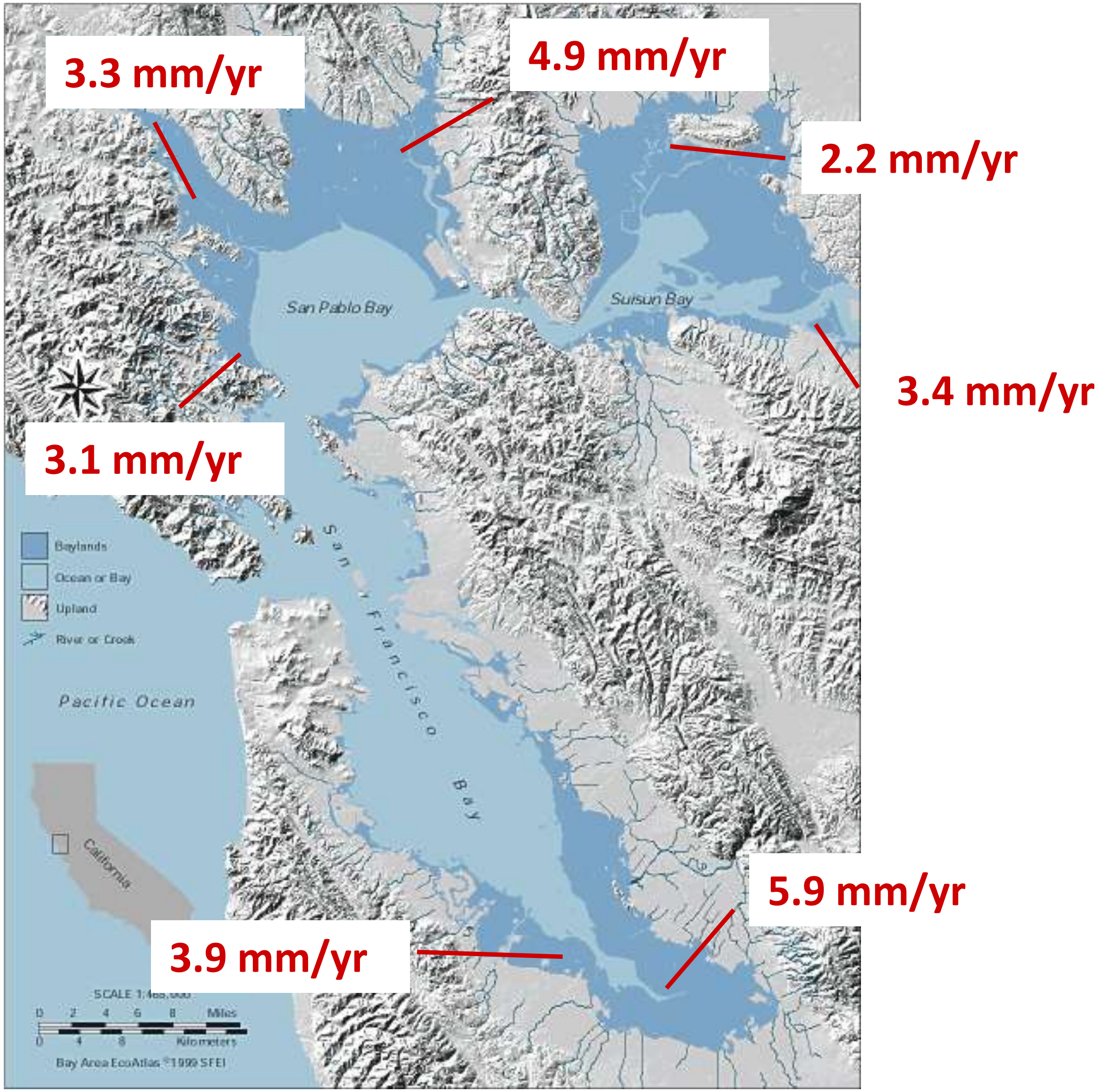
Macrodetritivores
Microbial decomposition

