Assessing trends in population size of three unmarked species: A comparison of a multi-species N-mixture Model and Random Encounter Models

Martijn Bollen[1], Pablo Palencia[2], Joaquín Vicente[2], Pelayo Acevedo[2], Lucía Del Río[2], Thomas Neyens[3], Natalie Beenaerts[1], and Jim Casaer[4]

[1]Centre for Environmental Sciences
[2]Instituto de Investigacion en Recursos Cinegeticos
[3]Data Science Institute
[4]Research Institute for Nature and Forest

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Abstract

Estimation of changes in abundances and densities is essential for the research, management, and conservation of animal populations. Recently, technological advances have facilitated the surveillance of animal populations through the adoption of passive sensors, such as camera traps (CT). Several methods, including the random encounter model (REM), have been developed for estimating densities of unmarked populations but require additional field work. Hierarchical abundance models, such as the N-mixture model (NMM), can estimate densities without performing additional fieldwork but do not explicitly estimate the area effectively sampled. This obscures the interpretation of its densities and requires its users to focus on relative measures of abundance instead. We compare relative trends in density/ abundance for three species (wild boar, red deer, and fox) based on the REM and NMM. The NMM applied here is adapted to overcome two issues potentially leading to poor abundance estimates: (i) we specify a joint observation model, based on a beta distribution, for all species within a community to strengthen the inference on infrequently detected species, and (ii) we model species-specific counts as a Poisson process, relaxing the assumption that each individual can only be detected once per survey. We reveal that NMM and REM provided density estimates in the same order of magnitude for wild boar, but not for foxes and red deer. Assuming a Poisson detection process in the NMM was important to control for inflation of density estimates for frequently detected species. Both methods correctly identified species ranking of abundance/density but did not always agree on relative ranks of yearly estimates within a single population, nor on its linear population trends. Our results suggest that relative population trends are better preserved between NMM and REM compared to absolute densities. Thus practitioners working with counts-only data should resort to relative abundances, rather than absolute densities.

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