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

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VIRGINIA INSTITUTE OF MARINE SCIENCE

AUBURN UNIVERSITY

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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U.S. DEPARTMENT OF COMMERCE

Presentation Outline

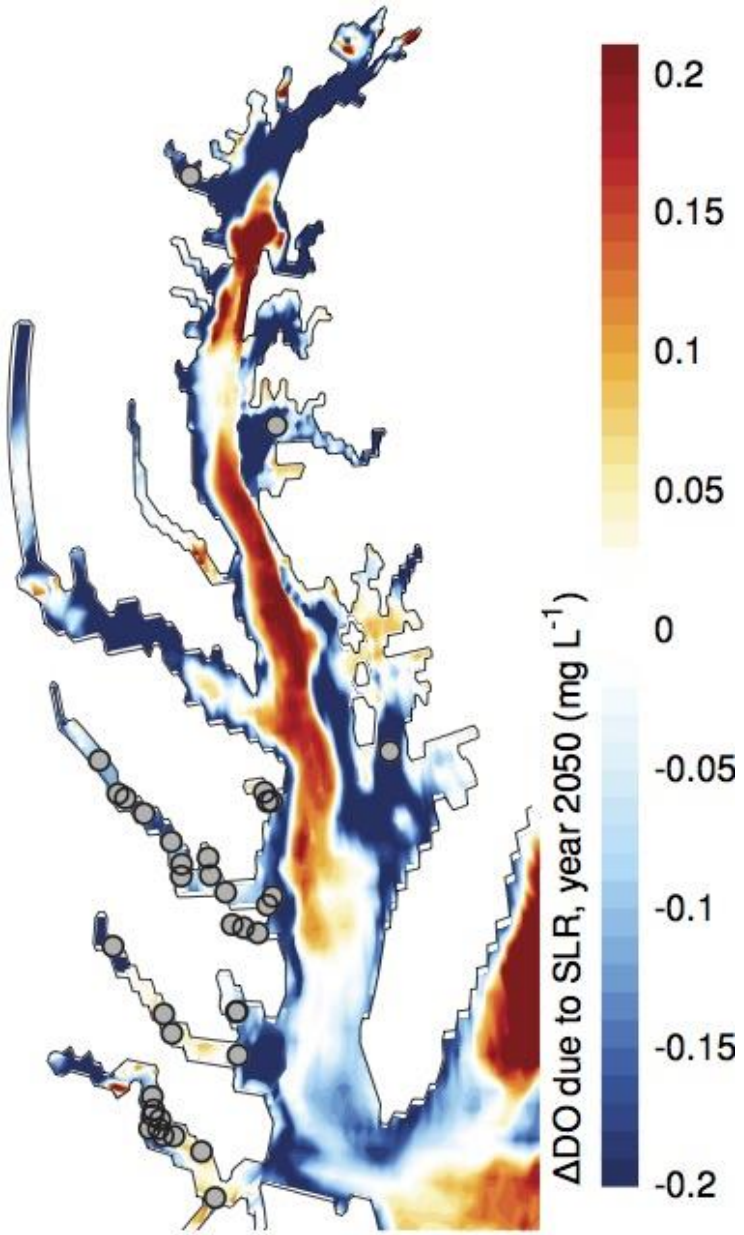
- Oyster-Dermo model application to Chesapeake Bay
- Simulation results
- Next steps

