Modeling the Potential Impacts of *Heterosporis sutherlandae* on the Harvest of Yellow Perch (*Perca flavescens)* in Leech Lake, MN.

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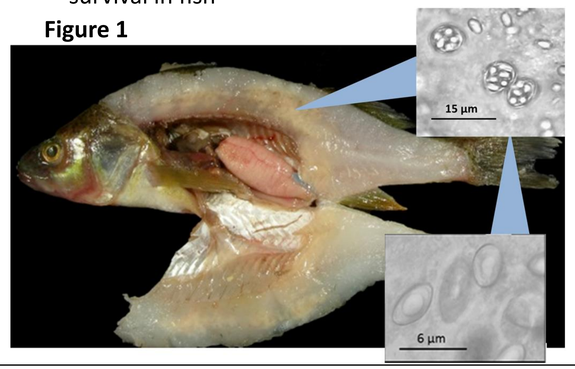
ENVIRONMENT AND NATURAL RESOURCES TRUST FUND

Background

- *Heterosporis sutherlandae* (HTSP)
  - Microsporidian parasite that forms lesions in skeletal muscles (Figure 1)
  - Theorized sub-lethal effects and increased mortality, additionally anglers will not eat fish with disease
- Few models exist which describe disease dynamics in a fishery,
  - Environmental factors determine growth, and therefore survival in fish

Figure 1



Objective

What loss could *Heterosporis sutherlandae* cause to the perch fishery in Leech Lake, MN?

1. **Collected field data** to determine prevalence of *H. sutherlandae*
2. **Performed laboratory experiments** to determine *H. sutherlandae* transmission, host mortality and growth effects
3. **Developed integrated model** to combine field, experimental and historical data to predict harvest outcomes

Methods

- **Field data** – collected >100 yellow perch seasonally for demographic data and to assess disease status.
- **Laboratory data** - Fed infected tissue to yellow perch and fathead minnows (*Pimephales promelas*), then euthanized after exposure period to test force of infection (FOI) due to consumption
  - Co-house dfathead minnows and yellow perch to test FOI due to direct contact
  - Monitored mortality and growth

Methods

- **Integrated Model** (Figure 2): bioenergetics, SEIR disease (Figure 3) and population models , tested model with scenarios (Figure 4)

Figure 2

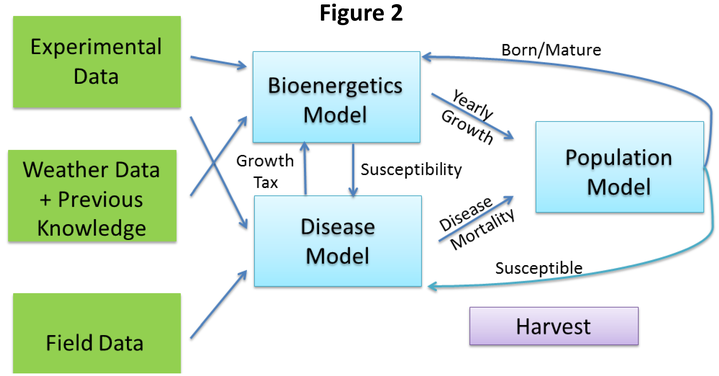
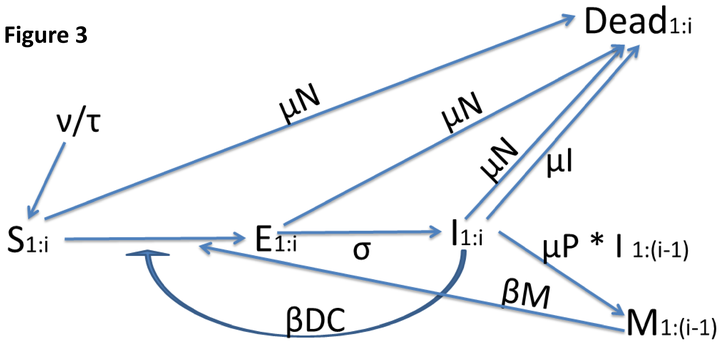


Figure 3



v/τ = birth/survival
µN = natural mortality
µI = disease mortality
µP = predation mortality

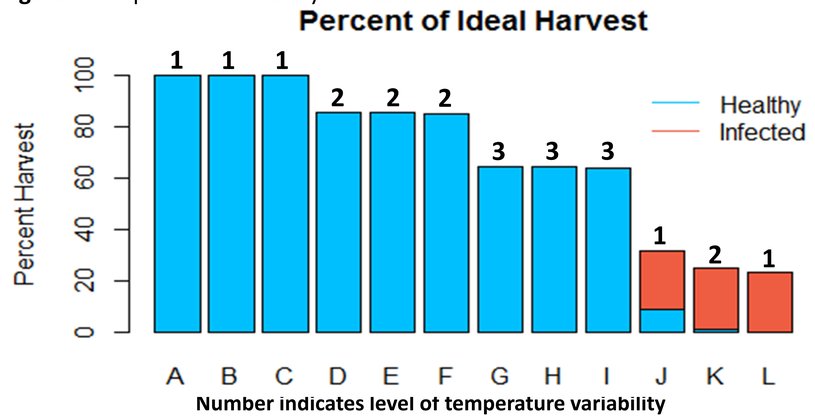
σ = rate to move to infectiousness
βDC = transmission via direct contact
βM = transmission via consumption

Results

- Low prevalence of HTSP lesions and detected spores in the wild (<5% and <10%)
- FOI is low due to consumption, (0.5 for fathead minnows and 0.31 for perch.).The FOI for direct contact minnows and perch is 0.17, and 0.01 for fathead minnows.
- Little evidence of growth or mortality effects
- The model of *H. sutherlandae* as we know it has no effect on overall harvest (Figure 4)

Results

Figure 4: Proportion of healthy harvest under tested scenarios



A	HTSP as we know it	**G**	Healthy
B	HTSP , FOI consumption = 0.62	**H**	HTSP as we know it
C	HTSP, 10x more deadly	**I**	HTSP, FOI direct contact during bad year = 0.4, Dis. Tax =0.25
D	Healthy	**J**	HTSP, FOI direct contact = 0.4
E	HTSP as we know it	**K**	HTSP, FOI direct contact = 0.4
F	HTSP, FOI direct contact during bad year = 0.4, Dis. Tax =0.25	**L**	HTSP, FOI direct contact = 0.5

Discussion

- *H. sutherlandae* as we know it causes minimal losses
- If susceptibility increases due to stress, potential to have greater impact
  - More research is needed regarding relationship between temperature and disease transmission
  - Impacts of vertical transmission may be important
- Useful method for fish systems–ability to discern environmental interactions

Acknowledgements & References

Thank you to our funding source the Minnesota Environment and Natural Resources Trust Fund as recommended by the Legislative-Citizen Commission on Minnesota Resources (LCCMR).

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