Tools to Measure the Water Quality Benefits Provided by Oysters and Other Bivalves

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Aquaculture Growers Forum

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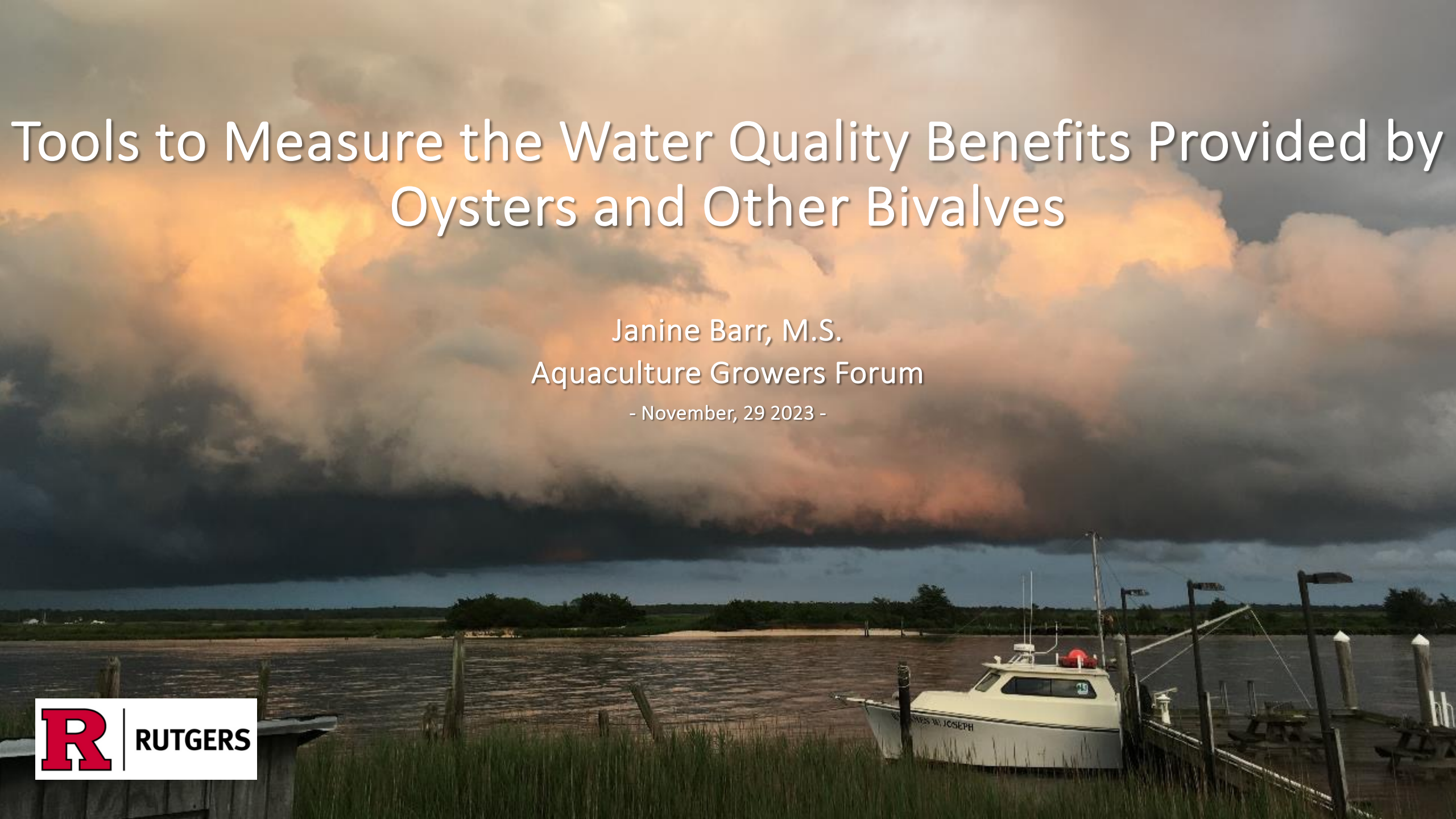


RUTGERS

What is an Eastern oyster?

- Marine bivalve
  - Canada through Gulf Coast
  - Found on reefs and farms

Oysters and Water Quality Benefits

- Suspension feeders
- Oysters are a tool in the nutrient mitigation toolbox
- 85% decrease in oyster reefs in the past 130 years
  (Beck et al. 2011)

Scale of water quality benefits provided by oyster farms are not well understood.

Ecosystem Service Value

- Chesapeake Bay TMDL (Maryland and Virginia)

- Bioextraction vs. Filtration

How can we use science to improve local water quality in the Mid-Atlantic and help farmers' bottom line?

