

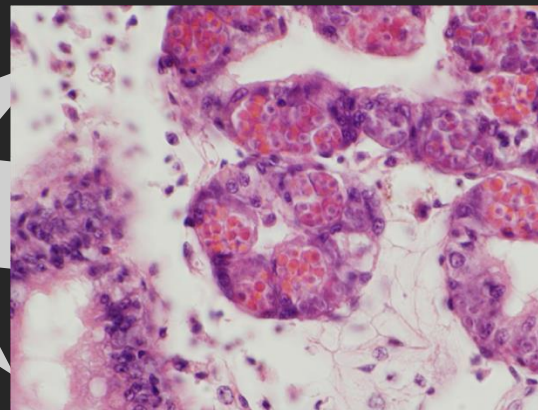
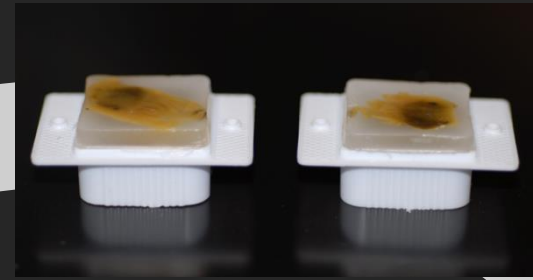
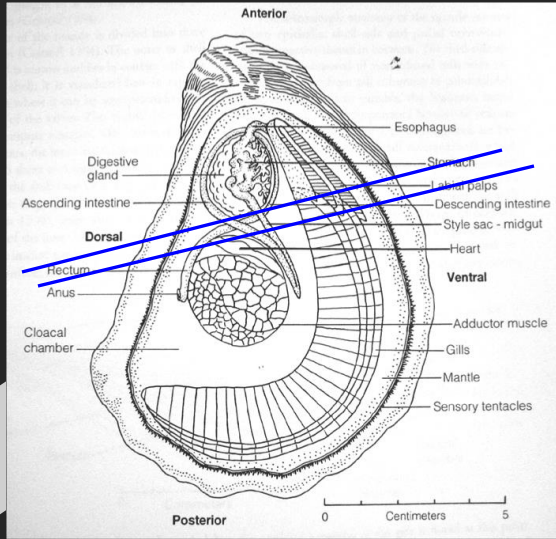
A primer on MSX and dermo diseases and a consideration of potential dynamics and impacts in the Atlantic Provinces

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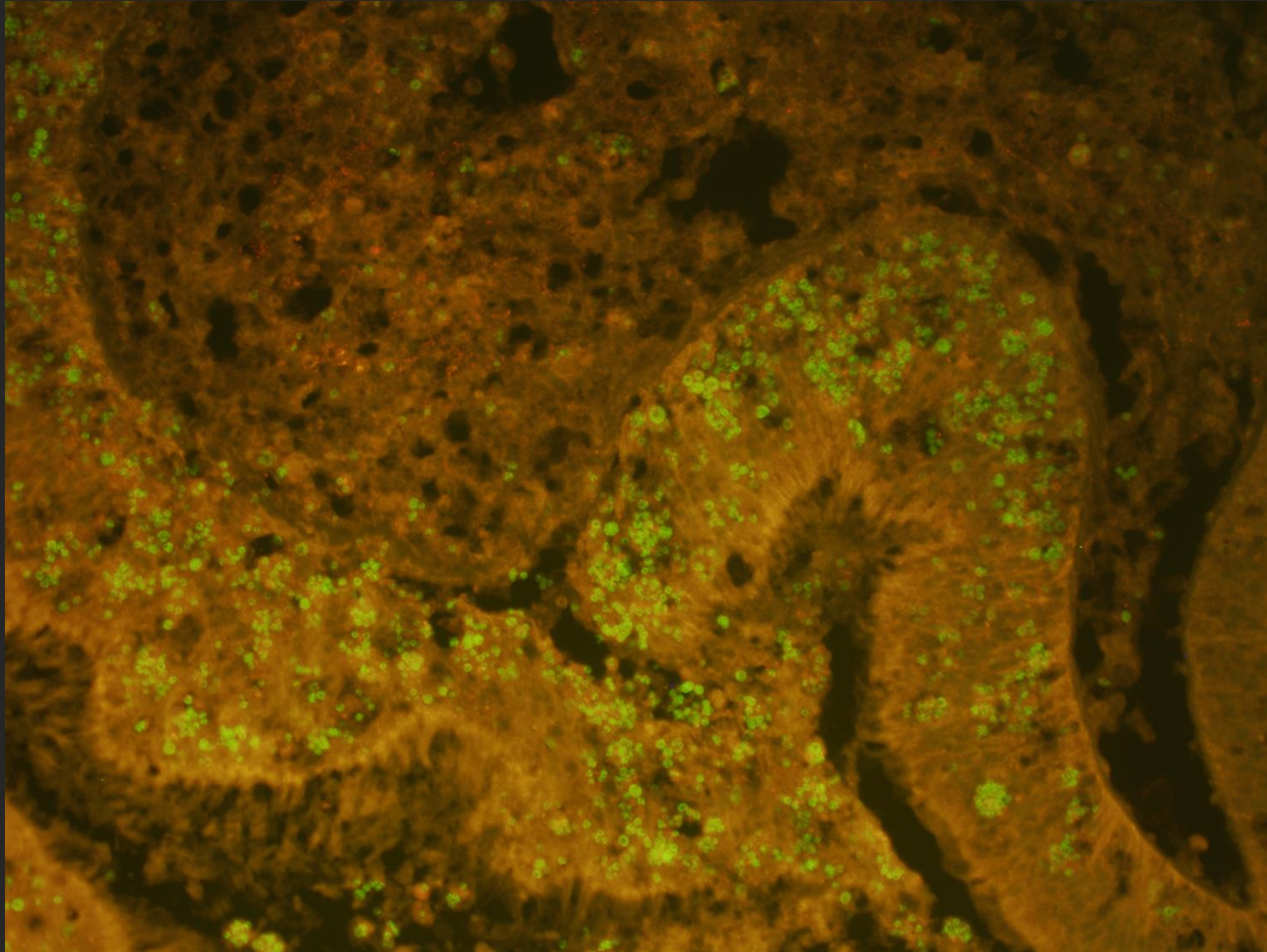


