

Sediment Denitrification and the Fate of Nitrogen in the Guana Estuary

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State of the Reserve 2022

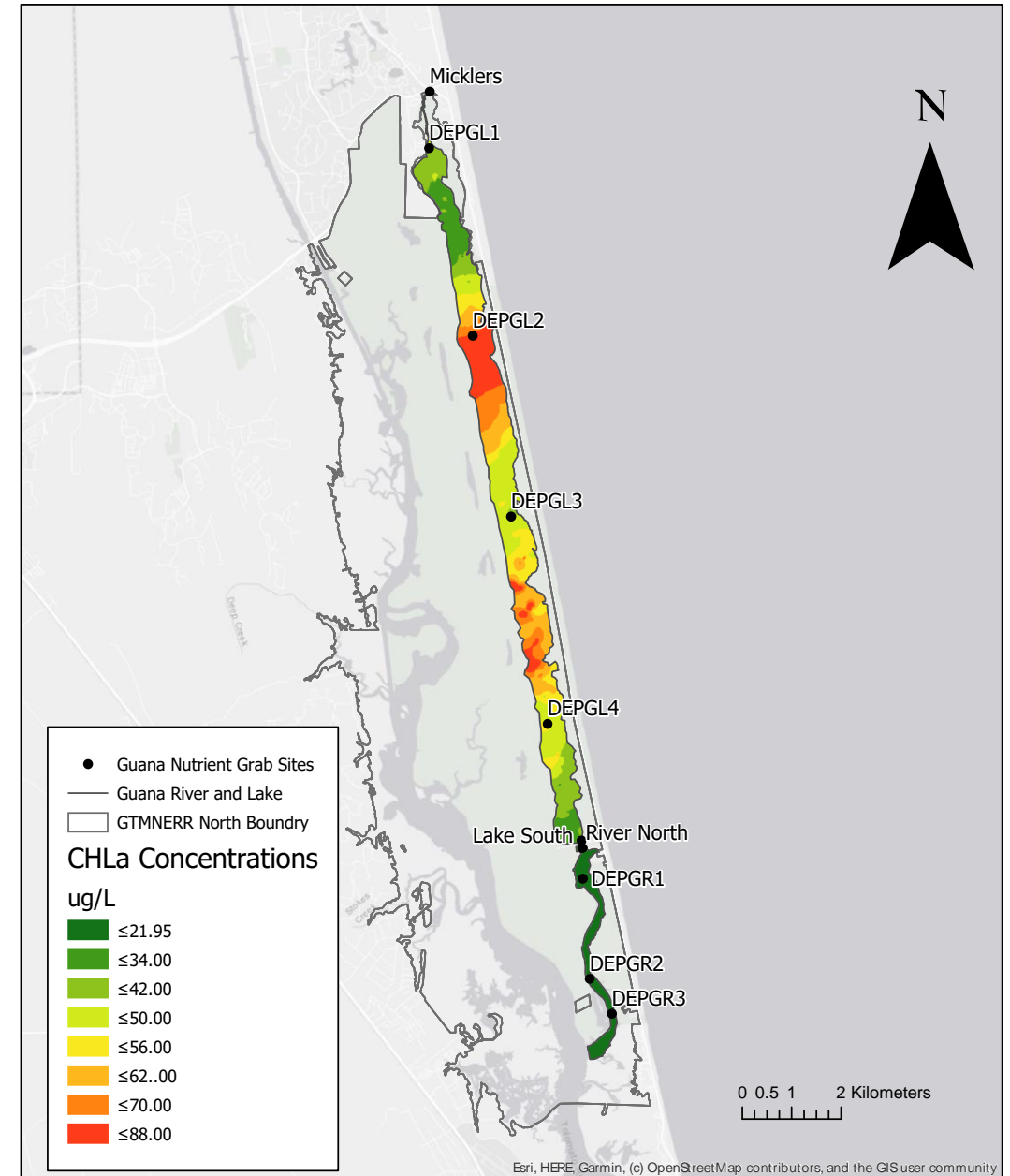




Photo credit: Allix North, GTM Research Reserve

Too Many Nutrients

- Signs of a problem
- High chlorophyll *a* concentrations
- Impairments
- Management Needs
 - *Inform the Reserve management community of the impact of watershed actions on water quality...*
 - *Determine the ecosystem benefits and tradeoffs of different management options.*



