アラスカ内陸部クロトウヒ林における有機物層の発達程度の空間変動とその要因

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Spatial variation in development of organic layer and its controlling factor under black spruce stands in Interior Alaska

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Responses of both vegetation and soil to changing climate are key processes to estimate the future effect of warming climate on forest ecosystems in circumpolar region. In discontinuous permafrost region, distribution of different forest types and tree growth rate are affected by spatial variation in active layer depth. Meanwhile, soil biogeochemical process that controls greenhouse gas emission and removals may also be affected by the development of organic layer in forest floor. We focused on moss and lichen that form thick organic layer in subarctic forests and investigated spatial variation in thickness of organic layer and its controlling factor within a watershed. Study site is Caribou-Poker Creeks Research Watershed (CPCRW) in Interior Alaska, The Bonanza Creek Long Term Ecological Research sites. In CPCRW, black spruce (*Picea mariana*) is dominated especially in north-facing slope and lower slope position where active layer is shallow. We set a plot of 600 m × 600 m and 49 grid points of 100m intervals in a northeast-facing slope with altitude of 250-350 m in July 2015 (Figure 1). In each grid point, we investigated coverage ratio of forest floor (leaf litter, moss, lichen and soil), thickness of organic layer, density of individuals of moss (5 cm × 5 cm), temperature (5 cm below from surface), tree density within 2 m of moss census point, diameter of breast height (DBH) of each tree. Moss species in study site were mainly *Hylocomium splendens* and *Pleurozium schreberi*. The thickness of organic layer ranged 6 to 41 cm. Thick organic layer (>20 cm) was obtained grid point where tree size was relatively small (DBH <11 cm, Figure 2). The grid point with thick organic layer was also characterized by the absence of coverage of leaf litter in forest flower (Figure 3). The relationship between temperature and thickness of organic layer was not clear, while organic layer was thick in north-facing slope and upper slope position. Accordingly, thick organic layer might be formed in the north-facing slope where tree and canopy size are small and there is no inhibition of moss growth by leaf litter. Additional advantage for moss growth by longer duration of daylight is offered in the upper slope position and it might also contribute to the forming of thick organic layer.

周極域の温暖化が森林生態系の構造と機能に与える影響を将来予測するためには、植生と土壌の両方の応答を明らかにする必要がある。不連続永久凍土帯では、森林タイプの分布や樹木の成長速度は、活動層厚の空間変動に影響される。一方、温室効果ガスの生成等に関わる土壌の生物地球化学プロセスは、林床の有機物層の発達程度の違いにも影響される可能性がある。本研究は、亜寒帯林下の厚い有機物層を構成する蘚苔地衣類に着目し、有機物層の発達程度、特に蘚苔類の厚さの空間変動とその要因を明らかにすることを目的とする。現地調査はアラスカ内陸部に位置する Bonanza Creek 長期生態学研究サイトの一つである Caribou-Poker Creeks Research Watershed で行った。同流域では活動層厚の小さい北斜面および斜面下部にクロトウヒ（*Picea mariana*）が優占する傾向がある。2015 年 7 月に標高 250-350 m の北東斜面に 600 m×600 m の調査区を設定し、49 の 100m 格子地点について林床被覆度（樹木リター、蘚苔類、地衣類、土壌のパッチの面積割合）、有機物層厚、蘚類パッチの個体密度（5 cm×5 cm）、地温（深さ 5 cm）、中心から半径 2m の樹木個体密度、樹木の胸高直径（DBH）を計測した。蘚苔類は主に *Hylocomium splendens* と *Pleurozium schreberi* が観察された。有機物層の厚さは 6-41 cm の範囲であった。有機物層の厚さが 20 cm を超える地点は、樹木の平均個体サイズが小さい傾向がみられた（DBH <11 cm、図 1）。またこれらの地点では林床においてリターのパッチが占める割合がほぼ 0 であった（図 2）。有機物層厚と地温の関係は不明瞭であったが、斜面方位がより北向きで、斜面位置が上部の地点において有機物層が厚くなる傾向が見られた。このとき、活動層厚の小さい北向き斜面では樹木の生育が不良で林冠が閉鎖されず、

リターの被覆に伴う蘚苔類の伸長阻害もなく、さらに斜面上部では下部より日照時間が長いため、蘚苔類にとって光環境が良好であり、厚い有機物層が形成されると考えられた。

References

Chapin, F.S., and Hollingsworth, J. Citing online sources: Caribou Poker Creek Research Watershed GIS Data, Digital Elevation Model (DEM), Bonanza Creek LTER - University of Alaska Fairbanks, BNZ:435, 2010.

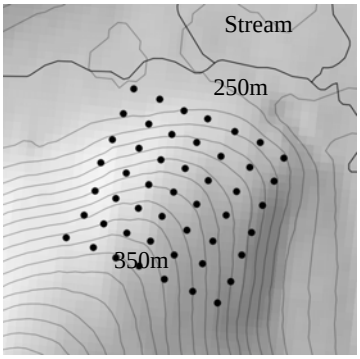

Figure 1. Study site and topography

Contour lines are at 10m intervals in elevation. The number is elevation (m). Closed points are grid point for tree and moss census. The figure is illustrated based on Digital Elevation Model (DEM) of CPCRW (Chapin and Hollingsworth, 2010).

図 1. 調査地と地形

等高線は 10m 間隔。図中の数字は標高、点は調査地点。Chapin and Hollingsworth (2010) の DEM データより作成。

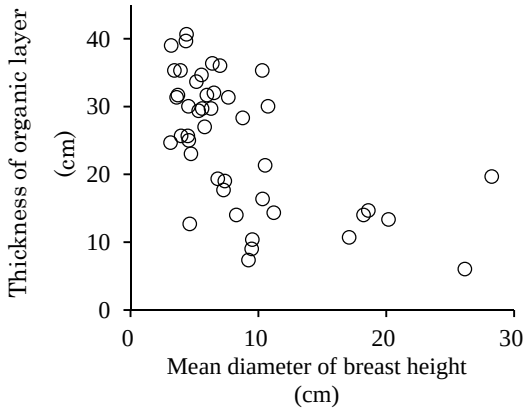

Figure 2. Relationship between diameter of breast height and thickness of organic layer

図 2. 樹木の胸高直径と有機物層厚の関係

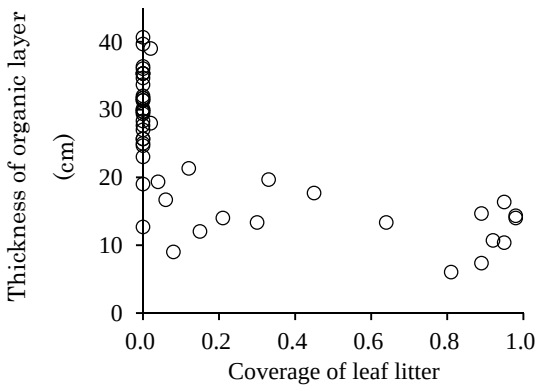

Figure 3. Relationship between coverage of leaf litter and thickness of organic layer

図 3. リターの被覆割合と有機物層厚の関係