

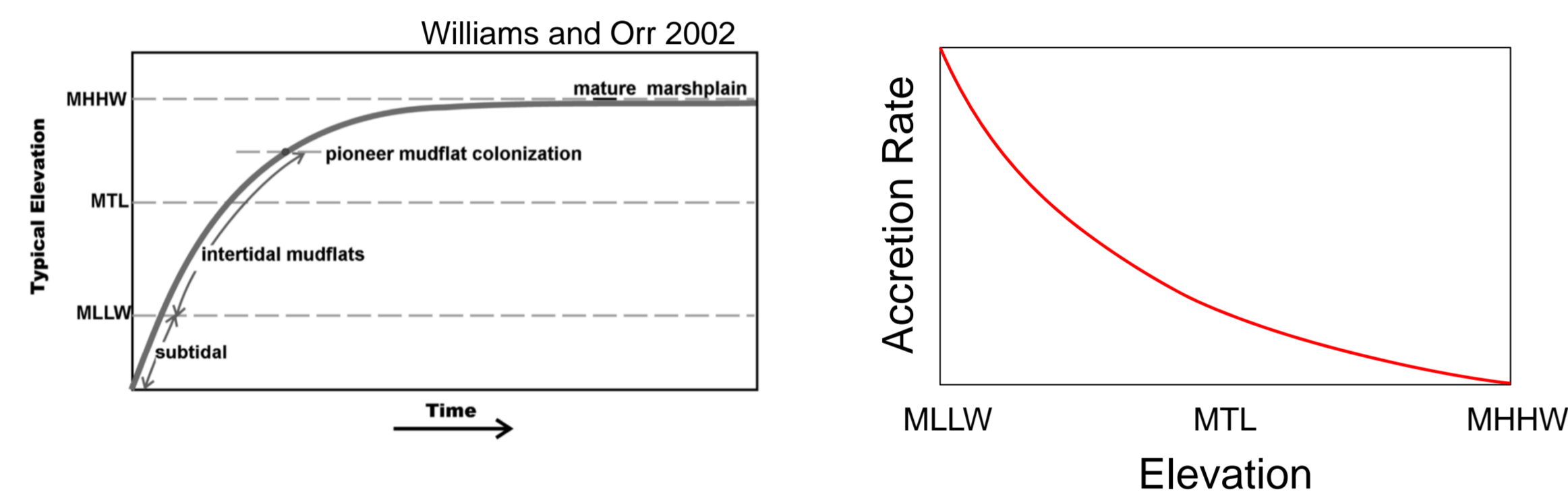
Sediment Dynamics and Vegetation Recruitment in Newly Restored Salt Ponds

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Introduction

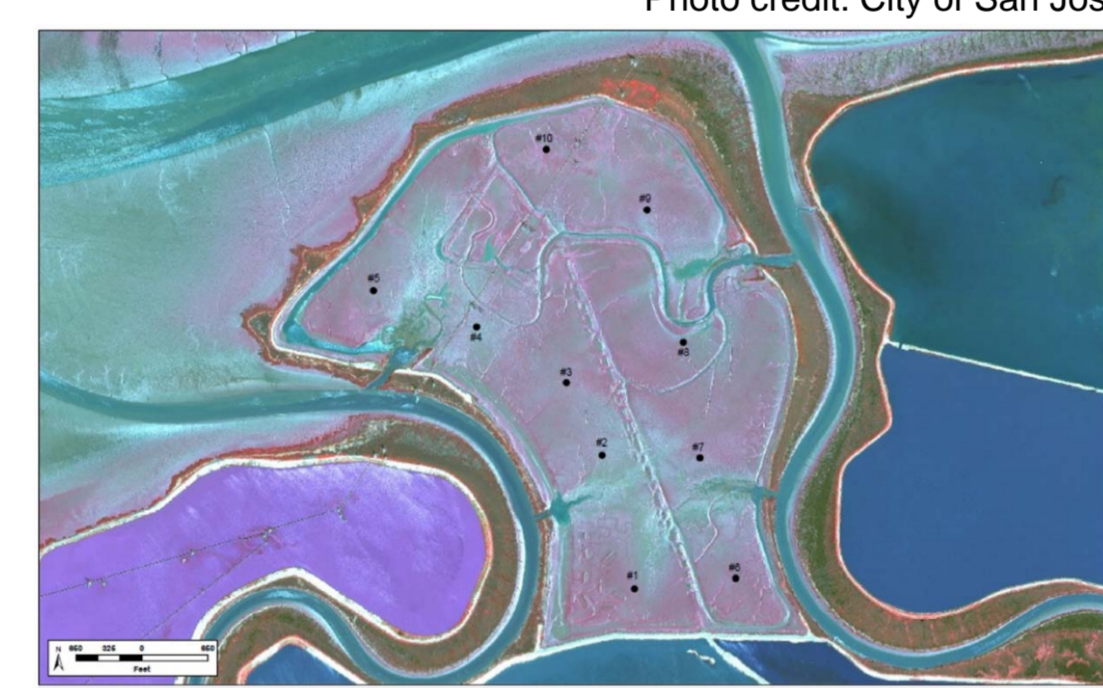
- Understanding elevation and sediment dynamics within restored salt ponds is critical to salt pond restoration planning because most of the ponds have subsided below elevations for vegetation establishment.
- There is growing concern for sediment accretion rates within San Francisco Bay tidal marshes because of documented decreases in suspended sediment concentrations (e.g., Schoellhamer 2011).
- A number of models have identified that sedimentation rates are negatively correlated with elevation, causing elevation in developing marshes to build asymptotically towards mean higher high water (see figure below from Williams and Orr (2002), as well as the adjacent figure which illustrates the predicted relationship between elevation and accretion).
- A key uncertainty for the South Bay Salt Pond Restoration Project has been stated as: "Will sediment accretion in restored tidal areas be adequate to create and to support emergent tidal habitat ecosystems within the 50-year projected time frame?"
- To address this question, we monitored sediment dynamics at Pond A6 (breached in 2010) and elevations of vegetation establishment at Ponds A6 and A21 (one of the Island Ponds; breached in 2006).



