

FACTORS AFFECTING PRODUCTIVITY OF MECHANIZED THINNING USING SMALL SIZE FOREST MACHINES

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Why small-sized forest machines?



Thinning



Vimek 404



Early tending



Vimek 610



Small ditch building

The **aim** of the research is to find out the changes in productivity depending on the diameter of the tree to be cut, as well as the most important factor influencing the reduction of productivity using small size forest machines in thinning in Latvia.

Working methods of Vimex 404 harvester



1. Keto Forest Xtreme (1+3 delimbing knives)



2. Keto Forest Eco (3 delimbing knives)



http://www.kone-ketonen.fi/images/Forst_Xtreme_kotisivuille.jpg

http://www.kone-ketonen.fi/images/tuote_forsteco.jpg

Work elements (productive time) in time studies



Number of working element	Explanation
1	Reaching for tree with crane
2	Positioning of felling head
3	Cutting of tree
4	Delimbing and bucking
5	Delimbing times (how many times trunk was dragged through delimbing knives)
6	Log moving and stacking
7	Undergrowth cutting
8	Time spent to drive into a stand
9	Time spent to leave a stand
10	Other non-standard operations, including machine maintenance

Characteristics of extracted tree dimensions

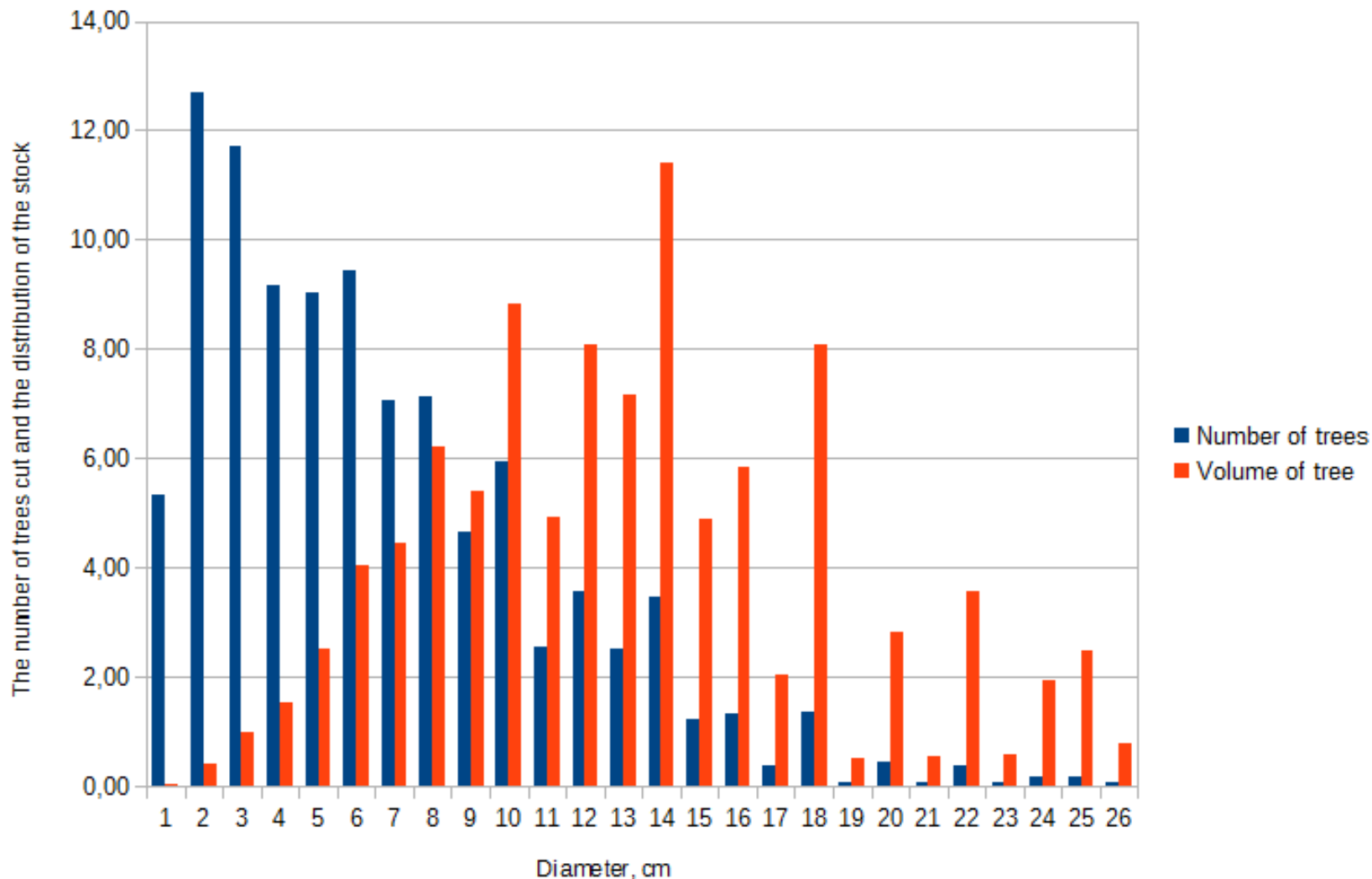


Forest stand	Working method	Extracted trees, pcs.	Average diameter of tree, cm	Extracted volume (according to harvester data), m ³	Average volume of tree, m ³
2	1	728	13 (± 5)	71	0,10
5		2 486	6 (± 3)	60	0,02
6		3 787	10 (± 5)	290	0,08
7		3 979	4 (± 5)	123	0,03
8	2	2 660	12 (± 4)	222	0,08
9		975	11 (± 4)	85	0,09
10	1	80	10 (± 3)	4	0,05
11	2	2 105	9 (± 3)	115	0,05
13		409	7 (± 4)	18	0,04

