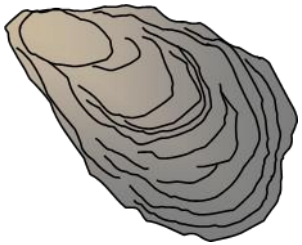
Oyster Model

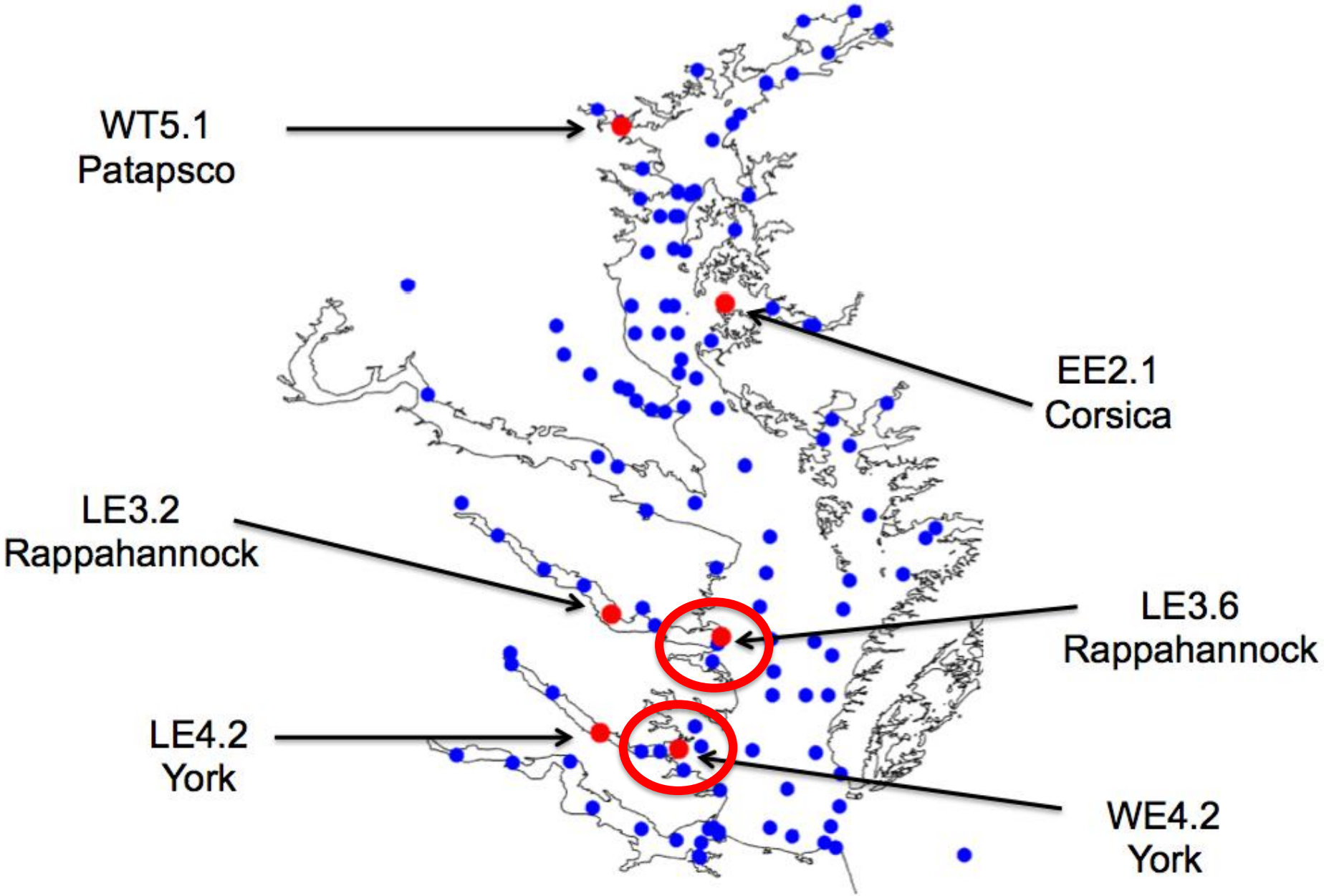
Objective: evaluate potential impacts of future changes in hypoxia on living resources in Chesapeake Bay – oysters provide a test organism



