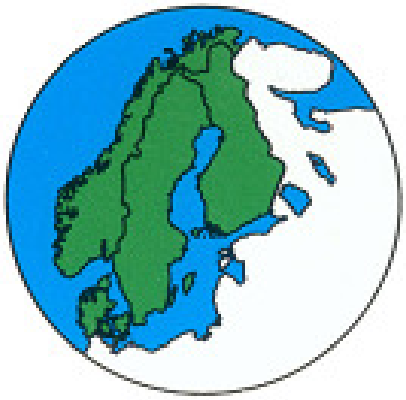
Scandinavian Forest Economics

No. 42, 2008



Proceedings

of the Biennial Meeting of the

Scandinavian Society of Forest Economics

Lom, Norway, 6th-9th April 2008

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Ås

Using lumber grade and by-products' yield predictions for standing scots pine trees in stand level optimization

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ABSTRACT

The purpose of this study was to develop models for estimating yields of lumber grades and by-products of individual Scots pine (*Pinus sylvestris L.*) stems using stem and crown dimensions as explanatory variables. The next stage will be combining models to simulation-optimization framework to optimize forest management at the stand level using climate change mitigation effect as an objective function when also material and energy substitution benefits of wood products are taken into account.

Two separate data sets were used as a material for analysis: 1) Simulated data set generated by the process-based growth model, PipeQual, which provides information about stem form and branch properties. The model was used to predict the 3D structure of Scots pine stems in thinning regimes of varying intensity and rotation periods and 2) detailed measured empirical data set. The stems were sawn using the WoodCim sawing simulator and the yields and grades of the individual sawn pieces, as well as by-products, were recorded. The sawn timber pieces were classified on A, B, C and D-grades for side and center boards separately (Finnish export rules). By-products were pulpwood, sawmill chips, sawdust and bark.

The response variables were formulated as proportions of the total volume of each stem. Multinomial logistic regression models were fitted to the both data sets. Models fitted to the real stems data set was found more accurate and the dead branch height, diameter at the breast height and the natural logarithm of the diameter at breast height was found the best combination of the explanatory variables. The models were tested in the generated data set and found to overestimate the quality in medium fertile stands.

The developed approach integrates forest management, its implications to the quality of raw wood and sawn wood conversion chain. The models can be used in stand management optimization for comparing different management options e.g. on the value-added basis from the sawmill's point of view or climatic benefits of wood products.

KEYWORDS: *Pinus sylvestris,* Timber products, product recovery, process based growth model, sawing simulations