Nitrogen Removal Services of Restored Salt Marshes in Jamaica Bay

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LOYOLA UNIVERSITY CHICAGO 1870 AD · MAJOREM · DEI · GLORIAM

COLBY COLLEGE 1813 LUX · MENTIS · SCIENTIA

RWA ROCKAWAY WATERFRONT ALLIANCE

NATIONAL PARK SERVICE

YORK College

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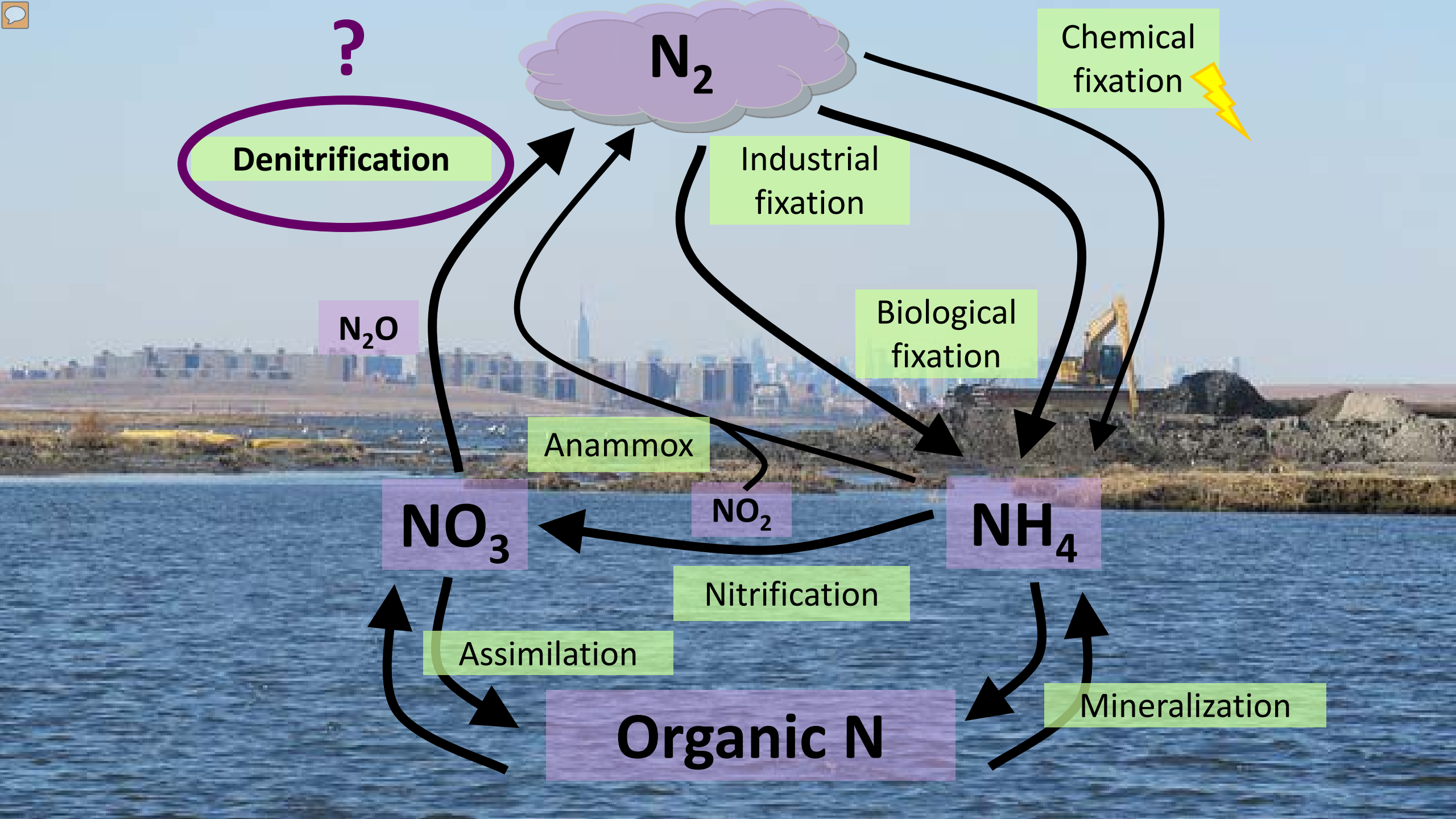
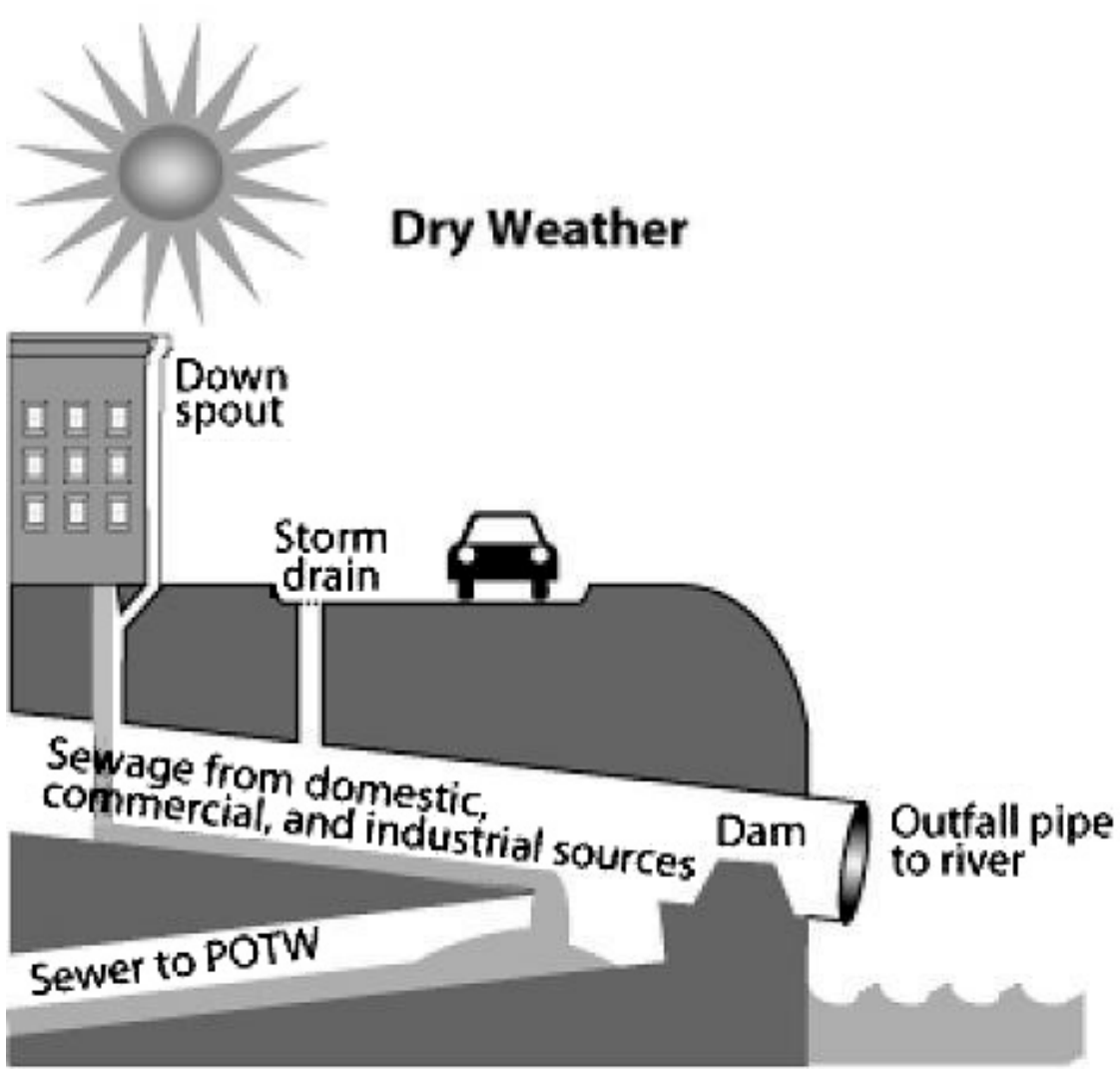
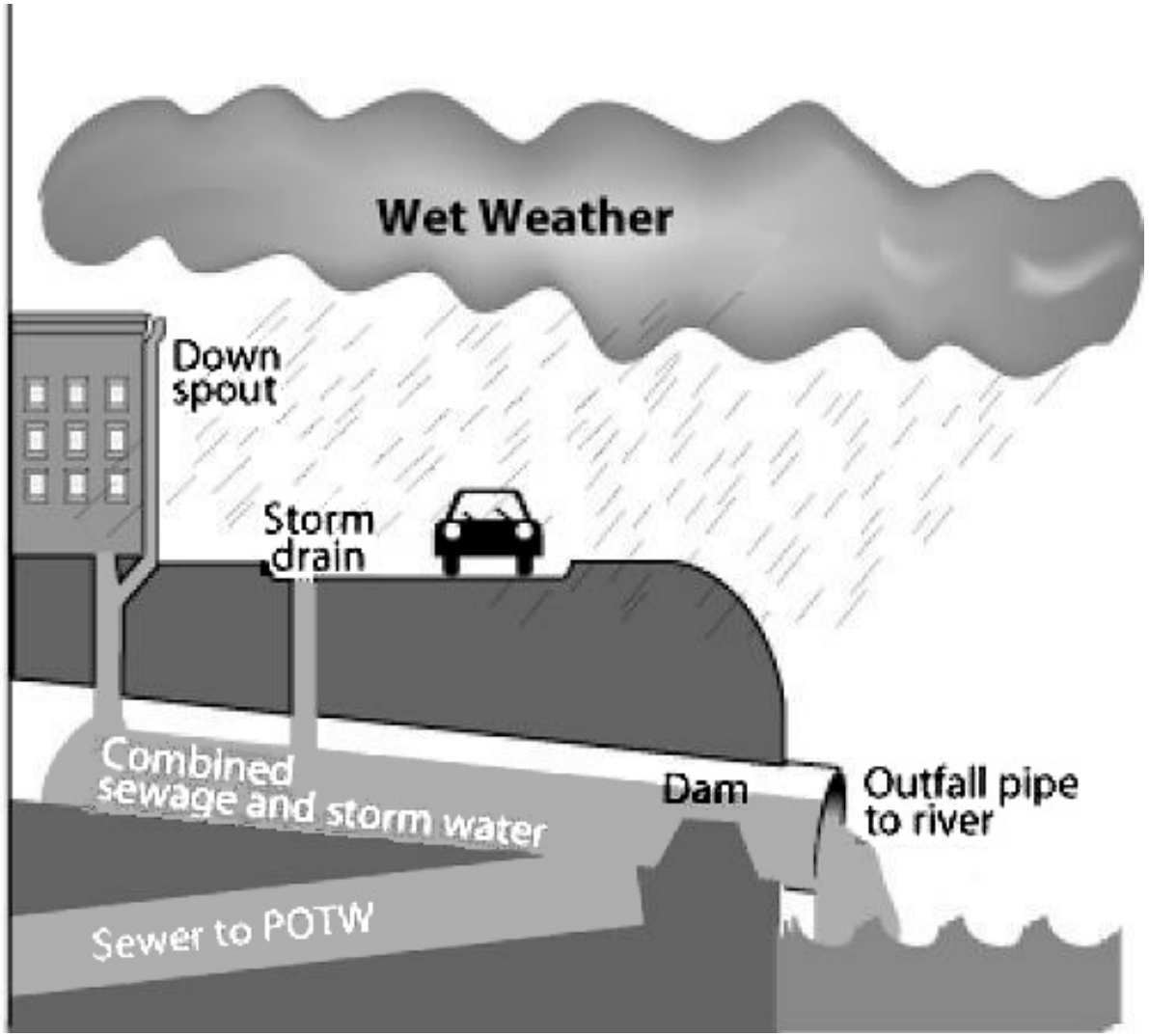
SRI@JB


