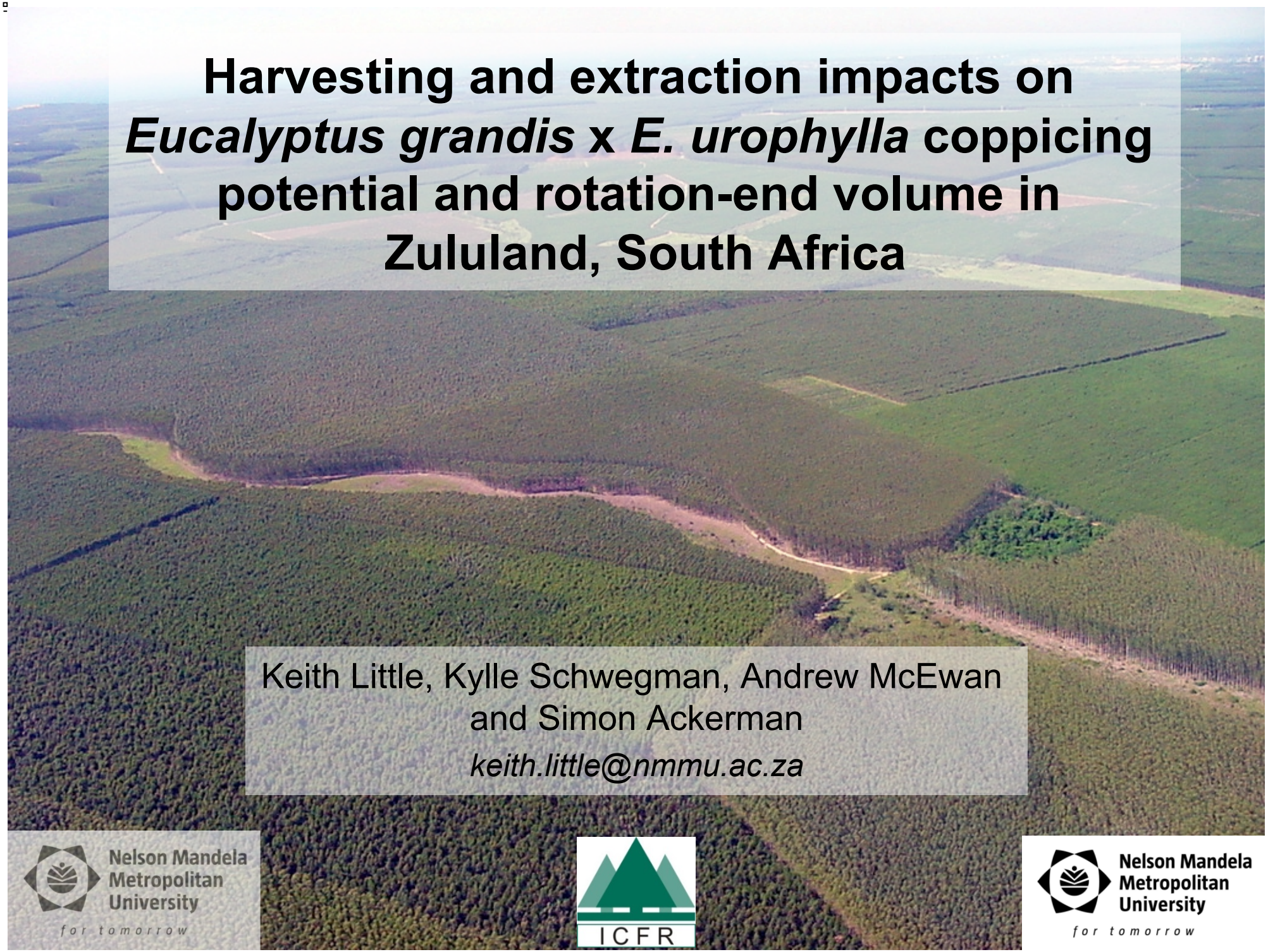
Harvesting and extraction impacts on *Eucalyptus grandis* x *E. urophylla* coppicing potential and rotation-end volume in Zululand, South Africa