Approach



Pond A6 (circle) and the Island Ponds (oval, including Pond A21) within the South Bay

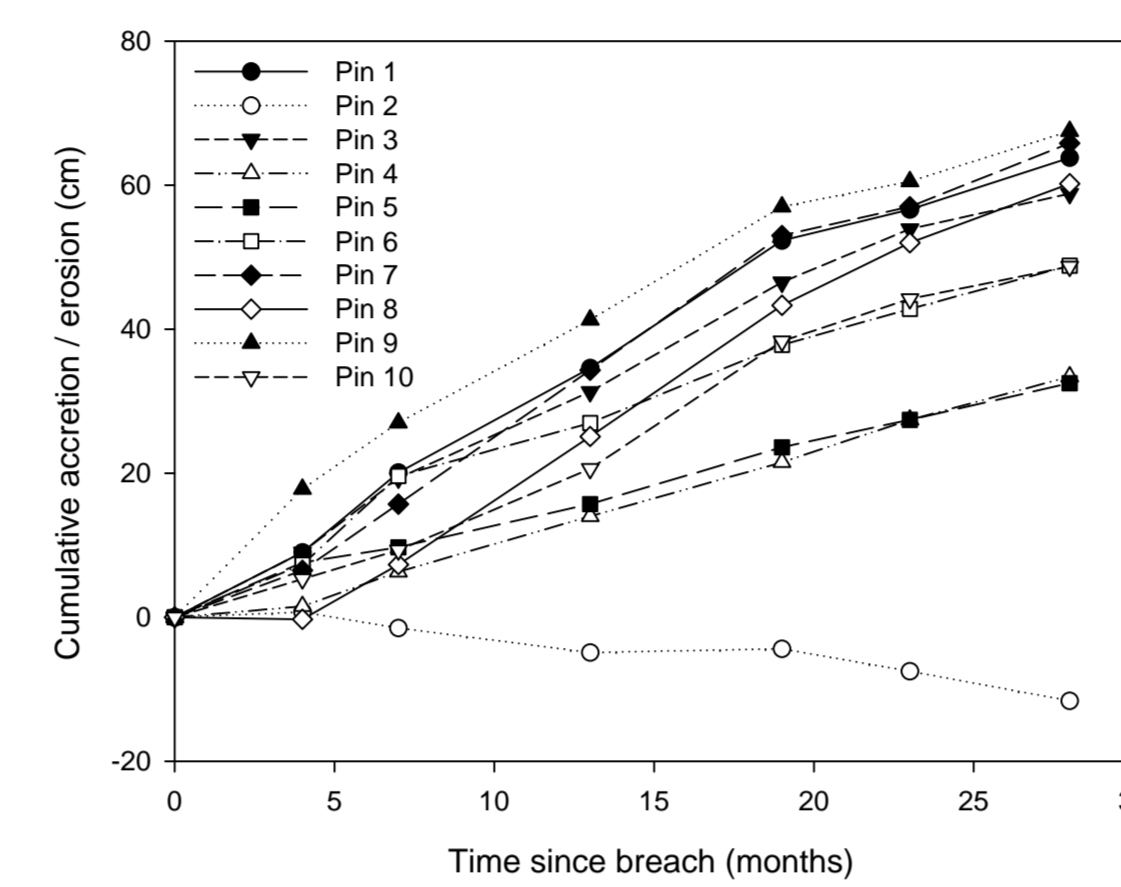


Sampling stations at Pond A6

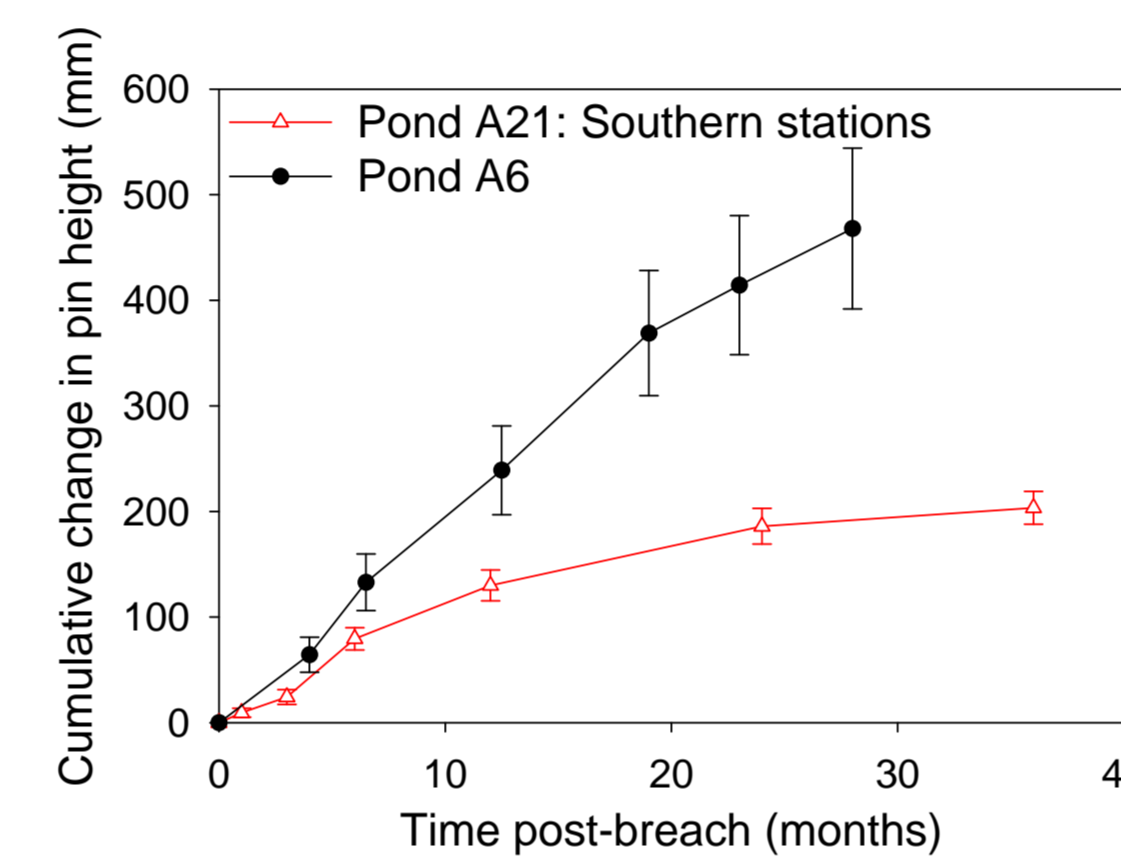
- We measured sediment accretion at Pond A6 for 28 months following the breach in December 2010.
- 10 sediment pins were established at Pond A6 prior to breaching.
- Data were compared to accretion rates that were measured using the same method at Pond A21 (Island Ponds, breached in 2006), and to accretion rates from Muzzi Marsh (restored) and multiple natural tidal marshes in the Bay (see next panel).
- Vegetation establishment was monitored at Ponds A6 and A21.
- Elevations of sampling stations and of vegetation distributions were measured using high-precision RTK GPS.



