A spatial capture-recapture model for single catch trap data

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Abstract: Spatial capture-recapture models have been developed in the literature to estimate demographic parameters for spatially collected animal detection data. As it stands, a method to appropriately model data collected in single-catch traps is lacking. Single-catch trap designs, for example small mammal trap arrays, induce a complex dependence structure between animals. Currently, the standard approach is to ignore this dependence and treat the animals as independent; this approximation does well in a suite of conditions. However, we show that ignoring dependence between animals leads to bias and poor coverage when the size of the population is large relative to the number of traps. Here, we develop a fully-specified hierarchical model for single-catch trapping surveys analysed in a Bayesian framework. We present a simulation study, which shows that for single-catch data, the bias from a multi-catch model increases with trap saturation, while the single-catch model typically outperforms the multi-catch model in terms of bias, coverage and mean squared error. We apply this to a study on Microtus and show the differences in bias of relative abundance parameters between the commonly used approximation and our single-catch trap model. Additionally, we present an approach for trapping methods that may allow more than one individual on rare occasions. With the prevalence of single-catch traps, this model should be widely applicable to a number of studies and other techniques where the order of capture matters.