Health Considerations for Oyster Restoration Programs

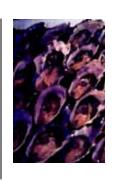
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- Roxanna Smolowitz
- Bower, S.M. and McGladdery, S.E. (2003):
 - Synopsis of Infectious Diseases and Parasites of Commercially Exploited Shellfish.

URL: http://www.pac.dfo-mpo.gc.ca/sci/shelldis/title_e.htm





- Major health goals
- Hatchery and nursery infectious diseases
- Infectious field diseases and diagnostics
- Health protocol and biosecurity considerations
 - General health
 - Potential pathogen risks
 - Mitigation approaches





- "Release" healthy oysters
 - Minimize infectious pathogens in culture
- 2. Avoid spread of pathogens and disease
 - Significance of pathogen
 - May be region specific
- (**Choose/use appropriate habitat/environment for "release"**)

1 and 2 require good husbandry and biosecurity

Pathogen significance



- Exotic (not local) vs. endemic (local)
- Regulated vs. unregulated
- Ubiquitous vs. rare or emerging
- Effect on health
 - Life stage differences
- Relative importance with regard to health assessment

Hatchery and Nursery Infectious Diseases



Potential Pathogen Sources in a Culture Facility



- Broodstock
- Algal stocks
- Seawater source
- Equipment
 - Gear
 - Cultch
 - Other animal vectors
- Miscellaneous sources
 - Air
 - Filters, surfaces, pipes, other system components

Juvenile and Larval Stages



- Diseases have only been identified in a captive setting
 - Nursery/hatchery
- Difficult to identify disease problems in wild stocks
- Greater susceptibility to more common opportunistic diseases

Hatchery/Nursery: Larval and Juvenile Diseases



- Fungi
- Bacteria
 - Opportunistic Vibrio spp.
 - Cytophaga-like bacterial infection of the hinge ligament
- Juvenile oyster disease (JOD)
 - C. virginica (MA, NY, ME)
 - Alpha-proteobacteria or protozoan
- Protozoa
 - Isonema-like flagellate

Hatchery/Nursery: Larval and Juvenile Diseases



- Viruses
 - Oyster velar virus disease (iridovirus-like)
 - Larval Pacific oysters (C. gigas)
 - Herpes-like virus infection
 - C. gigas, C. virginica (Maine)
 - Associated with high temps

Infectious Field Diseases and Diagnostics



Major Diseases of Concern

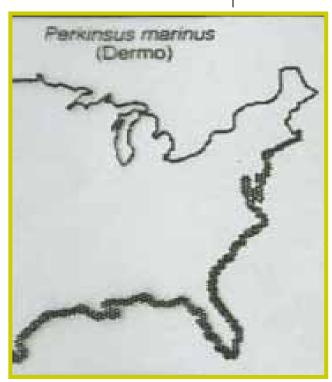


- Perkinsosis (Dermo)
- MSX
- Seaside Organism (SSO)

Perkinsosis (Dermo Disease)



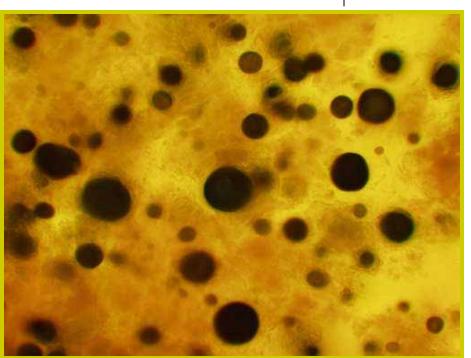
- C. virginicia, C. gigas
- Perkinsus marinus
 - Apicomplexa, but more closely related to dinoflagellates
- Occurs from Maine to the Gulf of Mexico
 - Potential strain variation
- Direct transmission or via vectors such as drills
- Temp > 18°C
- Salinity ranging 15-30 ppt
- May take up to 2 years to cause mortality



Perkinsosis



- Diagnosed via:
 - Histopathology
 - Culture
 - Ray's fluid thioglycollate media
 - hypnospores
 - PCR/RTPCR
- Management:
 - Require health screening before shipping seed
 - Develop resistant oysters
 - Allow infected leases/plots to lie fallow for 1-2 yrs
 - Monitor populations
- Listed in FDACS Division of Aquaculture BMPS







