学 位 論 文 内 容 の 要 旨

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学 位 論 文 題 名

Dynamic properties of subalpine coniferous forests in Nepal Himalaya and Hokkaido

（ネパール・ヒマラヤと北海道の亜高山帯針葉樹林の動態特性）

Subalpine coniferous forests in Northern Hemisphere are forested ecosystems located in the highest elevation, which provide a range of ecosystem services to not only local human communities but also those in the downstream regions. Subalpine forests in Himalayas in low latitude at 27-29°N are located in the world-highest locations, experiencing low atmospheric pressure and high UV-B radiation. In contrast, subalpine forests in Hokkaido around 43°N in low altitude experience high intra-annual temperature variation, where severe winter brings about tree damage by snow deposition and stem freezing. Himalayan subalpine forests usually suffer from land use pressure, while Hokkaido forests do not. This thesis examined determinants of population and biomass dynamics in two contrastive subalpine forests: *Abies spectabilis* dominated forest in Langtang National Park, eastern Himalaya, and primeval *Picea glehnii-Abies sachalinensis* dominated forest on Mt. Oakan, eastern Hokkaido, to specify major factors that determine the biomass storage and turnover of these forest ecosystems.

Over the entire range from 3100 to 3900 m in Langtang subalpine forest, I examined the effects of topographic and human disturbances on vegetation and *Abies spectabilis* population. Forest structure was mainly determined by altitude and topsoil disturbance by livestock trampling. Illegal logging enhanced but forest grazing suppressed regeneration of *A. spectabilis*. In high altitude with low canopy coverage, *A. spectabilis* showed high juvenile density fore regeneration. These results provide information of types and limiting intensities of human disturbances for the sustainable management of this forest along altitudinal gradient.

In the same Langtang forest, I quantified altitudinal change in aboveground biomass and its turnover rate by examining tree stem allometry and stem wood increment of canopy trees. Forests were tallest in lower elevation around 43 m. With altitude, tree height at any given stem diameter decreased. Therefore, even though growth rate in stem diameter for canopy trees was similar across altitude, growth in tree mass decreased with altitude. Large aboveground biomass of about 50 kg dry mass m^{-2} was maintained by slow demographic biomass turnover rate of 0.01 $year^{-1}$ relative to that in usual old-growth forest ecosystems (0.015-0.02 $year^{-1}$). Decrease in canopy height, aboveground biomass and biomass turnover rate with altitude suggested architectural adaptation to severe conditions for primary production in higher

altitude.

In the Oakan forest in eastern Hokkaido, I examined architectural and demographic properties of two dominant canopy tree species of *Picea glehnii* and *Abies sachalinensis*, based on repeated censuses in 1-ha permanent plot at 540 m above the sea level, over eleven years. Tree-size dependent growth rate and mortality rate varied between two species. *P. glehnii* showed better growth and survival at canopy with the maximum height of about 35 m, whereas *A. sachalinensis* did so in understory with higher recruitment rate, which contributed to coexistence through species stratification along canopy profile. Aboveground biomass of 14 kg m^{-2} in average was maintained by fairly high turnover rate of 0.04 $year^{-1}$, which suggests that the forest experienced high disturbance, resulting in high proportion of young stands in the plot. Increasing abundance of *A. sachalinensis* was therefore associated with young regeneration.

Comparison of results from two contrastive forests suggest that Himalayan subalpine forests in mild winter would experience lower natural disturbances compared to subalpine forests in higher latitude, regardless of the presence of anthropogenic disturbances. High biomass storage with tall canopy stature can be attributed to mild climatic conditions. In contrast, low biomass storage and high biomass turnover rate of the Oakan forest reflected a high proportion of young stands after natural disturbances. Co-dominance of two coniferous species can be associated with high disturbances in severe climate, which enhance inter-specific differentiation along canopy profile and regeneration stages.