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DO ECOSYSTEM MODELS SUCH AS FORCYTE-11 HAVE A ROLE IN BOREAL MIXEDWOOD MANAGEMENT?

E.B. Peterson, Western Ecological Services Ltd., Victoria, B.C.,
M.J. Apps, Forestry Canada, Edmonton, Alberta.

Current management concerns for boreal mixedwood ecosystems were taken as the points of focus for evaluation of FORCYTE-11. Applicability of FORCYTE-11 to the identified management concerns was judged from two vantage points - present applications and possible future applications. These assessments were based on professional knowledge of the modelling framework, tempered by judgements about how the model could find new applications in a setting where technical factors such as utilization, economics and climate, and social factors such as professional opinions and public perceptions, are rapidly changing. For only one of 16 identified concerns - need to define mixedwood management regimes - was FORCYTE-11 judged to have high applicability both presently and potentially. For three concerns (difficulty of white spruce regeneration, uncertain ecological effects of site preparation equipment, and inadequate use of existing information) applicability of the model was considered to be medium, now and in the future. There were three concerns with presently low but potentially medium applicability (competition from shrubs and grasses, restrictions to herbicide use, and integration of softwood and hardwood harvests). Concerns with presently low but potentially high application of FORCYTE-11 included: need to refine allowable annual cut calculations; nutrition management in boreal mixedwood ecosystems; energy production from mixedwood biomass; need for research to increase mixedwood productivity; development of short-rotation forestry; and the need to work with longer time horizons in forest planning. FORCYTE-11 was considered to have no present or foreseeable application for three identified concerns: management and use of decayed aspen; need for better inventory data for boreal hardwoods and understorey conifers; and the current lack of biophysical data at the scale at which operational decisions are made.

Les questions epineuses actuelles relatives a l'amenagement des ecosystemes boreaux melanges ont ete choisies comme points de mire pour l'evaluation du FORCYTE-11. L'applicabilite du FORCYTE-11 aux questions d'amenagement identifiees a ete jugee a partir de deux points de vue: les applications actuelles et les applications futures possibles. Ces evaluations etaient basees sur une connaissance professionnelle du cadre de modelisation, moderee par des jugements sur la facon dont le modele pourrait trouver de nouvelles applications dans un cadre ou les facteurs sociaux comme les opinions des professionnels et les perceptions du public, changent rapidement. Dans le cas d'un seul des seize problemes - la necessite de definir les regimes d'amenagement des forets melangees, on a juge que le FORCYTE-11 etait hautement applicable a la fois actuellement et potentiellement. Dans le cas de trois des problemes (difficulte de regenerer l'epinette blanche, incertitude quant aux effets ecologiques de l'equipement de preparation des sites et utilisation inadequate de l'information existante) on a considere que l'applicabilite du modele etait moyenne, actuellement et pour l'avenir. Dans trois autres cas (competition des arbrisseaux et des graminees, restrictions imposees a l'utilisation des pesticides et

integration des recoltes de coniferes et de feuillus), l'applicabilite s'est revelee faible pour le moment, mais potentiellement moyenne pour l'avenir. Parmi les problemes pour lesquels l'applicabilite du FORCYTE-11 est actuellement faible, mais potentiellement elevee pour l'avenir, on compte les suivants: besoin de raffiner les calculs des coupes annuelles permissibles; gestion nutritionnelle dans les ecosystemes boreaux de forets melangees; production d'energie a partir de la biomasse provenant de forets melangees; besoin d'effectuer des recherches pour accroitre la productivite des forets de bois melanges; mise au point de methodes de foresterie avec rotations courtes; et besoin de travailler avec des horizons plus longs dans la planification des forets. On a considere que le FORCYTE-11 n'etait pas applicable actuellement ni dans un avenir previsible dans le cas des trois problemes suivants: gestion et utilisation du tremble pourri; besoin ne donnees d'inventaires meilleures pour les feuillus boreaux et pour les coniferes de sous-etages; et manque de donnees biophysiques au niveau ou sont prises les decisions operationnelles.

INTRODUCTION

FORCYTE-11 (FORest nutrient Cycling and Yield Trend Evaluator), a stand-level ecosystem modelling framework, was developed under ENFOR contracts by Prof. J.P. Kimmins and co-workers at the University of British Columbia (Kimmins and Scoullar 1987). The boreal mixedwood region was selected by Forestry Canada as one of several areas in which to assess management and research roles for this modelling framework.

The present report is a result of a project that had two distinct objectives. The first was to identify stand-level boreal mixedwood problems based on interviews with foresters currently involved in mixedwood management. That objective is addressed in a separate report in these seminar proceedings (Peterson et al. 1989). The second objective, described here, was to relate the identified mixedwood management challenges to FORCYTE-11.

