Computer Modeling

1. Comeau, P. and D. Sachs. 1992. Simulation of the consequences of red alder management on the growth of Douglas-fir using FORCYTE-11. B.C. Ministry of Forests FRDA Report 187. 45 p.

Keywords: planting operations
                  yield
                  computer modeling

Abstract: The ecosystem model FORCYTE-11 was used to investigate the effects of initial red alder (Alnus glutinosa) density on yields of Pseudotsuga menziesii and alder over a 80-year rotation, the effects of delayed planting of red alder on stand yields, and the effects of 5 management strategies on the total yield over a 240-year period.

OSU Link
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2. Curtis, R.O. 1987. Levels-of-growing-stock cooperative study in Douglas-fir: Report No. 9 - some comparisons of DFSIM estimates with growth in the levels-of-growing stock study. Pacific-Northwest-Research-Station,-USDA-Forest-Service Research-Paper PNW-RP-376. 34 p.

Keywords: thinning
                  commercial thinning
                  growth
tree/stand health
computer modeling

Abstract: Initial stand statistics for the 9 levels-of-growing-stock (LOGS) study installations in Oregon and Washington, USA, and Vancouver Island, British Columbia, Canada, were projected by the Douglas fir (Pseudotsuga menziesii) stand simulation program (DFSIM) over the available periods of observation. Thinnings were simulated by use of observed top height trends, actual residual basal areas, and actual ratios of cut tree diameters to stand diameter before cutting (d/D). Estimates were compared with observed gross and net volumes and basal area growth, net change in quadratic mean diameter, and change in number of trees. Although the LOGS installations included regimes quite different from those in most of the data used to construct DFSIM, overall agreement was reasonably good. Results indicated some density-related bias in the thinned stands and a need for revision in the method used to control the maximum density in the DFSIM program and in the associated mortality estimates.

OSU Link
Non-OSU Link

3. Curtis, R.O., G.W. Clendenen and D.J. DeMars. 1981. A new stand simulator for coast Douglas-fir: DFSIM user's guide. Pacific-Northwest-Forest-and-Range-Experiment-Station,-USDA-Forest-Service General-Technical-Report PNW-GTR-128. ii + 79 p.

Keywords: planting operations
                  thinning

precommercial thinning
        commercial thinning
        fertilization
        yield
        computer modeling

Abstract: A description of a computer program, written in FORTRAN IV, for simulating managed stands. The program has been developed from remeasured plot data contributed by many organizations in the Pacific Northwest USA. It can produce yield tables which include estimates of effects of initial spacing, precommercial and commercial thinning and addition of N fertilizer. Topics discussed include program limitation and potential for further development. Appendices include operating instructions and notes on testing. The program is available from the authors on request.

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4. Duke, K.M., G.M. Townsend and W.A. White. 1989. An economic analysis of fertilization and thinning effects on Douglas-fir stands at Shawnigan Lake. Canadian-Forest-Service, Pacific and Yukon Region Information-Report BC-X-312. v + 19 p.

Keywords: fertilization
                thinning
                economics
                computer modeling

Abstract: A single-tree density-dependent growth model was used to project, from age 24 to age 120 yr, 9 combinations of thinning and fertilizer application (nitrogen as urea or ammonium nitrate) in Douglas fir (Pseudotsuga menziesii) near Shawnigan Lake, British Columbia. Costs and benefits were estimated as a function of stand diameter, and forestry investment criteria were used to evaluate each treatment on both an incremental and a regime basis. The effect of rising real prices, and the treatment of silvicultural costs as an initial investment or as a harvest cost were also studied.

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Non-OSU Link

5. Feller, M.C., J.P. Kimmins and K.A. Scoullar. 1983. FORCYTE-10: calibration data and simulation of potential long-term effects of intensive forest management on site productivity, economic performance, and energy benefit/cost ratio. *In* I.U.F.R.B. Symposium on.Forest Site and Continuous Productivity; Seattle, Washington; August 22-28, 1982. *Eds.* R. Ballard and S.P. Gessel. Pacific-Northwest-Forest-and-Range-Experiment-Station, USDA-Forest-Service General-Technical-Report PNW-GTR-163 Part B. 179-200 pp.