Project Approach

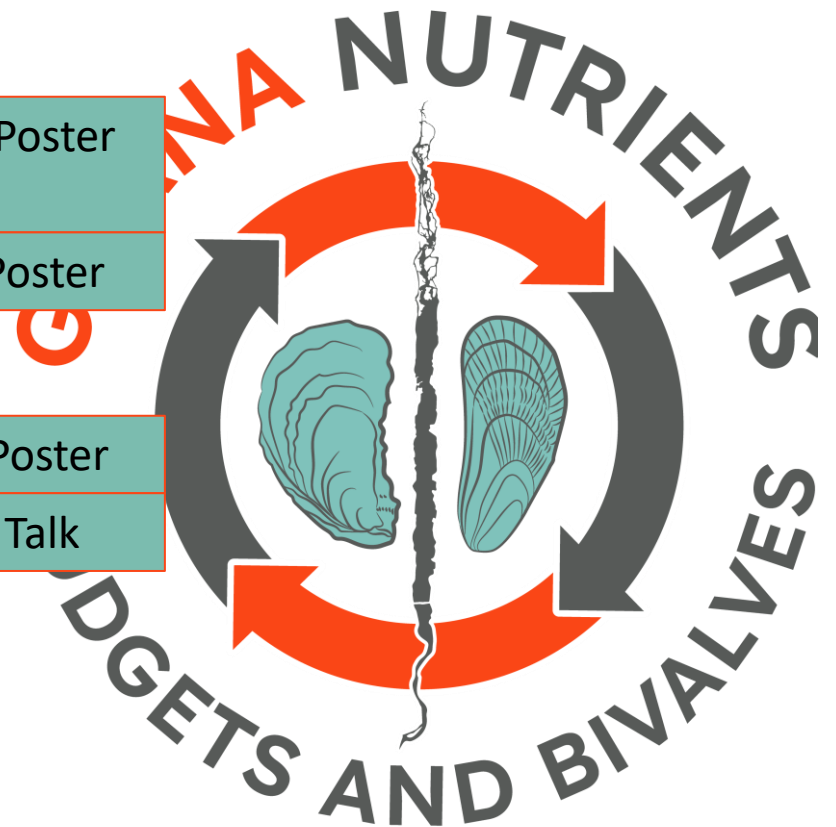
Identify	Identify nitrogen sources into Guana Lake
Understand	Understand how nitrogen moves and changes through Guana Lake and into Guana River
Assess	Assess how oysters in the lower intertidal and mussels in the upper intertidal can help filter and remove nitrogen
Evaluate	Evaluate how water quality impacts shellfish-mediated ecosystem services
Develop	Develop recommended water quality targets and restoration goals for a water quality restoration plan

Justina's Poster

Jenna's Poster

Kristie's Poster

Hallie's Talk



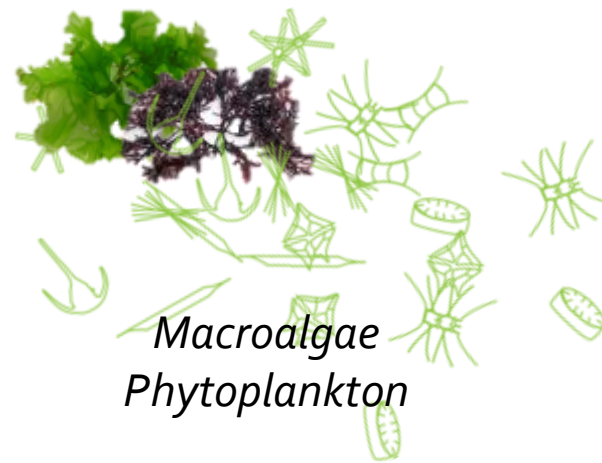
Eutrophication (noun):

an increase in the rate of supply of organic matter to an ecosystem

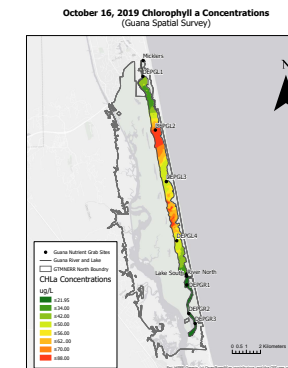
Causes

- Excess nutrients (N + P)
- Loss of grazers
- Increased sediment load
- Land-use changes

