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Estimating spatial and density-dependent survival using open-population spatial capture-recapture models

Open-population spatial capture-recapture (OPSCR) models use the spatial information contained in individual detections collected over multiple consecutive occasions to estimate occasion-specific density, but also demographic and movement parameters. OPSCR models can also estimate spatial variation in vital rates but such models have not been thoroughly tested. We developed a Bayesian OSPCR model that does not only account for spatial variation in survival using fixed spatial covariates, but also estimate the local density-dependent effects on survival within a unified framework. Using simulations, we show under what conditions the model provides robust inferences of the effect of spatial covariates on survival. Although more data-hungry and challenging to fit, local-density dependent survival can also be estimated using the OPSCR model described here. We also illustrate how this model can be applied to study spatial variation in survival in the Scandinavian wolf population. We provide a set of functionalities in the nimbleSCR package that allow efficient fitting of Bayesian OPSCR models with spatially varying survival. Our study represents an essential step towards a fully spatially explicit OPSCR model that can disentangle the role of spatial drivers of population dynamics.