Chapter 1

Spatial Capture-Recapture for Unmarked Populations

Traditional capture-recapture models share the fundamental assumption that each individual in a population can be uniquely identified when captured. This can often be accomplished by marking individuals with color bands, ear tags, or some other artifical mark that can be read in the field. For other species, such as tigers or marbled salamanders, individuals can be easily identified using only their natural markings. In a great number of cases, however, species do not possess sufficient natural markings and are too difficult to capture to make it practical to apply artifical marks. So we must throw up our hands and not study these species. End of chapter.

When capture-recapture methods are not a viable option, researchers often collect simple count data or even detection/non-detection data to estimate population parameters. These data are often analyzed using Poisson regression or logistic regression, perhaps with random effects; but when detection is imperfect, as it almost always is, these methods cannot be used to obtain unbiased estimates of population size or occurrence probability. Even when these data are used an index of abundance or occurrence, standard models may yield unreliable results when covariates affect both the state variable and detection probability. A classic example is the finding by Bibby and Buckland (1987) who reported that the probability of detecting songbirds in restocked confier plantations decreased with vegetation height; whereas population density was positively related to vegetation height. This intuitive and common phenomenon has led to the development a vast number of methods to model population size or density while controlling for factors affecting detection probability. A review of these models is beyond the scope of this chapter, but we mention a few deficiencies of existing methods that warrant the exploration of alternatives.

Distance sampling is perhaps the most widely used method for estimating population density when individuals are unmarked and detection probability is less than one. DESCRIBE. This class of methods is known to work impecibly

when estimating the number of stakes in a field or the number of duck nests in a wetland. In many other situations, factors such as animal movement and measurement error may result in substantial bias. In addition, traditional distance sampling methods assume that individuals are randomly located with respect to the observer and are available for detection (but see XXXX). Most other methods, such as double-observer sampling and repeated counts, can be used to estimate population size, but as with traditional CR methods, it may be difficult to covert abundance estimates to density estimates because the effective area sampled is unknown. We mention these issues not to suggest that they do not have value, and indeed we believe that can be used to obtain reliable density estimates in many situations, but rather to highlight the need for alternative methods when the assumptions of existing methods cannot be met.

In this chapter we highlight the work of Chandler and Royle (2012) who demonstrated that the individual recognition assumption of CR models is not a requirement of spatial capture-recapture models. In other words, SCR models can be applied to data collected on unmarked inidividuals. The only additional requirement above those made in standard SCR models is that the counts are spatially-correlated. Of course, this condition holds true in virtually all SCR models since animals are often detected at more than one trap.

Bibliography

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