

Rapid peat development beneath maturing mangrove forests: a mechanism to adapt to a rapidly changing world

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Thanks to 12 coauthors!

Ecological Applications, 0(0), 2020, e02085

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Rapid peat development beneath created, maturing mangrove forests: ecosystem changes across a 25-yr chronosequence

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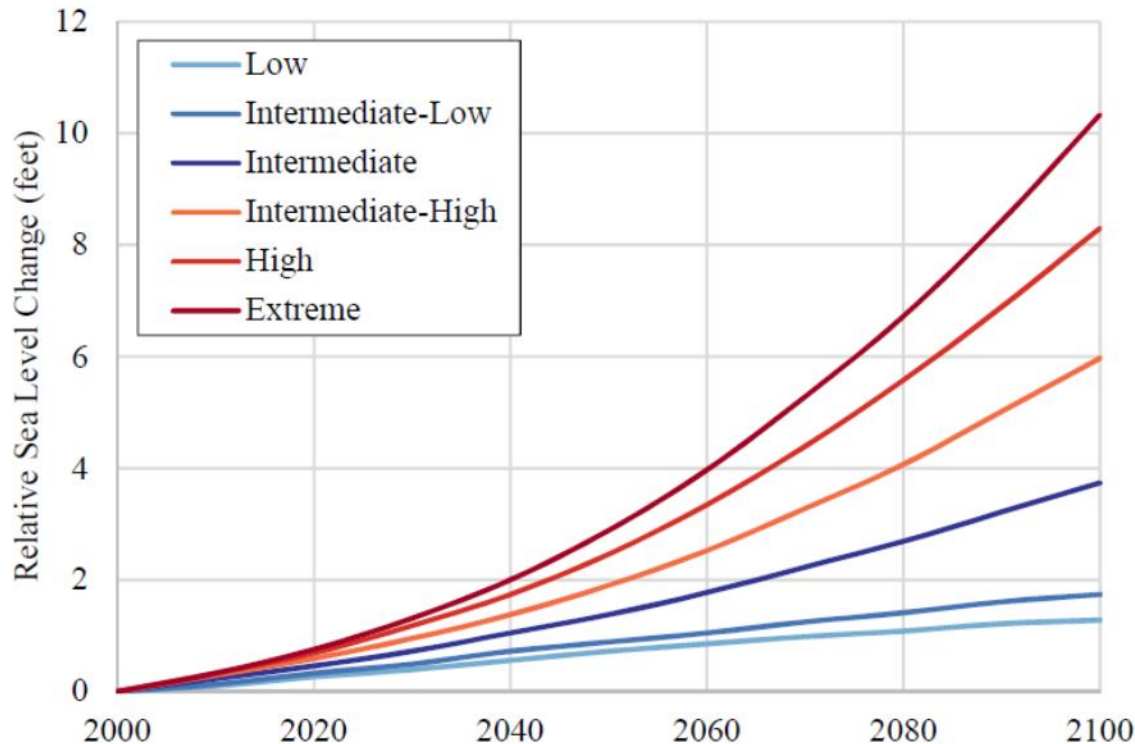
Citation: Osland, M. J., L. C. Feher, A. C. Spivak, J. A. Nestlerode, A. E. Almario, N. Cormier, A. S. From, K. W. Krauss, M. J. Russell, F. Alvarez, D. D. Dantin, J. E. Harvey, and C. L. Stagg. 2020. Rapid peat development beneath created, maturing mangrove forests: ecosystem changes across a 25-yr chronosequence. *Ecological Applications* 00(00):e02085. 10.1002/eap.2085

Abstract. Mangrove forests are among the world's most productive and carbon-rich ecosystems. Despite growing understanding of factors controlling mangrove forest soil carbon



Coastal wetlands in the Greater Everglades are highly vulnerable to sea-level rise (SLR)

RELATIVE SLR SCENARIOS FOR EVERGLADES NP



SCENARIOS FOR 2060

SLR in Everglades NP is projected to be about 25% greater than the global average. The bullets below summarize four scenarios for 2060.

- The **Low** scenario projects a SLR increase of 0.9 feet by 2060.
- The **Intermediate** scenario projects a SLR increase of 1.8 feet by 2060.
- The **High** scenario projects a SLR increase of 3.3 feet by 2060.
- The **Extreme** scenario projects a SLR increase of 4.0 feet by 2060.

Chivoiu et al. 2020; Adapted from Sweet et al. 2017.

An aerial photograph of a coastal region, likely New York City, showing the Hudson River, the city of New York, and the surrounding wetlands. The text is overlaid on the top left of the image.

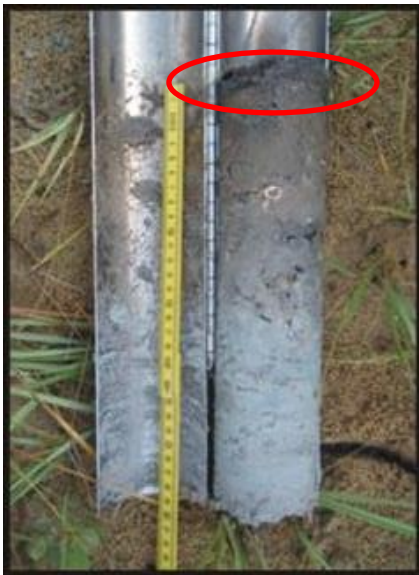
Sea-level rise effects on coastal wetlands will be influenced by interactions with many other aspects of global change

- Intensifying hurricanes
- Extreme precipitation
- Extreme drought
- Extreme temperatures
- Warming temperatures
- Restoration efforts
- Water management
- Fire
- Invasive non-native species
- Coastal protection efforts

Potential coastal wetland responses to rising sea levels

- Wetland conversion to open water- inability to adjust
- Local adjustment- via elevation gains that match SLR
- Landward migration- movement into adjacent freshwater wetlands or upland ecosystems

