

Landscape ecology of fungal communities: habitat specificity and disturbance-driven compositional shifts in tropical and arctic fungi

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Fungi represent one of the largest groups of living organisms and play central roles in the functioning of terrestrial ecosystems as plant symbionts, pathogens, and decomposers. However, only a small fraction of fungi has been described and there is even less information on their ecology, such as habitat preference, distribution, and functional guilds. In this talk I will present case studies on how large-scale metabarcoding can give first insights into diversity, spatial structuring, and community turnover of soil fungal communities in tropical and arctic biomes.

The Yungas, a system of tropical and subtropical montane forests on the eastern slopes of the Andes, are extremely diverse and severely threatened by anthropogenic pressure and climate change. Although well-studied for plants and animals, fungal diversity in the Yungas has remained mostly unexplored. We carried out DNA metabarcoding of soil samples taken at 24 sites along the entire latitudinal extent of the Yungas in Argentina. The results indicate very high fungal richness and strong community turnover among the altitudinal forest types. Fungal community composition correlated strongly with elevation, with many fungi showing preference for a certain forest type. Despite the strong altitudinal community turnover, total fungal diversity was comparable across the different altitudinal zones.

The arctic tundra is experiencing profound climate-induced changes, such as warming and precipitation increase, resulting in thawing permafrost, alterations in nutrient cycling and compositional shifts in plant communities. Fungi likely have important, yet largely unknown, roles in current and future changes in arctic vegetation and nutrient cycling. We studied the long-term effects of experimental summer warming and increased snow depth on fungal community composition in the dry heath and moist tussock tundra at Toolik Lake, Alaska. The results indicate that total fungal community composition responds strongly to summer warming in the moist tundra, but not in the dry tundra. On other hand, increased snow depth resulted in pronounced changes in both tundra types. Richness of ectomycorrhizal, ericoid mycorrhizal and lichenized fungi generally decreased, while saprotrophic, plant and animal pathogenic, and root endophytic fungi appeared to benefit from summer warming and increased snow depth. Responses of fungi to summer warming and increased snow depth appear to be dependent on tundra type as well as taxonomic identities. Therefore, we recommend an integrative approach to study fungal community ecology that takes into account fine-scale taxonomic assignments.