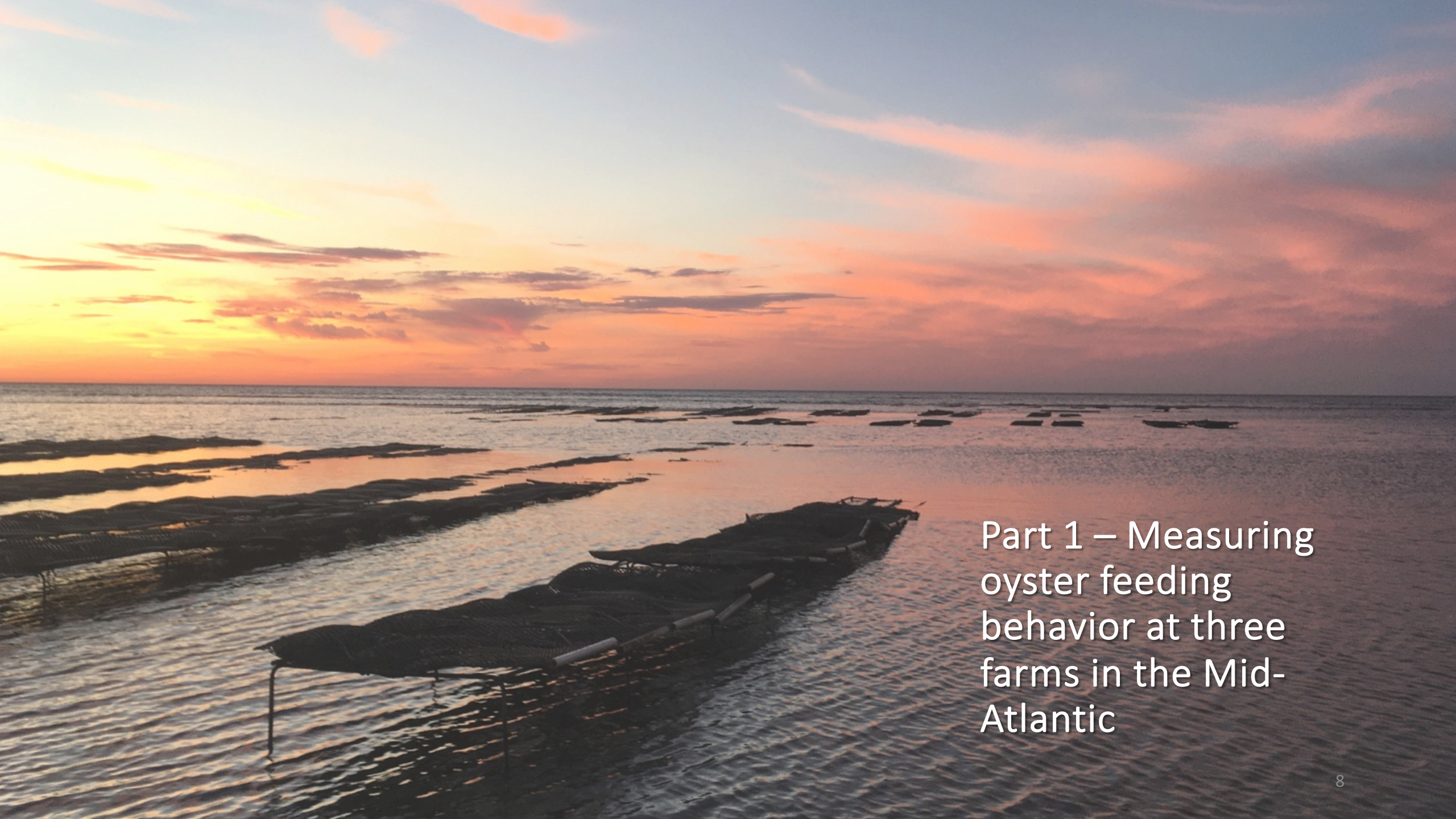
Estimate how much "stuff" oysters filter from the water column: annually, seasonally, and daily.

Presentation Overview

Part 1 – Measuring seasonal water quality improvement at **three oyster farms** in the mid-Atlantic.

Part 2 – Tools available for estimating water quality improvements generated by shellfish.

Part 3 – Next steps for the Rutgers Oyster Water Quality Benefits Calculator



Part 1 – Measuring oyster feeding behavior at three farms in the Mid-Atlantic

Farm Locations

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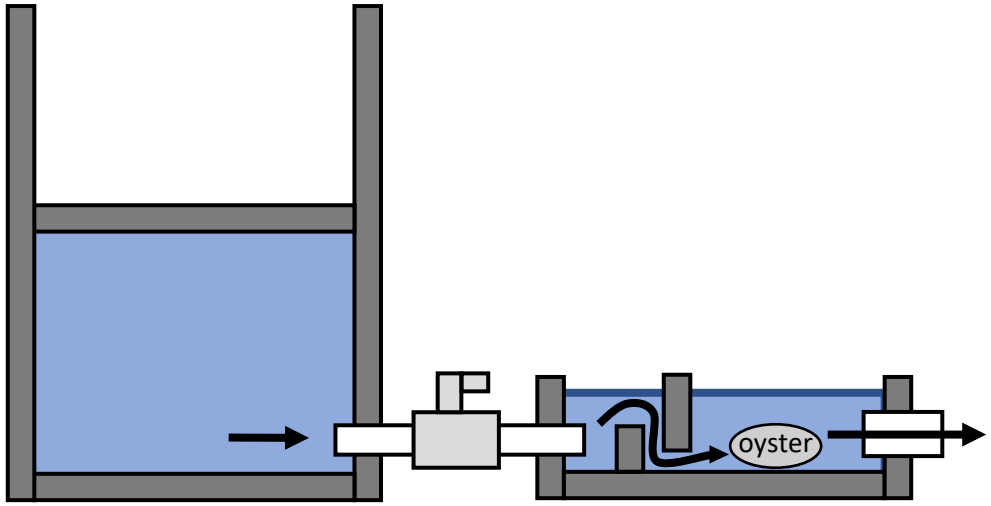
Barnegat Bay (n=3)

