

AN ALGORITHM FOR A LANDSCAPE LEVEL MODEL OF MAST PRODUCTION

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ABSTRACT

Masting is the reproductive habit inherent to some tree species where populations produce large seed crops in some years and small seed crops in others. This dissertation addresses two areas of oak mast production: i) formulating an approach to modeling mast production at a landscape scale and ii) evaluating the impact on tree growth when trees allocate resources to mast production. The model of mast production operates upon the predictions of forest structure and composition over large areas and long time-spans generated by the landscape model LANDIS. Forest inventory data (of local and national origin) are used to characterize the predicted size structure and species composition of oak subgenera based on stand age and ecological land type. This information is used to predict the potential mast production based on a diameter-acorn production relationship and assumed probabilities of inherent tree-level variability in mast production. Estimates of potential mast production are further stochastically modified to incorporate annual variation due to hypothesized: i) climatic conditions (freezing temperatures, humidity, and the temperature regime) during critical phases of flowering and acorn development, ii) random mast-limiting events (hail, insects, wind, and drought), and iii) phenological differences in acorn development between the red and white oak groups (*Erythrobalanus* and *Lepidobalanus*). Sensitivity analysis suggests that estimates of the proportion of trees in each subgenus strongly influenced estimates of mast production. Estimates of mast production were less

sensitive to the modeled diameter-age relationship and tree-density estimation. The model was tested on a 3,216 ha landscape southern Missouri. The masting model generates predictions that are within one order of magnitude of values observed in other studies (50 to 500 kg ha⁻¹) and comparisons of differences in mast production among ecological land types also conform to results from other studies. Due to the high degree of variability associated with the age-diameter relationship, a better description of the relationship would improve the model.

Intensive measurement of changes in diameter on *in situ* branches and correlated acorn production provided the most reliable indicator of the hypothesized tradeoff between mast production and vegetative growth. More data and more intensive data would be required to quantify the trade-off between acorn production and the subsequent year shoot growth.