Sediment accumulation at Pond A6

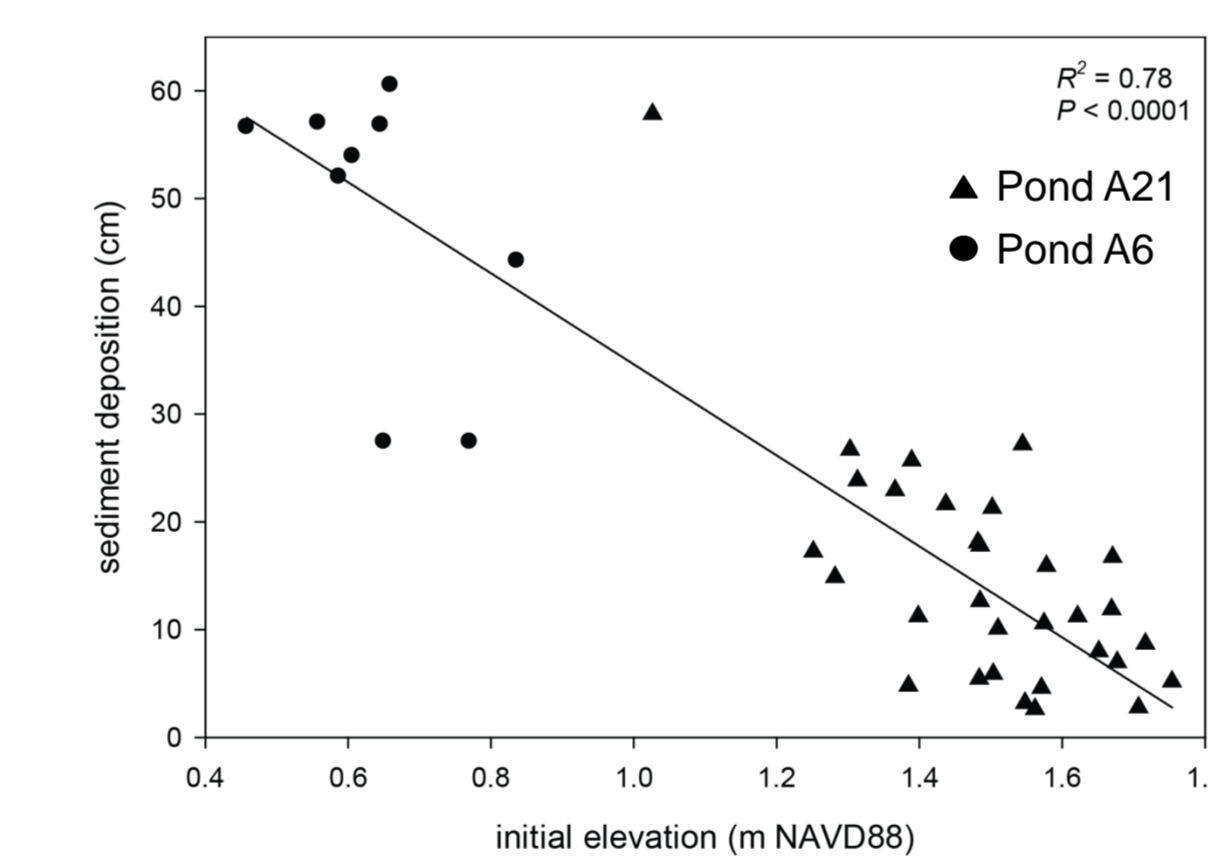


- Sedimentation at individual stations (pins) ranged from -12 cm (erosion) to 68 cm (accretion) over 28 months.
- All sampling stations had relatively consistent rates of accumulation over time, and only one of ten stations was erosional (station/pin 2).



