**Homework #1 – MLEs in Template Model Builder**

Goal: Practice and demonstrate ability to estimate parameters for a nonlinear model in Template Model Builder.

**Part 1**:

An important question in both basic and applied ecology is whether density-dependent or density-independent factors play a more important role in population regulation (Andrewartha and Birch 1954; Walters and Martell 2004). For example, a simple model that incorporates both density and environmental effects is

Eq. 1

Eq. 2

In this model, the number of juveniles *J* in year *i* is related to the abundance of adults through parameters and , which describes an asymptotic reproduction curve. Additionally, the number of juveniles produced in a given year is related to the temperature in that year through the parameter .

Estimate the parameters given the data (see hwk1.R) using TMB. Record the negative log likelihood, AIC, and AICc values for this model. How might you check whether this fit is any good? Does this model tell you anything about population regulation for this dataset? Is this model overparameterized?

**Part 2**: Prove to yourself that your model is coded correctly. Conduct a simulation experiment to demonstrate consistency of a correctly-specified model. Estimate and record parameter estimates from 100 simulated datasets and contrast this with truth. For this exercise, assume that truth is represented by the MLEs from part 1.

**Hint**: you can simulate data in TMB or in R—it doesn’t matter. Check out the SIMULATE{} blocks in the TMB documentation if you are interested in simulating data in TMB directly.

If you would like me to review your code, send me a single R script and TMB Template file. Or don’t—this is a fake class.