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Predicting Growth of Eucalyptus Marginata in a Mediterranean Climate Using an Individual-Based Modelling Approach

Authors : S.K. Bhandari, E. Veneklaas, L. McCaw, R. Mazanec, K. Whitford, M. Renton

Abstract : Eucalyptus marginata, E. diversicolor and Corymbia calophylla form widespread forests in south-west Western Australia (SWWA). These forests have economic and ecological importance, and therefore, tree growth and sustainable management are of high priority. This paper aimed to analyse and model the growth of these species at both stand and individual levels, but this presentation will focus on predicting the growth of E. Marginata at the individual tree level. More specifically, the study wanted to investigate how well individual E. marginata tree growth could be predicted by considering the diameter and height of the tree at the start of the growth period, and whether this prediction could be improved by also accounting for the competition from neighbouring trees in different ways. The study also wanted to investigate how many neighbouring trees or what neighbourhood distance needed to be considered when accounting for competition. To achieve this aim, the Pearson correlation coefficient was examined among competition indices (CIs), between CIs and dbh growth, and selected the competition index that can best predict the diameter growth of individual trees of E. marginata forest managed under different thinning regimes at Inglehope in SWWA. Furthermore, individual tree growth models were developed using simple linear regression, multiple linear regression, and linear mixed effect modelling approaches. Individual tree growth models were developed for thinned and unthinned stand separately. The developed models were validated using two approaches. In the first approach, models were validated using a subset of data that was not used in model fitting. In the second approach, the model of the one growth period was validated with the data of another growth period. Tree size (diameter and height) was a significant predictor of growth. This prediction was improved when the competition was included in the model. The fit statistic (coefficient of determination) of the model ranged from 0.31 to 0.68. The model with spatial competition indices validated as being more accurate than with non-spatial indices. The model prediction can be optimized if 10 to 15 competitors (by number) or competitors within ~10 m (by distance) from the base of the subject tree are included in the model, which can reduce the time and cost of collecting the information about the competitors. As competition from neighbours was a significant predictor with a negative effect on growth, it is recommended including neighbourhood competition when predicting growth and considering thinning treatments to minimize the effect of competition on growth. These model approaches are likely to be useful tools for the conservations and sustainable management of forests of E. marginata in SWWA. As a next step in optimizing the number and distance of competitors, further studies in larger size plots and with a larger number of plots than those used in the present study are recommended.

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