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森林土壌における窒素動態の空間的不均質性とその形成要因
Factors influencing spatial distribution of soil nitrogen dynamics in a natural mixed forest stand in northern Japan

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Nitrogen (N) dynamics in forest soils is often spatially heterogeneous. Such heterogeneity is important as a component of forest biodiversity and succession. Several factors, including plants, influence spatial heterogeneity of N in soils. Many studies have reported that tree species affect soil N dynamics, and that net N mineralization and nitrification are negatively correlated with litter Carbon (C) :N ratio, lignin:N ratio, and soil C:N ratio. As organic materials in soils are largely derived from forest floor, species-specific litter traits would affect soil N dynamics. Therefore, the spatial pattern of canopy tree composition in a natural mixed forest stand would be related to the spatial heterogeneity of soil N dynamics. In addition, understory vegetation also play a role in N cycling, and litterfall of both overstory and understory vegetation mixes in mixed forests. Hence, spatial pattern of both plant and litterfall would influence spatial heterogeneity of N dynamics of soils in a mixed forest stand. However, these relationships are not well understood.

We established two experimental sites (site A & B) in cool-temperate natural mixed stands of Uryu experimental forest of Hokkaido University. Site A is dominated by coniferous trees with dense understory of *Sasa senanensis*, while site B has more broadleaved trees with dense understory of both *S. senanensis* and *Viburnum furcatum*. Within each site, we conducted two types of surveys (survey 1 & 2). In survey 1, we corrected data and samples on vegetation, litterfall, forest floor, and mineral soils in 15plots at each site to understand the mechanisms of plants influencing soil N dynamics. Survey 2 focuses on understanding the spatial relationships between vegetation and soil N, and sampling were conducted in each of 50 grids covering entire site. The samples were analyzed for their physical and chemical properties such as pH, C, N, base cations and aluminum (Al) concentration (survey 1). Also, soil microbial respiration rates, net N mineralization and nitrification rates were measured with laboratory soil incubation.

In site A, the biomass of *S. senanensis* was high near broadleaved trees and in areas with less coniferous trees. In site B, the *V. furcatum* densities were low under conifer-dominated area, and the biomass of *S. senanensis* were low in the *V. furcatum* dense area. The spatial distribution of both overstory and understory vegetation influenced that of litterfall. The C:N ratio of coniferous litter was significantly higher than other litter types. The Calcium (Ca) concentration was the highest in *V. furcatum* litter, while it was the lowest in *S. senanensis* litter. Both *V. furcatum* and coniferous tree litter contained higher level of Al than others. Forest floor under coniferous trees were thick, while it was thin under *S. senanensis* and *V. furcatum* dominate area with nearby broadleaved trees. The C:N ratios of total litterfall were positively correlated with the thickness of FH layer, indicating that litterfall with higher C:N ratio decomposes more slowly. The FH layer thickness was negatively correlated with soil nitrate pool and net nitrification rates in both sites, suggesting that where litter decomposition is faster, nitrate production is higher. The spatial relationships between vegetation and soil N dynamics in survey 2 indicated that soil nitrate pool is higher under *S. senanensis* and *V. furcatum* dominate area with nearby broadleaved trees, and is lower in conifer-dominated area. These relationships may be due to the difference of litter C:N ratio and decomposition rates. As *V. furcatum* litter contained the highest level of Ca, Ca might promote nitrification in soils. Our results indicated that spatial pattern of both plant and litterfall influence spatial distribution of nitrate pool in soils through the difference in litter decomposition rate in cool-temperate natural mixed forest of northern Hokkaido.

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