

The Problem with Parameter Redundancy

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Keywords: capture-recapture, survey design and analysis, identifiability, simulation

Abstract: Consider the time-dependent Cormack Jolly Seber model, which is based on capture-recapture data. This has the last survival and last capture probabilities only ever appearing as a product and therefore they cannot be independently estimated. This is an example of parameter redundancy or non-identifiability of the parameters. In more complex models, it is not always as obvious that the model is parameter redundant (see for example Cole *et al*, 2010).

There are several characteristics of a parameter redundant model. Such a model does not have a unique maximum likelihood estimate as there will be a flat ridge in the likelihood surface (Catchpole and Morgan, 1997). In addition, the expected information matrix will be singular (Rothenberg, 1971) so that it is not possible to find standard errors. To use a parameter redundant model some form of constraints or a robust design is needed.

In practise, most ecology models are fitted using numerical methods so the flat ridge might not be obvious and therefore missed, or the approximate expected information matrix may not be singular. When fitting a model if standard errors are defined it is assumed that the model is not parameter redundant. However, this is not always the case. It is possible for parameter redundancy to be missed in a naive fit of a model. Using simulation, we demonstrate that up to half of models that are fitted naively are not obviously parameter redundant, and any estimates derived from these models can be biased.

References

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