

Nutrient and climate change effects on coastal marshes and implications for management



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Anthropogenic impacts to salt marshes

- Nutrient over-enrichment
- Accelerated sea level rise
- Increase in the frequency and severity of storms



Marsh sustainability depends upon:

- Sediment supply
- Organic matter accumulation



Is nutrient enrichment a marsh stressor? Southeast US, Minerogenic marsh system, North Inlet-Winyah Bay, SC, High sediment loads, 20 mg/L





control +P +N +N+P

North Inlet – Winyah Bay Fertilization Experiment, 1 g N m⁻² d⁻¹ Wigand et al. 2015

North Inlet- Winyah Bay fertilization experiment



Northeast US, Organogenic marsh system, Jamaica Bay, NY





N Loading rate: 300 mg N m⁻² d⁻¹

Black Bank, Deteriorating marsh 💳



Effect of Nutrient Addition on a Salt Marsh System with Low Sediment Supply and High Inundation



Organogenic systems depend upon plant production and sub surface expansion to build up peat.

Very little sediment input in Jamaica Bay!



CT cross section images of Jamaica Bay



Most deteriorated: Big Egg Moderately deteriorated: Black Bank Stable: JoCo marsh

Jamaica Bay marsh soil CO₂ efflux



Point of nutrient addition and area of exposure matter, Plum Island, MA

- Low sediment supply system;
- Low organic sediments;
- Long-term fertilization experiments



Fertilized Sweeney creekbank, Deegan et al. 2012



Fertilized marsh platform, Laws Pt., courtesy: K. Sundberg



Field Conclusions

- Nutrients increase belowground productivity in minerogenic systems and can decrease it in organogenic systems
- Marsh soil carbon dioxide efflux increases with nutrient additions



Stressor: Accelerated sea level rise



Annual average sea level at New London, CT. Sea level data comes from the NOAA New London, CT tide gage. Open circles indicate sea levels from 1939-1979 (y=0.0019x – 2.33, R²=0.46) and filled circles indicate sea levels from 1980-2013 (y=0.0047x – 7.91, R²=0.71). Dashed trend line represents entire dataset (y=0.0026x –3.53, R²=0.76).

Bristol, Colt State Park, RI tidal channel expansion



Narrow River Estuary, RI marsh ponding





Loss of high marsh habitat for salt marsh sparrow



Field mesocosm research



Watson et al., 2014.





Productivity responds to elevation



Watson et al., 2014, Climatic Change.

Profiled locations



Elevation distribution for 38 NE salt marshes



Narragansett Bay marshes

Watson, unpublished data.

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Key Findings

- Tidal marsh vegetation changes are linked with marsh elevation
- Marshes lack elevation capital



Greenhouse multi-stressor research







The Greenhouse Isotope Study

In all three cases, the ambient treatment had significantly greater uptake of % N than the storm treatment at the mid and high elevations; no difference at the low elevations.

Oczkowski et al. 2015.





Recommendations to Sustain Coastal Salt Marshes of Narragansett Bay



US EPA is working with State and Federal partners to develop climate adaptation strategies

Climate-change Adaptation Strategy For Salt Marshes