How we do what we do

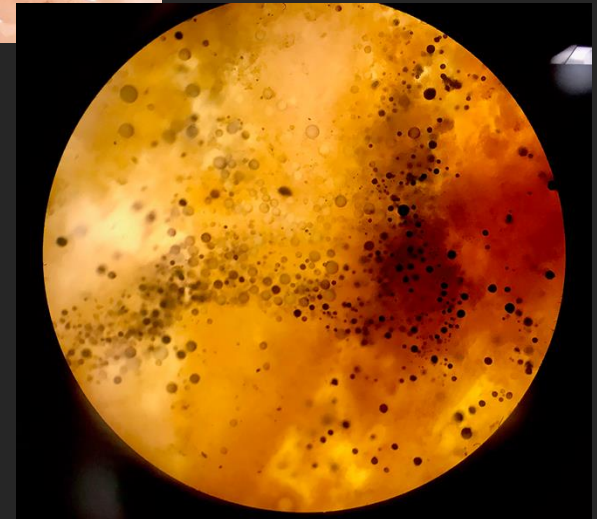
Histopathology



Molecular diagnostics, including in situ hybridization



Ray's fluid thioglycollate method (RFTM)

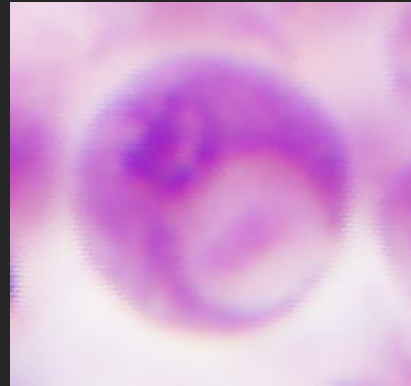


Dermo and MSX

Perkinsus marinus (dermo disease)

- Protozoan parasite, a native endemic (likely) pathogen
- Most destructive disease E. USA since the mid-1980s

A trophozoite



Dermo disease caused by *P. marinus* is the most common cause of emaciation as observed in oyster at right





