A Compendium of Forest Growth and Yield Simulators for the Pacific Coast States

Martin W. Ritchie

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Pacific Southwest Research Station

USDA Forest Service
General Technical Report
PSW-GTR-174

January 1999

[1] Numbers in parentheses refer to the simulator index for tree species in *appendix A*.

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In Brief. . .

Ritchie, Martin W. 1999. **A compendium of forest growth and yield simulators for the Pacific Coast states**. Gen. Tech. Rep. PSW-GTR-174. Albany CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture; 59 p.

Retrieval Terms: computer models, simulation

Growth and yield simulators are available for many of the forested regions of the western United States. A forest simulator is a computer program which, through a system of equations, produces forecasts of forest stand development. Historically, growth and yield information was published in the form of tables indexed to discreet ages and levels of site productivity. With time the transition has been made to computer generated output. Currently, users generate yield information geared to their exact specifications on the computer.

This information is useful in evaluating the potential for various treatment regimes to produce some desired future outcome. Such information is also needed to develop forest plans. The planning process depends on knowledge of forest conditions over time. While forest managers can easily measure the current conditions, the simulator is a tool which provides a look into the future so as to catch a glimpse of the likely or potential conditions.

No simulators are perfect. All simulators have danger zones: those combinations of species, stand and site conditions that produce shaky results. A given simulator may be totally incapable of completing some tasks and may handle others poorly. However, output from a simulator rarely comes with any warnings when the user is operating in a danger zone. The prevailing philosophy is one of caveat emptor. Users must not rely on a simulator to review its own output. Determining legitimacy of output is the purview of the user.

Simulators vary in architecture. Some of the simulators require stand level statistics as input; these are typically referred to as whole stand simulators. Others require individual-tree information as input; most of these are classified as individual-tree simulators. There are also a couple of hybrid disaggregative simulators that have been developed for this region.

Simulators may also vary with respect to input, output and management options. Some simulators are designed to be run in a "batch" mode. That is, process of multiple stands is easily facilitated. Others are designed to be most efficiently run interactively on a stand-by-stand basis. Management options may include various thinning options, fertilization, pruning, and final harvest.

Simulators are categorized herein as belonging to one of five distinct types: individual-tree/distance-independent, individual-tree/distance-dependent, whole stand, disaggregative, and gap (otherwise referred to as successional models).

This manuscript provides information needed for the user to access current information about forest growth and yield simulators. Ultimately, the best source of information for any simulator is the user's guide and the sage advice of those who built the simulator. In some instances, these people are easy to find and are willing to provide all the support for the program. Other simulators have, unfortunately, been abandoned due to retirements and other career moves of researchers. Users should take advantage of the opportunity to make direct contact with developers whenever possible. Much which is useful is not published, and much which is published is not useful.

Glossary

ASCII: the American Standard Code for Information Interchange (ASCII) is a standard code for representing numbers, letters, and symbols.

BAF: basal area factor.

BAL: basal area per unit area of trees larger than the subject tree.

Basal area: cross-sectional area of a tree at 4.5 feet above the ground.

Basal area factor: amount of basal area per unit area represented by a single tree in a sample drawn with probability proportional to size (basal area) of the tree.

Basal diameter: diameter of the stem at 0.5 feet.

CCF: crown competition factor (Krajicek and others 1961).

Compile: a process whereby code for a given language, such as FORTRAN, is converted to instructions which may be executed by the computer.

Cover: vertical projection of crown area expressed as a percent.

CPU: central processing unit.

Crown ratio: live crown ratio, the ratio between crown length (numerator) and total tree height (denominator) wherein both are measured in the same units.

DBH: diameter at breast height (4.5 feet), outside bark unless otherwise specified.

d/D ratio: ratio of quadratic mean diameter of trees cut divided by the quadratic mean diameter of all trees prior to cutting.

DOS: acronym for disk operating system, the operating system for most IBM compatible computers.

Deterministic: used to describe a process that does not contain a random element.

Driving function: a function responsible for directly forecasting a dynamic element of any particular simulator.

Expansion factor: number of stems per unit area for each sampled individual. For a 10^{th} acre plot, the expansion factor is 10. For a variable-radius plot, expansion factor is a function of tree diameter and basal area factor (BAF). For English units expansion factor.

FVS: Forest Vegetation Simulator, formerly Prognosis Model for Stand Development. FVS refers to all those simulators (variants) derived from the original Prognosis architecture.

Growth interval: the length of time associated with the dynamic functions embedded in a simulator. A growth interval of 10 indicates driving functions that predict 10-year change in the response variable.

Height: total tree height.

Housekeeping function: a species-specific, and/or simulator-specific function for producing output or quantifying certain parameters within a simulator (Bruce 1990).

HT40: Height of the 40 largest (diameter) trees on a unit area (typically an acre), also maybe referred to as dominant height.

K: kilobytes; one kilobyte is 1024 bytes.

MAI: mean annual increment.

MB: megabyte; one megabyte is 1000 kilobytes.

Primary driver: that driving function which occurs first in the progression of growth estimates and often has the greatest impact on overall simulator behavior because the results of this function permeate the forecasts throughout the simulator.

QMD: quadratic mean diameter; breast height diameter of the tree of mean basal area in a stand. Quadratic mean diameter is always larger than mean tree diameter.

RAM: random access memory.

SDI: stand density index (Reineke 1933); and index relating any given stand to a reference stand with a quadratic mean diameter of 10 inches as expressed by number of trees per acre.

SDI maximum: a specified maximum value that SDI may attain for any given species. By convention, forest stands will exist in log(N), log(D) space where SDI is greater than zero but less than SDI maximum.

Self-extracting file: an executable file that contains one or more compressed files. Execution of this type of file results in the decompression of the specified files.