Keywords: thinning
                fertilization
                soil properties
                economics
                computer modeling

Abstract: FORCYTE (FORest nutrient Cycling and Yield Trend Evaluator) is a computer simulation model of forest plant biomass production, litterfall, and decomposition, complete with nutrient cycling, nutrient limitation on growth, and a variety of management interventions. The model is a computerized approach to the estimation of the effects of varying thinning and fertilizer regimes, utilization level, and rotation length on site nutrient budgets, stand productivity, and the economic performance and energy efficiency of management. The model has evolved over 5 years to its present version FORCYTE-10, which is briefly described. Accompanying the development of FORCYTE, there has been a series of field research projects. Detailed biomass and biogeochemical descriptions of age sequences of Douglas-fir stands on both good and poor sites have been prepared for purposes of model calibration and testing. The present report summarizes some of the results of the FORCYTE-10 field studies on Vancouver Island, British Columbia, and presents some examples of the use of the model when calibrated with these data.

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6. Fight, R.D., N.A. Bolon and J.M. Cahill. 1993. Financial analysis of pruning Douglas-fir and ponderosa pine in the Pacific Northwest. Western-Journal-of-Applied-Forestry 8(2): 58-61.

Keywords: pruning
economics
computer modeling

Abstract: Recent lumber recovery studies of pruned and unpruned Douglas fir (Pseudotsuga menziesii var. menziesii) and ponderosa pine (Pinus ponderosa var. ponderosa) were incorporated into computer software using lumber grade prices, growth and yield data, the cost of pruning, and interest rates to determine the expected financial return from pruning. Financial analyses showed that the cost of pruning at which the investment would yield an expected 4% real rate of return was positive on sites where individual tree growth is fairly high, pruning is done as early as biologically possible given limitations on crown removal, and the harvest is 30 to 70 yr after pruning. The better situations in Douglas fir showed a break-even cost of up to $21/tree and an internal rate of return exceeding 9%. The better situations in ponderosa pine showed a break-even cost of up to $11/tree and an internal rate of return of 7%.

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7. Fight, R.D., J.M. Cahill and T.D. Fahey. 1992. DFPRUNE users guide. Pacific-Northwest-Research-Station,-USDA-Forest-Service General-Technical-Report PNW-GTR-300. 12 p.

Keywords: pruning
economics
computer modeling

Abstract: The DFPRUNE spreadsheet program is designed to estimate the expected financial return from pruning coast Douglas fir (Pseudotsuga menziesii var. menziesii). It is a significant revision of the PRUNE-SIM program. The PRUNE-SIM program was based on the average product recovery for unpruned logs

from a single stand that received frequent light thinnings. The DFPRUNE program incorporates new recovery information for unpruned young-growth Douglas fir and can be used to assess the economic potential of pruning for a wide range of management regimes. Product prices and descriptions of trees at time of pruning and at time of harvest must be supplied by the user. The DFPRUNE program was developed for the Lotus 1-2-3 spreadsheet and should work on versions 2.01 or later.

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8. Fight, R.D., J.M. Cahill, T.D. Fahey and T.A. Snellgrove. 1987a. Financial analysis of pruning coast Douglas-fir. Pacific-Northwest-Research-Station,-USDA-Forest-Service Research-Paper PNW-RP-390. ii + 17 p.

Keywords: pruning
              fertilization
              economics
              wood quality
              yield
              computer modeling

Abstract: Unpruned stands of Douglas fir (Pseudotsuga menziesii) will yield little clear material under current management regimes in western Oregon and western Washington. Data from a recent study of grade recovery from pruned logs were analysed and a spreadsheet program was developed and used to simulate the increase in grade recovery and financial returns from pruning. Results are presented for a range of site indices, ages at time of pruning and time of harvest, product prices and interest rates, and for stands with and without nitrogen fertilizer treatment. Results showed that a 5-yr difference in the time of pruning can make a substantial difference in the financial return. An earlier age at pruning always gave a higher return. At 4 and 8% interest rates, the return was generally greatest when the harvest was 40-50 yr or 30-40 yr, respectively, after pruning. Fertilizer treatment substantially increased the return from pruning, especially on poor sites.

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9. Fight, R.D., J.M. Cahill, T.A. Snellgrove and T.D. Fahey. 1987b. PRUNE-SIM users guide. Pacific-Northwest-Research-Station,-USDA-Forest-Service General-Technical-Report PNW-GTR-209. 21 p.

Keywords: pruning
              economics
              computer modeling

Abstract: PRUNE-SIM is a spreadsheet template (program) that allows users to simulate a financial analysis of pruning coast Douglas fir (Pseudotsuga menziesii var. menziesii) in the USA. The program estimates the increase in product value resulting from pruning the butt 17-foot log. Product recovery information is based on actual mill experience with pruned and unpruned logs for both sawn and peeled products. Users must supply tree descriptions from sources of growth and yield information and product prices. The program calculates the difference in value for trees and stands with and without pruning.