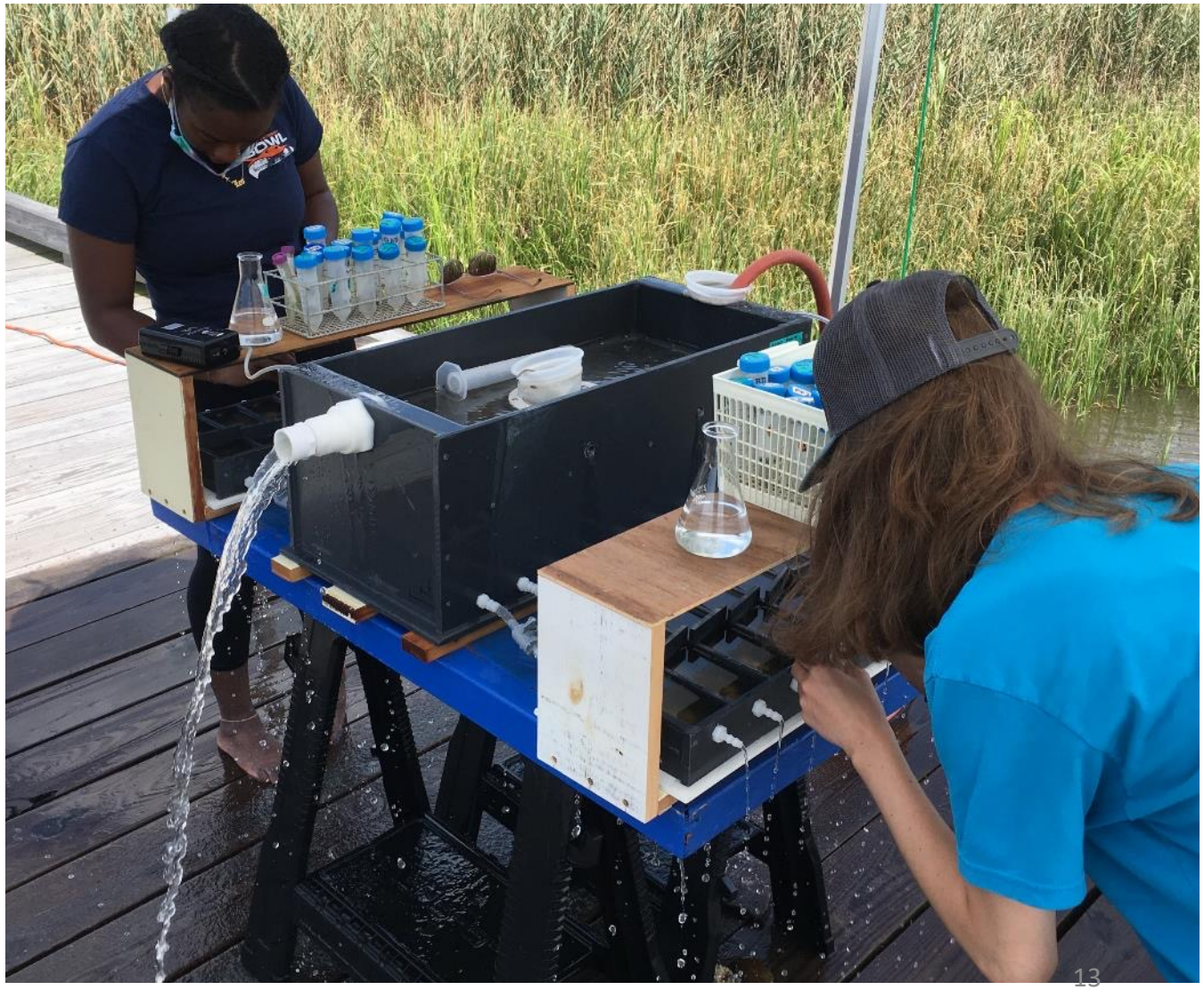
Delaware Bay (n=4)

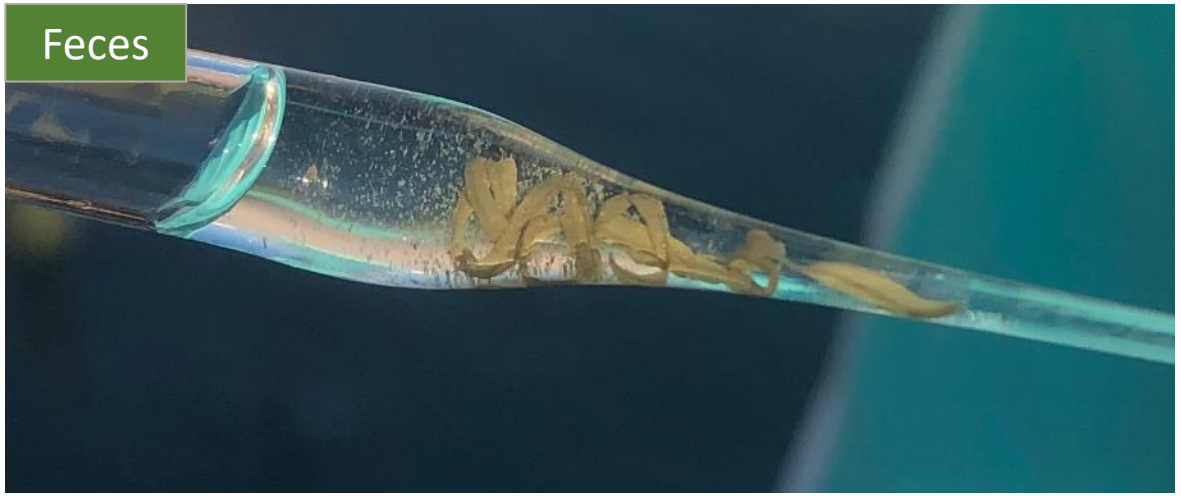
Rehoboth Bay (n=4)