Mangrove adaptation to global change will require rapid vegetation and soil development



Mangrove creation efforts provide an opportunity to measure the speed of ecosystem development



thailand.wetlands.org

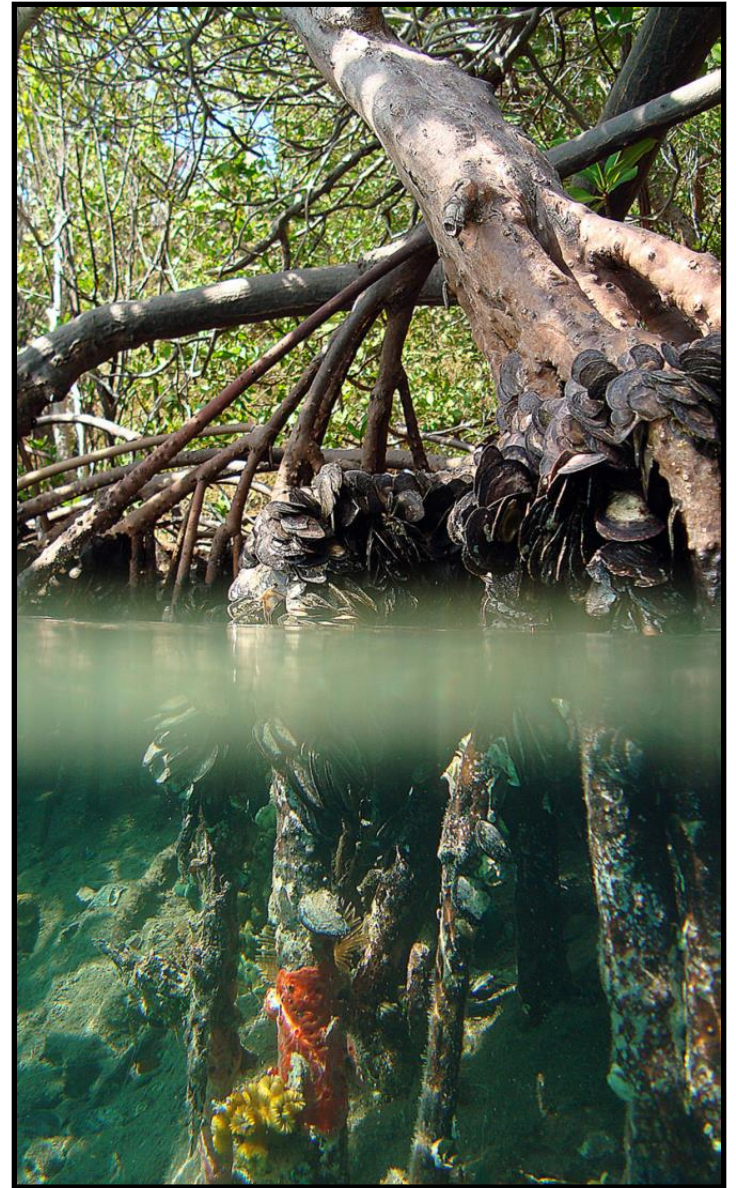


pixabay

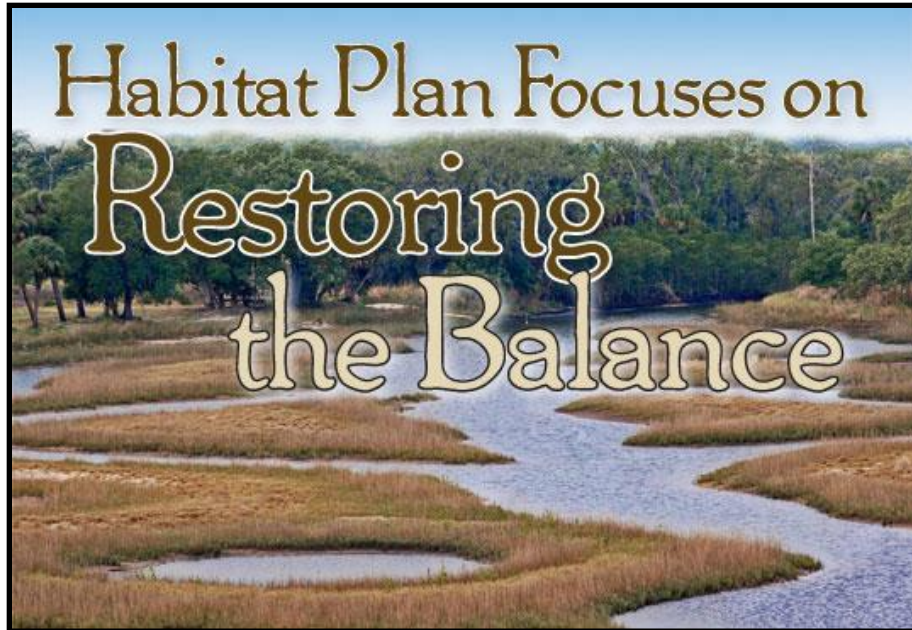
Research Questions

- Ecosystem structure and function: how do created mangrove forests compare to natural mangrove forests?
- After mangrove forest creation: what is the rate and trajectory of ecosystem development?
- How does the rate and trajectory of development in created mangrove forests compare to other created and restored wetlands?
- What do these results tell us about the adaptive capacity of mangrove forests?