Site index: height achieved by free-to-grow dominant or dominant and codominant trees at some specified base age.

Stochastic: random; a stochastic process is one that incorporates a random variable; hence, forecasts from a stochastic simulations will vary even when all input parameters are fixed.

Structural function: in growth and yield simulators, a standard, or generic function for producing some quantity in a common manner, e.g., stand basal area or stand growth rate (Bruce 1990).

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Pacific Southwest
Research Station
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General Technical Report
PSW-GTR-174

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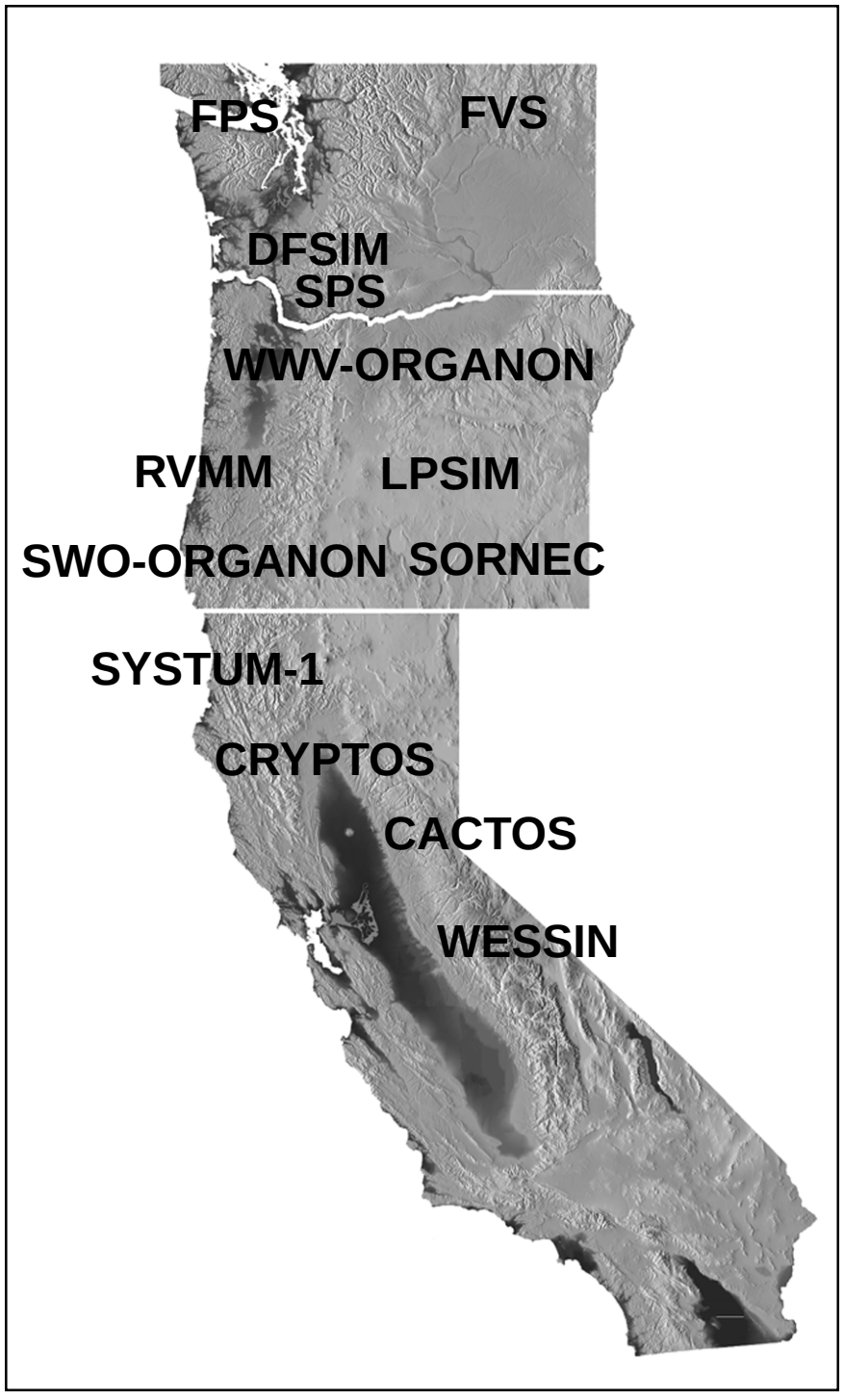

Publisher:

Albany, California
Mailing address:
PO Box 245, Berkeley, CA
94701-0245

(510) 559-6300

http://www.psw.fs.fed.us

January 1999

Pacific Southwest Research Station

Forest Service
U.S. Department of Agriculture

Abstract

Ritchie, Martin W. 1999. **A compendium of forest growth and yield simulators for the Pacific Coast states**. Gen. Tech. Rep. PSW-GTR-174. Albany CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture; 59 p.

The capabilities of 31 existing growth and yield simulators for California, Oregon, Washington, and Alaska were analyzed to determine their relevance in forest management and planning. Most of the simulators are available for the PC environment. Some are available at no charge, but others may require users to purchase a license. Simulators are classified in five groups: individual-tree/distance-independent, individual-tree/distance-dependent, whole stand, disaggregative, and gap. Simulators are briefly described in terms of the range of data, appropriate species, data requirements, and hardware requirements for execution.

Retrieval Terms: computer models, simulation.

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United States
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of Agriculture

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**Pacific Southwest
Research Station**

General Technical Report
PSW-GTR-174

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The Forest Service, U.S. Department of Agriculture, is responsible for Federal Leadership in forestry.
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- Protection and management of resources on 191 million acres of National Forest System lands
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- Research on all aspects of forestry, rangeland management, and forest resources utilization.

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