Oyster Model

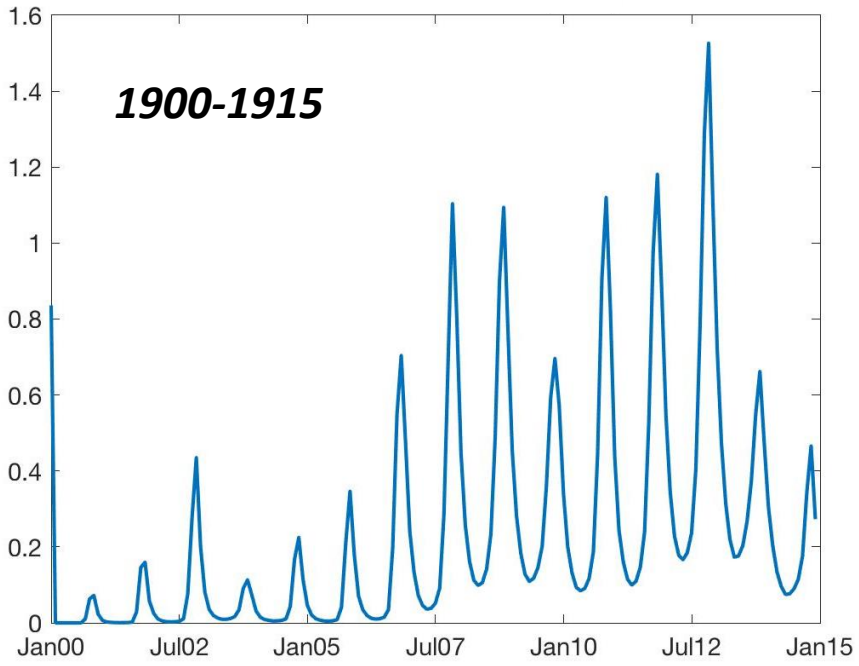
- Simulate Dermo disease infection intensity and prevalence
- Inputs are temperature, salinity, food from Chesapeake Bay biogeochemical model
    - 1900 -1914
    - 1980 - 2015
- Results presented as Mackin Index; semi-quantitative scale of infection intensity