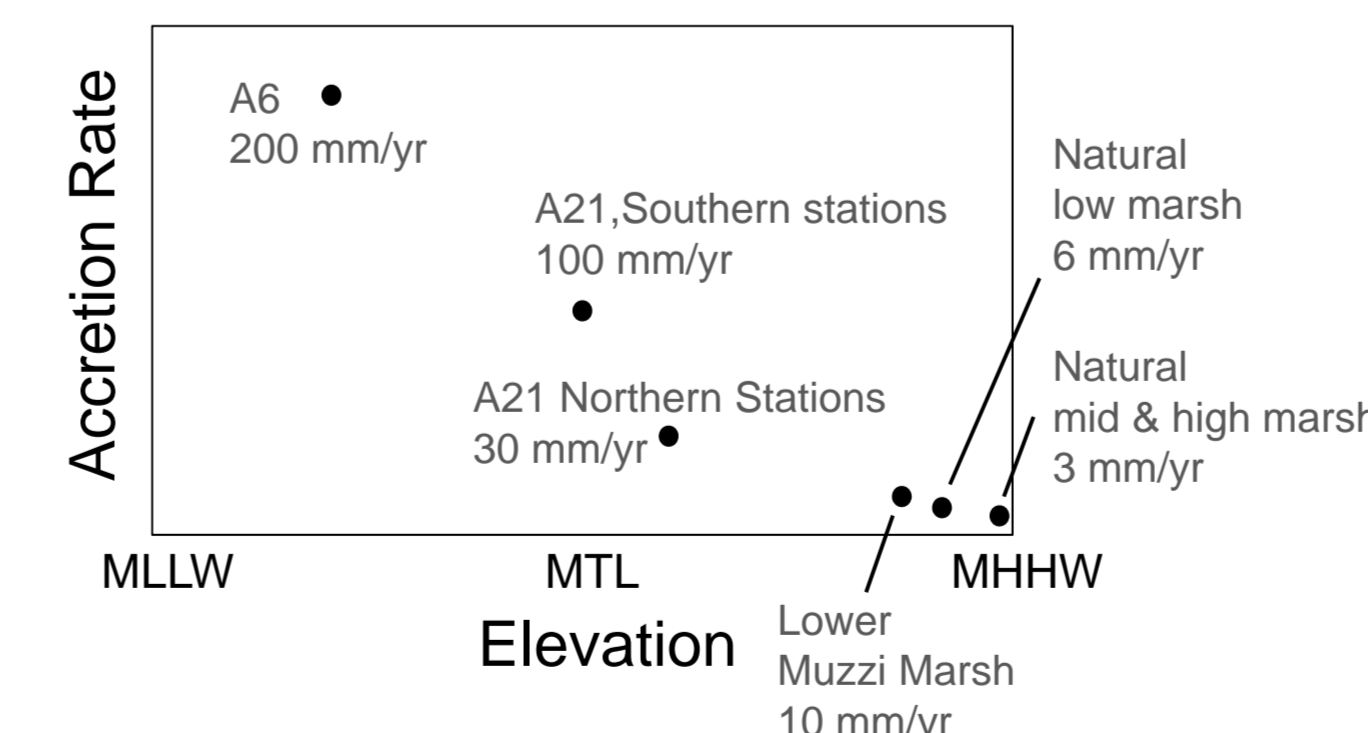
- Average deposition across all stations over 28 months was 47 cm (20.2 cm/yr). Rates were higher than those from Pond A21, (~20 cm over 3 years at the southern stations and ~5 cm at the northern stations (not shown)).
- There has been a slight decrease in accretion rates over the last two sampling periods at Pond A6.

Elevation vs. accretion within Ponds A6 & A21



- Accretion was correlated with elevation at Ponds A6 and A21, although there was substantial variation in this relationship.
- Other factors besides elevation affect accretion rates, including local hydrology.

Accretion across multiple sites



- Accretion data has been collected from multiple sites across the Bay, using marker horizons and isotopic dating methods (Callaway et al. 2012).
- Results from multiple sites strongly support the predicted relationship between elevation and accretion rates across the range of intertidal elevations.

Vegetation recruitment



- Plants established very rapidly at Pond A21, with some vegetation establishing within 12 months and large areas of recruitment within three years.
- Initial elevations at Pond A21 were substantially higher than those at A6, averaging ~1.2 m and ~0.7 m NAVD 88, respectively.
- Lower elevations for the current distribution of *Spartina foliosa* at Pond A21 are ~1.8 m NAVD88, and ~2.0 m NAVD88 for *Salicornia pacifica*.
- The highest elevations within the central areas of Pond A6 presently are ~1.2 m, indicating that it will need to build significant elevation before tidal marsh plant establishment is possible.

Conclusions

- Very rapid sediment accumulation is possible in restored salt ponds in the extreme South Bay.
- Elevation is a critical factor affecting accretion rates within the restored salt ponds.
- Results from the restored salt ponds and other sites closely match expectations of marsh development over time.
- Pond A6 still needs time to reach elevations suitable for plant colonization.

References

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Acknowledgments

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