FOREST MANAGEMENT TOOLS

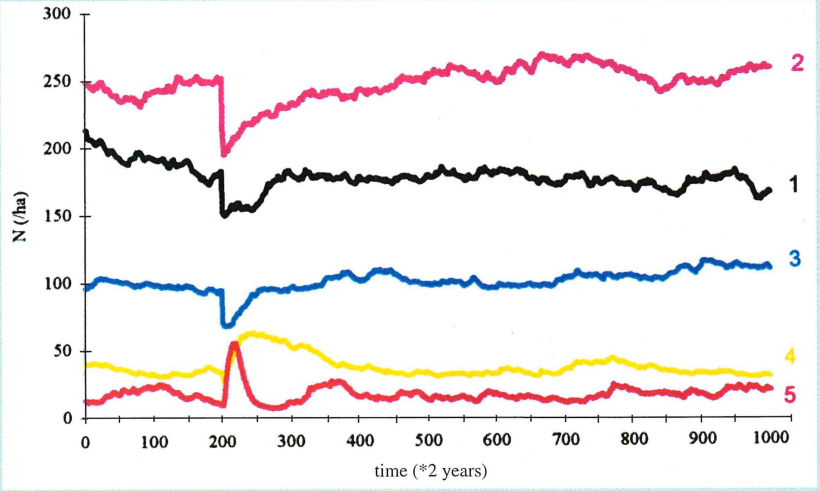
Modelling

Models* represent a decision-making tool that is becoming more and more widely used by forest managers in temperate regions. Things tend to proceed more slowly in the tropics particularly where natural forest formations are concerned, about whose functioning little is still known. The CIRAD-Forêt has embarked on the formulation of two models of forest dynamics in humid tropical regions, a demographic stand model, and a spatially explicit individual model. To this end, it is using the very large database available about the forest ecosystem at Paracou in French Guiana. The development of these computer tools in fact responds to a twofold task for the CIRAD and its partners :

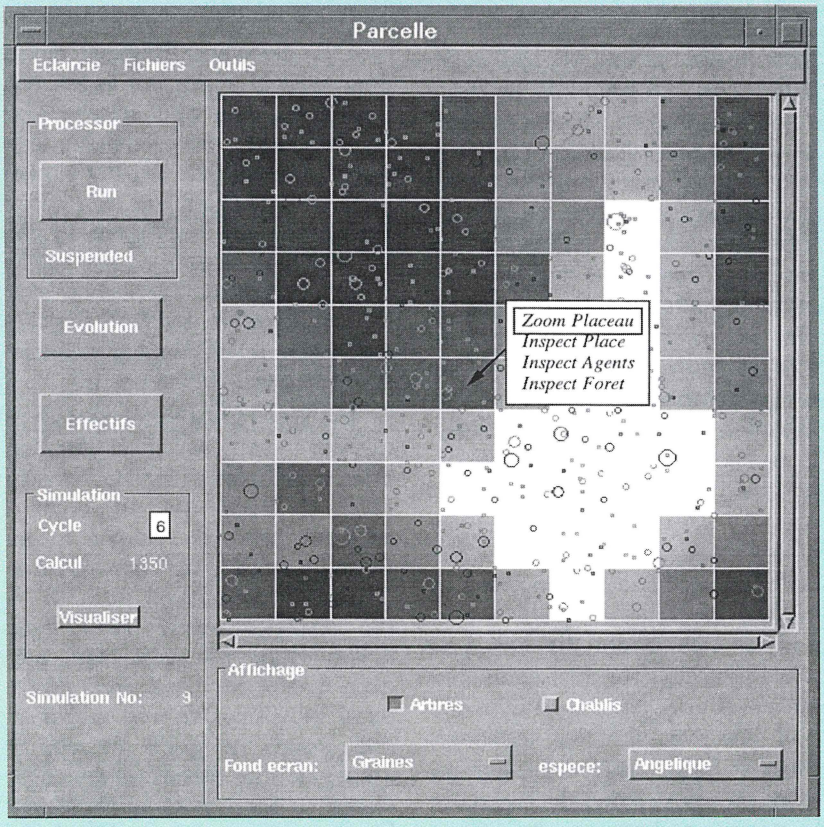
- a better understanding of the development processes of forest stands,
- and the provision of production forecasting tools for managers.

