



# Aquaculture for Water Quality Restoration in Florida: Nitrogen Removal Services

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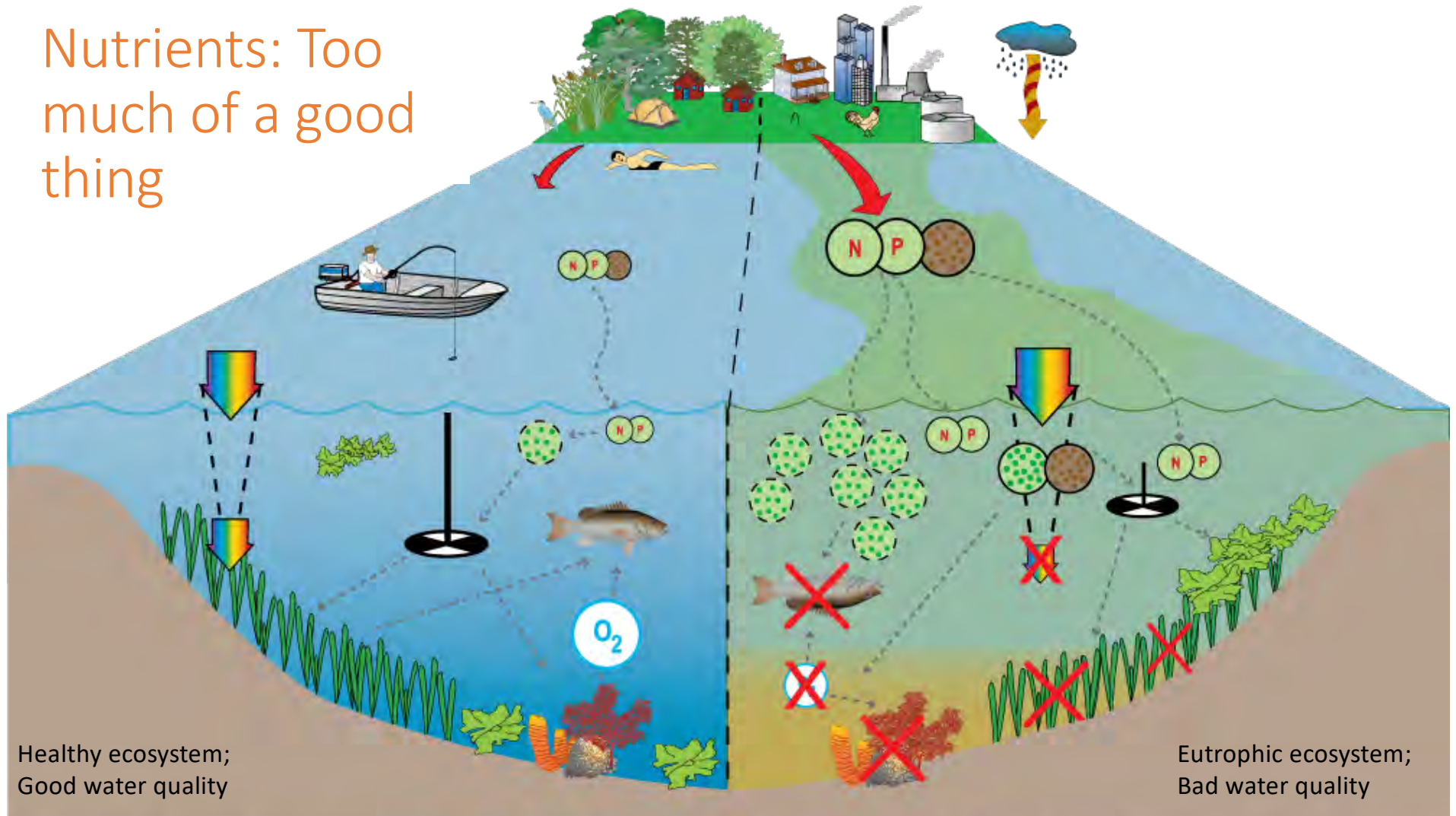
## What is nutrient pollution?

- Nutrient pollution is the process where too many nutrients, mainly nitrogen and phosphorus, are added to bodies of water and cause excessive growth of algae.



