Multi-site mark-recapture model selection using score tests

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Current information-theoretic approaches to classical model selection, such as the use of Akaike's Information Criterion (AIC), require all models considered biologically reasonable to be fitted. For Cormack-Jolly-Seber models [2, 4, 5] for mark-recapture data, this set of models will usually be small enough to allow such model selection to be simple to implement, however some of the models being fitted might not be supported by the data. Fitting such models might lead to computational issues such as local minima to likelihood.
The number of possible multi-site/state mark-recapture models can be very large, for example a simple three site system with only time or site-dependence can create in excess of 100 models for consideration. Therefore, the use of the AIC as a model selection tool can be computationally prohibitive for such models.
This talk proposes a step up model selection procedure to select appropriate models for multi-site mark-recapture data using score tests. The use of score tests for model selection of ring-recovery models was proposed by [1]. The selection procedure is such that only models supported by the data require fitting, and thus over-complicated model structures with too many parameters do not need to be fitted. As the procedure is performed step-wise, it also readily provides appropriate starting values for parameter estimation of the selected model at the next level of tests. This attractive by-product of the procedure thus reduces the chance of estimating parameters at local minima.
The robustness of the technique is assessed using simulation studies, and the procedure is used on a multi-site data set of Great cormorants, *Phalacrocorax carbo sinensis*. Additionally, the technique is applied to the well known multi-site mark-recapture data set of Canada geese, *Branta canadensis*, [3] and is able to detect the necessity of additional parameters accounting for memory to model this data set successfully.

References

[1] Catchpole EA and Morgan BJT (1996) Model selection in ring-recovery models using score tests. Biometrics 52:664-672

[2] Cormack RM (1964) Estimates of survival from sightings of marked animals. Biometrika 51:429-438

[3] Hestbeck JB, Nichols JD and Malecki RA (1991) Estimates of movement and site fidelity using mark-resight data of wintering Canada geese. Ecology 72(2):523-533

[4] Jolly GM (1965) Explicit estimates from capture-recapture data with both death and immigration-stochastic models. Biometrika 52: 225-247

[5] Seber GAF (1965) A note on the multiple-recapture census. Biometrika 52: 249-259