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Assessing precision and accuracy of hierarchical models for abundance estimation in camera trap studies through a simulation study of movement trajectories from focal and non-focal species.

In many wildlife monitoring programmes the aim is to obtain animal densities from spatially referenced binary or count data. Since accurately estimating density often demands auxiliary data collection, inferring distributional patterns or abundance is favoured in many cases. Hence, the increasing popularity of hierarchical models (HMs) for abundance estimation. This demands for a better understanding of factors that determine the accuracy and precision of abundance obtained from HMs. Moreover, camera trapping networks are often designed for optimally detecting just one focal species. Hence, the question emerges whether such networks can also be used to make meaningful inference on abundance of non-focal (by-catch) species. In this presentation, I will focus on (i) a comparison of abundance estimates obtained through fitting a Royle-Nichols (RN) and N-mixture model (NMM) to data collected on a virtual focal species; (ii) the optimal study design with regard to this focal species; and (iii) the potential to also infer abundance of non-focal species using the study design optimized in (ii).

To compare abundance estimates from RN and NMM, I generated count data by simulating virtual populations moving according to a group-specific activity-adjusted random walk and monitored through virtual observers (i.e. camera traps). Movement trajectories were simulated for three virtual species (one focal and two non-focal), whose movement characteristics were informed by real trajectories of Sus scrofa (wild boar), Capreolus capreolus (roe deer) and Vulpes vulpes (red fox). Next, I compared the abundance estimates, in terms of bias, root mean square error and coverage of 95% confidence intervals, from RN and NMM under the study design that is currently adopted in the Hoge Kempen National Park (Belgium). I then sought to optimize this design by adjusting the number of cameras deployed (25%, 50% or 100% of sites with a camera), its placement (stratified-random, lattice, lattice plus close pairs) and the sampling duration (5, 25 or 50 days). Finally, I evaluate the abundance estimates obtained for non-focal species using the optimized design.

In summary, this work provides important insights in the impacts of (i) animal-specific characteristics and (ii) study design choices on the performance of HMs for abundance estimation.