An Agent-Based Model of Diel Vertical Migration in *Mysis diluviana*

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Results

- *Mysis* survival rate is highly sensitive to perturbations in their feeding efficiency.
- Water temperature limits migration extent for the middle of the year whereas light levels do for the rest.

Introduction

- *Mysis diluviana* (*Mysis*) is a macro-invertebrate crustacean that lives in Lake Champlain and other deep glacial lakes.
- *Mysis* migrate up and down the water column daily in a process called "diel vertical migration."
- We used publicly available data and previous studies to construct a model that simulates the environmental pressures on a *Mysis* at an hourly time interval over the course of a year.

Agent-Based Modeling

- Simulates an individual *Mysis*.
- Every hour draws are taken from probability distributions to decide if the *Mysis* migrates and how successful their feeding is.
- Good for complex scenarios with noisy input variables (e.g. cloud cover for light intensity).
- Many individuals are simulated to get a sense of population level trends.
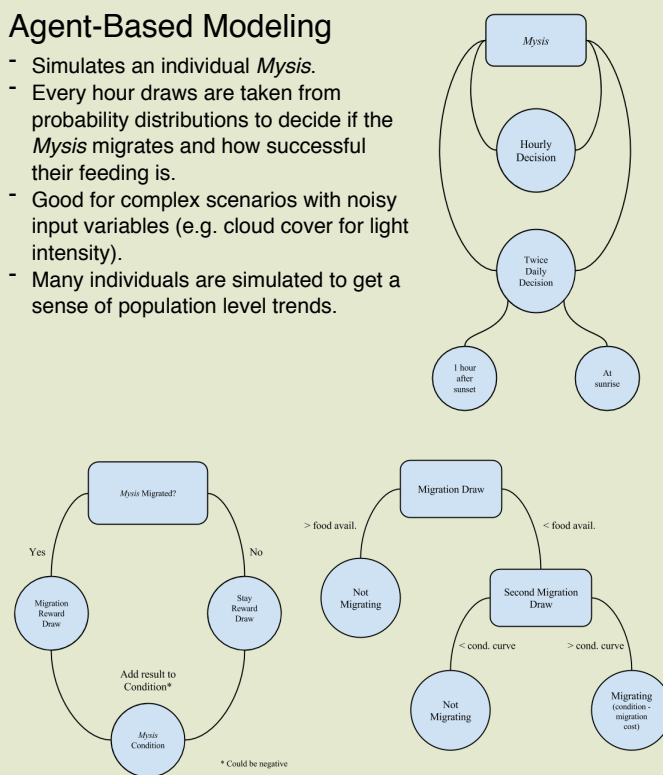
Mysis Energy Conditions

Condition Over Year
*500 mysids, Reward: 0.66 , Migration Cost: 20 , Mortality Rate: 0.182*
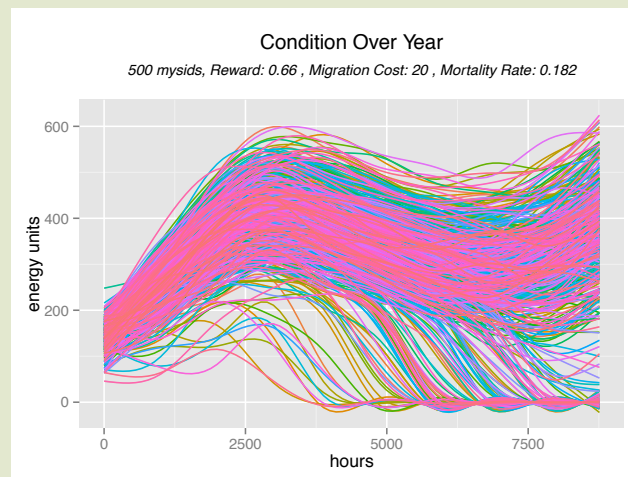
- Each line represents an individual being simulated over the year.
- Lines that drop to or below zero are *Mysis* who have starved.
- Demonstrates model's stochasticity.

## Interactive Application

Mysis Condition
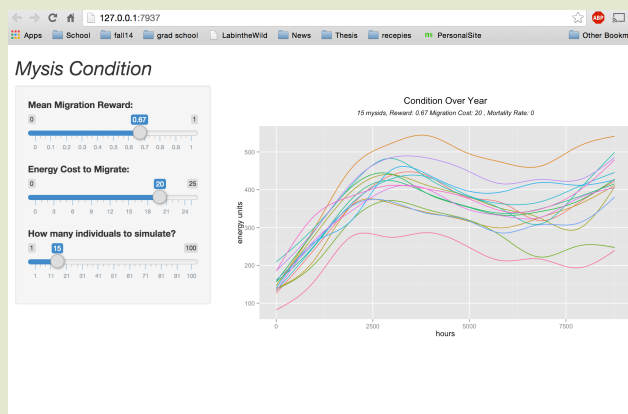
- Utilizes R Shiny Servers to allow user to interact with model parameters without tinkering with code.
- Rapidly facilitates insights into effects of changing parameters.
- Hosted on the web for anyone to use. (https://nstrayer.shinyapps.io/mysisApp)
- Helps make research reproducible by others.

Mysis Migration Extent
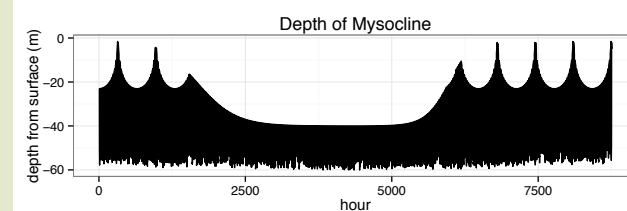
Depth of Mysocline

- Light intensity (isocline) and thermocline data combine to paint a picture of *Mysis* migration extent (mysocline).

Mortality Rates
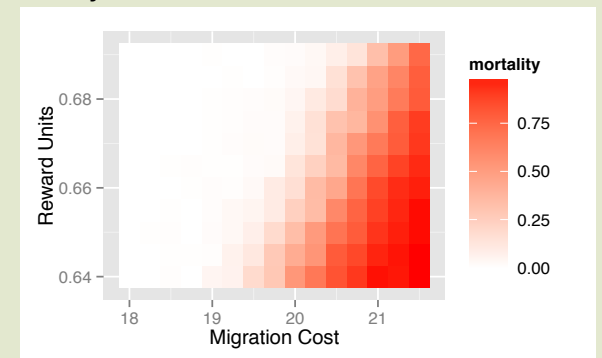
- There is greater sensitivity to changes in migration cost than in reward units.
- Follow expected trends based upon ecological theory.

Future Directions

- Probe the possibility of multiple stable migration patterns.
- Dig in to specific aspects of the model. E.g. predation risk, benthic food availability
- Utilize real data in model inputs such as thermocline depth and food availability.

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