RESTORATION AQUACULTURE

An Ecosystems Services Approach to Water Quality Enhancement

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Coastal Issues, Marine Solutions

- Problems
  - Land based pollution
  - Atmospheric Carbon
  - Sea Level Rise
  - **Harmful Algal Blooms**
- Solutions
  - Nutrient Reduction
  - Carbon Sequestration
  - Wave Attenuation
  - **Water Quality Improvements**

Species as the Solution

Sponges, Coral, Macro-Algae, Bivalves

Provide an understanding of…

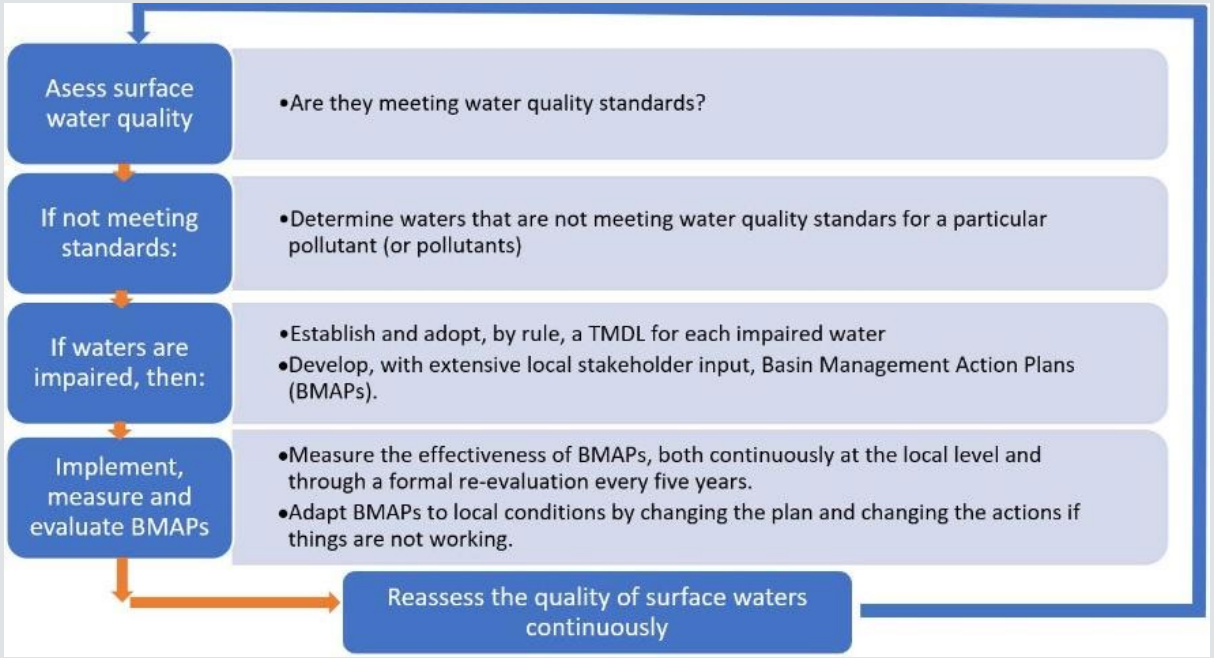
- what restoration aquaculture is
- how aquaculture works in today’s legal landscape
- how ecosystem services may be effectively valued in Florida

Types of Restoration Aquaculture

Conservation	*Regenerative*	*Mixed*
• Focused on species • Habitat restoration	• Highlights ecosystem services • Outcome driven	• Highlight species and benefits • Integration with current aquaculture programs • Multi-trophic

Legal Framework: Driver of Water Quality Improvement

- Clean Water Act
  - Water Quality Standards
  - Determines Impairment
  - TMDLs - Total Maximum Daily Loads
  - Basin Management Action Plans
- Sovereign Submerged Lands
  - *Public Trust Doctrine*
- State Regulatory Agencies
  - DEP:
    - Sets standards
    - Runs current market
  - FDACS
    - Aquaculture leases



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Filtration Service for Oysters

Why Oysters?

- Filter 60% GTM in 12.6 days
- Filtration services varied greatly depending on spatial distribution (Gray, 2021)

How to quantify?

- In-water monitoring
- Per oyster
- Per acre

https://shellfish.ifas.ufl.edu/environmental-benefits/

Oyster Credit Categories	Size Class (Inches)	Diploid (g/oyster)		Triploid (g/oyster)	
		Nitrogren	Phosphorous	Nitrogen	Phosphorous
Small:	2.0 - 2.49	0.05	0.01	0.06	0.01
Medium:	2.5 - 3.49	0.09	0.01	0.13	0.01
Large	>3.5	0.15	0.02	0.26	0.03

CREDIT GENERATION FAQ: OYSTER AQUACULTURE January 2020

Other Ecosystem Services Have Value

- Other Nutrient filtration
- Carbon Storage
- Habitat development
- Wave attenuation

Forms of Ecosystem Service Payments: Subsidies, Taxes, Fees, Credits

Subsidies

- Gov't programs; grants; voluntary contributions
- Pay people to grow species of value
- Unpopular at scale, not a "market" solution

Taxes

- Well understood
- State, county, municipal level
- Constitutionally restricted; may require legislation
- Can be difficult politically

Fees

- Those using should help pay for it (polluter/user pays principle)
- Boaters, Restaurants, Licenses
- Agencies and local governments can enact
- Potentially less revenue

