How may agriculture benefit biodiversity?

A global meta-analysis of the effects of land management on species abundance and richness

Level: Master
Start: Any time
Project form: Literature study and meta-analysis
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Background

Land use is considered the predominant cause of terrestrial biodiversity loss (Maxwell et al. 2016). Quantitative data on biodiversity responses to land use are key in global biodiversity assessments (Newbold et al. 2015, 2016; Schipper et al. 2020) as well as assessments of biodiversity losses due to the consumption of goods and services (‘footprints’) (Chaudhary et al. 2015; Marques et al. 2019). However, global databases of biodiversity responses to land use so far only differentiate between major land use classes and broad intensity levels (minimal, light, and intense; Fig. 1b). This means that more subtle aspects of land management, including management practices potentially beneficial to biodiversity, cannot be captured in current assessments.

Aim

In the internship, you will contribute to a global meta-analysis of the effects of land management on terrestrial animal and plant biodiversity. You will be collecting literature data and perform a meta-analysis in order to assess the impacts of land management on species richness and abundance of a specific taxonomic group (e.g., plants, mammals, birds, amphibians, reptiles, or insects).

Approach and outcome

You will perform a systematic literature search to obtain data on species abundance and richness in relation to land management (e.g., Fig. 1a) and you will synthesize these data in a meta-analysis. Meta-analysis is a common approach to summarise results across independent studies according to quantitative methods for systematically aggregating and comparing data. The results of your analysis will help to reveal biodiversity responses to land management (similar to the results presented in Fig. 1b), which in turn can be used to improve global biodiversity assessments (e.g., Fig. 1c) and impact assessment methods (e.g., life cycle impact assessment).

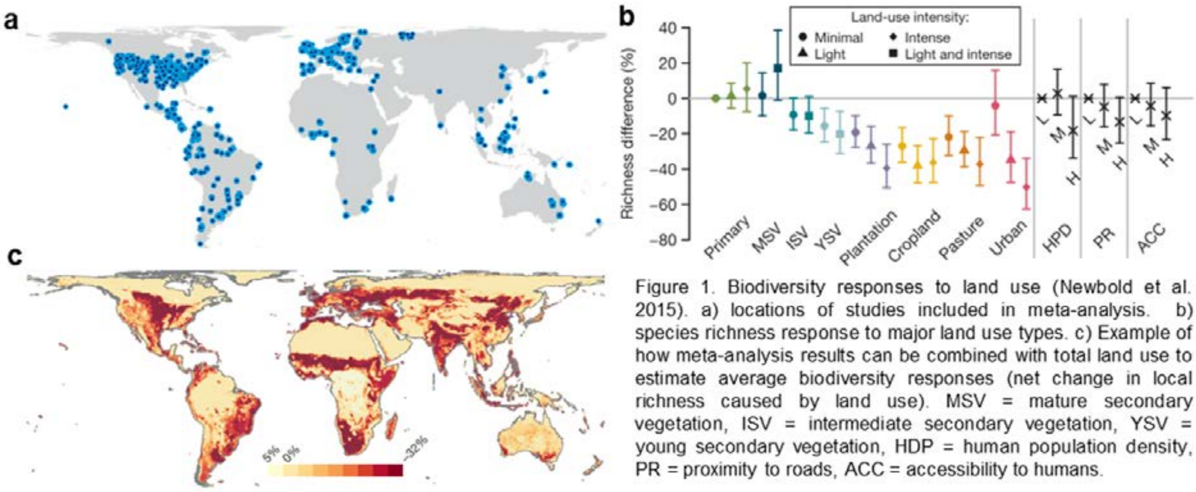

Figure 1. Biodiversity responses to land use (Newbold et al. 2015). a) locations of studies included in meta-analysis. b) species richness response to major land use types. c) Example of how meta-analysis results can be combined with total land use to estimate average biodiversity responses (net change in local richness caused by land use). MSV = mature secondary vegetation, ISV = intermediate secondary vegetation, YSV = young secondary vegetation, HDP = human population density, PR = proximity to roads, ACC = accessibility to humans.

Literature

Chaudhary A, Verones F, De Baan L, Hellweg S (2015) Quantifying Land Use Impacts on Biodiversity: Combining Species-Area Models and Vulnerability Indicators. Environ Sci Technol 49:9987–9995. https://doi.org/10.1021/acs.est.5b02507

Marques A, Martins IS, Kastner T, et al (2019) Increasing impacts of land use on biodiversity and carbon sequestration driven by population and economic growth. Nat Ecol Evol 3:628–637. https://doi.org/https://doi.org/10.1038/s41559-019-0824-3

Maxwell SL, Fuller RA, Brooks TM, Watson JEM (2016) Biodiversity: The ravages of guns, nets and bulldozers. Nature 536:143–145. https://doi.org/10.1038/536143a

Newbold T, Hudson LN, Arnell AP, et al (2016) Has land use pushed terrestrial biodiversity beyond the planetary boundary? A global assessment. Science (80-) 535:288–291. https://doi.org/10.1126/science.aaf2201

Newbold T, Hudson LN, Hill SL, et al (2015) Global effects of land use on local terrestrial biodiversity. Nature 520:45–50. https://doi.org/10.1038/nature14324

Schipper AM, Hilbers JM, Meijer J, et al (2020) Projecting terrestrial biodiversity intactness with GLOBIO 4. Glob Chang Biol 26:760–771. https://doi.org/10.1111/gcb.14848