FISH 559: Example Application II (Fitting predation functions)

One of the components of the move to Ecosystem Based Fishery Management is the use of multispecies models for assessments purposes. The results of these types of models depend on the assumed functional form that relates predation rate to the density of prey and predators. However, there are many potential functional forms (Koen-Alonso and Yodzis 2005; Canadian Journal of Fisheries and Aquatic Sciences 62: 1490-1512; Kinzey and Punt, 2009: Natural Resource Modelling 22(1): 67-104).

$$P_y = \begin{cases} \alpha N_y^C & \text{Linear} \\ \alpha N_y^C / (1+\beta N_y^P) & \text{Holling Type II} \\ \alpha N_y^C (N_y^P)^{\gamma-1} / (1+\beta (N_y^P)^{\gamma}) & \text{Sigmoid} \\ \alpha N_y^C / (1+\beta (N_y^P) + \lambda (N_y^C)) & \text{Pre-emption} \end{cases} \quad (1)$$

where N_y^C is the number of consumers (predators), N_y^P is the number of prey, and α, β, and γ are parameters.

The file EX2.DAT lists data for a consumer and four prey species. Write a single program (i.e. one CPP and one R file) that:

- Reads the basic data from EX2.DAT
- Can be used to fit any of the four models (hint: set the entries in the *map* argument based on the variable Model_Num)
- There should be separate values for each parameter for each species, and the data for all three species should be fitted simultaneously (i.e. for the 2nd model there are six parameters).
- The objective function should be the sum (over predator densities and prey species) of the logs of the differences between the observations and the model-predictions.