Transmission Experiments

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What Controls *Pathogen* Populations Across Space and Time?

- **Scales:**
  - Temporal: seasonal > interannual > decadal > longer
  - Spatial: host > bed > estuary > region > continent

- **Host-Pathogen-Environment Interactions:**
  - Physical tolerances/limits
  - Transmission: Pathogen sources, dispersal, sinks
  - Genetics of resistance and virulence
  - Interactions with other organisms
Conceptual variation in H-P-E interactions
Transmission dynamics ~ Recruitment dynamics

Transmission is a process with several steps involving several rates dynamics.
“Environment” component includes all ecosystem processes

To fully understand this requires a comprehensive view that considers individual to ecosystem interactions
Fig. 3. Relationship of weighted prevalence from Ray’s tissue assay with cumulative percent mortality of oysters in Delaware Bay. Circles = weighted prevalence; squares = cumulative nonpredation percent mortality.
Transmission: Pathogen proliferation in host

Transmission is a process with several steps involving several rates dynamics.
Pathogens in cell culture

What moves the pathogen down into the lag phase?

- Rapidly growing lab culture/
  Diseased oyster population
- Long-term lab maintenance
  Healthy oyster population
Seeding density controls lag duration
Transmission dynamics ~ Recruitment dynamics

Transmission is a process with several steps involving several rates dynamics:

- **Source**
  - Proliferation
  - Maturation

- **Release**
  - Spawning

- **Contact**

- **Settlement**

- **Sink**
  - Infection
  - Metamorphosis

- **Dispersal**
Are oysters sources or sinks for planktonic stages of *P. marinus*?

**LOCATION**
- MOUTH, TERMINUS

**TIDAL STAGE**
- FLOOD, HIGH, EBB

**TREATMENT**
- CONTROL CREEKS, REMOVAL CREEKS

**MONTH**

R. Ellin
What is the role of oysters in governing the planktonic abundance of *P. marinus*?
Planktonic abundances of *P. marinus*

- Peak abundance occurs before mortality
- Parasites present throughout year
- Source?

Source: Ragone Calvo et al. 1995
Fig. 7. *Perkinsus marinus* abundance in the water column in 2002. (A) Weekly average parasite abundance. (B) Interval average parasite abundance. Error bars correspond to standard deviations. Averages correspond to back-transformations of the averaged transformed data.
Peak planktonic abundance precedes infection intensity in North Inlet, SC

\[ \begin{array}{ccc}
\text{NO LAG} & 0.126 & 0.256 \\
1 \text{ MON} & 0.371 & 0.023^* \\
2 \text{ MON} & 0.064 & 0.360 \\
\end{array} \]

(R. Ellin 2000)
Transmission dynamics ~ Recruitment dynamics

Transmission is a process with several steps involving several rates dynamics:

- Dispersal
- Release
- Spawning
- Contact
- Settlement
- Proliferation
- Maturation
- Infection
- Metamorphosis

Source -> Sink
Viability outside host

Proportion of samples remaining viable

Days in seawater

AIC
- Constant: 363.7
- Gompertz: 279.7
- Step: 343.4
Circulation controls on dispersal

North Inlet, SC

Murrells Inlet, SC

Land Classification:
- agriculture
- beach
- forest
- recreational
- scrub/shrub
- developed
- water
- wetland

White et al. 1997
Result is a reduction in transmission


Ellin, R – USC Thesis
Transmission dynamics ~ Recruitment dynamics

Transmission is a process with several steps involving several rates dynamics.

- Contact
- Settlement
- Infection
- Metamorphosis
- Proliferation
- Maturation
- Source
- Sink
- Dispersal
- Release
- Spawning
Host density changes contact rate

Parasite concentration (cells L$^{-1}$) vs. Time (days)

Different line styles and colors represent different host densities:
- N=10
- N=25
- N=50
- N=100
- N=200
Host density changes infection rate

![Graph showing incidence of Perkinsus marinus infection with different initial doses and host densities.]

- Y-axis: Incidence of Perkinsus marinus infection
- X-axis: Initial Perkinsus marinus dose (cells L⁻¹)
- Colors represent different host densities (10, 25, 50, 100, 200)
What are the portals of entry and processes of initial dissemination into hosts?

What are the processes of parasite proliferation and reproduction within hosts?

How do parasites disperse from bivalve hosts?

Are there additional sources of infective parasites?

How long do free-living parasite stages survive and remain infective outside hosts in the water column?

Are there alternative and/or intermediate hosts?

Parasite transmission in bivalve hosts
Questions?
Stop before you get into more trouble