FRDA Research Memo

February 1996 No. 227

Modelling the Dynamics of Dead Trees in TASS and WinTIPSY

by

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INTRODUCTION

Dead trees play important ecological roles; for example, as food sources, as nesting substrates, or as nutrient reservoirs. These roles are dynamic and change as the tree breaks down. Changes may occur rapidly (as when a tree falls) or very slowly (a dead tree may decay over centuries), and are influenced by the stand, the site, and forest management.

Models of forest stand growth aid in the silvicultural decision process. These models provide information on wood production under various silvicultural treatments over time. Such models also supply mortality information, necessary for inputting into models of dead tree dynamics.

This memo describes the standing dead tree dynamics models integrated into the British Columbia Ministry of Forests' Tree And Stand Simulator (TASS) and Table Interpolation Program for Stand Yields for Windows (WinTIPSY).

TASS/WinTIPSY

TASS is a computer model that simulates the growth of individual trees within a stand. In this model, the growth of a tree (the stem) is based on the development of the tree's crown in response to internal growth regulation, the physical restrictions imposed by neighbouring trees, and to environmental and silvicultural factors. Because the model is based on the individual tree and crown, many silvicultural practices can be simulated (e.g., thinning and pruning). However, due to hardware and maintenance needs, TASS is not distributed[AC1].

Yield tables from TASS may be accessed through WinTIPSY. WinTIPSY is a computer-based program that retrieves yield tables from a database generated by TASS. WinTIPSY enables the quick display of yield tables for a range of species, for initial densities (natural and planted), and with or without pre-commercial thinning. WinTIPSY is available from the contact listed at the end of the memo.

STANDING DEAD TREE MODELS

Models of the dynamics of standing dead trees describe the transition of a dead tree from death to tree falldown. This description can include the tree's vertical position (i.e., standing or down), fragmentation, or decay state. The form of model depends not only on the available data, but on the input source of dead trees (e.g., a forest growth model).

Linear logistic regression models were fitted to available data from growth and yield permanent sample plots (for Douglas-fir, western hemlock, lodgepole pine, white pine) to determine falldown probabilities. For TASS and WinTIPSY use, only the time since death and the diameter at breast height were considered for dependent variables. For species with limited or no available data, parameters were determined based on the literature, or on similarity to other species.

In TASS, the model is applied to individual trees. A dead tree is considered to have fallen if the falldown probability exceeds a random probability. In WinTIPSY, the models are applied directly to stand tables of mortality (probability represents the proportion of standing dead trees that will remain standing). Additionally, in TASS the amount of breakage is modelled. That is, a linear logistic model determines if breakage will occur, and if breakage occurs the percentage of breakage is calculated by a linear regression model. No breakage model is included in the WinTIPSY model.

OUTPUT

Both mortality and standing dead tree summaries are obtainable in TASS and WinTIPSY. For mortality, stand-level summaries provide average tree statistics (height, dbh, volume) and a stand table for 10-cm dbh classes. For standing dead trees, WinTIPSY provides only a stand table (size class counts) due to the stand level modelling approach. In TASS, detailed information (e.g., dbh, height, volume) for individual standing (and down) trees is available, as well as stand-level summaries.

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***** TASS v2.06.73US Standing Dead Tree Summary  *****  Wed Jan 31 11:26:30 1996
Plot Description: 5000/ha natural - untreated
Species: Int. Lodgepole Pine  Site Index (@ BHage 50): 20.00 m   Curve: PL_GOUDIE
Mean Age is average number of years since death of trees.
Mean Height is average current height of snags.
Other statistics (DBHg, BA, Volume) represent values at time of death.
Summary only includes fully standing snags, not leaning or fallen snags.
The values reported are for the standing dead trees at the stand age, not an
accumulation between stand age steps.
Plot size:100.00 m  x 100.00 m  = 1.0000 ha

