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

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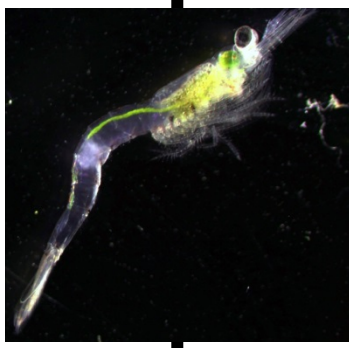
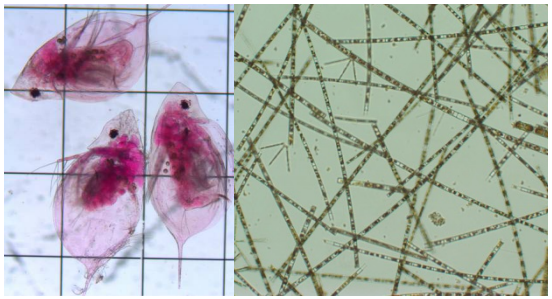
Mysis diluviana is a mid-trophic level omnivore; links upper/lower trophic levels across habitats via DVM

Pelagic and benthic fishes access *Mysis*





Mysis have multiple foraging options

What We Want to Figure Out

- According to _____ et al. we know that Mysis exhibit partial dvm.
- Why do Mysis exhibit partial diel vertical migration?
  - Are there multiple stable strategies?
  - What are the main driving forces pushing them to migrate.
- Modeling the migration as a whole will pave the way to understanding decision processes and tease out the motivating factors driving migration.

An agent-based, Monte-Carlo style model

- Simulates an individual *Mysis* throughout the entire year.
- At every hour of the year, draws are taken from probability distributions for decision making.
- Many individuals are simulated to get an idea of population-wide trends.
- Input comes in the form of *Mysis* migration extent and…
- Food availability/variability for the pelagic (surface) waters.

Input comes in terms of *Mysis* migration extent under the assumption of temperature and light "ceilings"

