## Ecosystem Services Provided by Shellfish Aquaculture

Bob Rheault Executive Director East Coast Shellfish Growers Association bob@moonstoneoysters.com www.ECSGA.org





#### What are Ecosystem Services?

The processes by which the environment produces resources that we often take for granted.

Example: Wetland marshes clean the water that passes through and provide food and habitat for juvenile fish and birds.

Grasses capture sediment which improves water quality and bacteria decompose organic waste.The plants produce oxygen and stabilize sediment during storms and provide food.

# What services are associated with shellfish aquaculture?

#### • Nutrient removal

- At harvest
- Through stimulated denitrification
- Turbidity reduction
  - Light penetration deepens oxic zone and allows eelgrass to repopulate
- Improved habitat quality

#### **Nutrient impacts**

Nutrient pollution is the primary cause of eutrophication in our coastal waters.

Two thirds of our rivers and coastal waters are classified as "degraded" due to excessive nutrient inputs from fertilizer, sewage and fossil fuel combustion. (NOAA)

#### **Eutrophication**

When excessive nitrogen leaches into coastal waters from fertilizer or sewage it can lead to blooms of algae and phytoplankton.. Which shades out eelgrass and.... When the algae dies bacterial decomposition leads to hypoxia, loss of habitat and diversity

#### **Reactive Nitrogen**



#### **Nutrient impacts**

- Nutrients are removed when shellfish are harvested
- Shellfish feeding enhances bacterial denitrification
- Shellfish enhance sedimentation rates and speed the sequestration of nutrients
- Shellfish repackage phytoplankton biomass and make it available to benthic deposit feeders

The harvest of 3,750 oysters compensates for the nitrogenous wastes from one person leaching into the watershed. A market-size oyster contains about 0.5 grams N and 0.16 g P

The combined effect of US eastern oyster aquaculture harvest removes 357 metric tons of nitrogen and 110 metric tons of phosphorus from the marine environment. That's just the eastern oyster... Shellfish Filtration A single oyster filters 15-50 gallons a day

- Reduces turbidity
- Improves water quality and clarity
- Improves light penetration
  - Allows eelgrass to recolonize areas.
  - Increases depth of oxic layer
- Stimulates bacterial denitrification

#### Ecosystem Services from Shellfish Aquaculture

- Nutrients are removed when shellfish are harvested
- Shellfish enhance bacterial denitrification
- Oysters enhance sedimentation rates and speed the sequestration of nutrients
- Filter feeding improves water clarity and increases light penetration which helps eelgrass

 Aquaculture gear provides habitat and supports a diverse assemblage of juvenile fish, crabs, lobsters....



#### **Point Judith Pond**





# **Bottom Cages**



# Fouled growout bags





#### **Study Area**





## Aquaculture Structures Provide Habitat

- Kilpatrick (2002) found several times the abundance of fish and crustaceans in oyster gear vs. eelgrass beds
- Species diversity was similar to eelgrass and far superior to non-vegetated bottom

Are cages simply acting as "fish attracting devices" or do fish utilize them as habitat ?

Shelter (demography) Feeding & Breeding (productivity) Tallman & Forrester 2007Mark and recapture study comparing cageswith constructed and natural reefs

- Density
- Size
- Growth
- Survival

Black sea bass Centropristis striata





Cunner Tautogalabrus adspersus

Scup Stenotomus chrysops





Tautog *Tautoga oniti*s

#### **Tallman's Conclusions**

- Cages are structurally similar to natural and constructed rocky reefs
- Develop similar species assemblages, similar growth and survival rates
- Preserve patterns of biodiversity
- Cages mimic essential fish habitat

**Physical structure** and firm substrate provided by mussel longlines, floating trays and oyster bottom culture also enhances juvenile fish populations

Mussel longline ready for harvest. Photo by T. Holm



# What happens when gear is tended or at harvest?

- Impossible to harvest or tend gear all at once
- There is some mortality of associated organisms
- Farmers replant following harvest replacing structure
- On balance predict a strong positive impact

#### Ecosystem Services from Shellfish Aquaculture

- Nutrients are removed when shellfish are harvested
- Shellfish enhance bacterial denitrification
- Filter feeding improves water clarity and increases light penetration which helps eelgrass
- Aquaculture gear provides habitat and supports a diverse assemblage of juvenile fish
- Carbon deposited in shell is sequestered for decades
- Cultured shellfish release larvae into the environment

# Cultured Eastern oysters release at least 1.7 x 1019 Janvae annually

#### **Benefits of Oyster Farming**

- 357 metric tons of nitrogen removed
- 110 metric tons of phosphate removed
- Hundreds of tons of other nutrients removed by burial or denitrification
- 51,559 tons of carbon sequestered
- 1.7 x 10E15 larvae released each year
- 94 million cubic meters of water filtered daily
- Thousands of acres of barren bottom turned into productive fish habitat

### And that is just the cultured Eastern oyster

#### Add in 500 Million cultured clams

#### Not a panacea

- Probably not going to solve the nutrient problems – but it will help
- Issues of scale monoculture, habitat diversity
- Issues of temporal dislocation
- Really the only affordable mechanism to address non-point source nutrient issues

Shellfish farmers are passionate stewards of the environment and advocates for clean water.

And we are the virtual canaries in the coal mine when it comes to detecting (and fighting) declines in water quality.

#### Shellfish farmers lead the seafood industry in sustainability

- West Coast growers adopted Environmental Codes of Practice
- Cooperate with Monterey Bay Seafood Watch and Chef's Collaborative
- ECSGA formulating BMPs
- WWF Dialogs to foster sustainability certification



#### **BEST CHOICES**

Arctic Char (farmed) Barramundi (US farmed) Catfish (US farmed) Clams, Mussels, Oysters (farmed) Clams: Softshell/Steamers (wild) Cobia (US farmed) Crab: Dungeness, Stone Croaker: Atlantic\* Halibut: Pacific Lobster: Spiny (US) Pollock (Alaska wild) Salmon (Alaska wild)" Scallops: Bay (farmed) Squid: Longfin (US) Striped Bass (farmed or wild\*) Swordfish (Canada and US, harpoon and handline)\* Tilapia (US farmed) Trout: Rainbow (farmed) Tuna: Albacore (troll/pole, US\* or British Columbia) Tuna: Skinlack (trall/nale)

#### WWF Bivalve Aquaculture Dialogs

- Performance standards based on best science.
- International Steering Committee
- Ensure sustainable practices and social standards
- Lead to certification via Aquaculture Stewardship Council
- Question of whether market cares enough to cover the cost of certification?
- www.worldwildlife.org/bivalvedialogue



### Virtues of Shellfish

- Delicious
- Nutritious (high in protein, minerals, omega 3 fatty acids – heart healthy)
- Feed low on the food chain
- Sustainably cultured
- Proven environmental benefits



#### www.ECSGA.org bob@moonstoneoysters.com