Stand  Stem  Mean  Mean  Mean  Basal   Total        Size Class (Stem Count/ha  )
 Age  Count  Age   DBHg Height  Area  Volume   0.1- 10.1- 20.1- 30.1- 40.1- 50.1- 60.1+
(yrs) /ha    (yrs) (cm)  (m )  (m 2/   (m 3/   10.0  20.0  30.0  40.0  50.0  60.0
                              ha  )   ha  )
-------------------------------------------------------------------------------------
    1      0   0.0  0.00  0.00   0.00   0.000     0     0     0     0     0     0     0
    2      2   0.0  0.00  0.03   0.00   0.000     2     0     0     0     0     0     0
    3      9   0.2  0.00  0.05   0.00   0.000     9     0     0     0     0     0     0
    4     22   0.5  0.00  0.08   0.00   0.000    22     0     0     0     0     0     0
    5     36   0.6  0.00  0.09   0.00   0.000    36     0     0     0     0     0     0
                                                ...
   96     66  10.9 15.68 11.64   1.27   7.841     4    57     5     0     0     0     0
   97     64  10.6 15.62 11.60   1.23   7.592     3    57     4     0     0     0     0
   98     65  11.1 15.67 11.83   1.25   7.731     3    59     3     0     0     0     0
   99     64  10.8 15.89 11.98   1.27   8.041     2    58     4     0     0     0     0
  100     64  10.3 15.96 11.84   1.28   8.150     2    58     4     0     0     0     0
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FIGURE 1. Example of TASS output, summarizing the standing dead trees.

EXAMPLE

Dead tree models, in conjunction with growth and yield models, enable comparison of silvicultural treatments in terms of dead trees (i.e., the density and size of dead trees). For example, pre-commercial thinning (PCT) decreases the number of standing dead trees (Figure 2), as expected. However, as opposed to live trees, dead trees of size class >20 cm dbh appear 6 years earlier where no PCT occurs than where PCT is as high as 1250 stems/ha (i.e., few of the larger trees are dying in the PCT).

RESEARCH NEEDS

Research is needed if the dynamics of dead trees are to be understood relative to stand and site conditions, and to silvicultural practices. Basic information can be collected in conjunction with existing growth and yield programs; however, specific research will need to address the unique dynamics in areas managed for dead and dying trees (e.g., wildlife tree patches).

Models are summaries and extrapolations of our knowledge. Models are not only tools for understanding or predicting dead tree dynamics, but are tools for identifying research needs as well. The dead tree models in TASS/WinTIPSY are based on literature sources and limited data from British Columbia. As such, many refinements to the models are expected. Users of these models are encouraged to bring new research information or defic-iencies in the existing model to the attention of the contacts listed below.

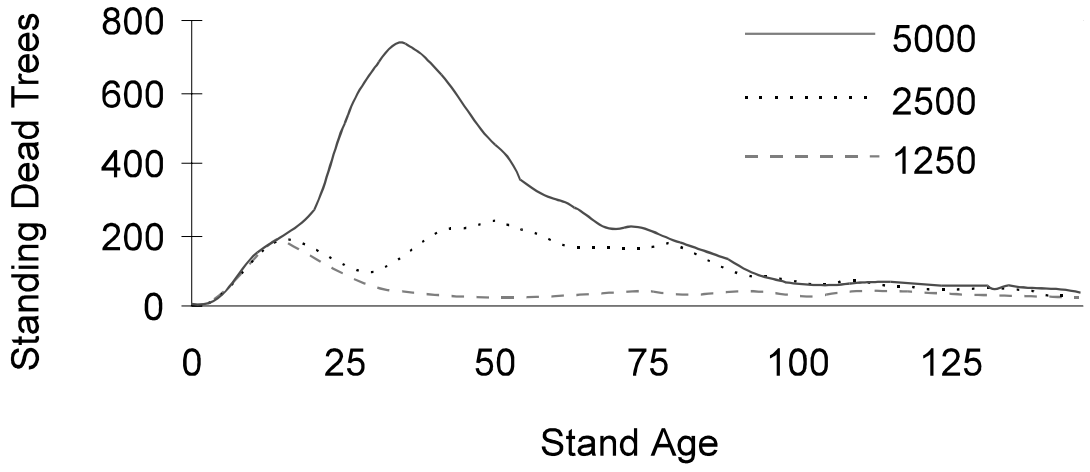

FIGURE 2. The 5-yr moving average of standing dead Lodgepole pine, per hectare, for 3 precommercial thinning treatments (PCT): none, PCT to 2500 stems/ha, and PCT to 1250 stems/ha. Initial density is assumed to be 5000 stems/ha. Site index is 20 m @ 50 yr.

FOR MORE INFORMATION CONTACT:

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[AC1] This is unclear. Do you mean that it is not ‘distributed’ across a network, or that copies are not available to those ask for them?