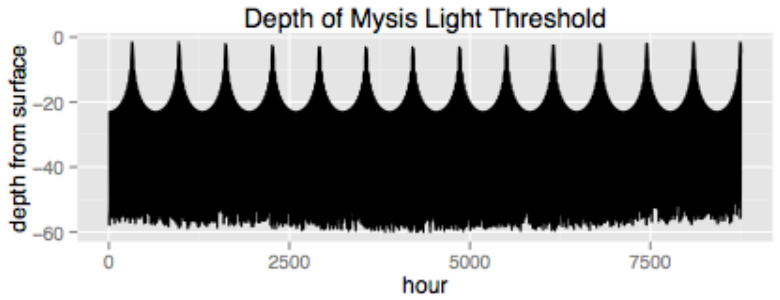
Light intensity levels

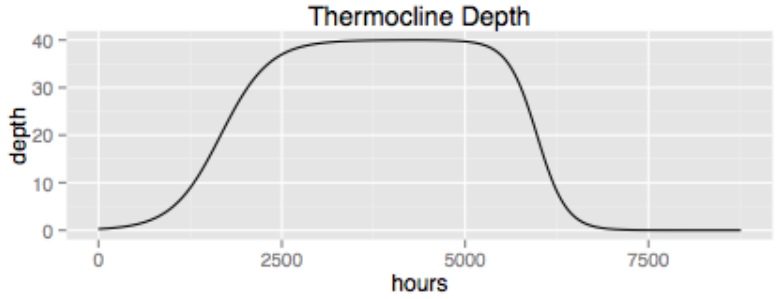
+

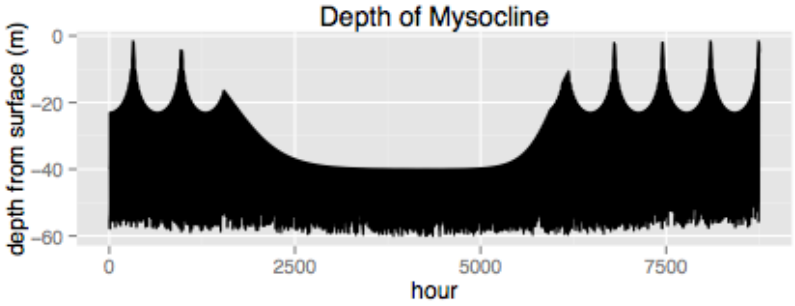
Temperature profile

=

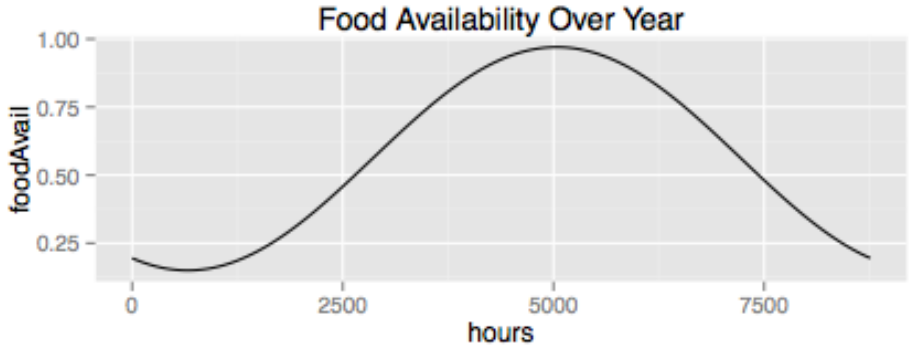
Mysocline



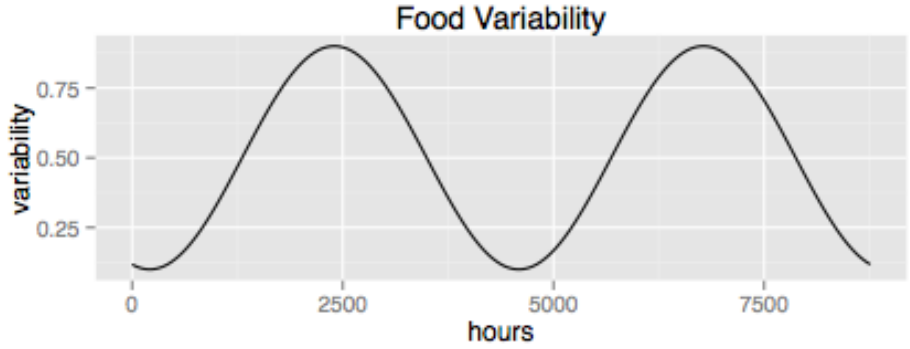




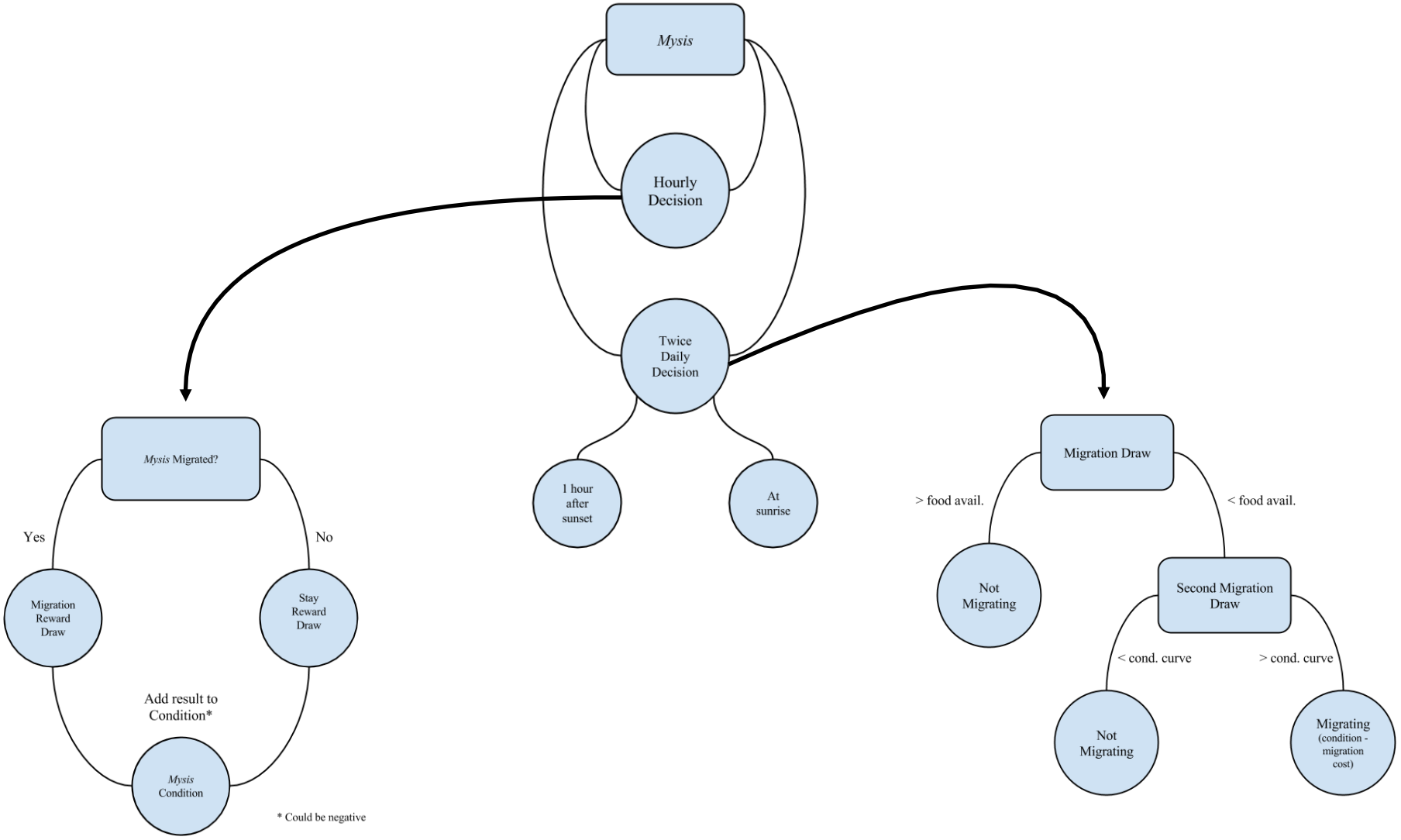
