Salt marsh carbon burial in response to rising sea level and ecosystem restoration

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OCB June 26, 2017

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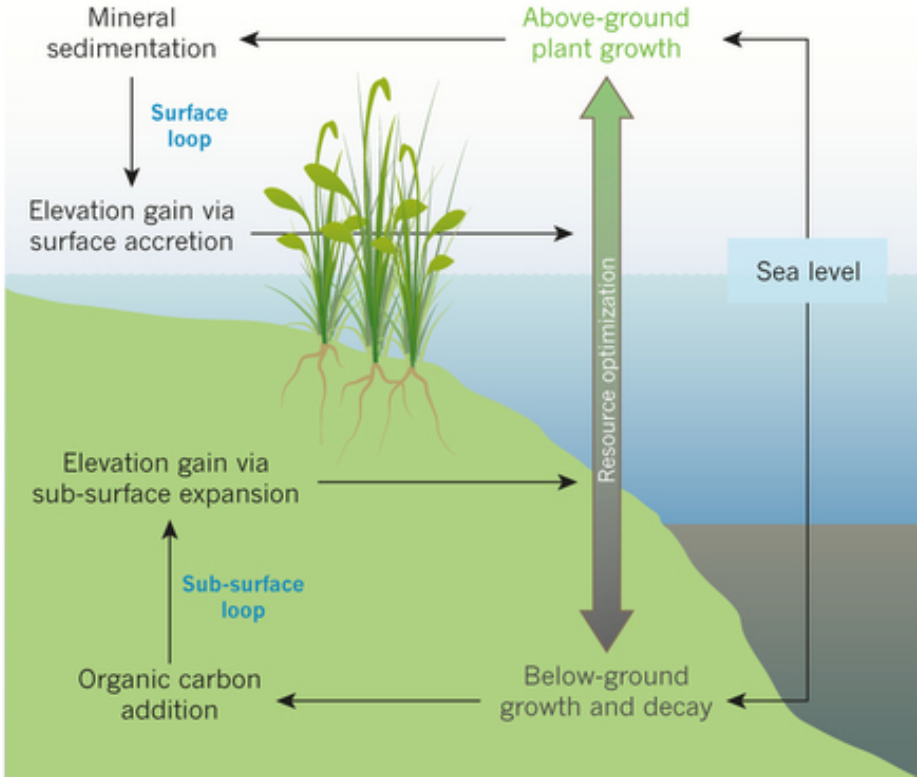
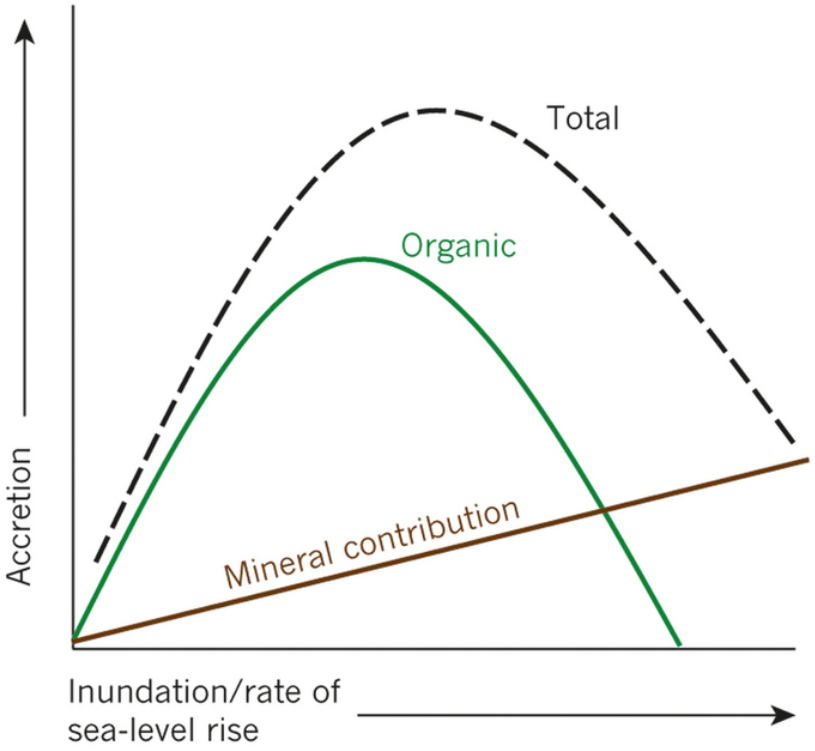
Salt marsh growth involves complex biological and physical interactions. There is an optimal elevation within the tidal frame for maximum biological productivity.