?
N_2
Chemical fixation
Denitrification
Industrial fixation
N_2O
Biological fixation
Anammox
NO_2
NO_3
NH_4
Nitrification
Assimilation
Organic N
Mineralization

New York City has a nitrogen problem: Combined sewage overflows





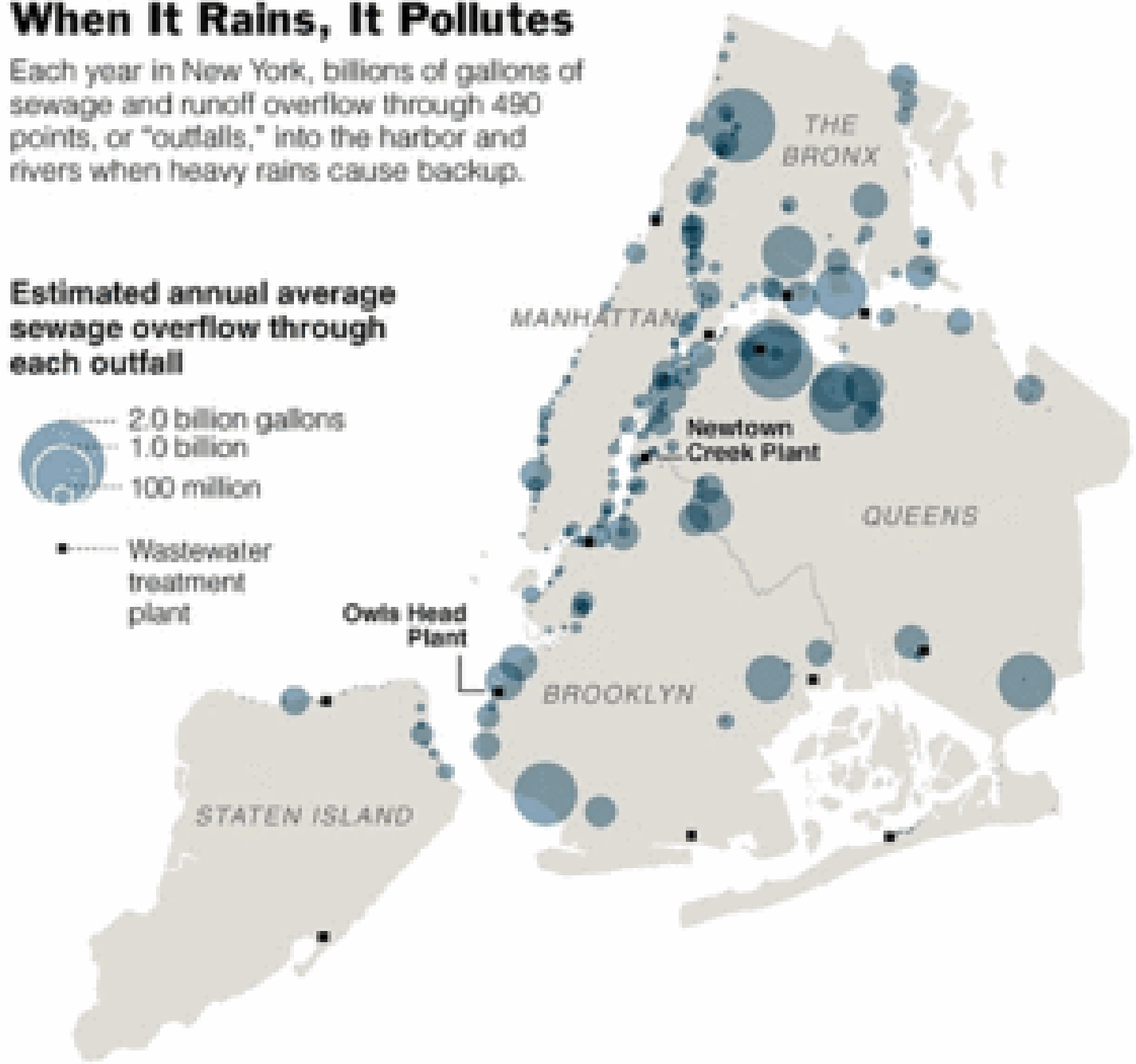
US EPA

The New York Times

November 22, 2009

When It Rains, It Pollutes

Each year in New York, billions of gallons of sewage and runoff overflow through 490 points, or "outfalls," into the harbor and rivers when heavy rains cause backup.



Wetland loss in Jamaica Bay

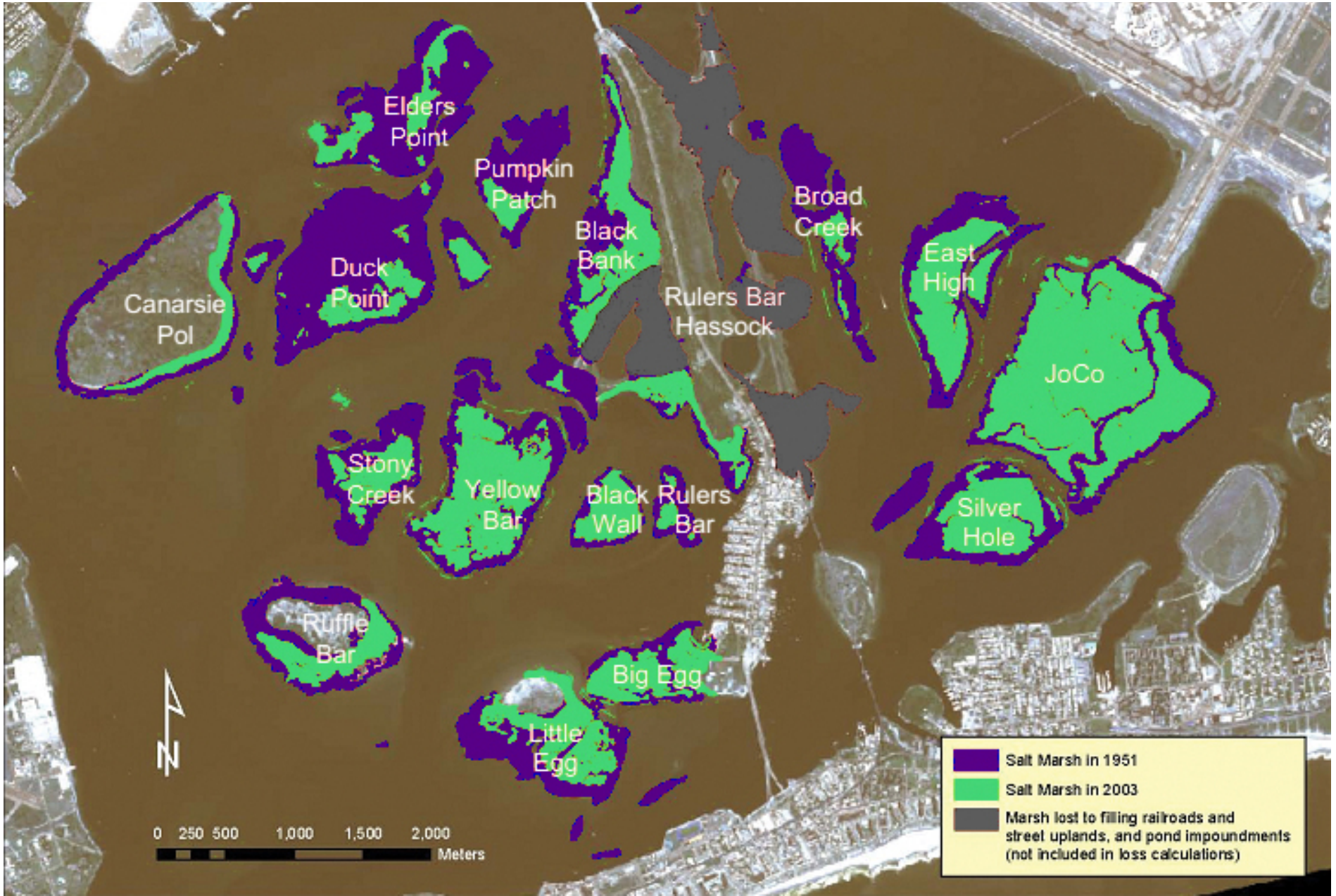


Figure modified from GATE and Jamaica Bay Watershed Protection Plan Advisory Committee, 2007


Yellow Bar 2002
Photo: National Park Service

Big Egg 2003

Harmon, David, ed. 2006. *People, Places, and Parks: Proceedings of the 2005 George Wright Society Conference on Parks, Protected Areas, and Cultural Sites.* Hancock, Michigan: The George Wright Society.