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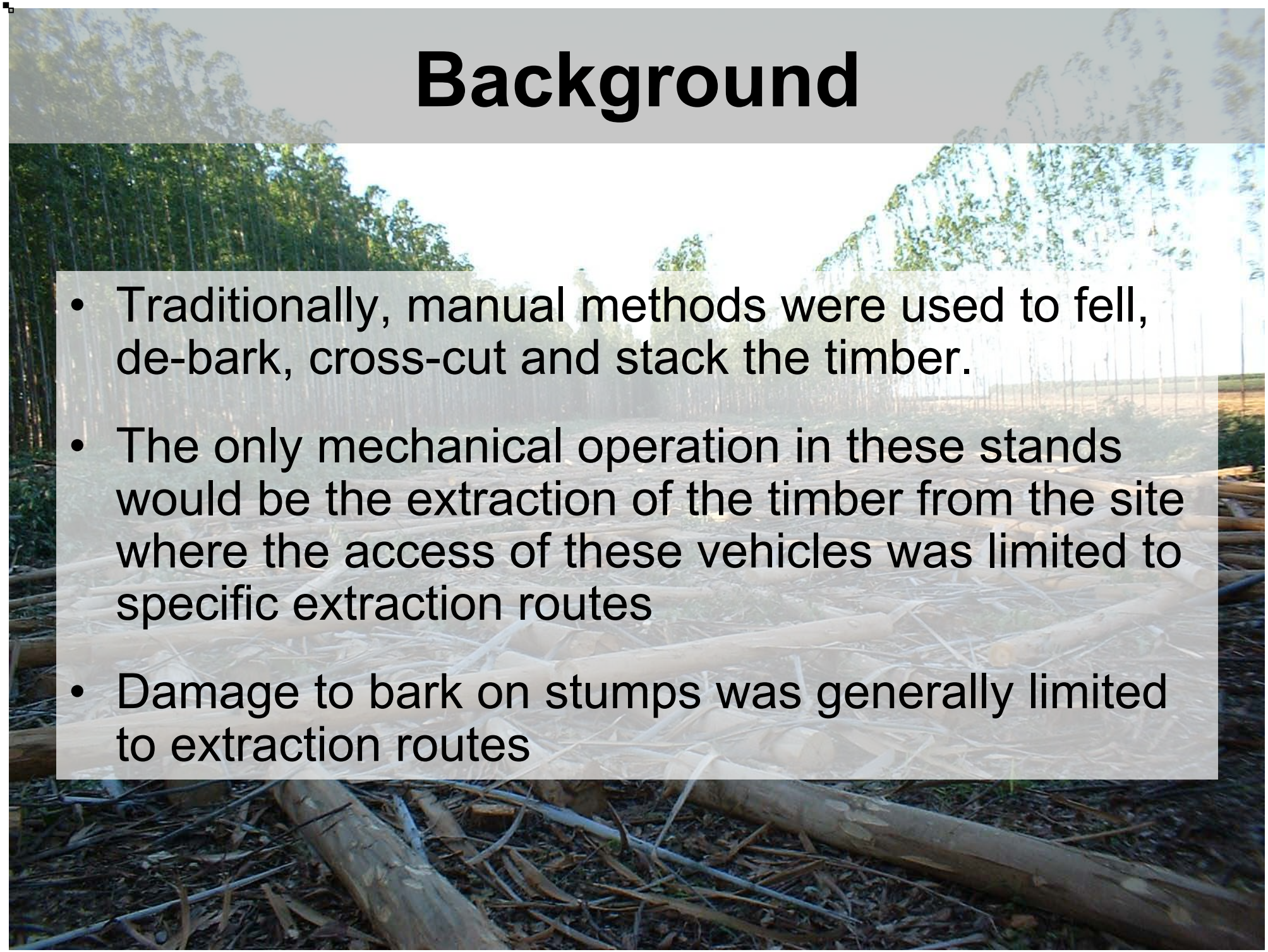