Algae



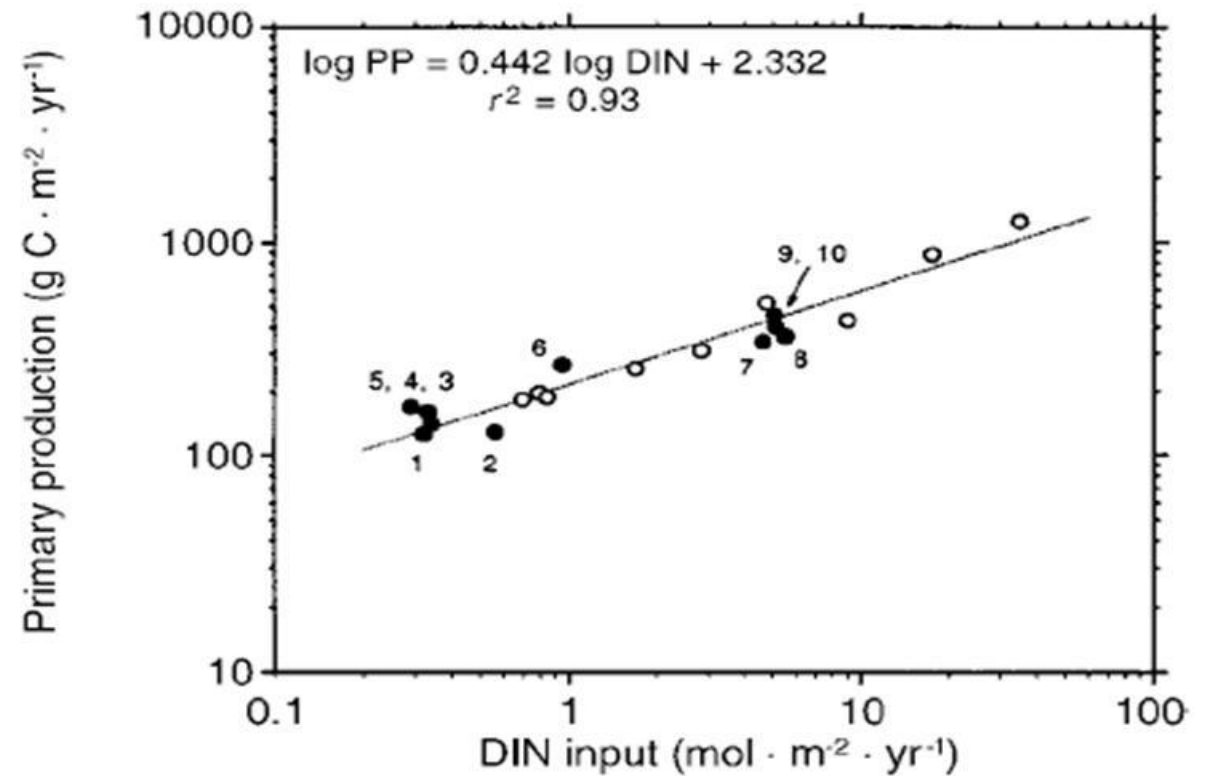
Coastal + Estuarine



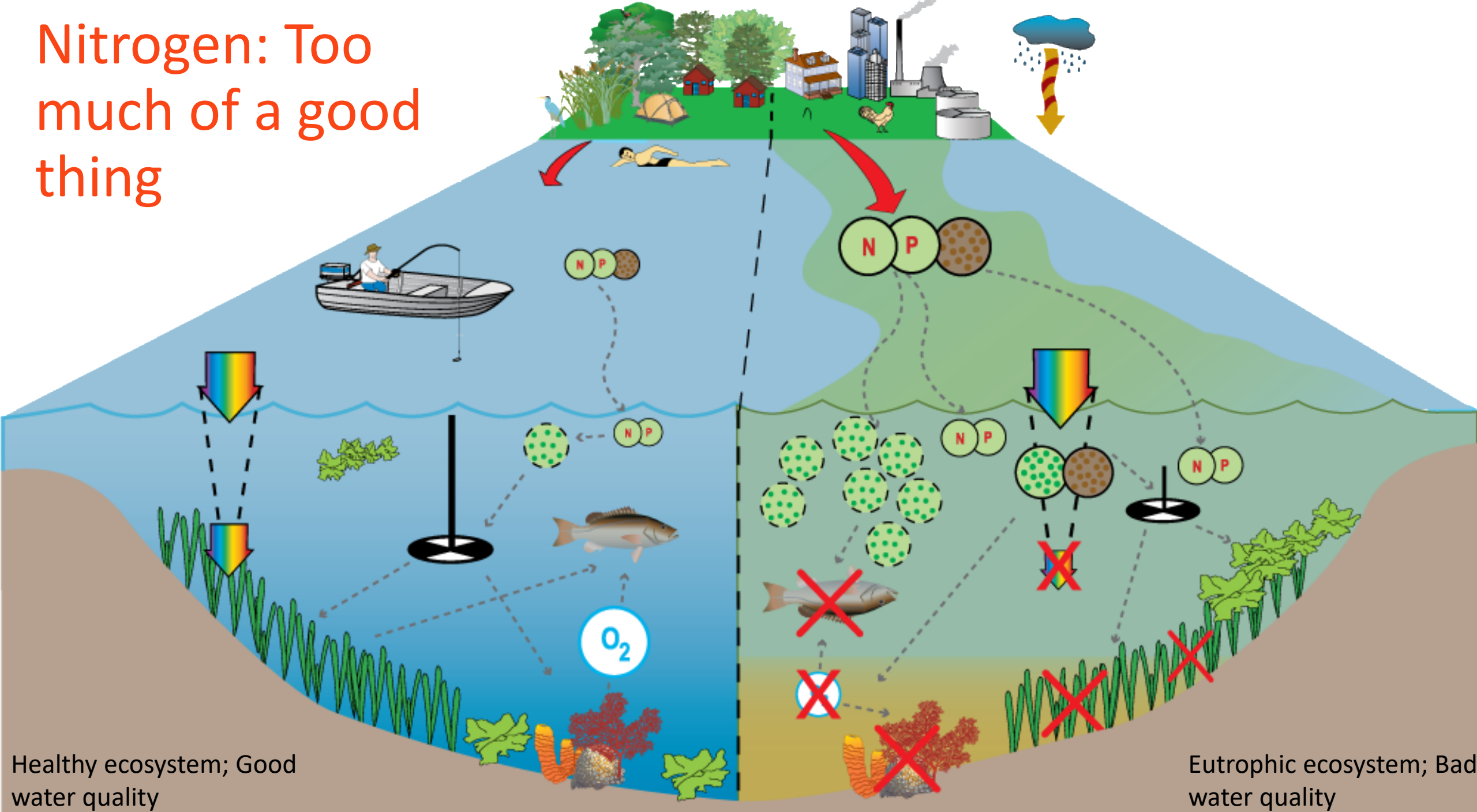
Nitrogen Enrichment in Coastal Ecosystems



Increases in N inputs have led to increased primary production and eutrophication.



