Modeling spatial variation in density

Abstract

All SCR models considered so far assumed that animals are distributed uniformly in space, but ecological processes such as habitat selection and territoriality can result in non-uniform distributions of organisms. In this chapter we present a method for fitting spatial capture-recapture models process where the location of an animal’s activity center is a function of spatially-referenced covariates, thus allowing for variation of density across the state space. These models are referred to as ‘inhomogeneous point process’ (or IPP) models.

To analyze SCR data using an IPP model in continuous space we provide a custom MCMC algorithm in the accompanying R package. Discrete space IPP models can be implemented in the BUGS language, or in the R package secr. Moreover, we can combine IPP models with models using ecological distance (i.e., distance as perceived by the organism under study, for example due to habitat quality) instead of Eucledian distance (see Chapt. XXX) in the detection model and simultaneously estimate both parameters describing the effect of habitat on density and on animal movement from simple SCR data.

We apply the IPP model to a camera trap data set of jaguars from Argentina, using the degree of protection of areas within the state space as a density covariate. Indeed, jaguars occur at much higher density in areas with higher levels of protection.

While they require more data than ‘simple’ SCR models, IPP models are an important advance in our ability to study the ecology of animals from SCR data.

Key words: habitat selection, inhomogeneous point-process, spatial randomness, rejection sampling