

Working with Shellfish for Nitrogen Mitigation (The Cape Cod experience thus far)

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Josh Reitsma
Cape Cod Cooperative Extension
& Woods Hole Sea Grant



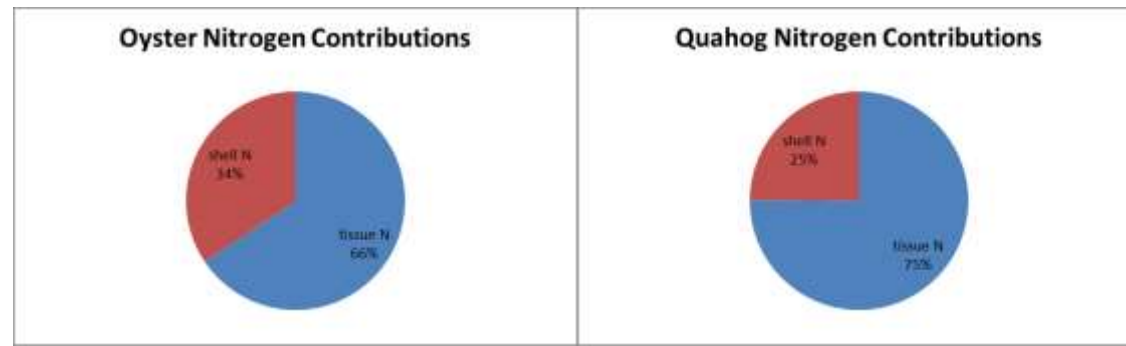
Cape Cod's water problem...

- Excess nitrogen (N) is deteriorating marine water quality
 - Water quality standards for wildlife habitat being exceeded
 - 80% from septic-wastewater
 - On average 50% removal to meet standard
 - Population is up (steep increase since 1960, 4x increase)
- 208 plan update in 2015 to address issue – region wide
 - Series of approaches, traditional and non
 - Provide management strategies for consideration
 - TMDL info based on Mass. Estuaries Project (MEP) monitoring
- Shellfish aquaculture one of 20+ potential methods for consideration



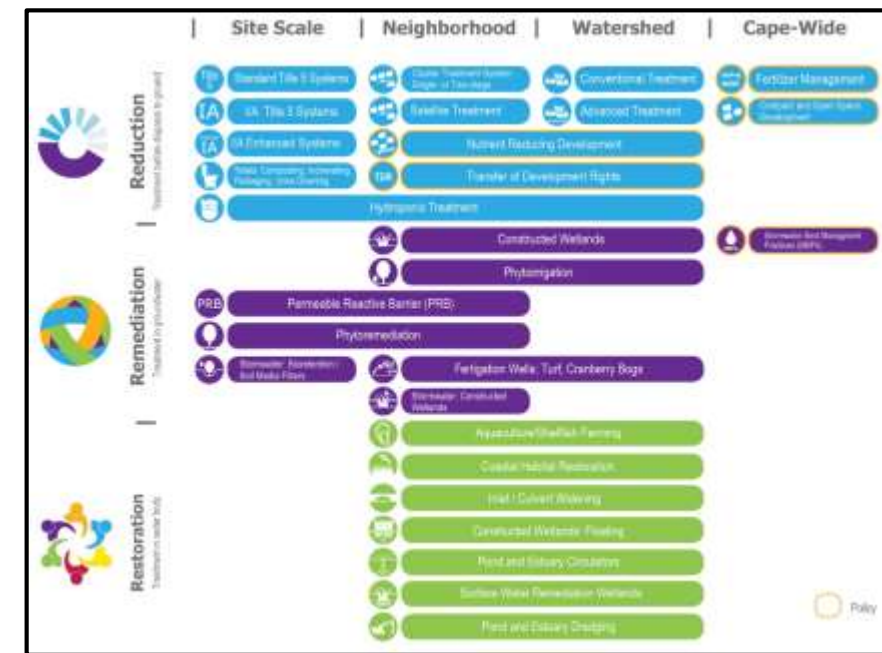
Quantifying the nitrogen extraction potential

