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Variable Retention Yield Adjustment Factors for TIPSY

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Abstract

Variable retention adjustment factors (VRAFs) incorporated in the Table Interpolation Program for Stand Yields (TIPSY version 3.2) enable forest managers and timber supply analysts to explore the impacts of the variable retention approach to harvesting on future harvest yields. VRAFs are based on the level and pattern of both group and dispersed retention. The VRAF model uses three primary variables from the retained stand: percent crown cover, edge length (perimeter), and top height. The system also includes subordinate models to predict edge length and retained crown cover from other retention measures such as basal area.

Introduction

The variable retention approach to harvesting leaves some trees from the original stand behind after harvest to mimic natural disturbance patterns and thereby maintain some of the original forest attributes (biodiversity, down woody debris, etc.) (Mitchell and Beese 2002; Beese et al. 2003). Since its introduction through the

Clayoquot Scientific Panel (1995), variable retention has provided an alternative to traditional clearcutting in British Columbia. Variable retention incorporates green-tree retention within cutblock boundaries to address social and ecological concerns. The level and spatial pattern of retention depends on management objectives and site-specific conditions (Franklin et al. 1997).

The Table Interpolation Program for Stand Yields (TIPSY) (Mitchell et al. 2000) is the forestry community's primary source of yield tables for managed stands, and is used widely for timber supply analyses in British Columbia. TIPSY's database of tables is generated by the Tree and Stand Simulator (TASS) (Mitchell 1969, 1975). The acceptance of the variable retention approach gave rise to requests for its inclusion in TIPSY. This report outlines the development of variable retention volume adjustments for use in yield tables applied to variable retention cutblocks, polygons, or analysis units. Work by the Research Branch of the B.C. Ministry of Forests was funded by the B.C. Forest Investment Account – Research Program.

VRAF Background

Development of TIPSYS variable retention yield adjustment builds on earlier work by Goudie (1999) following the public announcement by MacMillan Bloedel (now Weyerhaeuser) to cease traditional clearcutting in their coastal British Columbia operations. Alternative variable retention scenarios envisioned by MacMillan Bloedel included dispersed (scattered individual tree) retention and various forms of group retention. MacMillan Bloedel adhered to the common practice of not harvesting retained trees in the future. Consequently, MacMillan Bloedel anticipated a reduction in post-harvest regenerated yields relative to traditional clearcutting. This yield reduction has two components: the withdrawal of retained areas from future timber production, and the competitive influence (shading, etc.) of retained areas on the adjacent regenerating portions of the cutblock.

Using TASS, Goudie (1999) demonstrated a negative relationship between regenerated yield and group edge length (perimeter) for various spatial retention patterns. Figure 1 depicts TASS-generated images representing a 10% retention as either grouped or dispersed trees 10 years after variable retention harvest and planting. The circles around the retained trees represent the vertical projection of the open crown edges on the ground.

For the same level of retention,

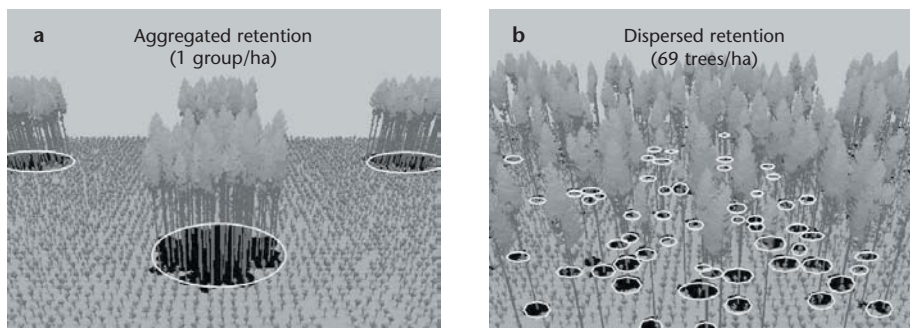


FIGURE 1 TASS-generated images depicting 10% retention 10 years after variable retention harvesting as one aggregated group (a), and 69 dispersed trees (b), per hectare. Circles were added to highlight canopy shadows (After Goudie 1999).

dispersed retention recorded more total edge length per hectare than did group retention, and a larger volume reduction relative to a clearcut scenario. This edge length relationship became the basis for developing the first-generation variable retention adjustment factors (VRAFs) incorporated in TIPSYS version 3.2.