□ **The first model** describes a stand by the diametric structure of five functional groups of species defined by their growth behaviour. The growth dynamics – transition from one diameter class to another –, recruitment and mortality are adjusted for each group as a function of the average density per hectare. A matricial equation analyses these parameters and makes it possible to simulate the changes of the stand characteristics with time.

□ **The second model** describes each individual specimen with its spatial position. The growth of each tree is based on the botanical group to which it belongs and on what is growing near it, by a POT*RED-type



Simulated changes of the numbers of trees by groups of species with logging at t : 200 years (Favrichon, 1995).



Copy of the screen showing part of the user interface of the SELVA simulator (Gourlet-Fleury).

* Cf. BFT nº 249.

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equation, where POT is the potential growth and RED is a reducer based on an index of local competition. Mortality and recruitment modules make it possible to complete this representation and the simulations give a very accurate picture of the stand dynamics.

These two models respond to a variety of concerns and have different potential : assistance with the definition of silvicultural scenarios and management strategies, the pooling of knowledge originating from different disciplines, and studies of the impact of upheavals imposed on the environment. In particular, they make it possible to simulate, on different scales, the impact of logging and silvicultural treatments on the dynamics of a stand. They are also an arena of reflection which may give rise to new lines of research. The importance of a better understanding of natural regeneration, associated with the dynamics of animal populations, has, for example, been underscored. Likewise, the requirements of a more general overview of a typology of stands are given pride of place in order to permit an extrapolation of the models to various types of forests.

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Remote-sensing

For more than 20 years or so, the CIRAD-Forêt has been using satellite data to map forest formations in tropical regions.

The first inventories, almost exclusively drawn up for the sole purpose of logging, relied on aerial photographs to delimit and identify forest stands. Little by little, the dictates of an integrated management system for the forest environment have called for comprehensive and repetitive approaches, and the remote-sensing tool has been quick to show its advantages in this field.

Data from the Landsat MSS* have been used to produce vegetation maps on a national scale for such countries as Cameroon, Benin, Togo and Senegal. The overview given by the satellite images has turned out to be thoroughly suitable for a global appreciation of vegetation formations.

The availability of images acquired on different dates has made it possible to describe the evolution of forests and forested regions, as in Guinea.

Other sensors with a finer ground resolution – 10 and 20 m for SPOT* and 30 m for Landsat TM*, have proven more suitable for analysing the heterogeneous ligneous formations of dry tropical regions. An inventory of wood resources in Mali and a project on the supply of firewood in Niger were both based on the use of these high-resolution data.

More recently, the CIRAD-Forêt has undertaken research work on the evaluation of radar images for potential applications in tropical forestry. In fact, the more or less permanent presence of clouds over tropical rain forests hampers the acquisition of Landsat and SPOT images of these regions. With their ability to see through clouds, radar systems present a definite advantage. At the CIRAD-Forêt, research activities are focusing on the use of radar data both for forest resource estimates and for the monitoring of managed forests.

Landsat MSS (Land Satellite MultiSpectral Scanner).
SPOT (Land Observation Satellite/Satellite pour l'Observation de la Terre).
Landsat TM (Thematic Mapper).

The GIS

Finally, the applications of remote sensing are no longer conceived without the use of Geographical Information Systems**. Such interactive tools for managers and decision-makers not only allow the incorporation of multi-source data, but also their matching by means of spatial analysis.

At present, the CIRAD-Forêt is developing the potential of these techniques as management tools suitable for use in forest resource management projects.

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* Cf. BFT nº 193, nº 206 and 240.
** Cf. BFT nº 250.