- Extension looked harvestable shellfish – oysters and quahogs
- Looked at a range of water bodies, culture conditions, season
 - <http://dx.doi.org/10.1016/j.marpolbul.2016.12.072>
- There is some variability – SIZE, season, culture conditions
 - Avg market bound littleneck or oyster 0.2-0.3g N
- Isotope analysis – N source link to us (nutrients from us)
- Provided some review of denitrification science – variable
 - Needs further study



208 Technologies Review

- 2017 panel reviewed shellfish and PRB technologies
- Hope was to clarify numbers from pilot projects
- Updated numbers but a range was best
- Every project will be different depending on approach
 - Species
 - Size – full grow out or relay after a season
- Denitrification with sediments unlikely to be approved at this time
 - Just harvest of N through harvest of shellfish
- Shellfish culture/harvest still in pilot phase but can be an approved technology



A close-up, high-angle photograph of a large pile of oyster shells. The shells are densely packed, showing various shades of brown, tan, and grey. Some shells are open, revealing the interior, while others are closed. The texture is rough and uneven.

Projects currently using shellfish

- Falmouth – Little Pond
- Orleans – Lonnie's Pond
- Mashpee – town wide
 - Comprehensive Wastewater Management Plan - shellfish an approved part

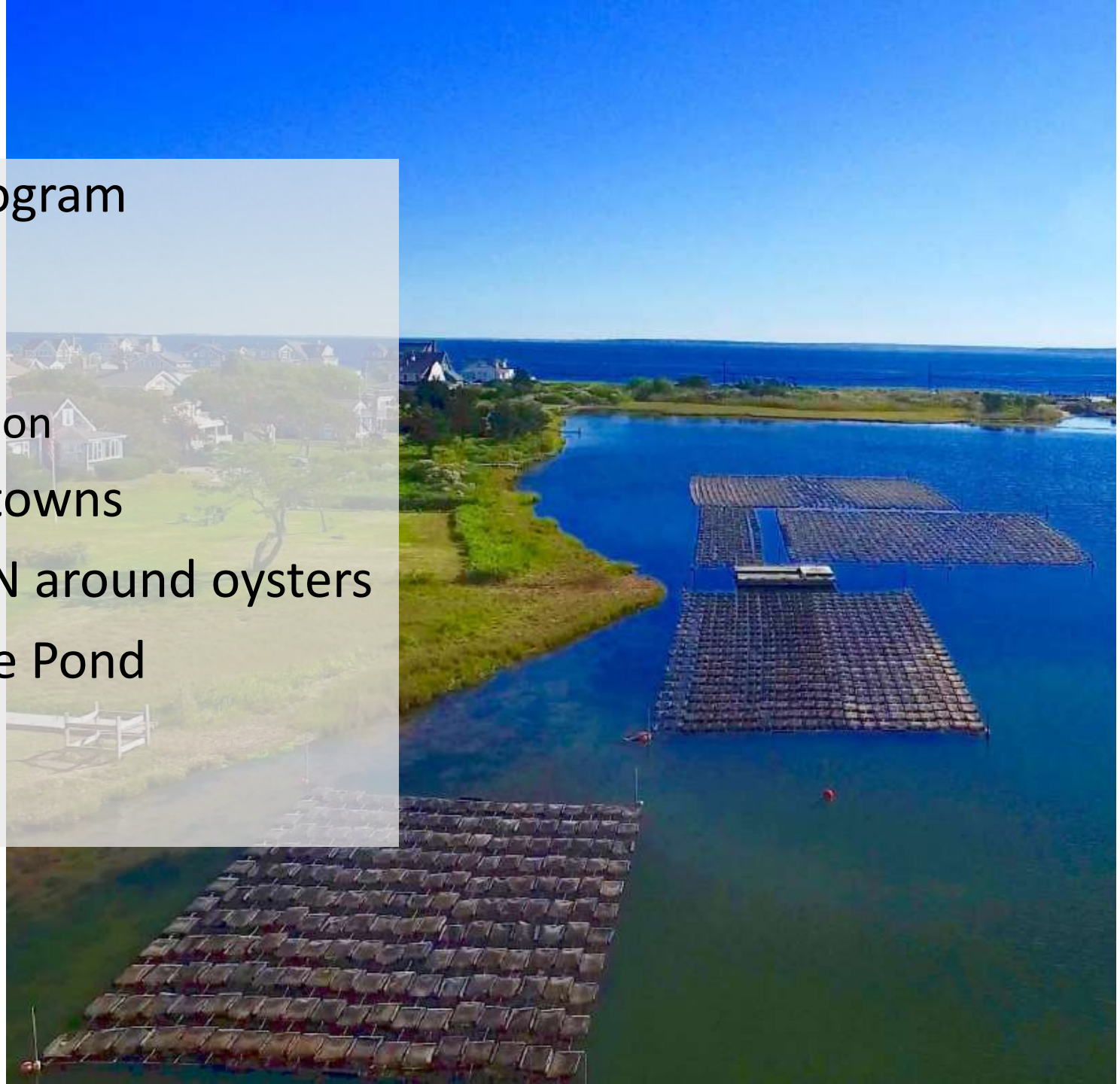
Falmouth – Little Pond Pilot

- Degraded estuary with lots of development
- Planted 1.5M oyster seed in 2013 ramping up to 3M 2017
- 9 upwellers to floating oyster bag array
 - 4500 bags!
- 1 season of growth then relay to other areas – fishery enhancement



Falmouth – cont.

- Very successful propagation program
- Good outreach with neighbors
- Cost ~\$250k per year
 - Mostly staff, 4-5 for growing season
- Selling some big seed to other towns
- Modest clearing of particulate N around oysters
- Target is 10-20% of load to Little Pond
- Still a pilot



Orleans – Lonnie's Pond Pilot

- Smaller estuary off Pleasant Bay
- Targeting 100% of 300kg N if possible
- Working with 4500 floating bags in an acre
- Scaling up to 2.7M oysters in year 3 of pilot
 - \$200-300k per year
- Locally reduced particulate N (algae)
- Town would like to have industry take over
 - After pilot is complete