METHODS

To relate present concerns to the FORCYTE-11 modelling framework required the contractor's judgement of whether each identified mixedwood management theme might be served by this modelling framework, in its present state of development. The method adopted for this part of the project was very subjective. The recorded opinions about FORCYTE's applicability to a given mixedwood management concern are not the result of consensus-building during interviews because the latter focussed on problem definition rather than detailed discussions of the model.

IMPLICATIONS OF 1988 INTERVIEW INFORMATION FOR FORCYTE-11

This section examines FORCYTE's possible role in relation to sixteen themes revealed during 1988 interviews with boreal mixedwood managers and researchers. For some of the themes the subjective rating is considered to be the same now and in the future; for other themes FORCYTE-11 is considered to have a higher potential use than it has at present. The themes are listed in order of decreasing applicability of FORCYTE-11.

Theme 1: Appropriate mixedwood management regimes

Applicability to FORCYTE-11: high

Reasons for opinion: FORCYTE-11 is designed to simulate competition and the dynamics involved in two-species stands. FORCYTE's highest present and potential applicability lies in the many specific concerns about optimum mixedwood management. These problems involve planning periods of several decades, a time horizon that matches the intended purpose of FORCYTE-11.

Theme 2: Coniferous regeneration

Applicability of FORCYTE-11: medium

Reasons for opinion: Coniferous regeneration in mixedwood ecosystems is amenable to FORCYTE-11 simulation because in many cases it involves competition between two tree species (spruce and aspen). Furthermore, it is a challenge of longer duration than the shrub-grass

problem described in theme 11. Some respondents stressed that spruce regeneration is largely under the control of microsite differences which are at a spatial scale that cannot be addressed by a stand-level model such as FORCYTE; this is the reason for a medium rather than a high rating.

Theme 3: Ecological effects of site preparation

Applicability of FORCYTE-11: medium

Reasons for opinion: Slash management and the influences of site preparation activities on decomposition rates and nutrient cycling are subjects that can be simulated by FORCYTE-11. For those topics FORCYTE's present and potential applicability was rated as medium, rather than high, because respondents who expressed concern over site preparation effects focussed on variables that FORCYTE-11 does not address, such as changes to bulk density, aeration in the rooting zone, soil moisture and soil temperature, as well as successional changes in post-treatment vegetation.

Theme 4: Better use of existing information base

Applicability of FORCYTE-11: medium

Reasons for opinion: FORCYTE-11 is considered to have a role here, presently and in the future, because its calibration and use requires the user to assemble data and ecological information which might otherwise remain unapplied.

Theme 5: Boreal hardwoods and shorter rotations

Applicability of FORCYTE-11: presently low / potential high

Reasons for opinion: Because there is presently very little interest in short rotation management, it is premature to suggest a high applicability of FORCYTE. However, if there is a trend towards shorter rotations, the nutrient cycling and productivity consequences of such a trend are precisely the kinds of changes that FORCYTE was designed to simulate.

Theme 6: Allowable annual cut calculations

Applicability of FORCYTE-11: presently low / potential high

Reasons for opinion: At present, this concern reflects a data collection need which cannot be served by a simulation model such as FORCYTE. However, if long-range yield predictions become integral parts of allowable annual cut calculations for sustainable forestry then FORCYTE-11 could have a high applicability in the calculations.

Theme 7: Short time horizons for planning

Applicability of FORCYTE-11: presently low / potential high

Reasons for opinion: With short time horizons there is no reason for forest managers to be interested in the multi-rotation predictions that can be made with a calibrated FORCYTE dataset. However, the potential applicability of the model will be high once managers need to have forecasts of site conditions and productivity in the next rotation.

Theme 8: Nutrition management

Applicability of FORCYTE-11: presently low / potential high

Reasons for opinion: Nutrition management is the centrepiece of FORCYTE's original intent. Its applicability to nutrition management will obviously be high once nutrients become a concern amongst boreal mixedwood managers and researchers. Although there is little interest now in fertilization of mixedwood stands there are several unanswered questions that could be researched with the aid of FORCYTE. For example, will fertilizers be required to sustain productivity during subsequent rotations?

Theme 9: Energy production from boreal mixedwood biomass

Applicability of FORCYTE-11: presently low / potential high

Reasons for opinion: Energy values can be attached to any of the biomass components simulated by FORCYTE. The model can also compile the energy cost of silvicultural operations to produce the biomass. Potential applicability of the model for prediction of energy production, based on prediction of biomass production, could be important in the future even if it is not now.

Theme 10: Research and demonstration areas for increased mixedwood productivity

Applicability of FORCYTE-11: presently low / potential high

Reasons for opinion: FORCYTE-11 may find its greatest application as an education tool or as a research planning tool. Many models serve a function by forcing researchers to develop new hypotheses

about ecological processes in their search for model refinements.