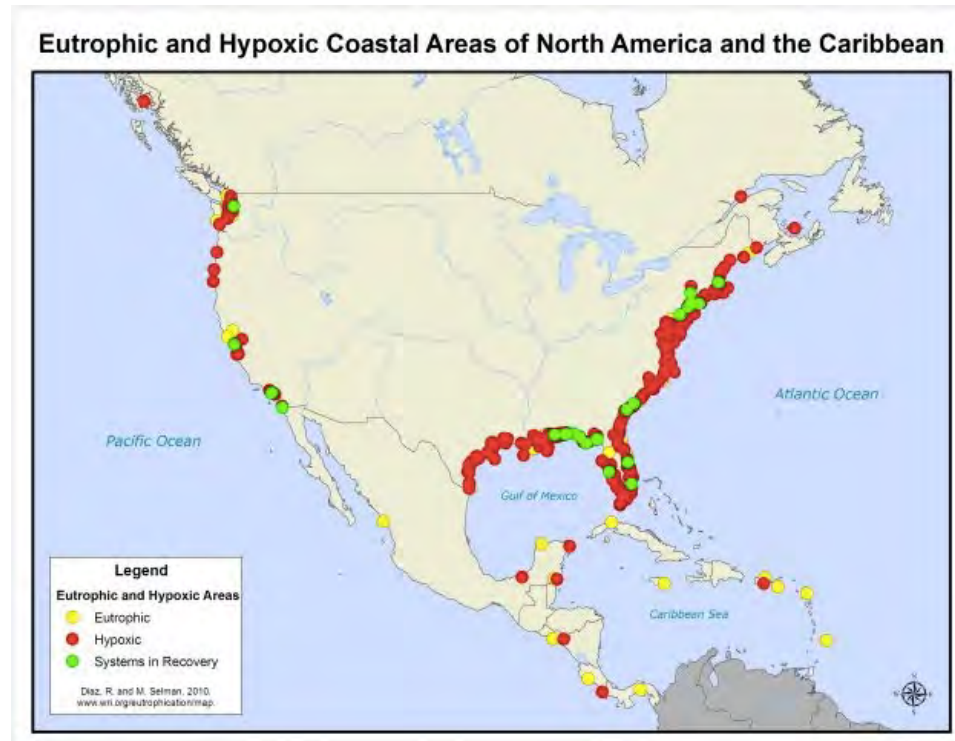


Nutrients: Too much of a good thing

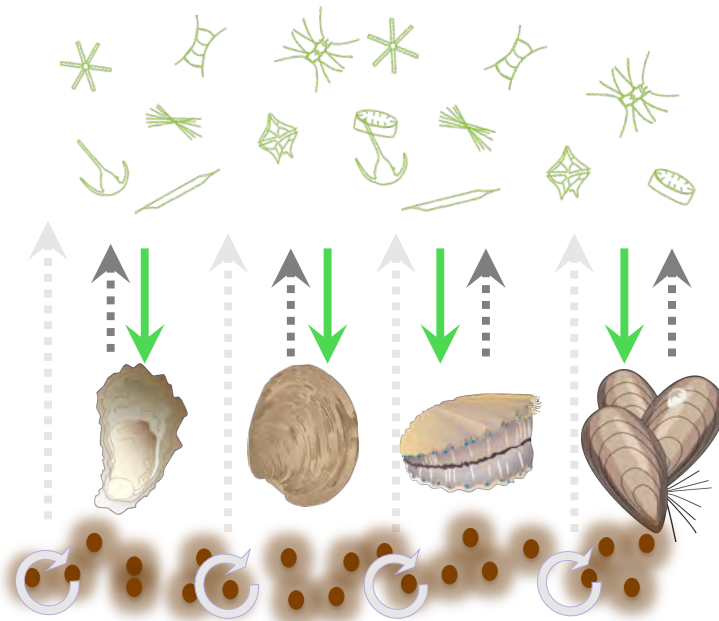


# Coastal Eutrophication (Nutrient Pollution)

- Excess Nutrients → Algal Blooms → Dead Zone, Turbidity, Habitat Loss
- 65% of US and many global estuaries have moderate to high impacts.



