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A DATA GENERATOR LINKING ONTARIO'S FOREST RESOURCE INVENTORY TO FORMAN+1*

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INTRODUCTION

Inventory projection models are commonly used in forest resource management planning. Examples include FORMAN (Wang et al. 1987), NORMAN (Hauer 1989), CROPLAN and FORMANCP (Willcocks et al. 1990, Williams 1991), HSG (Moore and Lockwood 1990), and FORMAN+1 (Vanguard Forest Management Services Limited 1991). These examples are even-aged management simulation models developed, largely, to fit planning applications germane to the boreal forests of eastern Canada. Typically they are used in "what if" scenarios, such as determining what pattern(s) of forest development might be expected given various assumptions about natural growth and development, coupled with alternative management interventions including harvesting, artificial and natural regeneration, and tending.

In a recent collaborative study[1], FORMAN+1 was used to evaluate the economic impact of spruce budworm defoliation on selected northwestern Ontario forest management units. To facilitate the analyses, a data generator was developed that integrated Ontario forest resource inventory (FRI) data with a localized growth and yield model to produce the necessary FORMAN+1 data input files.

Depending upon intended application and compatibility with FRI data formats, the data generator will be of interest to those using or considering the use of FORMAN+1.

METHODS

Figure 1 provides an abbreviated schematic illustrating the application of FORMAN+1. The data generator is a front end to the FORMAN+1 model. Figure 2 shows the linkages between the forest resource inventory (Phase 1, data capture) and the data input requirements of the model (Phase 2, data compilation and editing). Phases 3 (simulation) and 4 (interpretation of results) are tasks particular to the use and application of the FORMAN+1 model and, as such, are distinct from the data preparation requirements incorporating the use of the data generator.

Using a process of interactive query, the data generator assimilates both empirical and judgmental information to build necessary FORMAN+1 input data files — the forest classes data file, the timber values "curvesets" file, and a

*FORMAN+1 is a proprietary product of Timberline Forest Inventory Consultants Limited. Further information on FORMAN+1 may be obtained from the company at: #315, 10357-109 St., Edmonton, AB. T5J 1N3. Tel. 403-425-8826. The use of FORMAN+1 does not constitute endorsement, implied or otherwise, by Natural Resources Canada or Avenor Inc.

[1]Completed in 1994, this economic impact study was a joint initiative undertaken by the Canadian Forest Service – Ontario (Sault Ste. Marie, Ontario) and Avenor Inc. (Thunder Bay, Ontario). Results of the study may be obtained by contacting the authors.

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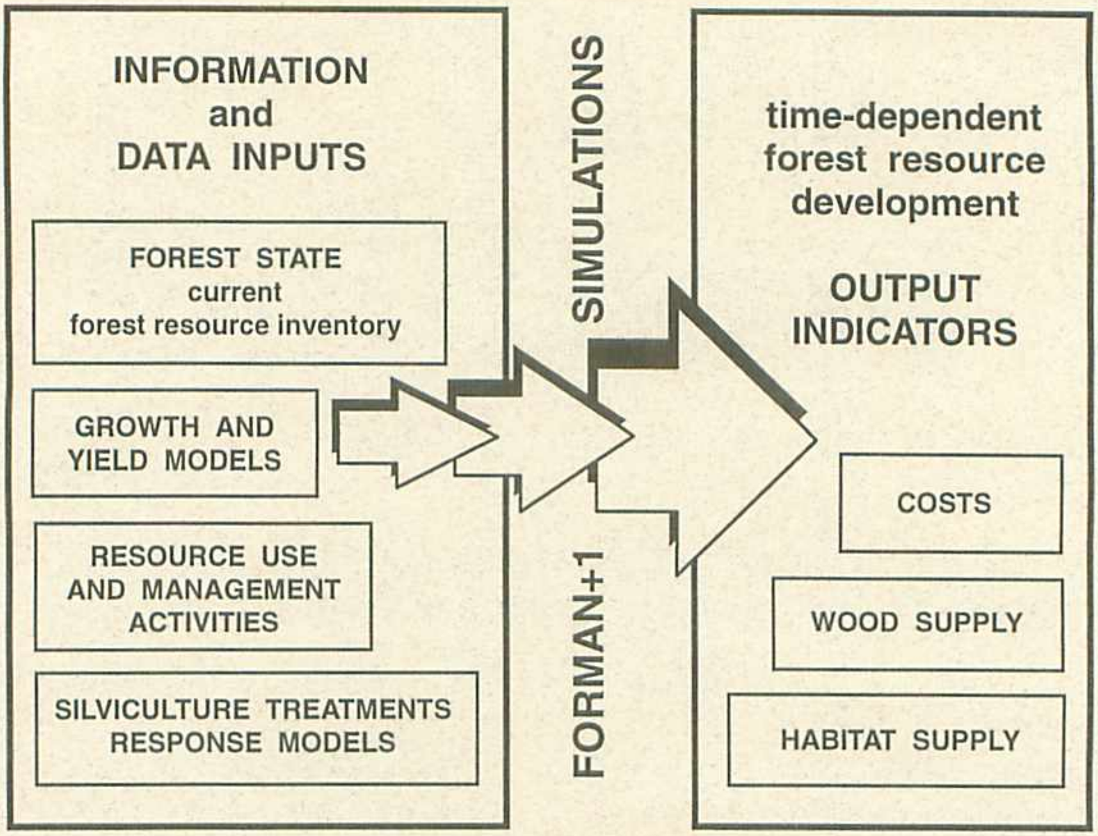