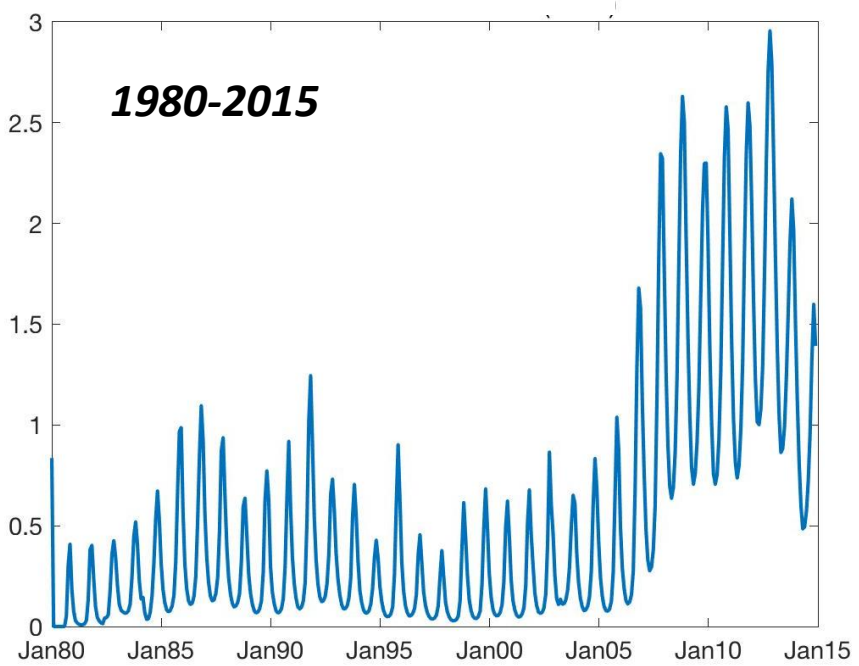
Oyster-dermo model implementation sites

- Coincide with VIMS and Bay program long-term monitoring sites



Mackin Index



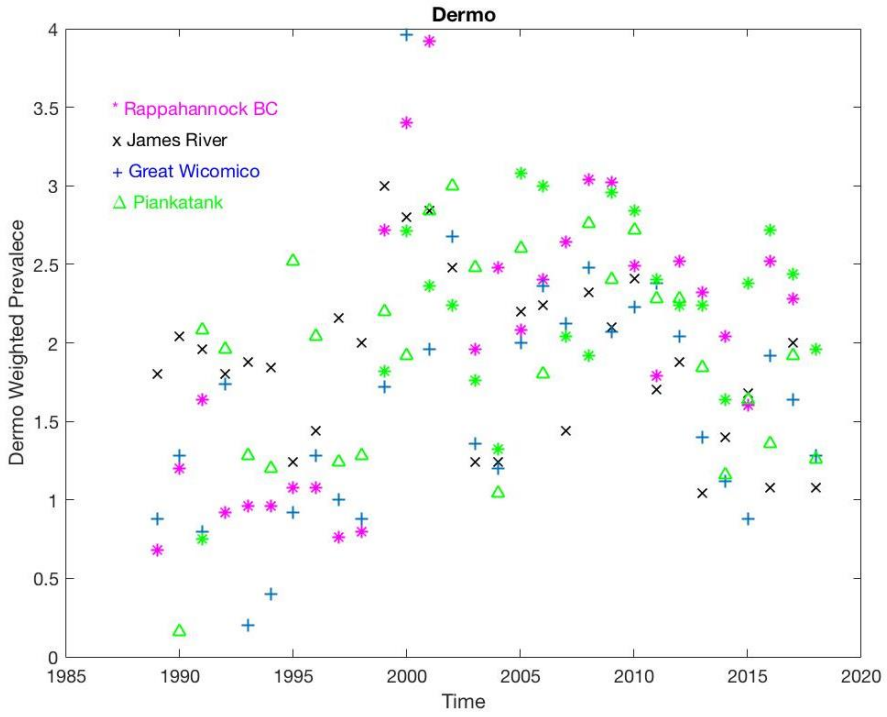