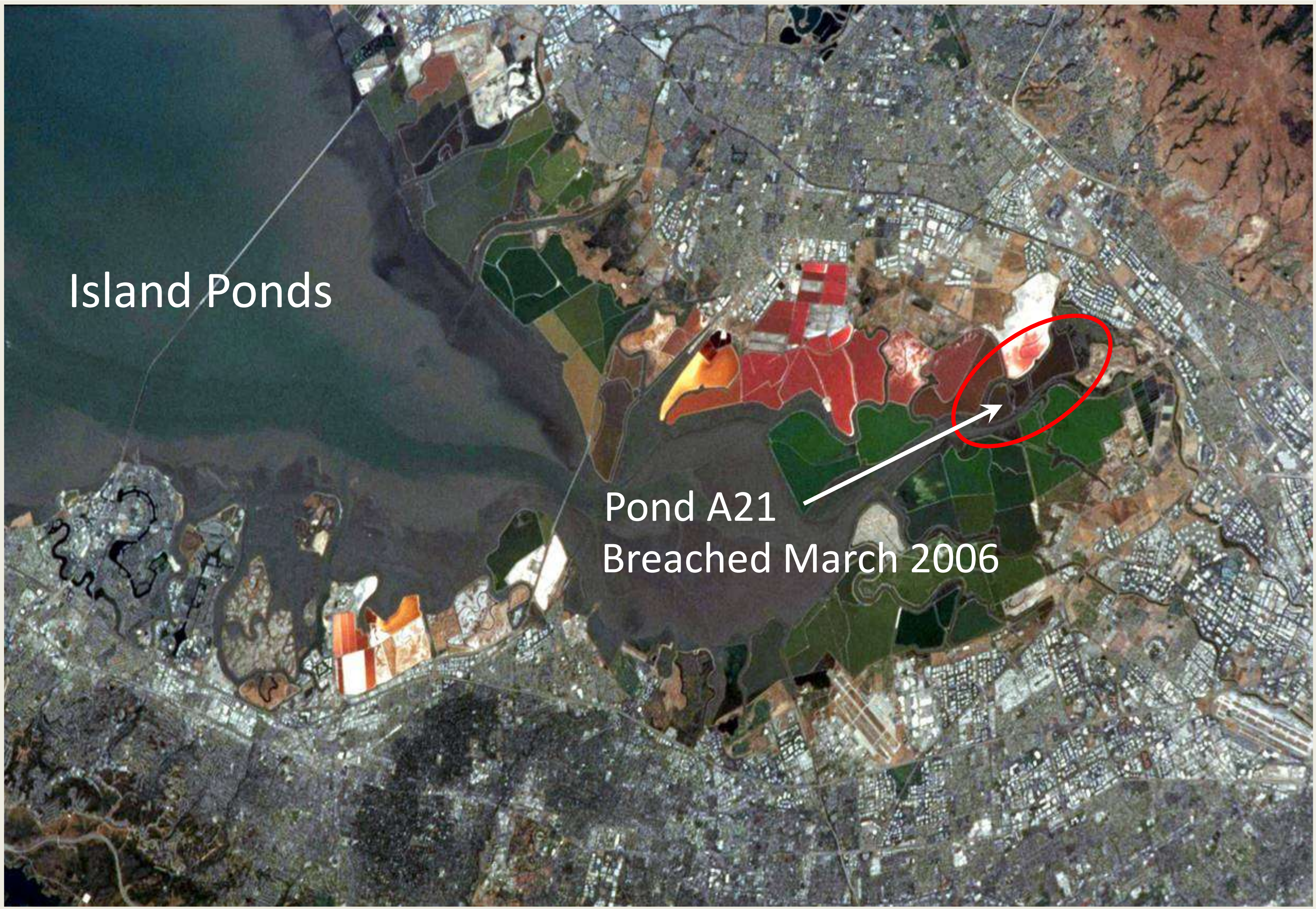
Is sediment supply sufficient?