Oyster Model

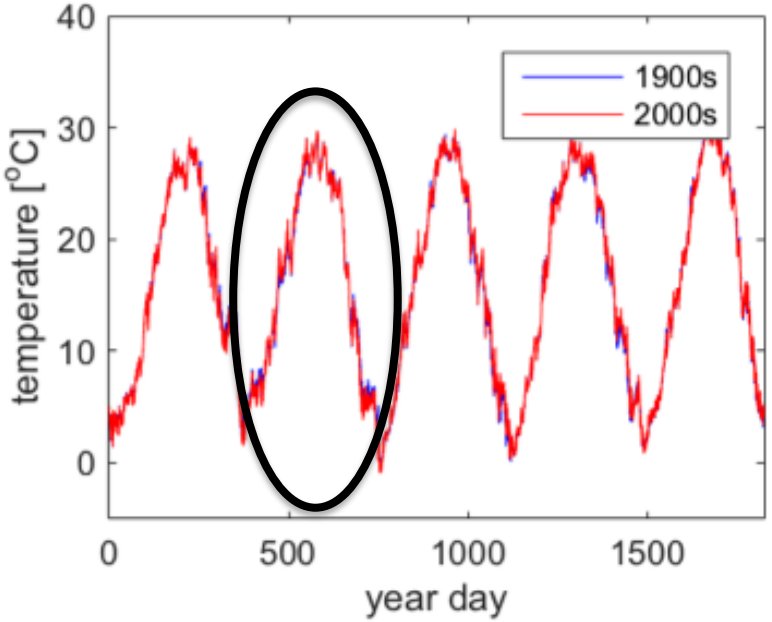
- Focus is *Crassostrea virginica* (Eastern oyster)
- Model simulates post-settlement population dynamics (growth, reproduction, mortality)
- Includes larval, Dermo disease, MSX disease and genetics submodels
- Inputs are temperature, salinity, food, turbidity, bottom velocity
- Outputs are total number, population size frequency, reproductive capacity, mortality distribution, disease prevalence and intensity
- Model applied in a time-dependent mode at specific locations in Chesapeake Bay

