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 small 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.

Mysocline


Depth of Mysocline
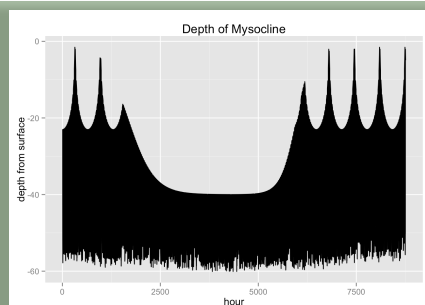
- Light intensity and thermocline data combine to paint a picture of mysis migration extent.

Agent Based Modeling

- Simulates an individual Mysis.
- Every hour draws are taken from probability distributions to decide if the mysis migrates, how much they feed, etc.
- Good for complex scenarios with noisy input variables (e.g. cloud cover for light intensity).
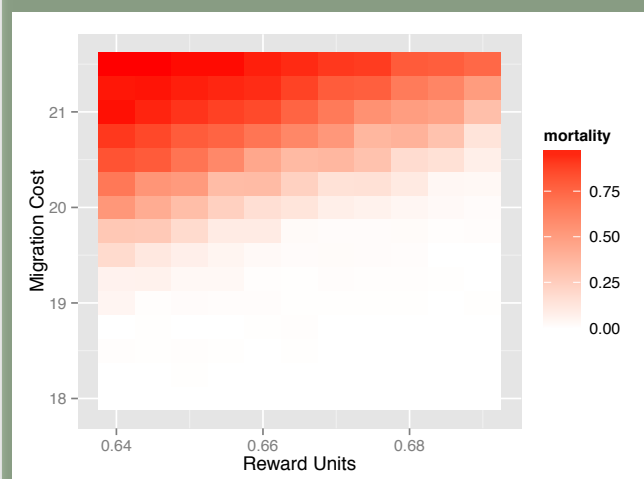- Many individuals are simulated to get a sense of population level trends.

Energy Conditions

Mysis condition over year, Mortality Rate: 0.499
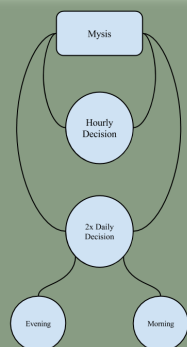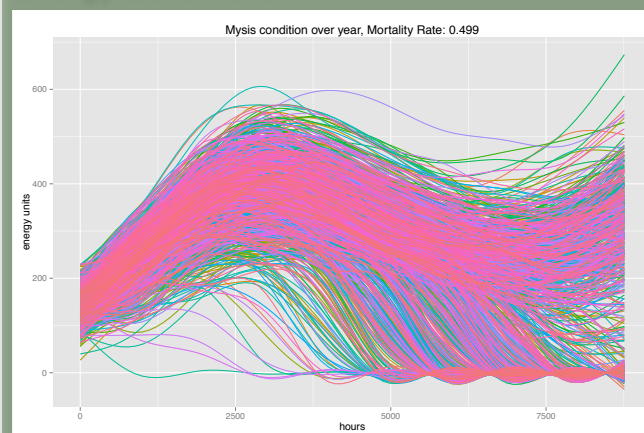
- Each line represents an individual being simulated over the year.
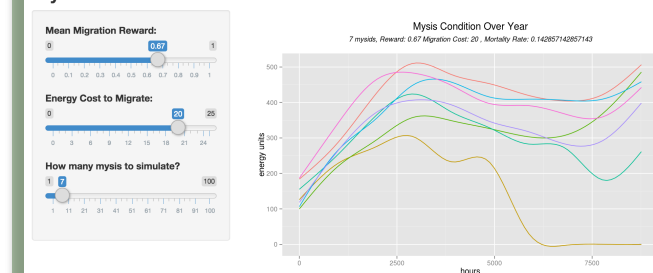- Lines that drop to or below zero are individuals who have starved

Mortality Rates

- There is greater sensitivity to changes in reward units than migration cost.
- Results follow expected trends based upon ecological principles.

Interactive Application

Mysis Condition

Mean Migration Reward: 0.67

Energy Cost to Migrate: 20

How many mysis to simulate? 7

Mysis Condition Over Year
7 mysids, Reward: 0.67 Migration Cost: 20 , Mortality Rate: 0.142857142857143

- 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. (_____ nstrayer.shinyapps.io/mysisApp
- Helps make research reproducible by others.

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.

References

- Jensen O. P., Hrabik T. R., Martell S. J. D., Walters C. J., Kitchell J. F., Diel vertical migration in the Lake Superior pelagic community. II. Modeling trade-offs at an intermediate trophic level, Can. J. Fish. Aquat. Sci. 63: 2296-2307 (2006)
- Grimm V. et all, A standard protocol for describing individual-based and agent-based models, Ecological Modeling, V. 198(1-2): 115-126 (2006)

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