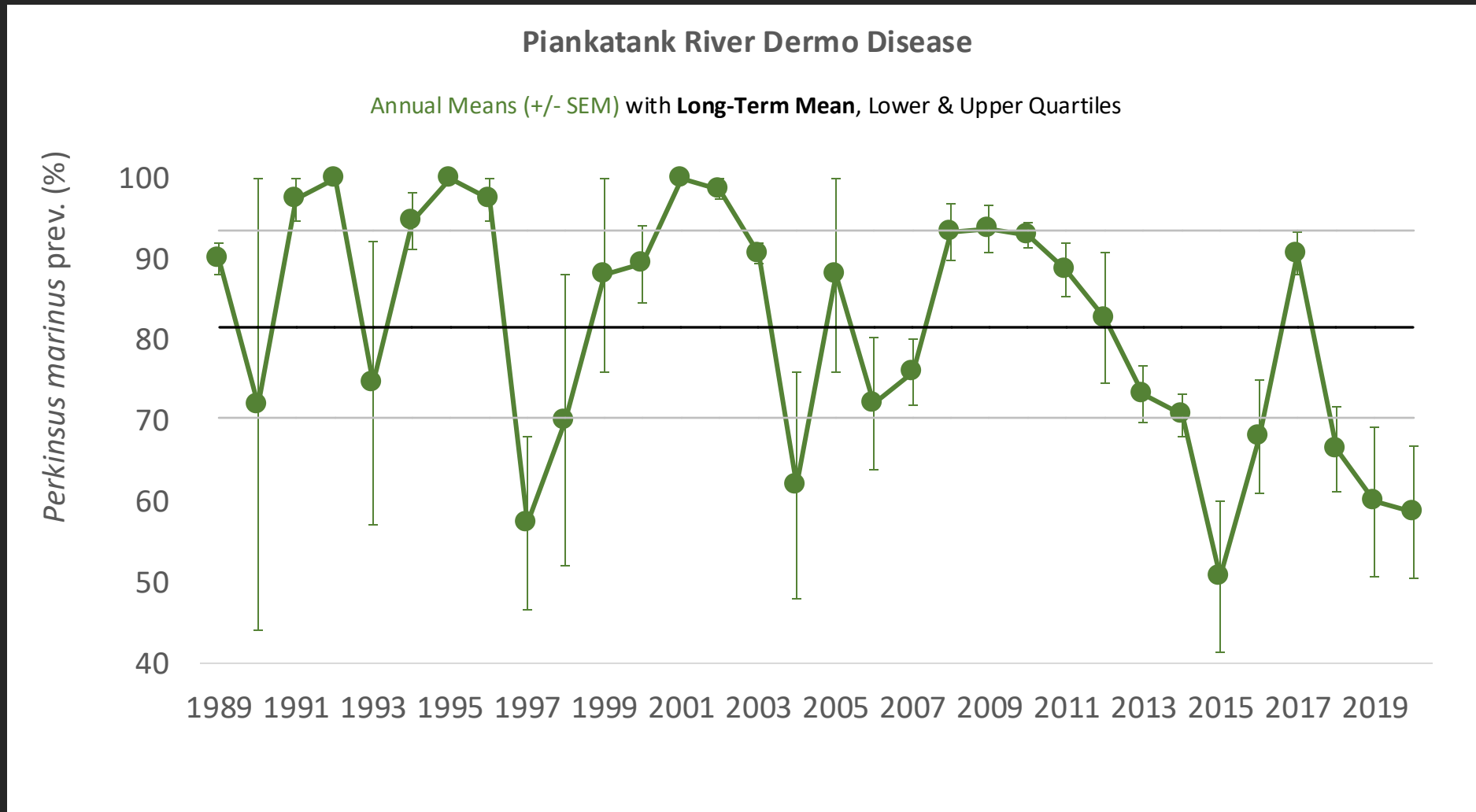
Normal digestive
epithelium



Dermo-diseased

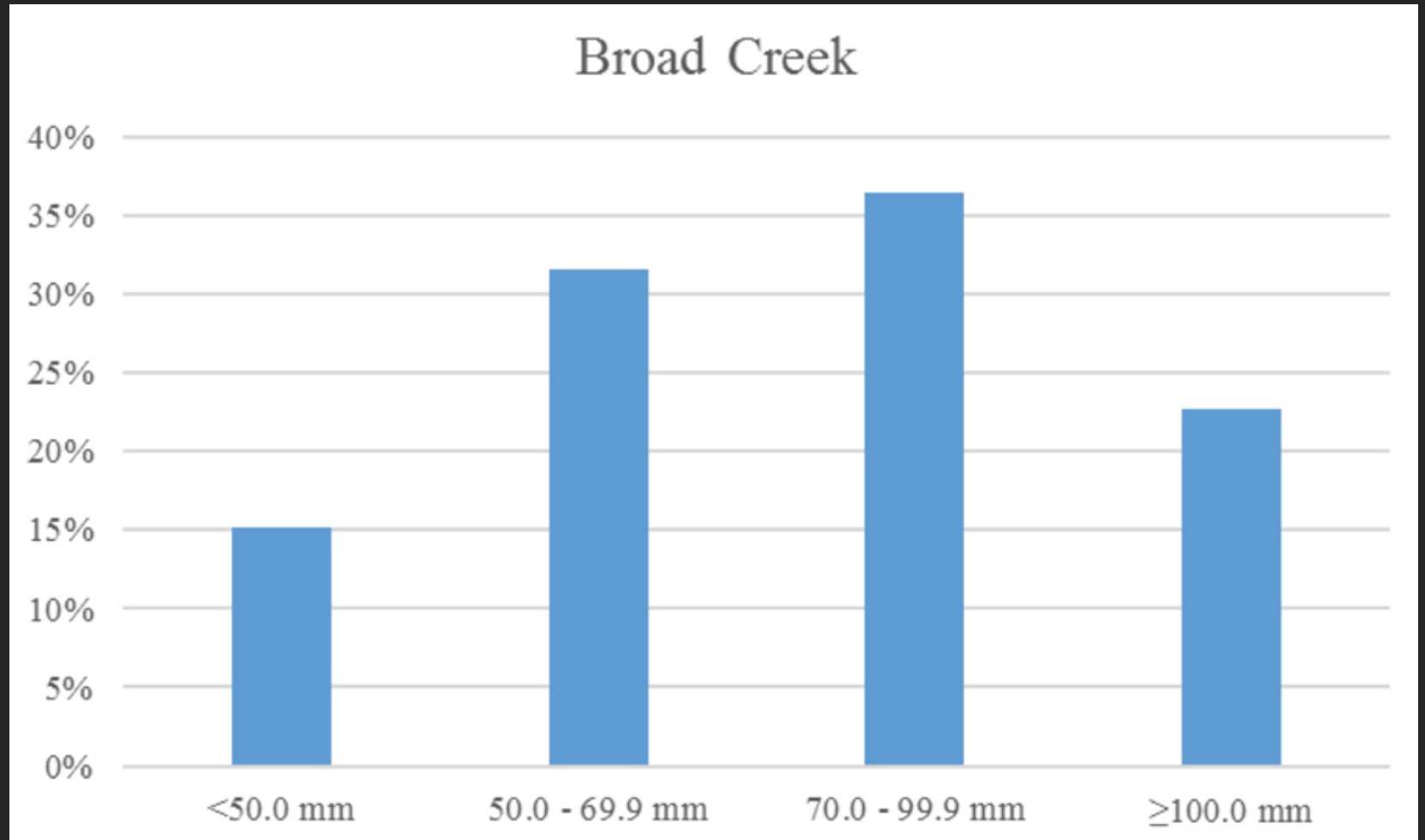


Perkinsus marinus is very prevalent . . .