Oyster Farm Methods



Galimany et al. 2018





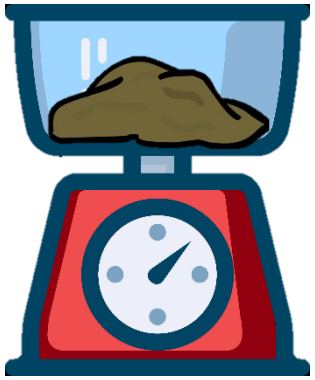
Iglesias et al. 1998

Key Environmental Parameters

- Water Temperature (Temp)
- Salinity
- Total Particulate Matter (TPM)
- Organic Content of TPM (WC.Org)

Measuring time it takes oysters to digest food.

Key Physiological Parameters

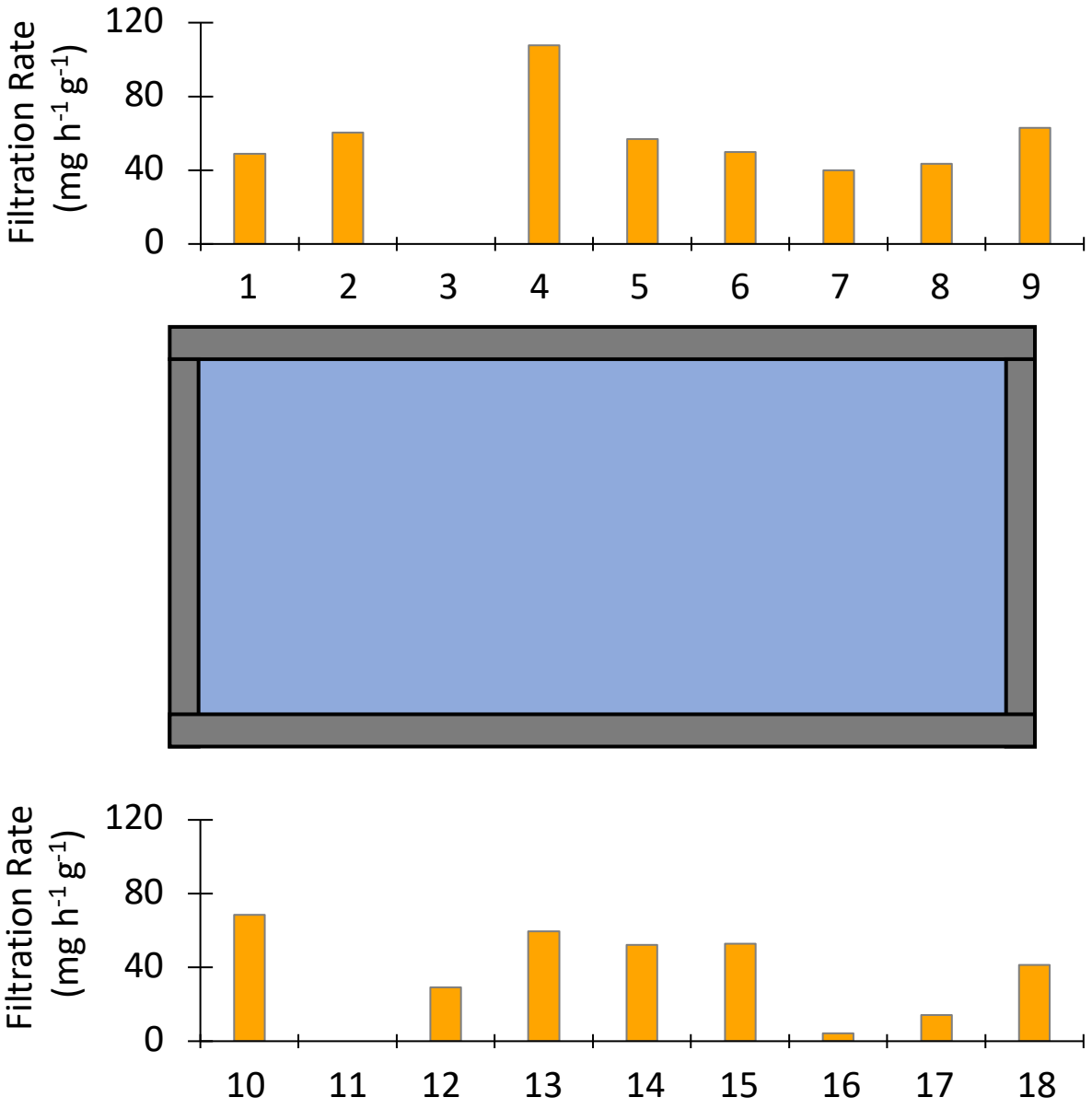


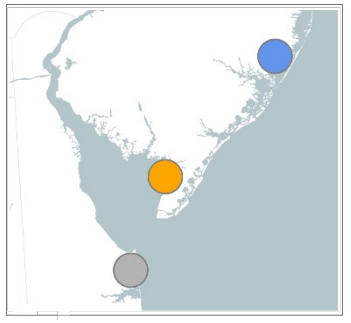
Filtration Rate

Clearance Rate

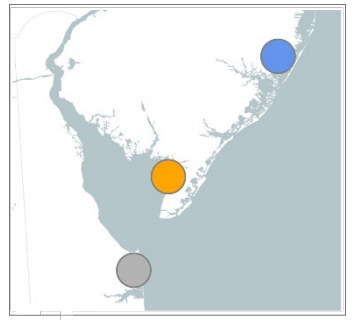
Biodeposit Rate

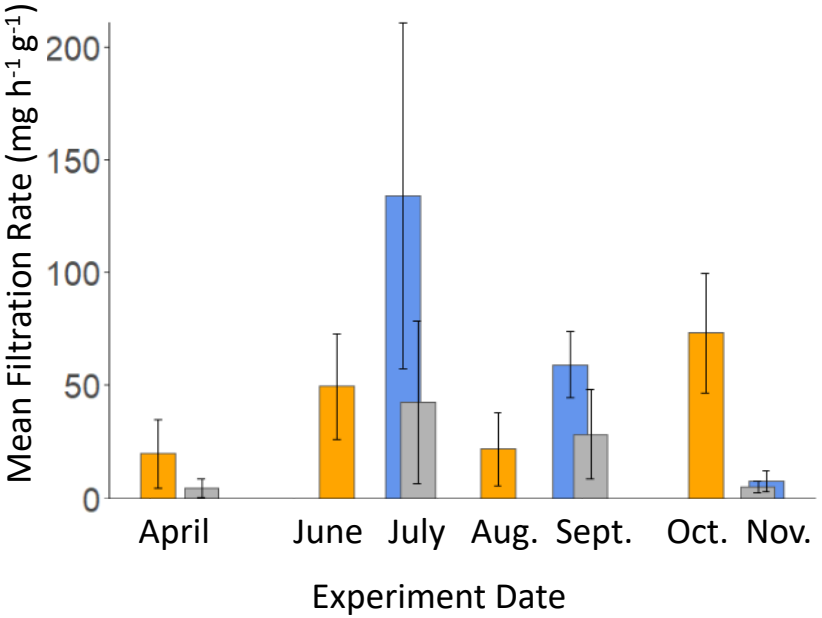
Delaware Bay Oysters - Filtration Rate





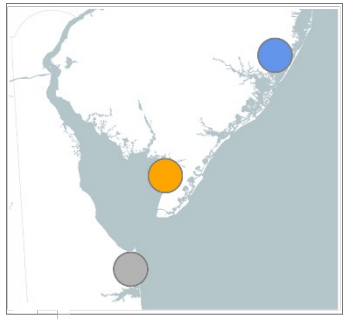
Results - Filtration Physiology





Location: Barnegat Bay Delaware Bay Rehoboth Bay

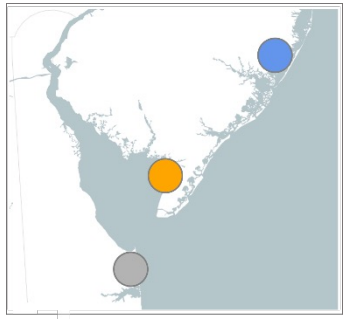
What was the estimated water quality impact of these farms?



Farm Location	Number of Olympic Sized Pools Cleared (10^9 L per yr)	Particles Filtered (tons per year)	Mass of Deposited Pseudofeces (tons per year)
Barnegat Bay	2.4	78.9	62.1
Delaware Bay	0.8	43.8	36.4
Rehoboth Bay	1.2	32.5	20.2

*water quality benefits estimated for a full calendar year
*last column is not total biomass production

How do these oysters compare to the often sited “an oyster can filter up to 50 gallons per day” stat?