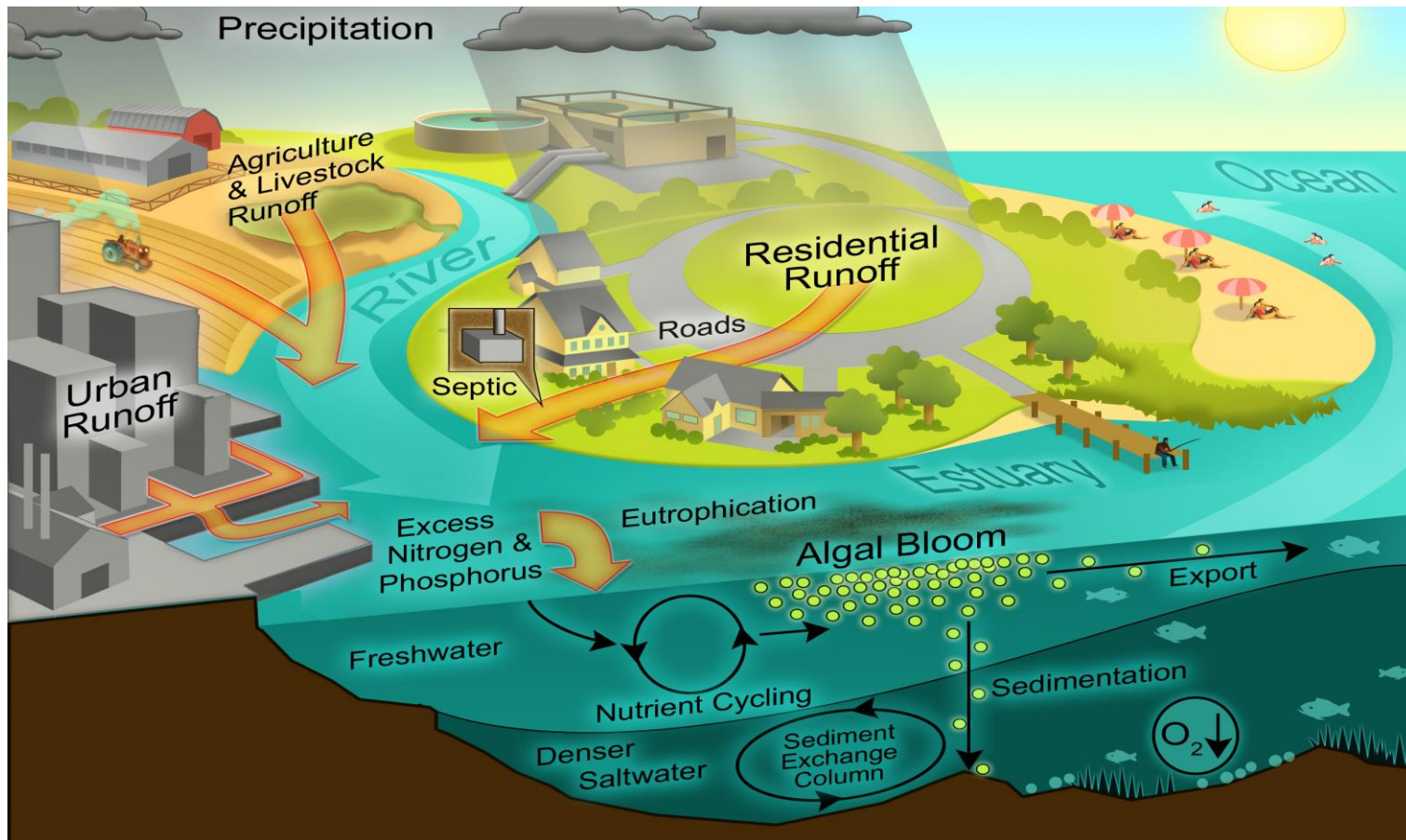
Nitrogen: Too much of a good thing



Healthy ecosystem; Good water quality

Eutrophic ecosystem; Bad water quality

Nitrogen Inputs and Losses



• Nitrogen Inputs

- Point source
- Surface flow
- Groundwater
- Marsh erosion
- Atmospheric deposition
- Nitrogen fixation

• Nitrogen Losses

- Exchange with the ocean
- Storage in biomass
- Burial
- Denitrification

Feedback in the Sediments

- Sediment respiration removes oxygen from the water column
- Sediments recycle nutrients back to the water column
- Sediment denitrification