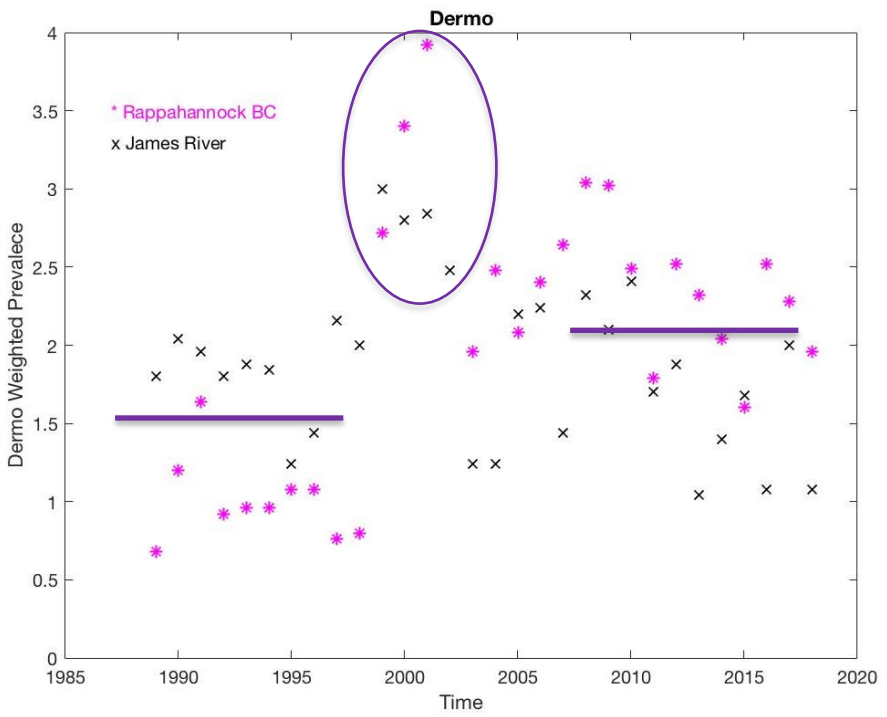
1900-1915

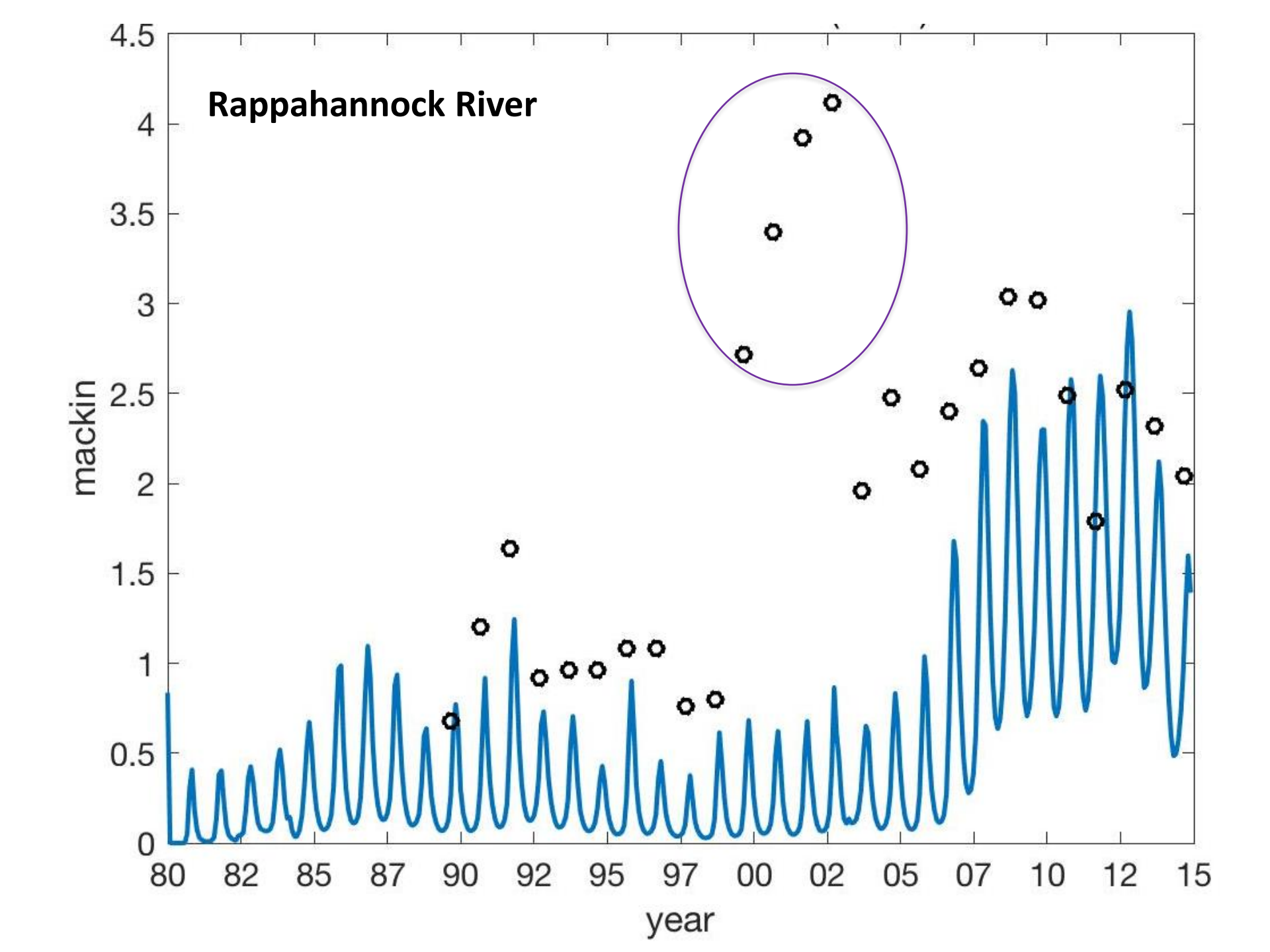
1980-2015

Observed Dermo Weighted Prevalence

VIMS monitoring data – provided by Ryan Carnegie






Rappahannock River