Yellow Bar 2012

Ecowatchers

US Army Corp of Engineers

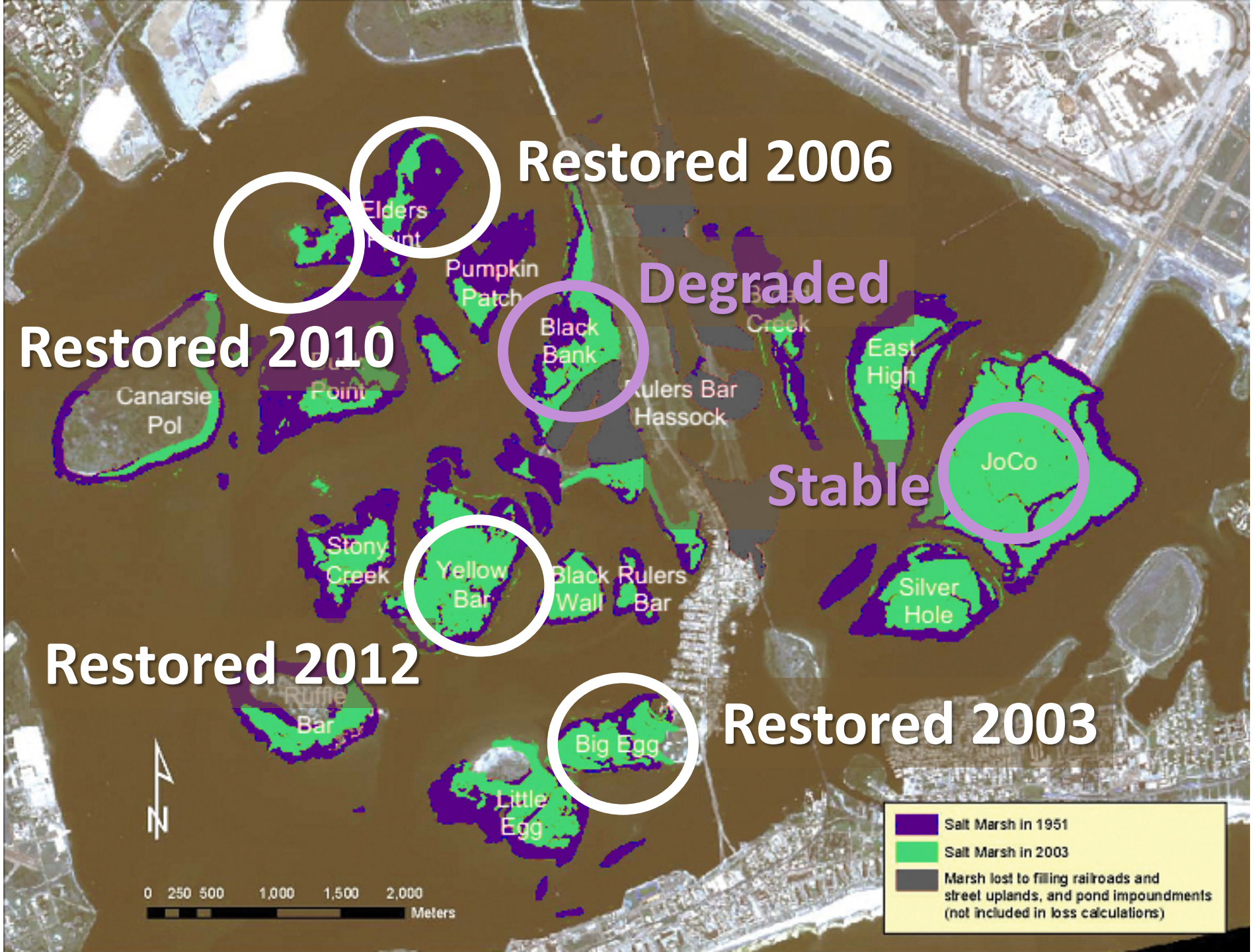
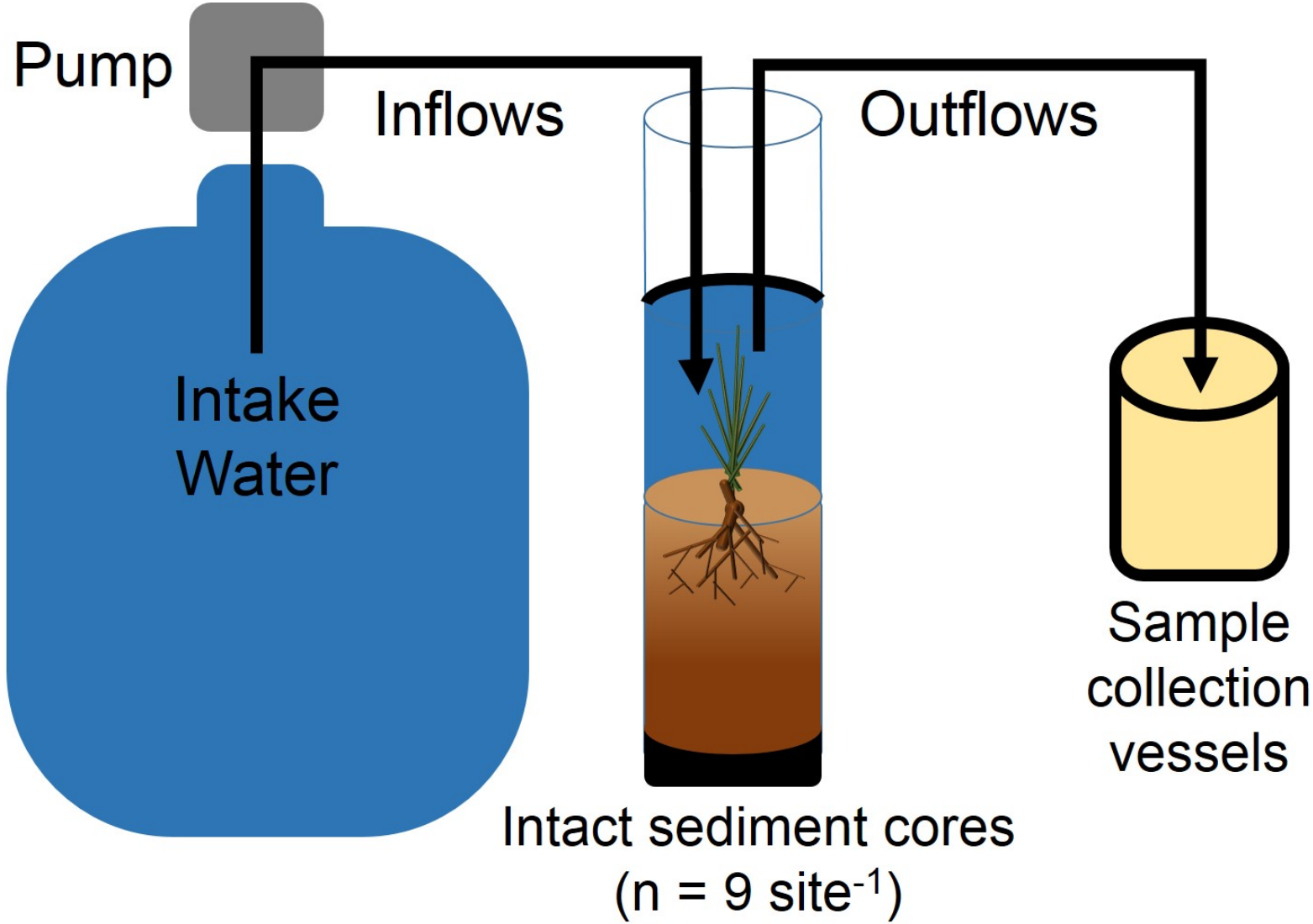


Figure modified from GATE and Jamaica Bay Watershed Protection Plan Advisory Committee, 2007

Flow-through incubations: What the flux?

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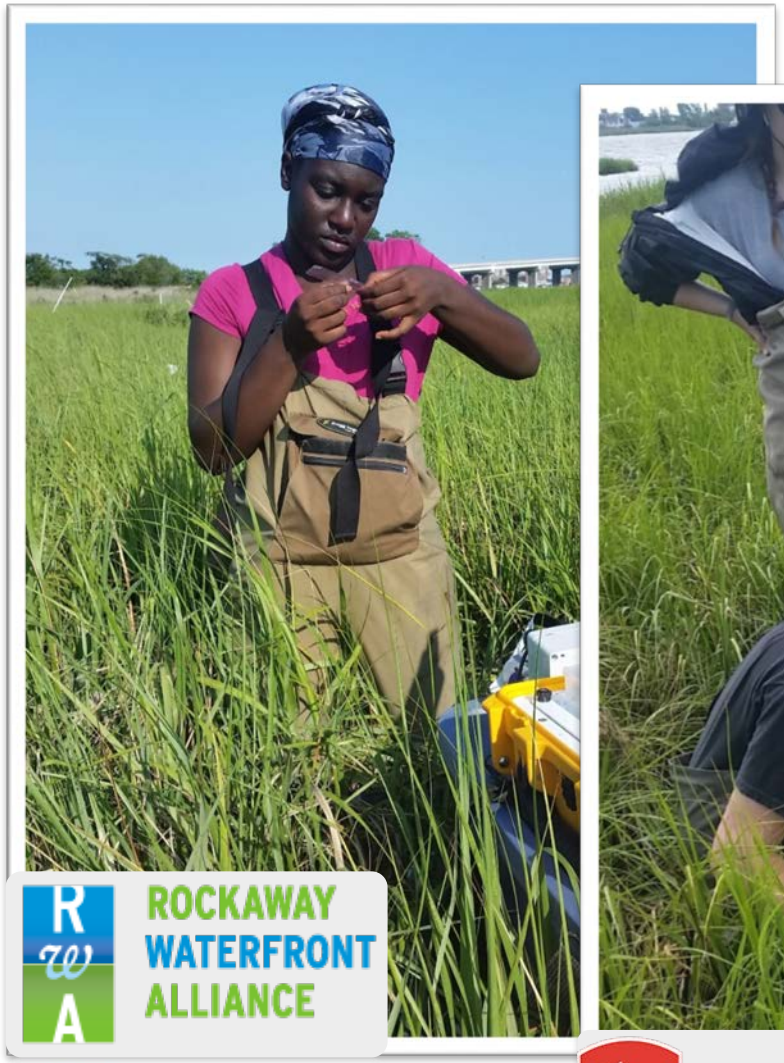
General trend of increasing **denitrification** with marsh age

Field Surveys to characterize…

- Vegetation characteristics
- Sediment characteristics
- Microbial community
- Nitrogen transformations
- Sediment respiration