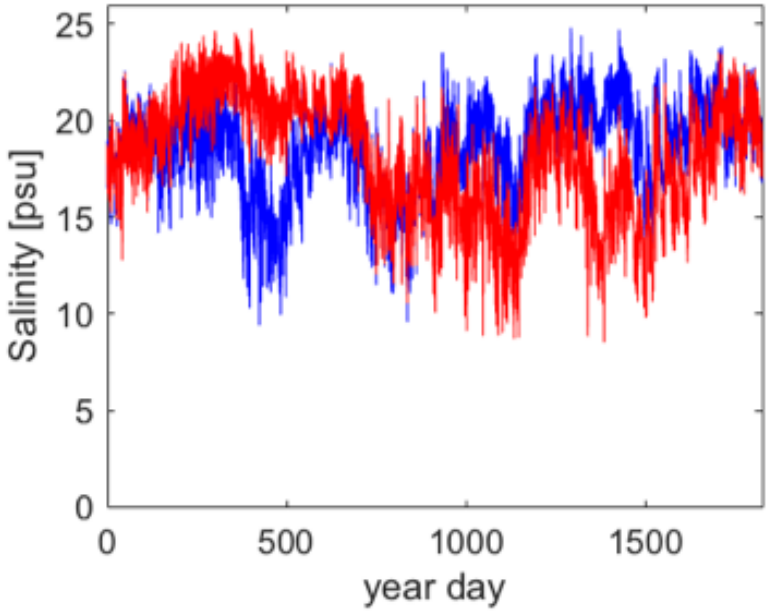
Chesapeake Bay Program Stations

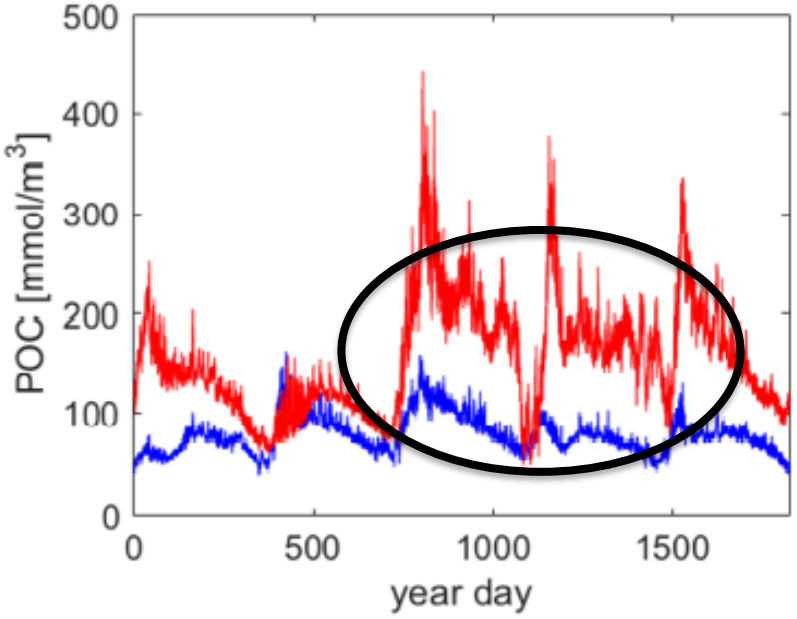


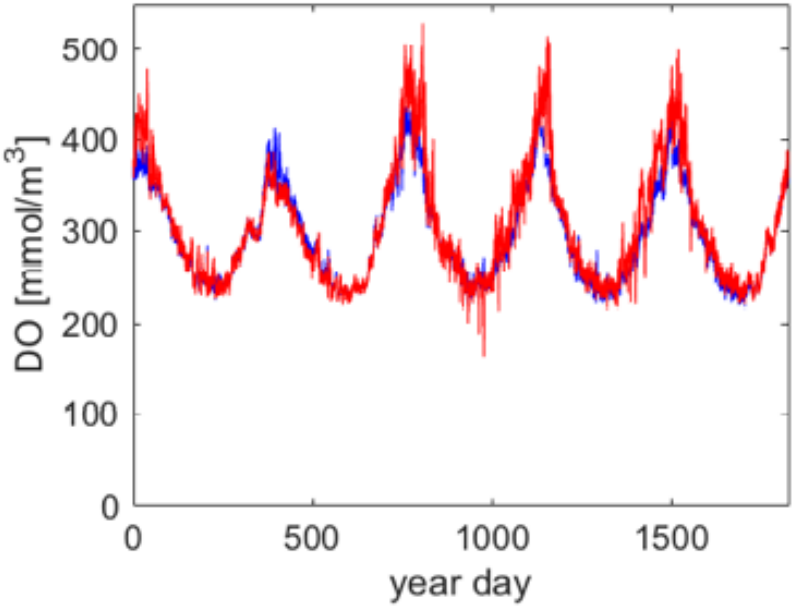
CB Biogeochemical Model

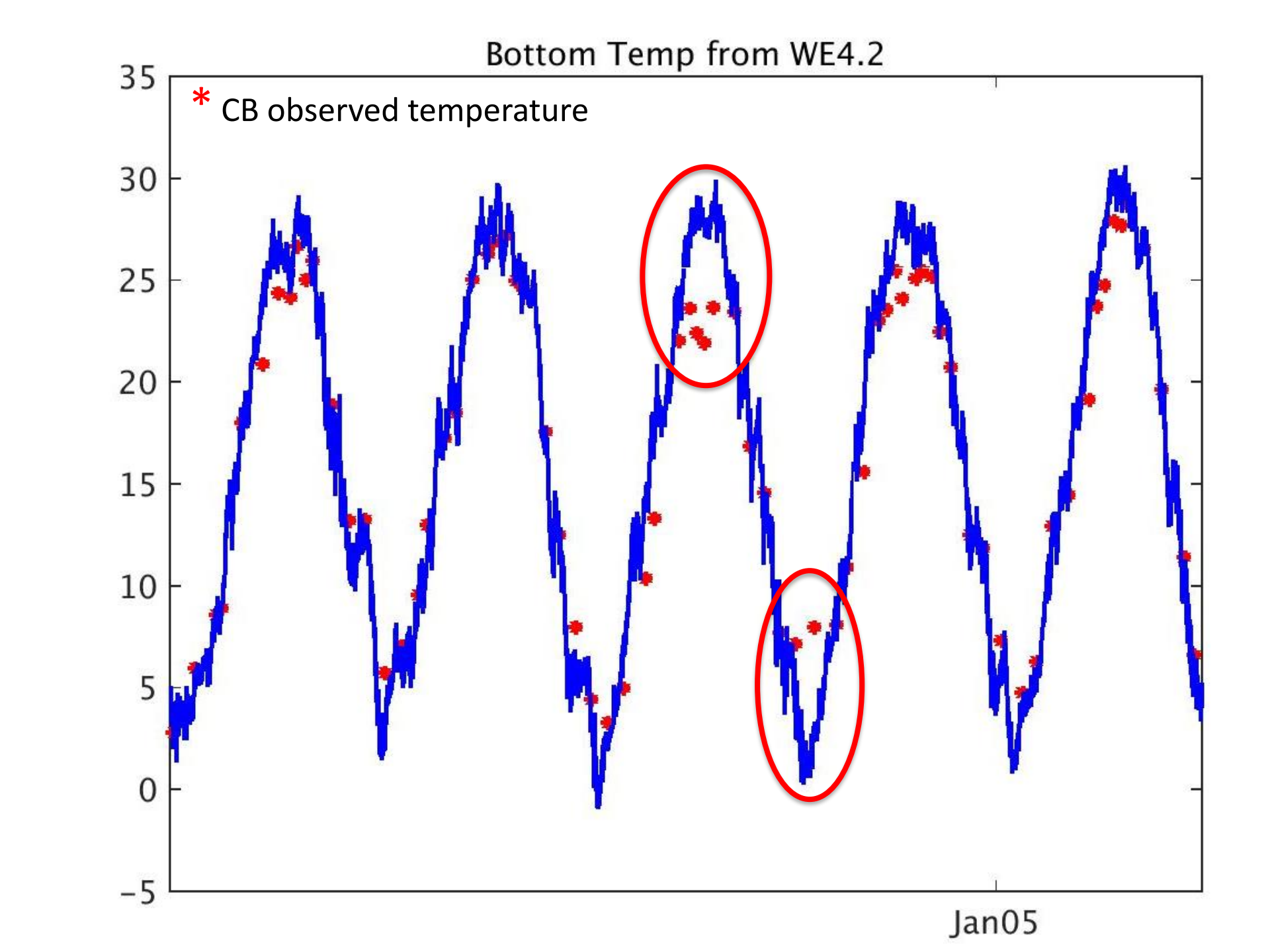