- Perkinsus olseni
 - Mya arenaria, Tridacna sp., others (Tapes decussatus), incidental finding in others such as M. mercenaria
 - Low mortality/prevalence
 - Maine to Gulf of Mexico, Portugal and Spain
- Perkinsus chesapeaki
 - Mya arenaria and Macoma balthica

Multinucleated Sphere Unknown (MSX)



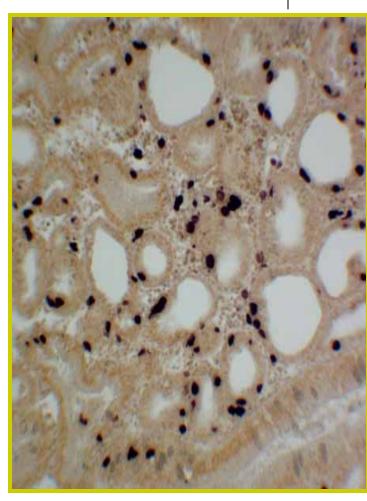
- C. virginica, C. gigas
 - Oysters considered aberrant hosts
- Haplosporidium nelsoni (protist)
 - Doesn't survive low salinities
- Florida to Maine
- Introduced to the East coast via C. gigas
- Listed in FDACS Division of Aquaculture BMPS



Multinucleated Sphere Unknown (MSX)



- Morts can reach 90-95%
- Diagnosis via:
 - Gross exam
 - Squash preps
 - Spores in digestive gland 7.5 x
 5.4 μm
 - Histocytology
 - Plasmodia in blood cell suspensions
 - Histopath
 - Multinucleate plasmodia
 - DNA probes





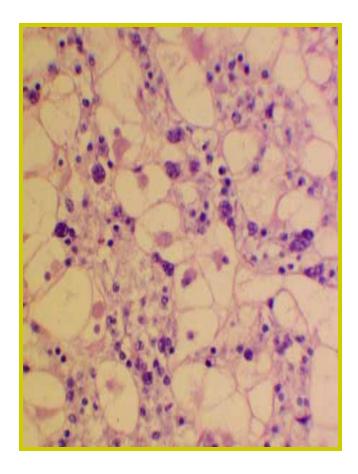


- Caused by the protist, Haplosporidium costale
- C. virginica
- Seasonal, complex life cycle ending in final sporulation killing the host
- Distribution on east coast of United States and Canada (from Virginia to Nova Scotia) in water with a salinity over 25 ppt
 - Outbreaks in Canada in 2003





- Diagnostics
 - Histopathology
 - Multinucleate plasmodia and uninucleate spores containing bright red cytoplasm
 - Modified Ziehl-Neelsen carbol fuschsin technique
 - DNA probes
 - Difficult to differentiate MSX from SSO histologically in many cases







- Aber Disease (Digestive Gland Disease; Protist: Marteilia refringens)
 - Ostrea edulis, C. gigas, (calico scallop has similar disease)
 - Europe, but considered an import risk in the US
 - Calico scallop
 - Mass mort prior to 1988
 - East coast of Florida
- Bonamiasis (Microcell; Protist: Bonamia ostrea)
 - Affects flat oysters, O. edulis
 - 2 new species affecting the Asian oyster (Crassostrea ariakensis) and flat oysters
 - Most infected oysters appear normal
 - Distribution
 - Europe and the United States (California, Maine and Washington)
 - Confirmed cases in Virginia and North Carolina in 2003 and 2004

Other Diseases



- Quahog Parasite X (QPX)
 - Net slime mold
 - M.mercenaria
 - import risk; listed disease in the Florida Division of Aquaculture's BMP document
- Nematopsis gregarian
 - All bivalves
- Xenoma
 - Ciliates (Thigmotrix)
- Coccidiosis (Klossia and Pseudoklossia)
 - Various bivalves, but common in bay scallops

Other Diseases

- Rickettsiales/Chlamydiales
 - Most bivalves
 - Any epithelium
 - High morts in bay scallops
- Ovocystis
 - C. virginica, C. gigas
 - Papillomavirus-like papovirus
- Leukemia (hemic neoplasia)
 - Various bivalves
 - Unknown if infectious
- Others



Health Protocol and Biosecurity Considerations







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Important Factors



- Life stage
- Population locale
- Endemic diseases
- Water body of origin or destination
- Water quality parameters (e.g., salinity)
- Source of materials used

