Case study 13. Functional shifts in community composition of soil invertebrates under elevated CO2

Increased CO2 concentration is predicted to stimulate both primary production and decomposition, resulting in an increase in soil organic matter. Clear evidence exists for the potential impact of climate change-related factors such as eCO2 (elevated levels of CO2), temperature change and altered rainfall patterns on community composition of soil invertebrates. Among these, micro-arthropods living in the litter and the topsoil represent an important functional group in nutrient cycling and litter decomposition.

Under increased CO2 there are important functional changes in the community composition of soil invertebrates. In a FACE (Free-Air Carbon dioxide Enrichment) experiment it was observed that mean micro-arthropod abundance was 33 percent lower in the eCO2 treatment, but with significant decline only for oribatid mites. Other studies report increases in microbial-feeding, free-living nematodes, enchytraeid worms, and even earthworm biomass. Functional groups can exhibit different responses to soil warming, for example, depletion of epigeic species of ecosystem engineers, and augmentation of fungivorous mites. Collembolan populations have increased in most studies of eCO2, although some have reported lower collembolan numbers. Both negative and positive single responses of eCO2 on soil micro-arthropods have been found and can be explained by the inherently high soil CO2 concentration, so certain species are already adapted to these conditions. The responses of soil invertebrates have been interpreted as responses to increased root-derived carbon and subsequent microbial community changes.

How soil communities will be affected by climate change-related factors acting simultaneously is not known although indirect effects are envisaged as both plant composition and productivity can promote important functional shifts. The structure of soil invertebrate communities is affected and impact is driven by changes in soil moisture content. Several climate change factors acting simultaneously will result in reduced moisture causing changes in soil micro-arthropod communities that can affect the functions that these organisms provide, such as decomposition.

Responses of micro-arthropod communities seem to be specific to particular plant communities and ecosystems. Functional changes within soil invertebrate communities due to climate change are expected to occur although more evidence is required.

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