The cutting productivity in integrated harvesting of pulpwood and delimbed energy wood with a forestry-equipped peat harvesting tractor

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The purpose of the study was to determine the productivity of the integrated cutting of pulpwood and delimbed energy wood, along with the time consumption of cutting work phases performed with a forestry-equipped Valtra T171 peat harvesting tractor as the base machine and a Nisula 400C as the harvester head (Figure 1). In total, 1010 stems were cut in the Scots pine (*Pinus sylvestris*) dominated time study stand located on drained peatland, consisting of 44.0 m^3 of pine pulpwood and 53.8 m^3 of delimbed energy wood. The average stem volume was 97 litres (minimum 5 and maximum 679 litres). On the basis of the time-study data collected, per-stem time-consumption and productivity models were prepared for the single-stem cutting of delimbed wood. In the single-stem cutting time-consumption model, productivity was explained in terms of stem volume and harvesting intensity (number of stems removed per hectare). Productivity was expressed in solid cubic metres per effective hour (m^3/E_0h).

Figure 1. Forestry-equipped Valtra T171 peat harvesting tractor.

The tractor harvester's ability to operate was good where terrain and ground surface was easy (flat) and there were no interruptions caused by machine breakdowns. Moreover, the harvesting quality met the recommended standards. The results indicate that the productivity of the Valtra T171 tractor-based harvester and the Nisula 400C harvester head was at the same level as that of conventional small and medium-sized wheeled harvesters in previous studies during the last ten years in Finland. Cutting productivity per effective hour (m^3/E_0h) increased as the trees' stem volume grew, with a stem volume of 50-200 litres and a harvesting intensity of 737-368 trees per hectare, a cutting productivity of 8.0-19.1 m^3/E_0h

and 7.1-17.7 m^3/E_0h, when the effect of undergrowth clearing with harvester head was taken into account (Figure 2).

Figure 2. Cutting productivity m^3/E_0h) as a function of stem volume, when the effect of undergrowth on cutting productivity is either taken into account or not.