Kirwan & Megonigal, 2013





Marsh growth

- Production above (leaves) and below ground (roots)
- Mineral sediment deposition

Marsh decay and loss

- Decomposition
- Erosion

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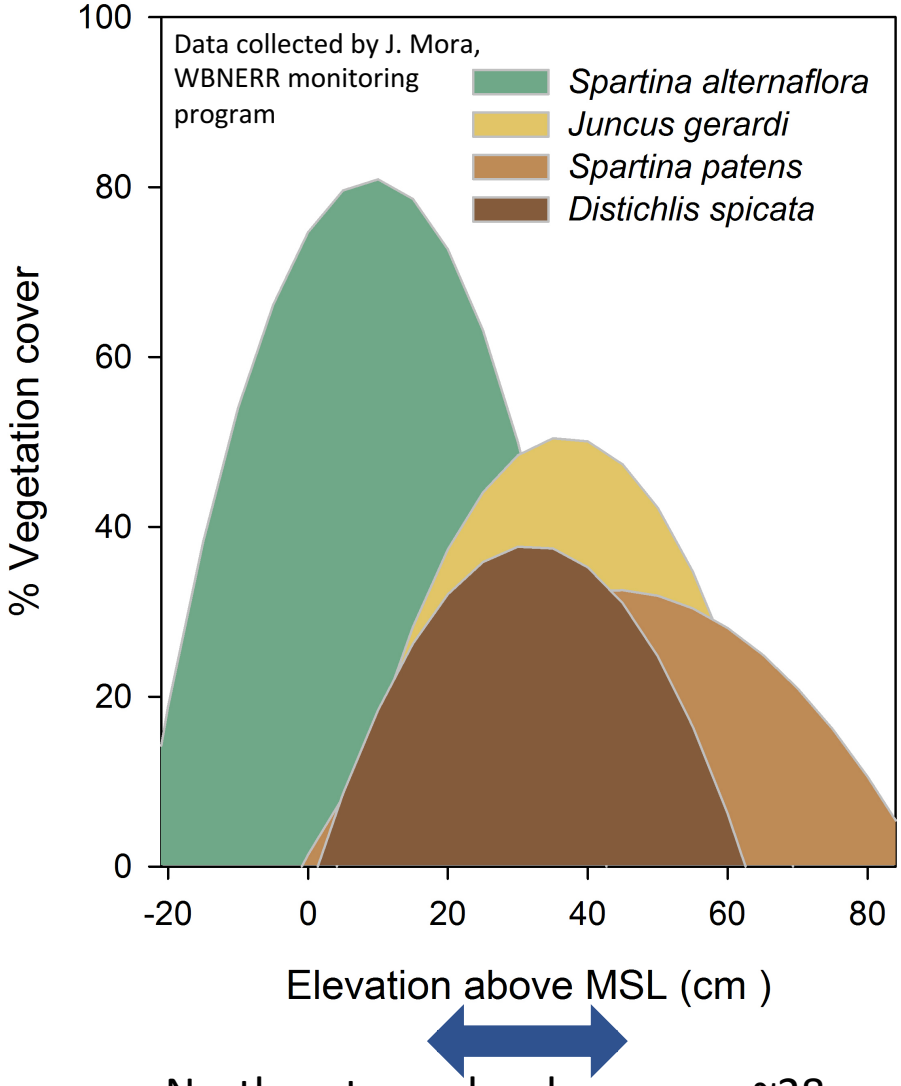
As sea level rises, the relative marsh platform elevation drops and low marsh vegetation dominates, which has higher productivity resulting in higher maximum vertical accretion and carbon storage rates.



