Ch 4 Closed Population Models

In this chapter we introduce traditional non-spatial closed-population capture-recapture models for estimating abundance, emphasizing analysis in a Bayesian framework, by using data augmentation. If N is known, these models resemble simple logistic regressions, where the observations – 0 or 1 on each occasion – are Bernoulli draws with detection probability p.

Usually, N needs to be estimated, and we can apply data augmentation to achieve that. In data augmentation, we add a large number of all-zero encounter histories to the n observed encounter histories, and estimate how many of these ‘hypothetical individuals’ are part of the population but were never observed. This reformulation of the capture-recapture model facilitates Bayesian analysis and we employ this strategy to spatial capture-recapture models throughout the book.

Detection probability can be constant or vary; for example, we can build an individual heterogeneity model where individual p (on the logit scale) come from a normal distribution. We present examples and BUGS code for some of these models. The drawback of non-spatial estimates of abundance is that they are not linked to a specific area and that we need to apply ad hoc approaches to estimate density. We present some common approaches to this problem and discuss their shortcomings, which provide immediate motivation for the development of spatially explicit models. We show that individual covariate models, where covariates are some description of an animal’s location in space, such as average capture location, are a step towards fully spatial capture-recapture models. The last section of this chapter highlights the parallels of distance sampling and spatial capture-recapture. With its treatment of two common survey techniques and their link to spatial capture-recapture, this chapter facilitates understanding of spatial capture-recapture model, which are fully introduced in the following chapter.