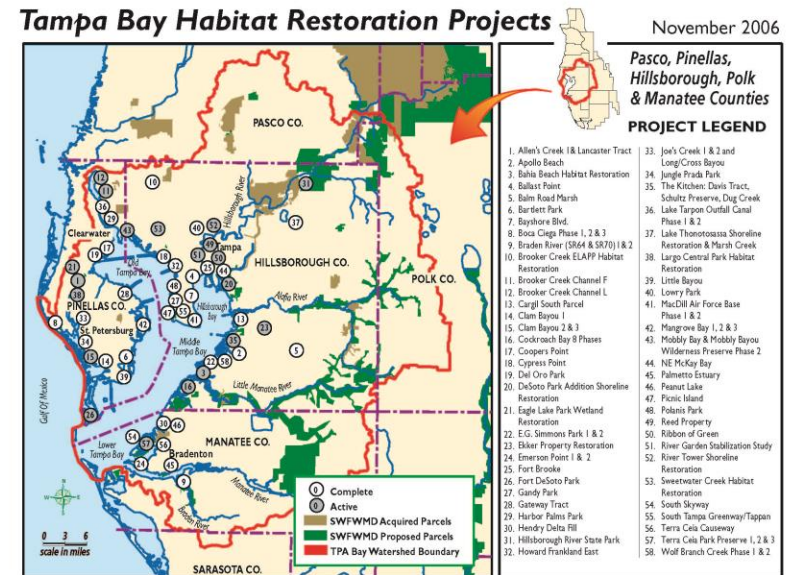
Methods



Tampa Bay Wetland Loss and Restoration



<http://www.baysoundings.com>
Lewis and Robison 1995



<http://www.swfwmd.state.fl.us>

A 25-year created mangrove forest chronosequence



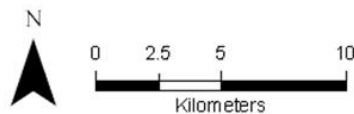
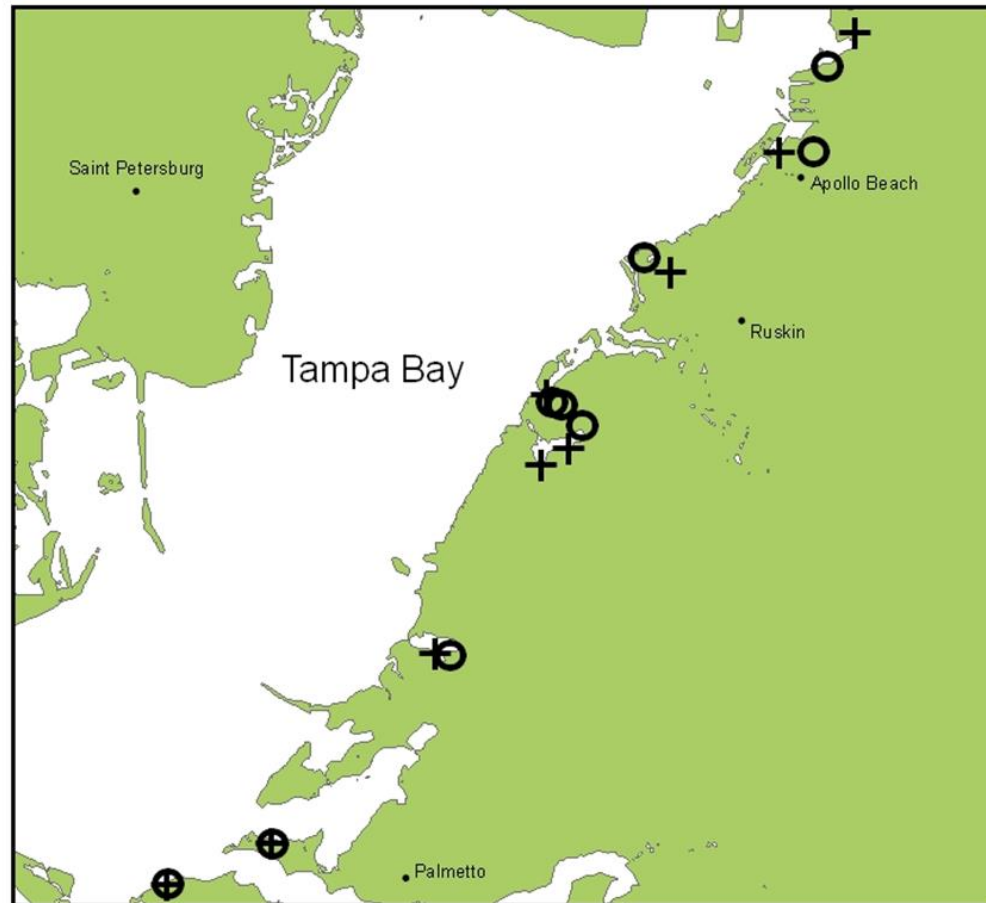
Spartina salt
marsh