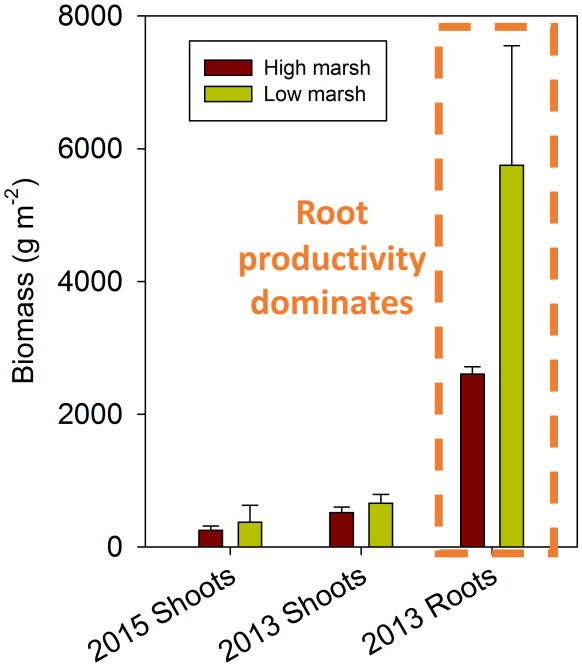
Northeast marshes have seen ~28 cm rise in sea level over the past 100 years

J. gerardi
Saltmeadow rush

D. spicata
Spike grass

S. patens
Saltmarsh hay

S. alternaflora
Smooth cordgrass



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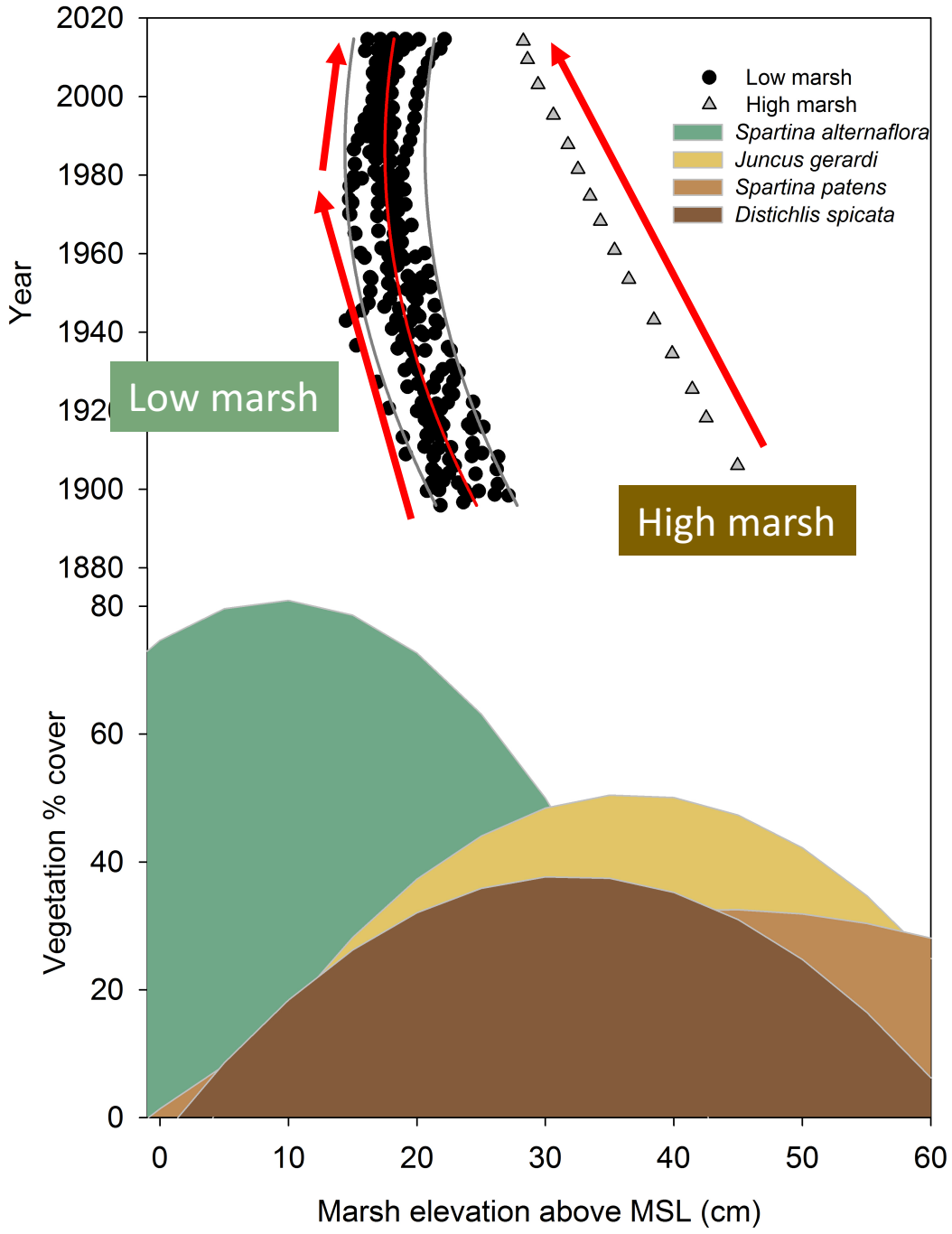

