Ecological diagnostic tool for metal-contaminated soils: using functional traits of bacteria and macroinvertebrates

Vincent Laderriere*[1], Margot Jans[1], Alienor Duval[1], Delphine Aran[1], Amandine Zahm[1], Christophe Gauthier[1], Frederic Boyer[2], Aurélie Cébron[1], Philippe Usseglio-Polatera[1], and Florence Maunoury-Danger[1]

[1]Laboratoire Interdisciplinaire des Environnements Continentaux – Université de Lorraine, Centre National de la Recherche Scientifique - CNRS – France

[2]Laboratoire d'Ecologie Alpine – Université Grenoble Alpes, Université Savoie Mont Blanc, Centre National de la Recherche Scientifique - CNRS – France

Abstract

A key question in community ecology is to understand how abiotic (*e.g.* climate, habitat characteristics), anthropogenic factors (*e.g.* contamination), and species interactions drive the structure and composition of biological communities in the environment. For instance, metal soil contamination is known to cause changes in the taxonomic structure of communities living in soils. However, soil functions (*e.g.* organic matter degradation) are not systematically affected by metal contamination. To highlight the responses of macroinvertebrate and microbial assemblages to both ecological factors and metal contamination, we have developed a generalizable approach based on functional traits (such as morphological, physiological, and genomic traits) as proxies of functions. We sampled 40 sites in the Grand-Est region of France characterized by different levels of metal contamination. In soil samples, microbial assemblages were identified through high-throughput sequencing of 16S rDNA while macroinvertebrate communities were sampled using both pit-falls and monoliths and identified to the best possible level of identification (for example, mainly species for beetles and spiders). Using existing databases and a literature review, we compiled a database for the 2 communities (bacteria and invertebrates) containing respectively 41 and 65 traits, each described by different attributes. Based on these attributes, mean trait profiles of microbial and invertebrate assemblages were deduced from the list of taxa captured and their abundances within the assemblage. Preliminary results have highlighted the influence of abiotic factors, such as soil texture, dissolved organic carbon or nutrients, on trait profiles of the bacterial communities. Soil contamination selected also macroinvertebrates with specific traits such as beetles with a one-year life cycle, a fecundity level with an important number of eggs/female cycle or an herbivorous/detritivorous diet. Finally, we examined the possibility of using taxonomic and trait-based information on microbial and macroinvertebrate assemblages as predictors in the random forest models developed to assess the risk of degradation of the two communities by metal contamination, at each site of interest.

Keywords: Soil ecology, Community, Metals, PAH, Ecological preferences, eDNA, Risk assessment

*Speaker