Short-term Sediment Accretion Rates
using feldspar markers: MID-MARSH LOCATIONS

North Bay rates based on one year of data

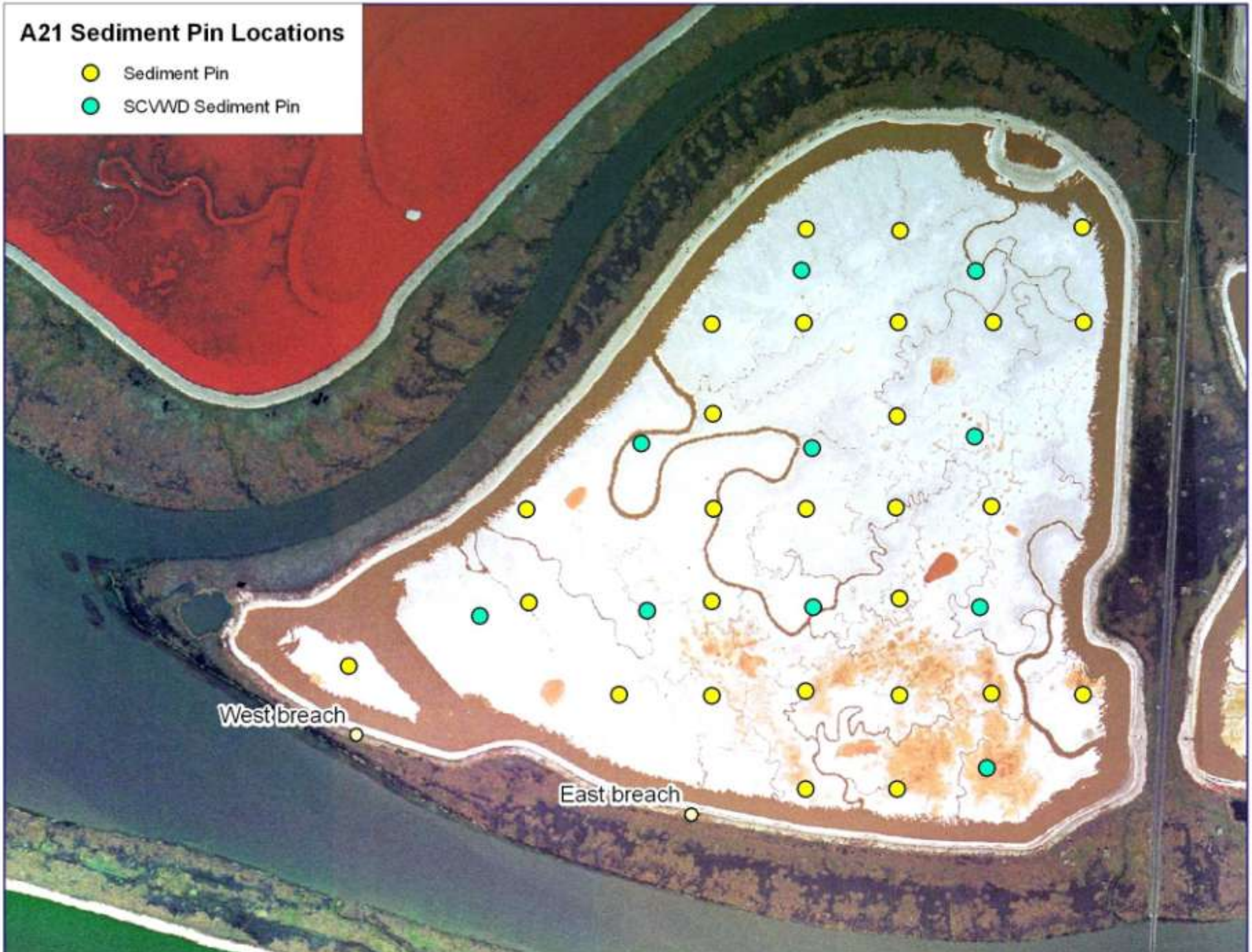
South Bay rates based on six years of data