mackin
year
4.5
4
3.5
3
2.5
2
1.5
1
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0
80
82
85
87
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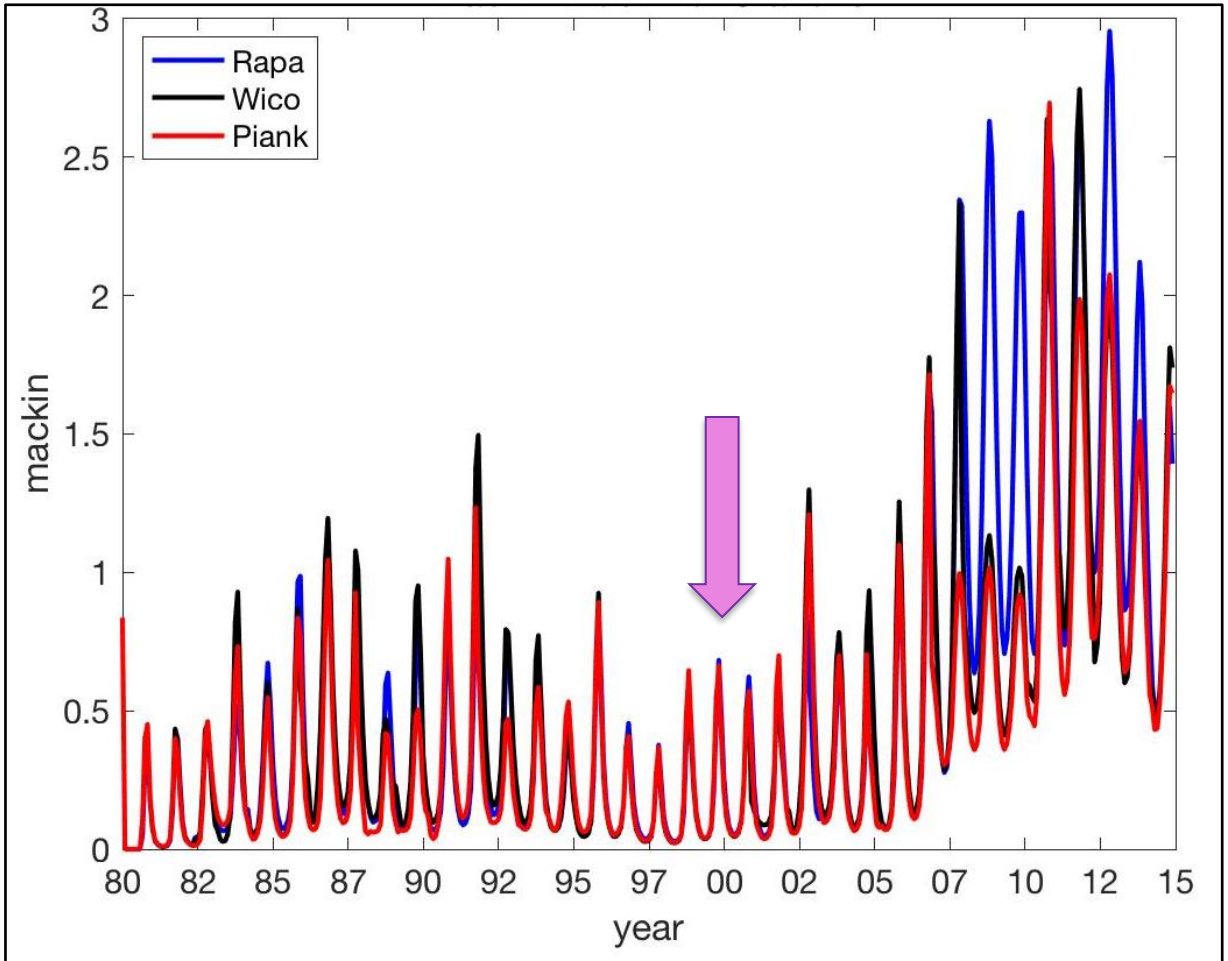
15

