# FORESTS AND SOCIETY: THE ROLE OF RESEARCH

*POSTER ABSTRACTS*
V0LUME 111

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## 4.01.00 Using growth models for better forest management in the tropics

# A Process-based Model to Assess Forest Management Strategies in Tropical Rain Forests

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Until now, attempts to model and simulate tropical rain forest are very few. The approach we present here is highly focussed on available field data, their analysis and the state-of-the-art knowledge on rain forest tree growth. Our model FORMIND is an individual-oriented and process-based rain forest growth model with special emphasis on dry matter dynamics. To predict tree growth, we model photosynthesis and overcome the problem of estimating respiration - where normally data are not available - by integrating diameter increment data from field observations in the model. Together with precise tree geometry information (incl. relation between diameter, height, leaf area, crown extension, aboveground biomass) single tree growth can be determined very accurately. Modules for light competition on patches of 20m x 20m in size, mortality (incl. falling trees creating gaps) and establishment enable FORMIND to simulate forest stands up to a size of several tens of hectares. Tree species are aggregated based on a generalized approach to derive typically 5-10 plant functional types with respect to their light demand (shade tolerance) and their potential maximum height. Because of the general formulation of basic processes, sites in different world regions can be simulated. Including typical environmental factors like dry seasons of various lengths, rain forest stands in South-East Asia and South America were simulated with a satisfying precision.

As one of the most urgent model applications, the impacts of different management scenarios on tropical rain forest are discussed in detail. Due to a lack of field data it is still not clearly known how management of tropical forests influences tree mortality, forest regeneration potential and its time scale. We therefore simulate the huge variety of possible impacts of different logging strategies and compare simulation results with field observations to identify those impacts, which might be of major importance for forest growth. This analysis has a special focus on establishment processes and how their changes due to logging impacts are responsible for future forest development.

The results show that even with an optimistic constant seedling input logging intensity and the length of logging cycles have to be on levels which are not observed in practice at the moment. If highly likely impacts of logging on seedling input and survival rate are taken into consideration it becomes very clear how far common logging practices are away from sustainability.

# The Influence of Age on Forest Site Productivity: A Case Study with Suppressed Black Spruce Trees

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In forestry work the age of a tree, as indicated by the number of annual growth rings at the base or at breast height, is generally the only age considered. Studies related to the phenomenon of tree suppression in juvenile age of black spruce trees (*Picea mariana*) have raised doubts as to whether the total age of a tree is the best indication of its true physiological or economical age on a given site. Tree suppression usually occurs when black spruce advance regeneration suffers from competing, taller trees. Tree growth is then severely limited, and these trees have distinct, slow growing annual rings. This slow accumulation of diameter growth during the juvenile years leads to a sigmoidal pattern of diameter increment over age. By considering this, our aim was to develop a method that removes the influence of the initial suppression years, and provides an estimate of the "economical" age of a tree.

To achieve this goal, we sampled three black spruce sites (6 plots per site) growing in north-east Québèc, Canada. On each site, all merchantable trees were tallied and tree height as well as tree diameter at 1 m were recorded. In addition, an increment core was taken at 1 m for patterns of diameter growth accumulation. Traditional site index determinations were calculated using the 4 biggest trees per hectare using total age at 1 m. With these data, a method was developed using a logistic nonlinear regression model of cumulative annual ring widths regressed against age in order to determine the "economical" age of a tree. This was done by extrapolating the linear portion of the