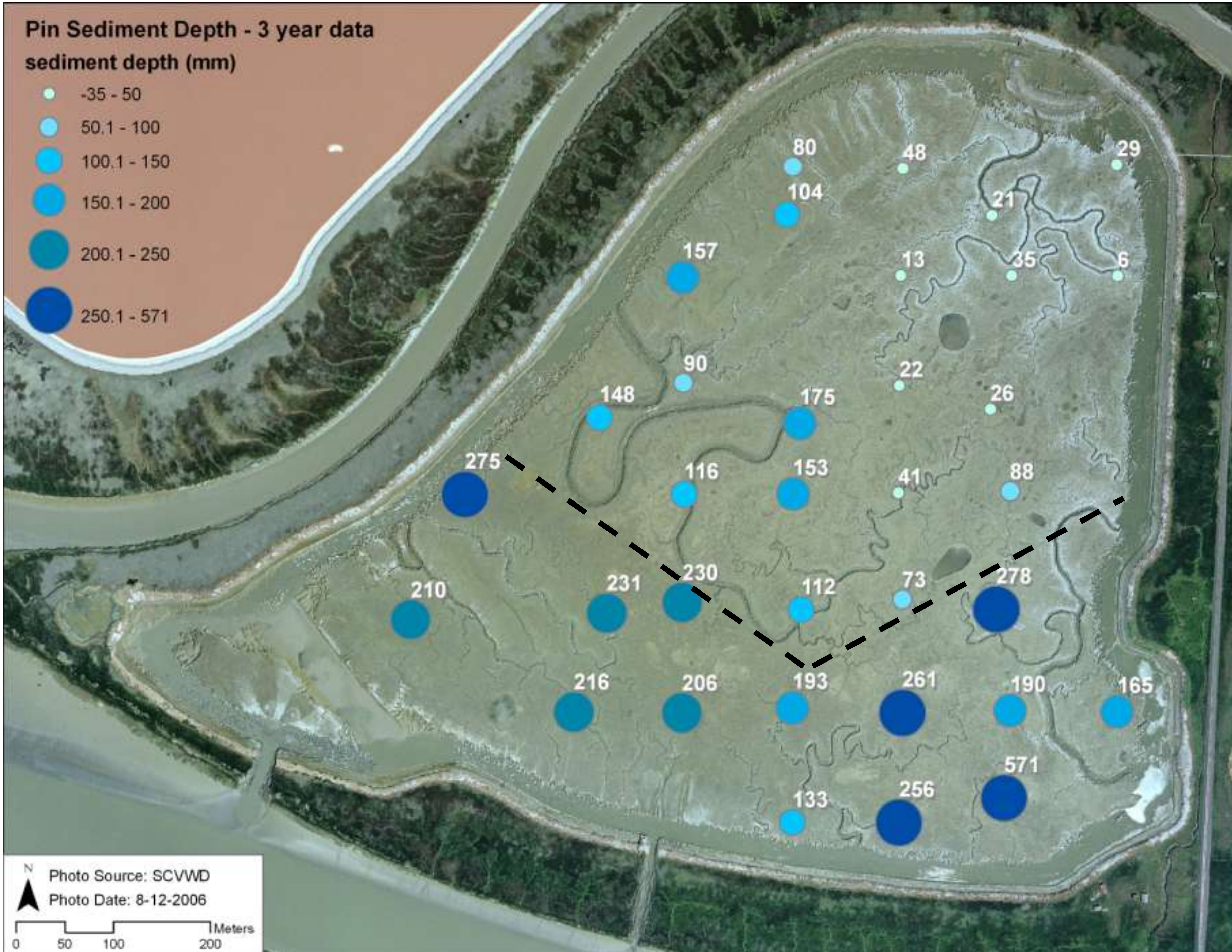




Island Ponds
Pond A21
Breached March 2006

Sediment pins


A21 Sediment Pin Locations
Sediment Pin
SCVWD Sediment Pin
West breach
East breach


Pin Sediment Depth - 3 year data
sediment depth (mm)
-35 - 50
50.1 - 100
100.1 - 150
150.1 - 200
200.1 - 250
250.1 - 571
80
48
29
104
21
157
13
35
6
90
22
148
175
26
275
116
153
41
88
210
231
230
112
73
278
216
206
193
261
190
165
571
133
256
Photo Source: SCVWD
Photo Date: 8-12-2006
N
Meters
0
50
100
200

High rates of sedimentation-colonization in the 3rd year

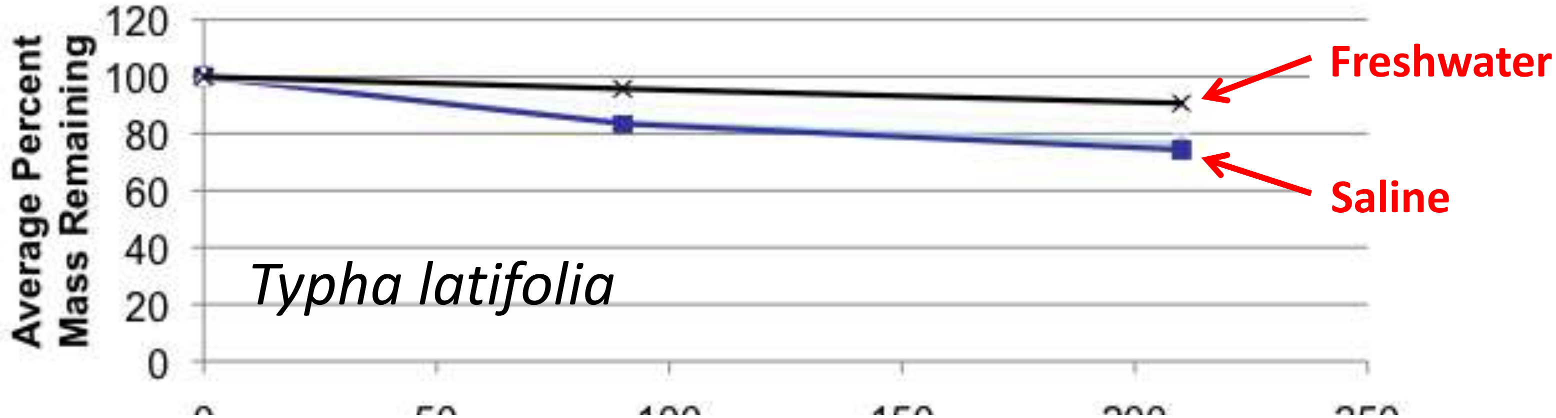
http://steel.ced.berkeley.edu/research/hidden_ecologies/

