"Green" Clams

Assessing, Quantifying, and Promoting the Value of Ecosystem Services Provided by the Hard Clam Aquaculture Industry in Florida

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Introduction: Ecosystem Services

- Transformation of natural assets supplied by ecosystems into beneficial goods and functions that humans value
- Those generated by bivalves are widely acknowledged, but not well-quantified or valued for most specific populations
  - Values depend on location
  - Requires site-specific studies for validation and use in decision-making

References: Chan et al. 2006, Cloern 1982, Officer et al., 1982, Shumway et al., 2003, Newell 2004

Introduction: Ecosystem Services (ES)

- Bivalves and shellfish farms are ecosystem service providers
  - Regulating services: Improve water quality / Store carbon
  - Supporting service: Nutrient cycling
  - Provisioning service: Provide food
  - Cultural services: Recreation, ecotourism, and heritage
- ES have not been quantified or valued for the Florida hard clam farming industry
  - Provides over 600 jobs and produces 180 million clams annually
  - Economic impact of $53 million estimated in 2007 (Adams et al. 2008)




OBJECTIVES

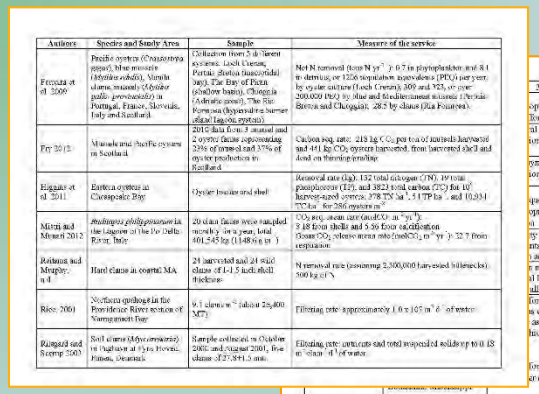
- Conduct literature reviews
- Identify and address ecosystem services information gaps
- Determine feasible range of ecosystem values
- Disseminate research results

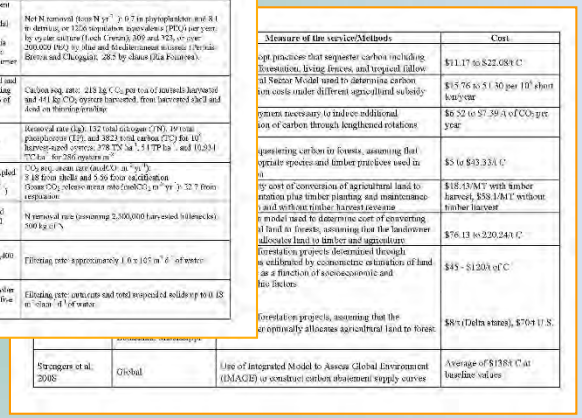
Conduct Literature Reviews

- Searched literature for information
  - ES provided by shellfish
    - Clam farming in particular
    - ES related to nitrogen removal and carbon storage
  - ES valuation associated with bivalve culture
- Used search engines:
  - Web of Knowledge
  - Google Scholar
  - Science Direct
  - Springer Link

Conduct Literature Reviews

- Information on ES summarized and reported include
  - Bivalve species
  - Ecosystem service
  - Unit of analysis
  - Quantitative measure of service
  - Valuation associated with bivalve culture
    - Valuation of ecosystems
    - Valuation of ES from bivalves
    - Studies on carbon storage by timber rotation
    - Nitrogen removal from wastewater
    - Nitrogen abatement costs



