Increased Dermo Disease in Chesapeake Bay Oysters Caused by Continued Warming and Nutrient Loading

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Presentation Outline

- Oyster-Dermo model application to Chesapeake Bay
- Simulation results
- Rethinking simulation results
- Next steps
Oyster Model

- Simulate Dermo disease infection intensity and prevalence
- Inputs are temperature, salinity, food from Chesapeake Bay biogeochemical model
  - 1900 -1914
  - 1980 - 2015
- Results presented as Mackin Index; semi-quantitative scale of infection intensity
- Model setup
Oyster-dermo model implementation sites

- Coincide with VIMS and Bay program long-term monitoring sites
York River Environmental Conditions

1900s cooler

1980s-2000s higher food
Mackin Index

1900-1915

1980-2015

1900-1915

1980-2015
Dermo Body Burden

More oysters at higher body burden in 2000s

1905 simulation start
September – year 3

2005 simulation start
September – year 3
York River - September Survey
Carnegie & Burreson (2009)
Observed Dermo Weighted Prevalence

VIMS monitoring data – provided by Ryan Carnegie
Rappahannock River
Simulated Mackin Index

Rappahannock, Wicomico, Piankatank
What is happening?

- Environmental conditions insufficient to produce observed signal
- Missing process(es)
- MSX disease present – dual disease effect
- “Unprecedented high prevalences and intensities of H. nelsoni were observed in the Great Wicomico, Coan, Yeocomico and Rappahannock Rivers.” (Calvo & Burreson, 2000)
What is happening?

- Change in dermo pathogen (*Perkinsus marinus*)
- Major phenotypic change producing increased virulence occurred in 1985/1986 epizootic
- Cell diameters smaller by 2011-2012
- Second change in 1999-2000?
Summary

- Temperature higher in 1980s-2000s than early 1900s
- Nitrogen loading to Chesapeake Bay is higher in 1980s-2000s – enhances chlorophyll/POC concentrations
  - Higher temperatures released pathogen
  - Higher food allows oyster to exist with higher pathogen load
- Changed pathogen virulence?
Oyster-dermo model implementation sites

- Potential effects of decreased oxygen at some sites
Next Steps

- Simulations with variable dermo virulence
- Revise model to allow recruitment
  - Broodstock-recruitment relationship from oyster survey
- Begin process of integrating oyster-dermo model with Chesapeake Bay model