

CURRENT VEGETATION OF THE SURROUNDING FOREST OF SHUGAKUIN IMPERIAL VILLA

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Introduction

Shugakuin Imperial Villa is known as a circuit style garden that represents Japan. The surrounding forest is an important element for the landscape and thus it is managed for conservation. On the other hand, the forest around Kyoto Basin recently has some severe problems: pine wilt disease [1], the mass mortality of oak trees caused by the fungus *Raffaelea quercivora* [2], the expansion of *Castanopsis* forest [3], the vegetation degradation caused by deer browsing [4]. Shugakuin Imperial Villa is located at the bottom of the northeast hill of Kyoto Basin thus the same problems can affect the vegetation of the surrounding forest and its landscape. In 2008, every tree measurement survey is conducted in the surrounding forest. This study aims to grasp the current vegetation of the surrounding forest of Shugakuin Imperial Villa and its changes in the last 7 years, and to consider the future management for the conservation of the vegetation and landscape.

Methods

The every tree measurement and vegetation survey of understory was conducted on 24 quadrats (10m*10m each) placed on the surrounding forest of Shugakuin Imperial Villa, located on northeast of Kyoto Basin, Kyoto Prefecture, Japan. 5 quadrats were placed on Japanese red pine (*Pinus densiflora*) forest and 19 quadrats on Broad-leaved forest. The species, height and DBH were surveyed in every tree measurement targeting trees of more height 1.3 m and more DBH 1 cm. In vegetation survey, 5m*5m quadrats was set on each 10m*10m quadrat, the emergence species, the coverage and the sociability for each species was surveyed targeting the vegetation below 1.3 m. From the results of every tree measurement, the vegetation of plots was classified into 4 layers each; canopy layer (80% or more of the maximum height), sub-canopy layer (50% - 80%), lower layer (20% - 50%), and shrub layer (20% or less). In each layer, the degree of dominance (the basal area ratio) of the species was estimated and the plots were classified according to the vegetation of each layer.

Results and Discussion

For 5 plots of Japanese red pine forest, the population of Japanese red pine was reduced from 160 to 86 in 2008 to 2015. These plots were classified roughly into two types without pure stand according to the vegetation of sub-canopy layer; the plots lower tree species are dominant such as *Ilex pedunculosa* and *Lyonia ovalifolia*, and the plots tall deciduous tree

species are dominant such as *Quercus variabilis* and *Quercus serrata* (Table 1). When the Japanese red pine in canopy layer is reduced by pine wilt disease in the future, the dominant species of the canopy layer are going to change according to the type of sub-canopy and lower layer vegetation; The plots of former type is going to transfer into unclosed forest whose canopy layer is composed of lower tree species, and later they change into evergreen broad-leaved forest that is dominant in lower layer and shrub layer; The plots of latter type is going to transfer into deciduous broad-leaved forest, but deciduous tall tree species are suppressed by lower tree species in lower and shrub layer, thus it is necessary to promote the growth of the successor.

Table 1: The degree of dominance for Japanese red pine forest

Layer	Life form	Plot number				
		R1	R2	R3	R4	R5
Sub-canopy layer	Coniferous tall species	100%	0%	100%	0%	53%
	Deciduous lower species	0%	0%	0%	0%	0%
	Deciduous tall species	0%	0%	0%	0%	35%
	Evergreen lower species	0%	100%	0%	32%	0%
	Evergreen tall species	0%	0%	0%	68%	12%
Lower layer	Coniferous tall species	100%	0%	100%	0%	19%
	Deciduous lower species	0%	0%	0%	0%	38%
	Deciduous tall species	0%	0%	0%	0%	13%
	Evergreen lower species	0%	0%	0%	100%	3%
	Evergreen tall species	0%	0%	0%	0%	27%

The 19 plots of broad-leaved forest were divided into two stand types according to the dominant species of the canopy layer (Figure 1): deciduous broad-leaved forest (11 places) and unclosed forest (lower tree species make up the canopy; 8 places). In addition, each stand type is grouped roughly into two types according to the vegetation of the sub-canopy and lower layer; the plots tall evergreen tree species are dominant and the plots lower tree species are dominant. Because most plots of deciduous broad-leaved forest has canopies composed of large oak trees such as *Quercus variabilis* and *Quercus serrata*, when such large oak trees die from Japanese Oak Wilt, they lost large area of their canopies and the stand type is going to transfer to evergreen broad-leaved forest or unclosed forest according to the vegetation of the sub-canopy layer. The vegetation of unclosed forest plots is going to transfer to evergreen broad-leaved forest or remain unclosed forest in the same way.