WE4.2





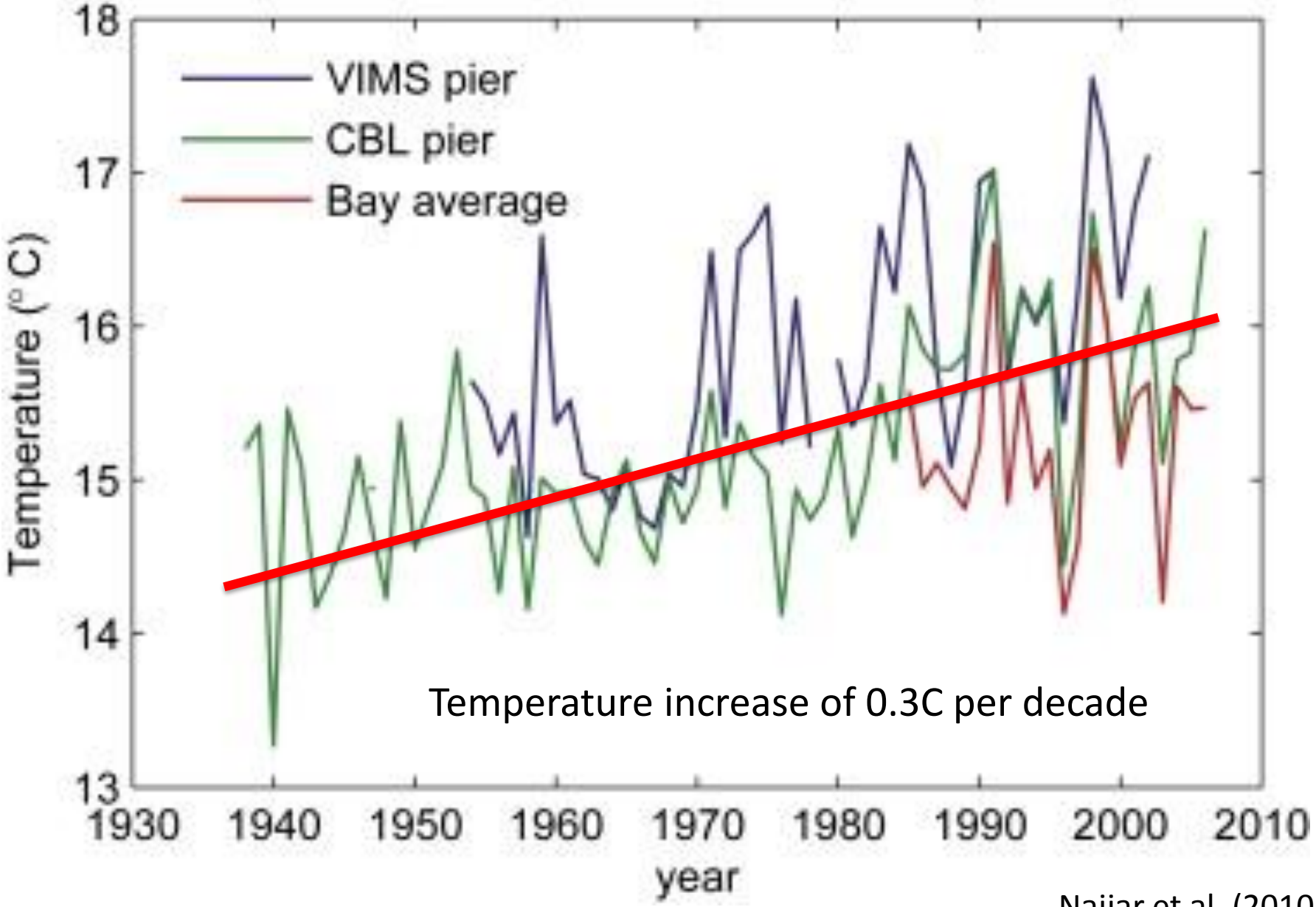





Bottom Temp from WE4.2
* CB observed temperature
35
30
25
20
15
10
5
0
−5
Jan05

Oyster Model Forcing

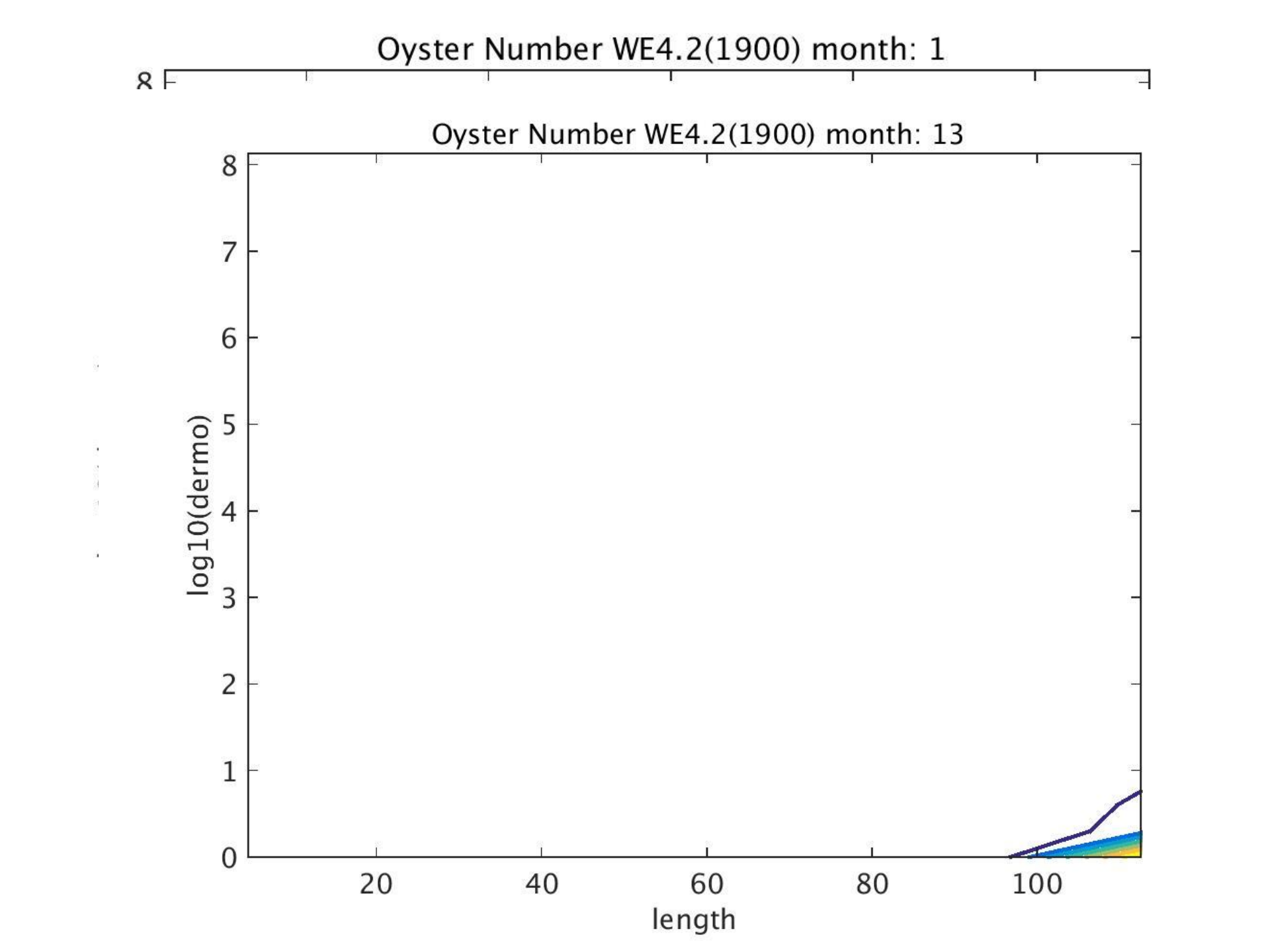
- Input salinity and velocity time series from CB simulations
- Used CB monitoring program bottom temperature for 2000-2005 for the oyster model
- Adjust CB monitoring program bottom temperature for 1900-1905
- Adjust food values for 2000-2005

