Bayesian Identifiability in Ecological Models

Although it has been noted that identifiability presents no problem in a Bayesian framework (Lindley, 1971), non-identifiability may still be an issue. Non-identifiability can lead to poor mixing (Carlin and Louis, 2000) and little Bayesian Learning (Xie and Carlin, 2006). A commonly used check for Bayesian weak identifiability is to compare the overlap between the prior and posterior (Gimenez et al, 2009).

In this talk we explain how and why this method does not always work. For example, in an integrated population model including census and capture-recapture data, presented in Abadi et al (2010), the productivity and immigration parameters are confounded – both are non-identifiable. However, only the productivity parameter has a large overlap between the prior and posterior. This leads to the incorrect conclusion that only the productivity parameter is weakly identifiable.

We show how a targeted sensitivity analysis can be used diagnose this problem. This involves considering different priors for the weakly identifiable parameter. A confounded parameter will be sensitive to changes in the prior, whereas identifiable parameters will not.

We recommend that either the identifiability of a model is explored before carrying out a Bayesian analysis (see, for example, Cole, 2020), or that examining the prior and posterior overlap is combined with a targeted sensitivity analysis. Otherwise, any biological conclusions could be misleading.