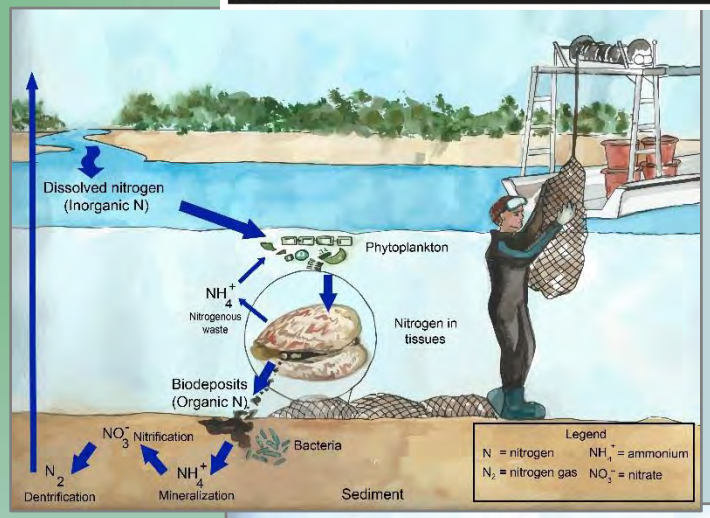


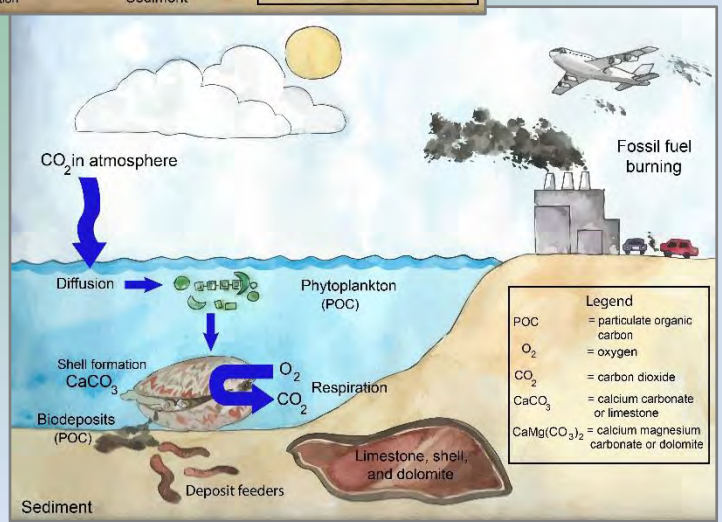
Reviews can be accessed at website:
http://shellfish.ifas.ufl.edu/environmental-benefits/

Address ES Info Gaps

- Examined three environmentally beneficial ES provided by clam farming
  - Water filtration
  - Carbon (C) storage
  - Nitrogen (N) removal
- Identified key ES knowledge gaps in literature
- Measurements not available for harvest-sized clams at water temperatures found in Florida

Water filtration video, N and C cycle illustrations can be accessed at website:
http://shellfish.ifas.ufl.edu/environmental-benefits/





Address ES Info Gaps

- Conducted laboratory measures to address information gaps
  - Clearance (filtering) rates measured as decrease in light absorbance of algal and detrital suspensions using fiber-optic colorimeter
  - C and N amounts determined by measuring contents of clam tissue and shell using stable isotope mass spectrometry
- Other measures determined
  - Nitrogen excretion
  - Oxygen uptake / respiration

References: Baker and Hornbach 1997, 2001, 2008; Dame 1996; Engleman et al. 1985; Hornbach et al. 1991; Verardo et al. 1990

Address ES Info Gaps

- Clams incorporate N from their food (phytoplankton) into tissues and shell
- Clams also store C in shells and tissues, but also process $CaCO_3$ while they grow
- At harvest, accumulated N and C is removed from the water
- N and C extraction values determined and used in valuation

Clam Grade	Shell Width (inches)	Shell Length (inches)	Water Filtration (gal/day)	N Removed (grams)	C Stored (grams)
Littleneck	1.03	1.88	4.5	0.09	2.76
Button	0.92	1.67	3.5	0.07	1.97
Pasta	0.80	1.49	2.7	0.06	1.37