Figure 1. Using FORMAN+1 to simulate forest development.

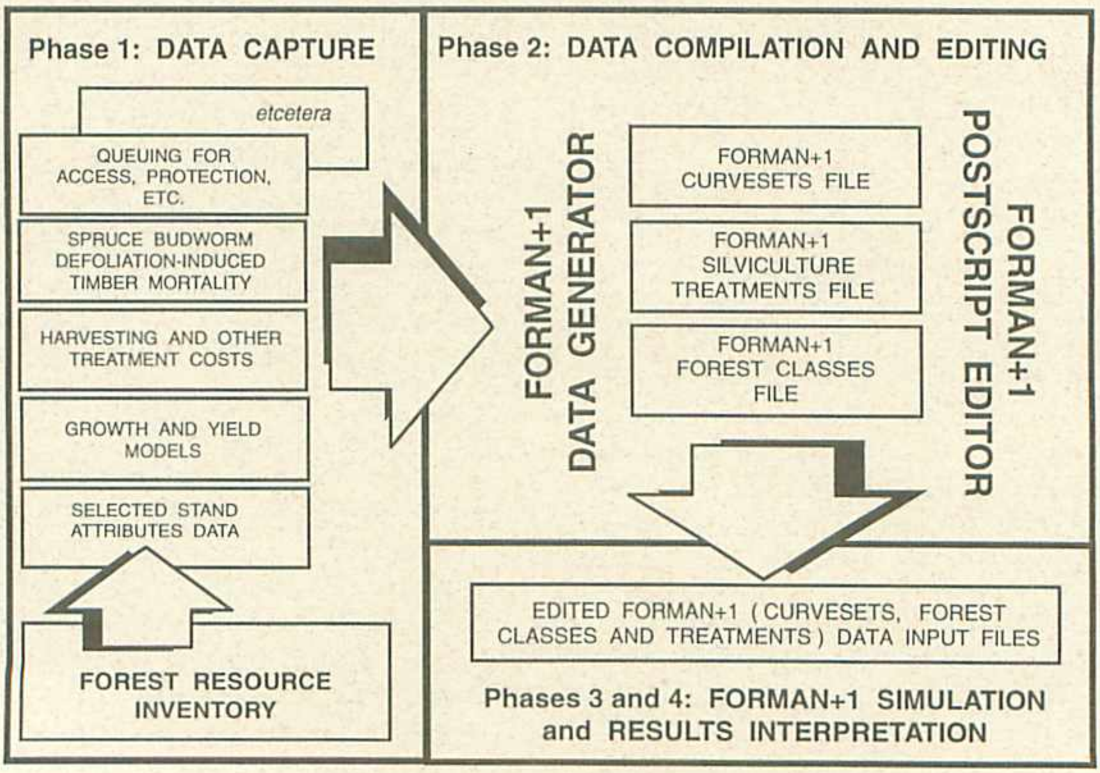

Figure 2. The FORMAN+1 data generator and "postscript" editor.

preliminary treatments response file. The data generator derives measures of the forest state from the current forest resource inventory. To complete the data preparation process, however, a subsequent step is needed to introduce information pertaining to future treatments and treatment effects (timber values associated with planting, tending, etc.) and to enter relevant cost data as required. This follow-up step can be taken by using a systems editor or by invoking the "postscript" editor. The postscript editor is a complementary program that, depending upon need or user preference, can be used to complete the input data files.