Mangrove
forest

Increasing time since wetland creation →

18 research sites



Type of Site

- Created
- + Natural

Before Wetland Creation

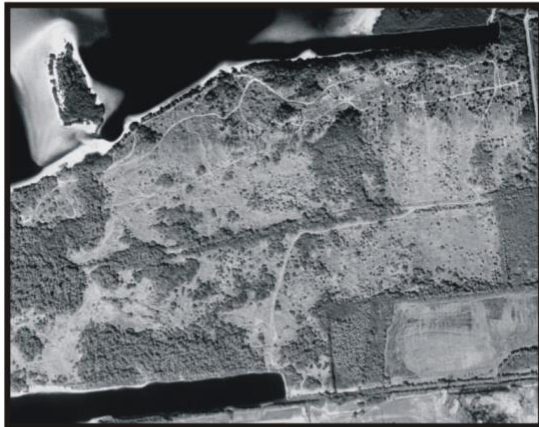
After Wetland Creation

A



Cockroach Bay

B



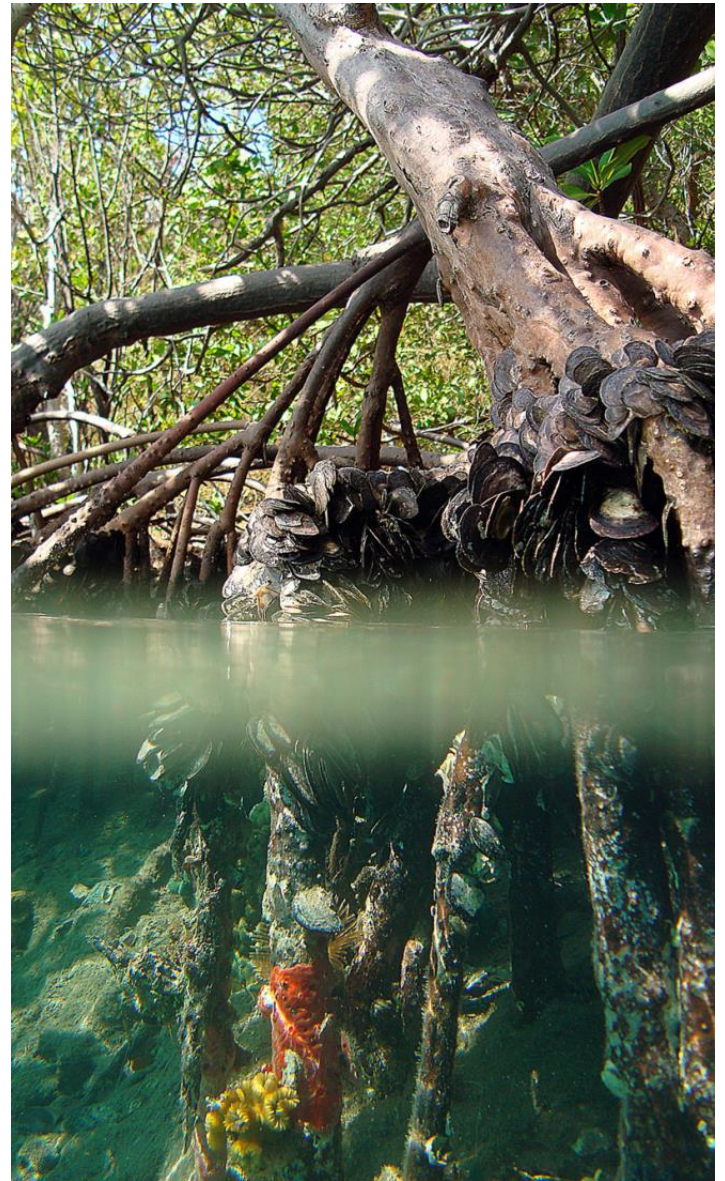
Schultz Preserve

C

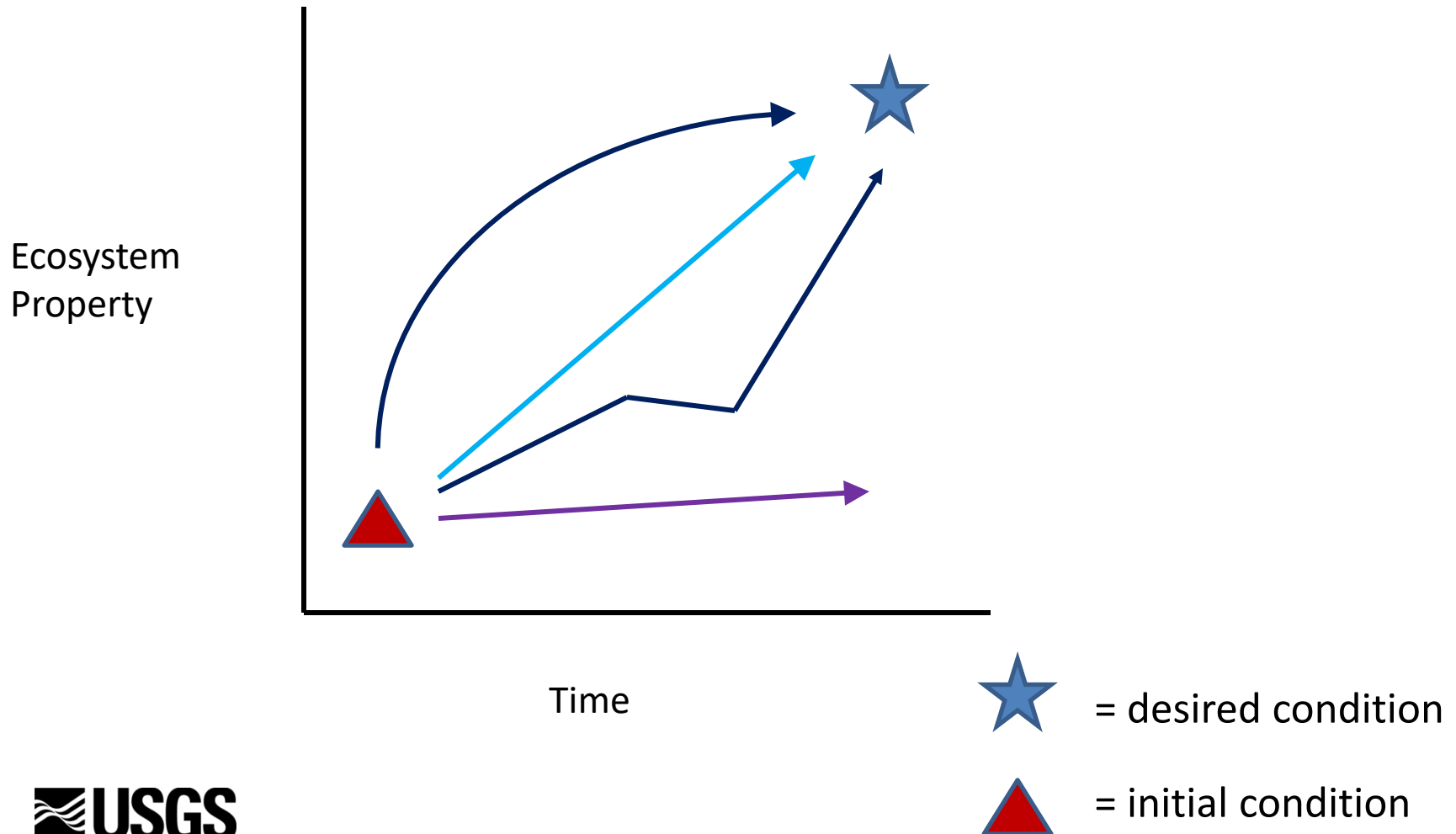


Cockroach Bay

Results



What is the rate and trajectory of ecosystem development after mangrove forest creation?