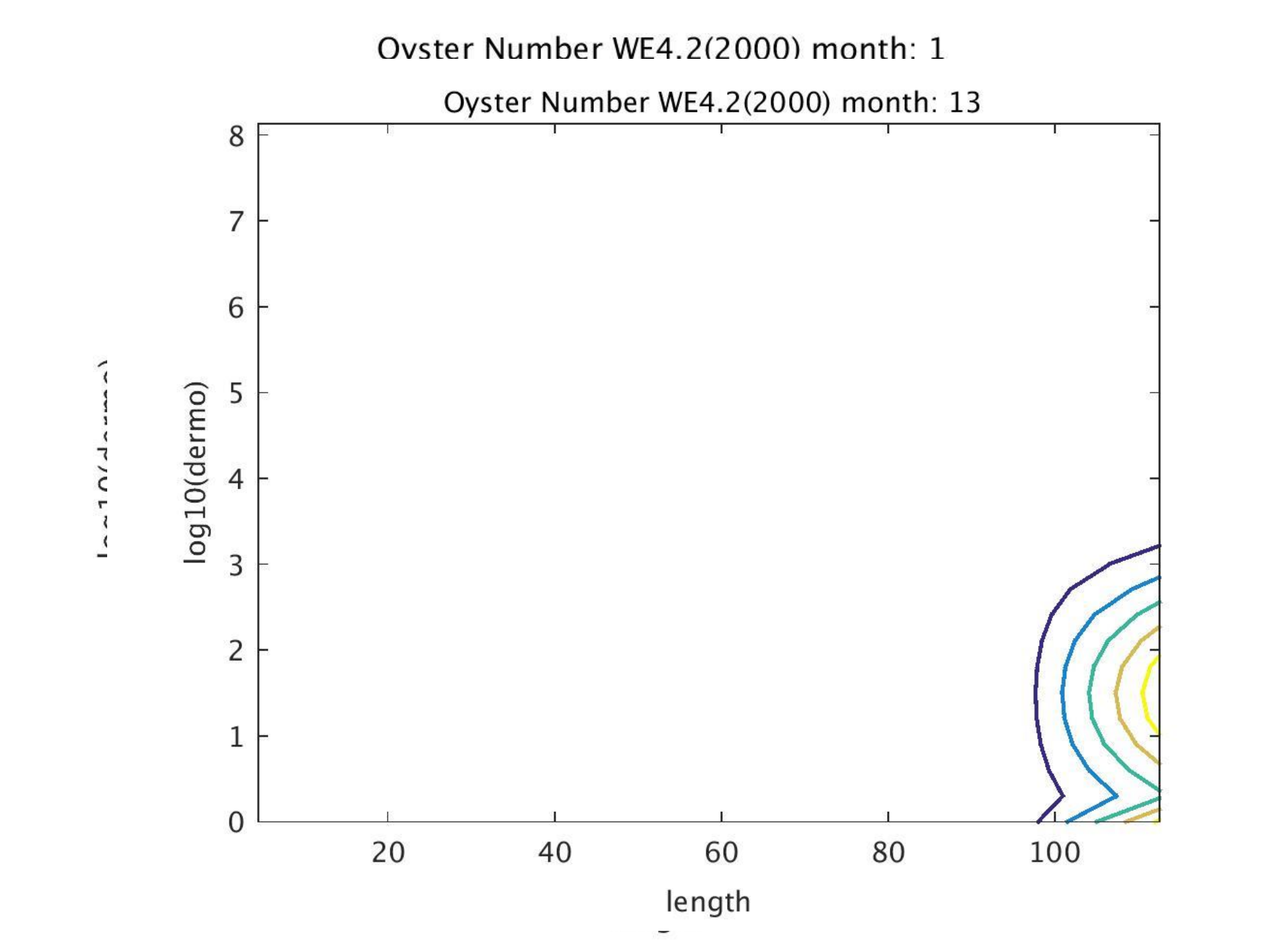


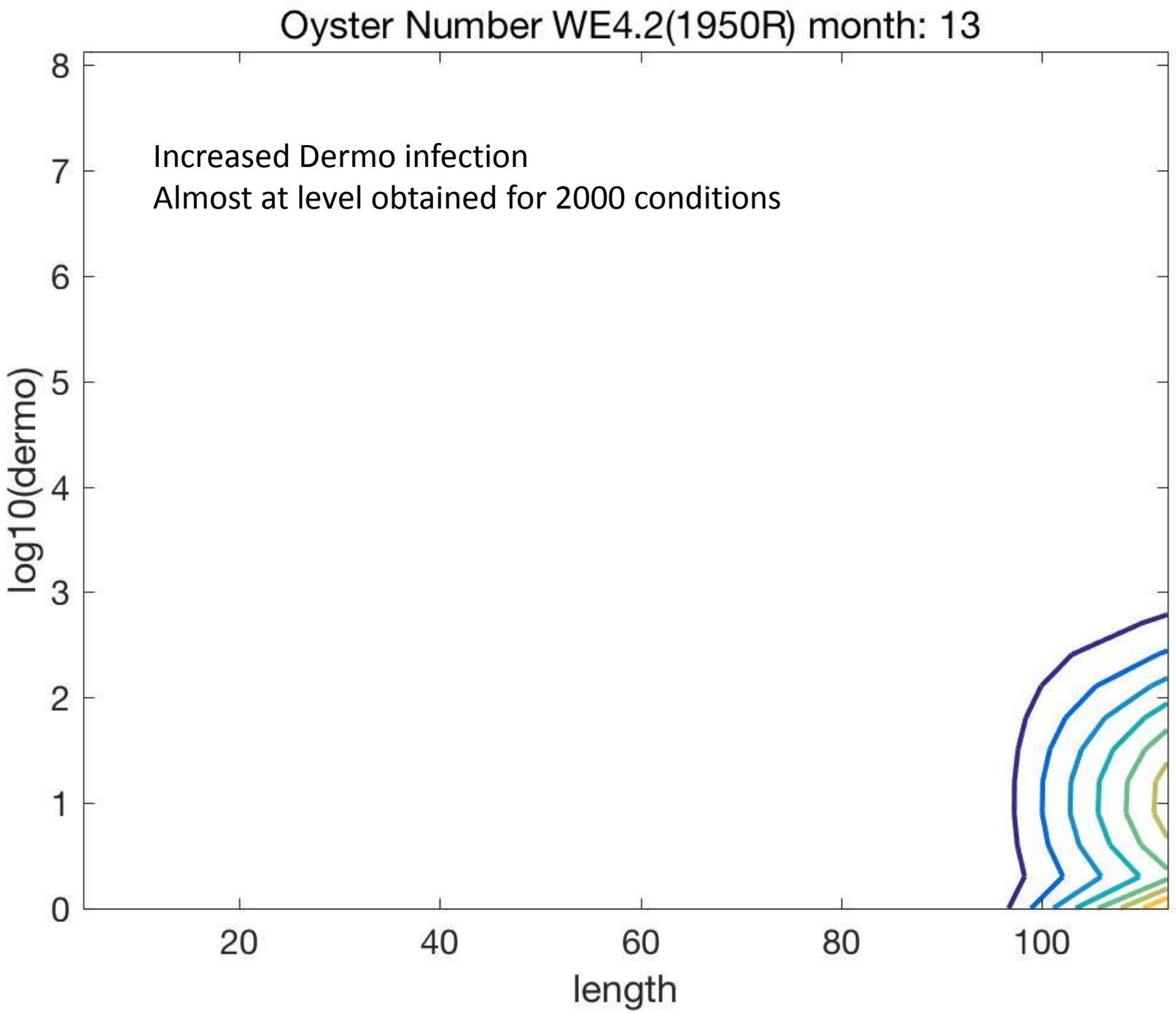
Najjar et al. (2010)

