

# Improving Removal-Based Estimates of Local Abundance in a Metapopulation of Endangered Fishes

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A statistical modeling framework is described for estimating the abundances of spatially distinct subpopulations of animals surveyed using removal sampling. To illustrate this framework, hierarchical models are developed using the Poisson and negative-binomial distributions to model variation in abundance among subpopulations and using the Beta distribution to model variation in capture probabilities. These models are fitted to the removal counts observed in a survey of a federally endangered fish species. The resulting estimates of abundance have similar or better precision than those computed using the conventional approach of analyzing the removal counts of each subpopulation separately. Extension of the hierarchical models to include spatial covariates of abundance is straightforward and may be used to identify important features of an animal's habitat or to predict the abundance of animals at unsampled locations.