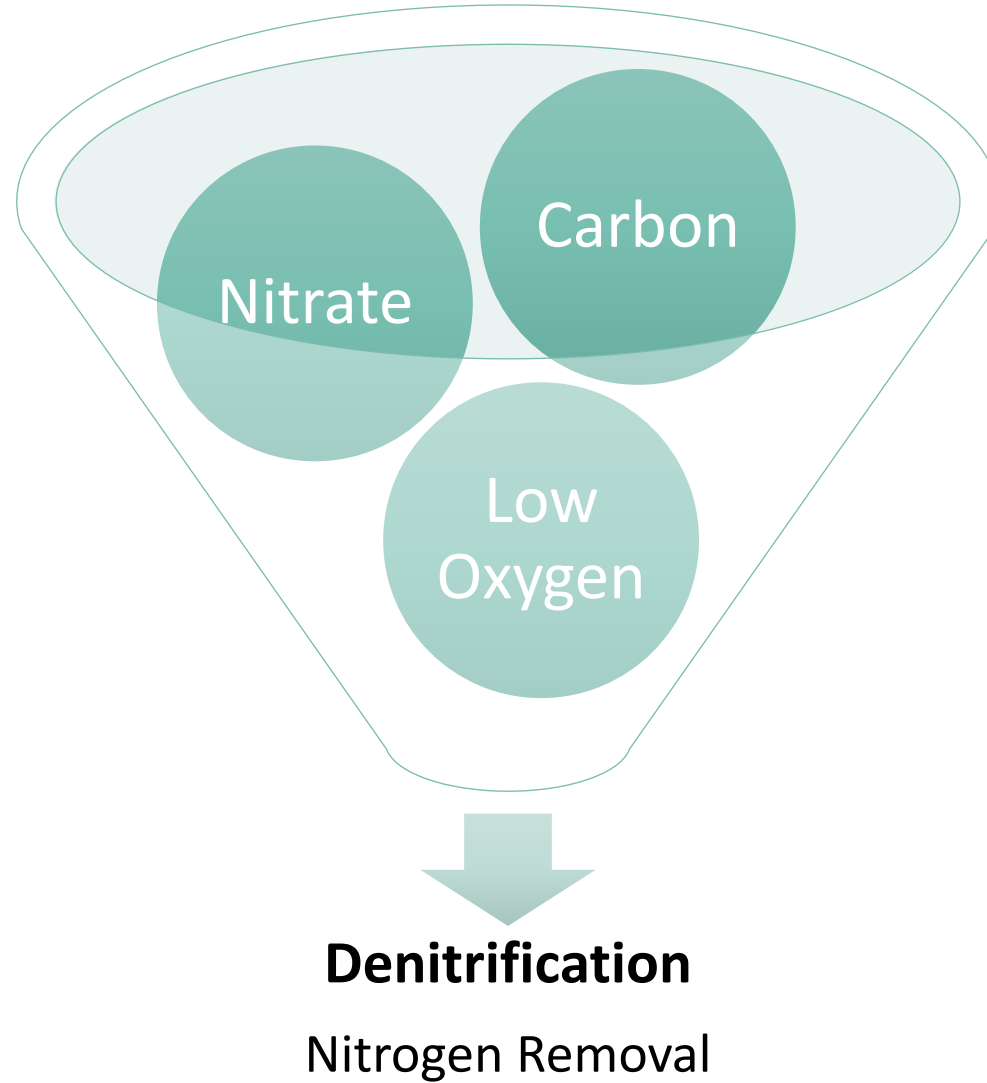
Denitrification



atmosphere



Factors Controlling Denitrification





Denitrification in Guana Estuary

- Denitrification is an important ecosystem service since it removes nitrogen
- Gaps remain in our understanding of the spatial and temporal controls of denitrification
- Measurements in Guana Estuary are lacking

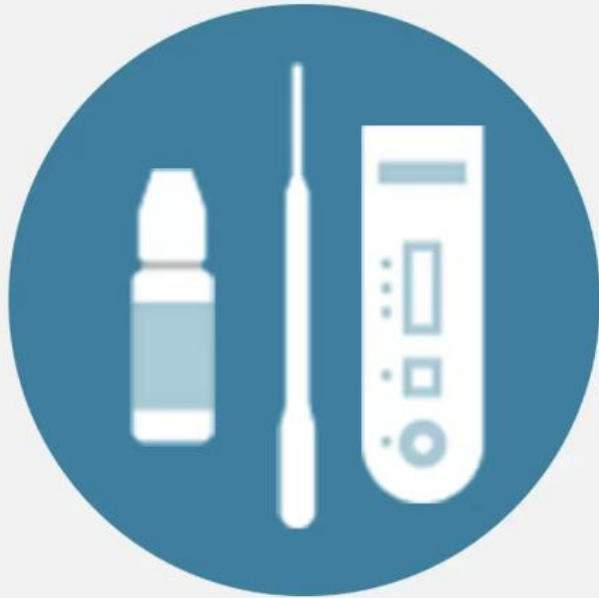
Approach to Measuring Denitrification

Sediment Slurry

Whole Cores

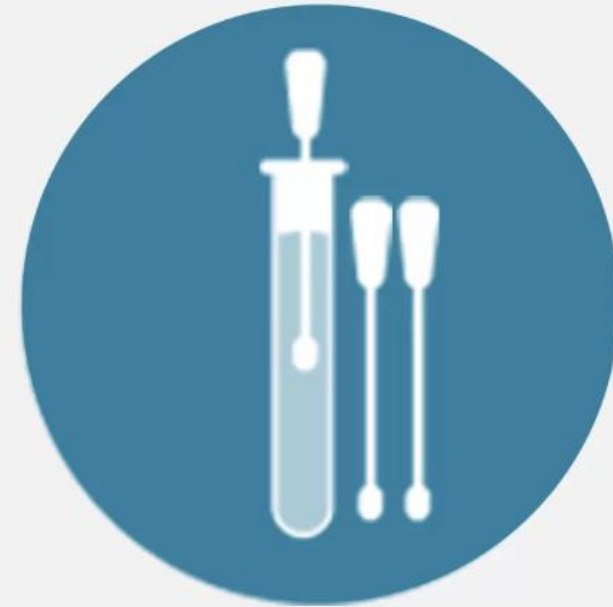
Approach to Measuring Denitrification

Slurry



**Rapid lateral
flow test**

Whole Cores



**PCR test
(polymerase chain reaction)**



Where do we measure denitrification?