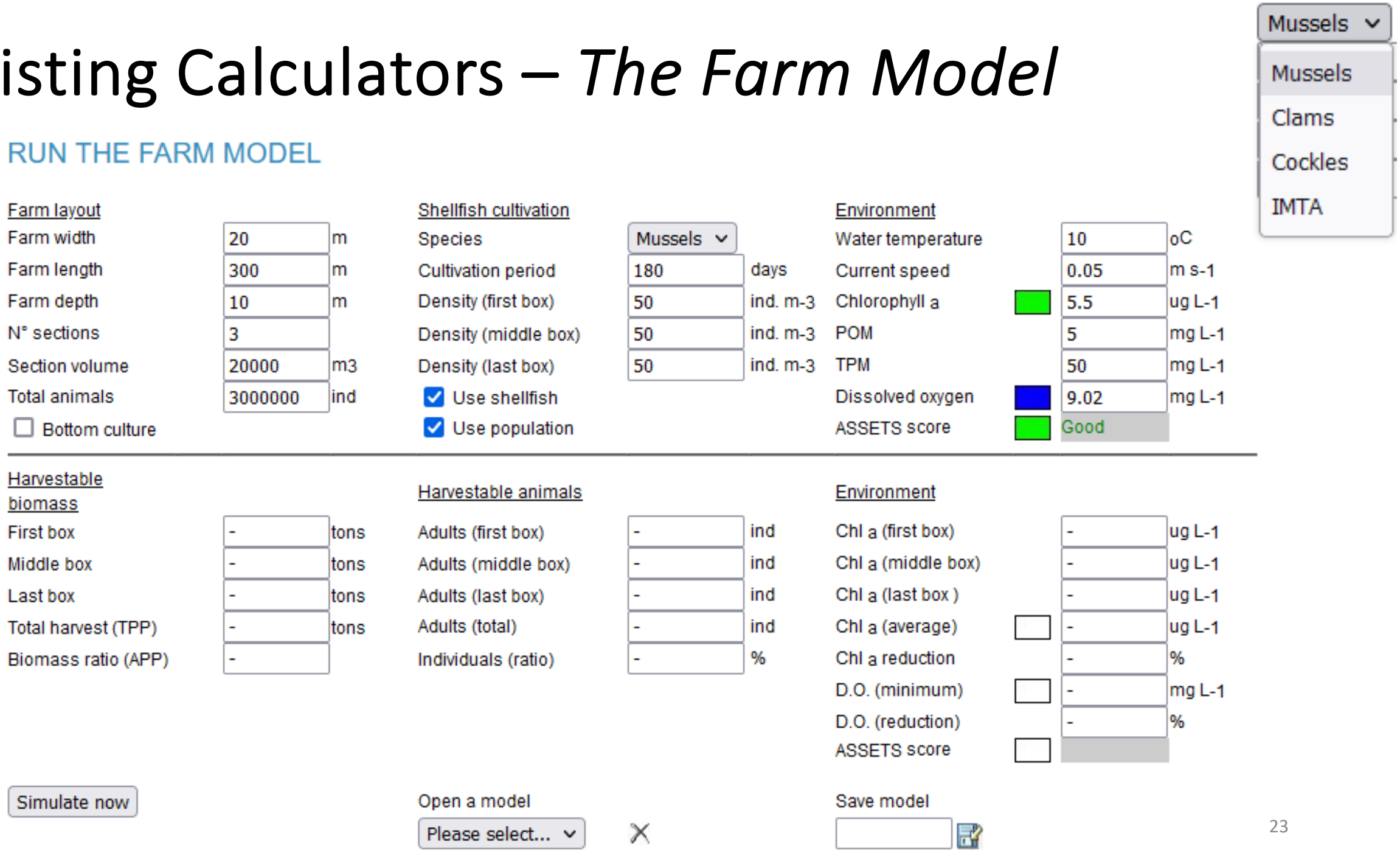


Farm Location	Spring (gal day^{-1})	Summer (gal day^{-1})	Fall (gal day^{-1})
Barnegat Bay	----	16.8 (34.1)	3.5 (9.5)
Delaware Bay	5.7 (17.2)	3.4 (10.3)	4.3 (7.7)
Rehoboth Bay	1.8 (4.0)	9.4 (28.2)	3.2 (7.3)

