Land use changes negatively affect soil fauna communities: preliminary results of a meta-analysis

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SHORT DESCRIPTION

Land use changes can alter ecosystem functioning not only directly but also by its effects on soil fauna communities. However, the effects of land use can vary among different soil taxonomic groups, as well as with different land uses and intensities. Research on anthropogenic effects on soil fauna has increased in recent decades which highlights the need to identify general patterns and understand the divergent evidence in the land use effects on soil biodiversity.

RESEARCHS QUESTIONS

- How do the land use change affect the abundance, richness and diversity of soil invertebrates?
- Do the effects of land use changes on soil invertebrates depend on the type of land use?

METHODS

We compiled a dataset of 152 publications that have evaluated the effects of land use changes on the soil invertebrates. We used Hedges unbiased standardized mean difference (Hedges' d) as the metric of effect size. We conducted a hierarchical meta-analysis to evaluate the overall effects of land use on soil invertebrates abundance, richness and diversity. We also examine if these effects vary across different land uses types (plantation, pasture, logging, grazing, agroforestry and agriculture).

RESULTS

Across all studies, land use changes had a negative and significant effect on abundance, species richness and diversity although richness of soil invertebrates suffered the strongest reduction (Fig. 1). The overall heterogeneity of effect sizes was large and statistically significant for abundance (Q_{total} = 26112, P < 0.001), species richness (Q_{total} = 1197, P < 0.001) and diversity analyses (Q_{total} = 307, P < 0.001).

Figure 2: The effects of land use on abundance, species richness and diversity of soil fauna depending on type of land use. Asterisk represents a significant influence of type land use as moderator.

