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主　論　文　の　要　旨

論文題目　The effect of disturbance by oak wilt disease on litterfall production, forest dynamics, and seedling dynamics in a warm-temperate secondary forest

氏　　名　策勒格尔（CELEGEER）

論　文　内　容　の　要　旨

Secondary forest is one of major forest types in the warm-temperate region and accounts for 23% of the total land area in Japan. Forest and seedling dynamics in warm-temperate secondary forests are influenced by human activities and natural disturbances, such as Japanese oak wilt disease (JOW). Since the 1990s, oak trees including *Quercus serrata*, *Quercus variabilis*, and *Quercus acutissima* have been attacked by Japanese oak wilt disease (JOW), which is a fungal disease caused by *Raffaelea quercivora*, in warm-temperate secondary forests in Japan. The impact of the JOW on forest structure has been well studied. Meanwhile, although litterfall production, net primary productivity (NPP), and seedling recruitment are vital processes in a forest ecosystem, limited attention has been paid to these processes in the forests afflicted by JOW. Clarifying the effect of JOW disturbance on warm-temperate secondary forests will aid prediction of changes in forest structure and function after JOW and consider the proper forest management.

This study was conducted in the warm-temperate secondary forests in the Kaisho Forest, Seto City, Aichi prefecture, central Japan. Since 2008, high mortality among Fagaceae species such as *Q. serrata* and *Q. variabilis* by JOW has been reported in the Kaisho Forest. The objectives of this study were to clarify the effect of disturbance by JOW on litterfall production, forest dynamics, and seedling dynamics in a warm-temperate secondary forest, to characterize the JOW disturbance and to discuss the direction of vegetative change after JOW.

In Chapter III, I examined the effect of JOW on litterfall production and forest structure using the long-term data for litterfall production and forest structure over 6 and 12 years, respectively. The results revealed the differences in the temporal patterns of basal area (BA) and stem density between deciduous and evergreen trees. I also found that total

annual litterfall and leaf fall showed little change in peak to post-JOW periods and that the change in BA were unrelated to total litterfall and leaf fall. The observed fluctuation in BA in the Kaisho Forest may not have been large enough to clearly reveal the effect of JOW during these periods. In Chapter IV, I calculated the mortality, recruitment, and growth rates of tree communities and estimated the aboveground biomass (AGB) and aboveground NPP, to clarify the effect of JOW on the forest dynamics and aboveground NPP. I found substantial temporal variations in mortality and recruitment rates over the 12-year study period. After JOW infection, wilting of a large number of oak trees led to high tree mortality in the peak JOW period. The resulting canopy gaps and improved light conditions drove increased recruitment and growth rates of sub-canopy and understory trees during the late JOW period, but subsequent competition and canopy reclosure minimized this effect 5 years after JOW disturbance. The increment of AGB (ΔAGB) and aboveground NPP showed little changes in peak to post-JOW periods. The effect of dead oak trees may be counteracted by increased recruitment and tree growth rates. In Chapter V, I quantified environmental conditions and seedling functional traits and monitored seedlings during 2018–2020 to explore the factors affecting the seedling dynamics using the structural equation model (SEM). Canopy openness, soil water content, and seedling density all fluctuated temporally. Seedling recruitment was improved during JOW disturbance through improved environmental conditions. The results of SEM models indicated that the functional traits of current-year seedlings were likely to be affected by soil nutrients in the late JOW period, whereas litterfall production impacted the functional traits of current-year seedlings in the post-JOW period. The relative importance of different factors for seedling survival also varied with changes in environmental conditions as JOW disturbance progressed. Seedling survival was enhanced by increased canopy openness in the late JOW period, and by reduced litterfall, high soil nutrient content and soil moisture in the post-JOW period. No direct effect of seedling functional traits on seedling survival might be due to the drastic temporal changes in abiotic conditions by JOW disturbance.

The effects of JOW on litterfall production, forest dynamics, and seedling dynamics may differ from those of other pulse-like disturbances through gradual and long-lasting changes in the environmental conditions responding to the gradual decay of standing dead oak trees. Evergreen trees are increasing after JOW and SEM models indicate the increase in seedlings of species with large seed mass, high tree height and root length species such as *Q. glauca*. Continued long-term monitoring of litterfall production, forest dynamics, environmental conditions, and seedling dynamics, together with litterfall decomposition and belowground NPP, will further elucidate the effect of JOW on the forest function and the direction of vegetative transition in secondary forests after JOW.