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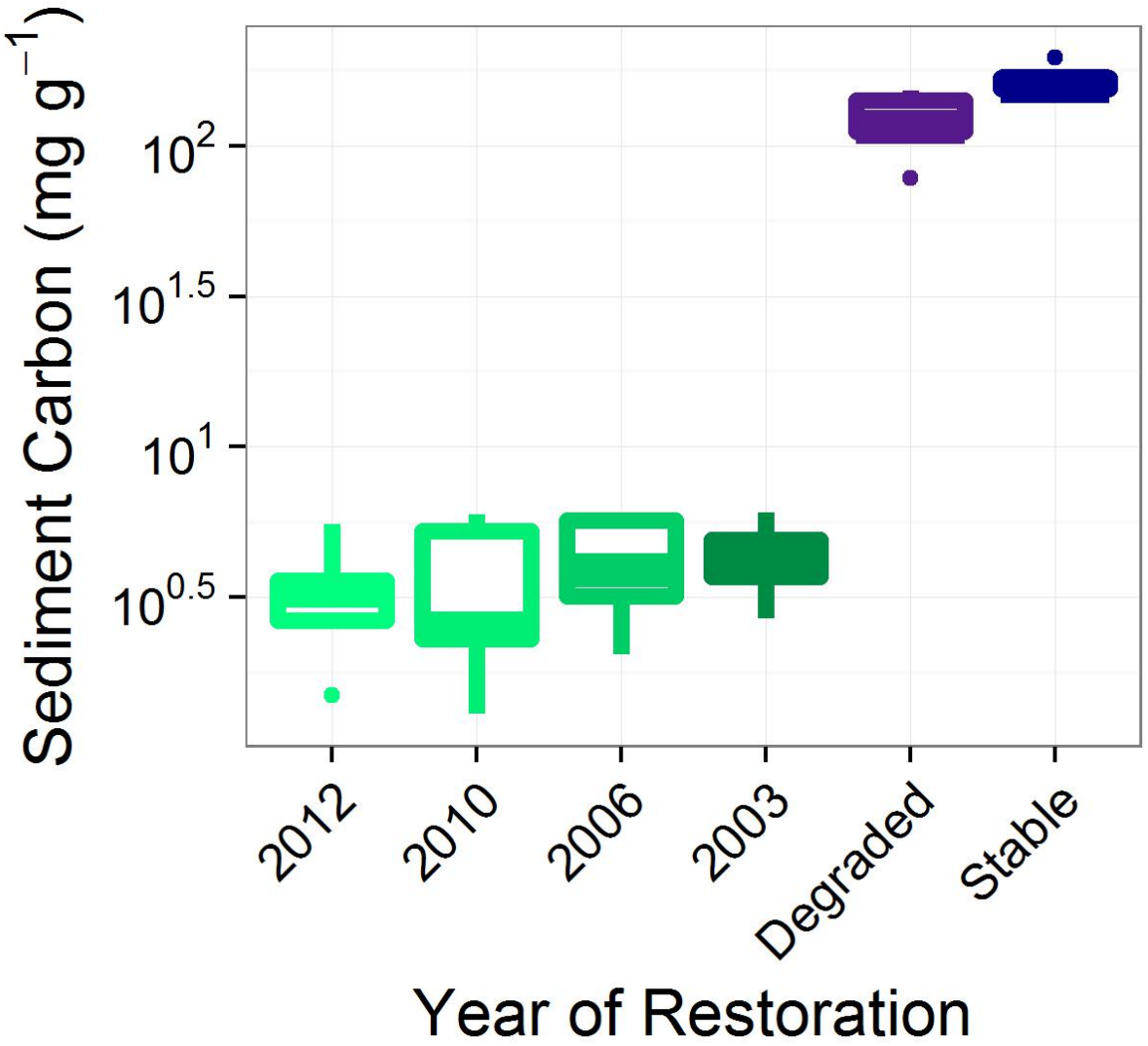
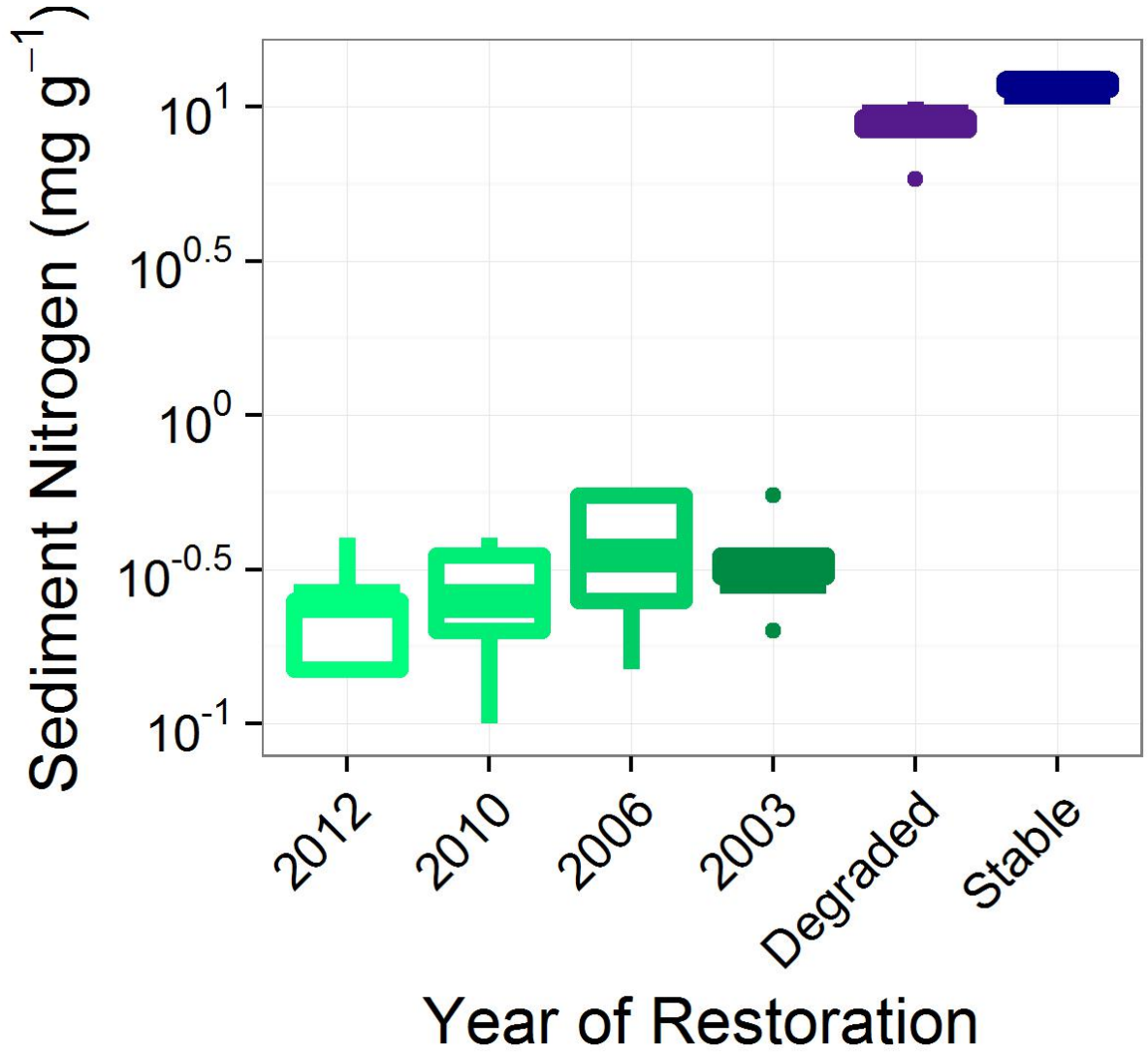
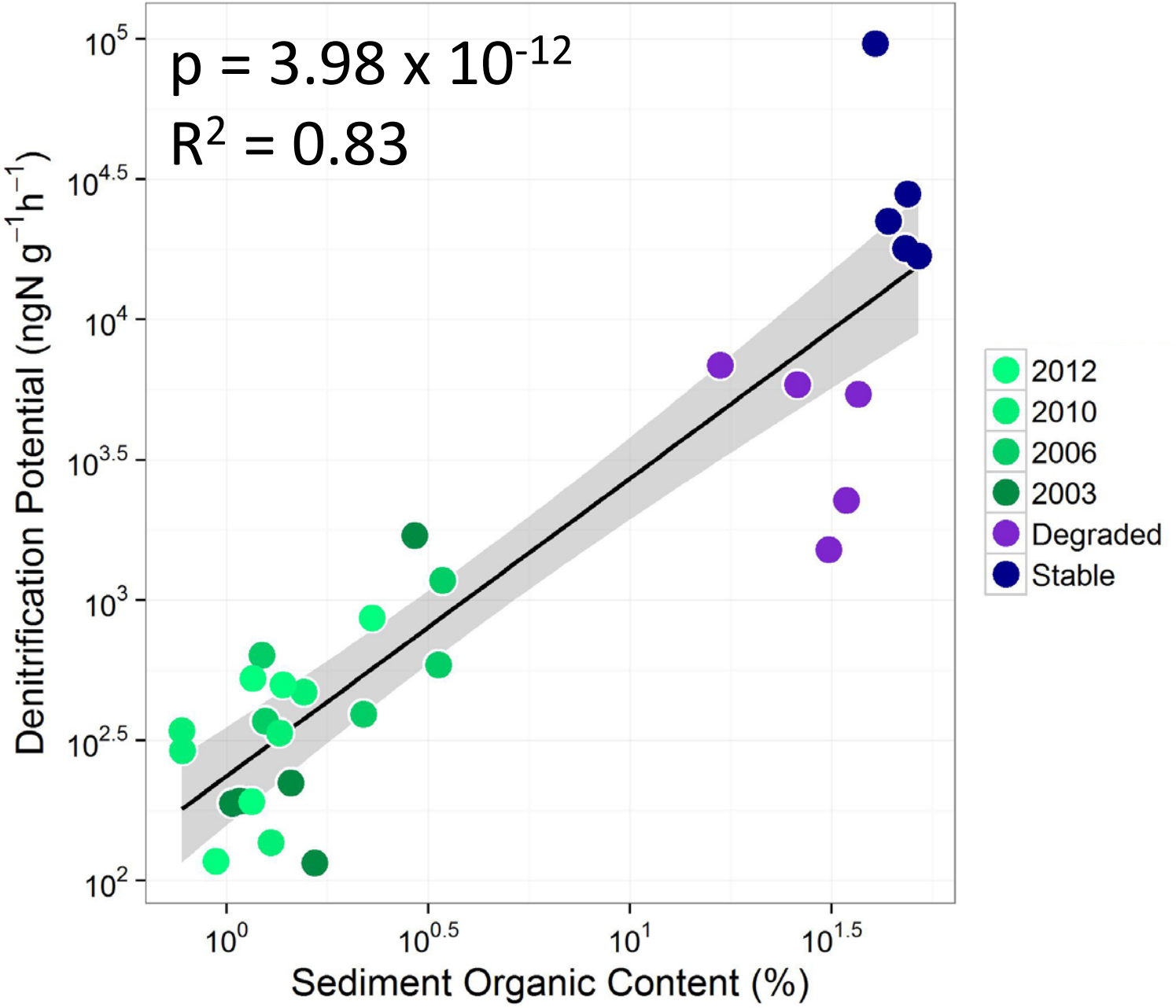
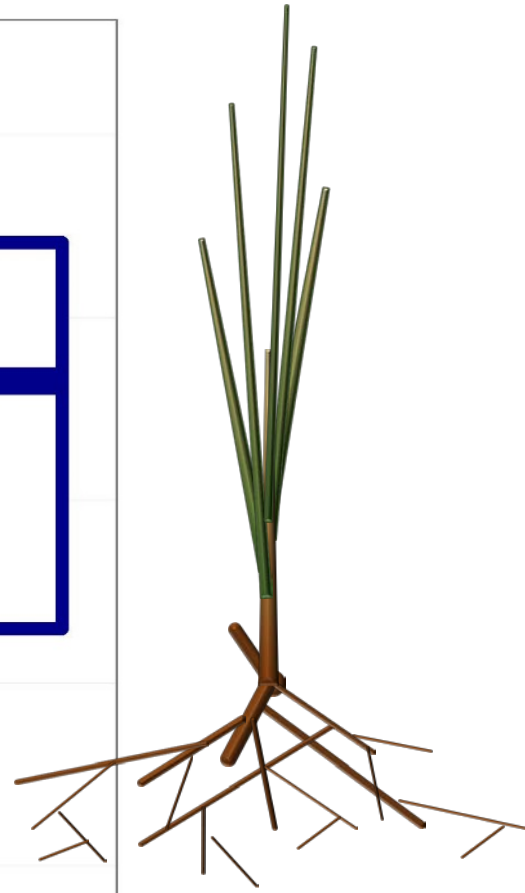
Organic carbon and nitrogen in sediments increase with marsh age