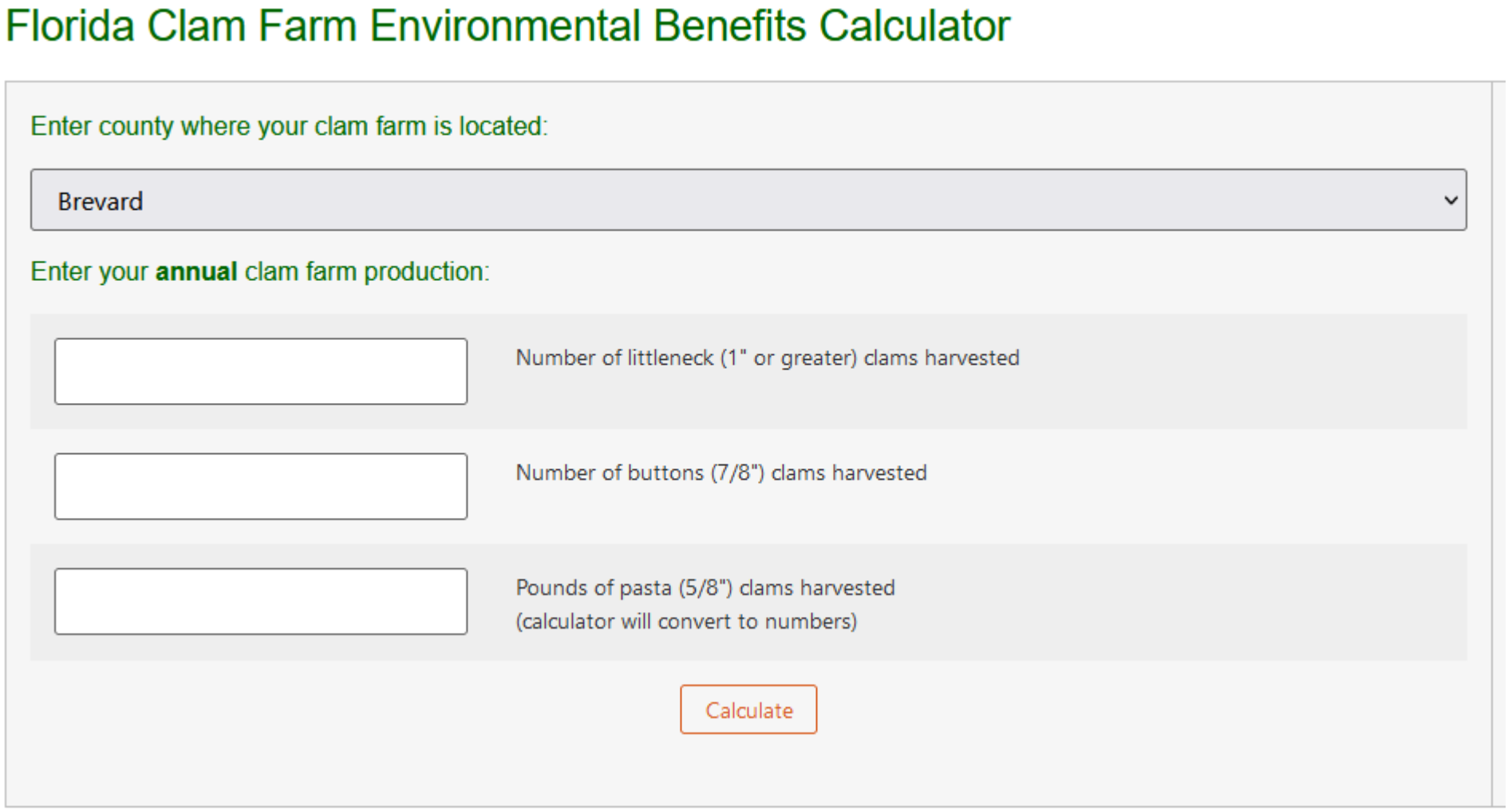
*values reported as the mean and (maximum) volume of water cleared by individual oysters at each farm location and during each season

Part 2 – Tools for estimating water quality benefits provided by shellfish

Existing Calculators – *The Farm Model*



Existing Calculators – *University of Florida*



*estimates nitrogen removal and carbon sequestration of clams

*should be used as "a starting point" for understanding potential ecosystem benefits of clams

Existing Calculators – *The Nature Conservancy and NOAA*

Delaware Bay, NJ

To use the calculator, first select a bay location from our database. If using your own site, select the closest site within our database to load oyster mass formula and fish benefits data.

Select site | Reset data

BAY PROPERTIES

Bay Volume: 12668400 1000m^3

Residence Time: 8 days

Temperature: 22.18 °C

Current Reef Area: 11471 ha

CURRENT OYSTER PROPERTIES

Mean Oyster Length (< 76mm): 51.98 mm

Mean Oyster Length (≥ 76mm): 86.7 mm

Mean Oyster Density (< 76mm): 13.14 ind/m^2

Mean Oyster Density (≥ 76mm): 2.36 ind/m^2

GOALS

Estuary Filtration Percent: 50 %

Mean Oyster Length

An estimated **12%** of the bay is currently filtered by oysters. To increase the filtration of the bay to **50%** will require **0 ha (0 ac)** of restored habitat.

Filtration | Fish Production

ESTUARY FILTRATION

Estuary filter volume
66.0 B L/h

Historic filtration
24.0 B L/h (36%)

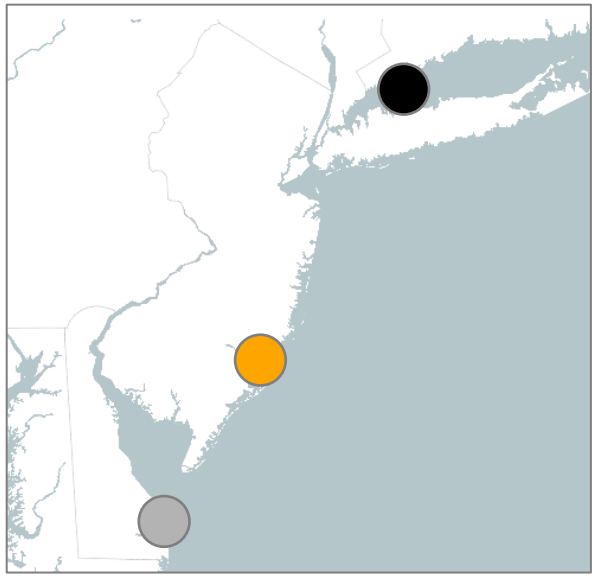
Current filtration
7.6 B L/h (12%)

