

# A spatial occupancy model for predicting metapopulation extinction risk

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## Abstract:

Many metapopulations are completely isolated from external sources of immigrants such that colonization is an internal process, determined by the distances to and occupancy status of *all* other sites within the metapopulation network. While internal colonization is an important component of modern metapopulation theory, it has been largely ignored in occupancy models that account for imperfect detection. As a result, these models predict that the metapopulation will reach a state of quasi-equilibrium in which permanent extinction is not possible. We present a spatial occupancy model that allows for internal colonization and hence can be used to predict metapopulation extinction risk. We applied the model to six years of data on the threatened Chiricahua leopard frog (*Lithobates chiricahuensis*) and estimated extinction risk of the metapopulation to be  $> 5\%$  by 2020. We also used the model to generate colonization probability surfaces to identify optimal locations for establishing new sites and increasing metapopulation viability.