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A Bayesian Approach to Estimating Animal Density from Binary Acoustic Transects

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Abstract

A Bayesian model is proposed for estimating abundance or density of animals from passive acoustic binary data. The data are collected at points along one or more transects, and the points are spaced so that a single individual can be heard multiple times. Thus successive data points are dependent and this dependence is exploited to simultaneously estimate density, range of detection and probability of detection. The data are assumed to follow a homogeneous Poisson process. The Bayesian model combines a prior distribution for the model parameters, with a second-order Markov approximation to the likelihood. Sensitivity of the model to choice of priors is investigated. The method is illustrated using acoustic data from a survey of sperm whales (*Physeter macrocephalus*).

Keywords: Abundance, Animal density, Binary time series, Bayesian methods, Passive acoustic surveys, Second-order Markov approximation, Spatial Poisson process, multiple transects

1. Introduction

The estimation of absolute density and abundance of wild animals is important for protection of the environment, management of stocks, and monitoring of species that might be at risk of extinction. When estimating abundance from a survey, one must account for the fact that there is a non-zero probability that

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