# An Optimal Annual Routine Model of Diel Vertical Migration of the Macro-Invertebrate *Mysis diluviana*

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Abstract:

The macro-invertebrate *Mysis diluviana* ("*Mysis*") occupies a critical part of lake ecosystems by transferring energy from the lower to upper trophic levels. *Mysis* exhibit diel vertical migration ("DVM") where they ascend from benthic (bottom) to pelagic (surface) waters every night to feed, followed by a morning descent. A survey of the literature and from Lake Champlain suggests not all *Mysis* migrate every night, challenging the conventional view that DVM is a population-level behavior. Many hypotheses have been proposed to explain conventional DVM, but the non-migratory behavior suggests our understanding of the causes and consequences of DVM is still limited. Using mathematical modeling, I will break down the motivating factors behind DVM behavior into "state variables" and then simulate the behavior over time based upon the pressures exerted on *Mysis* by those variables and a seasonally fluctuating environment. The model will allow us to test hypotheses about *Mysis* DVM patterns. For example, we will use the model to test for differences in fitness levels among migration strategies and the potential for multiple evolutionary stable strategies (i.e., is there more than one migration strategy that results in the same end fitness). Using a model to address these questions is an important step in improving our theoretical understanding of *Mysis* DVM.