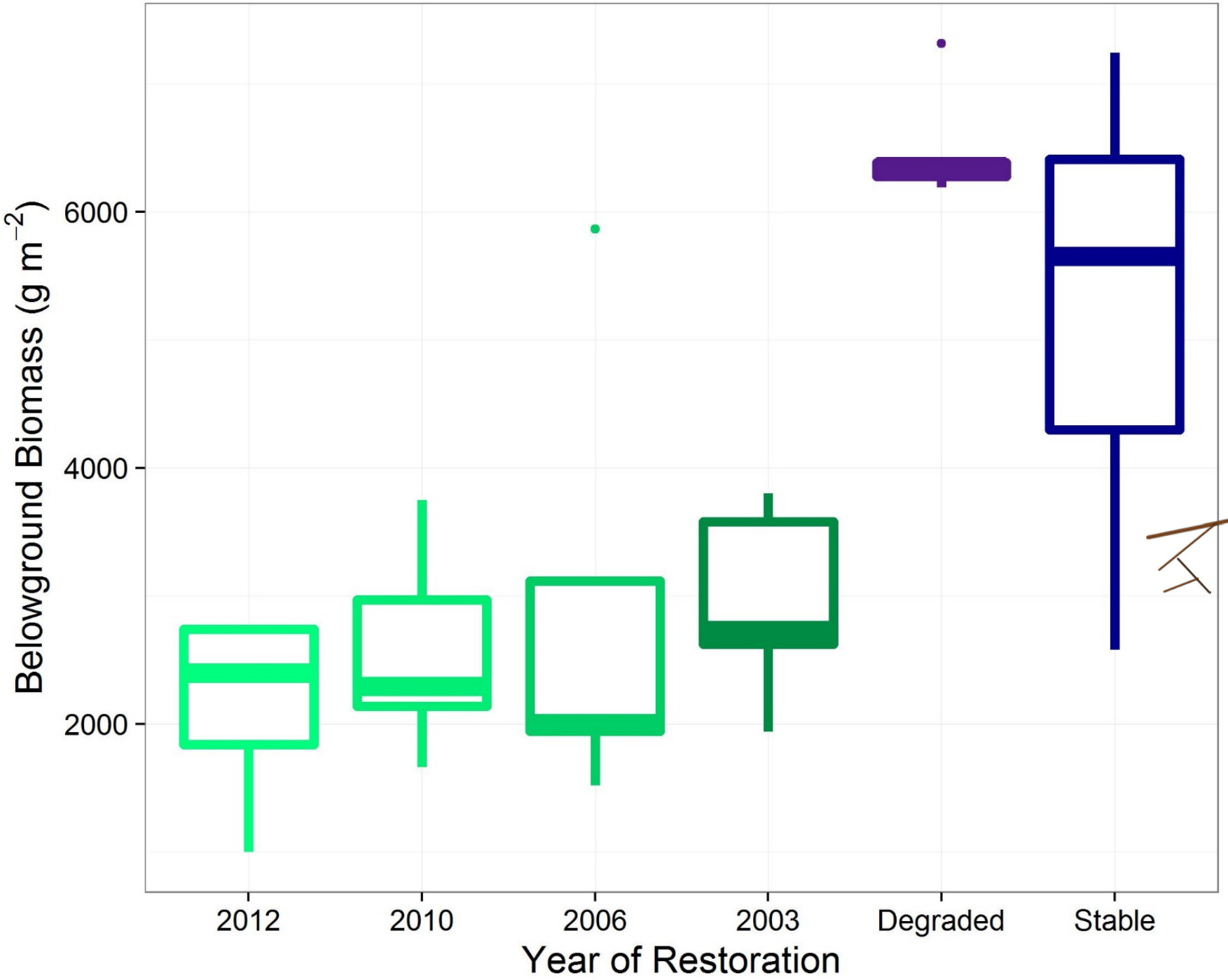


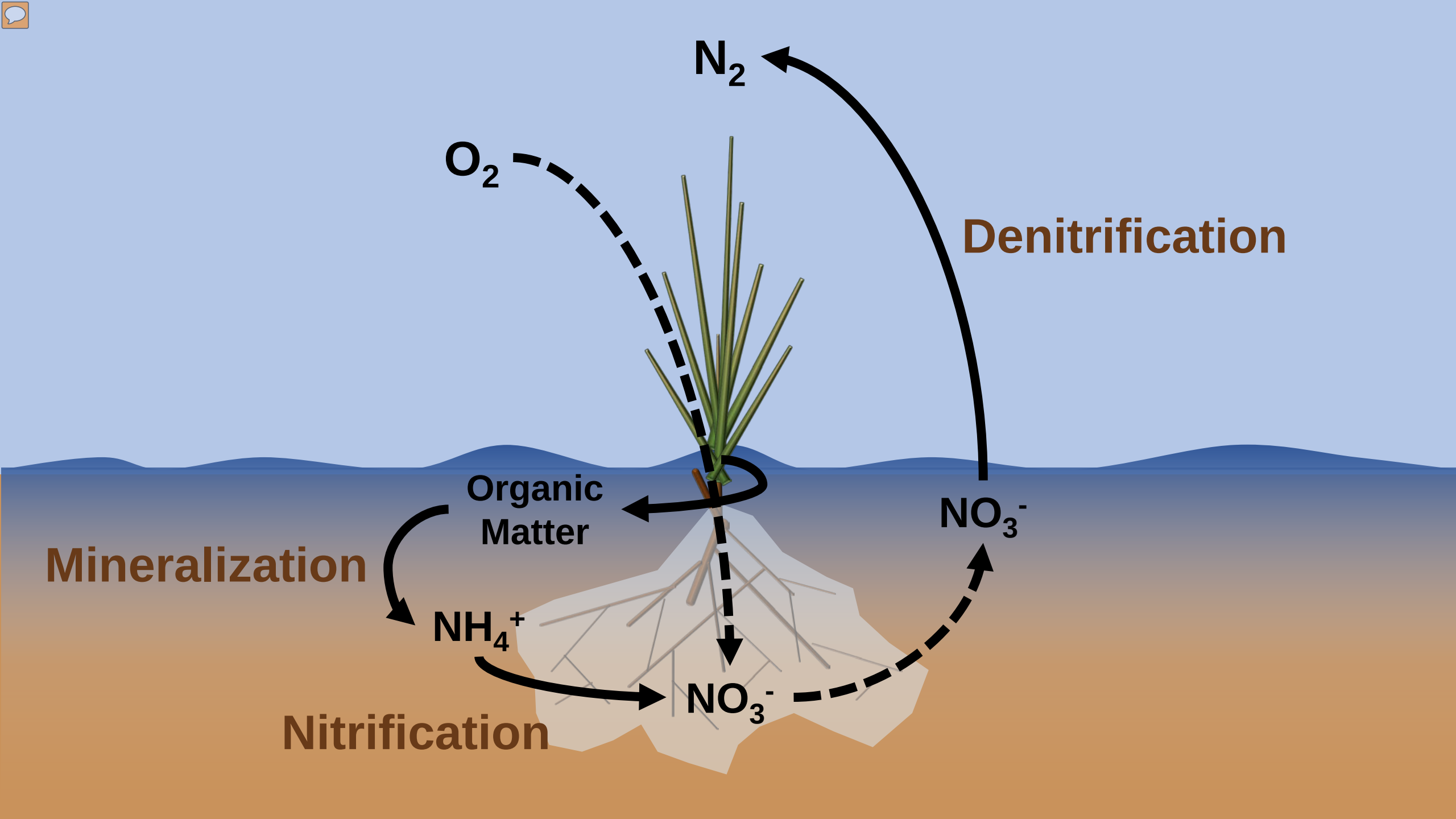


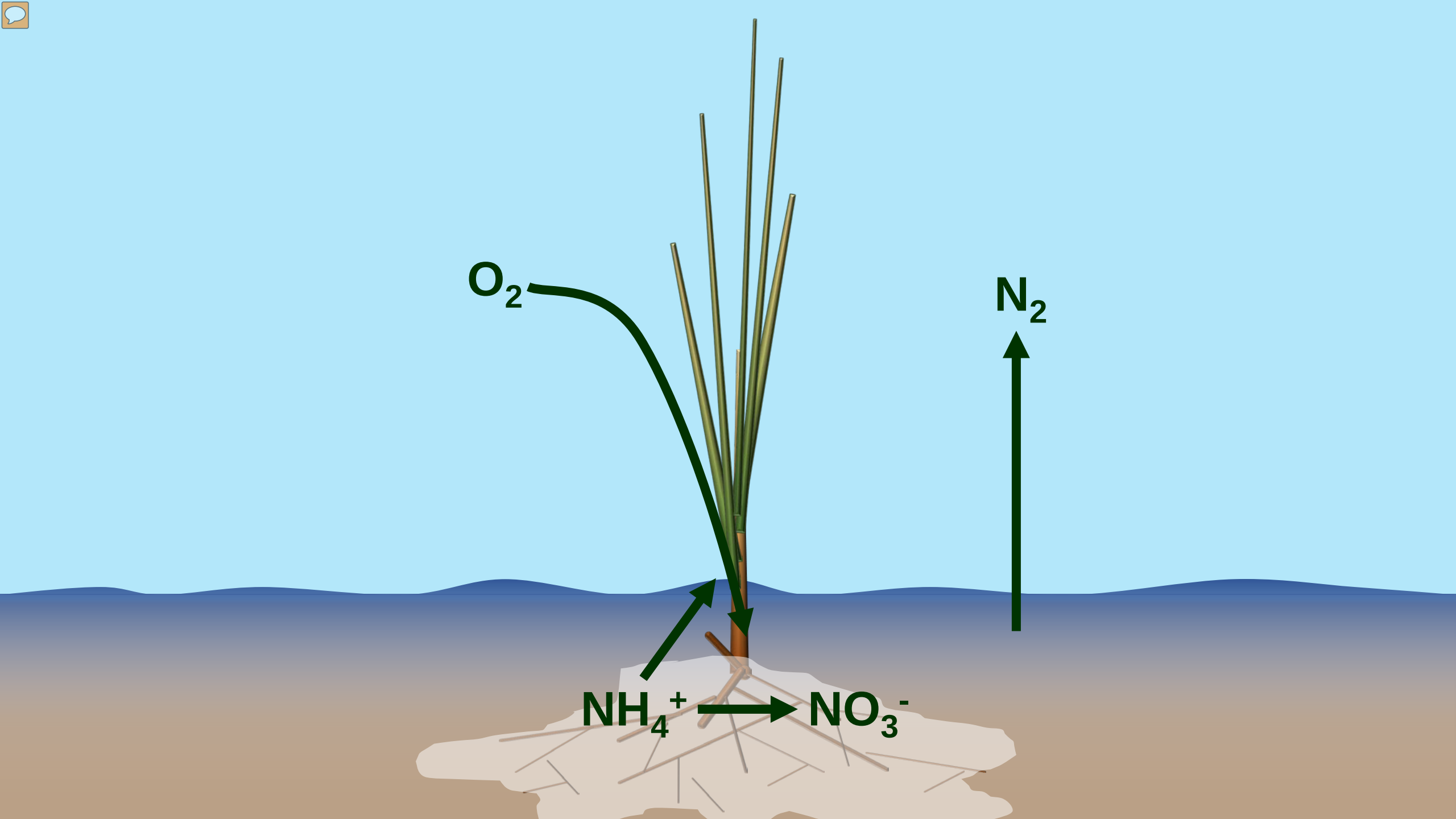
Denitrification in restored marshes is limited by **organic matter**

