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Effects of land use, seasonality and soil properties on earthworm abundance and species diversity

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Field boundaries, such as hedgerows and grassy margins are potentially important reservoirs of soil biodiversity and their connectivity could be key in restoring biodiversity following changes in land use or soil management practices. As part of the SoilBioHedge project (UK), hedge-to-field transects were established in arable, arable-to-ley conversion, permanent pasture and pasture-to-arable conversion transects. We compared earthworm abundance and species composition in biodiversity reservoirs (hedgerows and field margins) and land use (arable vs pasture); and determined the impact of changes in soil management on earthworms e.g. use of grass-clover leys, conventional or minimum tillage practices. Ley transects were either 'connected' to the hedge-margin field boundary or 'disconnected' to determine the importance of migration of earthworms from field boundaries. Earthworm surveys were conducted annually from 2015 – 2017 and seasonally between April 2015 and April 2016. Soil properties and hydrological measurements were also taken.

Our results show that within 2 years, ley transects increased earthworm abundance and species diversity, reaching a similar density and diversity to the permanent pasture fields. However, connectivity to field boundaries was not important, which suggests that arable soils may remain as reservoirs of earthworm biodiversity, facilitating rapid earthworm population recovery in a ley system, despite continuous tillage. Changes in soil properties and hydrology (e.g. proportion and rates of macropore flow) were also seen in the ley treatments. Seasonality had a strong effect on earthworm abundance and diversity, with low soil moisture and high soil temperature in summer months lowering earthworm populations to the extent that only juvenile earthworms were found. This highlights the importance of long-term monitoring to understand the interactions between soil biodiversity and land use change.