And food availability/variability in pelagia



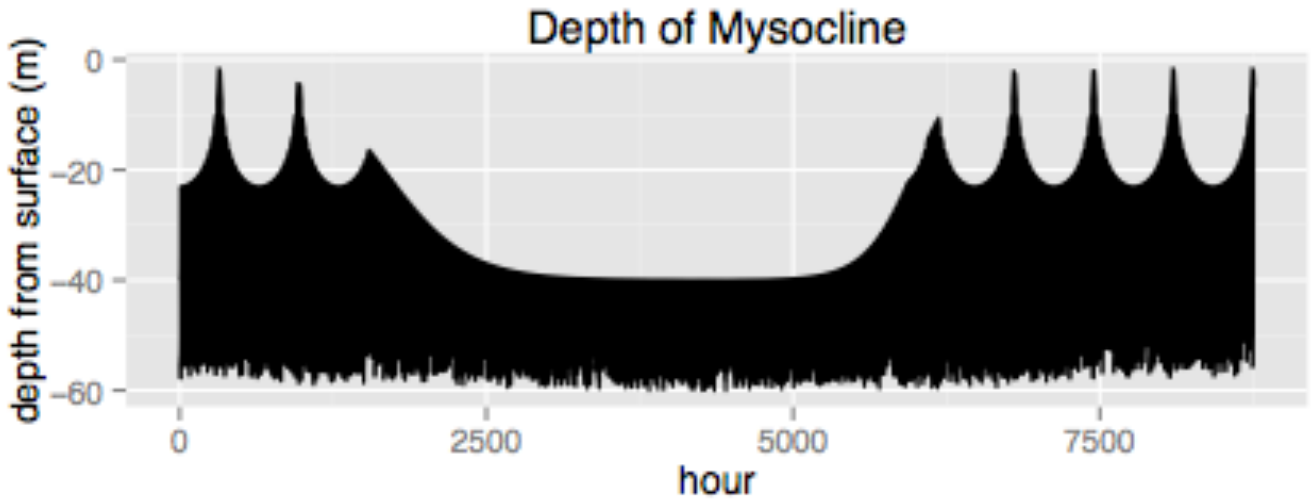
- Normalized measure of food quality and quantity in the pelagic environment to the benthic environment.
- Directly maps to probability of migrating, scales feeding reward.
- Paired with food variability to approximate seasonal variability.