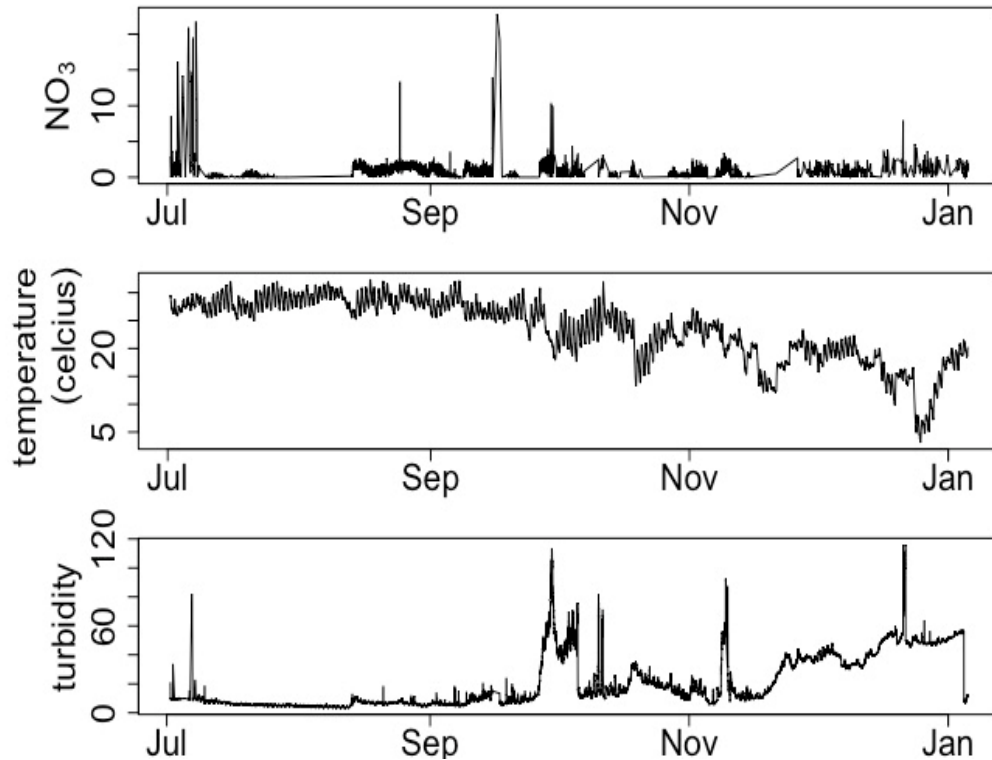
- Guana Estuary Sediments
 - Monthly at 10 sites, slurries
 - Jenna's Poster
 - Seasonally at 4 sites, cores
 - Justina's Poster
- Guana Estuary Coastal Ecosystems
 - Marshes
 - Oyster Reefs
 - Mussel Mounds
 - Intertidal Flats