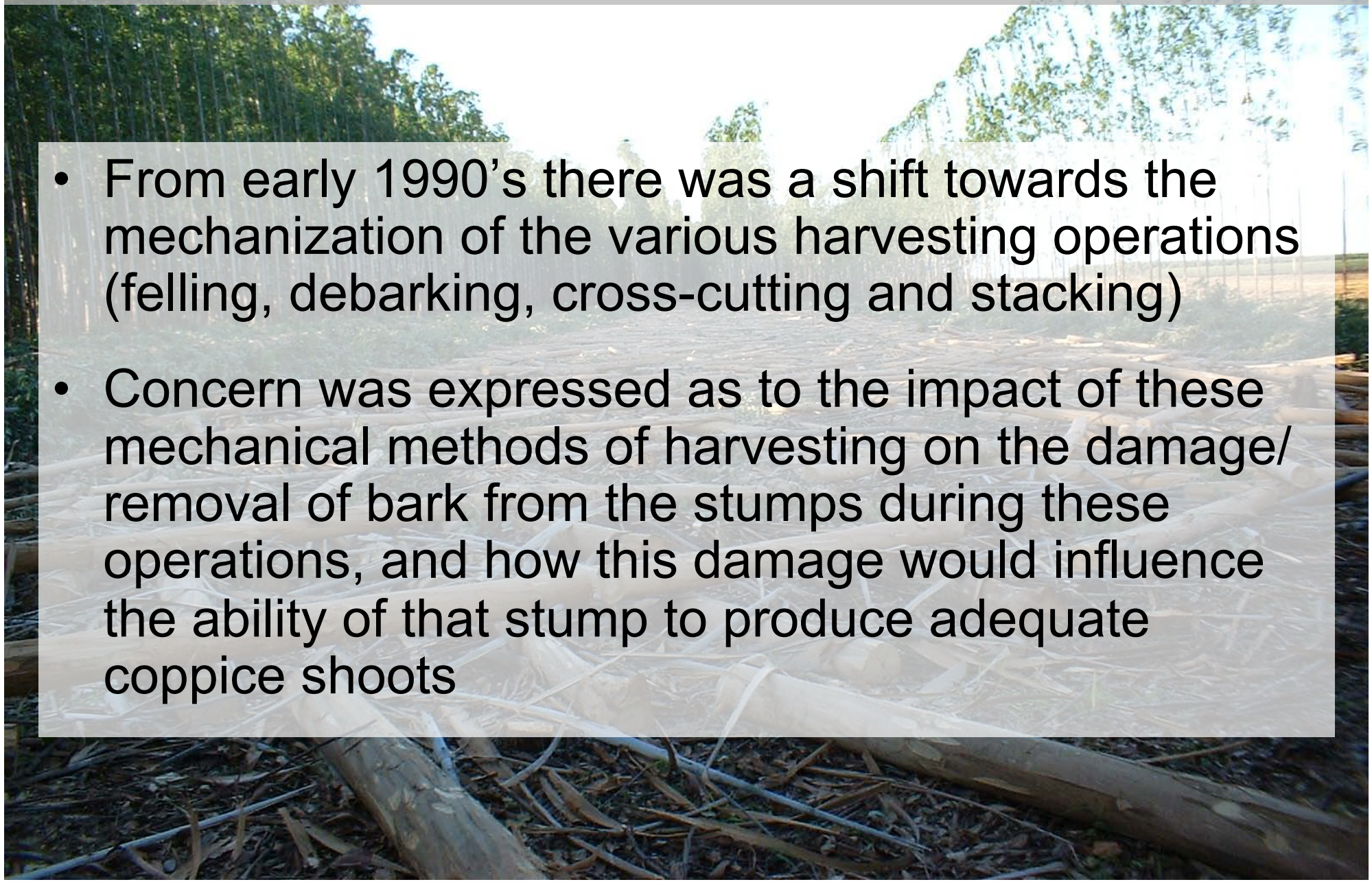
Background