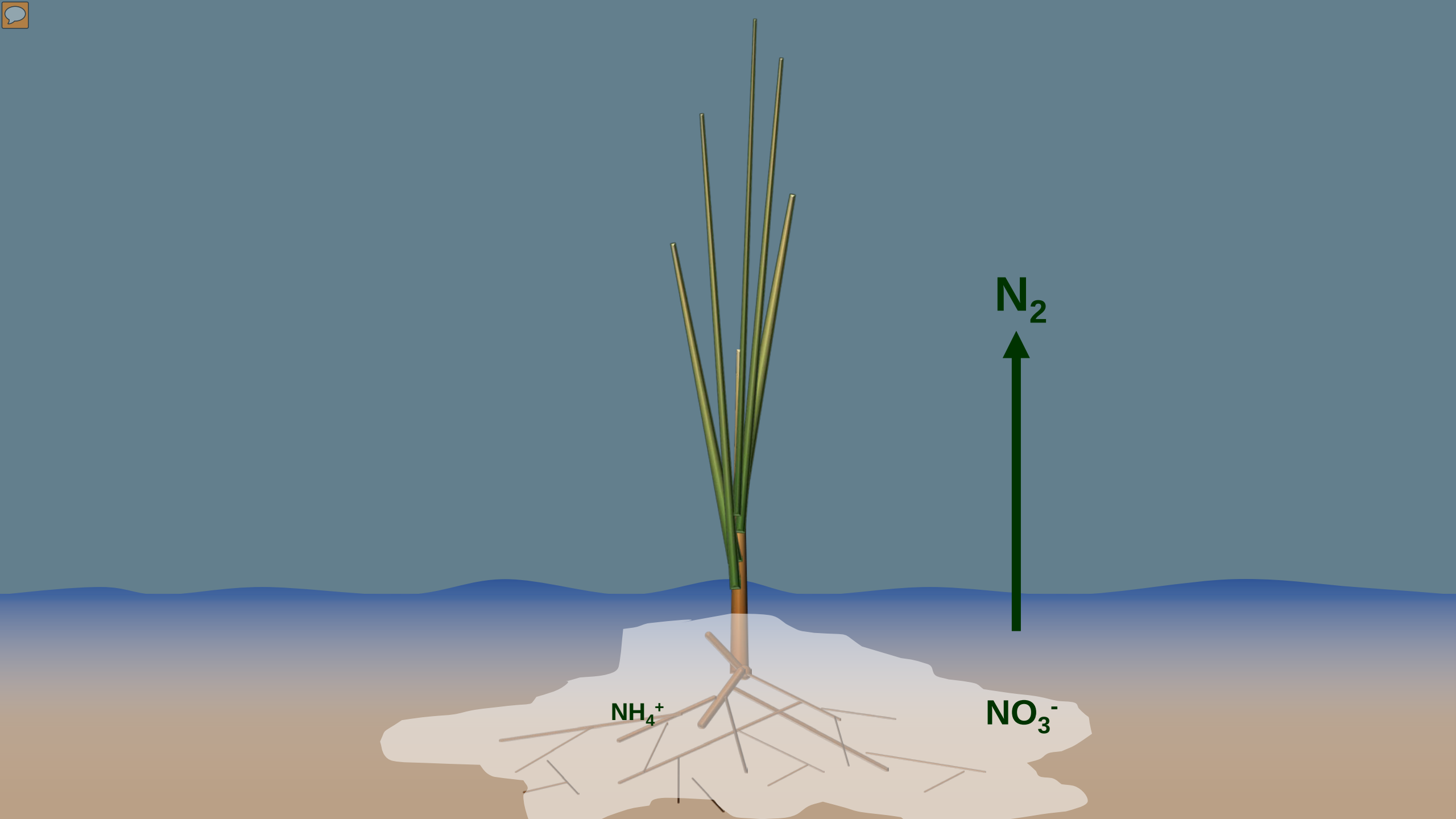




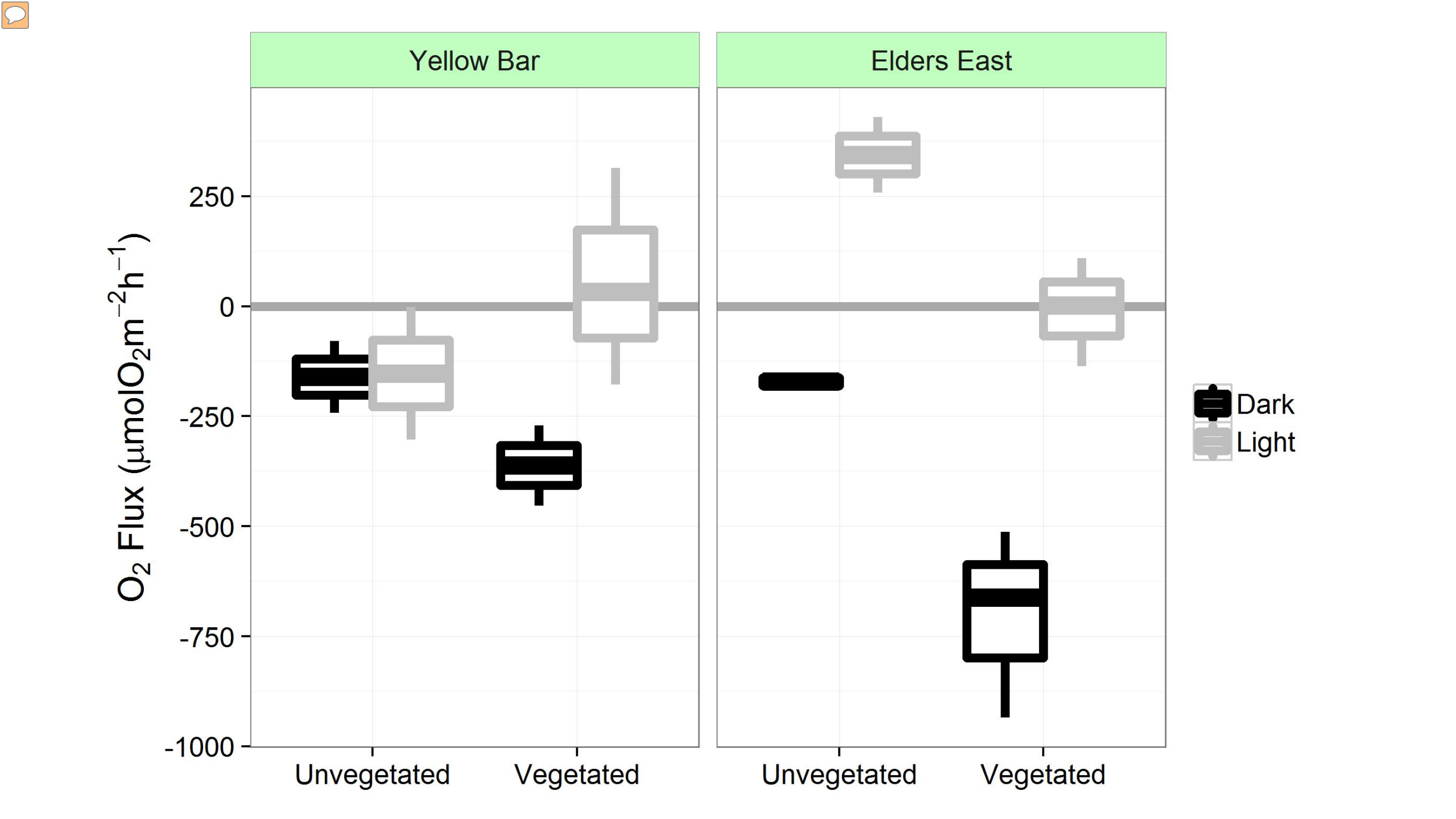

Belowground Biomass (g m^{-2})
6000
4000
2000
2012
2010
2006
2003
Degraded
Stable
Year of Restoration

