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 trials with detection probability p. Usually, though, we are interested in estimating N, and we can do so by using data augmentation. Using 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 rest of the book. In traditional capture-recapture detection probability can be constant or vary; for example, we can build an individual heterogeneity model where individual detection probabilities (on the logit scale) come from an underlying common normal distribution. We present examples and BUGS code for some models incorporating different sources of variation in p.

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 define an area in order to estimate density. We present some common approaches to do so and discuss their shortcomings. We show that individual covariate models, where the covariate is 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. Providing background on capture-recapture in general, the chapter facilitates understanding of spatial capture-recapture models, which are fully introduced in the following chapter.

Key words: behavioral response, data augmentation, density estimation, detection probability, distance sampling, effective area sampled, heterogeneity model, individual covariate model, MMDM, model Mh, non-spatial capture-recapture