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U. B. C. SEMINAR ON SIMULATION MODELLING: Comments and
Impressions.

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U.B.C. SEMINAR ON SIMULATION MODELLING:

Comments and Impressions

by

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INTRODUCTION

Seminar on Simulation Modelling was the first in a series to be given to Environment Canada personnel from across Canada, by the Institute of Resource Ecology of the University of British Columbia. Participants of the Seminar, held during a 4-day period, 6-9 March, 1972, were from the various services in the Prairies Region and included representatives also from the headquarters Services in Ottawa. This report outlines the nature and scope of the Seminar and gives our impressions of the impact and relevance of this type of approach to solution of research and resource management problems.

SUMMARY OF SEMINAR

The Seminar started with an introduction of its aims and a brief description of the rationale and various steps involved in the model building process. In addition to demonstrating the working of the existing models, the seminar objectives included an opportunity for the participants to follow the various stages of model-building by developing a new simulation model for a hypothetical "Trilakes" area in northern Saskatchewan.

The introductory remarks were followed by a detailed description of model-building ideas and processes. Given a set of initial conditions, the dynamic simulation model serves as a convenient device to assist in the prediction of how such a system would change over time. In addition to a realistic assessment of the existing conditions, the model-building process requires a thorough knowledge of the rules of change. Thus the basic structure of the model consists of present condition of variables, rules of change and predicted (new) values for given inputs.

With adequate mathematical representation, the multiplicity of choices available can be readily determined and optimum combinations conveniently explored. The enormous complexity of the natural resources and management systems can thus be tackled to arrive at correct decisions. Dr. Walters presented this aspect of the model-building process clearly and convincingly.

The next speaker was Dr. Holling. He presented and discussed a paper entitled "Resource Science: The Nurture of An Infant". The need for more frequent contacts among various disciplines had led to a series of interdisciplinary workshops at the University in the past. Dr. Holling described some of the experiences, frustrations and gains that characterized such efforts in recent years. He pointed out that environmental problems had economic, social, ecologic, and physical dimensions; therefore no single discipline could ever encompass all the necessary concepts and techniques related to their research and management. The present seminar was also an attempt to increase University involvement in pragmatic problems.

The next session was devoted to the development of a model to optimize exploitation of a fishery resource near a West Coast port. It

depicted in a simple way how various decisions could influence the management of this resource. Some management decisions could result in rapid depletion of the fishery resource whereas others, instead, provided stable conditions that are needed for the optimum sustenance of the fishery industry.

The session on 7 March centered mostly on the discussion of an approach to, and interactions involved in, multi-resource management of the hypothetical "Trilakes area". The segments of the whole system in this case were conveniently identified as recreation, forestry, mining, fisheries, urban development and air and water pollution. The participants were accordingly split into six sub-groups. Graduate student programmers were assigned to each sub-group to assist in developing the appropriate sub-models, an exercise which took the entire afternoon. The sub-models so developed were later to be interfaced into a single integrated model. Some of the many possible actions and interactions were discussed at length.

The next session, on 8 March, was taken up primarily in presenting the GIRLS (Gulf Islands Recreational Land Simulation) and FARMS (Forest and Range Management Simulation) models. For the GIRLS model, the complex inter-relationships of supply and demand, environmental quality, social dissatisfaction and ecological feedback had been previously discussed by a number of graduate students and many specialists drawn from related disciplines. The model, generated as a result, simulated the rise and fall of various indices which typified speculation, development, and economic values over a period of 100 years (1900 to 2000 A.D.) and according to the various initial input conditions and management decisions fed into the computer.

The FARMS model depicted the case of a much-needed line of communication that should exist amongst the various decision-makers operating in the mutually interrelated domains of agriculture, forestry, and grazing by domestic livestock and wildlife. This model showed clearly how any single use in one discipline could inadvertantly affect the users in associated disciplines. The model is based on the experience gained from some of the past studies undertaken in the East Kootenay region of British Columbia.

The final day, 9 March, was spent mainly on testing the various sub-models that had now been developed for the Trilakes area by each sub-group. Various inputs by way of management decisions and constraints, were fed into the model. Outputs thus obtained were examined critically regarding how rational and realistic were the simulated predictions. The inherent complexities of the multivariate system under scrutiny became more evident as the day progressed. A good deal of frustration was generated occasionally but most of the difficulties and shortcomings were overcome before the day was over! Quite often results of computer simulation provided extra stimulus to the participants to ponder over the results obtained and ask further questions which provided better insight into the working of such systems.

In the evening session, written comments were sought in order to improve the quality and usefulness of future seminars of this kind.

DISCUSSION AND CONCLUSIONS

For the individual without a significant background in systems analysis, the U.B.C. Seminar helped to reduce much of the aura of mystery often associated with simulation modelling. Aside from the more obvious applications of model building in aid of resource management, the approach

has a tremendous potential in assisting to define problem areas, in developing interdisciplinary research and in assigning research priorities. Even a short 4-day seminar such as the one held at U.B.C. had immediate benefits for the participants by facilitating an interchange of ideas and approaches to research and development work in the various services and agencies.

Simulation as a meaningful tool in resource management is in its infancy, but its use up to now has already served the purpose of linking together conflicting policies and management. Realistic understanding of a natural system determines how accurate the model is, however, imperfect knowledge doesn't necessarily mean that the model is of no value in decision making. A simulation based on first approximations may still predict the basic pattern over time and will force the participant to ask more searching questions about a problem.

An approach to integrate interdisciplinary studies of resource and environmental problems with the help of models and computers was described by Dr. Holling in his paper, "Resource Science: The Nurture of an Infant". An interdisciplinary project team is in a much better position to fragment a complex problem into parts to facilitate the assessment of variables and inter-relationships. By doing this at the beginning, the common tendency of individual researchers to delve deeply into a relatively small problem can be avoided. Thus the use of the systems approach is likely to lead to a more balanced consideration of components of complex natural systems, thereby eliminating large gaps between methods and practice.

More specifically, our conclusions relative to simulation modelling are as follows:

- (1) Simulation models can be extremely useful in providing answers for the management of complex systems which involve numerous acting and interacting decision variables.
- (2) Simulation modelling is as good as the rational and realistic understanding of the various causative factors that govern a system under investigation. Rough graphical relationships can be used, in most cases, as first approximations and can be improved gradually as further knowledge from research is gained in future.
- (3) Research should be directed and balanced to provide the needed physical and empirical bases for accurate assessment of mutual interactions involved in the management of complex natural systems.
- (4) Computers are powerful tools for prompt synthesis of the available information and need to be used more extensively for adequate understanding of multivariate and complex systems and complex phenomena.
- (5) The models derived need to be tested and evaluated at every possible opportunity for assessing their performance in the real world situation. The discrepancies so found can often provide insight into future data gathering efforts.

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