A new device for reducing crew size and operator workload during log winching operations

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Introduction

Intermediate harvesting technology

Tractor and winches

Winching

- heavy physical work
- low productivity

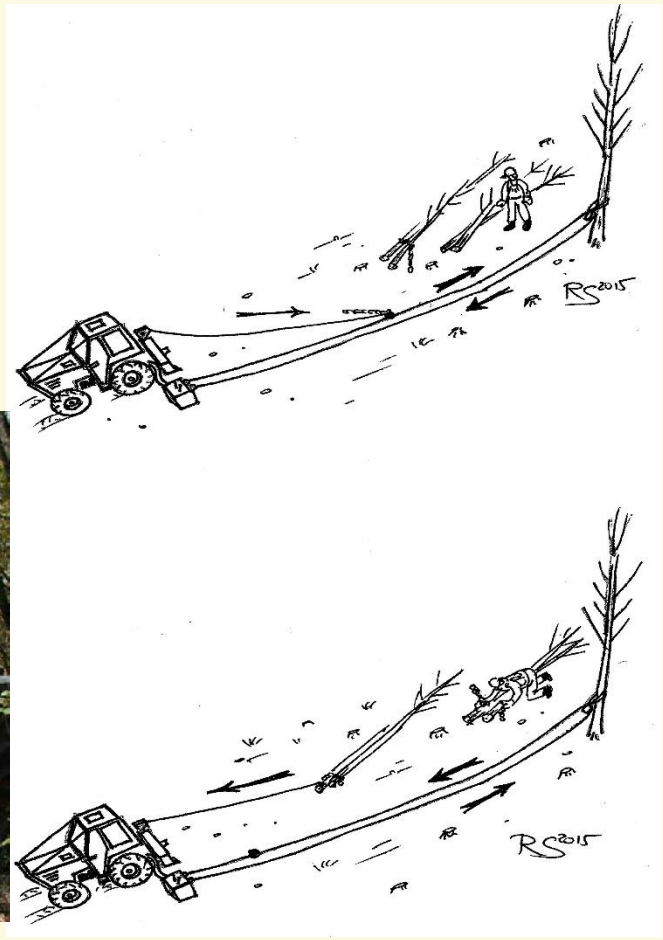
Is it possible to increase winching performance and reduce winch operator workload?

Introduction

Yes!

With an auxiliary double-drum winch for automatically returning the winch cable to the load site

Piccino



Goals

1) Verify the improvement of winching productivity
2) Determine the reduction of winching cost
3) Measure the operator workload