 - Not cheap, don't have the staff
 - Ideally as a nursery site with sale of seed or relay after one growing season
- Still working with DEP for approval



Mashpee

- First to have shellfish culture/harvest approved in CWMP
 - <https://www.mashpeeema.gov/mashpee-water/watershed-nitrogen-management-plan/pages/final-recommended%20A0-planfinal-environmental>
- Started in 2004 with 160 bags of oyster remote set to 2000 bags/year
 - Mashpee River – harvest 100-500k oysters per year mostly recreational
 - Target 10% of N load
- Quahogs – most of the other program areas
 - 1M to 3M to 5M to 8M (last year) and 10M this year
 - 10 upwellers and some field nursery trays
 - Initial plan called for buying large quahog seed – not doable
 - All for fishery enhancement – mostly commercial
- Also trying to include private shellfish farms



Mashpee - continued

- Still awaiting comprehensive water quality info
 - Should start seeing results in next year or 2?
- Mashpee River had fish kill in 2005
 - No fish kills since significant oyster planting
 - DO does not go below 2mg/L anymore
- Quantifying rec harvest with game cameras at landings
 - Review video and estimate shellfish quantity in buckets/baskets
 - In addition to sporadic spot checks
- Will continue ramp up
 - “Plan B” was required in CWMP in case shellfish does not work out



Universal Challenges thus far...

- Conclusive data...still waiting on the official success story
- Staffing for municipal oversight
 - Always complaints of being short handed
- How does private aquaculture fit in?
 - Public-private partnership needs to be worked out
- Seed availability, and sometimes quality
- Fiscal resources for gear and staff
 - Enforcement need increases
- Scaling up takes longer than expected



Other Challenges-Risks

- Predators
 - Crabs with quahogs – trapping programs seem to help
 - Drills with oysters planted on bottom
- Mortality events
 - Disease: MSX, Dermo, QPX, neoplasia
 - Could new diseases emerge?
 - Ice and storm loss
 - HAB's



Other Challenges-Risks

- Social acceptability of use of space
 - User conflicts
- Harmful algal blooms and harvest closures
 - Affect harvest and market
- Market Challenges
 - Oysters too big or too ugly for half shell market
 - No harvest...no credit



Is Assumed Market a Risk With These Programs?