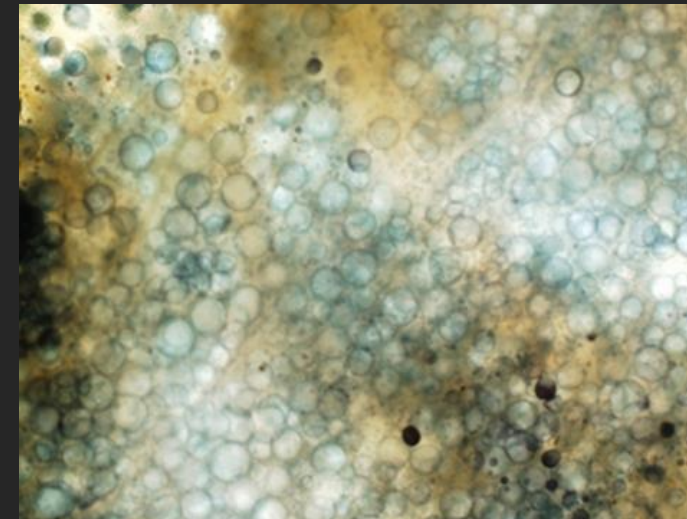
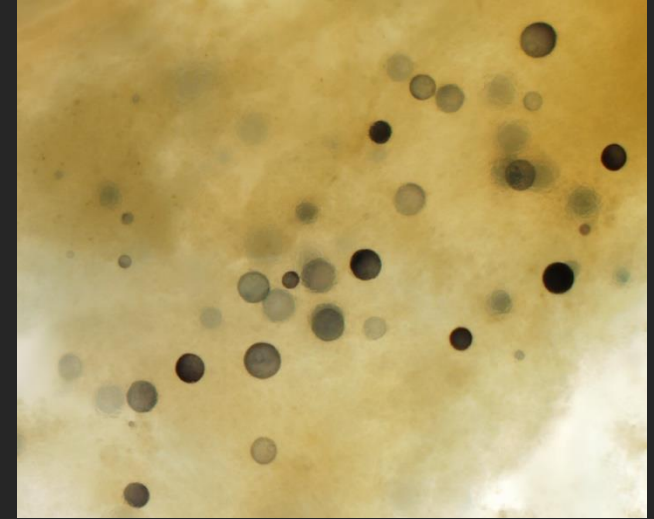
... and probably causes 20-30% annual mortality

Mortality based on box counts in summer 2017, Broad Creek, Rappahannock River



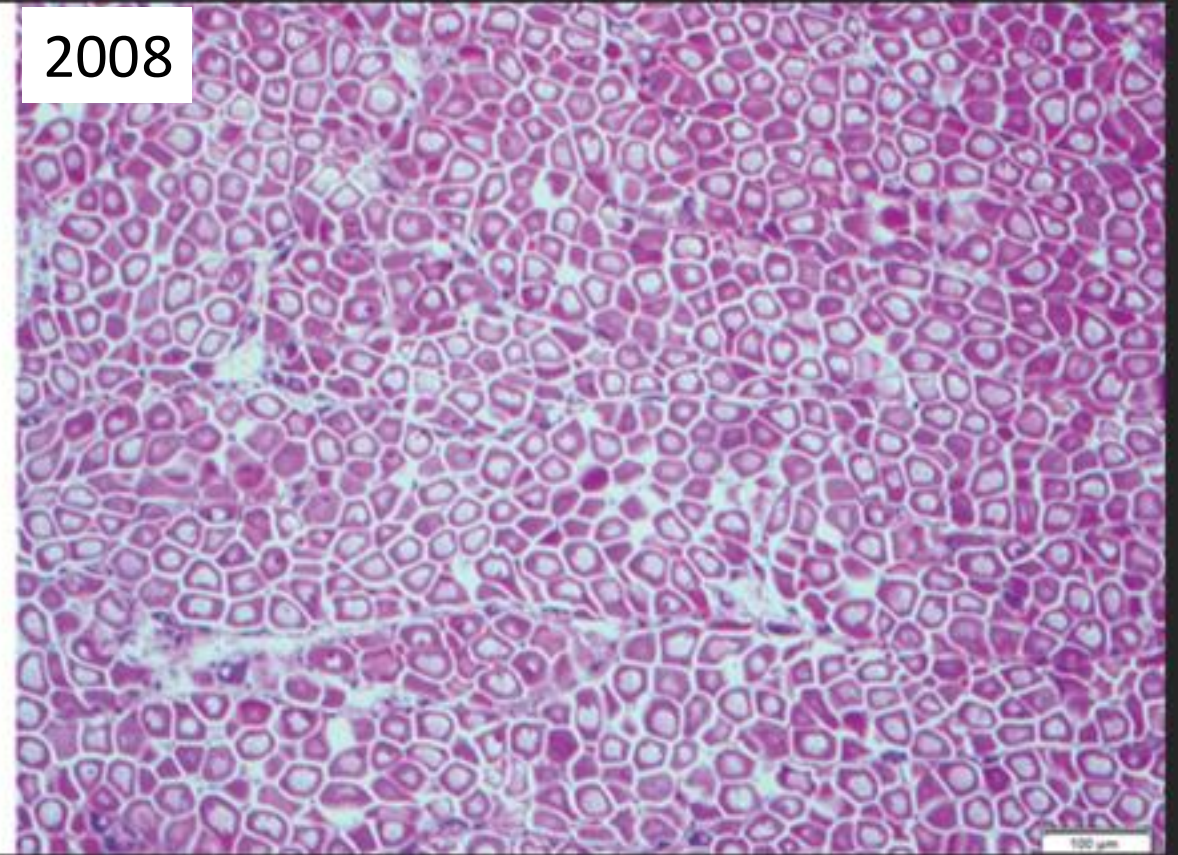
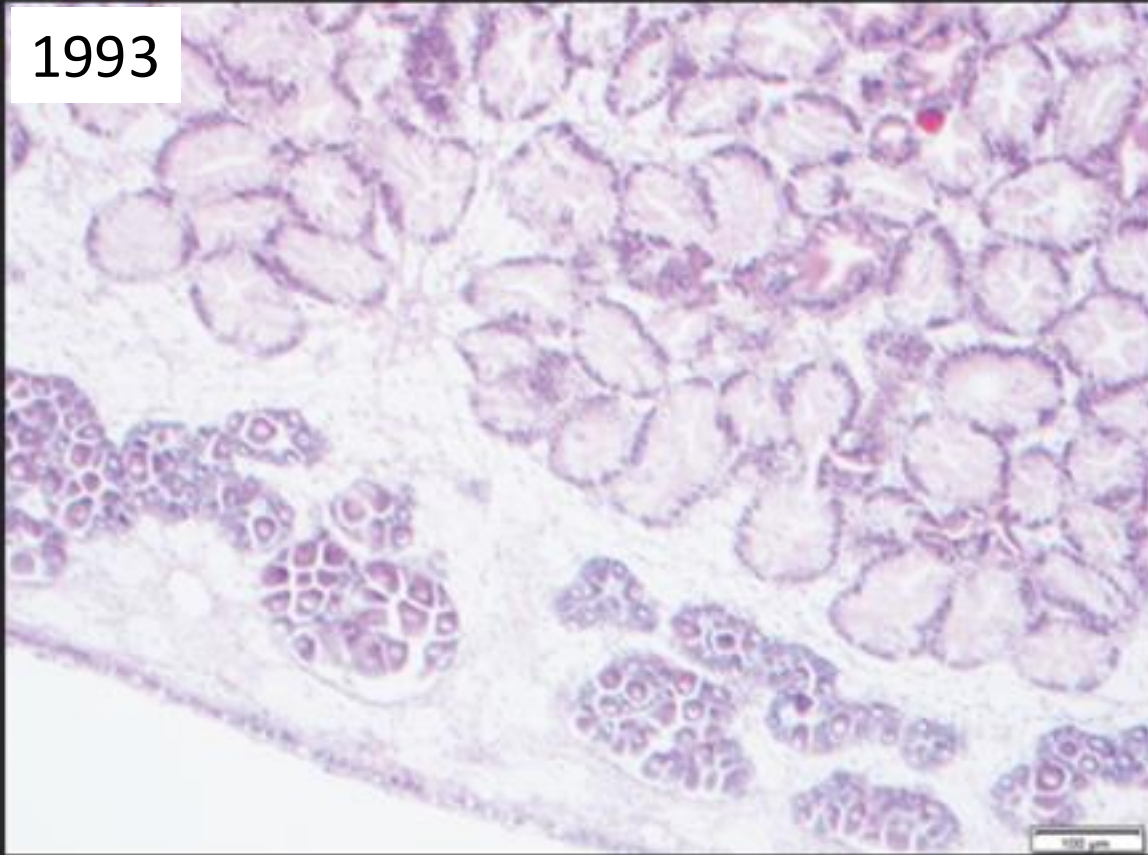
Fundamentals of *Perkinsus marinus* ecology