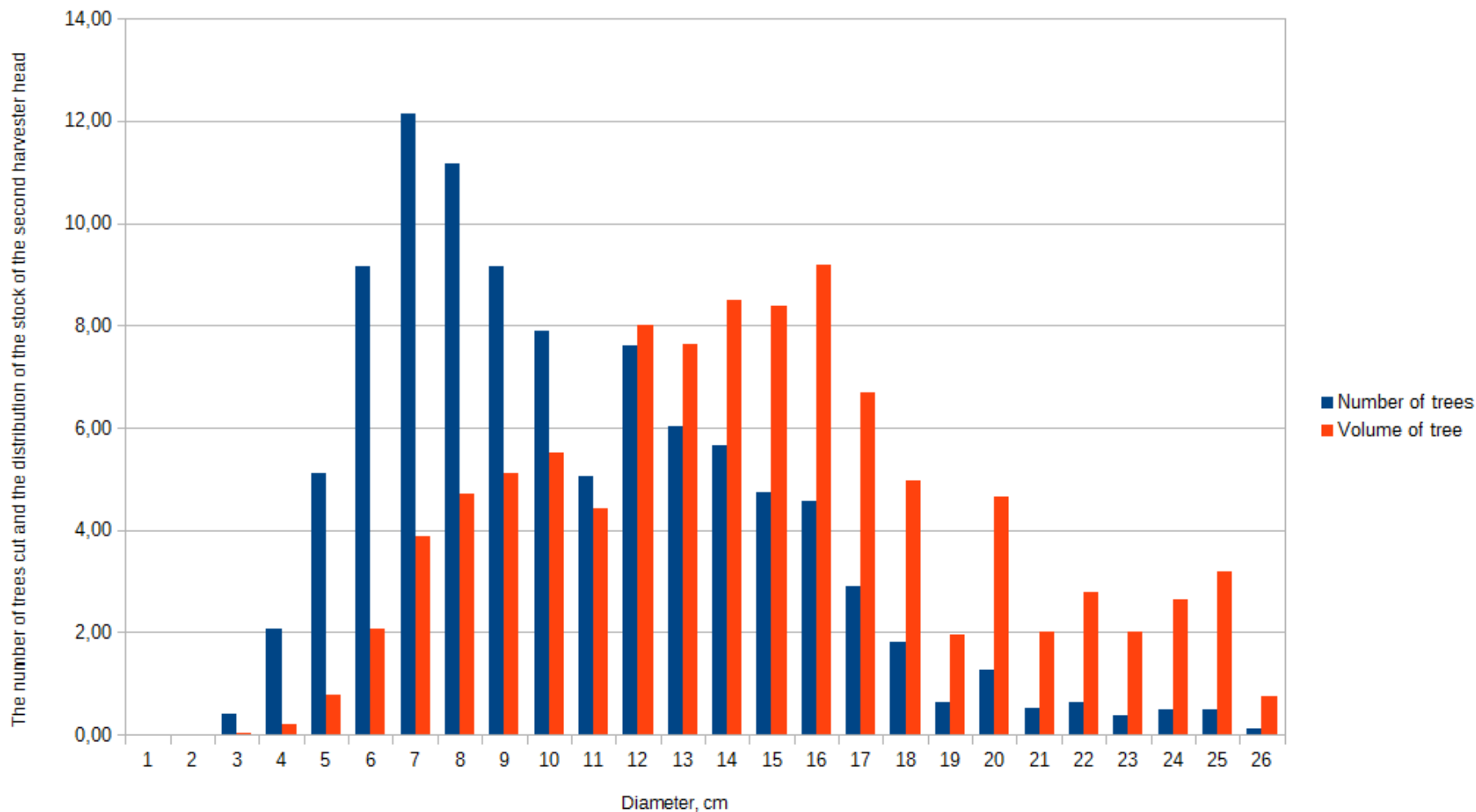
Working methods:

1. Keto Forest Xtreme
2. Keto Forest Eco

The proportion of amount and volume of extracted trees using first working method



The proportion of amount and volume of extracted trees using second working method



Summary of average productivity indicators



Tree species	Working method	Trees, pcs. per productive hour	Average productivity, m ³ per productive hour
Spruce	1	95	7,01 (±4,3)
	2	79	9,59 (±6,0)
Deciduous trees	1	102	14,36 (±10,9)
	2	72	10,17 (±8,1)
Pine	1	83	6,73 (±4,8)
	2	95	10,19 (±7,7)

Working methods:

1. Keto Forest Xtreme
2. Keto Forest Eco

To optimize thinning productivity with a Vimek harvester, it is possible to use linear regression equation for the DBH range from 4 to 25 cm

$$R = K + K_D * D$$

Regression summary R ² =0.85 F=372>Significance F=2.82*10 ⁻²¹		
	Coefficients	P-value
K	-1.827090812	0.001
K _D	0.700114608	0.000

Conclusions



1. In Latvian conditions the most suitable is Vimek harvester equipped with Keto Forest Eco felling head. It can work up to 14% more productive (average tree diameter of 4 to 25 cm) compared to Vimek equipped with the Keto Forest Xtreme felling head.
2. The main factor affecting work productivity at the diameter of the trees over 25 cm is the diameter of the branches.
3. The average productivity of a forwarder in thinning is $8,6 \text{ m}^3 \text{ h}^{-1}$ in the cutting sites located at the wood yard area.

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