# Relationship with shellfish and eutrophication



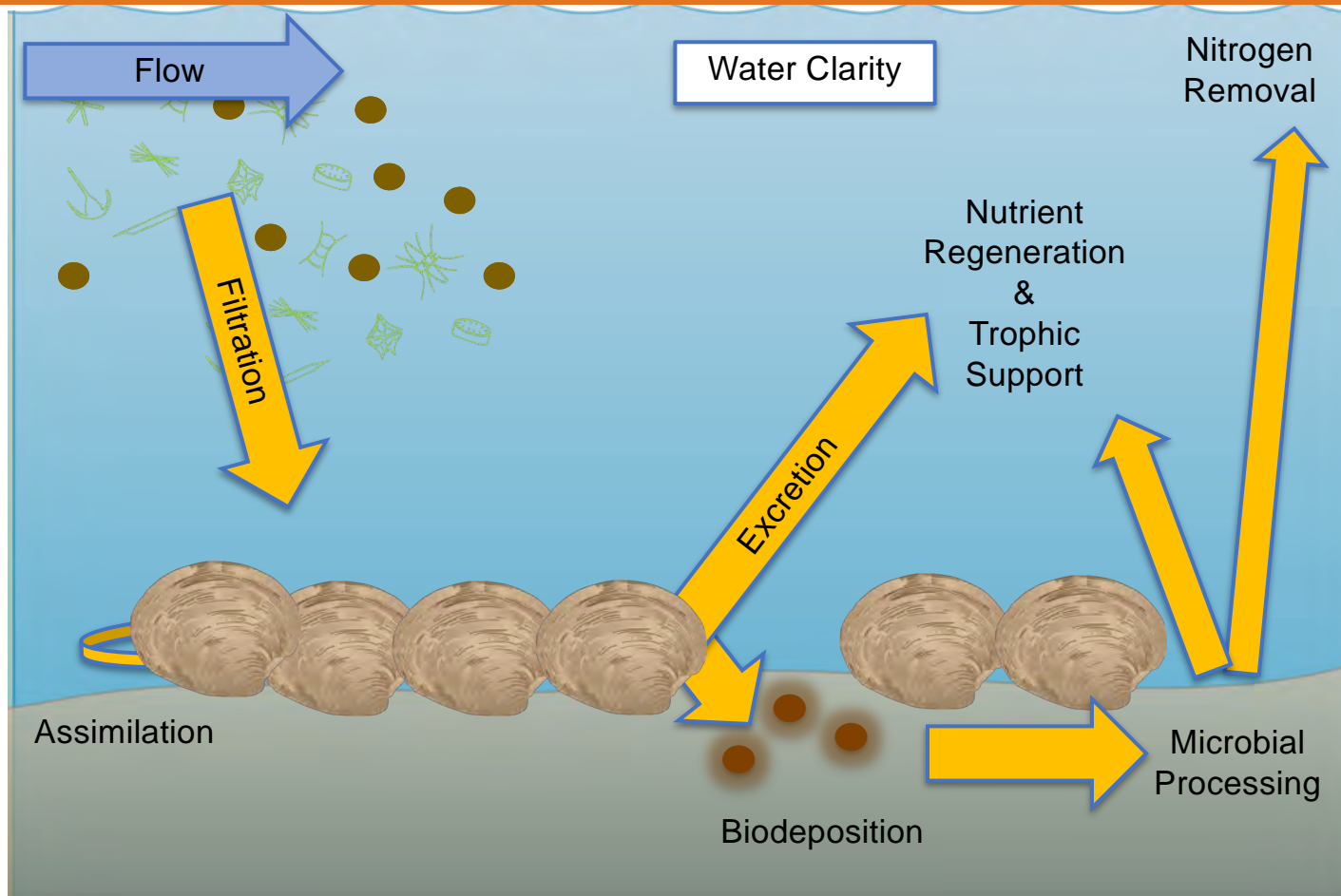
Bivalve shellfish are filter-feeders and nutrient transformers

- Remove particulates
- Use nutrients for growth
- But excrete ammonium and release biodeposits
- The biodeposits are used by microbes

Transformation rates and nutrient pools depend on:

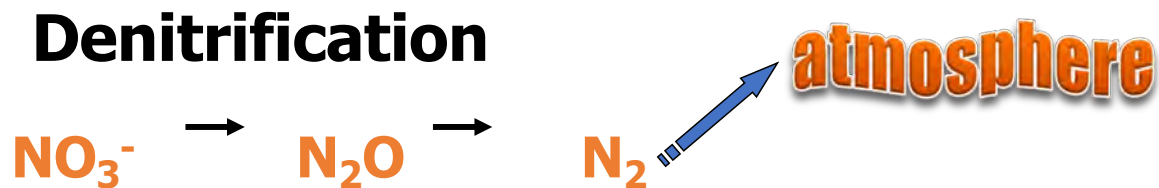
- Environmental context
- Bivalve physiology, density
- Microbial Community