- Oyster aquaculture is growing everywhere
 - Steady growth
 - 95+% of cultured shellfish are oysters
 - Steady market that has been built for high end raw bar
- Similar growth up and down East Coast
- Will there be a saturation point???

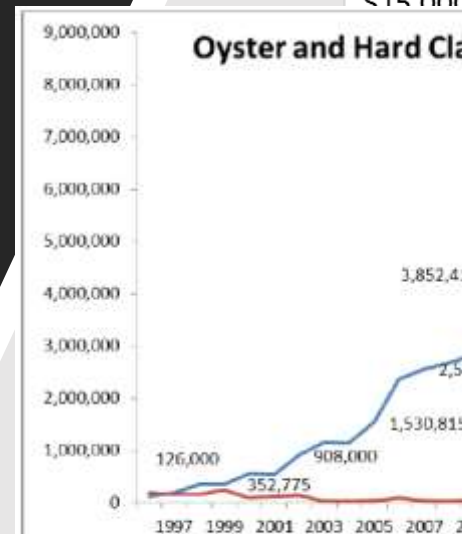
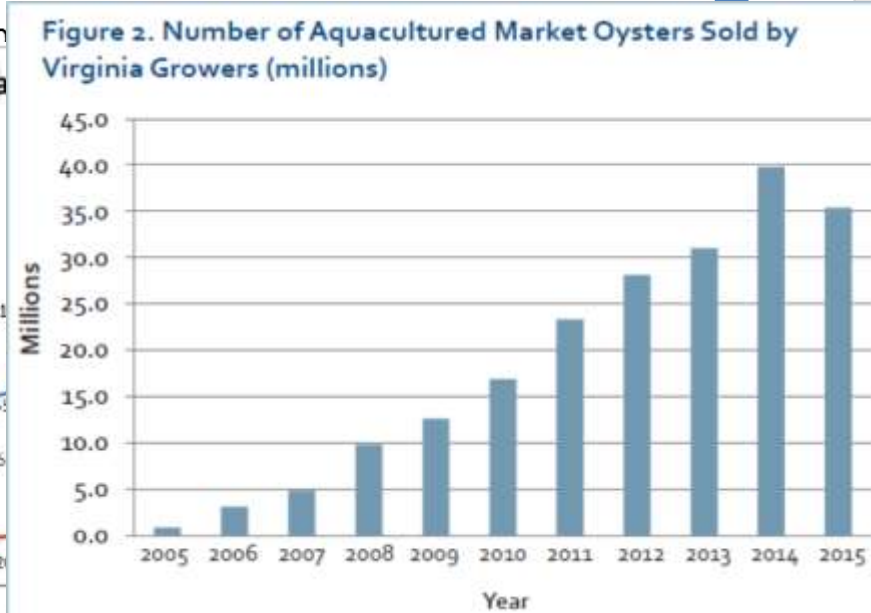


Figure 3.
The American oyster remains Rhode Island's dominant shellfish product.



Consideration for diversifying markets...

- Shucked or value added products
 - Avoid diluting the growing farmed oyster industry
 - Can harvest at larger sizes
 - More Nitrogen removed through bigger oysters
 - Less concern over time of year for harvest
 - Less stringent Vibrio controls
 - Can arrange harvest period for maximum N remediation and off-season for harvesters
- Increased volume of nitrogen remediation oysters could benefit with alternate market!
- But we have no infrastructure...



Preliminary Conclusions

- We have some solid pilot programs/projects going
- Time will tell how effective they are at reaching targets
- Nobody is approaching this as the sole solution to N issues
- Municipal shellfish programs have challenges/opportunities
 - Best suited to meet the town/publics goals (rather than profit driven)
 - Already know the waters and history
 - But need to really scale up to meet WQ goals
- Municipal shellfish programs should be engaged early
- Growing shellfish requires resources!



Acknowledgements

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