Notes for Adding Hypoxia Stress to DEBkiss Model

General concepts

* Need to add data for the four different oxygen levels: 8, 4, 3, and 2.5 mg l-1.
  + Use the actual oxygen means not the target levels.
  + The response variables are length, egg buffer, and survival over time.
* Need to add stress function to change the parameter(s) of interest for different oxygen levels.
  + Start with ones from Jager book and then change if want different shape.
  + Threshold comes from Pcrit.
* Ideally the output would include predicted response variable levels for the existing x-values for which we have data, in addition to the AIC and NLL.

Is it added exactly the same as a toxicant?

* Jager’s BYOM manual shows how to add data for different levels of a toxicant or treatment, and how to set the initial values for those levels or a level for which you don’t have data (simulation).
* In Desforges et al (2017) they describe how a stress factor is used to affect the parameters.
  + Physiological modes of action (pMoA) – effect of toxicant on different DEB parameters. This helps us understand the metabolic process affected by the toxicant.
  + Replace a parameter with its associated stressed version.
* Toxicant Effects in DEBkiss book by Jager (section 5.2)
  + “When the damage level exceeds a threshold, the value of one or more of the primary parameters changes proportional to the amount by which damage exceeds the threshold. For survival, the affected parameter is the hazard rate, and survival will have its own threshold and proportionality (the effects strength).”
  + Hazard rate for survival effects:
    - So you multiply the effects strength (b) by the amount by which scaled damage (D) is over the threshold (z). The *i* means it can either be mass or volume specific. Units of concentration-1 time-1.
    - Can be linked to survival probability:
  + Sub-lethal effects, use linear relationship with threshold for stress level (s) with similar implementation:
    - Generally the threshold is lower than the mortality threshold.
    - Units of concentration-1.

There seem to be three components to attend to:

1. Adding the data for different DO levels.
   1. This involves entering the data for different scenario numbers, including weights and initial values (X0mat). For missing data use NaN.
2. Adding the stress function to alter a parameter at different DO levels.
   1. This will include telling it what the DO levels are for each scenario.
3. Getting the model to estimate parameters for all scenarios at once.
   1. Need AIC, predicted and observed data
      1. AIC wouldn’t be comparable between different DO levels because of the different data and missing data at low DO levels.
   2. Would there be different parameters for each DO level? I think we want to keep all fixed except the ones that are changed with the stress function.
   3. Alternatively, maybe I would paste in the data for each treatment separately and run the model, but only if there isn’t a way to do it all at once.