Fire and co-occurrence soil microbial networks

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Fires are important disturbances whose effects upon ecosystems are complex, including changes above and below-ground that affect composition and phylogenetic structure of microbial communities (1–3). The way a community is phylogenetically structured provides clues about the main assembling mechanisms (4). While environmental filtering tends to reduce the phylogenetic diversity of a community by allowing the coexistence of functionally (and hence phylogenetically) similar species, processes like competitive exclusion by limiting similarity tend to increase it by preventing the coexistence of functional and phylogenetically similar species (5,6). We used co-occurrence networks that detect relationships of co-presence or exclusion and inform us about the composition and ecological interactions taking place in the bacterial communities (7). We propose that network analysis, which can reduce the complexity of interactions to co-presence or exclusion modules depending on the interaction sign, can be combined with phylogenetic analysis to discern between the main processes involved in the community assembly. We tested such assumptions in soil bacterial communities exposed to an experimental fire. We found that fire altered the composition of soil bacterial communities, while maintaining a low phylogenetic diversity. Both co-presence and exclusion modules were more phylogenetically related than expected by chance. We interpret phylogenetic clustering in co-presence modules as a result of environmental filtering, and that in exclusion modules as reflecting competitive exclusion by limiting similarity. This pattern remained unchanged despite the changes in the composition of bacterial communities caused by fire. Thus, we suggest that both environmental filtering and limiting similarity are simultaneously operating to assemble soil bacterial communities and this can be detected by inspecting the phylogenetic signal in co-occurrence networks.

References

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