Adjustments

- Used temperature trend to adjust 1900-1905 temperatures to cooler values (3 degree reduction)
- Food values are the sum of POC
- Used 1900 POC values as food input
- Reduced 2000-2005 food by one-third
- More detritus (non-food) in current POC time series


Oyster Number WE4.2(1900) month: 1
Oyster Number WE4.2(1900) month: 13
log10(dermo)
length
0
1
2
3
4
5
6
7
8
20
40
60
80
100


Oyster Number WE4.2(2000) month: 1
Oyster Number WE4.2(2000) month: 13
log10(dermo)
length
0
1
2
3
4
5
6
7
8
20
40
60
80
100

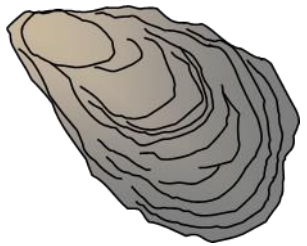

Oyster Number WE4.2(1950R) month: 13
Increased Dermo infection
Almost at level obtained for 2000 conditions
log10(dermo)
length
0
1
2
3
4
5
6
7
8
20
40
60
80
100

Possible Results

- Increased temperature in 20th century released Dermo pathogen
  - When did temperature exceed pathogen threshold?
- Change in food composition between 1990 and 2000 affects growth rates
  - More ‘food’ is available but of the wrong form?

Next Steps?

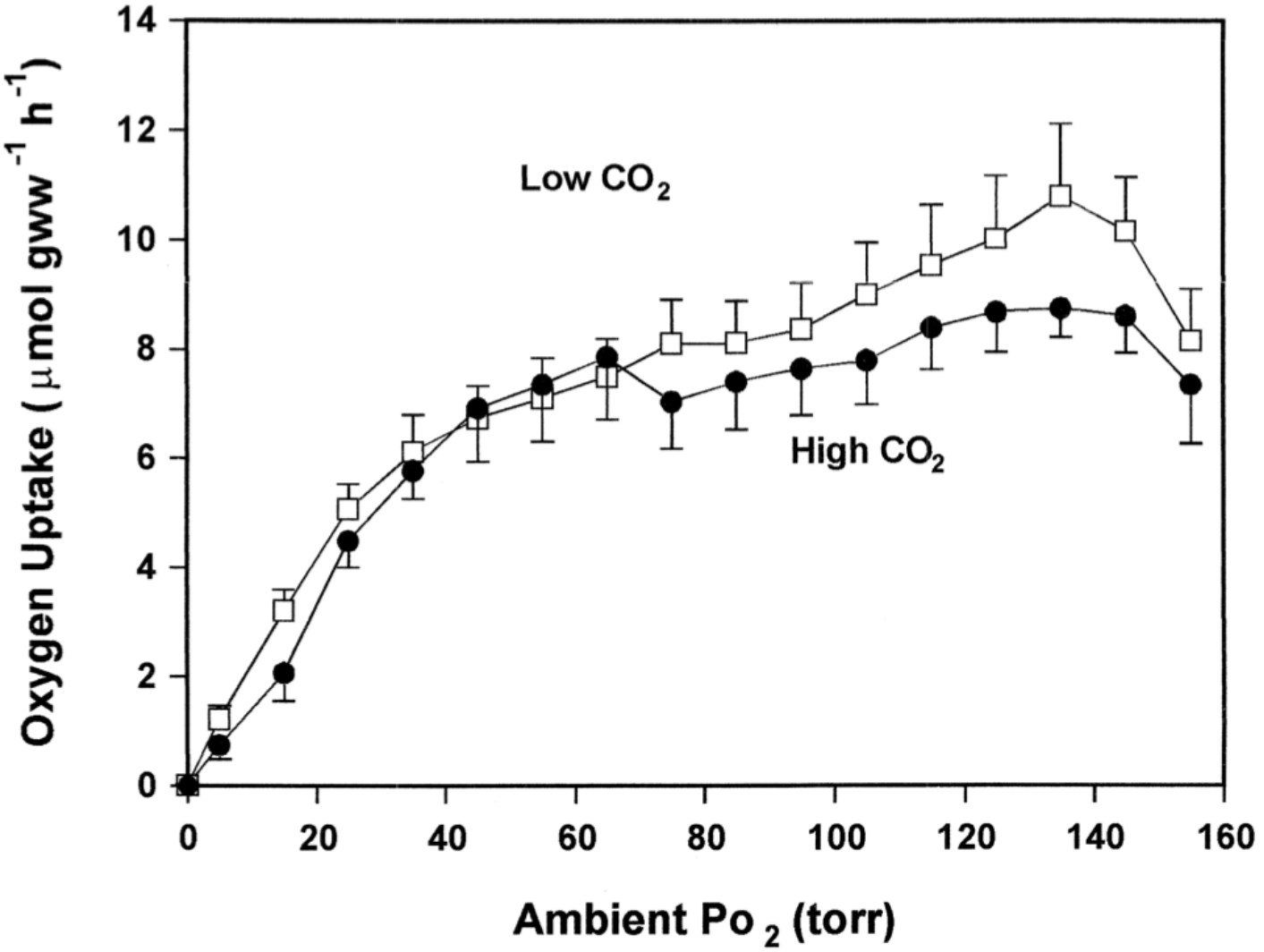
- Modify oyster model to include explicit oxygen dependencies on physiological processes
- Continue refinement of input time series
- Implement additional simulations to compare past and current conditions and effects
- Input simulated environmental conditions to evaluate effects on Chesapeake Bay oysters