- Directly transmissible among oyster hosts; via deaths, feces
- Infection, impacts greatest by 2nd+ year of exposure
- Seasonal peak Aug-Oct; minimum late winter
- Temperatures $> 20\text{C}$ favor the parasite
- Full activity at salinity $> 10-12$; tolerant of lower



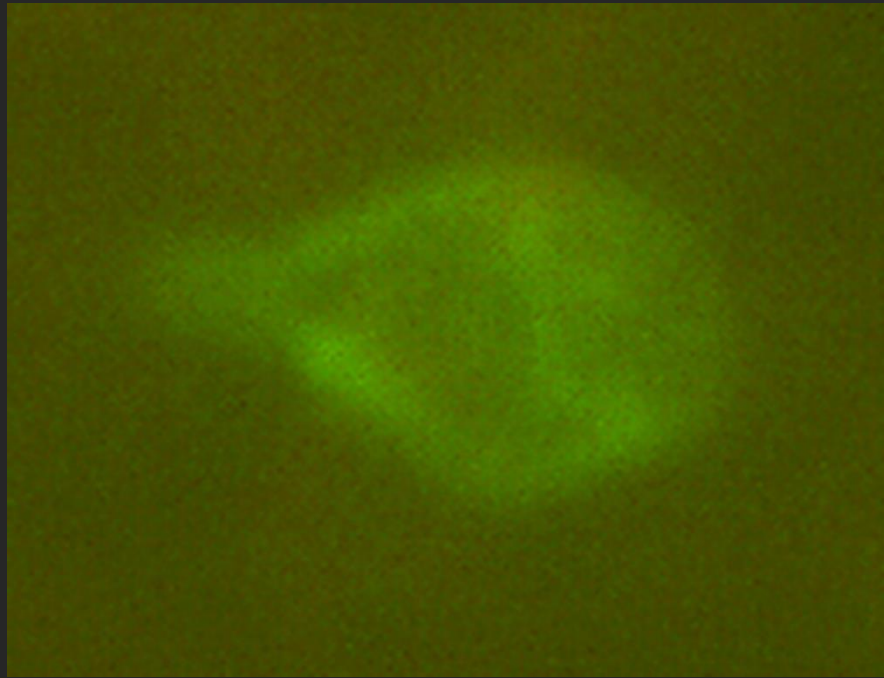
Secrets of the oyster's success with dermo?

Disease resistance and tolerance, both



Key question regarding *Perkinsus marinus*

What's going on that's important – ecologically, evolutionarily – that we can't quite see?