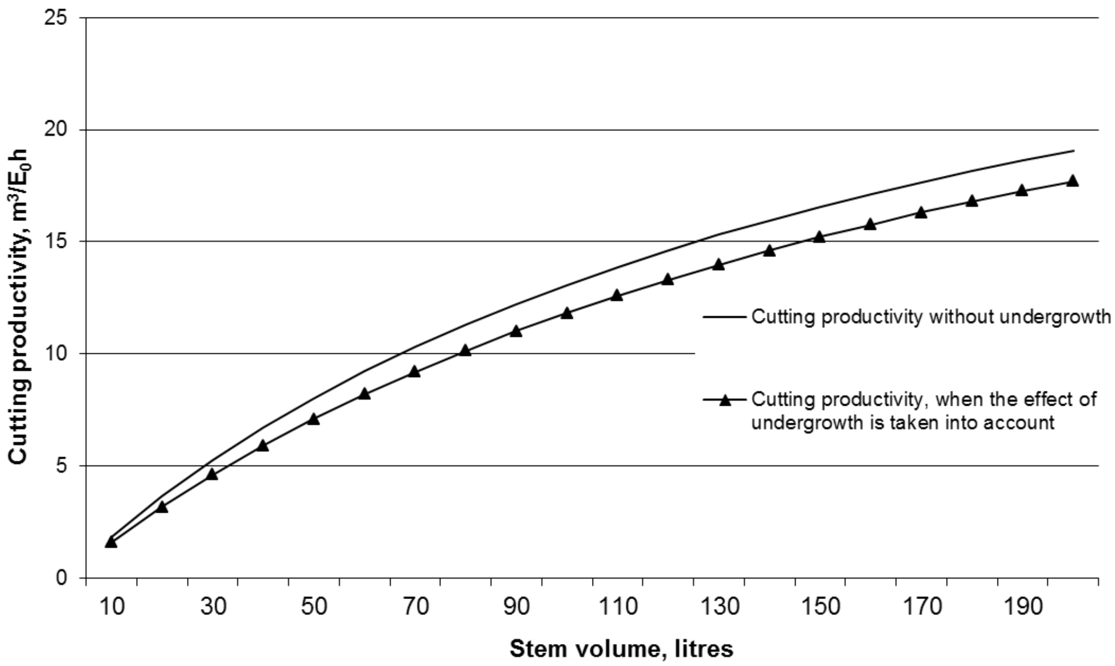
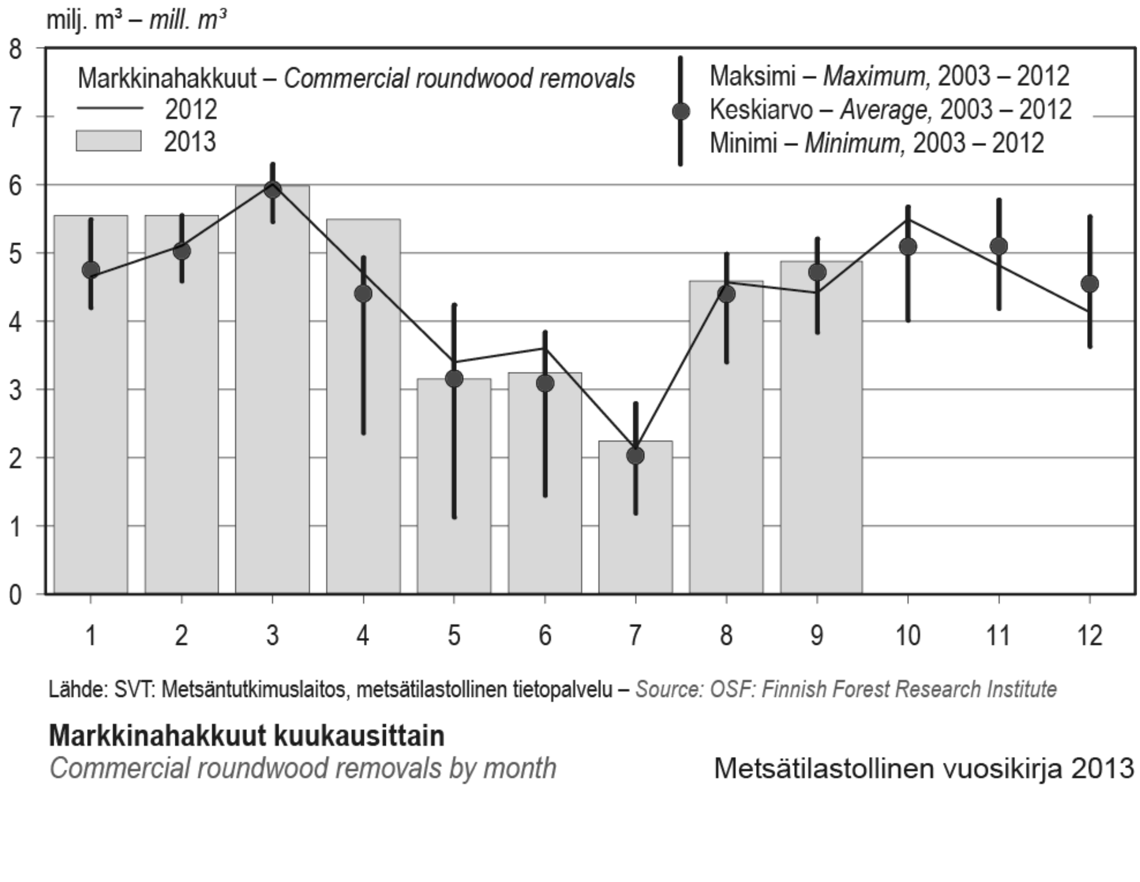


Figure 3. Commercial roundwood removals by month in Finland.



In Finland, forest machines are fully utilised for only around six months of the year, between September and March (Figure 3). The seasonal nature of wood procurement leads to the underutilisation of forest machines and employee layoffs. Idle time lowers the utilisation rate of forest machines and whittles away at the profitability of the machine-contracting business. Versatility of machinery represents one way of achieving year-round employment and ensuring the availability and stability of a professional workforce. One way of evening out the seasonal fluctuation in harvesting would involve utilising machinery that is deployed seasonally in peat harvesting as base machines for harvesters in logging operations during the autumn and winter. At the same time, the number of conventional harvesters would be reduced.

The advantage of heavy-duty tractors produced in high volumes include a purchase price that is lower than that of forest machines and, outside the harvesting season, the option of removing the forestry equipment and using the base machine in the work for which it was originally designed. The investment in additional equipment and work output would improve the utilisation rate of the base machine while reducing the amount of capital tied up in the base machine per hour of its operation. However, a contractor should also always bear in mind the amount of work and money required to render the investment in additional equipment for the base machine profitable, with sufficient return on capital. The regression models presented provide accurate productivity estimates in typical Finnish thinning conditions as well as for cost calculations and different types of simulation and modeling purposes.

References

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