Quantifying the transition from salt marsh to mangrove forest



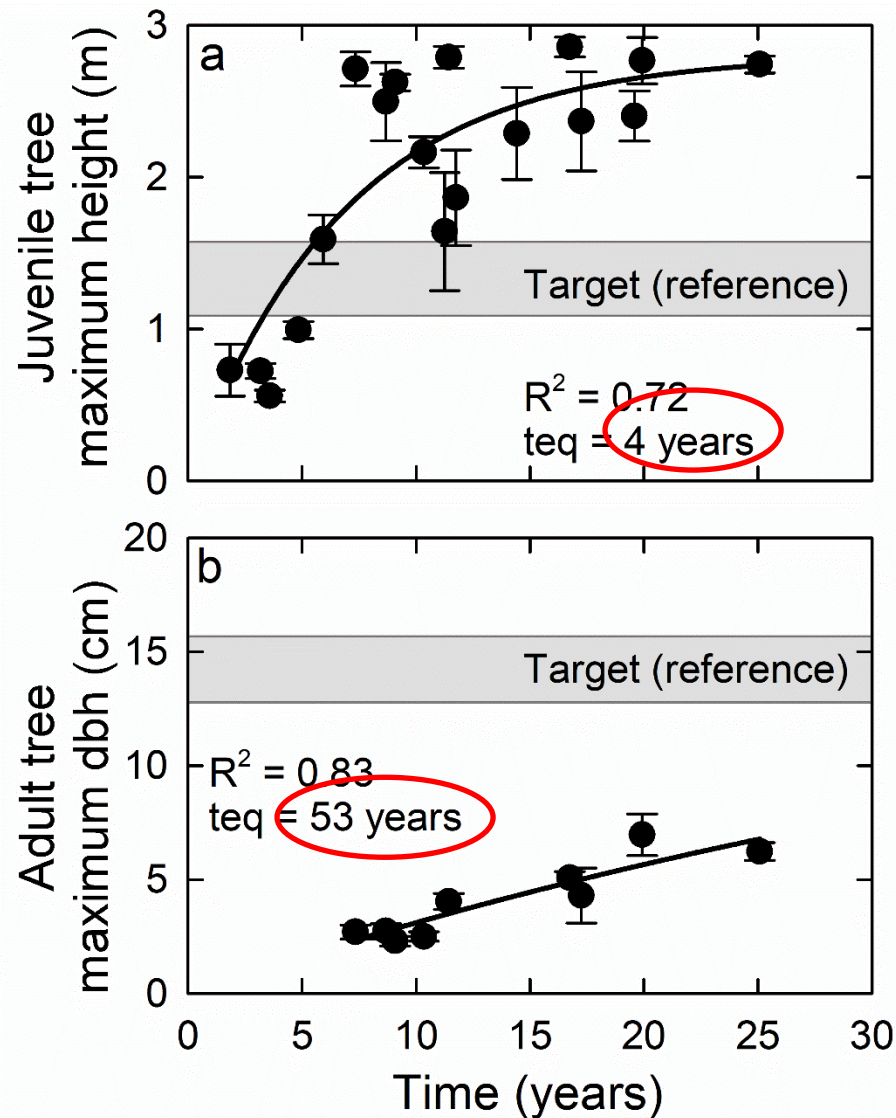
Spartina salt
marsh



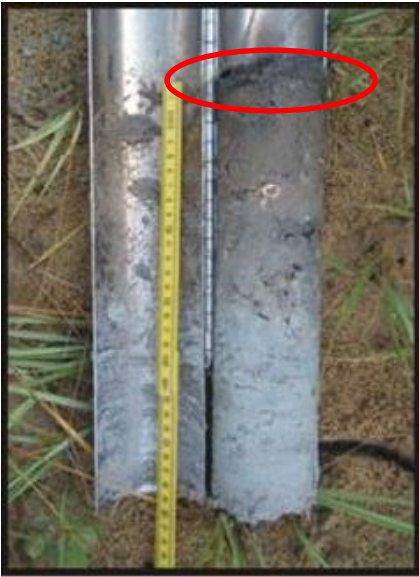
Mangrove
