Group work proposal for Bayesian thinking - part B

Understanding the temperature-dependence of predator-prey interactions

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Software: R, BayesianTools package, Stan
Datasets: Dauggard et al. 2019, Delong & Lyons 2020

The goal of the group work is to understand the temperature-dependence of predator prey interactions by fitting dynamic models to two datasets that have measured changes in predator and prey densities across a temperature gradient. The first dataset has quantified the functional response, i.e., the consumption of prey by a predator across a prey density gradient across three temperatures, while the second dataset has collected time-series data of predator and prey densities across six temperatures. In contrast to the analyses published, we aim to characterize the temperature-dependence of key parameters like the space clearance rate constant, the space clearance rate exponent and the handling time in a hierarchical fashion, meaning we will fit the temperature-dependence across all temperatures simultaneously, rather than for each temperature in isolation.

Work flow:
- ☑ ~~Prepare data for analysis~~
- ☑ ~~Familiarize ourselves with the two datasets (exploratory analysis)~~
- ☑ ~~Implement fitting of ODEs in Bayesian context using BT package and Stan~~
- ☐ Reproduce the estimated parameters from the two publications (fitting ODEs to each temperature in isolation)
- ☐ Implement fitting in a hierarchical framework, where the temperature dependency of certain parameters of interest is fitted, while other parameters are fitted as random effects
- ☐ Describe the workflow to fit ODEs, potential pitfalls and advantages

We will first work with the functional response dataset and then move to the time series dataset.

Expected outcomes:
- R scripts to fit ordinary differential equations to data in a Bayesian context
- Group members will implement code in R / BayesianTools and Stan simultaneously to learn about potential advantages / disadvantages of both languages
- How-to-guide to fit ODEs in a Bayesian context