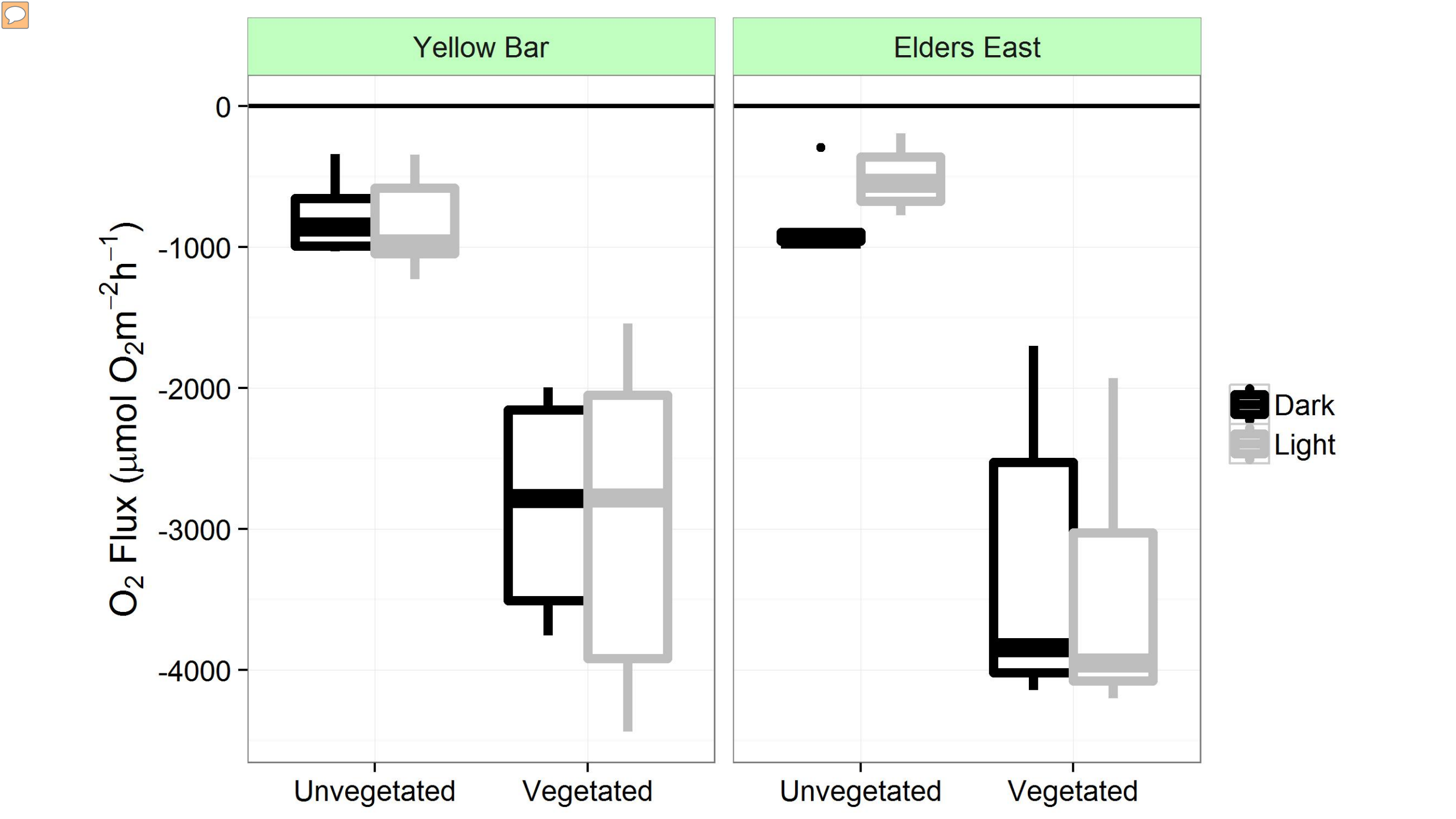

N_2
O_2
Denitrification
Organic Matter
Mineralization
NH_4^+
NO_3^-
NO_3^-
Nitrification

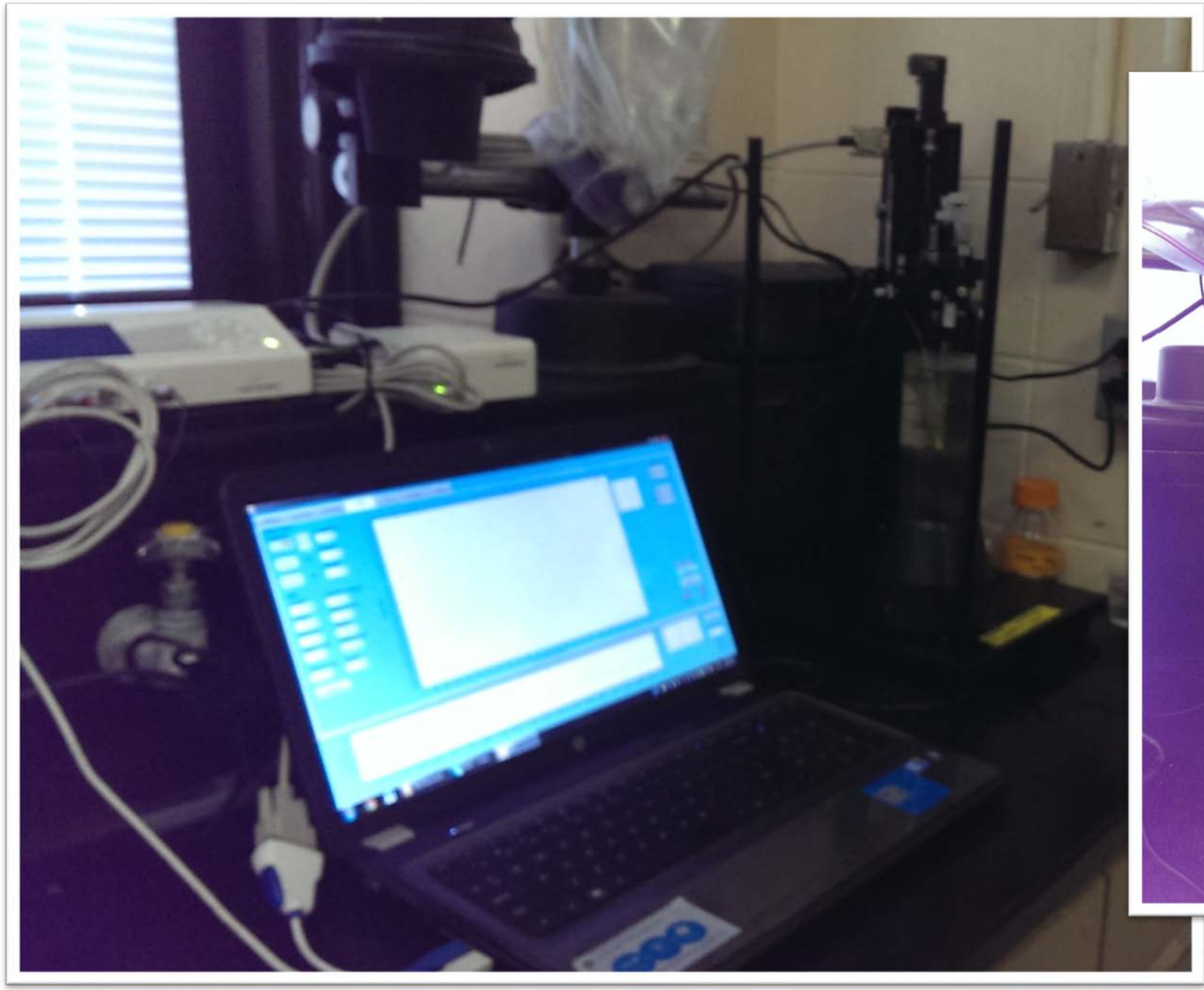

O_2
N_2
NH_4^+
NO_3^-


N_2
NH_4^+
NO_3^-

Experiments: Influence of Plants on Denitrification

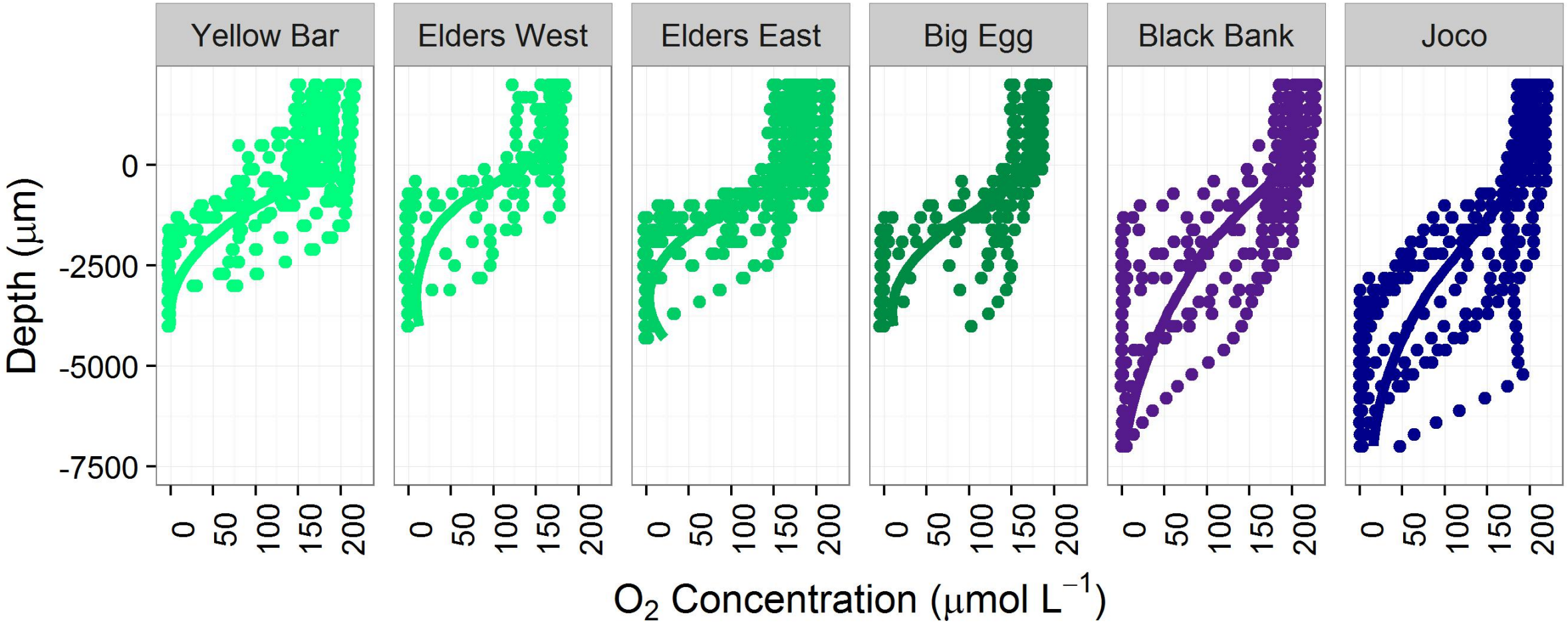

Yellow Bar
Elders East
250
0
-250
-500
-750
-1000
O2 Flux (μmolO2m-2h-1)
Unvegetated
Vegetated
Unvegetated
Vegetated
Dark
Light