The present value of this difference represents the maximum amount that could be spent on pruning without reducing the rate of return on the investment below the specified rate. The LOTUS 1-2-3 spreadsheet program was used to develop PRUNE-SIM.

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10. O'-Hara, K.L. and C.D. Oliver. 1988. Three-dimensional representation of Douglas-fir volume growth: comparison of growth and yield models with stand data. Forest-Science 34(3): 724-743.

Keywords: planting operations
thinning
growth
yield
computer modeling

Abstract: Growth and yield estimates for unthinned stands from the Douglas fir Stand Simulator (DFSIM) and the Tree and Stand Simulator (TASS) were used to construct graphical three-dimensional representations of Douglas fir (Pseudotsuga menziesii) stand growth on site index 44 m (50 yr). The three-dimensional models used three variables: trees per hectare, b.h. age, and either mean tree vol. or stand vol. The TASS and DFSIM models were in agreement over most of their common range of age and number of trees. At wider spacingsand older ages, however, the volumes predicted by the DFSIM model exceeded those predicted by the TASS model by as much as 25%. Comparisons of these three-dimensional models to unthinned and thinned stand data from a site of similar quality in the Delezennethinning trial, Washington, found the models to be reasonably accurate representations of unthinned stand growth. The thinned stands, however, had greater mean tree and stand volumes than those indicated by the TASS model for unthinned stands at similar spacings. Complete comparisons were not possible with the DFSIM model because of its limited range of number of trees. These results suggest that the TASS model, and to a lesser extent, the DFSIM model may be underestimating the growth of widely spaced stands, or thinning may actually increase the growth of thinned trees over that of trees which had always grown at the post-thinning spacing.

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11. Sachs, D. and P. Sollins. 1986. Potential effects of management practices on nitrogen nutrition and long-term productivity of western hemlock stands. Forest-Ecology-and-Management 17(1): 25-36.

Keywords: thinning
commercial thinning
yield
soil properties
computer modeling

Abstract: The FORCYTE-10 computer model, developed by J.P. Kimmins and K. Scoullar for Douglas-fir forests in British Columbia, was modified to simulate growth and nutrient cycling of coastal western hemlock stands in Oregon. Initial calibration indicated that predicted yield was extremely sensitive to

the rate of mineralization of soil organic matter (SOM), variation in SOM C/N ratio with site quality, the soil extractable NO3-/NH4+ ratio, and the decomposition rate and N mineralization pattern of large and medium-size roots and woody debris. The predictions suggested that yield and SOM remain stable under a management system consisting of six successive 90-yr rotations. More intensive utilization (e.g., shorter rotations, whole-tree harvesting and commercial thinning) causes depletion of soil and forest floor nitrogen and a small decline in site productivity in later rotations.

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12. Sachs, D. and J.A. Trofymow. 1991. Testing the performance of FORCYTE-11 against results from the Shawnigan Lake thinning and fertilization trials on Douglas-fir. Canadian-Forest-Service, Pacific and Yukon Region Information-Report BC-X-324. viii + 58 p.

Keywords: fertilization
thinning
precommercial thinning
growth
yield
tree physiology
carbon allocation
tree/stand health
computer modeling

Abstract: FORCYTE-11 is an ecosystem-based forest growth simulation model. Its performance was evaluated with data on stand and tree biomass, height, stocking (mortality) and foliar assimilation and loss rates for Douglas fir (Pseudotsuga menziesii) in thinning/fertilizer trials in British Columbia.

[OSU Link](#)
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13. Wilson, J. 2004. Vulnerability to wind damage in managed landscapes of the coastal Pacific Northwest. Forest-Ecology-and-Management 191(1/3): 341-351.

Keywords: planting operations
thinning
tree/stand protection
computer modeling
tree/stand health

Abstract: Managed forested landscapes in the coastal Pacific Northwest follow a pattern of transition from dominance by naturally regenerated second growth to dominance by planted stands. This transition should have dramatic influence on many characteristics of these landscapes and the larger region, including susceptibility to wind damage. In this paper, inventory and spatial information from an example landscape are integrated using the Landscape Management System to produce alternative management scenarios and evaluate the projections using a wind damage vulnerability rating system. Planted Douglas-fir stands tend to develop higher height to diameter ratios in the dominant trees, are

thinned more often, and tend to have more exposed windward edges; characteristics which increase susceptibility to wind damage. In this analysis, the increasing vulnerability factors are mostly compensated for by the reduced rotation lengths expected in the plantations. The pattern of transition in managed landscapes generates an associated pattern of vulnerability to wind damage. Homogeneously and heterogeneously aged landscapes have distinct patterns of vulnerability. These differences could be harnessed to enhance the particular goals associated with managing individual ownerships.

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