Different levels of importance based on type of restoration scheme

Restoration Health Protocol



- Agreement on what is "normal" and "acceptable" health
 - Including state and federal regulations
- Current understanding of etiology, epidemiology, and relative importance of diseases
 - Cultured and wild stocks
- 3. "Normal" baseline for different populations

Restoration Health Protocol



- 3. Sound protocol for health assessment
- 4. Methods for mitigation of risk for diseases
 - Will vary depending on restoration method
- 5. Plan for follow-up after release
 - Evaluation can be simple or more rigorous

Acceptable Health



- Agreement on what is acceptable "normal" health for each life stage used for restoration
- Scenario dependent
 - Can be simple
 - Within "region" materials and/or animals
 - Observation/mortalities
 - Can be more complex
 - Externally derived materials and/or animals
 - Observation and sampling

Biosecurity Considerations

- Potential pathogens
 - Introduction into "cultured" population and/or "receiving" population/environment
 - Pathogen significance
 - Locally exotic vs. endemic
 - Dermo
 - (Arnold): Tampa Bay vs. Mosquito Lagoon vs. St. Lucie-Central
 - Strain variations?
 - MSX?
- Broodstock origin, hatchery location, or transplant origin
- Consider regions
 - East vs. west coast
 - Currents
 - Major water bodies (Tampa Bay vs. Sarasota Bay)

Scenarios

- Natural recruitment
 - Shell/Cultch addition
 - Oyster vs. non-oyster
 - Reef balls (synthetic)
- Hatchery
 - Wild broodstock
 - Algal cultures and seawater source
 - Shell substrate in tanks for larvae
 - Post larvae vs. older life stages
 - Release of setting size larvae into enclosure with shell
- General: site-to-site transfer/release of animals
 - Age/size/genetics
 - Geographic proximity
 - Currents/other features



Scenarios: Risk and Mitigation of Natural Recruitment



Potential pathogen sources

- Shell/Cultch substrate (1)
 - Oyster vs. non-oyster
 - Origin
 - Species
- Mitigation: shell/cultch
 - Limit use to within "region"
 - Consider pros and cons of species
 - Disinfection?
 - Effect on recruitment?

- Reef balls (synthetic) (2)
- Mitigation: reef balls
 - New or disinfected
 - "Within region"
- Gear/boat/material vectors (3)
- Mitigation: Gear et al
 - "Within region"
 - Cleaning/disinfection

Scenarios: Risk and Mitigation of Hatchery



Potential pathogen sources

- Wild broodstock (4)
- Mitigation: broodstock
 - "Within region"
 - Statistical/random sampling
 - Separate conditioning broodstock into small tanks
 - Isolate and examine questionable broodstock
- Algal cultures (5)
- Mitigation: algal cultures
 - Periodically evaluate for potential pathogens
 - Bacteria, fungi, protozoa

- Seawater source (6)
- Mitigation: seawater source
 - "Within region"
 - Disinfection
- Shell substrate (1)
- Mitigation (discussed earlier)

Scenarios: Risk and Mitigation of Release and Site-to-Site Transfer



Potential pathogen sources

- Live oysters
 - ("Inherent" risk while in culture if animals become diseased)
 - Potential source of pathogens for endemic population
 - Age/size/genetics
 - Real or potential difference in susceptibility to disease
 - Difference in likelihood of harboring specific pathogens

- Mitigation: live oysters
 - "Within region"
 - Geography
 - Location, currents
 - Statistical/random sampling(i.e., health inspection)
 - Diagnostic methods will vary with:
 - Life stage
 - Pathogen





- Timing (collection, processing, and interpretation) and logistics
- Sample collection protocol to be developed
- Sample size
 - Numbers likely to be dependent upon
 - Pathogen of interest
 - "Relatedness" of sites of origin and release
 - Overall biosecurity of specific program
 - 30, 60, or 150
- Primary methods
 - Ray's Fluid Thioglycollate Medium (Dermo)
 - Histopathology (others)





- Other animals in/on culture materials, gear, or oysters
 - Vectors or carriers
- General vs. targeted surveillance
 - Loose or structured
 - Follow-up post-restoration event
 - Help determine etiology of morbidity/mortality or general health
 - Emerging or exotic pathogens and new information

Questions?

