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Community structure of wood-inhabiting fungi in relation to substrate quality of decaying Norway spruces

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Aim

Decaying woody debris plays an important role in forest biodiversity, nutrient cycling and carbon balance but the relationship between substrate quality and decomposers is poorly understood. This limits the extent to which these ecosystem services can be effectively managed.

We investigated (1) how does the fungal community change during decay of Norway spruce logs and, (2) which substrate properties have the greatest correspondence to fungal community structure.

Material and methods

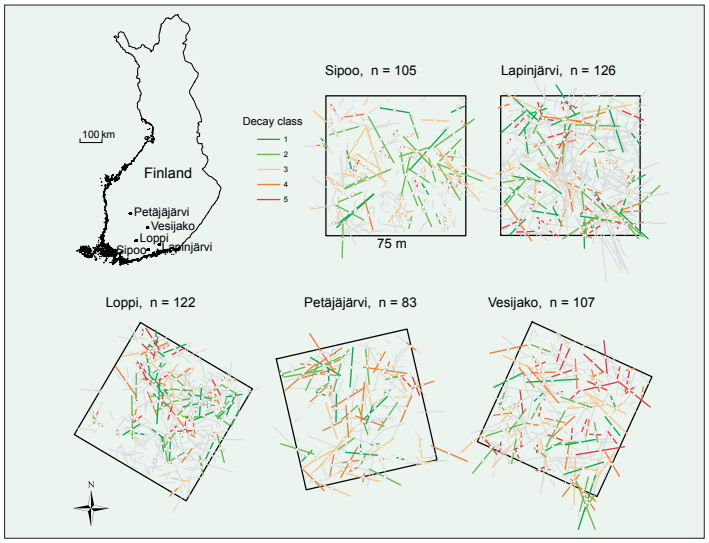


Figure 1. We have five study sites in unmanaged forests dominated by Norway spruce (*Picea abies* (L.) Karst.) from where all dead and living trees were located and measured. From each study site a representative set of fallen Norway spruce logs from all decay stages (classified to 1–5) were sampled.

Results

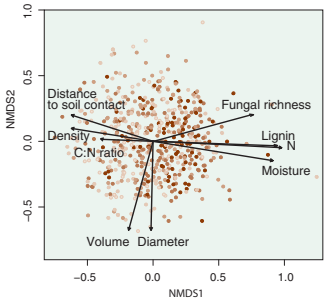


Figure 3. NMDS (non-metric multidimensional scaling) illustrates the separation of fungal communities along the decay profile. The level of shading of a symbol indicates stage of decay (increasing with decay). Characters of logs correlating with species composition of wood-inhabiting fungi were decay stage, density, distance to soil, lignin, moisture, N, diameter and volume.

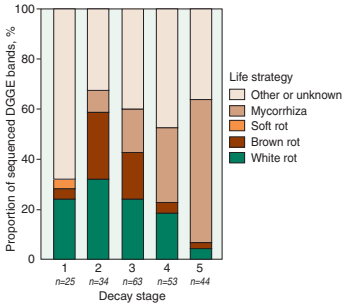


Figure 4. Proportions of fungal life strategy groups changed during the decomposition of Norway spruce logs. White- (e.g. *Phellinus viticola*, *P. nigrolimitatus*) and brown-rot fungi (e.g. *Coniophora olivacea*, *Antrodia serialis*) were common in the middle phase of decay succession. Mycorrhizal fungi (e.g. *Tylospora fibrillosa*, *Russula vinosa*, *R. emetica*) dominated in heavily decayed logs.

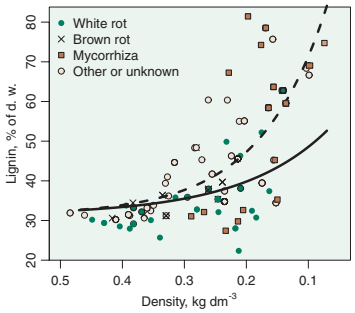


Figure 5. Lignin accumulated at a slower rate in decaying logs where white-rot fungi were detected (solid line) compared to logs where their DNA was not detected (dash line).

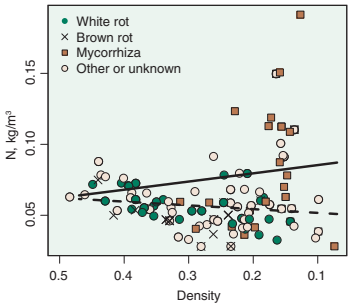
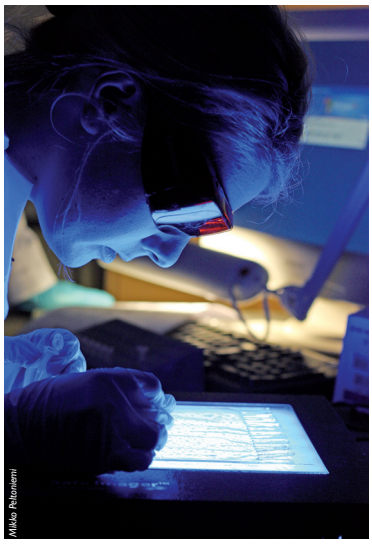
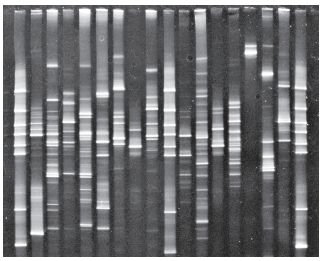


Figure 6. Amount of N increased in decaying logs where mycorrhizal fungi were detected (solid line) compared to logs where their DNA was not found (dash line).





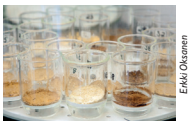


Figure 2. Fungal community was analysed by extracting DNA from the wood, amplifying fungal ITS region (ITS1F/ITS2 primers) and profiling by DGGE (denaturing gradient gel electrophoresis). Species identification was done through sequencing and Blast searches against GenBank. In addition, we analysed wood physico-chemical properties: density, moisture, C:N ratio and Klason lignin.

Conclusions

Decomposition is one of the key ecosystem services in boreal forests and our study improved the knowledge on fungal community responsible of that. Fungal composition in decaying Norway spruce logs changed with decreasing wood density and C:N ratio, and increasing moisture and lignin content. Presence of white-rot fungi seemed to reduce accumulation of lignin and mycorrhizal fungi was associated to high N amount, suggesting that fungal community affects decomposition and substrate quality.

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