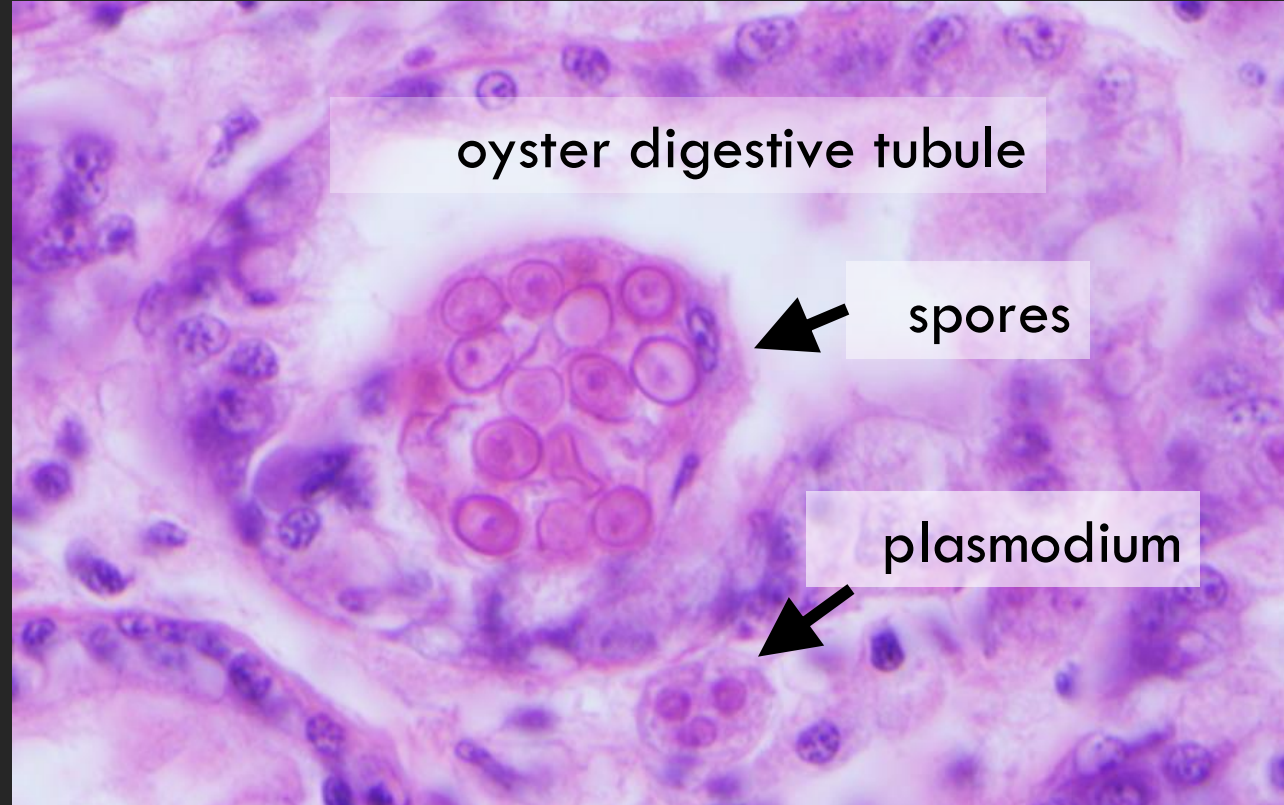
P. marinus zoospore



P. marinus hypnospore

Haplosporidium nelsoni (MSX disease)

- Protozoan parasite, exotic -- introduced from Asia
- Emerged in DE Bay in 1957, Chesapeake Bay 1959





This histological image compares normal fish gill tissue on the left with diseased gill tissue on the right. The normal gill shows well-defined primary and secondary lamellae. The diseased gill is characterized by a dense infiltration of *H. nelsoni* parasites, which has caused significant inflammation and a loss of the normal gill architecture. A scale bar in the bottom right corner indicates 200 micrometers.