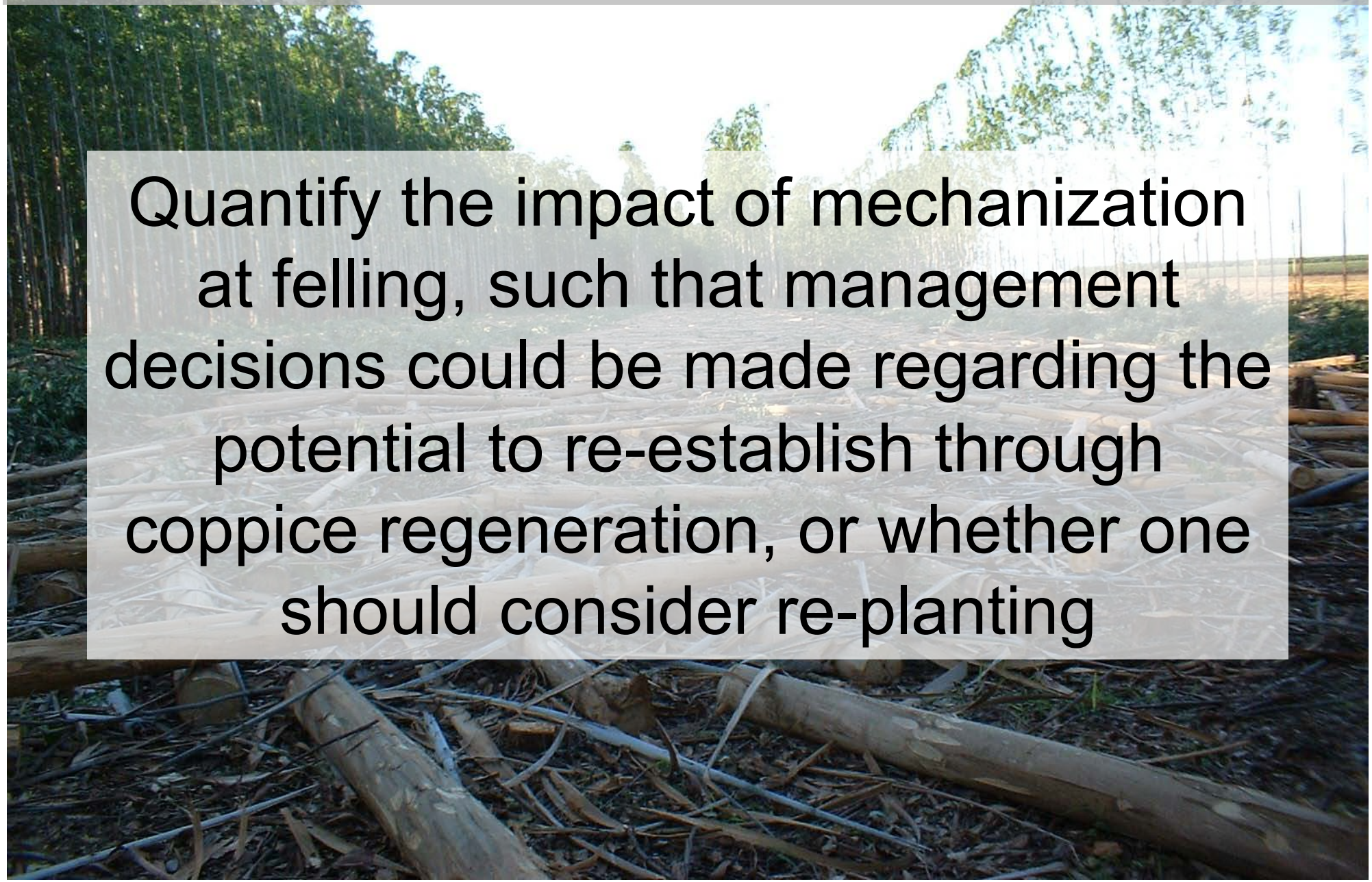
- Traditionally, manual methods were used to fell, de-bark, cross-cut and stack the timber.
- The only mechanical operation in these stands would be the extraction of the timber from the site where the access of these vehicles was limited to specific extraction routes
- Damage to bark on stumps was generally limited to extraction routes