Voluntary Nutrient Credit Trading in Florida

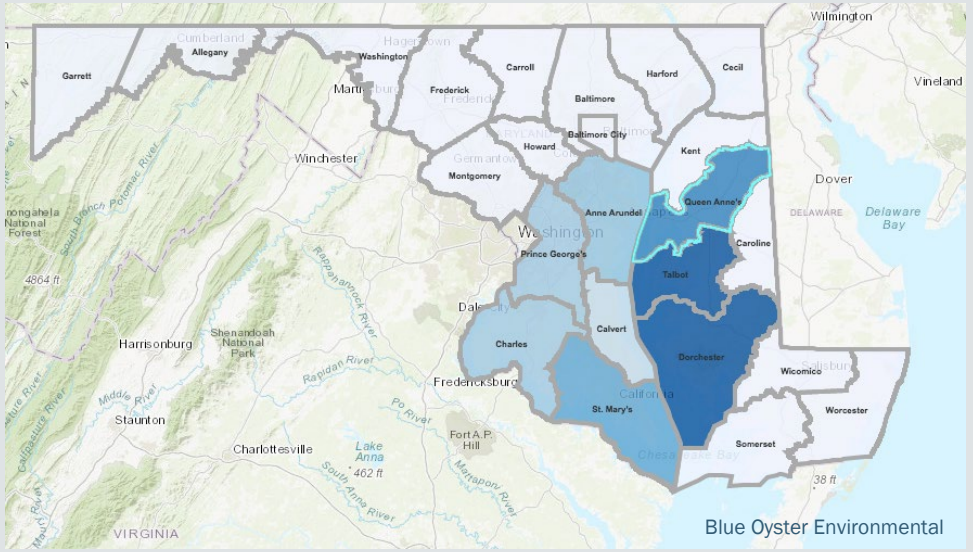
- FS 403.067: Voluntary nutrient credit trading program
- St. Johns River Basin
- NPDES Permitted Entities
- Reductions from baseline
- Offset, not necessarily improvement
- Issues for aquaculture integration
  - Basin definition
  - No baseline

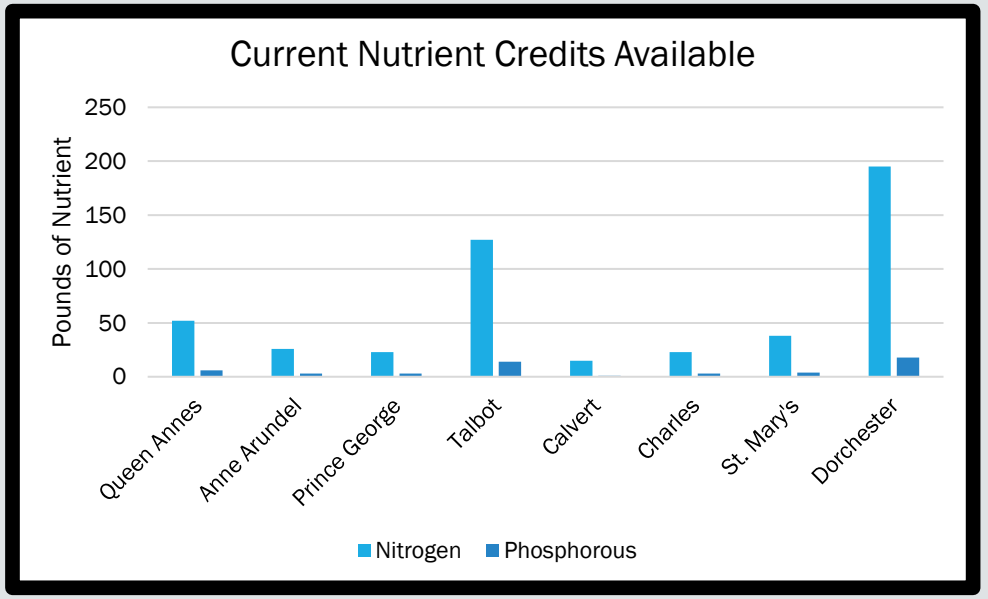
Calculating the Value

- Converting the quantified service to dollars, $/amount of nutrient removed from water
- Market forces dictate the price
- N: $0.11 - $28.23 USD kg^{-1} (*Alvia, Larkin, Grogan et al.*)

Case Study: Chesapeake Bay

- Robust nutrient credit trading system in place
- Different methods for different polluters
- Maryland: Oyster Trading Has Occurred
- Growers can sell credits directly or through an aggregator
- Blue Oyster Environmental





Risk

- Environmental catastrophe
- Able to classify likelihood?
- Liability if credits have been sold
- Maryland:
  - credits vest when oyster is taken out of the water
  - 5% of nutrient credit is banked as a buffer
- What if we want to capitalize on other ecosystem services?

Private Markets

- Credits generated by oyster farmers, quantified by 3rd party
- Sold to private entities
- Attractive to corporate sustainability goals
- Can be voluntary
- Electric Power Research Institute: Ohio River

Further Questions

The state of the science	• Measuring site specific nutrient uptake • Role of Denitrification • Calculating credit value
Matching geographies	• Determining appropriate watershed scale • Linking land-based sources to impaired waters
Species overrepresentation	• Other species exclusion • Habitat replacement/exclusion
Jurisdictional overlap	• Mesh of systems for food production and environmental protection
A question of scale	• How many individuals are necessary to make a difference? • Are 1 billion clams enough?

Conclusion

- Restoration Aquaculture can be part of the solution to Florida's water quality issues.
- Site specific science needs to be further developed.
- Administrative framework must be fully built out.
- Economic valuation must be demonstrated and established.
- The question of scale must be answered.

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What we are doing about it.

TNC funded ‘SOARS’ project: Dr. Ashley Smyth, Lead Investigator

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NOAA funded ‘Creating Community of Practice’: Josh Patterson, Tom Ankersen, Matt DePaolis et al., Florida Sea Grant

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Questions?

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