Stratified Populations: Multi-session and multi-site data

In this chapter, we describe SCR models for situations when we have multiple distinct sample groups, strata or “sessions” (the term used in secr) each with a population size parameter *Ng*, for group *g*. Such stratified populations are commonplace in capture-recaptures studies, especially in the context where the strata represent distinct spatial regions, yet most SCR applications have been based on models that are distinctly single-population models. This is done either by analyzing separate data sets one-at-a-time, producing many, if not dozens, of independent estimates of abundance, or by pooling data from multiple study areas. A standard example that arises frequently is that in which multiple habitat patches (often refuges, parks or reserves) are sampled independently with the goal of estimating the population size of some focal species in each reserve. If there are parameters that can be shared across sessions or groups, it makes sense to combine the data together into a single model that permits the sharing of information about some parameters, but provides individual estimates of abundance for each land unit. In this chapter, we focus on Bayesian analysis of stratified SCR models using data augmentation. However, we have noted previously that the **R** package secr fits a class of multi-session models which we have already seen (Sec. \ref{mle.sec.multisession}), and we used \mbox{\tt secr} to analyze several case studies using the multi-session models including the ovenbird (Sec. \ref{poisson-mn.sec.ovenbird}) and the possum data (Sec. \ref{poisson-mn.sec.possum}), and models with sex-specific parameters in Chapts. \ref{chapt.covariates} and \ref{chapt.gof}. In the stratified population models considered here, an individual is assumed to be a member of a single stratum, so that the population sizes $N\_{g}$ for the $g$ strata are independent of one another. However, stratified or multi-session SCR models are also directly relevant when the stratification index is time, either involving distinct periods within a biological season, or even across years. In this case, individuals might belong to multiple of the strata, but, the models discussed in this chapter do not acknowledge that explicitly. Unlike the case in which the strata represent spatial units, with temporally defined strata, we imagine a fully dynamic, or demographically open model for $N$ might be appropriate -- one that involves survival and recruitment. We deal with those models specifically in Chapt. \ref{chapt.open}. However, the stratified models covered here can be thought of as a primitive type of model for open systems in which the population sizes are assumed to be {\it independent} across temporal strata, and so we might still find them useful in cases where the strata are temporal periods or sessions.

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