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A spatial capture-recapture model with spatial clustering of detections within individual capture histories

Spatial capture-recapture (SCR) models are commonly used to estimate animal density from surveys on which detectors passively detect animals without physical capture, for example, using camera traps, hair snares, or microphones. An individual is more likely to be recorded by detectors close to its activity center, the centroid of its movement throughout the survey. Existing models to account for this spatial heterogeneity in detection probabilities rely on an assumption of independence between detection records at different detectors conditional on the animals' activity centers, which are treated as latent variables.

In this talk, I describe various ways in which this conditional independence assumption may be violated due to the way animals move around the survey region and encounter detectors, such that additional spatial correlation is almost inevitable. I will describe a model we developed to address this problem, which includes a latent detection field for each individual, and illustrate its use via both a simulation study and an application to a camera-trap survey of snow leopards (Panthera uncia). Standard SCR population density estimators are biased when these additional spatial effects are present, but our method mitigates this bias. Our model unifies several existing SCR approaches, with special cases including standard SCR, models that account for nonspatial individual heterogeneity, and models with overdispersed detection counts.