In addition, deer traces (browsing traces or feces) have been confirmed in all plots in this survey. Because many species important in maintaining the current vegetation, such as *Quercus variabilis*, *Quercus serrata*, *Lyonia ovalifolia* and *Quercus glauca*, are considered to be food plant of sika deer (*Cervus nippon*) [5], it is concerned about the vegetation simplification and obstruction of regeneration by deer browsing.

To conserve the current forest vegetation and landscape, it is necessary to protect the trees composing the canopy from wilt diseases, and to promote the growth of successor of the canopy trees. It is considered to be effective to establish the deer-proof fence to guard from deer browsing and to cut shade trees down selectively.

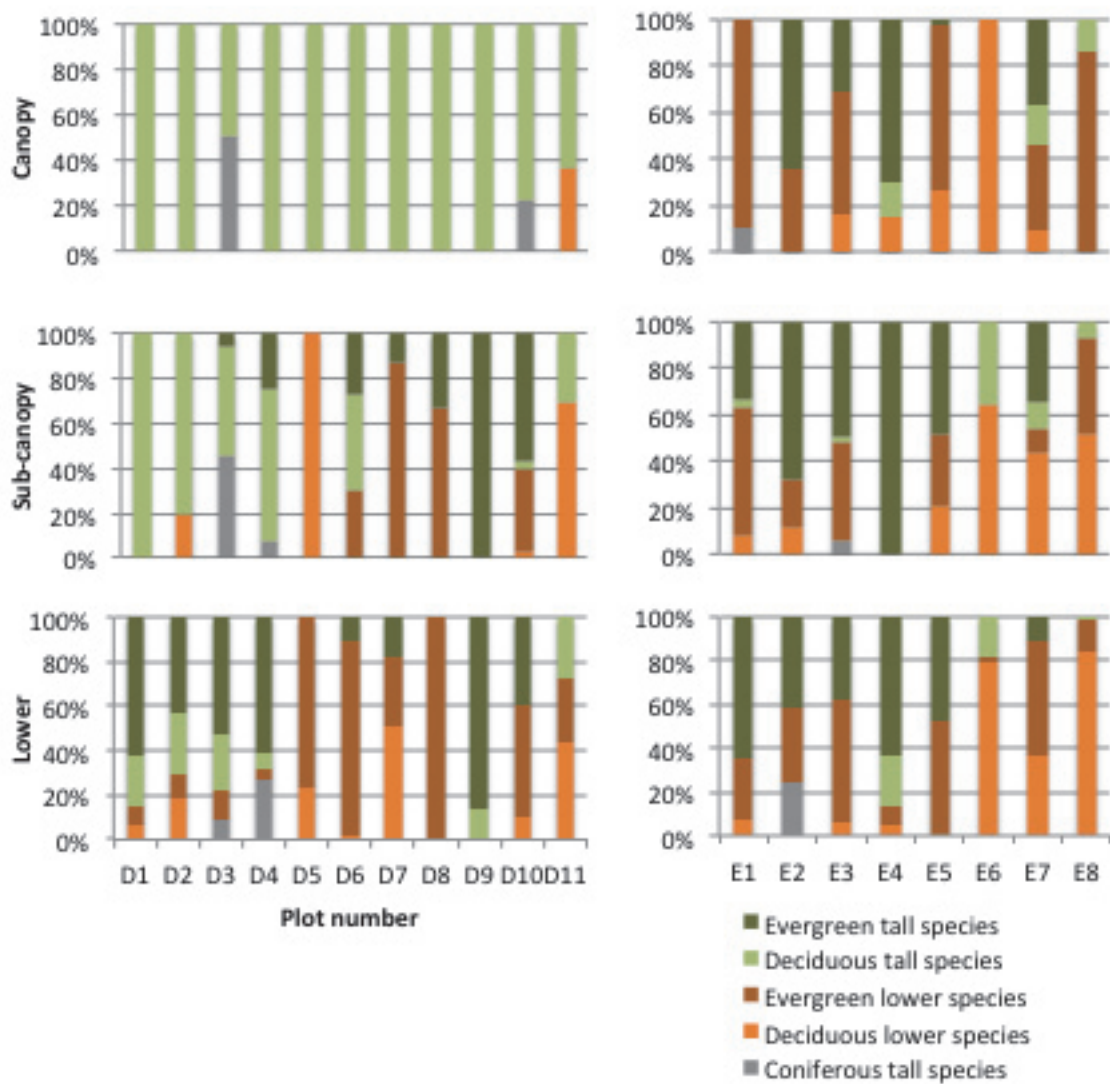


Figure 1: The degree of dominance for deciduous broad-leaved forest and unclosed forest

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