Materials and methods

30-year-old Turkey oak coppice

Whole tree extraction

Comparative test

6 different loggers

Work sessions randomly distributed

Parallel winching corridor

Materials and methods

Productivity - classic time-motion study

Winching distance and load size

Fuel consumption

Physiological workload - heart rate measurements

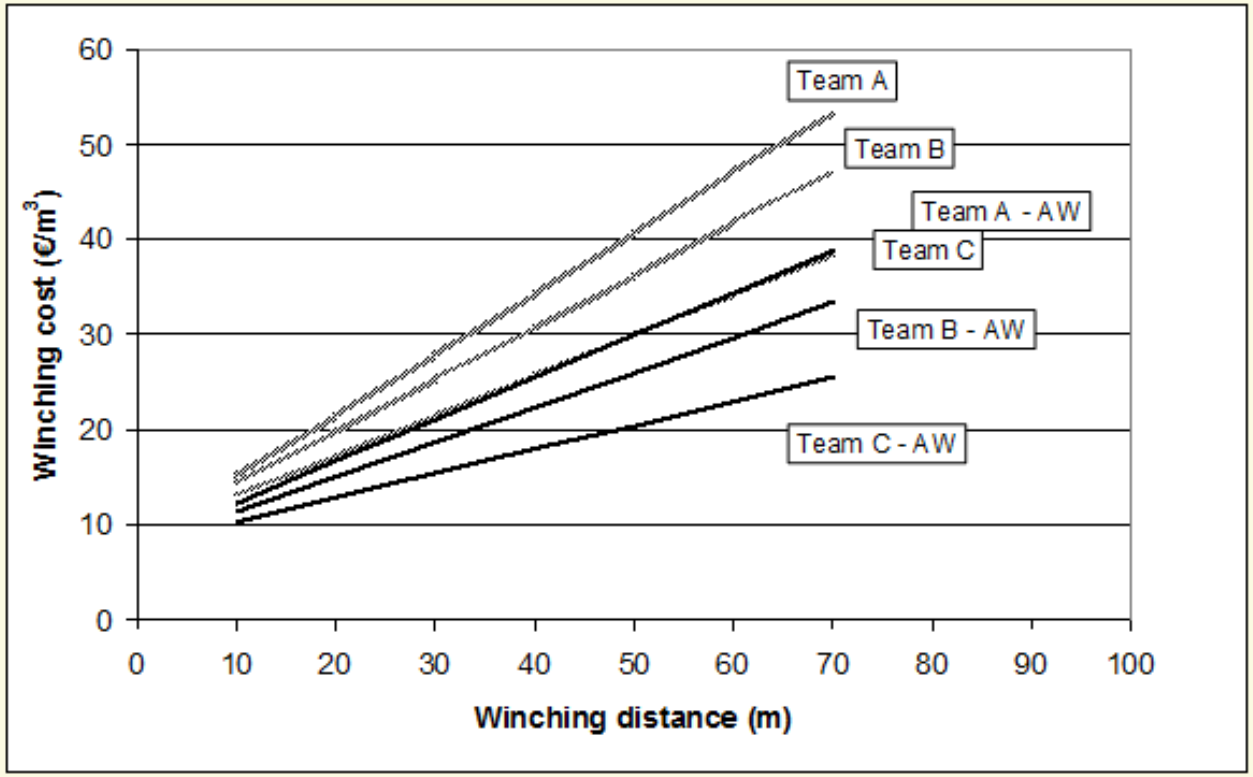
Polar RC3 GPS sport heart rate monitors

Results

Treatment	Team	Distance	Tree size	Load size	Cycle time
		m	m^3	m^3	s
Manual	A	35^{ab}	0.169^{a}	0.549^{a}	524^{ac}
	B	24^{a}	0.298^{ab}	0.441^{a}	324^{bc}
	C	35^{ab}	0.330^{ab}	0.659^{a}	301^{bc}
Auxiliary winch	A	38^{b}	0.286^{ab}	0.481^{a}	412^{ab}
	B	30^{ab}	0.530^{b}	0.586^{a}	327^{bc}
	C	31^{ab}	0.280^{ab}	0.375^{a}	289^{c}

Notes: Different superscript letters on the same column denote statistically significant differences between treatments, checked with Scheffe's test at the 5% level

