

Impact of slope on forwarder load size and productivity



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Overview

- Background
- Description of site and study
- Results
- Conclusions
- Further research

Background

- Worldwide desire to use ground-based systems on slopes to reduce costs
- In a harvester – forwarder system, the forwarder typically limits maximum operating slope



Study description

- Study conducted at two sites. At both sites:
 - Mature (32 year old) *Pinus radiata* clearfell
 - Harvester/forwarder harvesting system
 - Same forwarder (Valmet 890.3) and operator studied
- At the steep site band tracks were installed on the rear wheels



Study description

- At the steep (Murray) site, travel was mainly on tracks (Mean extraction distance = 390m)
- At the flatter (Baudin) site, travel was mainly in the stand (Mean extraction distance = 145m)
- A single landing was used at each site



Landing

Baudin



Murray

Description of study sites

Site attribute	Baudin	Murray
Surface area (ha)	2.3	2.2
Mean DBH (cm)	42.1	35.3
Mean tree height (m)	29.7	25.0
Mean merchantable tree volume (m ³)	1.53	1.3
Merchantable stocking (trees ha ⁻¹)	251	286
Standing merchantable volume (GMt ha ⁻¹)	385	360
Slope range (%)	0 - 10	21 - 45



Baudin



Murray

Study description

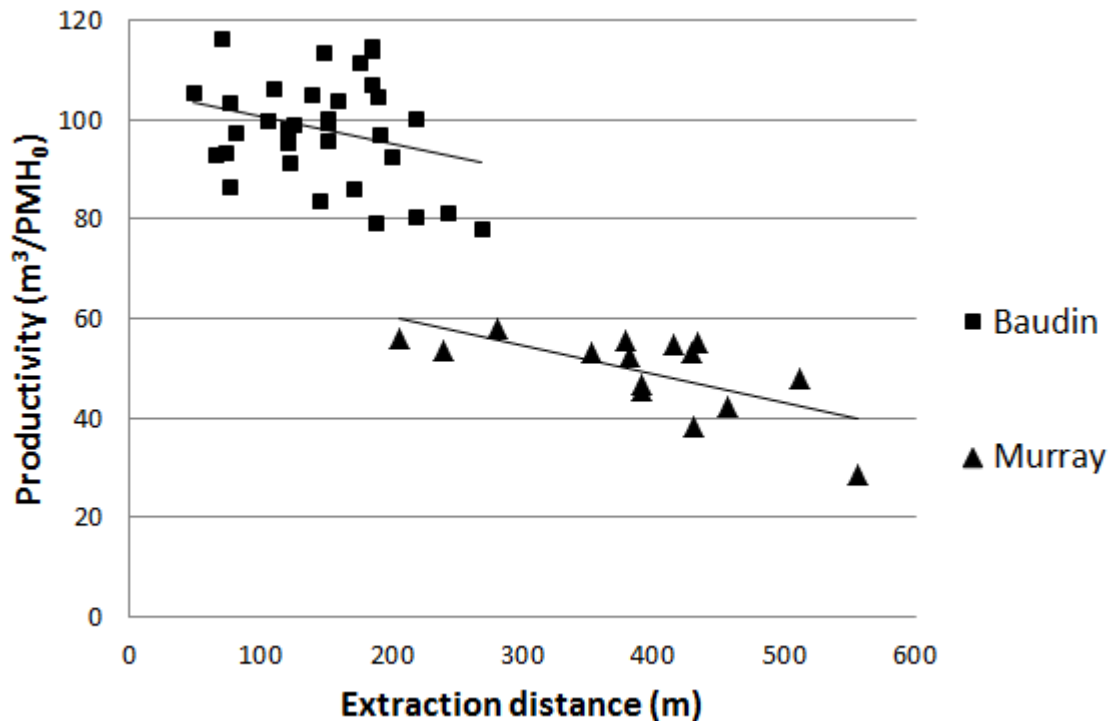
Studied	Methodology
Productivity	Digital video recordings + load volumes
Cycle times	Digital video recordings
Extraction distance	GPS (Multidat)
Travel speed	GPS (Multidat)
Load volume and number of logs	Mean log volume from StanForD stm files. Log count and volume from digital video recordings



Study description

- A range of log products were cut at each site
- For the study, only Laminated Veneer Lumber logs at the Murray site (mean 0.46m^3) and Sawlogs at the Baudin site (mean 0.43m^3) were included
- These were the major products at each site