Yellow Bar
Elders East
0
-1000
-2000
-3000
-4000
O2 Flux (µmol O2m-2h-1)
Unvegetated
Vegetated
Unvegetated
Vegetated
Dark
Light

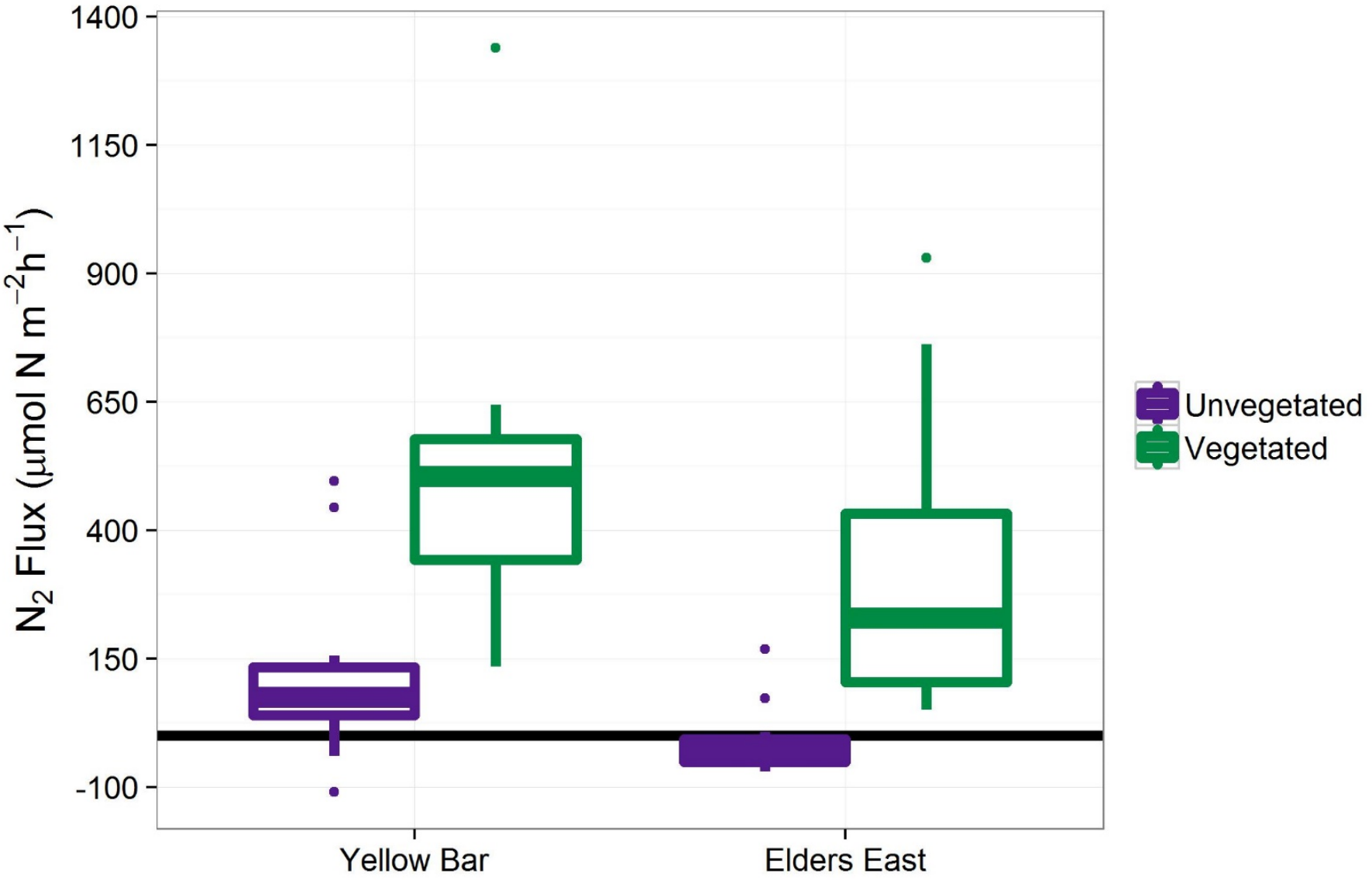



ZARNOCH - Tap to Remote
Microprocessing System

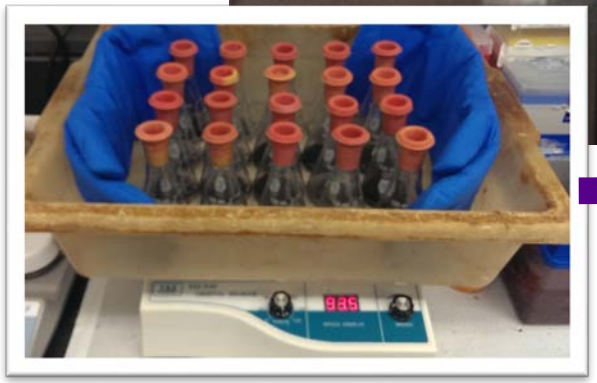
Oxygen extends deeper into the sediment in sites with greater root mass.



Much higher denitrification rates in **vegetated** than **unvegetated** plots



Method Comparison: Membrane-Inlet Mass Spectroscopy (MIMS) vs. Denitrification Enzyme Activity (DEA)



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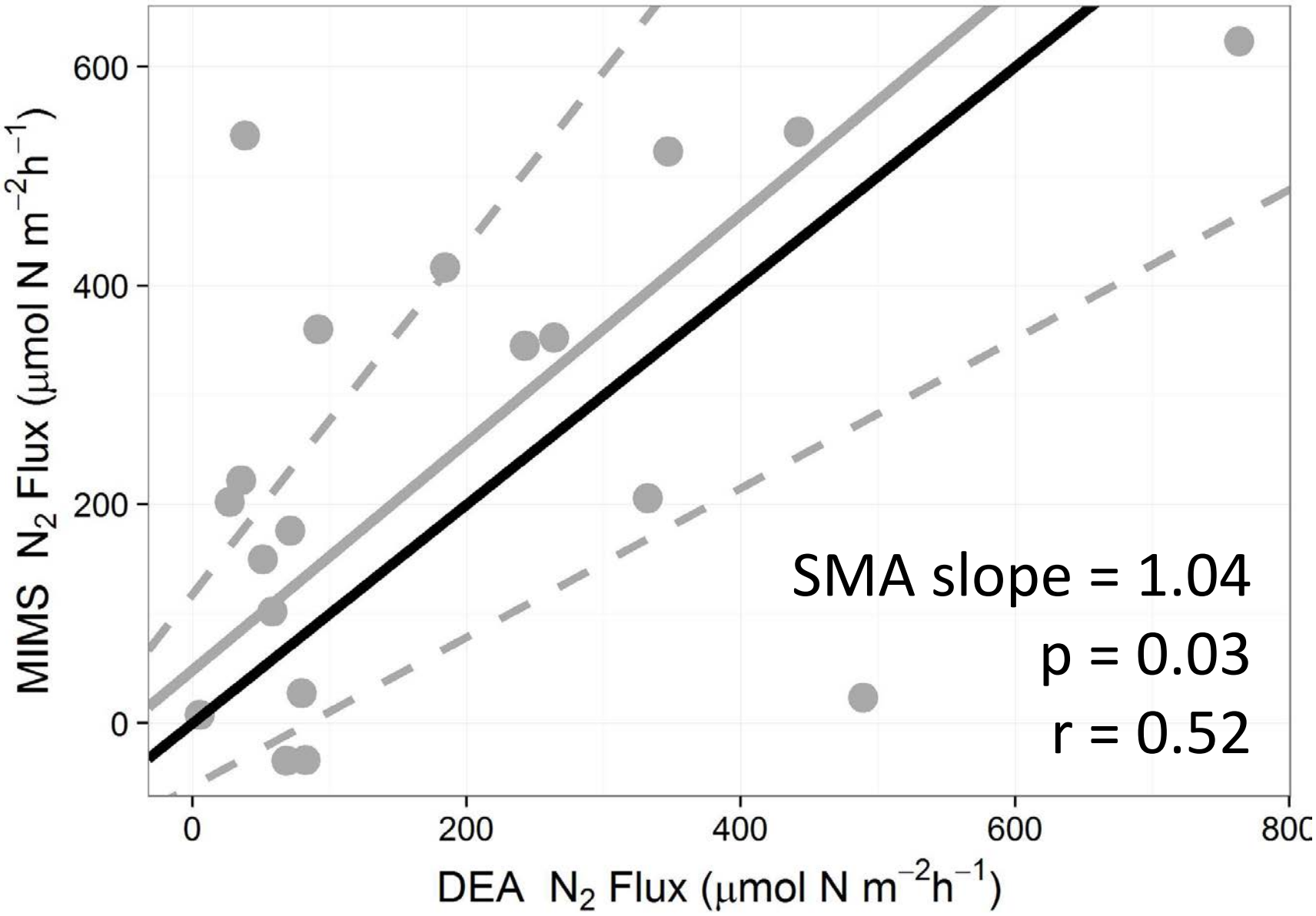
600
400
200
0
MIMS N_2 Flux (μmol N $m^{-2}h^{-1}$)
0
200
400
600
800
DEA N_2 Flux (μmol N $m^{-2}h^{-1}$)
SMA slope = 1.04
p = 0.03
r = 0.52

In Summary…

- Restored salt marshes effectively remove nitrogen via **denitrification**.
- Marshes accumulate **root mass** and **organic material**, likely resulting in increased **stability** and **nitrogen-removal services** as they age.
- Marsh **plants** increase **denitrification rates**.
- **Methods** used to measure denitrification provide comparable estimates of N_2 flux.

Questions?

http://malldred.github.io/