TIPSYS VRAF Development and Use

More than 2300 TASS simulation runs provided data for VRAF prediction models in TIPSYS based on retained edge length. These runs addressed pure, natural, single-species stands established at 5000 stems per hectare. After variable retention harvesting, each stand was regenerated with the same species (1200 planted + 600 natural/ha). VRAF model parameters were developed for retention levels up to 30% for four species: coastal Douglas-fir, western hemlock (coastal and interior), lodgepole pine, and white spruce. Species substitution in TIPSYS enables VRAF application for other species.

TIPSYS's VRAF model requires three primary input variables of the retained trees at the time of variable retention harvest: percent crown cover, edge length (perimeter), and top height. The system also includes subordinate models to predict edge length and retained crown cover. For group retention, retained crown cover is derived from ground surveys or

post-harvest aerial photos. TIPSYS can also predict crown cover from retained basal area, a common measure of dispersed retention.

TIPSYS accepts direct input of edge length per hectare, which can be estimated from digitized aerial photos or cutblock maps using GIS software. Alternatively, TIPSYS provides two methods for predicting edge length based on other retention parameters. First, edge length can be predicted from estimates of average group size and retained crown cover or basal area. In this case, the relative proportions of dispersed and group retention types must be supplied by the user. The second alternative derives edge length geometrically from average group size and shape. Twelve group shape options provide a wide selection of area-to-perimeter ratios.

TIPSYS VRAFs reduce post-harvest regenerated yields on a per-hectare basis over an entire variable retention cutblock. Similar to TIPSYS operational adjustment factor 1 (OAF₁), VRAF adjustments are primarily a function of the retained area(s) removed from timber production. Unlike OAF₁, VRAFs slowly increase over time as crowns grow and group size expands into harvested areas. The computed VRAF displayed in TIPSYS's Stand Description is indexed to age 100 for regenerated stands.

As with any predictive model, users should be aware of important modelling assumptions that affect projections and their interpretation. The operational version of TASS used to generate the TIPSYS database assumes that the sun is always directly overhead and that shorter trees will not survive within the vertical canopy shadow of taller trees. In effect, TIPSYS VRAFs remove the crown shadow area of retained trees from production. For dispersed retention in particular, users who consider this effect too extreme may wish to reduce inputs accordingly.

In some timber supply applications, low levels of retention (<10%) may already be included in existing allowances for riparian zones, wildlife tree patches, etc. Variable retention yield adjustments in TIPSy do not reflect pest or windthrow interactions that may accompany variable retention practices. However, light dynamics, pests, and windthrow may be included in future versions of TASS. Modifications such as topping or pruning for wind firmness are also not considered in TIPSy. However, the effect would likely be quite small, since retained tree crown growth accounts for less than 5% of the total VRAF.

TIPSy VRAFs are appropriate for single-species forests and assume that the retained stand is of the same species as the regenerated stand. For mixed-species stands, VRAF is calculated for each species and then the resulting single-species yields are prorated according to the species composition of the stand.

An Example Using TIPSy

Figure 2 depicts an example variable retention cutblock in the Fraser Timber Supply Area. Fifteen retention groups include the large riparian strip bisecting the block. GIS analyses of digitized aerial photos provided estimates of retained crown cover (4.38 ha or 14%), average group size (2920 m²), and edge length (111 m/ha). Given these inputs, TIPSy predicts a VRAF of 0.83 (Figure 3). If edge length was not known, given just crown cover and average group size, TIPSy would have estimated edge length at 151 m/ha and predicted a VRAF of 0.82 (Figure 4).

Figure 5 depicts the merchantable volume curves generated by TIPSy for this example, comparing variable retention with a clearcut scenario. Similar yield tables produced by TIPSy are often used in timber supply analysis and silvicultural planning.