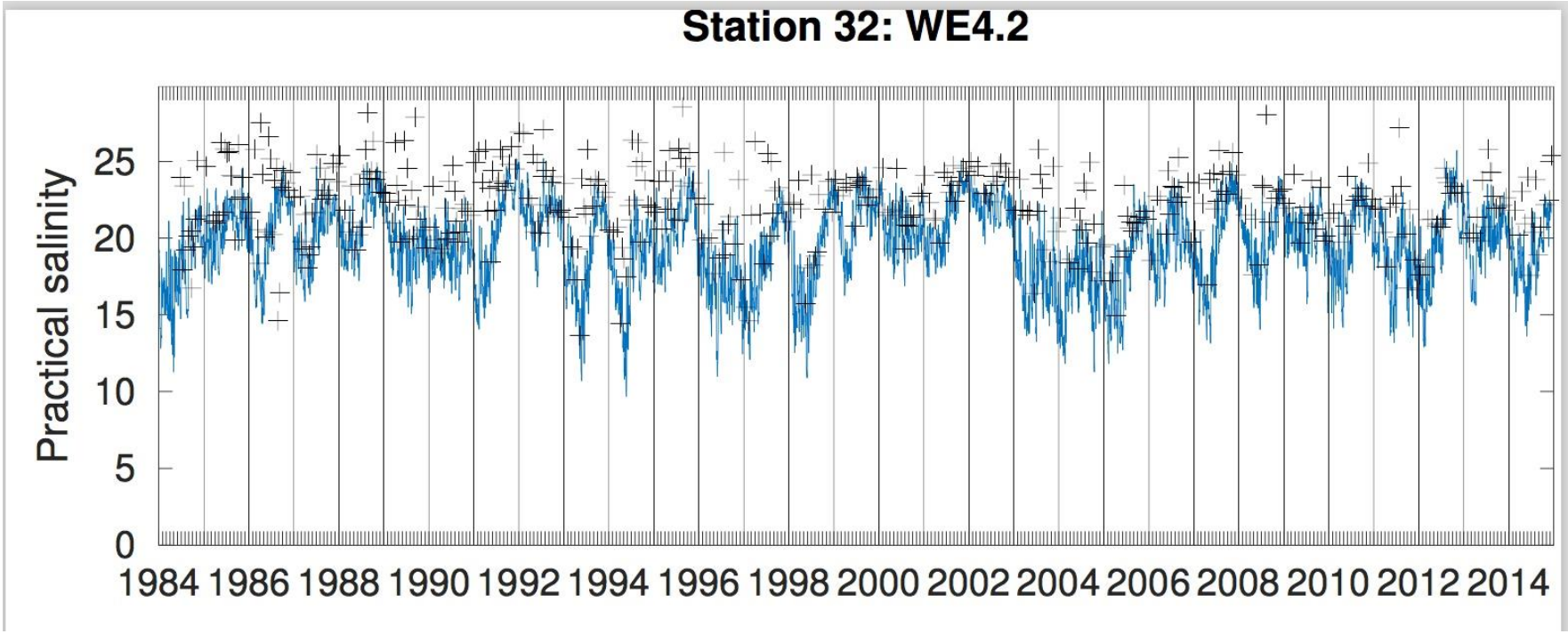
Simulated Mackin Index

Rappahannock, Wicomico, Piankatank

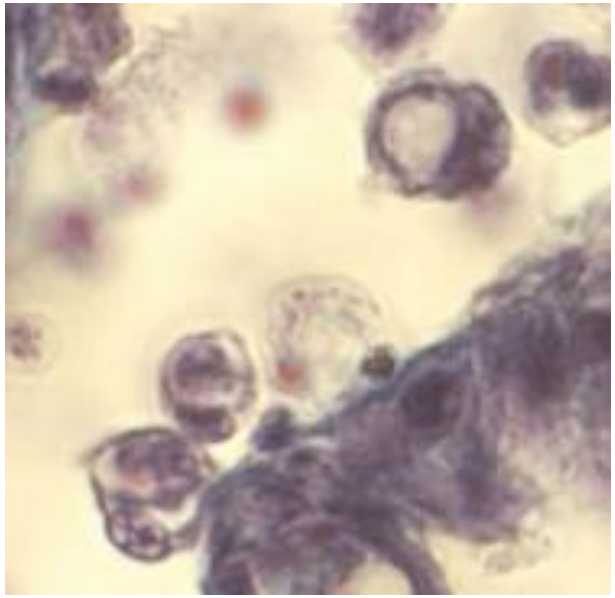


