

# Relative species abundance and population densities of the past; developing multi-species occupancy models for fossil data

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## Abstract

The number of individuals of species within communities varies, but estimating abundance, given incomplete and biased sampling, is challenging. Here, we describe a new occupancy model in a hierarchical Bayesian framework with random effects, where multi-species occupancy and detection are modeled as a means to estimate relative species abundance and relative population densities. The modelling framework is suited for occupancy data for temporal samples of fossil communities with repeated sampling including multiple species with similar preservation potential. We demonstrate our modelling framework using a fossil community of benthic organisms to estimate changing relative species abundance dynamics and relative population densities of focal species in 9 (geological) time-intervals over 2.3 million years. We also explored potential explanatory factors (paleoenvironmental proxies) and temporal autocorrelation that could provide extra information on unsampled time-intervals. The modelling framework is applicable across a wide range of questions on species-level dynamics in (palaeo)ecological community settings.

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