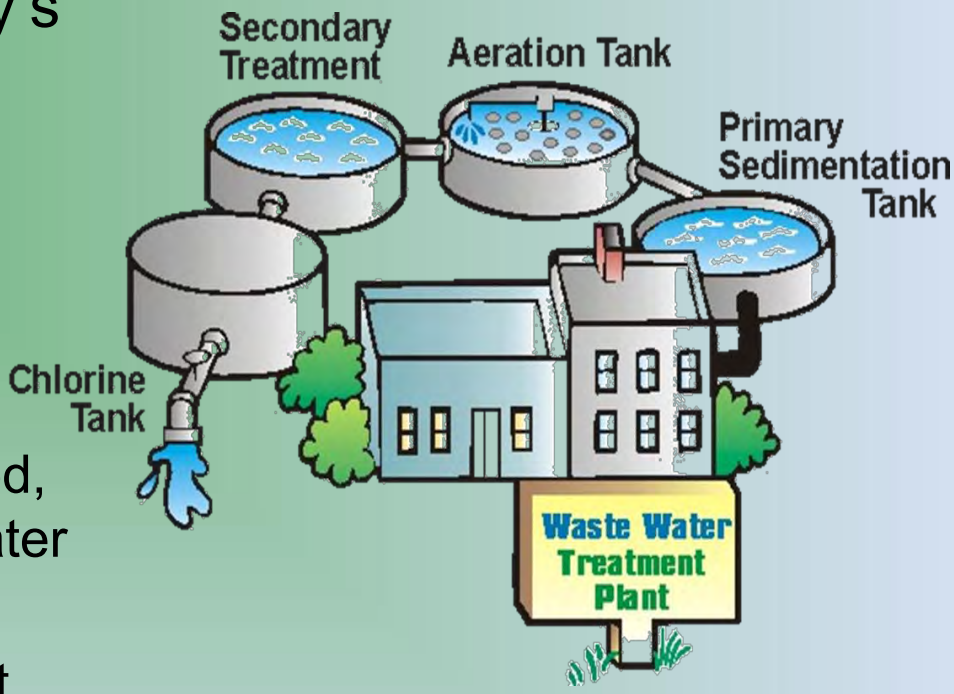
Valuation of ES provided by Clams

- ES provided automatically as a result of natural functions
  - "Free goods" that society does not have to pay for
  - Un-priced and at risk of being lost when ecosystems are lost or degraded
- Accepted methods used for estimating monetary value of ES

- Replacement cost method uses market information to obtain a conservative estimate of a feasible alternative
  - Quantity of ES is determined; then cost of providing service with human-made alternatives is estimated (e.g., wwt plant, planting new trees)