# Relationship with shellfish and eutrophication



## Can shellfish help improve water quality?

- Biologically mediated removal of nutrients by shellfish.
- Directly or indirectly filtering water.
- Land-based nutrient reductions not shown expected eutrophication reductions.
- Diminishing economic benefits for further wastewater treatment improvements.
- Non-point source pollution more difficult.
- **Shellfish presence enhances denitrification.**



# Shellfish-associated nutrient reduction processes

What is the net nitrogen removal from shellfish aquaculture in Florida?

- Nitrogen content in shell and tissues from clams & oysters in different waterbodies
- Enhanced denitrification due to shellfish farming in different water bodies

Is there a predictive relationship to estimate on farm denitrification?

- Denitrification is difficult to measure
- Nitrogen removal from restoration activities is through denitrification



# Nitrogen Removal: Site Selection

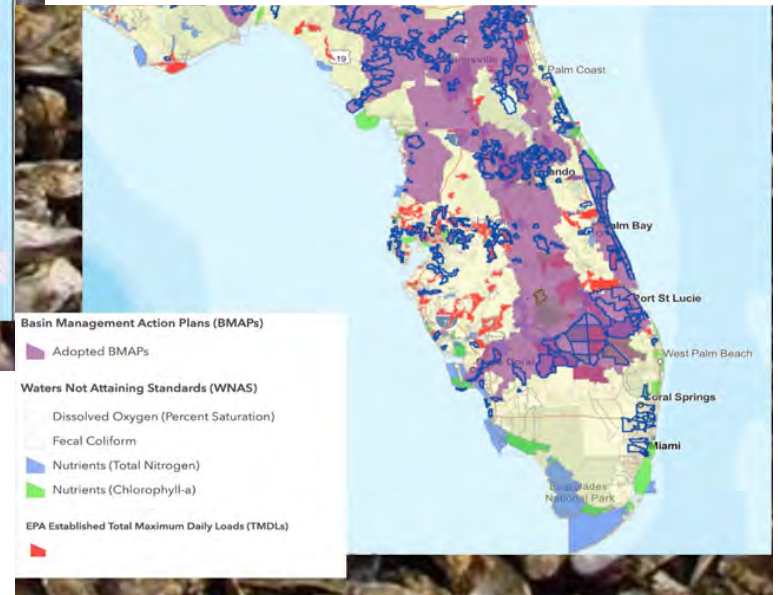
## Shellfish Leases

### Site Selection:

- Active leases (oysters and clams)
- Watershed nitrogen problem
- Within 6-hours of Homestead, FL



## Nutrient Issues



# How We Measure Enhanced Denitrification

Generate estimates of nitrogen reduction through enhanced denitrification from aquaculture farms