Shift towards mechanization



- From early 1990's there was a shift towards the mechanization of the various harvesting operations (felling, debarking, cross-cutting and stacking)
- Concern was expressed as to the impact of these mechanical methods of harvesting on the damage/ removal of bark from the stumps during these operations, and how this damage would influence the ability of that stump to produce adequate coppice shoots

Requested to:



Quantify the impact of mechanization at felling, such that management decisions could be made regarding the potential to re-establish through coppice regeneration, or whether one should consider re-planting

Trial design

- Area of trial = 6 ha
- 4 treatments replicated 4 times and arranged in a RCBD
  - treatments reflected the then current practices
  - ranged from manual → semi-mechanised → mechanised
  - felling swathes from road to road to approximated commercial operations
  - there were three sub-plots of 60 trees per whole plot
- 2 880 stumps measured, with 27 assessments made per stump

Manual felling

Bell 3W

Manual cross-cutting

Man_Mech_3W

Manual stacking

Bell 3W + Bell tractor & trailer

Manual felling

Bell 3W

Manual cross-cutting

Man_Mech_Flexi

Manual stacking

Flexiloader + Bell tractor & trailer

Mech

Felled, debarked cross-cut and "stacked" with Waratah head on Hitachi excavator

Extracted with flexiloader + Bell forwarder (T17)

Measurement plot: Location of stumps relative to extraction route

- Stumps on extraction route
- Stumps adjacent to extraction route
- Two stumps lines away from extraction route

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2nd row	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	x	x	x	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**
1st row	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**
Extraction	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**	**x**
1st row	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
2nd row	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

Description of trial site

- **Site:**
  - Trust Plantation, Sappi Central area
- **Soils:**
  - deep yellow Fernwood
  - low clay and OC contents
- **Mat and Map**
  - 21.8 ^{0}C
  - 1033 mm
- **Previous site history**
  - indigenous grassland (palmveld)
  - many rotation of *E. grandis*
  - planted in 1992 with GU A380
    - one of the first commercial plantings with this clone

Sequence of events

- Standing crop felled between the 13th September – 18th October 2002
- Slash removed from stumps
- Reduction operations
  - 1st reduction to 2 stems stump^{-1} at 5 months
  - 2nd reduction to final stocking at 15.5 months
- Coppice stand felled 10th October 2010
  - 8 yrs