Carl's Marsh at 8 years post-restoration

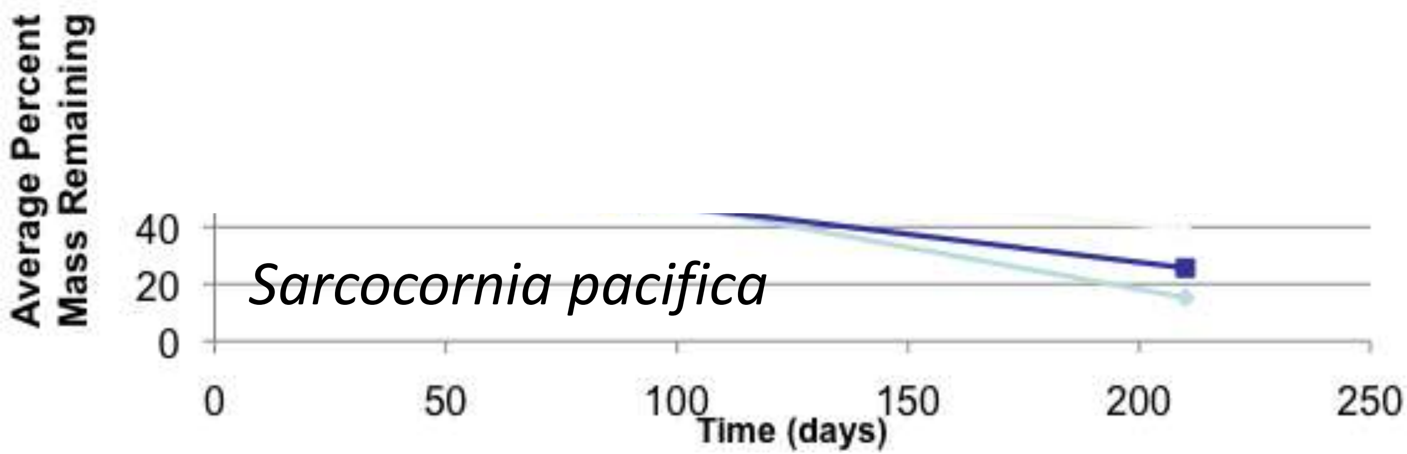
Suspended sediment currently is sufficient; other researcher's estimate it will not keep up with higher rates of sea level rise, especially in some areas of the Bay.

Organic matter additions?
Very high productivity and high belowground biomass:

