Impact of metal contamination on the taxonomic and functional structures of ground-dwelling spider communities

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Abstract

Soil contamination by metals modifies the taxonomic organization of local communities. These changes can lead to a loss of functional diversity, potentially limited by functional redundancy. Spiders are ubiquitous and abundant terrestrial top-predators, known to accumulate metals and then interesting to study in a metal contamination context. We hypothesized that soil metal contamination did not alter abundance or species diversity of spider assemblages, but did modify their taxonomic composition and functional trait profiles. To test these hypotheses, spider communities at 40 sites in north-east France, describing a wide range of metal contamination, were sampled in spring 2022 and 2023 using pitfall traps. 9037 individuals were captured and identified at the species level. Five functional traits (microhabitat, light and humidity preferences, web type and hunting mode) were described using trait databases and a literature review. Soil metal contents in sites were measured by ICP-MS. We identified five groups of sites corresponding to different levels of contamination. Canonical Correspondence Analyses (CCAs) were used to explain taxonomic and functional changes in spider assemblages by variations in environmental parameters including metal concentrations. Preliminary analyses of the data from spring 2022 revealed that there was no significant impact of the contamination level on the abundance and species diversity of spiders. However, soil metal contamination tended to eliminate some families (Linyphiidae, Agelenidae) and favor others (Lycosidae, Gnaphosidae). We also observed a change in trait profiles of spider assemblages depending on contamination level and metal mixture composition. But, it is possible that this was indirectly due to an effect of the metal mixture on habitat structure (impact on vegetation, physico-chemical parameters and local climate), rather than a direct toxic effect on the spiders, leading to the selection of species

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with preference for drier and more open environments. Our hypothesesseemed to have been validated: metals do not alterspider abundance or diversity, but modify the structure and trait profiles of communities. It would now be interesting to extend the study to traits linked to spider morphology or reproduction, which could provide original information on evolutionary strategies in a context of metal contamination.

Keywords: functional traits, spiders, metal gradient, soil contamination, community structure