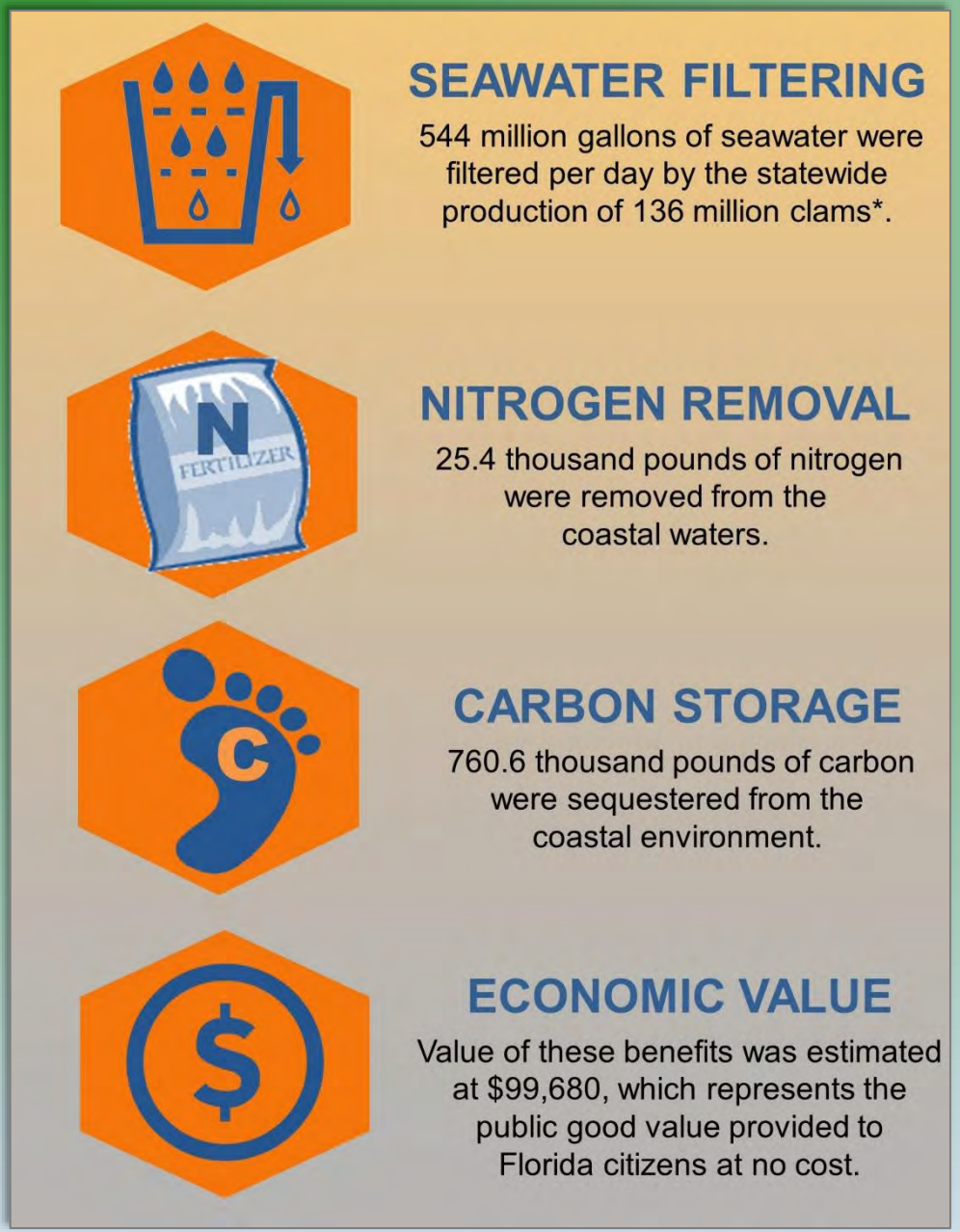
Valuation of ES provided by Clams

- Calculated costs that would be incurred to replace the industry's services with the next best alternative
- For N removal, values based on costs of wastewater treatment plants in Florida cities
  - Values per pound of N removed, ranged from $3.44 for Clearwater to $5.22 for Fort Myers
  - Based on land values and cost of living, factors that affect the cost of treatment plants



Valuation of ES provided by Clams

- For C storage, creation and maintenance of pine tree plantations used as a possible alternative to clam production
- Costs included pine production, as well as land value in an alternative use
- In counties with high urban, agricultural, or commercial land values, opportunity cost high
  - Highest values ($119.01 per ton) for Collier County
  - Lowest values ($0.71 per ton) in rural Franklin County



Disseminate Research Results

- Florida hard clam aquaculture provides economic values for ecosystem services generated by the industry
- These values based on production results from 2012 FL Aquaculture Survey
- Infographics poster developed by UF IFAS Dept. Agricultural Education and Communication

Disseminate Research Results

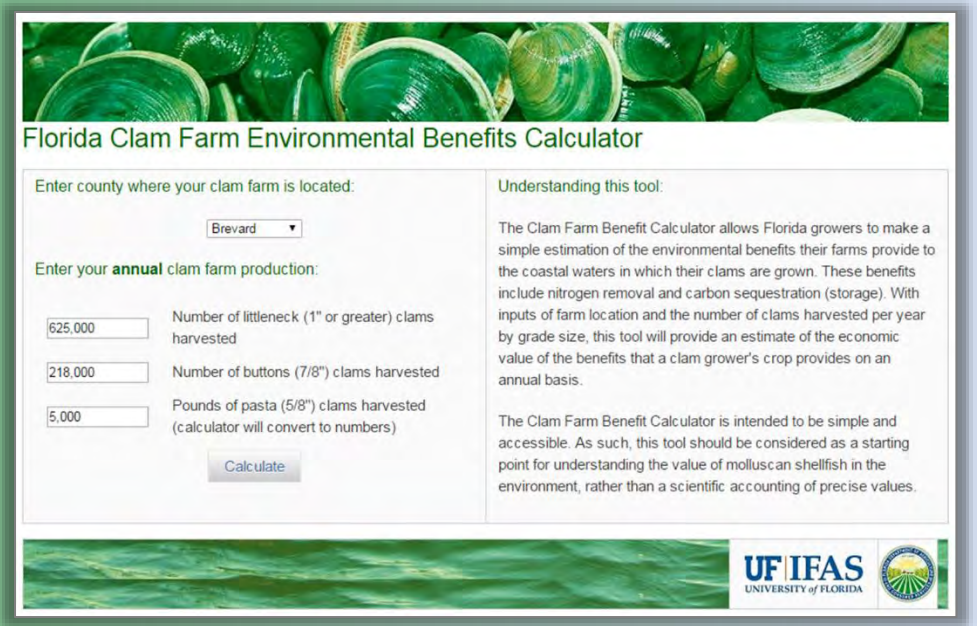
- All project results posted to new topic page on website, *Online Resource Guide for Florida Shellfish Aquaculture*