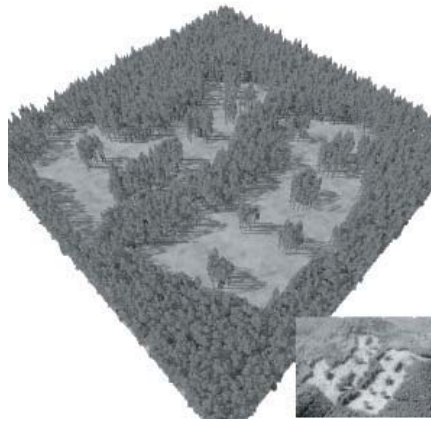


FIGURE 2 TASS-generated image depicting a variable retention cutblock in the Fraser Timber Supply Area, with cutblock photo inset.

The application of VRAF does not eliminate the need for OAF₁ and OAF₂ in timber supply analyses or similar applications. However, variable retention may affect both of these OAFs. OAF₁ could be adjusted to reflect small stocking gaps (wet areas, rock outcrops, etc.) included in retention groups. OAF₂ might be increased to reflect an expected increase in forest health losses due to variable retention (e.g., root rot or mistletoe). No changes were made to OAF₁ and OAF₂ default values in this example.

TIPSy Distribution and User Support

TIPSy is distributed and supported by the Research Branch, B.C. Ministry of Forests. Users are encouraged to consult TIPSy's online documentation and Help function, which provide answers to many common questions. Software distribution and additional support information is available on the Research Branch Growth and Yield Modelling website: <<http://www.for.gov.bc.ca/hre/gymodels/>>.

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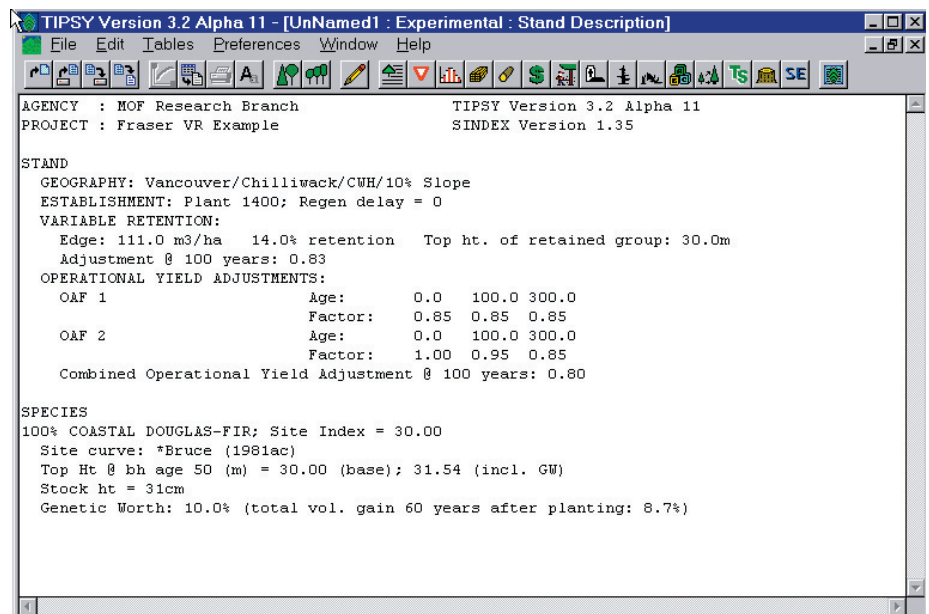


FIGURE 3 TIPSy's Stand Description display indicates a predicted VRAF of 0.83 for the Fraser variable retention cutblock example.

