Self-thinning process and its effects on aboveground mass dynamics and stand structure in overcrowded mangrove Kandelia obovata forest

Form 3

論 文 要 旨

Abstract

論 文 題 目

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In this study, the effects of self-thinning process on aboveground mass dynamics and stand structure were investigated over eight years in a subtropical overcrowded (ground is always 100% covered) mangrove *Kandelia obovata* forest on Okinawa Island, Japan. Plants are concurrently engaged in variable competitive interactions that take place under continuously changing densities. Competition occurs also between organs that develop under different growth conditions which often results in the dominance of the more successful organs at the expense of their less fortunate counterparts. This somatic self-thinning might result in radically different self-thinning exponents for tree organs. Applying Weller's allometric model, the slope of the self-thinning exponent α_x of a partial organ "x" was calculated from the allometric constants θ_x and δ_x obtained from the allometric relationships of mean tree height H and mean organ mass density $\grave{d}$ with mean organ mass. The self- thinning exponent, α_x, was estimated to be 1.509 for stem, 1.647 for branch, 1.090 for leaf, and 1.507 for aboveground. The ϕ_x-value was 0.6629 ± 0.0250 for stem, 0.6072 ± 0.0229 for branch, 0.9167 ± 0.0356 for leaf, and 0.6637 ± 0.0297 for aboveground. The value did not significantly differ from 2/3 but did significantly differ from 3/4 for stem, branch, and aboveground, indicating that the self-thinning exponents for woody parts did not significantly differ from 3/2. This result suggests that the self-thinning exponent is closer to 3/2 than to 4/3. In contrast, the ϕ_L-value for leaf significantly differed from both 2/3 and 3/4 but did not significantly differ from 1.0, indicating that stand leaf biomass was constant regardless of population density. The self-thinning exponent for leaf had a negligible effect on that for aboveground due to the small amount of leaf mass compared to the combined mass of all woody organs. The present results based on the allometric model of partial organs roughly support the 3/2 power law for aboveground self-thinning. For overcrowded *K. obovata* stands, self-thinning could be explained by a simple geometric model rather than a metabolic model. Self-thinning process was accompanied by changes in the dynamics of aboveground mass and stand structure during the study period. The rank of aboveground mass *w* was not completely constant as the stands grew, although the values of Spearman's rank correlation coefficient of *w* significantly differed from zero ($P < 0.01$). Therefore, the mass hierarchy of overcrowded *K. obovata* mangrove stands is variable as stands grow. The mode of the frequency distribution shifted to the right each year; smaller trees suffered high mortality, and surviving trees that were suppressed gradually continued to grow.

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