Bayesian parameter estimation of a multi species size spectrum model of the North Sea

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Abstract: Size spectrum models have been recognised as being a simple way of describing fish in a large community. They are complex ecological models that are solutions to partial differential equations which are driven by ecological rules and algorithms. Until Blanchard et al. (2013) fitted their model to 12 interacting fish species and a background resource community, which account for 90% of all species trawled in the North Sea, to time averaged data from 1985-1995 these models had not been applied to real data. They found that the difficult parameters to estimate were the maximum recruitment for each species, R_{max} and the level of background resource carrying capacity, κ. The authors found a point estimate of these parameters.

We are attempting to fit R_{max} and κ to data from 1967-2010 using time varying fishing effort, taken from CEFAS (2013), as input to the model in a Bayesian framework. The output of the model, given a particular parameter set, is difficult to estimate due to the sensitivity of the parameters. This, coupled with the high dimensional parameter space, means that emulation of the model is impossible and the only way to get the model output is to run the model which takes about 20 seconds for each parameter set. In addition to this, the posterior distribution is very multimodal which means that standard MCMC would get stuck in local modes and not explore the posterior distribution.

In this talk we will discuss the difficulties of this inference and how we got around these to perform Bayesian parameter estimation of R_{max} and κ. We will also compare results and interpretations between this work and the work of Blanchard et al. (2013).

References

J. L. Blanchard, K. H. Anderson, F. Scott, N. Hintzen, G. Piet and S. Jennings, *Evaluating targets and trade-offs among fisheries and conservation objectives using a multi species size spectrum model.* Journal of Applied Ecology, 2013.

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