Guana Lake



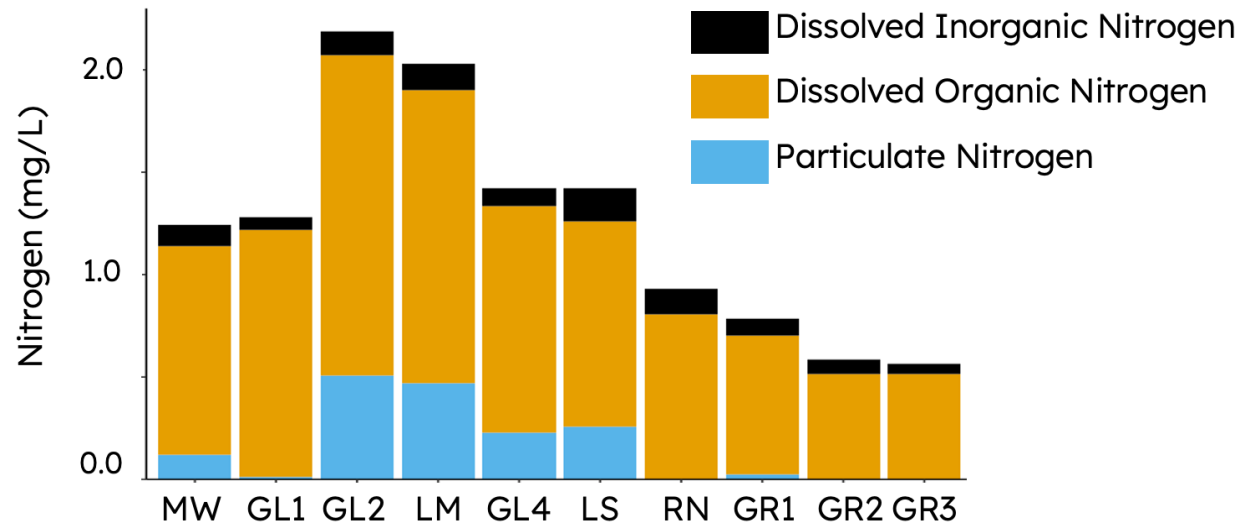
Denitrification limited by nitrate

High temporal resolution data of nitrate at the Mickler Weir



Jenna Reimer Sensor Data

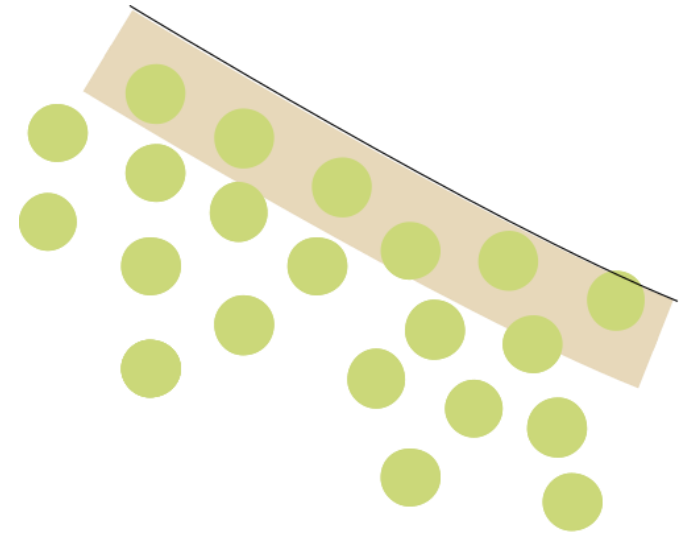
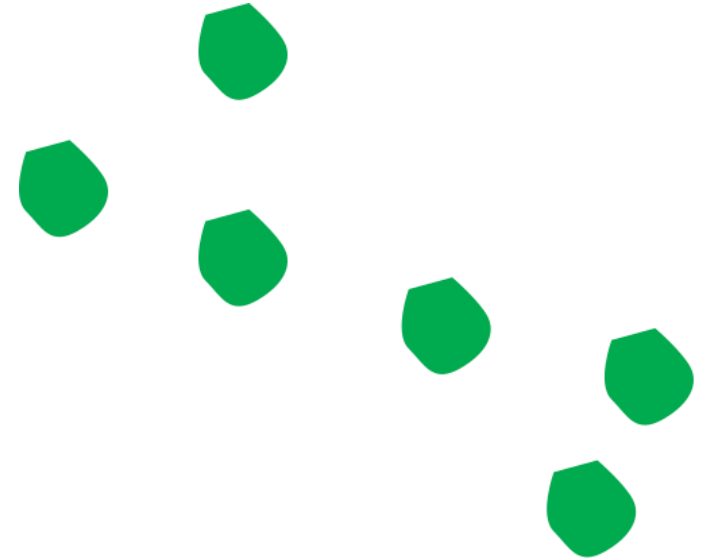
High spatial resolution data of nitrate along Guana Estuary

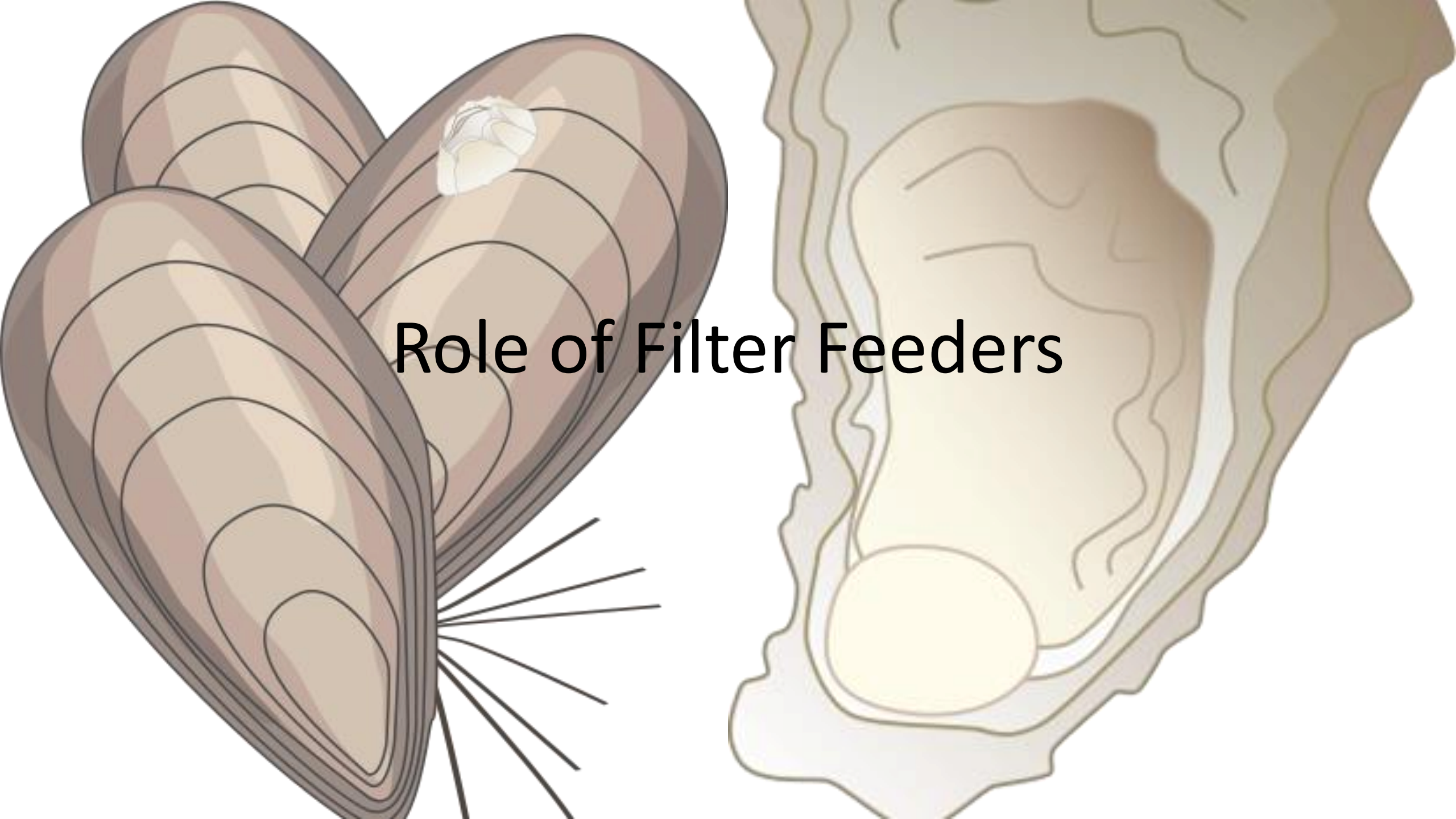


Nikki Dix Water Quality Monitoring Data

Where is the nitrogen?

