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Global drivers of population density in terrestrial vertebrates

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Abstract

Aim: Although the effects of life history traits on population density have been investigated widely, how spatial environmental variation influences population density for a large range of organisms and at a broad spatial scale is poorly known. Filling this knowledge gap is crucial for global species management and conservation planning and to understand the potential impact of environmental changes on multiple species.

Location: Global.

Time period: Present.

Major taxa studied: Terrestrial amphibians, reptiles, birds and mammals.

Methods: We collected population density estimates for a range of terrestrial vertebrates, including 364 estimates for amphibians, 850 for reptiles, 5,667 for birds and 7,651 for mammals. We contrasted the importance of life history traits and environmental predictors using mixed models and tested different hypotheses to explain the variation in population density for the four groups. We assessed the predictive accuracy of models through cross-validation and mapped the partial response of vertebrate population density to environmental variables globally.

Results: Amphibians were more abundant in wet areas with high productivity levels, whereas reptiles showed relatively higher densities in arid areas with low productivity and stable temperatures. The density of birds and mammals was typically high in temperate wet areas with intermediate levels of productivity. The models showed good predictive abilities, with pseudo-R^2 ranging between 0.68 (birds) and 0.83 (reptiles).

Main conclusions: Traits determine most of the variation in population density across species, whereas environmental conditions explain the intraspecific variation across populations. Species traits, resource availability and climatic stability have a different influence on the population density of the four groups. These models can be used to predict the average species population density over large areas and be used to explore macroecological patterns and inform conservation analyses.

KEYWORDS
abundance, amphibians, birds, mammals, population density, reptiles

1 | INTRODUCTION

Population density is one of the key demographic parameters determining the dynamics of populations. Clearly, it also represents a crucial information for conservation planning as it is a direct proxy for extinction risk (Brown, Mehlman, & Stevens, 1995; Currie & Fritz, 1993; Sanderson, 2006). In a macroecological context, research has mostly focused on the biological predictors of average population density per