Coppice reduced in a stepwise process

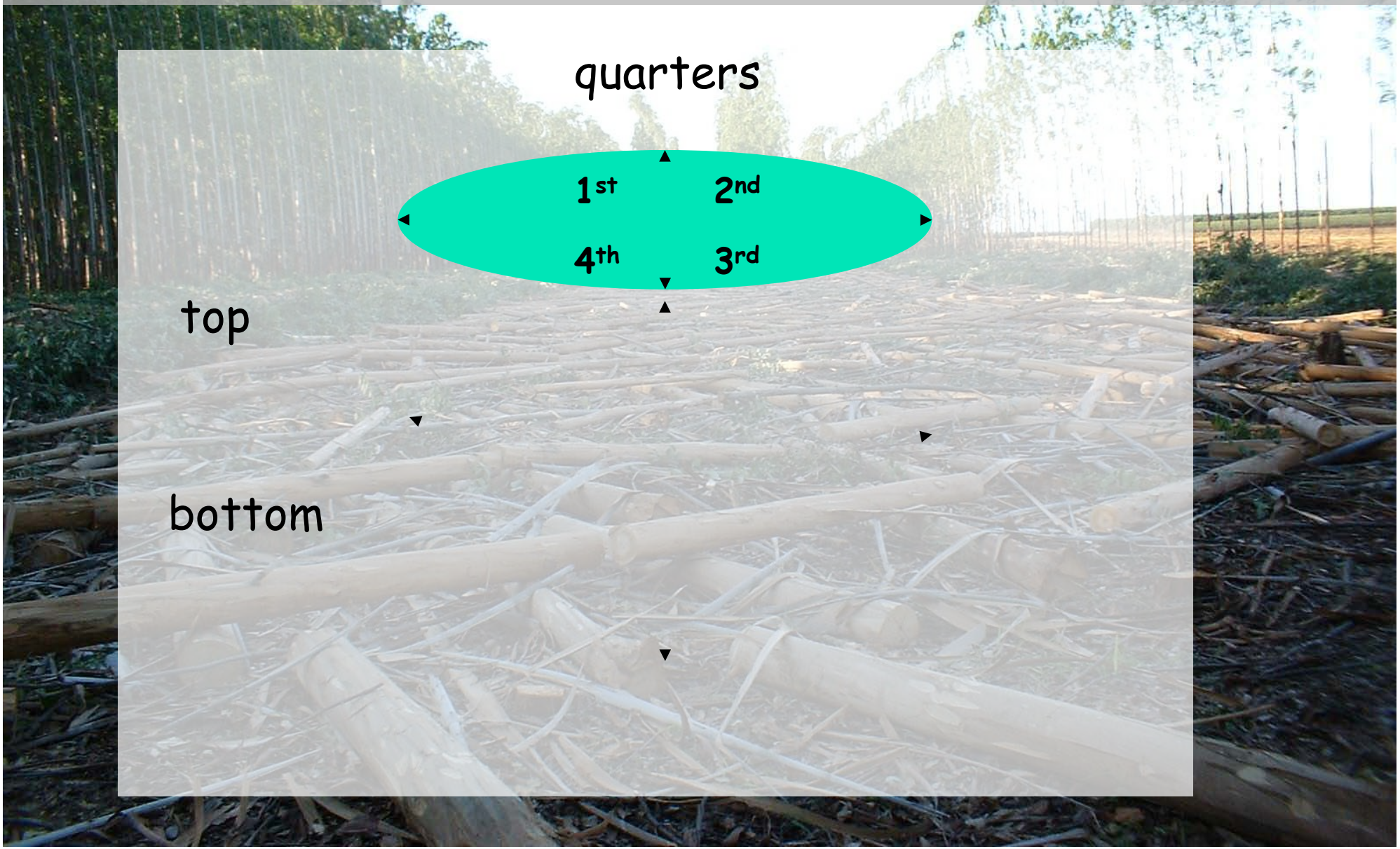
i) 1st reduction to 2 stems per stump at 3-4 m in height

