

## Can we learn about the spatial pattern of species' abundance from its probability of presence?

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**Abstract:** Accurate measures of species' abundance across space are crucial to their effective conservation and management. Many sampling methods and statistical tools have been developed to estimate species abundance per unit area. While density is a desirable state variable to report, there are two main practical issues in estimating it. First, even when possible to measure accurately, large-scale density sampling is prohibitively expensive in many cases. Second, animal abundance estimation is sensitive to detectability, but survey methods seldom detect all individuals present in an area. Because collection of presence data is much simpler to implement, many research programs rely on it to obtain approximations to species abundance. Indeed, collecting presence-absence data at a series of locations has become a preferred method of evaluating ecological status and trends, with statistical models relating species' presence to environmental variables used to interpolate between (or extrapolate beyond) the locations where species' presence is known. However, the statistical analysis of presence-absence data and the ability to infer abundance from such data has been questioned, because detection is seldom perfect and occurrence probability may not be linearly related to density. Here we used statistical models and data on the spatial distribution of North Pacific Right Whale (*Eubalaena japonica*) from 19<sup>th</sup> century American whaling voyages, to investigate if probability of presence is representative of abundance in this species. Given the short exploitation period (<20 years, implying little natural replenishment) and the nearly species extinction, it is an excellent test case for testing this relationship, as both occupancy and abundance can be accurately estimated. We assessed the effect of data quantity and quality by performing calculations with different subsets of the data.