Disease: Our Ever Present Problem

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MSX Disease (Haplosporidium nelsoni)

- Infection by “Multinucleate Sphere Unknown”, protozoan parasite
  - Introduced from Asia
  - Emerged in Delaware Bay in 1957, Chesapeake Bay in 1959

- Historical peak annual mortality > 90%

- Transmission indirect, life cycle unknown

- Causes disease and mortality ~ year-round where salinity is > 12 ppt

- Infection pressure has steadily increased over the decades; parasite thriving in more disturbed contemporary environment?
Dermo Disease (*Perkinsus marinus*)

- Infection by *Perkinsus marinus*, native protozoan parasite
- Since the 1980s the most significant oyster disease in the Mid-Atlantic
- Historical peak annual mortality > 70%
- Transmission direct, oyster-to-oyster
- Peak disease and mortality August-October, where salinity is > 10-12 ppt
- Levels of infection higher this decade than last, elevation of disease “baseline”
Haplosporidium nelsoni emerges

Perkinsus marinus intensifies
Oyster Abundance per Dredged Bushel of Reef Material
(a crude metric but one used systematically over many years)

Wreck Shoal
Haynie Bar

Not Restored
Restored
Some Definitions

- **Resistance**: host limits pathogen, either in colonization of the tissues or proliferation within.

- **Tolerance**: host does not limit pathogen, but rather minimizes physiological consequences of infection.

Roy and Kirchner 2000
For *H. nelsoni*, it’s all about resistance...

- Clear limiting of the parasite by the host, manifest in reduced prevalences in selected populations
- Increasing resistance over time in wild populations

Carnegie and Burreson 2011
For *P. marinus*, it’s mostly about tolerance... 

- Limitation of *P. marinus* not apparent from historical data
- *P. marinus* abundance today as high as it was early post-intensification
Oysters are investing more in reproduction
While Prevalence of Dermo Remains High…

Mean *Perkinsus marinus* Prevalence (%)
Fewer Infections Are Advanced

- Lower % of intense infections in wild relative to SI’s points to resistance
- The change between 1988-1998 and 2003-2016 suggests *increasing* resistance through the period
- Even though oyster abundance is markedly higher at all locations

Error bars: 95% CIs
Improved survival* (longevity)

Greater size & fecundity

Improved shell persistence

Increased reproduction

Increased substrate availability, recruitment and population growth
Dermo and MSX Impacts on Aquaculture

- Oysters frequently escape dermo impacts through early harvest
- Prevalence of infection can be very low in even market-sized cultured oysters
- MSX impacts may, occasionally, be surprisingly high
- Prevalence > 40%, advanced infections suggesting mortality
- Good resistance, except under the highest disease pressure?
“Triploid Mortality”

- Mortality of 30% (or higher), May-June
- Second-year, near-market-sized production affected
- Ploidy? Specific strains? Sites?
- Physiological disorder associated with polyploidy and reproduction seems likely
- May be advantage to growing diploids, especially for winter market
Shellfish Health in the Hatchery

**APPRAOCHES**

**SEAWATER CHEMISTRY**
- pH, carbonate saturation
- Role of algal toxins

**MICROBIOLOGY**
- Prokaryotic, eukaryotic diversity
- Role of known pathogens

**STUDY SYSTEMS**

**RESEARCH HATCHERIES: FOUNDATIONAL ANALYSES**
- Experimental manipulation of water handling to understand responses
  - *Intensive, high-frequency sampling*

**COMMERCIAL FACILITIES: COMPLEMENTARY ANALYSES**
- Ground-truthing experimental results
  - *Low-intensity, low-frequency sampling*

**OUTCOMES & PRODUCTS**

- Determination of how hatchery sanitation practices influence microbiology, and in turn shellfish health and production
- Resolution of the contribution of ocean chemistry and algal toxins

**IMPROVED GUIDELINES FOR MANAGING WATER CHEMISTRY AND MICROBIOLOGY IN SHELLFISH HATCHERIES**
What Can We Do For You?

- All monitoring data from the VIMS Oyster Disease Monitoring Program is freely, publicly available to support interstate seed transfer requests.
- Fall Survey of 32 Virginia oyster beds (James, Rappahannock, Piankatank, Great Wicomico, York, Mobjack Bay, seaside Eastern Shore).
- Additional James and seaside ES analyses for January, April, July.
What Can We Do For You?

- Perform seed certifications on shellfish of any size, from larvae to near-market-sized individuals
- Turnaround from 7-10 days (broodstock, large seed) to 3-4 days (small seed) to overnight (larvae, germplasm)
- Fees for “business as usual” analyses to cover material costs, unsubsidized labor
What Can We Do For You?

- Investigate disease events, mortality or unusual observations
- NEVER a charge for investigation of such events
Questions?

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