Model Structure

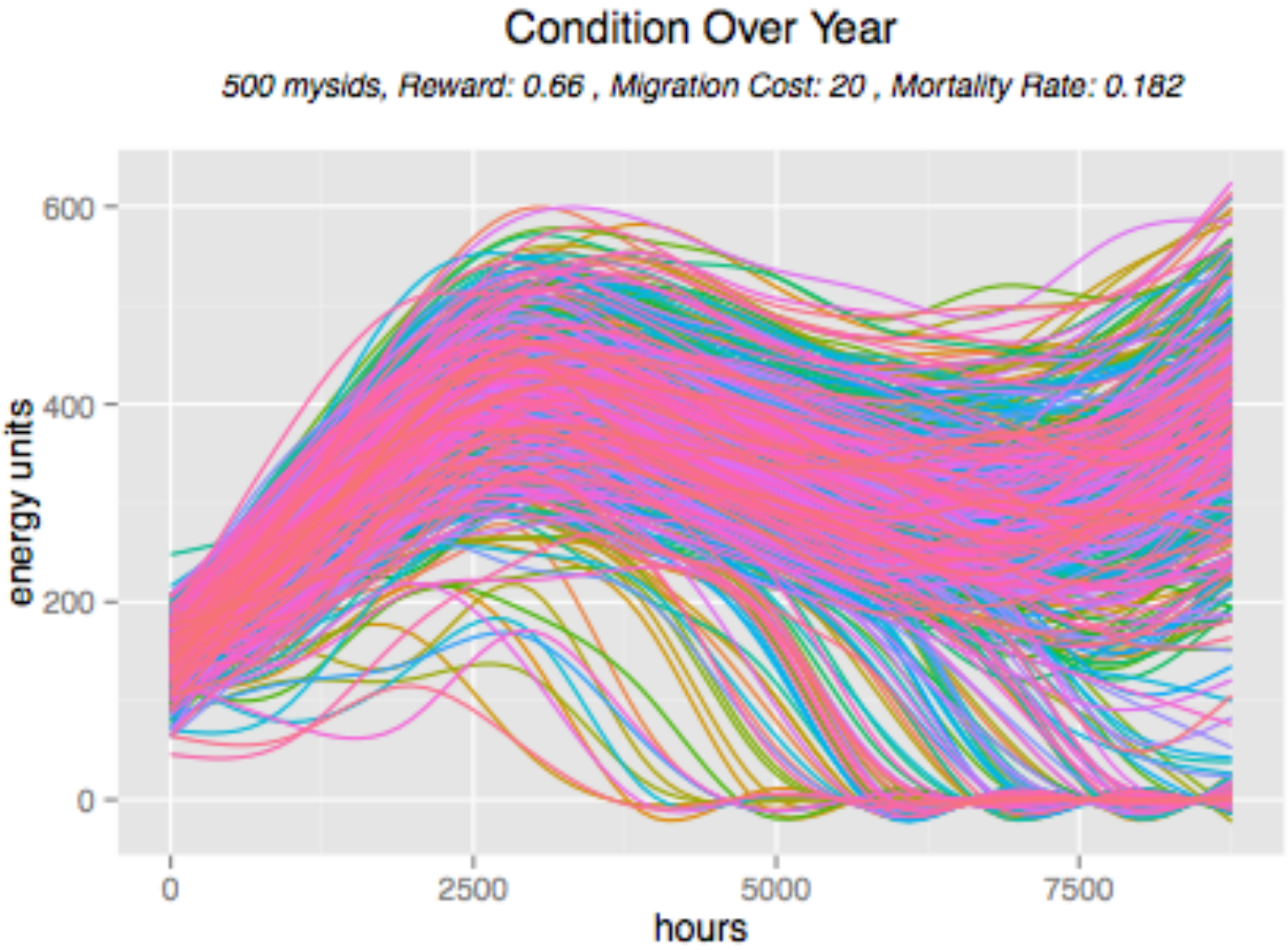


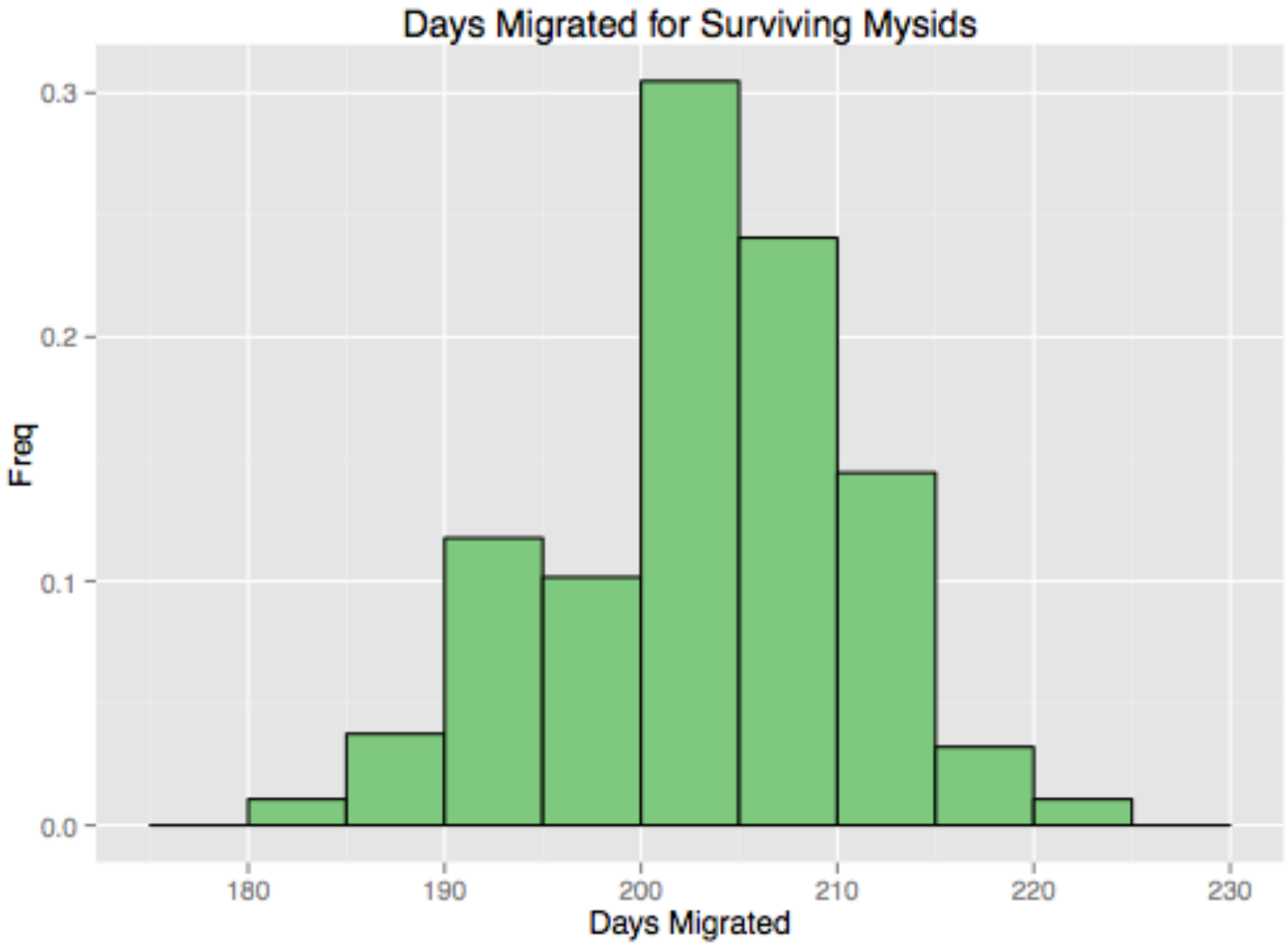
The Mysocline



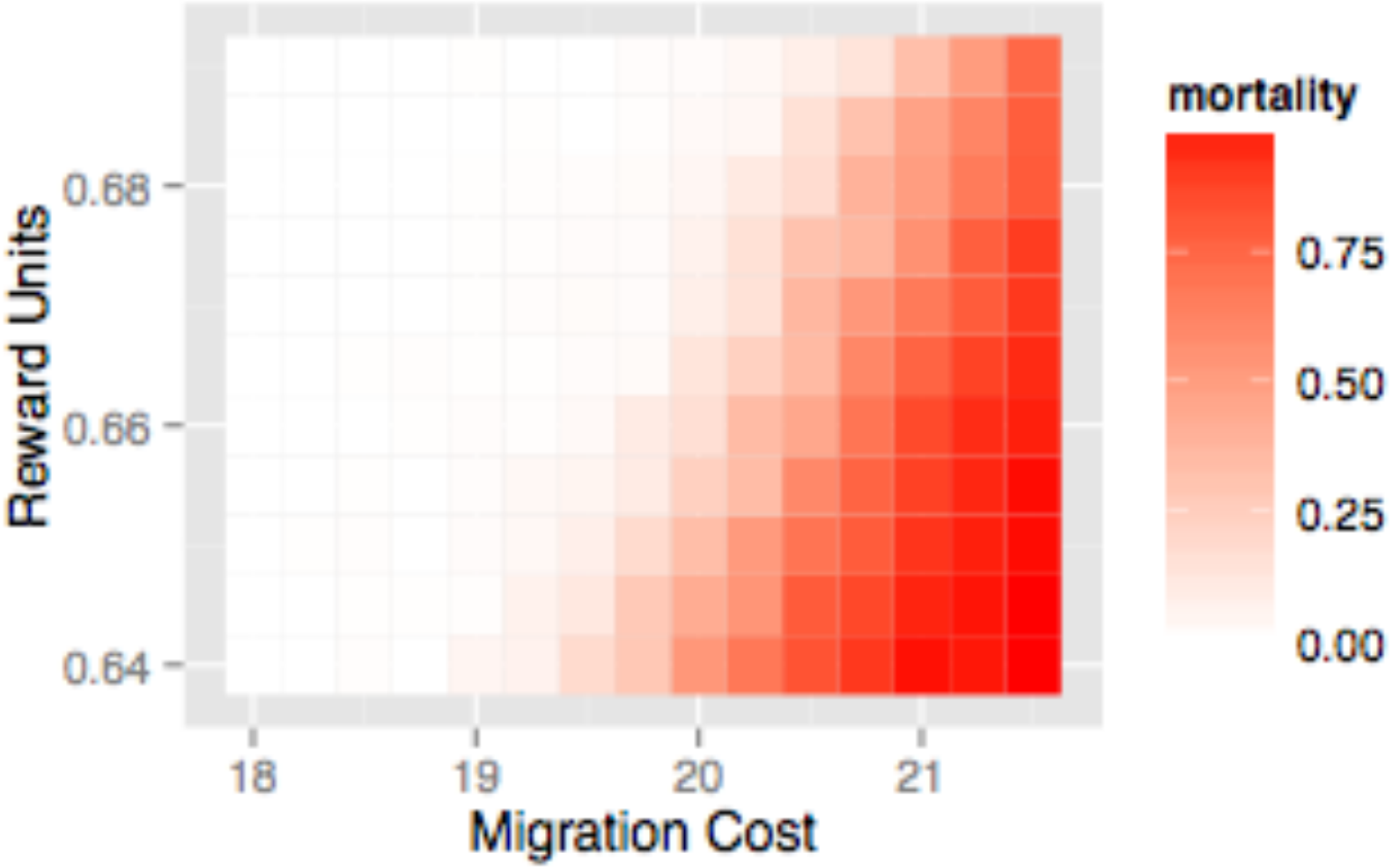
- Highlights seasonal fluctuations in migration extent
- Early spring and late fall are light bounded.
- Late spring, summer and early fall are thermocline bound

Each line represents a single M*ysis;* seasonal trends in condition values; cost of migration weighed with the variability of reward




Days Migrated for Surviving Mysids
Freq
0.3
0.2
0.1
0.0
180
190
200
210
220
230
Days Migrated