Environmental conditions

- Bottom salinity
- Drought 1999 – 2002



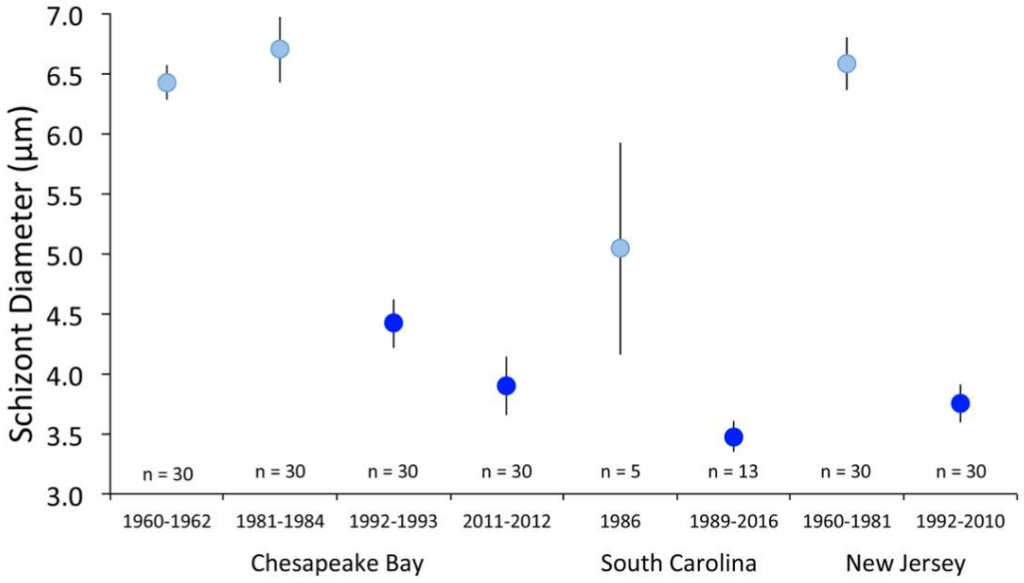
What is happening?