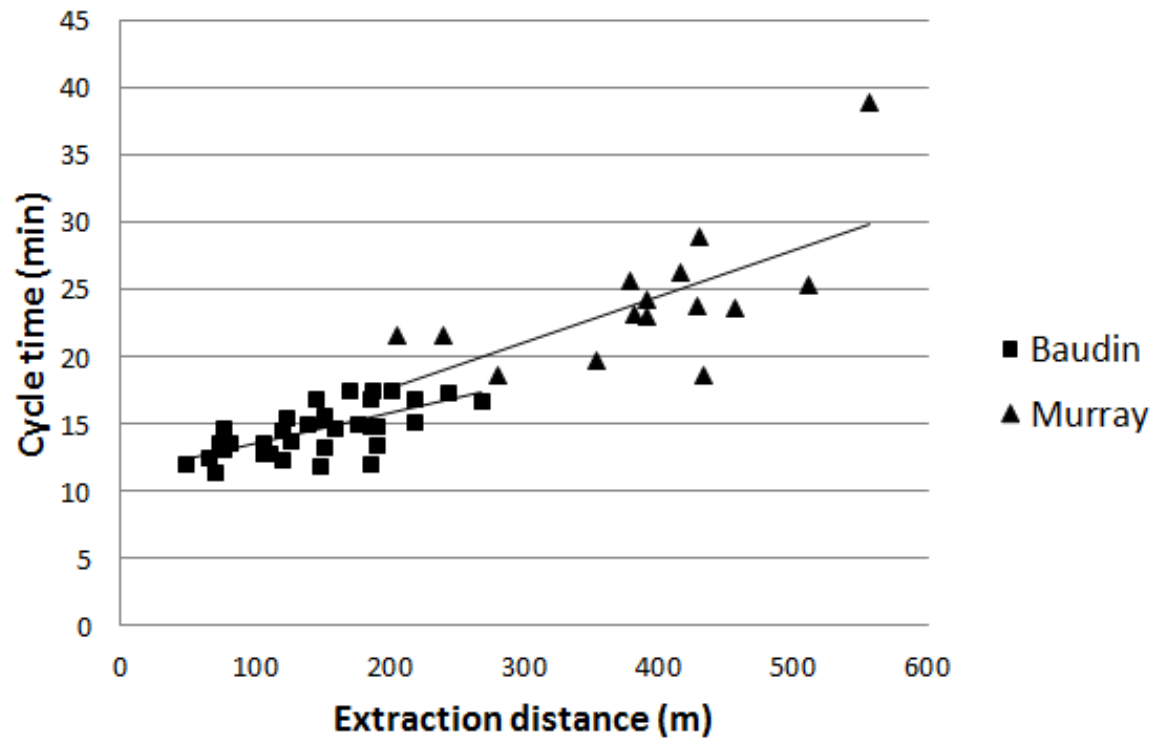
Results - Productivity



Site	Mean Productivity (m³/PMH₀)
Baudin	98.2
Murray	49.4

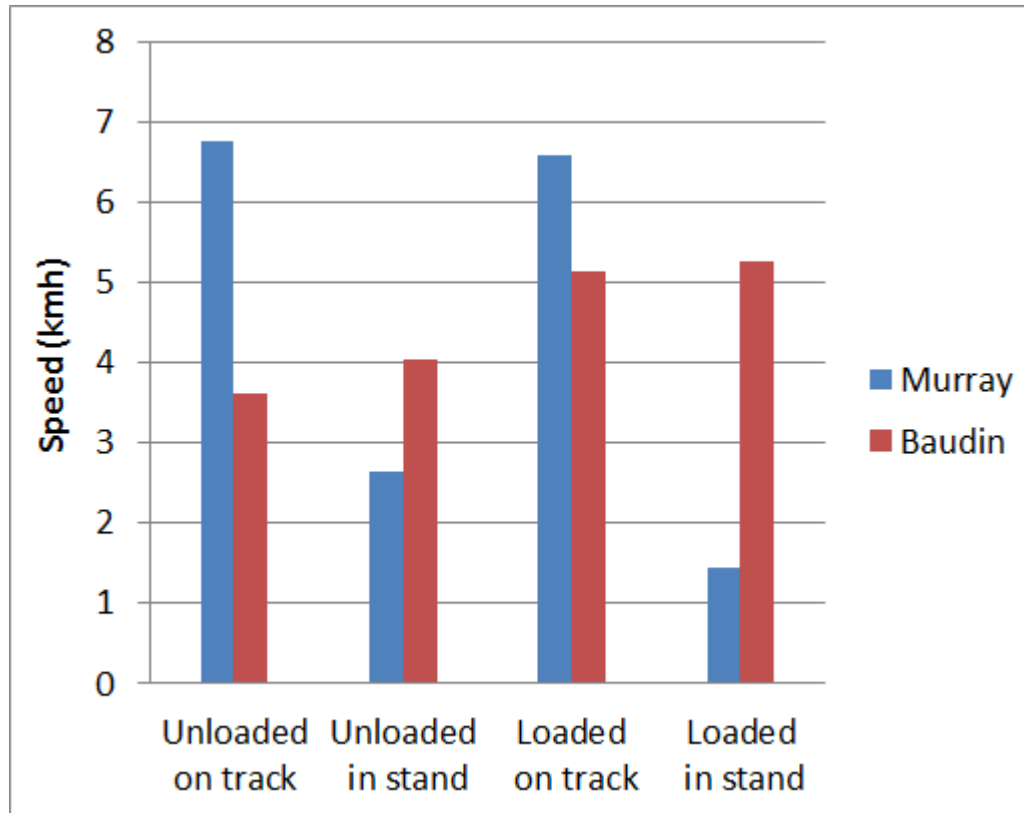
Productivity was higher at Baudin, but parallel regressions implied a systematic difference

Results – Cycle time



No significant differences between cycle time regressions

Results – Travel speeds



- Travel speeds at Murray were significantly faster than at Baudin on the track and significantly slower in the stand
- Faster on track travel speeds at Murray balanced the slower in stand travel speeds

Results – Load sizes



Baudin mean load =
21.3m³ and 49.6 logs



Murray mean load =
19.4m³ and 43.4 logs

Conclusions

- Extraction distance was the major driver of cycle time at both sites.
- Significantly larger loads at the Baudin site explained most of the increased productivity at this site
- Slower forwarder travel speeds in the stand (on the slope) at the Murray site were balanced by faster on track speeds

Further research

- More sites – different slopes, uphill vs downhill, different products, different ground conditions
- Tethered forwarders (none operating in Australia at present)
- Comparison of costs and fuel consumption

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Thank-you