Marshes lost elevation from 1900 to 1980. Elevation loss was greatest in the high marsh: 1.5 mm y^{-1}, compared to sea level rise rates of 2.8 mm y^{-1}.

Since 1980, many low marsh sites have switched to gaining elevation relative to sea level. The rate of elevation loss in the high marsh continues, suggesting the high marsh is at maximal growth. We anticipate an acceleration in accretion rates as high marsh converts to low marsh vegetation.

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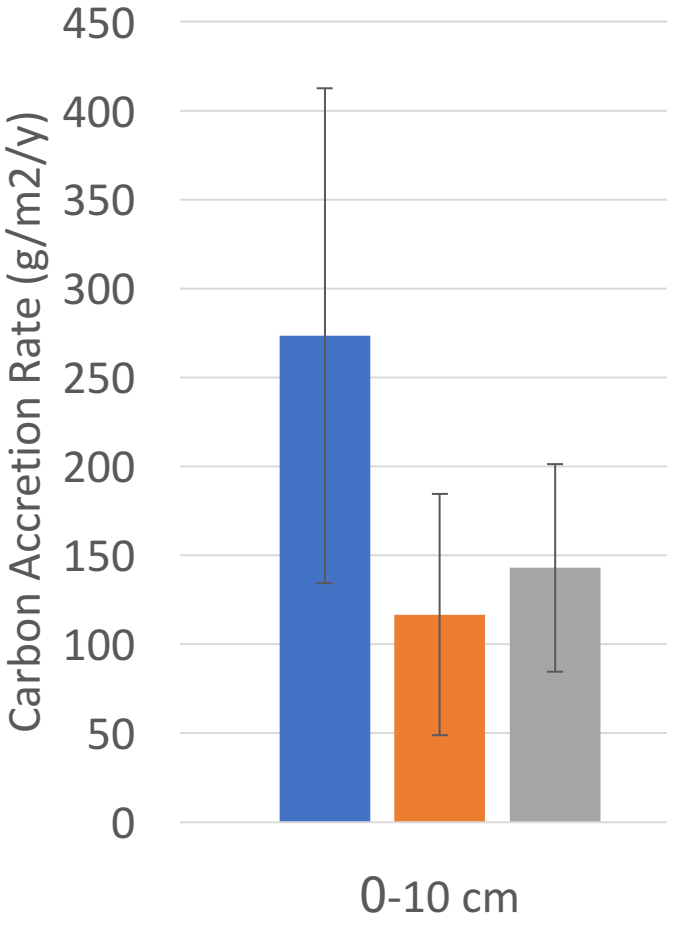
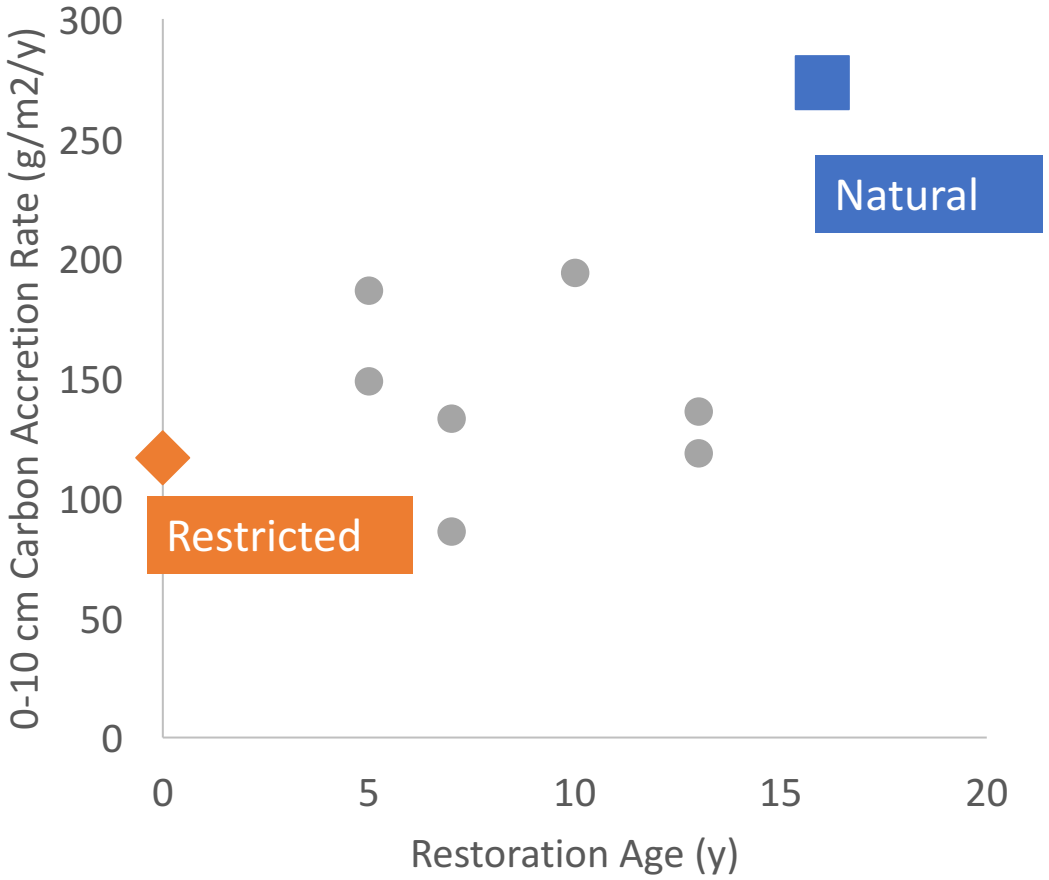
Carbon burial is controlled by accretion rates since C density is nearly constant across ecosystems. Accretion is highest in natural salt marshes, with restoration of tidal flow resulting in an increase in C burial.





Natural Restricted Restored

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Over the past century…

~100 tons/ha* of carbon burial has been AVOIDED due to tidal restriction

Natural

Salt marsh

Carbon burial (~170 tons/ha)

Restricted

Phragmites

Carbon burial (~70 tons/ha)

Typha

*Using values in the 10-30 cm sediment interval

$(C_{natural}-C_{restored})x\ years=C_{avoided}$