Factors determining the spatial distributions of epiphyte biomass and species in a tropical montane forest of northern Thailand

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Abstract

Chapter 1. General introduction

Species-rich and abundant epiphyte communities, which contribute to biological diversity and ecosystem function, are the prominent and essential feature of tropical montane forests. Vertical habitat partitions by epiphyte species have long been recognized in tropical forests. However, the influence of forest structure, such as characteristics of a stand, host tree, and branch, on spatial distributions of epiphyte biomass and species remain unclear in some regions, particularly in tropical montane forests in Southeast Asia. The objective of this study was to identify factors influencing spatial distributions of epiphyte biomass and species in a tropical montane forest in northern Thailand.

Chapter 2. Study site: Doi Inthanon Forest Dynamics Plot

Fieldwork was conducted in the Doi Inthanon Forest Dynamics Plot located approximately 1700 m above sea level in the Doi Inthanon National Park, Chiang Mai, Thailand.

Chapter 3. Composition and spatial distribution of epiphyte biomass on large trees

The dry mass and composition of epiphytic matter (EM) consisting of living epiphytes and canopy humus were investigated on three large canopy and emergent trees. A large variation in the mass and composition of EM was found, even among and within the large host trees. With an increase in host tree size, the mass of EM increased from 73.4 kg to 339.6 kg to 480.9 kg, and proportions of vascular epiphytes and canopy humus to the entire mass of EM increased, whereas that of bryophytes decreased. Within-tree distribution patterns of EM differed among host trees, and the larger mass of EM on larger host trees was attributed to the development of vascular epiphytes and canopy humus, even in the outer crown of the host trees. Therefore, the development of thick EM mats, mainly consisting of vascular epiphytes and canopy humus, contributed to the large mass of EM on emergent trees.

Chapter 4. Distribution patterns of vascular epiphyte species within forest stands

To understand the influence of forest structure on spatial distributions of epiphytes, species distribution patterns of vascular epiphytes along habitat structural gradients were examined. Relationships between 32 common vascular epiphyte species, including six life forms based on leaf habit (deciduous and evergreen) and growth form (fern, forb, and shrub), and five habitat structural variables [topography, diameter at breast height (DBH) of the host tree, relative height, diameter, and inclination of substrate] were analyzed. All habitat structural variables significantly influenced species distributions of vascular epiphytes. Species richness of vascular epiphytes was higher on thick horizontal branches located at the mid-canopy of large host trees in the lower-slope stand. Within the distribution pattern of each epiphyte species, at least one of the five habitat structural

variables had a significant influence on species distributions of the 30 vascular epiphyte species, and the relative importance of habitat structure was ranked as follows: topography > substrate height > substrate diameter > DBH of host tree > substrate inclination. Habitat partitions by vascular epiphyte species and life forms were found within the forest; however, the epiphytes gradually present shifted and overlapped their distributions along habitat structural gradients.

Chapter 5. Leaf traits of vascular epiphytes in relationship to the spatial distribution

The link between spatial distributions along habitat structural gradients and leaf traits of vascular epiphyte species were investigated. For the 32 vascular epiphyte species investigated in Chapter 4, six leaf morphological and chemical traits related to leaf lifespan and photosynthetic capacity were measured: leaf size, leaf mass per area (LMA), leaf dry matter content (LDMC), leaf thickness, leaf toughness, and leaf nitrogen content (N_{mass}). Leaf traits differed among epiphyte species of different leaf habits and growth forms; evergreen species had leaves with higher LMA, leaf thickness, and leaf toughness, and lower leaf size and N_{mass} than those of deciduous species. Forb species had lower LDMC than fern and shrub species. These results indicated that deciduous and forb epiphytes represented the “acquisitive” leaf strategy (rapid resource acquisition), whereas evergreen, fern, and shrub species showed the “conservative” strategy (long resource conservation). Leaf traits of vascular epiphyte species correlated with habitat structural gradients, and in particular, the variation in LMA characterized the species shift along the environmental gradient from thick branches in the lower canopy to small branches in the upper canopy.

Chapter 6. General discussion

This is the first comprehensive study on epiphyte community structure in a tropical montane forest in Southeast Asia. This study revealed the unique epiphyte communities characterized by the large amount of EM and the habitat partitions by epiphyte species of different leaf habits and growth forms with contrasting leaf strategies. The forest structure significantly influenced spatial distributions of epiphyte biomass and species. These results suggested that heterogeneous habitats enabled the coexistence of diverse epiphytes in this forest. For an improved understanding on community dynamics, conservation, and restoration of epiphytes, long-term monitoring and experimental studies are required.