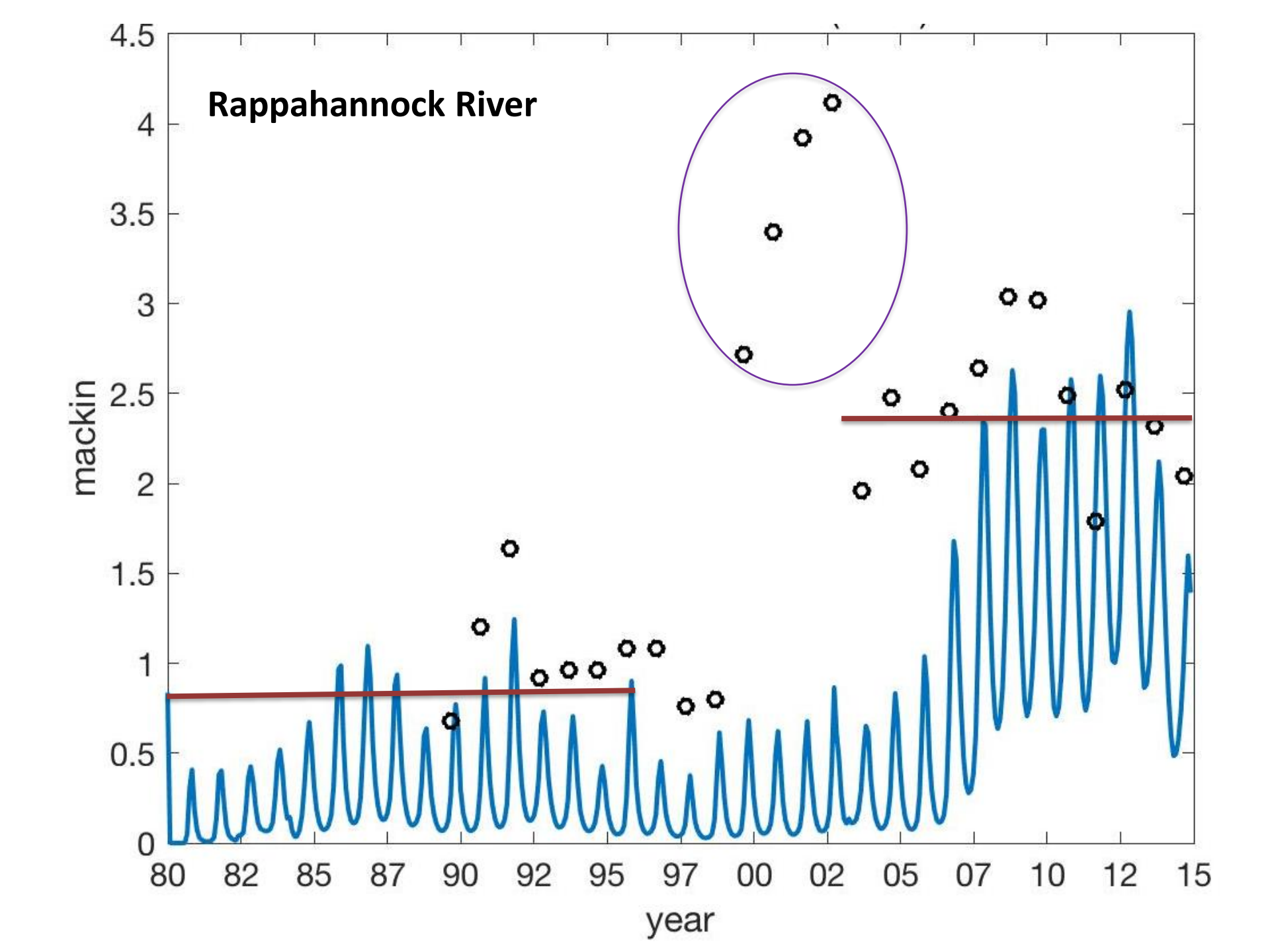
- Environmental conditions may not represent actual conditions
- MSX disease present – dual disease effect
- "*Unprecedented high prevalences and intensities of H. nelsoni were observed in the Great Wicomico, Coan, Yeocomico and Rappahannock Rivers*." (Calvo & Burreson, 2000)

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



Carnegie et al. (2021)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Summary

- Temperature higher in 1980s-2000s than early 1900s – released pathogen
- Changed pathogen phenotype and virulence in 1980s
- Occurrence of MSX in 2000 and drought
  - Allowed new pathogen to be established
- Oysters adjusted to a new equilibrium at higher pathogen load
- Rerun simulations
  - modified bottom salinity
  - Increased virulence