The type of land use explained the variation among effect sizes for abundance ($Q_{between}$ = 13.01, P = 0.02) but not for richness ($Q_{between}$ = 9.02, P = 0.11) and diversity of soil invertebrates ($Q_{between}$ = 3.72, P > 0.05). Plantation and agriculture had the strongest negative effect on abundance of soil invertebrates (Fig. 2). Similar tendency was observed for richness and diversity since agriculture had the strongest effect and different from zero (Fig. 2).
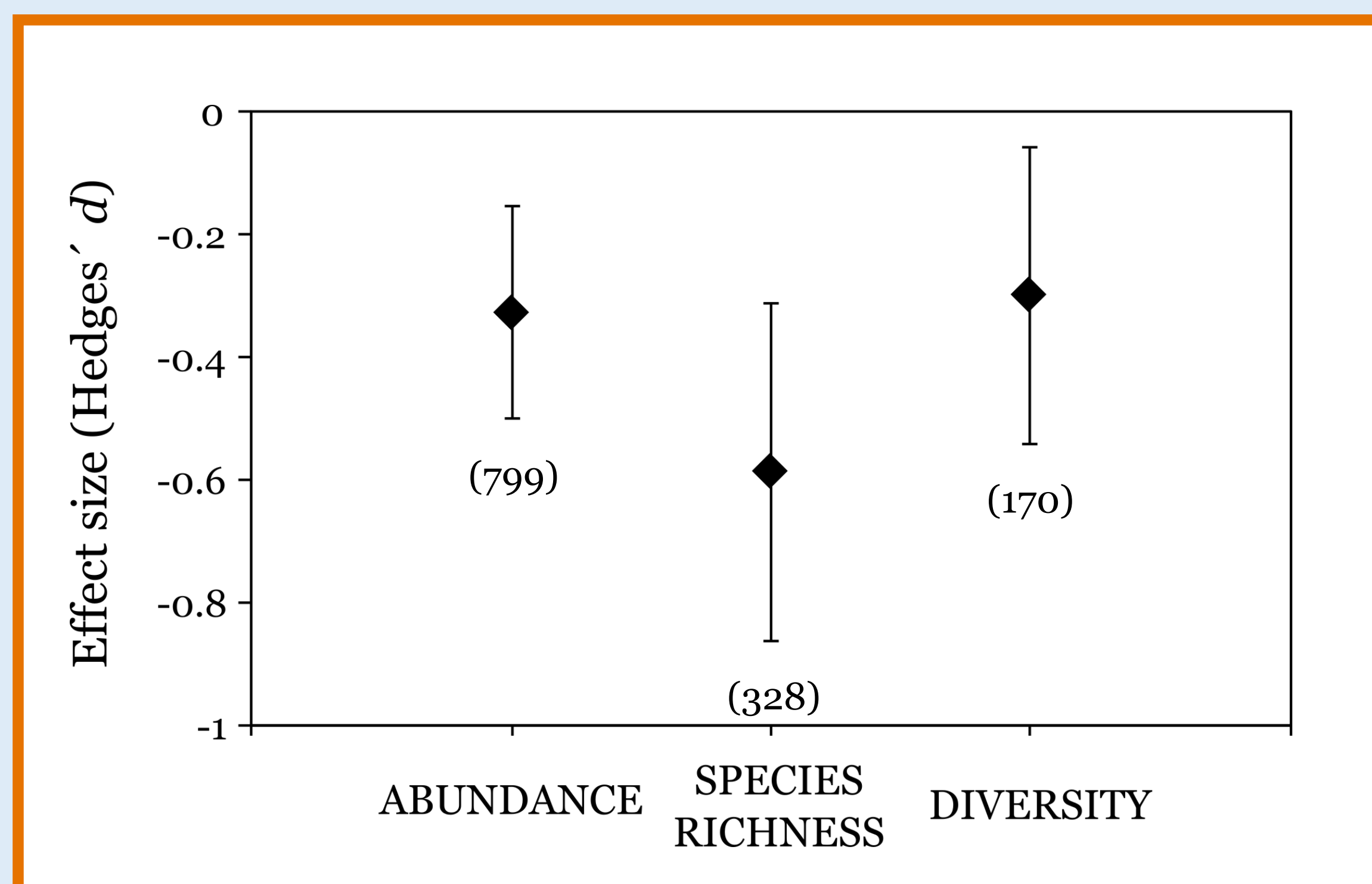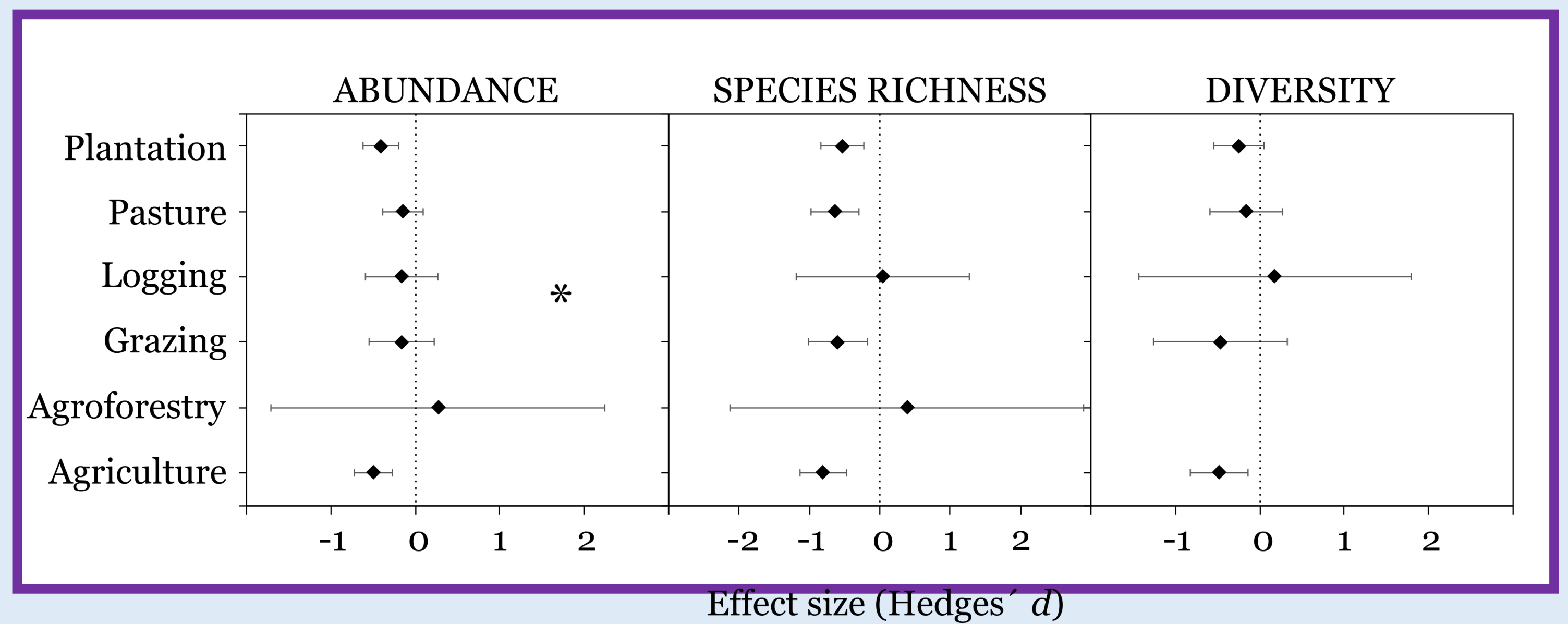
Figure 1: The effects of land use on abundance, species richness and diversity of soil fauna. Numbers in parentheses indicate the sample size.

SUMMARY

This is the first global meta-analysis studying effects of land use changes on soil fauna. Our results suggests that soil invertebrates communities are detrimentally affected by land use change, mainly causing a great impoverishment in species richness. Among different types of land uses, agriculture caused the strongest reduction throughout the variables considered. It remains to analyze if other variables such us functional and taxonomic groups of invertebrates are modulating the effects of land use changes. The changes caused by land use on soil invertebrates could have strong effects on ecosystem services, such as food production, climate mitigation and soil erosion, in which these organisms are involved.

IMAGES

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