

A P P L I E D S Y S T E M S A N A L Y S I S

I N F O R E S T M O D E L L I N G *

by

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I n t r o d u c t i o n

The description of the structure, functions and behaviour of virgin and modified forest ecosystems and the integration of natural, economic and social ecosystem models to reflect real interactions and interdependency is a target of the Unesco program "Man and Biosphere" (MAB), project area 1 "Ecological effects of the increasing human activities on the ecosystems of the tropical and subtropical forest". One of the objectives is to identify and quantify the consequences of the manifold human impacts on the forest ecosystem and its environment. The results can be applied in designing silvicultural and agrosilvicultural stand types and production schedules (BRUNIG and SANDER, in press).

P r o b l e m s

Growth and yield models are widely used in forestry. Models in practical use are deterministic and mostly based on regression equations which use such independent standard variables as site class, age, density, diameter or height usually obtained from selected and ideal permanent sample plots. Nearly all models apply to even-aged, single species stands and describe the effects different thinning strategies. Such

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models are easily constructed and can give very useful results: economically and partly ecologically (ALDER, 1977; ALDER and SCHNEIDER, 1979; TINT and SCHNEIDER, 1980; KREYSA and SCHNEIDER, 1981). Their usefulness is limited by their excessive simplification. The reason is that the great complexity and variability of the simulated system cannot be included in a practicable mathematical method.

Environmental variables, such as edaphic and climatic factors, or pollution and fertilization, are or cannot be included.

Models of mixed forests, especially tropical rainforests, are in their infancy for the same reason. But models for such forests are badly needed to guide research and forestry practice. So far, for tropical mixed forest, only detailed models of structural data or very generalized models of successional dynamics are available.

O n - g o i n g r e s e a r c h a t H a m b u r g

Structural analyses and studies of tropical rainforest ecosystems in Sarawak and Brunei (Borneo) have been conducted since the fifties, supplemented since 1975 by a MAB pilot project, supported by DFG, in the Amazon basin near San Carlos de Rio Negro, Venezuela, and data from a study near Manaus, Brazil. The results have been reported in a great number of publications by ASHTON, BRUNIG, KLINGE and collaborators since 1966 and have been applied to design preliminary local production programmes for Scots pine and Douglas fir in Auermuehle after the gale of November, 1973.

More recently, the larger data stock from Borneo and Amazonia has been supplemented with sample plot data from Liberia, supplied from a GTZ project. The most critical major data gap exists on growth data of which only few reliable and useful data sets are available from Sarawak.

Another difficulty concerns the study of systems dynamics and is more basic. The longer the time horizon extends the fewer information of precise and detailed nature are available. The decline is less marked for information on general ecosystem structure and type of behaviour pattern. But the more considerations are extended into the future the more it becomes apparent that the very complexity of interactions and feed-backs, and the occurrence of rare or completely unexpected constellations and consequent effects make such systems as a forest or forestry increasing by more unpredictable as a result of their overall indeterministic nature. Special methods of study and system analysis are being developed to cope with this situation.

The concept and problems of the systems approach applied to the study of the ecosystems has recently be summarized for the whole hierarchy from leaf through tree, stand and forest to finally forestry and region in a number of papers in Mitteilungen Nr. 10 of the German National Committee for the Unesco-Program MAB (see list of references), and in a poster paper to the Tropical Ecology Symposium of the British Ecological Society at Leeds (BRUNIG et al., in press).

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