

Effects of thinning on the species and functional diversity of woody plants in a secondary tropical lowland rain forest

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Background: Tropical secondary forests play important role in conserving biodiversity and providing ecosystem functioning, but their recovery is usually slow and succession trajectory is distinct from old growth forests. Thinning is an essential silviculture approach to enhance recovery rate and timber production of tropical secondary forests. However, there is limited empirical evidence of thinning effects on secondary forests.

Method: Sixty 0.25ha plots were established and all woody stems ≥ 1 cm DBH were tagged and measured before thinning in 2013 (Figure 1). We selectively removed or girdled individuals which hindered the growth of target species (e.g. late-successional species, high timber value species) in 30 plots and re-censused woody plants in all 60 plots in 2018. Specific leaf area (SLA), wood density (WD) and maximum height (MH) were also measured.

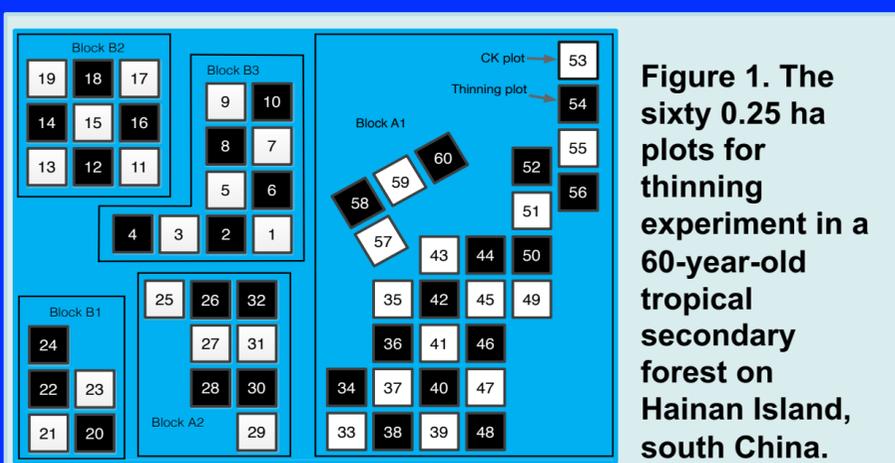


Figure 1. The sixty 0.25 ha plots for thinning experiment in a 60-year-old tropical secondary forest on Hainan Island, south China.

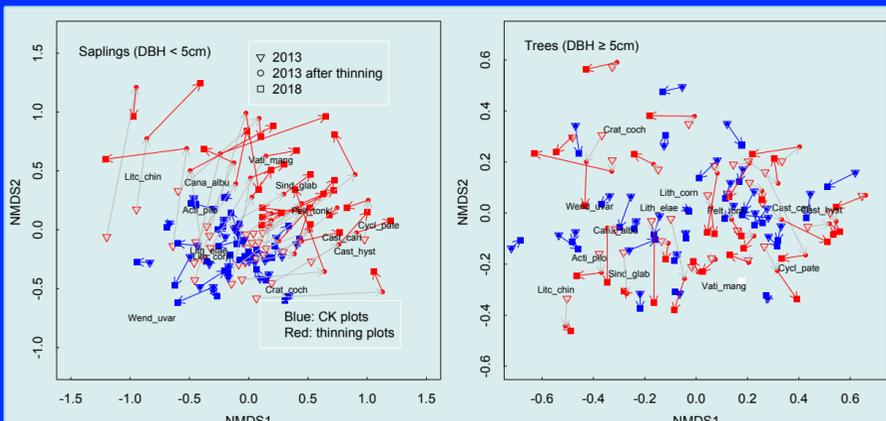


Figure 2. The changes in species compositions in nonmetric multidimensional scaling at the different time.

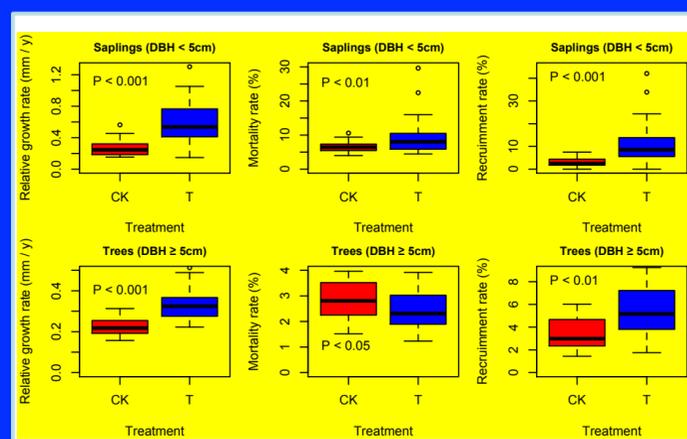


Figure 3. The relative growth rate, mortality rate, and recruitment rate in thinning (T) and control (CK) plots.

Results:

- In 2013, 57.6% of stems and 51.5% of basal area of saplings ($1\text{cm} \leq \text{DBH} < 5\text{cm}$) and 22.7% of stems and 12.3% of basal area of trees ($\geq 5\text{cm}$ DBH) were removed.
- The density and basal area of trees significantly increased after five years with no significant change for saplings. The rarefied species richness was not significantly between treatments and remained unchanged after five years.
- The species composition after thinning significantly changed and middle or late-successional species were more abundant after five years recovery (Figure 2).
- The relative growth rates (RGR) and recruitment rates were significantly higher in thinning plots for saplings and trees, and RGRs increased by 127% and 48%, respectively. The mortality rates decreased by 13% for trees and increased by 47% for saplings in thinning plots compared to control (Figure 3).
- Community weighted mean (CWM) of SLA of saplings showed significantly decreasing trend while CWMs of WD and MH increased after thinning. By contrast, CWMs of SLA and the MH of trees were significantly higher but wood density was significantly lower in thinning plots than control.
- RGR and recruitment rate of saplings and trees increased significantly as thinning intensity increased. However, the thinning intensity had weak or no effect on the mortality rate.

Conclusion: Selective removal and girdling of pioneer and middle successional species could accelerate recovery and improve the growth and recruitment of late-successional species, which is very enlightening to future managements of the tropical secondary forests.

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