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Conference Abstract

A review of model-based scenarios on biological invasions

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Abstract

Biological invasions are a major driver of global change with largely negative impacts on biodiversity, sustainability and human well-being. Understanding and predicting patterns and trends in future biological invasions requires a variety of model and scenario-based tools. Here, we present the outcome of the first comprehensive literature review synthesising the state of the art in model-based scenarios. Through a systematic review we considered the scope of studies in terms of spatial, temporal and taxonomic coverage, drivers of global change involved, model and scenario types covered, as well as facets of biological invasions including impacts, pathways and management. Additionally, we assessed the coverage of overarching themes relating biological invasions to human health and well-being, understanding the role of Indigenous and local knowledge for understanding biological invasion, and how biological invasions affect nature's contributions to people. We found 1,268 studies (English-literature) using model-based scenarios, with 81% focussing on correlative modelling approaches developing forward-looking correlative scenarios. Target-seeking and policy-screening scenarios were less frequently developed in the literature (5 and 7% respectively). The main driver implemented in the model-based scenarios to shape future biological invasions is climate change (66%) with other important drivers like land-use change, socio-economy, policy or technology being substantially less covered. Cluster analysis revealed distinct groups of studies associated with different foci on:

1. process-based models investigating species abundance changes, particularly in vertebrates over short-term futures until 2030,
2. correlative models and quantitative exploratory scenarios focusing on projecting habitat suitability under climate change and other direct drivers, and
3. expert-based and hybrid models that investigate changes in species richness and impacts under policy-screening and target-seeking scenarios.

In summary, while we show that literature on model-based scenarios of biological invasions is advancing rapidly, there is a dominance of exploratory scenarios using correlative models to understand potential future changes in biological invasions by projecting large-scale patterns of alien species richness and distribution. The value of such approaches is widely recognized but our findings suggest that there could also be increased focus on regional and local scale scenarios. Impacts of invasive alien species are rarely included within studies. Furthermore, the voices of Indigenous People and local communities (IPLC) in particular, but also those of land managers and other relevant stakeholders are only included in a very small number of studies, indicating that future research might focus more strongly on co-development and collaboration with IPLC and other groups. To adequately inform future implementation of policy targets on invasive alien species, the share of target-seeking and policy-screening scenarios to explore the option space for different management interventions at local and global scales and across contexts (e.g., realms or habitats) needs to be increased. While recognizing the value and application of correlative models, we call for extending the breadth of these studies to routinely encompass more process-based and hybrid models approaches, as well as target-seeking and policy-screening scenarios. This way, model-based scenarios will contribute robustly to understanding the complex interplay amongst drivers of environmental change and specifically reveal plausible futures across social-ecological systems.

Keywords

Biodiversity Modelling, Biological Invasions, Drivers, Forecasting, Impacts, Management, Models, Scenarios

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Conflicts of interest

The authors have declared that no competing interests exist.
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