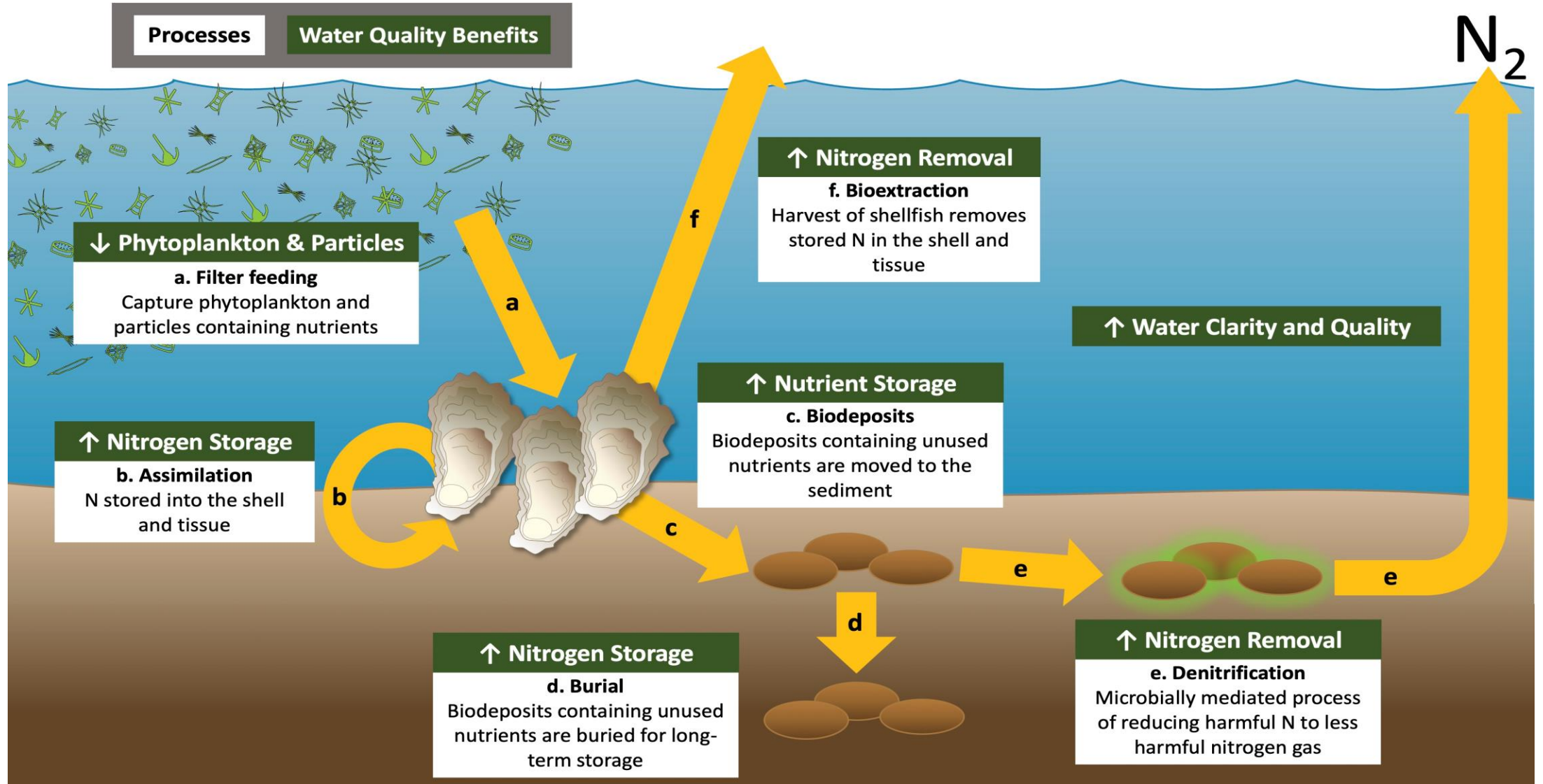
Consider assimilation





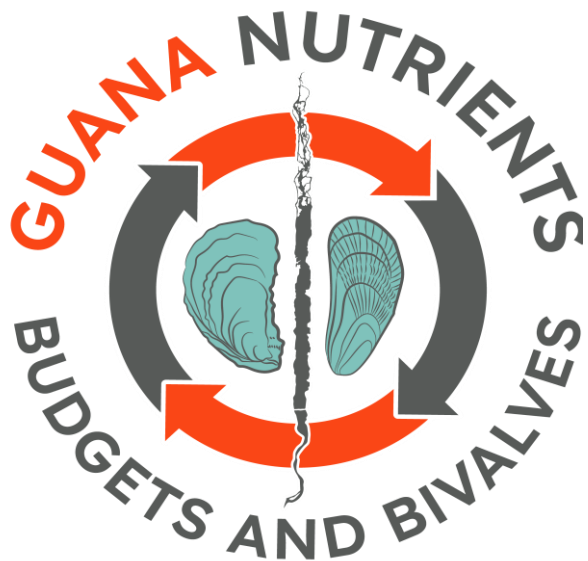
Role of Filter Feeders

Water Quality Benefits of Shellfish



Thank you!

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Everyone lives downstream

Knowledge of the physical, chemical, and biological characteristics of the Guana Estuary is needed to develop management