Title: Estimating Abundance from Counts in Large Data Sets of Irregularly-Spaced Plots using Spatial Random Effects with Fixed Rank

by Jay Ver Hoef and John Jansen
NOAA National Marine Mammal Laboratory
International Arctic Research Center
University of Alaska, Fairbanks, USA

Abstract: Monitoring environmental populations is an important goal for both research and management of natural resources. Successful management of populations often depends on obtaining estimates of their mean or total over a region. The basic problem considered in this paper is the estimation of the total from count data. Our application has counts from thousands of irregularly-spaced aerial photo images. We model counts in plots as a realization of an inhomogeneous Poisson process and use a fixed-rank spatial-random-effects approach to model its spatial intensity surface. This surface is then integrated to provide an estimate of all unsampled area, which is added to the observed counts and also provides a finite area correction factor to variance estimation. One of the main problems is developing a variance estimator. The data contain nonzero counts that are highly clustered in space with large areas of zeros, but where they occur, the counts themselves show overdispersion. We consider two variance estimators coupled with some novel overdispersion estimators. We use simulated data to examine estimation bias and to investigate the variance estimators with overdispersion factors. A real example is given of harbor seal counts from aerial surveys in an Alaskan glacial fjord.