ii) 2nd reduction to original stocking at 7-8 m in height

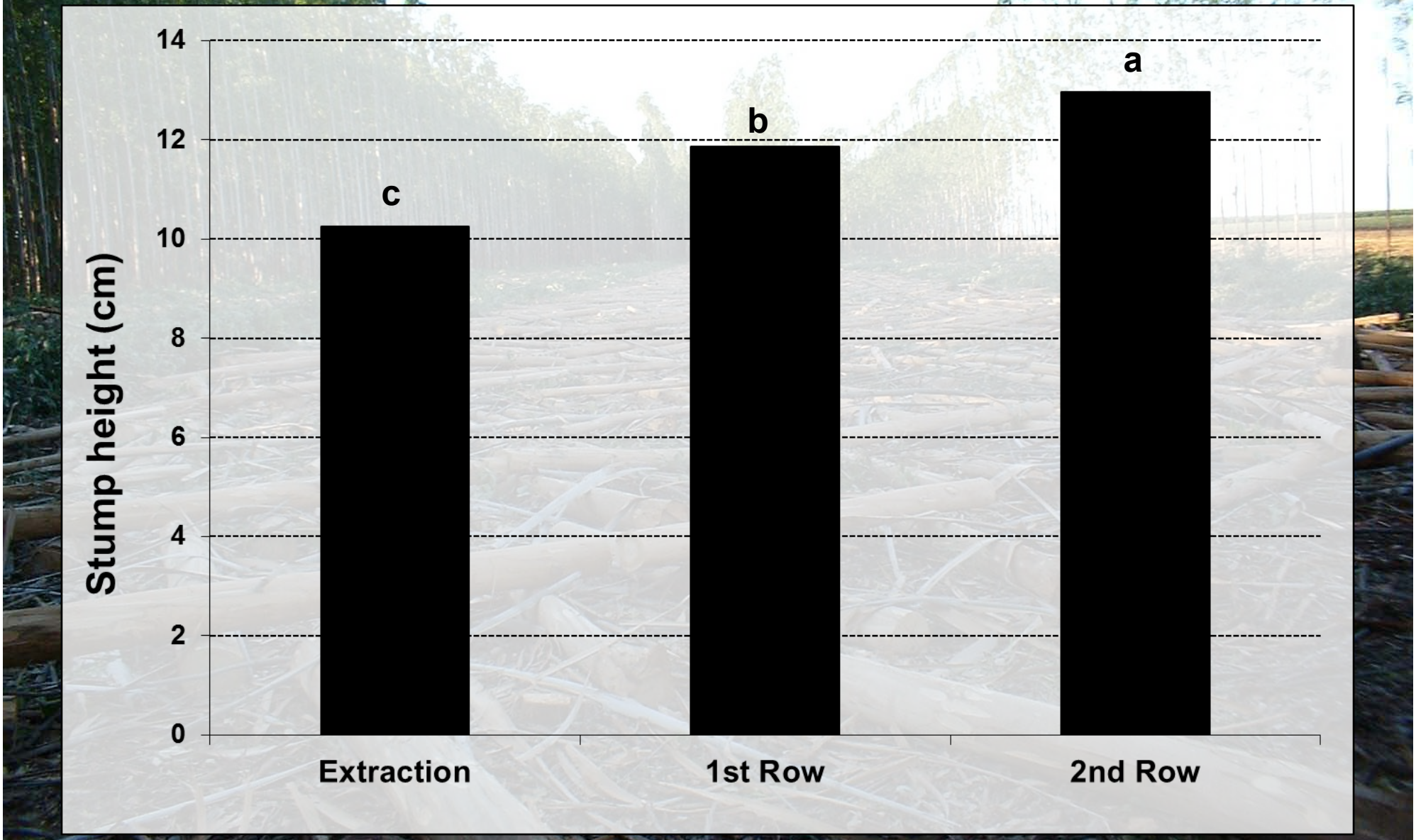
Measurements

- Stump measurements
  - Diameter, height and volume
  - Presence or absence of stumps for determination of stocking
- Damage to bark on stumps
  - graded from 0-2 (0 = no damage; 2 = severe)
- Type of visible damage to stumps
  - Tyres; Tear out; Stumps ground; Damage during felling; Damage during debarking etc…
- Presence or absence of coppice
- Dbh, Ht, BA, Vol and number of stems before and after reduction operations

Partitioning of stump into 4 quarters at 2 levels, each of which was assessed for damage to bark and presence of coppice