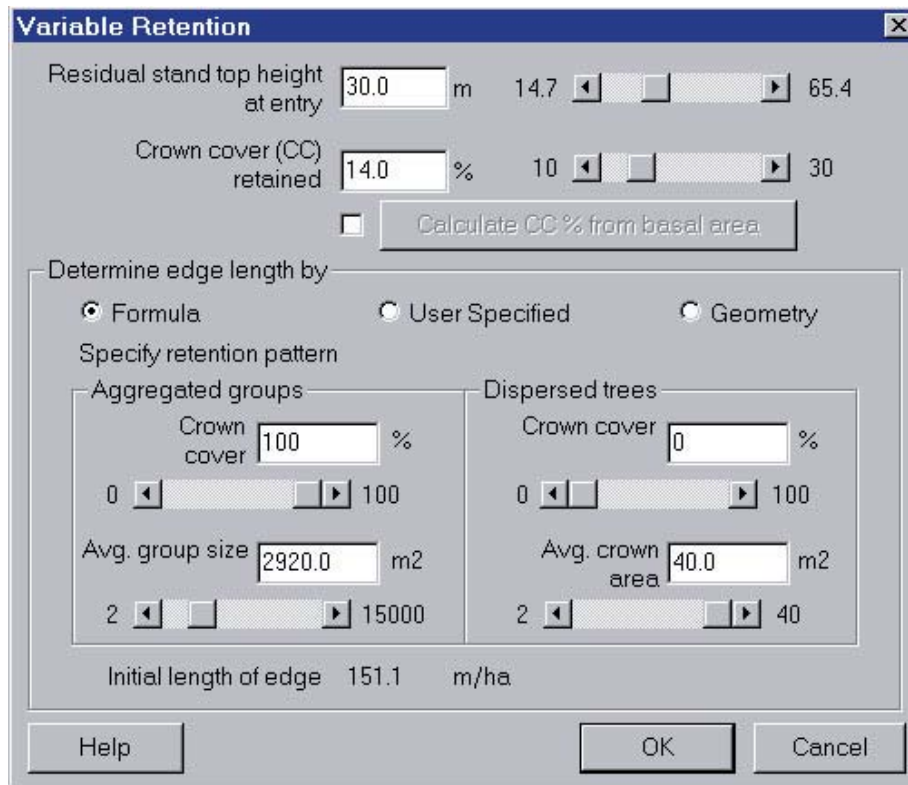


FIGURE 4 TIPSYS's VRAF input screen showing data for the estimation of edge length from retained crown cover and average group size.

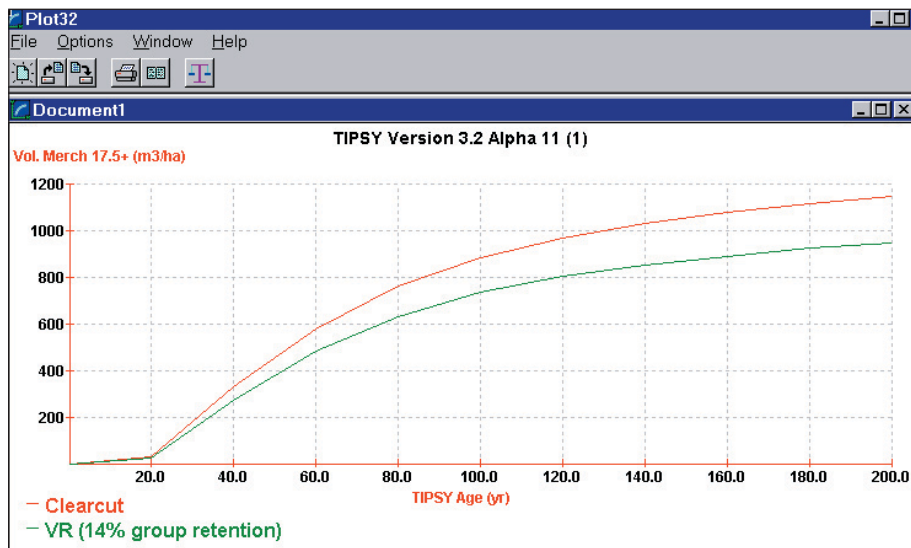


FIGURE 5 TIPSYS generated these merchantable volume ($17.5+ \text{ m}^3/\text{ha}$) curves, comparing a clearcut scenario with the Fraser variable retention example.

Citation

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