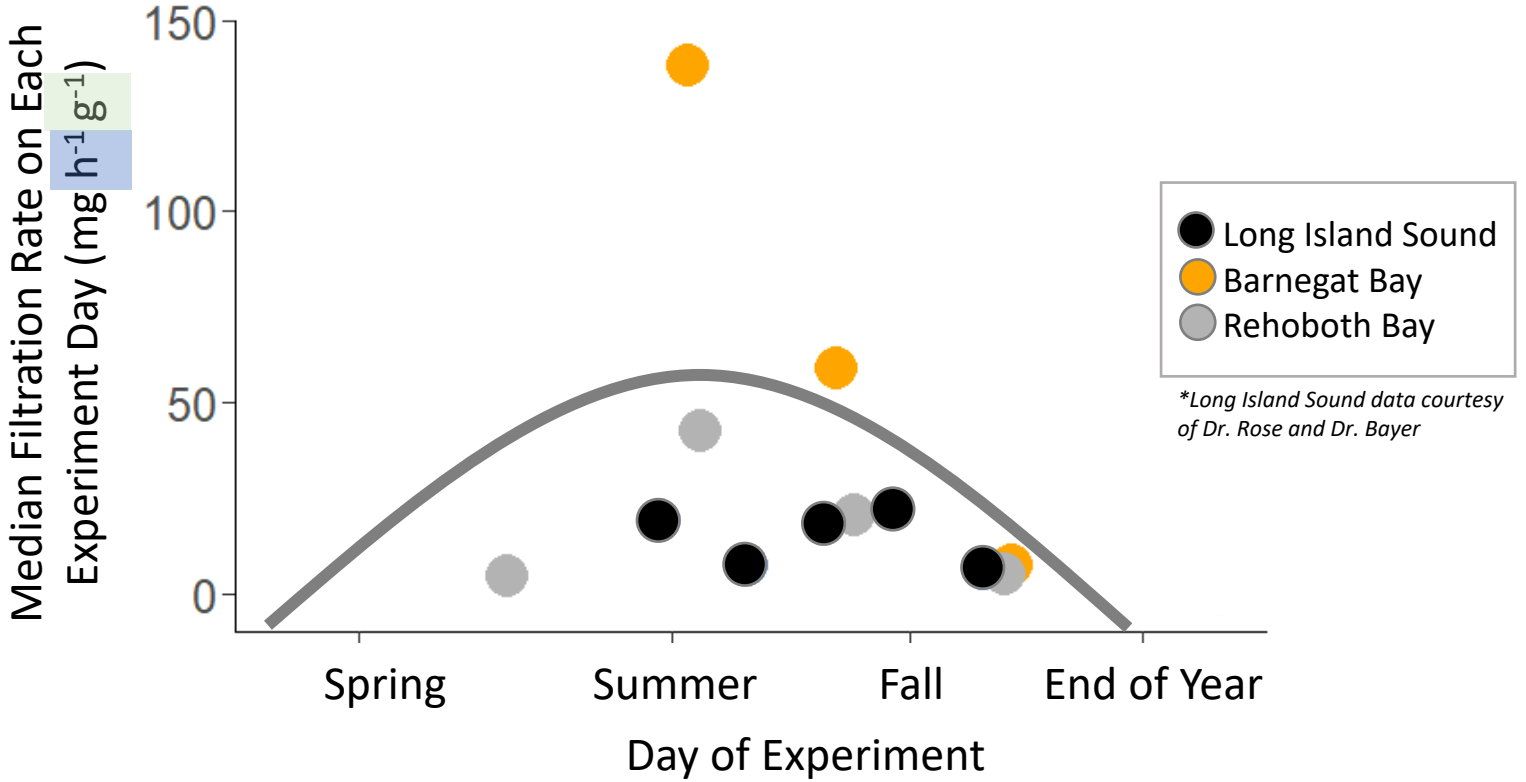
Goal data, including estuary filtration goals and fish production, is not shown until at least one goal oyster length and density is entered. All calculations are estimates only, based on an extensive literature review.

Ecoregion
Virginian

Oyster mass to Length formula
Bushek unpublished data
0.00003*Length^2.4503

Rutgers Oyster Eco-Serve Calculator - Methods





Milligrams of “stuff” an oyster filters per hour per gram of try tissue weight

each day for all the oysters on a given farm

Part 3 – Next Steps

- Gather input on, and publish, the calculator
- Develop calculator 2.0

ACKNOWLEDGEMENTS

Existing Calculators

- The Farm Model - http://www.farmscale.org/
- University of Florida - https://shellfish.ifas.ufl.edu/farm-benefits-calculator/ (and background information here: https://shellfish.ifas.ufl.edu/environmental-benefits/)
- The Nature Conservancy and NOAA - https://oceanwealth.org/tools/oyster-calculator/

Research and Calculator Team

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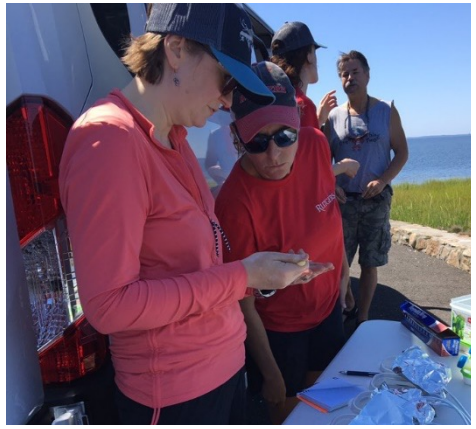






Collaborators and Funders

Collaborators

- Farmers:
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  - Mark Casey and Brent Hott
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Thank you!!

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