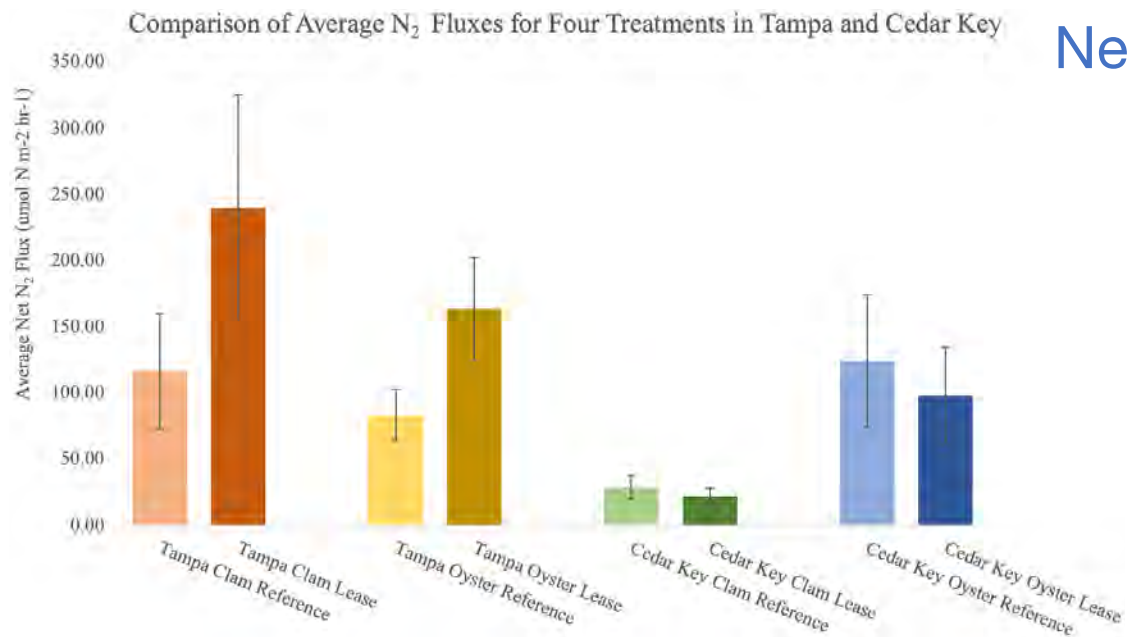
## Sample Collection



## Measuring Denitrification



# Enhanced Denitrification Varies by Site



## Need for site-specific data

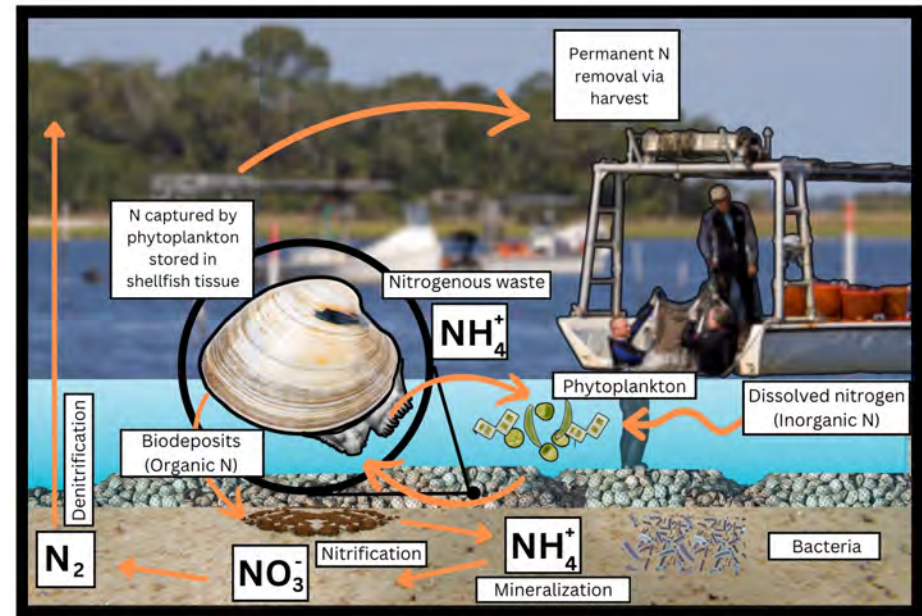
- Variation in local hydrology, sediment type, number of farms may affect denitrification enhancement
- Importance of shellfish biomass and fate of biodeposits



# How We Measure Nitrogen Assimilation

Nitrogen content in tissue is shell from different species, sizes, salinities, and locations

## Measuring shellfish





## Protocol To Predict

If there is a predictive relationship, it would reduce need for measurements

- Compiled data on denitrification from shellfish systems, using the same methods used in this study (n=230)
- Identified predictors that are easy to measure and known drivers of denitrification

