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学位論文の要約

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Comparative studies on soil microbial community structures and their function in boreal and subarctic ecosystems
(北方林およびツンドラ生態系における土壌微生物群集とそれらの機能性についての比較研究)

Climate change is a critical issue throughout the world. The boreal tree species migrate to north, leading to the increase of not only vegetation diversity but also carbon cycle in the ecosystems. However, the impacts of such climate change on nitrogen cycle are still unclear. Hence, the soil microbial community structures in boreal forest beds and forest limits were investigated to reveal their roles in the ecosystems, particularly in the relation with their nitrogen fixing potentials. Here I showed abstract of my doctor thesis consisting of three main topics.

1. A comparative study on soil microbial community linked to water soluble organic carbon (WSOC)

Rising atmospheric temperature promotes litter decomposition, leading to an increased carbon availability in soil. I compared microbial community structures and their nitrogen-fixing potentials in soil of following 2 sites: a spruce forest edge in high latitude and altitude in Pallas, Finnish Lapland with poor litter supply and slow decomposition, and a planted larch forest in cold-temperate zone in Tomakomai, Japan with large amount of litters supply and rapid decomposition. The potentials of nitrogen fixing communities were similar among the mineral soils. The Pallas B1, B2, and Tomakomai B soils-inoculated cultures showed higher acetylene reduction at relatively low carbon concentration, while Tomakomai A soil-inoculated culture did at higher concentrations. *Thaumarchaeota,* a major phylum of mesophilic ammonium oxidizing archaea, was frequently detected from all of the soil samples, which may contribute to nitrogen cycling in subsoil.

2. Relationship between vegetation and soil microbial community structure in subarctic tundra in northern Sweden

Tundra landscapes can exhibit large topographical related variations in vegetation and soil properties across short distances. Here I investigated how this small-scale

variation reflects bacterial community structures across different vegetation types in a subarctic tundra landscape in the Karkevagge valley. Humus-rich soils were collected from five major types of vegetation. Mesic meadow, *Dryas* heath, and grassland showed a high nitrogen fixing potential while mesic heath and boulder heath showed low or no activity. The soil bacterial communities and their nitrogen fixing potentials were linked via the vegetation types.

3. A role of soil microbial community under a mycelial mat of *Hydnellum ferrugineum*

Hydnellum herrugineum forming a thick mycelial mat is known as a fairy ring-forming ectomycorrhizal fungus with their fruiting bodies on the edge. Besides, highly developed eluvial soil known as podzol is observed just under the mat. The soil microbial community in each soil profile showed characteristic pattern to reflect the soil environments, suggesting that the microbial community was highly influenced by the mycelial mat. Furthermore, *Collimonas* (family *Oxalobacteriaceae*, class *Betaproteobacteria*) was isolated from B horizon, which has been reported as a bacterium which can solubilize inorganic phosphorous and iron. This result may suggest that some of soil bacteria also contribute to progressing pozdolization and mineral leaching together with *H. ferrugineum*.

Increasing temperature accelerates litter decomposition and WSOC supply to the mineral horizon, and the bacterial community in the mineral horizon having high nitrogen fixing potentials shows clear responsiveness toward the increased WSOC. Soil microbial community plays an important role in elemental circulation in the boreal and subarctic ecosystems.