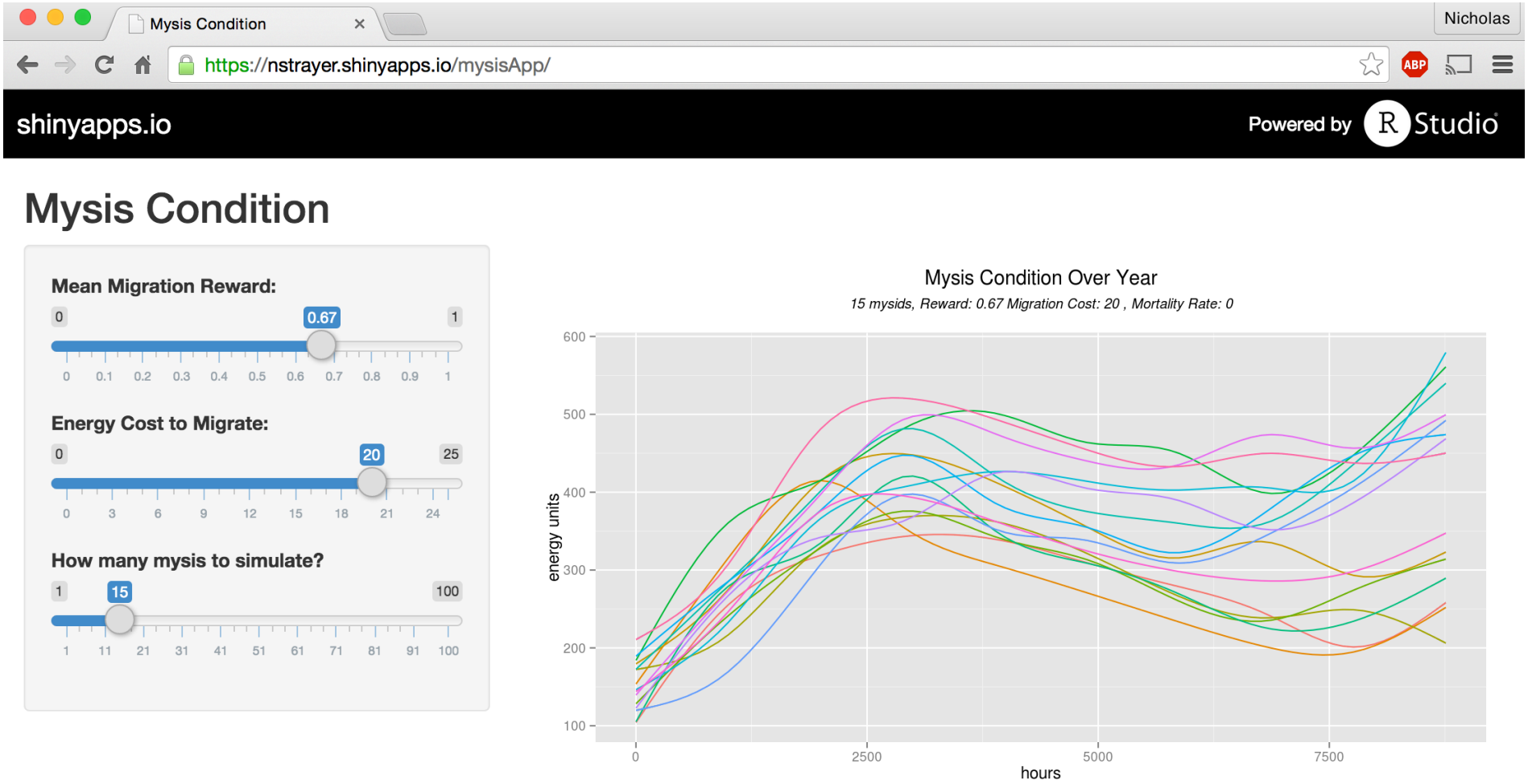
Model shows greater sensitivity to migration cost changes than feeding reward



Language

- The entire model was coded in R.
- This makes it easier to share the code with peers for future investigation and expansion.
- Shiny Servers and RMarkdown furthered the accessibility.

https://nstrayer.shinyapps.io/mysisApp/



Where To Go Now?

- 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. (Oh, and to validate.)

Acknowledgments

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