### **Predictor Variables**

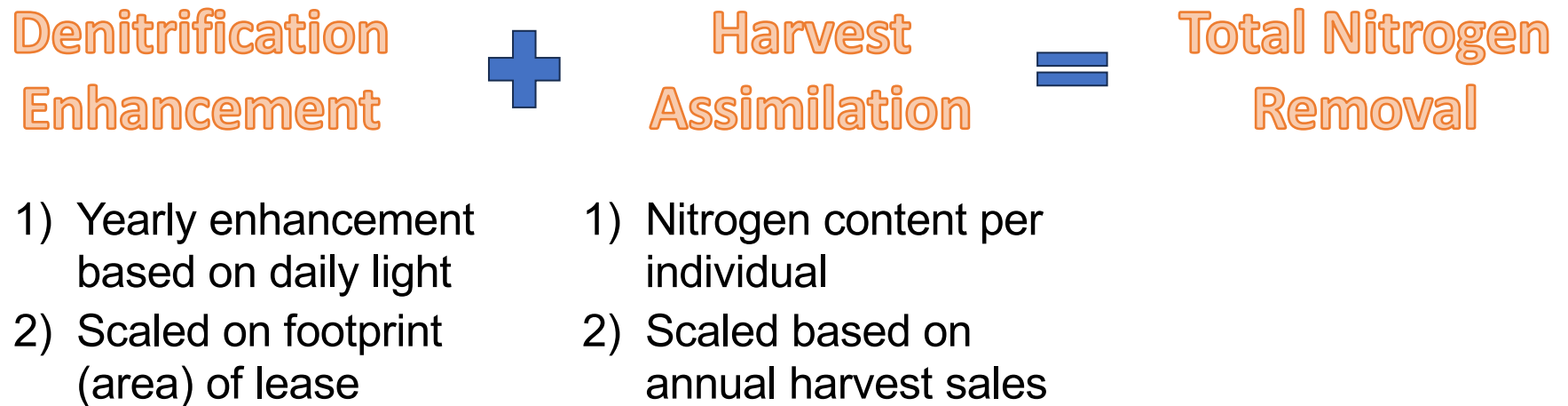
Water column nitrate  
Sediment organic matter

**Of variables considered, none explained more than 8% of the variation in denitrification**

Prediction of nitrogen content in shell is more promising, based on shell length only

# How much nitrogen is removed by shellfish farms?

To determine total annual nitrogen removal from a shellfish farm, we can upscale field measurements\*



\*Many, many assumptions, for illustrated purposes only

## Total Nitrogen Removed by Aquaculture

Extraction – based on assimilation and harvest numbers

Denitrification – based on enhancement

<b>N removed</b>	<b>Oysters</b>	<b>Clams</b>
Extraction (lbs/yr/100,000 individuals)	32	17
Denitrification (sediments) (lbs/yr/acre)	8	35
Total removal (lbs/yr)	40	52

# How much is nitrogen removal worth?

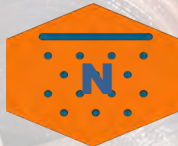
## FLORIDA HARD CLAM AQUACULTURE provides environmental and economic values for nutrient removal services generated by the statewide industry

For more information go to <https://shellfish.ifas.ufl.edu/environmental-benefits-shellfish-aquaculture/>



### NITROGEN EXTRACTION

XXX thousand pounds of nitrogen were removed from coastal waters through the statewide harvest of XXX million clams



### ENHANCED DENITRIFICATION

XXX thousand pounds of nitrogen were removed from the XXXX acres of bottom aquaculture leases in the state



### ECONOMIC VALUE

Potential monetary value of these nitrogen removal services was estimated at \$XXXX, which represents ecosystem benefits that clam culture provides to Florida citizens at no cost

\*Based on Florida production results and total acreage of bottom aquaculture leases in the state over 2023 obtained from the Florida Department of Agriculture and Consumer Services .

## FLORIDA OYSTER AQUACULTURE provides environmental and economic values for nutrient removal services generated by the statewide industry

For more information go to <https://shellfish.ifas.ufl.edu/environmental-benefits-shellfish-aquaculture/>



### NITROGEN EXTRACTION

XXX thousand pounds of nitrogen were removed from coastal waters through the statewide harvest of XXX million oysters



### ENHANCED DENITRIFICATION

XXX thousand pounds of nitrogen were removed from the XXXX acres of water column aquaculture leases in the state



### ECONOMIC VALUE

Potential monetary value of these nitrogen removal services was estimated at \$XXXX, which represents ecosystem benefits that oyster culture provides to Florida citizens at no cost

\*Based on Florida production results and total acreage of water column aquaculture leases in the state over 2023 obtained from the Florida Department of Agriculture and Consumer Services .



# A tool in our toolbox



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Thank you!





Give it a try!

# FLORIDA SHELLFISH FARM NITROGEN CALCUALTOR

This calculator estimates the amount and potential monetary value of nitrogen removal services that your shellfish farming activities provide

GET STARTED

Try it out: <https://ufl864.outgrow.us/ufl864-2>

