GROWTH RING RESPONSE IN SHORTLEAF PINE FOLLOWING GLAZE ICING CONDITIONS IN WESTERN ARKANSAS AND EASTERN OKLAHOMA

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INTRODUCTION

Width reduction in growth rings in shortleaf pine (*Pinus echinata* Mill.) following glaze ice conditions produces a characteristic pattern dependent on live-crown ratio and extent of crown loss. Ring widths of 133 trees for 3 years preceding and 7 years following the December 2000 ice storm (Bragg and others 2002) in western Arkansas and eastern Oklahoma were cross-dated to detect missing rings, then measured under a 32X microscope. Data from undamaged trees was detrended using a logarithmic decay function to identify the climate signal, which was then incorporated into the model. Ring width was affected by live-crown ratio, proportion of crown lost, presence of branch damage, and tree basal area (Aubrey and others 2007, Smolnik and others 2006). Stand basal area, tree height, and diameter were not significant. Three trees produced no growth ring in 2001; no tree survived loss of more than 83 percent of its crown. Ring widths of undamaged trees declined slightly from an average of 0.064 inch in 2001 to an average of 0.058 inch in 2007. Branch-damaged trees had ring widths inversely proportional to live-crown ratio and averaged 0.055 inch throughout the 7 years following the storm. After 7 years, radial growth rates in trees with <55 percent crown loss are increasing, while those with >55 percent crown loss are decreasing. Diameter growth initially accelerated following ice damage; after 2 to 4 years diameter growth began to decline on trees with >55 percent crown loss.

RING-WIDTH MODEL FOR SHORTLEAF PINE GROWTH FOLLOWING ICE STORM DAMAGE

$$W = \text{Climate} * \text{TreeBA}^{b0} * (b_1 + \text{Con} * \text{TreeBA} * \text{LCR} * (1 - \exp(b_2 * t)) + b_3 * \text{Branch} / \text{LCR} + b_4 * \text{Stem} * (\text{LCR} - b_5 * \text{CrownLoss}) / (1 + \exp(\text{CrownLoss} - 1 + b_6 * t)) + b_7 * \text{Stem} * (1 - \text{CrownLoss}) * \exp(t * (\text{CrownLoss} - 1) + b_8 * t)) \quad (1)$$

where

W = width of annual growth ring (inches)

Climate = average width of corresponding detrended growth ring from undamaged trees

TreeBA = tree basal area (square feet)

LCR = live crown ratio

CrownLoss = proportion of live crown lost

t = years since ice storm

Con, Branch, and Stem = dummy variables denoting an undamaged tree, a branch-damaged tree and a stem-damaged tree, respectively

$b0$, b_1, b_2, b_3, b_4, b_5, b_6, b_7, and b_8 = regression coefficients

Analysis of variance

Source	df	SS	MS	F(9,1215)	*P*
Model	9	4.1791	0.4643	762.50	<0.0001
Error	1215	0.7399	0.000609		
Uncorrected total SS	1224	4.9190			

Fit index = 0.8496
s = 0.02468

Coefficient	Estimate	Standard error
b_0	0.3517	0.0263
b_1	0.9885	0.0166
b_2	0.0427	0.0135
b_3	–0.0416	0.00997
b_4	2.4195	1.0019
b_5	0.7002	0.3452
b_6	0.7697	0.2264
b_7	–0.6720	0.2914
b_8	0.4702	0.0656

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CONCLUSIONS

There is an initial increase in diameter growth following ice storm damage. After 2 to 4 years growth levels off. Loss of more than 55 percent of the top part of the trunk results in progressive reduction in radial growth. Loss of more than 83 percent of the live crown is fatal.

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