Theme 11: Competition from shrubs and grasses after clearcutting

Applicability of FORCYTE-11: presently low / potential medium

Reasons for opinion: This is a short-duration problem in the overall life of a forest stand. Seasonal events or short-term dynamic changes that can be assessed directly by field observations are not high priority topics for a modelling approach and for this reason FORCYTE is considered to have only a medium potential applicability. The present applicability is judged to be low because calibration of the model for simulation of competition for nutrients or competition from shading would be hampered by lack of data. Furthermore, FORCYTE-11 does not simulate competition from moisture, nor is it designed to portray spatial representation, a feature involved in most competition indices developed to date.

Theme 12: Herbicide use in mixedwood management

Applicability of FORCYTE-11: presently low / potential medium

Reasons for opinion: Although FORCYTE could be calibrated to simulate the ecological effects of a shrub or herb understorey species, such information is more readily attainable by direct measurement rather than modelling, because it is part of the same short-term phenomenon referred to in Theme 11. In any case, the herbicide concern expressed by respondents is a public relations and regulatory problem, not an ecological problem for which FORCYTE-11 was designed.

Theme 13: Integration of softwood and hardwood harvests

Applicability of FORCYTE-11: presently low / potential medium

Reasons for opinion: This concern presently involves questions of costs, scheduling, and administrative or regulatory arrangements that seemingly have no relationship to the simulation capabilities of FORCYTE. However, the model may have application because of its ability to simulate sizes of individual stems and to attach economic values to biomass components of various sizes. Diameters of raw materials and the economic values associated with logs of various sizes can help define optimal uses of softwood and hardwood components.

Theme 14: Spatial scale

Applicability of FORCYTE-11: presently nil / potential medium

Reasons for opinion: This concern is considered to be a data collection problem as in theme 16, with no obvious contributions from a modelling approach. However, if FORCYTE is used in the future as a trend evaluator for certain biomass or nutrient variables that are recorded in a geographic information system, then the model could help to identify data collection needs.

Theme 15: Aspen decay

Applicability of FORCYTE-11: nil

Reasons for opinion: Decay management involves silvicultural and clonal manipulation, genetic selection and changing utilization standards, none of which have obvious present or potential relationships to FORCYTE's simulation capabilities.

Theme 16: Forest inventory data

Applicability of FORCYTE-11: nil

Reasons for opinion: This concern is a data collection requirement for which FORCYTE is not applicable.

DISCUSSION AND CONCLUSIONS

FORCYTE-11 and today's time horizons for forest planning

Although sustainable forestry is advocated by an increasing number of analysts, the 1988 interviews did not reveal much interest amongst managers for long planning horizons. Comments from several respondents did reveal an understanding that if we are to manage the mixedwood forest it is important to know something about the genetic and ecological blueprint that sustained these ecosystems up to now. But no respondents went the extra step to encourage the use of models such as FORCYTE-11 for prediction of how simulated management alternatives relate to the basic blueprint.

Links between FORCYTE-11 and forest site classification

Interviews revealed potential links between the geographically-oriented focus of forest site classification and the time-oriented focus of ecologically-based computer simulations. Developers of the FORCYTE-11 modelling framework (Kimmins and Scoullar 1987) recognized that to deal with the variability that exists

over large management areas it is necessary for forest managers to consider variation in space as well as variation in time. To aid in the understanding of spatial variation, ecosystem classification systems such as those developed for west-central Alberta (Corns and Annas 1986) and Saskatchewan (Kabzems et al. 1986) are used. Variations in time are the explicit role of models such as FORCYTE-11.

The FORCYTE-11 modelling framework requires the user to provide vegetational and soil data on a site-specific basis. Up to five different site qualities or ecosystem types can be calibrated in the input files. Thus, use of FORCYTE-11 establishes an obvious link with site classification data.

The prospect for use of FORCYTE-11 by forest managers

The 1988 interviews led to the general conclusion that a modelling framework such as FORCYTE-11 will not be applied operationally until site classification systems are in widespread use. This will not happen quickly because site classification faces its own problems of acceptance by forest managers. In addition to this dependency on the acceptance of site classification, FORCYTE faces two other deterrents to its use: a relative lack of concern by forest managers in the processes that the model simulates; and the model's complexity.

The FORCYTE-11 modelling framework was designed to simulate several forest management activities that do not appear to be of much interest yet to managers in the Mixedwood Section - fertilization and thinning are the most obvious examples. This poses at least temporary limitations on the degree to which FORCYTE can be applied in the boreal mixedwood context.