forest

Increasing time since wetland creation →

Vegetation change: mangrove forest development

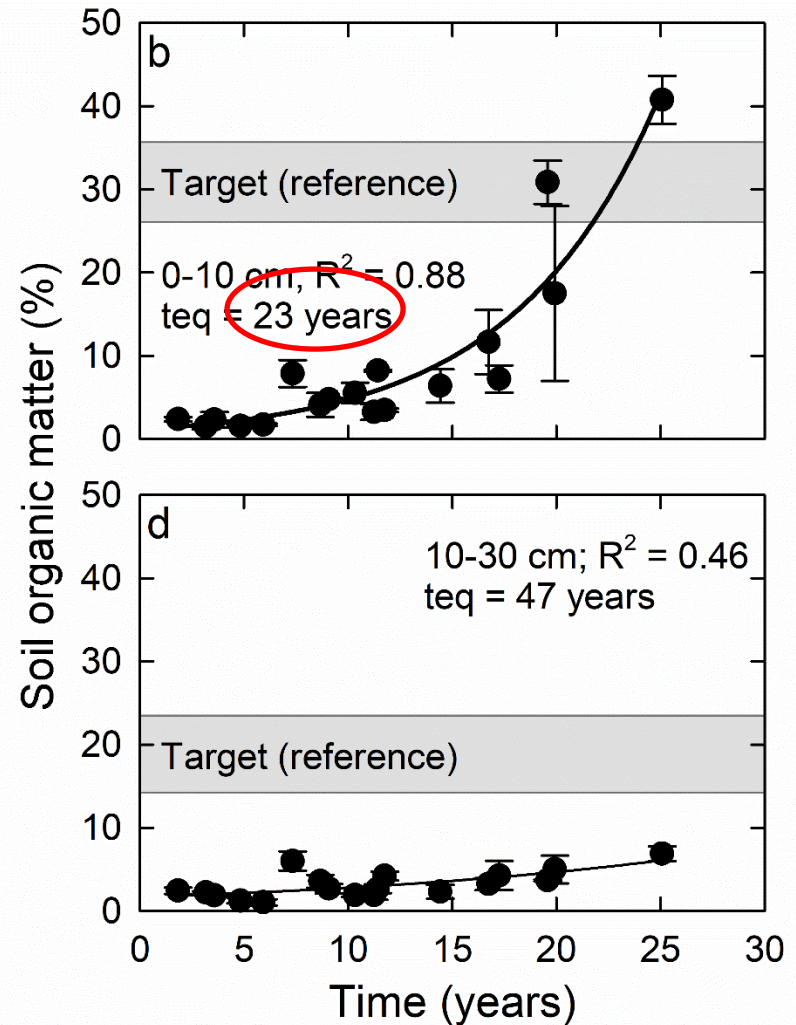
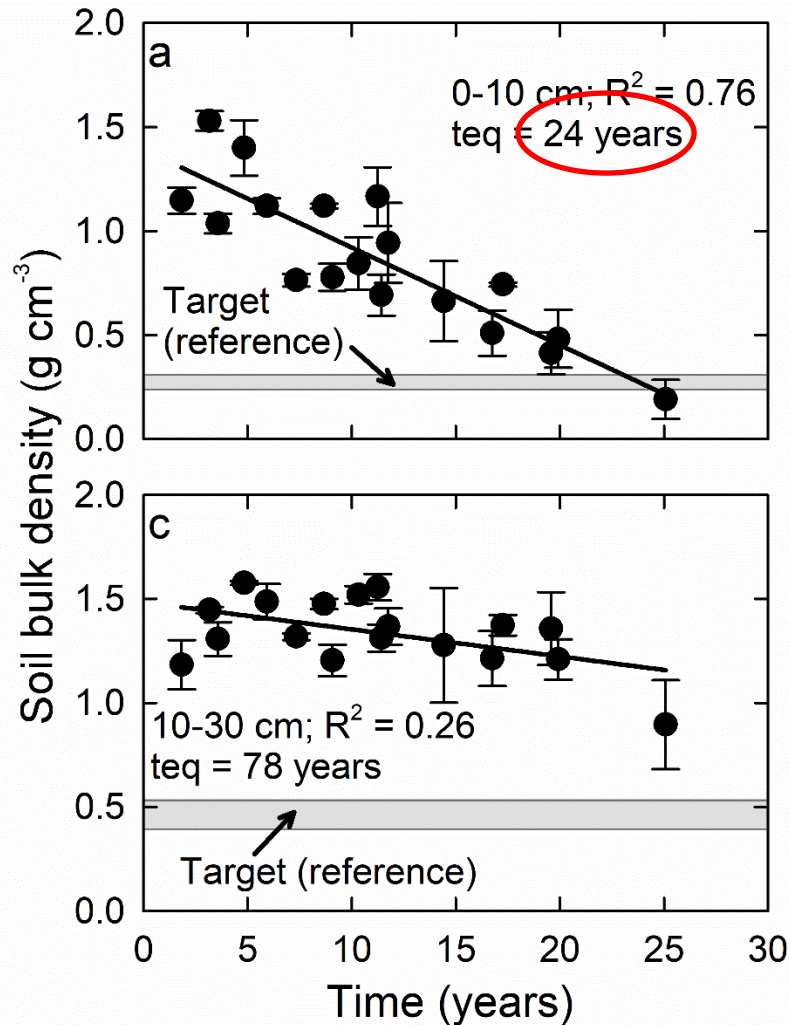


