Climate change effects on the forest fungi

Fungi are present everywhere in the forest. They decompose dead organic material, provide nutrients to the trees and cause damage as plant pathogens. This research network integrates research on forest fungi across nine North European countries by coordinating database developments, thematic conferences, field surveys, workshops, PhD courses and inter-institutional study visits.

Brief Policy

The main goal of the NEFOM network is to provide a platform facilitating research collaboration, data sharing and analysis infrastructure and phd education within the area of Northern Forest Mycology. During 2018 this goal was reached through our annual conference, this year with the theme "Climate change effects on fungi and their activities", a number of smaller workshops and phd courses and by continued development of databases.

Northern forests and forestry are currently debated in relation to several important societal values, such as wood production, climate mitigation, carbon sequestration and biodiversity conservation, which may all be affected by belowground fungi. In times of rapid climate change, there is even more focus on how Northern forests can maintain all these values high. During 2018, NEFOM network members published several new studies suggesting strong climatic effects on fungi, for example based on large scale studies of the timing of mushroom production and distribution of soil fungi. These studies pointed to strong climatic effects on fungal fruiting patterns over the last century and on large-scale geographical distribution of soil fungi. Other studies highlighted important functional differences among fungal species, for example, that different ectomycorrhizal fungal communities affect soil nitrogen and carbon dynamics very differently and that forest management clearly affect these communities. Together these findings underpin the importance of furthering our understanding of how climatic change and management affect fungal provisioning of important functions in Northern forests, particularly fungal mediated tree nutrient delivery and soil carbon sequestration.

In conjunction with our annual meeting at Oulanka Research Station, Finland, we visited several northern boreal 'taiga' ecosystems. Field trips are excellent for both scientific and social networking. Professor Lynne Boddy from Cardiff University (purple jacket) visited our meeting and gave an excellent talk on climate change effects on fungi. **Photo:** Karina Clemmensen

An important technical line of 2018 activities has been to integrate DNA-based fungal data into the Global Biodiversity Information Facility (GBIF) database. In the publicly available GBIF, it is easy to visualize geographical distributions of fungi, now also based on knowledge achieved by DNA sequencing of soil fungi - otherwise mostly living secret lives below-ground!

North European forest and forestry are exposed to conditions that are specific to the north, such as short growing season, low temperatures, nitrogen limited primary production and low organic matter decomposition rates. Trees that form ectomycorrhizal symbioses with soil-living fungi typically dominate boreal and temperate forests, and fungi are particularly important for decomposition processes and nutrient transfer to the trees, and as tree pathogens. Further, particular fungal communities are characteristic of Nordic forests. On top of this, climate warming is most rapid towards the north. Therefore, research cooperation aimed at understanding the environmental and management-related drivers of fungal diversity and community patterns as well as understanding how different fungi affect forest processes and production in a Northern perspective is highly needed.

One important conclusion from our annual meeting was that it is urgent to consider soil fungi when managing forest ecosystems for sustainability. From a fungal perspective, it seem likely that different management practices are needed to optimize the different major forest services: biodiversity conservation, wood production, C storage (climate mitigation) and bioenergy production, as all of these services cannot be optimized at the same time in the same stand. This is for example suggested by a trade-off between boreal forest productivity and soil carbon storage - mediated by ectomycorrhizal fungal community composition and function, which seem to support either high productivity or belowground carbon sequestration.