Oxygen

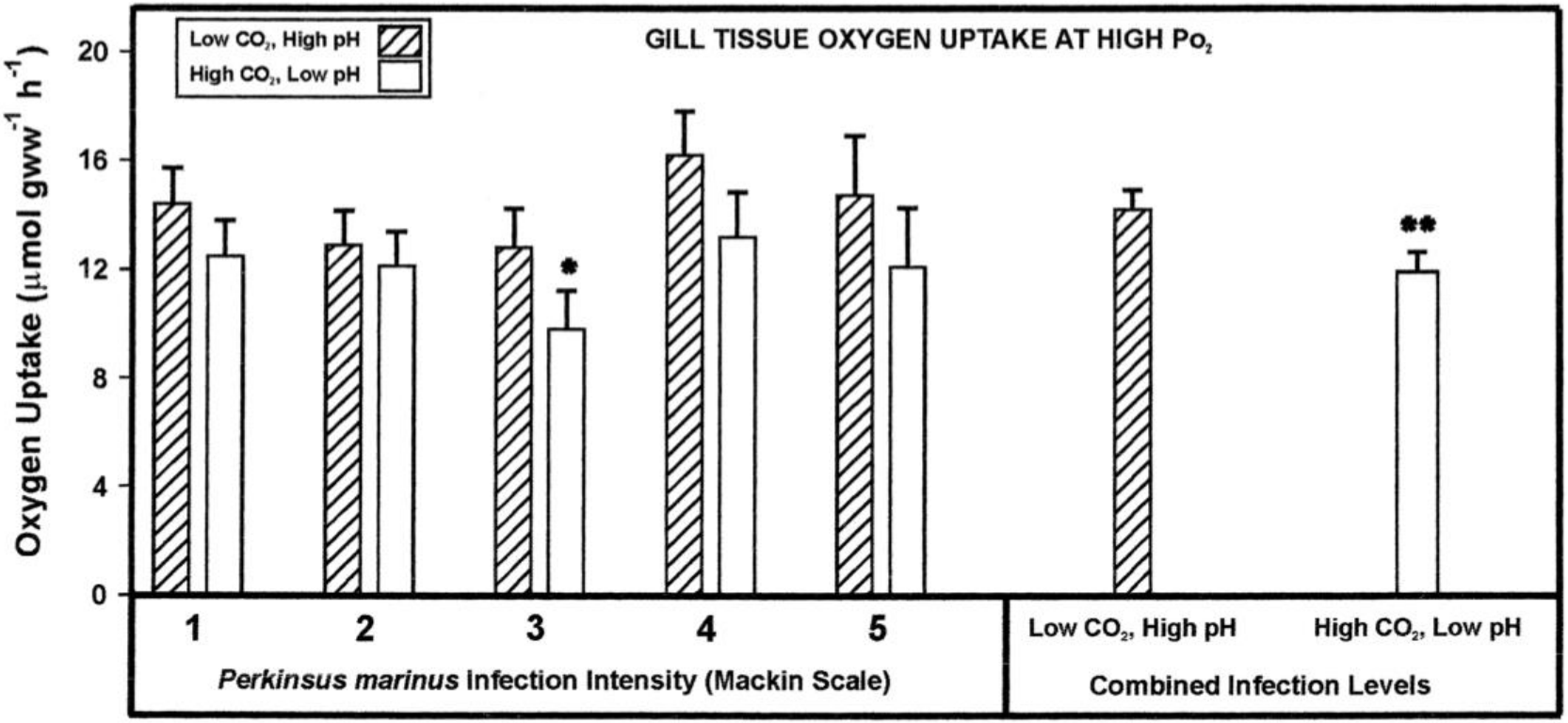
- Post-settlement population – respiration, disease intensity, metabolism
- Larvae – set survivorship
- Explicit respiration parameterization included for adult oysters – salinity and temperature
- Explicit larval settlement mortality

L.L. Willson, L.E. Burnett / J. Exp. Mar. Biol. Ecol. 246 (2000) 223–240



Hyperbolic relationship that modifies respiration rate

Willson et al. (2000)



No low oxygen effect on disease prevalence; some effect from high CO_2 and low pH

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