Soil change: peat development

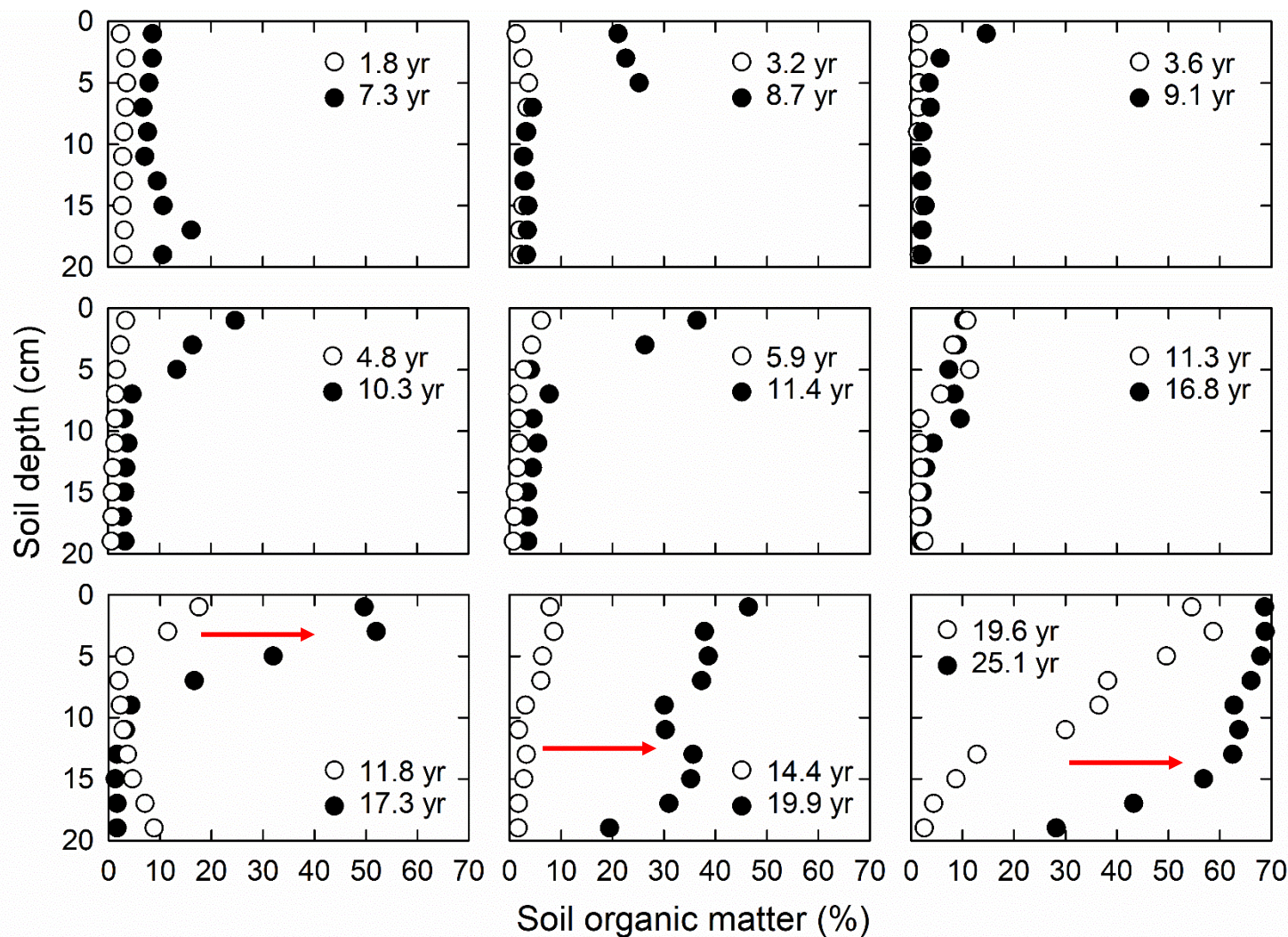


Increasing time since wetland creation →

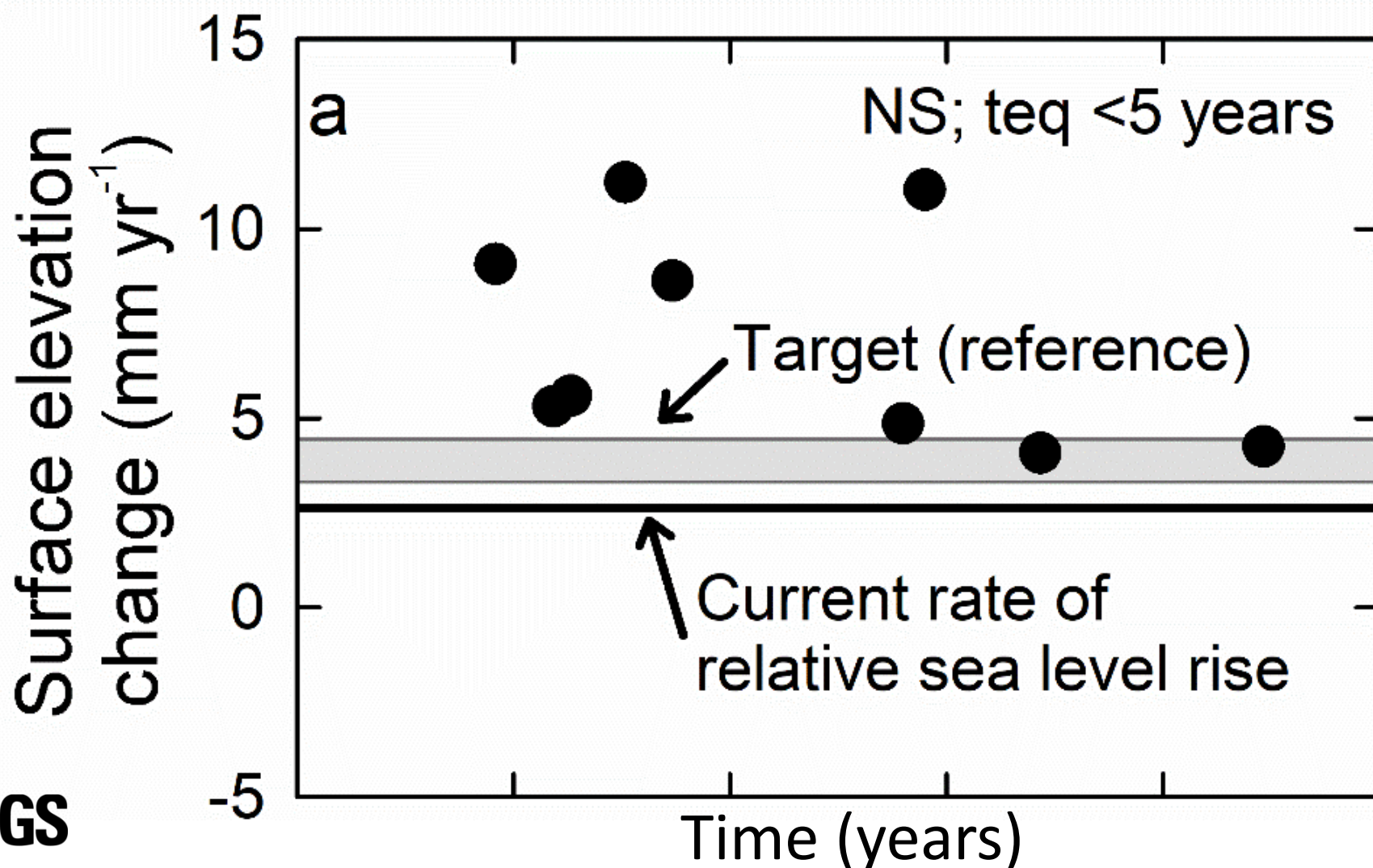
Soil change: bulk density and organic matter



