

Ecological modelling in BUGS: Some tricks of the trade

Leslie New

Patuxent Wildlife Research Center
U.S. Geological Survey
Laurel MD, USA
lnew@usgs.gov

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Abstract: The use of the BUGS programs (OpenBUGS and WinBUGS) is popular within the ecological community for analyses that use Markov chain Monte Carlo. Numerous books and papers have been written on the subject, covering topics including population dynamics, capture-recapture, hierarchical models and more. Despite its utility, the BUGS programs have a number of limitations. While the potential for long computational times is one of the most frustrating, there are also restrictions on the distributions available to users, and how the defined distributions can be implemented. This can be overcome by using the BlackBox Component Builder, which allows users to define their own distributions and functions. This requires some familiarity with coding in Component Pascal, and is a topic best learned in a computer classroom. An alternative to BlackBox is to use the statistical properties of distributions to approximate them within BUGS. I will use two case studies, hen harriers (*Circus cyaneus*) whose population dynamics model was part of a larger multispecies model, and golden eagles (*Aquila chrysaetos*) for which an integrated population model has been built, to discuss four distribution-related limitations in BUGS. I will approximate two distributions not available in BUGS, the double Poisson and discrete uniform, and two whose use can be restricted in BUGS, the multinomial and Dirichlet. In general, knowledge these and other approximations is important, because not only can it overcome limitations in BUGS, but it can also be used to improve the efficiency of the Markov chain simulations.