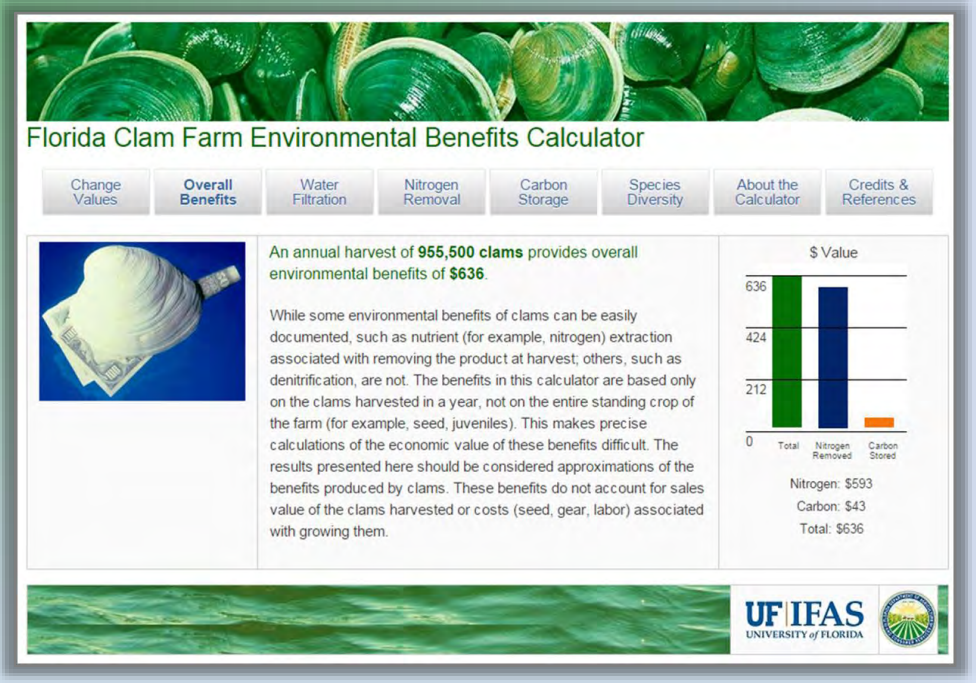
Go to http://shellfish.ifas.ufl.edu/environmental-benefits

Disseminate Research Results

- *Clam Farm Benefits Calculator* allows growers to inform buyers, consumers, and resource managers that shellfish aquaculture is a sustainable “green” industry

- With inputs of farm location and # clams harvested per year by grade size, the *Calculator* provides an estimate of the economic value of ES a grower’s crop provides on an annual basis





Disseminate Research Results

- *Florida Clams* website designed and produced to showcase the industry
- Working platform to promote cultured clams as environmentally friendly and benign

Go to
http://www.flaclams.com

ACKNOWLEDGEMENTS

- University of Florida graduate students
  - Angelo (Jason) Spadora, SFRC Fisheries & Aquatic Sciences
  - Jorge Avila, Food and Resource Economics
- Motionbuzz Multimedia developed *Environmental Benefits* webpages
- Dacing Tree, Inc. developed web-based *Clam Farm Calculator* which was inspired by the National Tree Benefit Calculator
- Ada Lang developed the *Florida Clams* website
- Nitrogen and carbon cycles illustrated by Anna Hinkelday
- Clam filtration video created by UF IFAS Communications
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