Normal gill

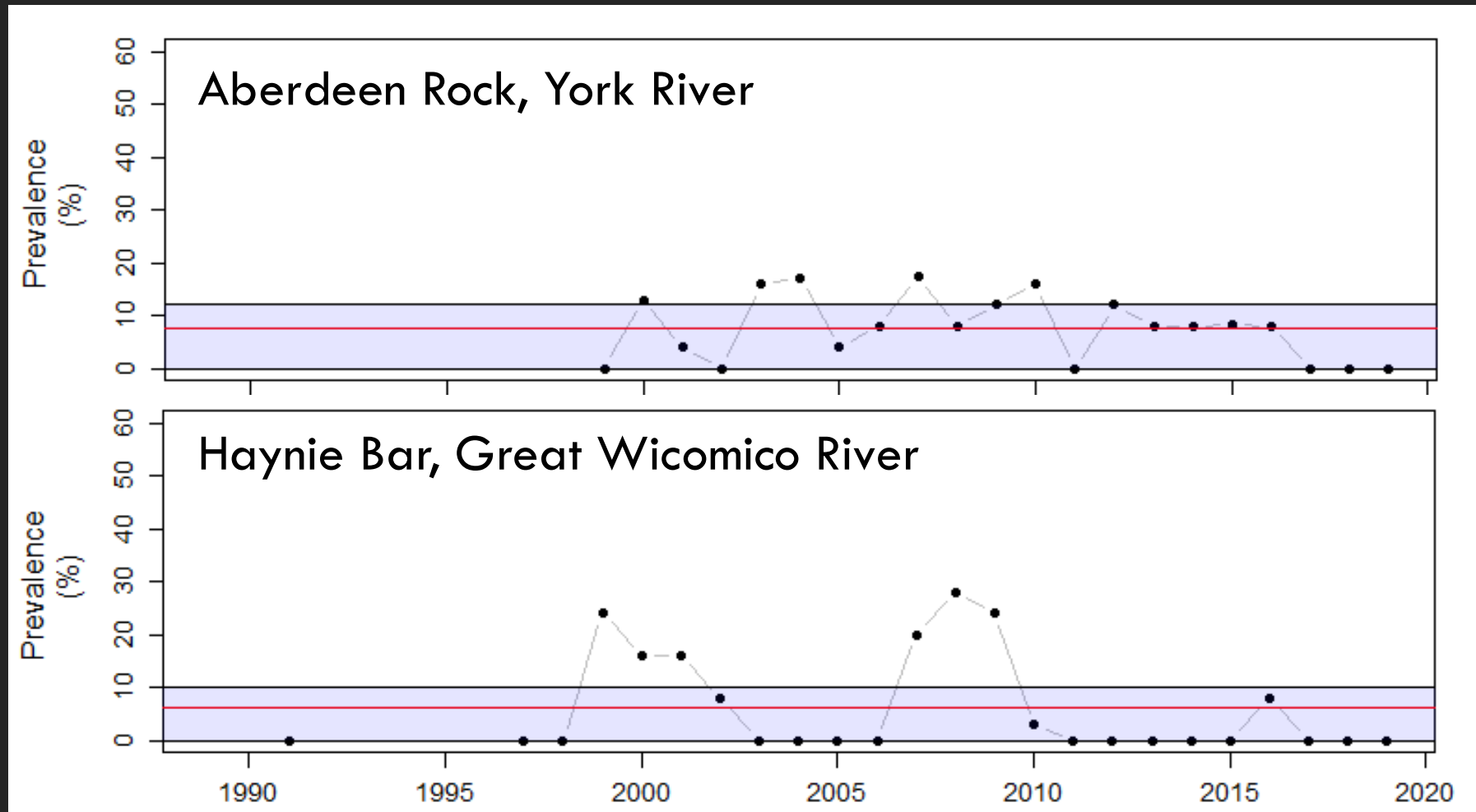
Abundant
H. nelsoni

Inflammation, loss
of normal gill
structure and
function

Diseased gill

200 μm

Now modest in prevalence, sometimes absent



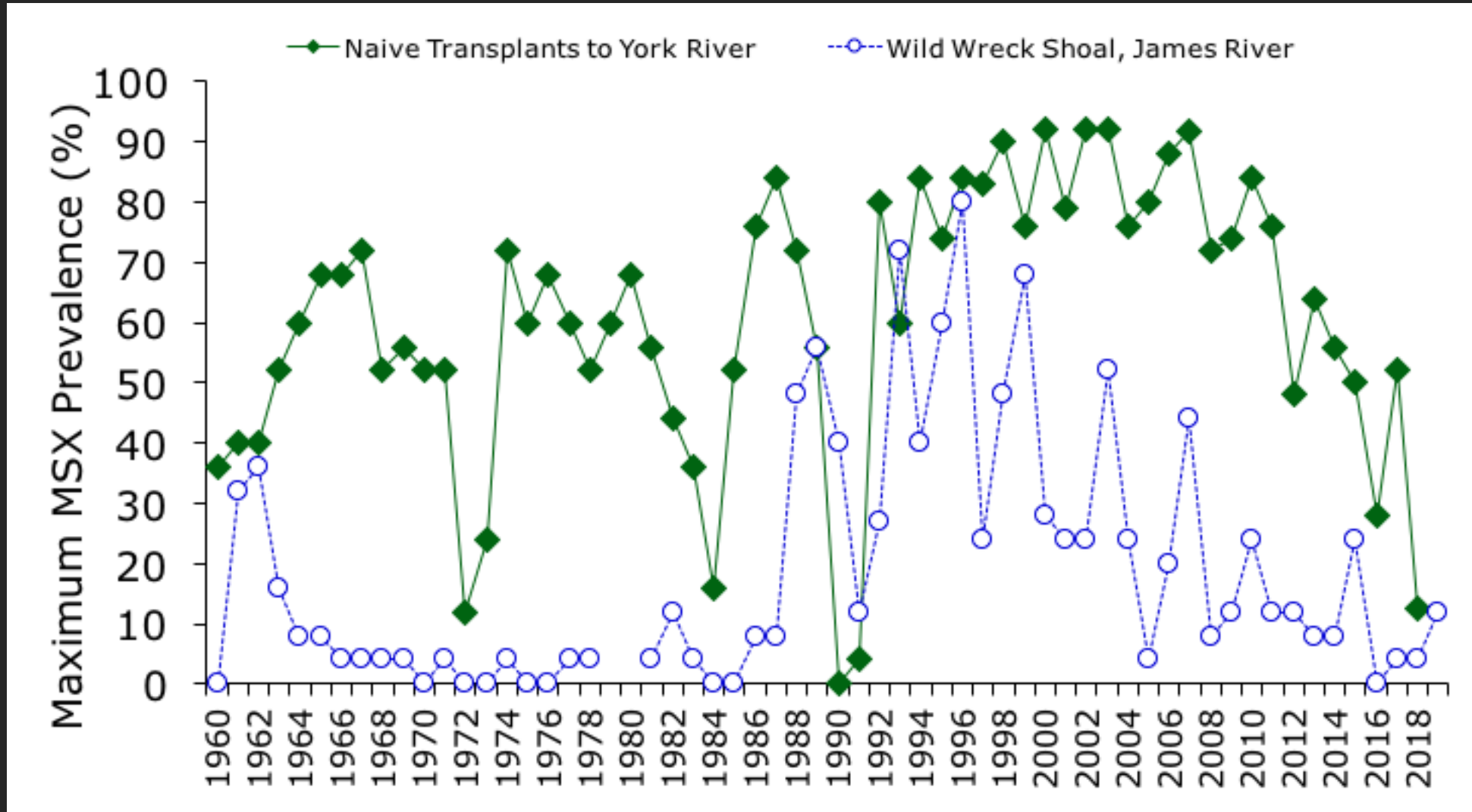
- Probably causes <10-15% mortality annually most years

Fundamentals of *Haplosporidium nelsoni* ecology

- NOT directly transmissible among oyster hosts
- Infection, acute impacts on all age/sizes, but especially young; very rapid disease development
- Seasonal peaks spring, fall
- Limited only by very low temperatures, maybe: $< 5\text{C}$
- Full activity at salinity > 15 ; intolerant of salinity < 10

Secrets of the oyster's success with MSX?