Predictions from complex models are difficult to check because of limited data on actual events over several decades of forest ecosystem development. This limitation will remain as long as there is little activity or interest in nutrition management in boreal mixedwoods; without such interest th will not be information with which judge the reasonableness of FORCYT predictions. FORCYTE's intended roles simulating forest nutrient cycles predicting long-term consequences intensive biomass harvesting will be m readily evaluated in forest regions wh fertilization and nutrition managem are already operationally implement For example, those forest ecosystems British Columbia and the Paci Northwest in which fertilization is no part of forest management are bet sites for evaluation of FORCYTE than the less intensively managed bor mixedwoods.

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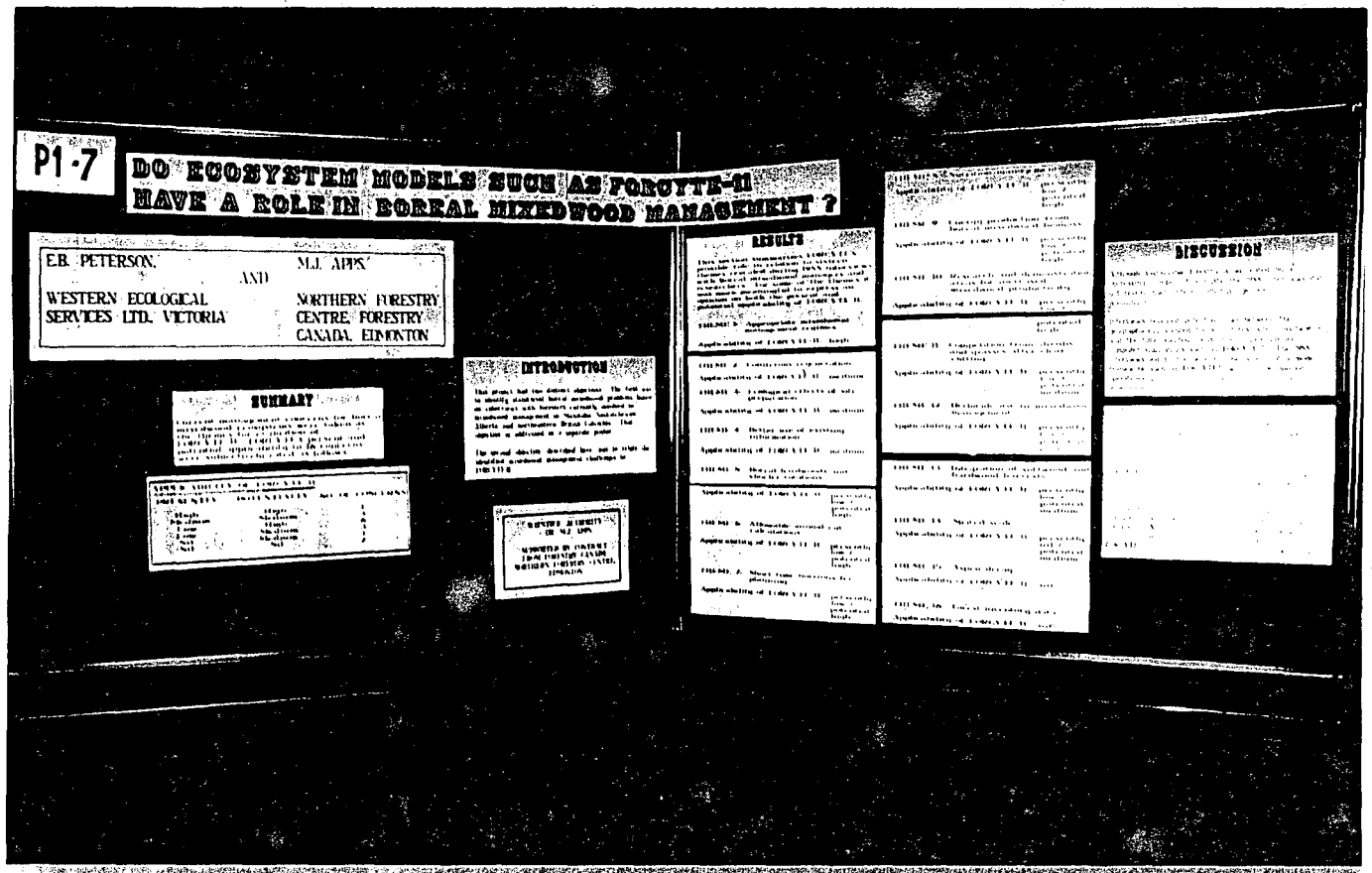
P1-7
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E.B. PETERSON,
AND
M.J. APPS
WESTERN ECOLOGICAL SERVICES LTD. VICTORIA
NORTHERN FORESTRY CENTRE, FORESTRY CANADA, EDMONTON
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