Results - winching cost

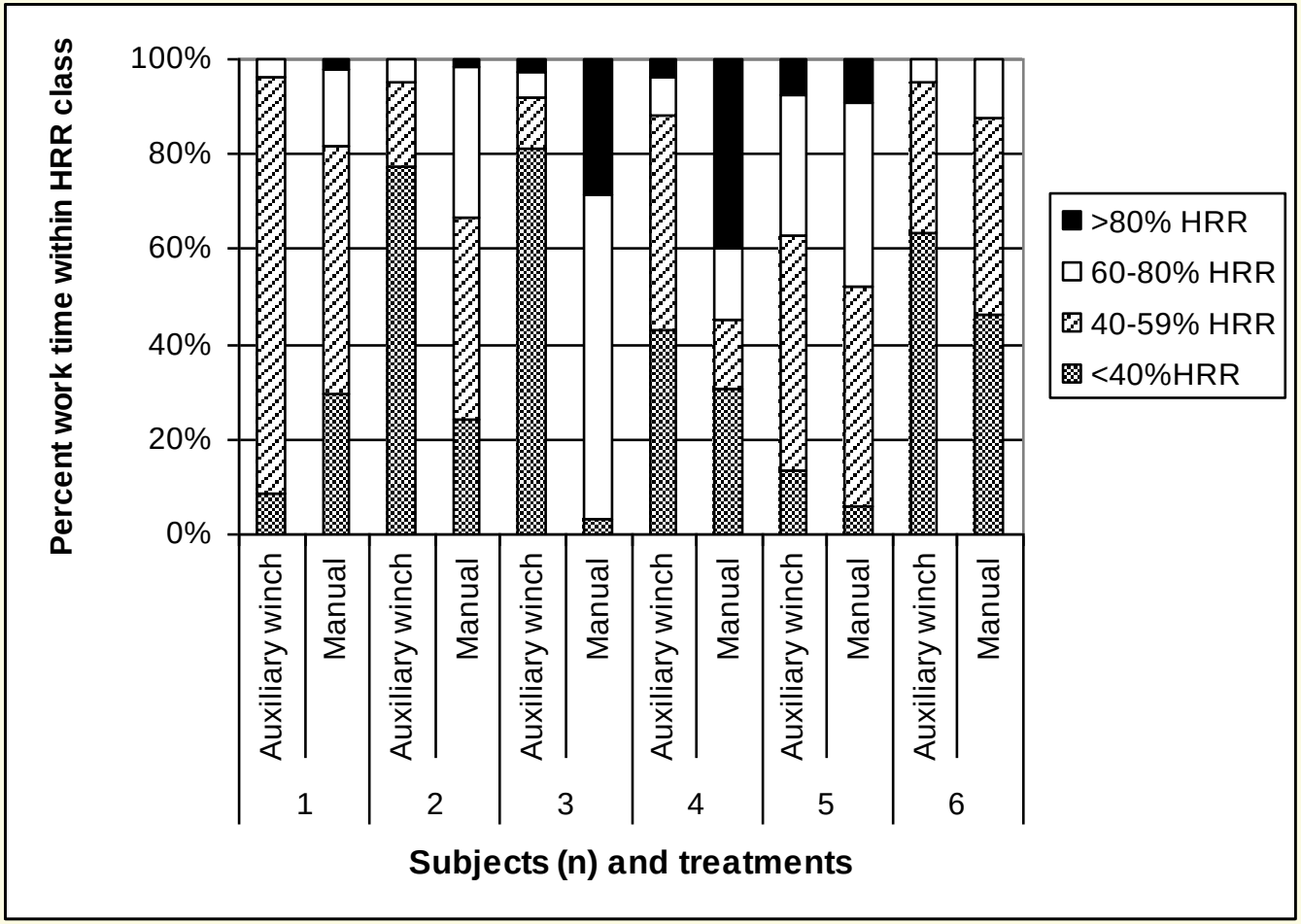


Results - operator workload

Treatment	Auxiliary winch		Manual	
Subject #	Mean	SD	mean	SD
	bpm		bpm	
1	106A[a]	13	133B[abc]	17
2	107A[a]	18	132B[abc]	20
3	98A[a]	18	140B[abc]	18
4	109A[a]	20	136B[abc]	35
5	141A[b]	27	152A[b]	25
6	105A[a]	16	114A[c]	14

Notes: Different capital letters on the same row, indicate statistically significant differences between treatments, after testing with a pair t-test at the 10% level. Different superscript letters on the same column denote statistically significant differences between workers, checked with the Kruskal-Wallis test at the 10% level.

Results – operator workload



Conclusion

Productivity increased

Workload decreased for most operators

- reduction in manpower to achieve the same job
- sped up the winching cycle by returning the cable faster
- the winching assistant had more time to prepare the loads

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