Disease resistance



Key question regarding *Haplosporidium nelsoni*
What is the intermediate host?



Questions from PEI aquaculture

Disease progression

Pre-existing infections versus those acquired from the environment, which is more important?

Pre-existing vs. new infections driving outbreaks

- Dermo: tempted to say “pre-existing” in the US, as Pm can overwinter at high prevalence—though new infections can be acquired anytime
 - Favorable early (spring) conditions may bode particularly poorly
- MSX: new infections are probably key

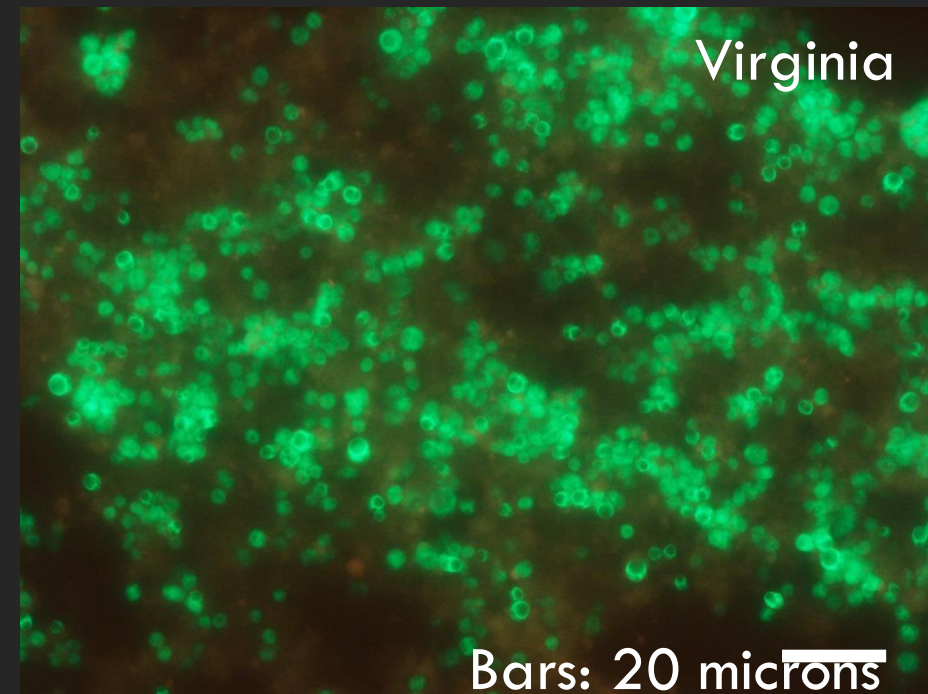
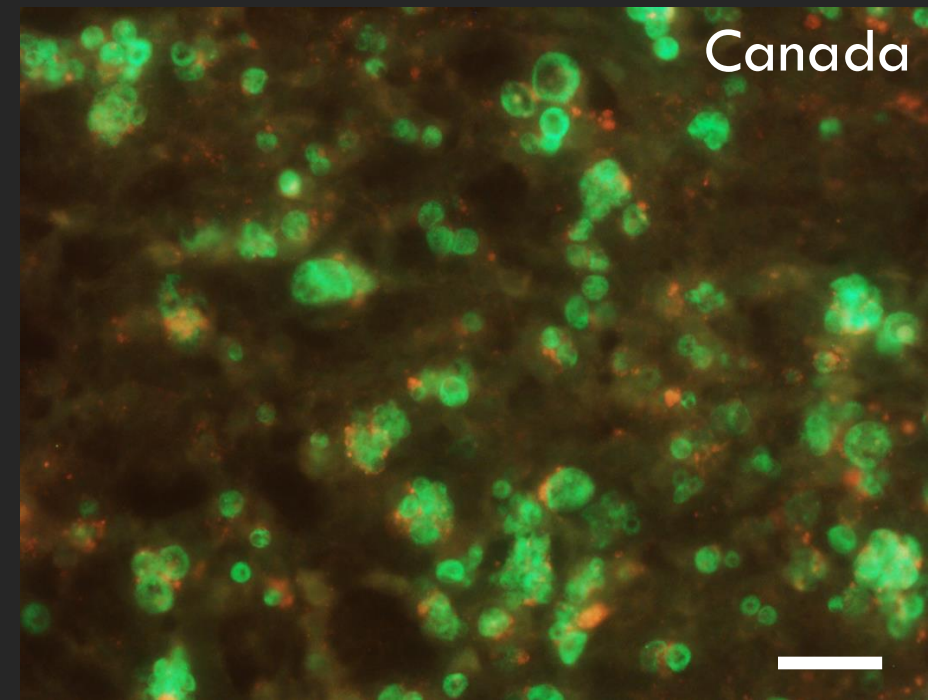
Sampling VIMS Spring Imports sentinels (L. Safi photo)



Is dermo a significant threat to PEI?

Is dermo really a threat to PEI?

- If dermo is new to the north, it may be encountering naïve oyster pops, which it might devastate
- Completely unclear this is the case
- Dermo may have been present a while, functioning entirely differently than in the south
- Different genetically, ecologically...
- May not be as damaging as it is in southern waters



Parasite burdens in “resistant” oysters?

Parasite burdens in “resistant” oysters

- MSX, few infections at all; dermo is more complicated
- With dermo, resistant oysters are often infected but keep intensities to “tolerable” levels