Examples of empirical information include the forest resource inventory and localized growth and yield information. Judgmental information, predicated upon the considered opinion and knowledge of the user, might include such data as perceptions of timing of access and, as in the case of the spruce budworm economic impact study, expectations of the severity of defoliation damage. A detailed description of the data generator can be obtained from the *FORMAN+1 Data Generator User's Guide*[2].

In terms of detail, the highest order of spatial resolution maintained by the data generator is that of a FRI "basemap". Within each basemap, or some predetermined aggregate of basemaps, forest classes (that constitute the basic FORMAN+1 analysis units) are differentiated by user-specified definition of working group, site class, and age class categories. This degree of informational specificity serves two purposes. First, it facilitates the capture of what may be significant stand-level detail – information that might otherwise be lost if data were solely to be aggregated at the forest (or management unit) level. Secondly, it provides for flexibility and a capability for building credible simulation scenarios. Specifically, it is able to build a set of "what if" scenarios at a level of informational detail consistent with the analytical objectives of a particular enquiry. For example, if the desired analysis required the targeting of specific locations for particular management interventions, say, for purposes of timed access or protection, then the data generator provides for this capability at an intermediate level. It is intermediate in the sense that it provides for spatial resolution at a scale that is coarser than that of the stand-level resolution maintained by HSG, yet substantially finer than that of the forest-level resolution of models like NORMAN and FORMANCP.

In the current version of the data generator, information is pulled from the FRI and aggregated in response to user-specified criteria. The resultant analysis unit is a FORMAN+1 forest class bearing information with respect to the following elements:

1. Compartment identifier: a basemap or some specified aggregate of basemaps;

2. Working group: a specific working group like birch or, perhaps, an aggregate working group such as "primary conifers" that may comprise spruce, balsam fir, and jack pine working groups;

3. Site class: a differentiation by site productivity. For example, Site Class 1 would be indicative of good sites, Site Class 2 of moderate sites, and Site Class 3 of poor sites; and

4. Age class category: a user-specified differentiation of working groups by age class category. For example, (working group) cover types might be differentiated so as to be indicative of immature, mature, or overmature standing timber.

As input to the data generator, the required FRI stand record data elements include: basemap identification number, stand identification number, working group designation, site class, stocking, age, stand area, and species composition.

APPLICATIONS

In the collaborative Canadian Forest Service – Avenor study, the economic impact of spruce budworm defoliation was evaluated using two-staged FORMAN+1 simulations. In the first stage, aggregated information was used to develop credible scenarios of sustainable wood supply over time (i.e., timber production targets). In the second stage, detailed information was drawn into the analysis. Simulation-generated results were used to gain insight into the possible effect of defoliation-induced timber mortality on mill-delivered wood costs and on the product mix of mill-delivered wood over time. The two-staged analysis provided a mechanism for determining economic impact through the provision of opportunity cost estimates that contrast alternative forest resource management strategies.

CONCLUSIONS

Compiling necessary FORMAN+1 input data files can be demanding, particularly where sensitivity analysis of alternative forest management or timber production planning options are desired (i.e., where credible results are contingent upon the provision of several simulation results, or where simulation results must carry a particularly high order of informational detail).

By using the data generator in conjunction with the Ontario-specific FRI data and localized growth and yield models, the application of FORMAN+1 was greatly enhanced. In terms of the spruce budworm impact study, the savings in time and personnel resources were substantial.

Although the data generator was developed with a particular study in mind, it is structured in modular form so that specific modules can be invoked or excluded at the user's *discretion*.

[2]The *FORMAN+1 Data Generator User's Guide* is a set of notes and annotated listings of illustrative computer sessions and is available from Stig Andersen, Canadian Forest Service – Ontario.

As such, the generator is sufficiently generalized to permit useful integration with any number of forest management or timber production planning applications (using FORMAN+1).

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