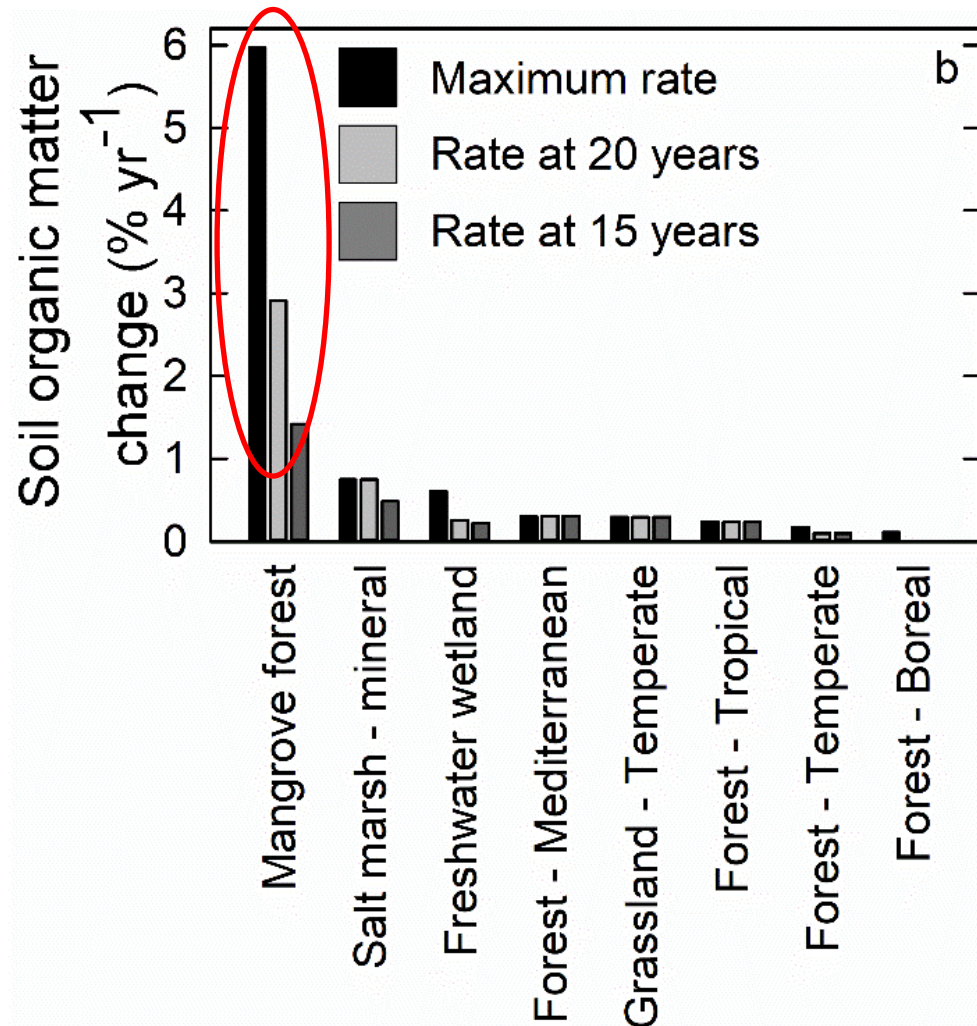
Soil change: organic matter



Soil change: elevation



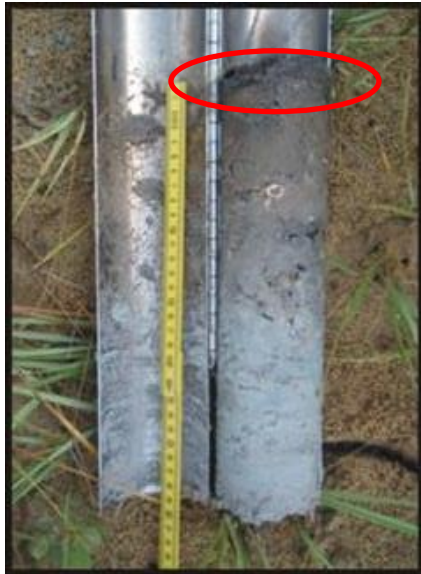
How do mangroves compare to other ecosystems?



Osland et al. 2020,
Ecological Applications

Take home messages

- Peat development in maturing mangrove forests is very fast- much faster than other terrestrial and wetland ecosystems
- From a global change perspective, rapid peat development increases the adaptive capacity of mangrove forests



Potential coastal wetland responses to rising sea levels

- Wetland conversion to open water- inability to adjust
- Local adjustment- via elevation gains that match SLR
- Landward migration- movement into adjacent freshwater wetlands or upland ecosystems

Support

- USEPA Gulf Ecosystem Measurement and Modeling Division
- USGS Greater Everglades Priority Ecosystem Science
- USGS Ecosystems Mission Area
- USGS Climate R&D Program











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An aerial photograph of a coastal region, likely San Francisco, showing a city area with a grid of streets and buildings, surrounded by a large body of water and a hilly, less developed area.

Questions:

mosland@usgs.gov