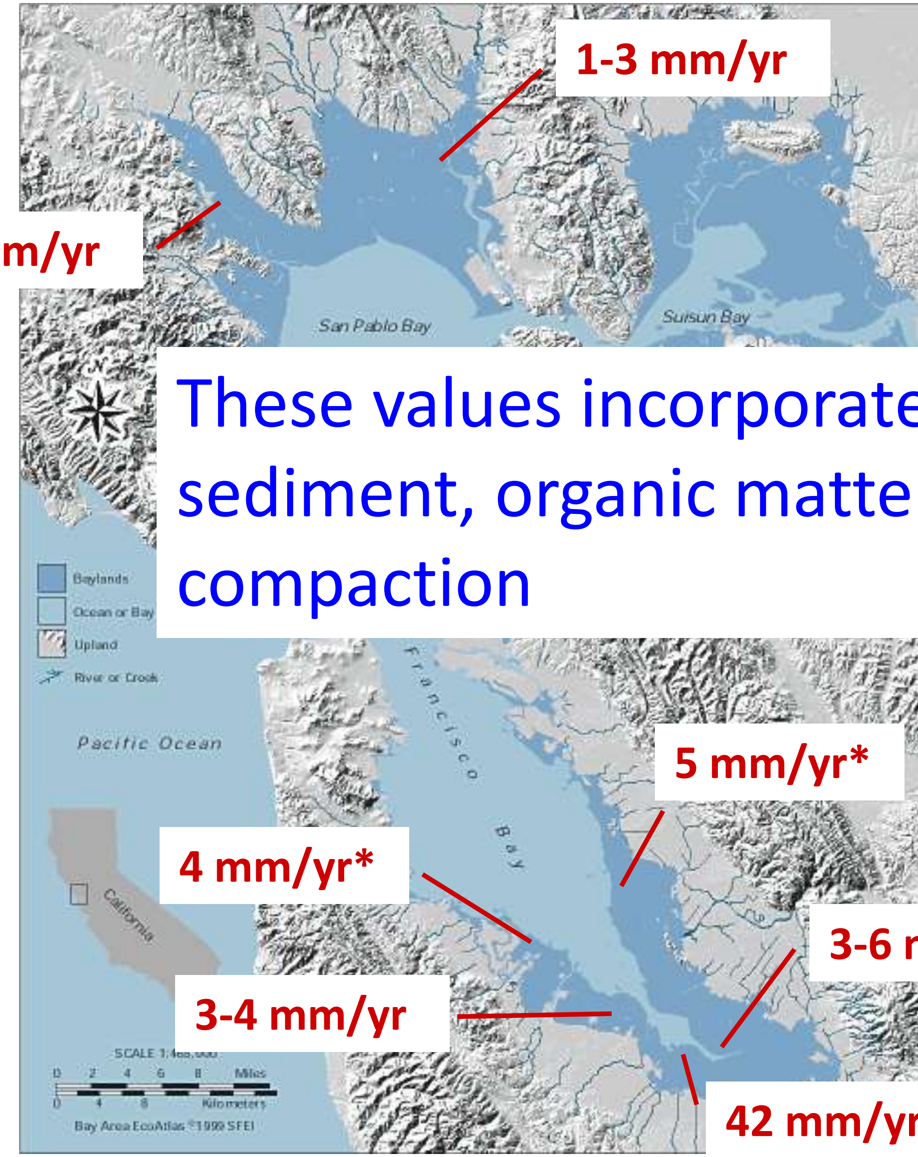
Decomposition?



Current data indicate 5-10% lasting to the end of the second year. Differences among species and wetlands decrease.



Long-term Sediment Accretion Rates
(^{137}Cs and ^{210}Pb dating-)



These values incorporate sediment, organic matter and compaction

Data from Callaway et al. (unpublished) or *Patrick and Lehune (1990)

Gaps in our knowledge

- CO_2
- Temperature

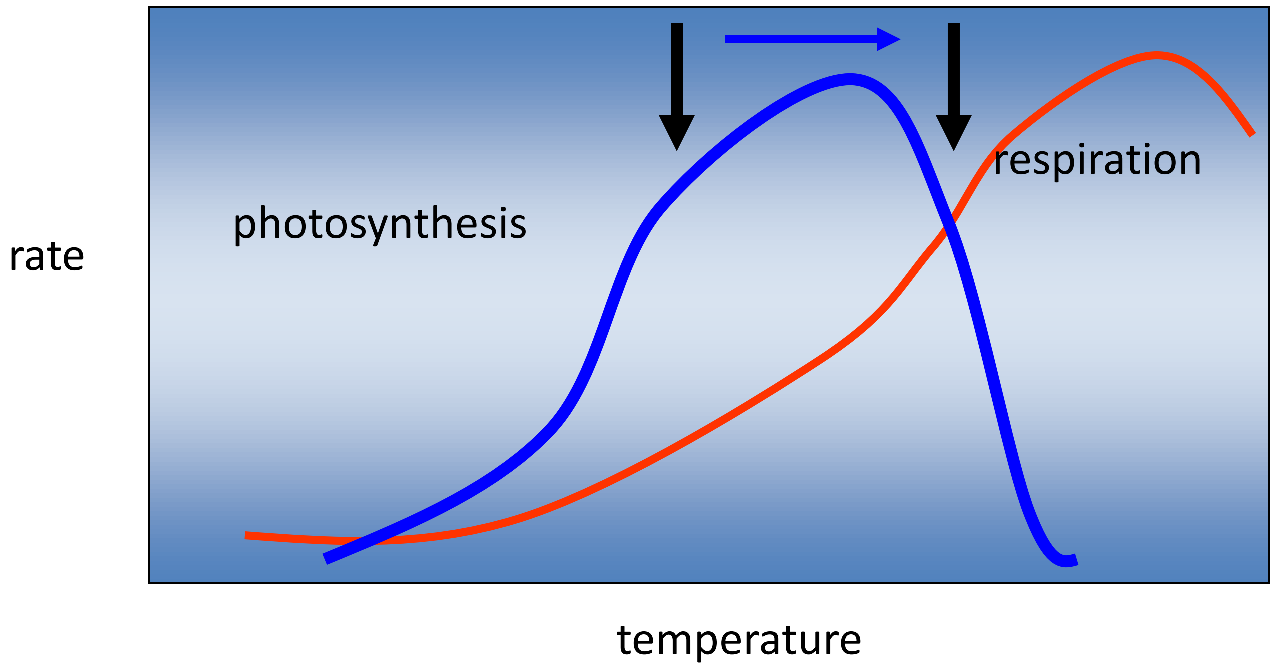
Impact on plant physiology and interactions

