The impact of data quantity on decision making using a Bayesian stochastic patch occupancy model

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Abstract: Stochastic patch occupancy models or SPOMs are used to describe stochastic changes in the occurrence of populations due to local colonization and extinction. Data on occupancy turnover are used to fit these models. SPOMs are useful tools in environmental decision making, e.g. in modelling the effect of management actions on the extinction risk of endangered species. Managers aim to optimize spending between data collection and implementing management actions. Using more data is beneficial for model-fitting but not always necessary for better management decisions. The goal of this retrospective study is to investigate the effect of data quantity on parameter uncertainty and predictions of population viability of an endangered frog. In addition we aim to gain a better understanding of the optimal allocation of resources between data collection and management. A Bayesian SPOM was used to describe the metapopulation dynamics of the frog. Data on occupancy turnover and wetland characteristics were collected over six years. The management question was to determine the number of new wetlands that need to be created to offset population losses due to urbanisation. We investigated how gathering more information about metapopulation dynamics contributed to the management decision by estimating the parameters in MCMC runs with different amounts of data and subsequently predicting population viability through simulation based on those parameter values. By assuming particular costs for data collection and wetland creation, we evaluated the effect of data quantity on decision making. Results show that thorough temporal sampling is necessary to arrive at stable parameter estimates and that using all gathered data is necessary to enable making a reliable management decision. This is largely due to the low cost of data collection compared to the cost of management. Our approach illustrates how data quantity affects parameter estimates and downstream conclusions in environmental management.

“will consider delivering a lightning talk”