Zero-inflated count distributions for capture-mark-reencounter data

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Abstract

The estimation of demographic parameters is a key component of evolutionary demography and conservation biology. Capture-mark-recapture methods have served as a fundamental tool for estimating demographic parameters. The accurate estimation of demographic parameters in capture-mark-recapture studies depends on accurate modeling of the observation process. Classic capture-mark-recapture models typically model the observation process as a Bernoulli or categorical trial with some detection probability conditional on a marked individual's availability for detection (e.g., alive, or alive and present in a study area). Alternatives to this approach are underused, but may have great utility in capture-recapture studies. In this paper we explore a simple concept: in the same way that counts contain more information about abundance than simple detection/non-detection data, the number of encounters of individuals during observation occasions contain more information about the observation process than detection/non-detection data for individuals during the same occasion. Rather than using Bernoulli or categorical distributions to estimate detection probability, we demonstrate the application of zero-inflated Poisson and gamma-Poisson distributions. This allows for inference on availability for encounter (i.e., temporary emigration), as well as a wide variety of parameterizations for heterogeneity in the observation process. We demonstrate that this approach can accurately recover demographic and observation parameters in the presence of individual heterogeneity in detection probability, and discuss some potential future extensions of this method.

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