Impacts of CO_2

- Plant resource, especially for C3 plants
- Shown to stimulate root growth in 2 experiments (Maryland, Louisiana)

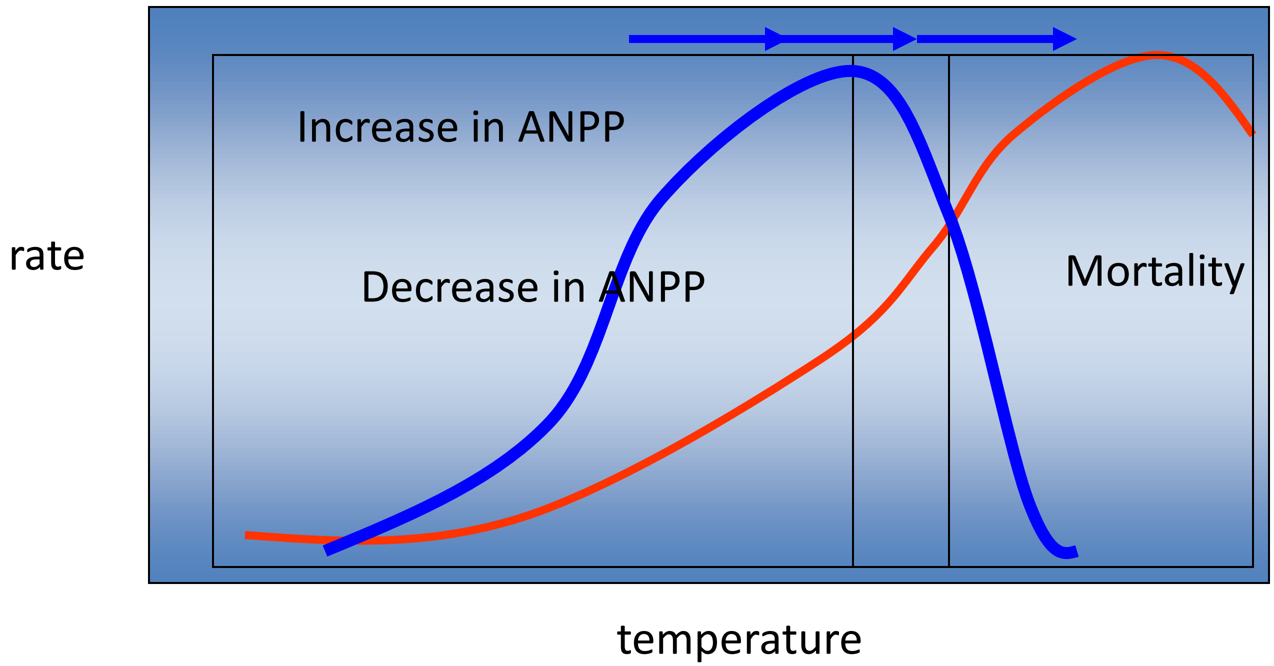
Direct effects-temperature

- Influence on photosynthesis/respiration balance of dominant plants



Direct effects-temperature

- Influence on photosynthesis/respiration balance of dominant plants



Interactions among all these processes?