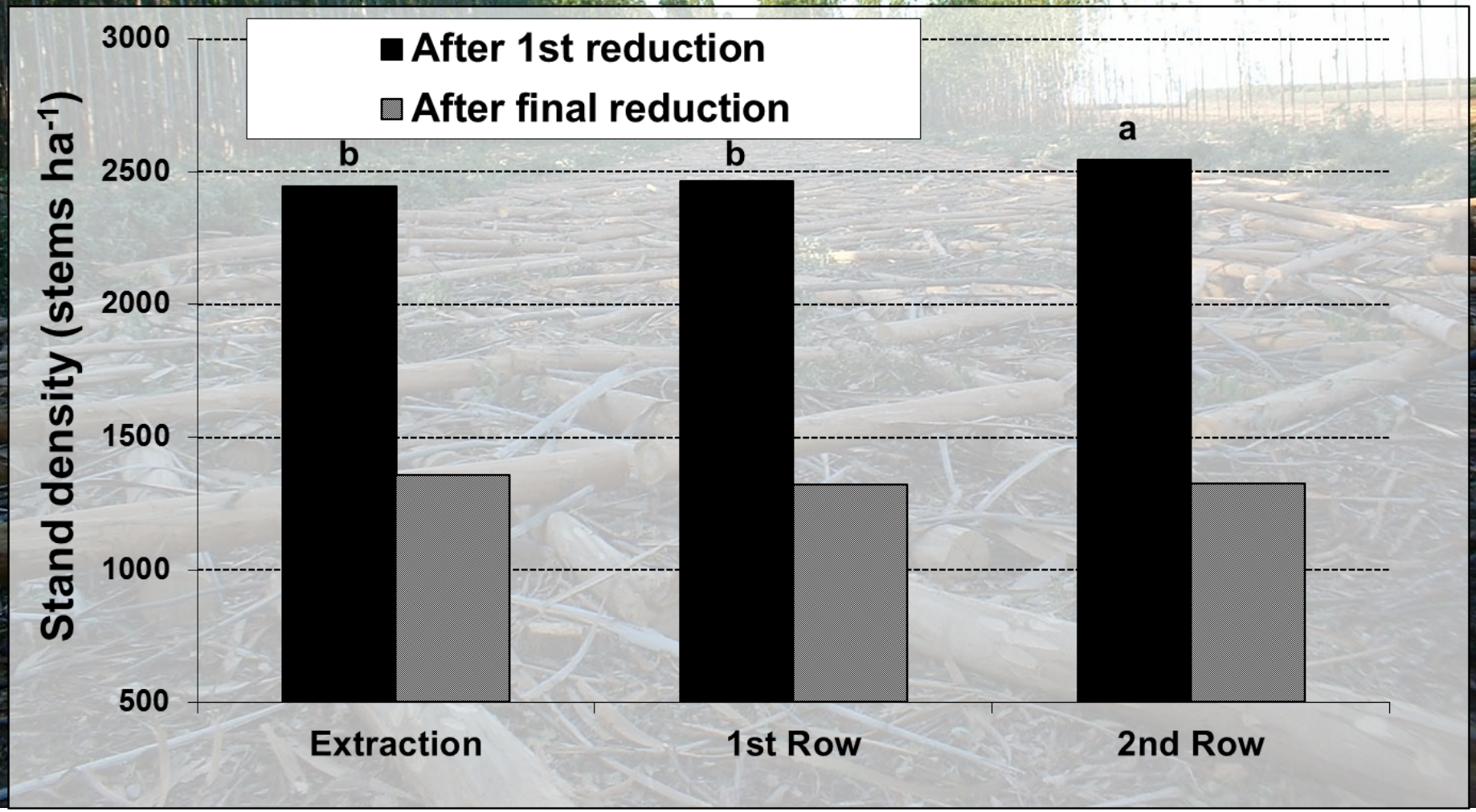


Influence of distance from extraction route on stump height

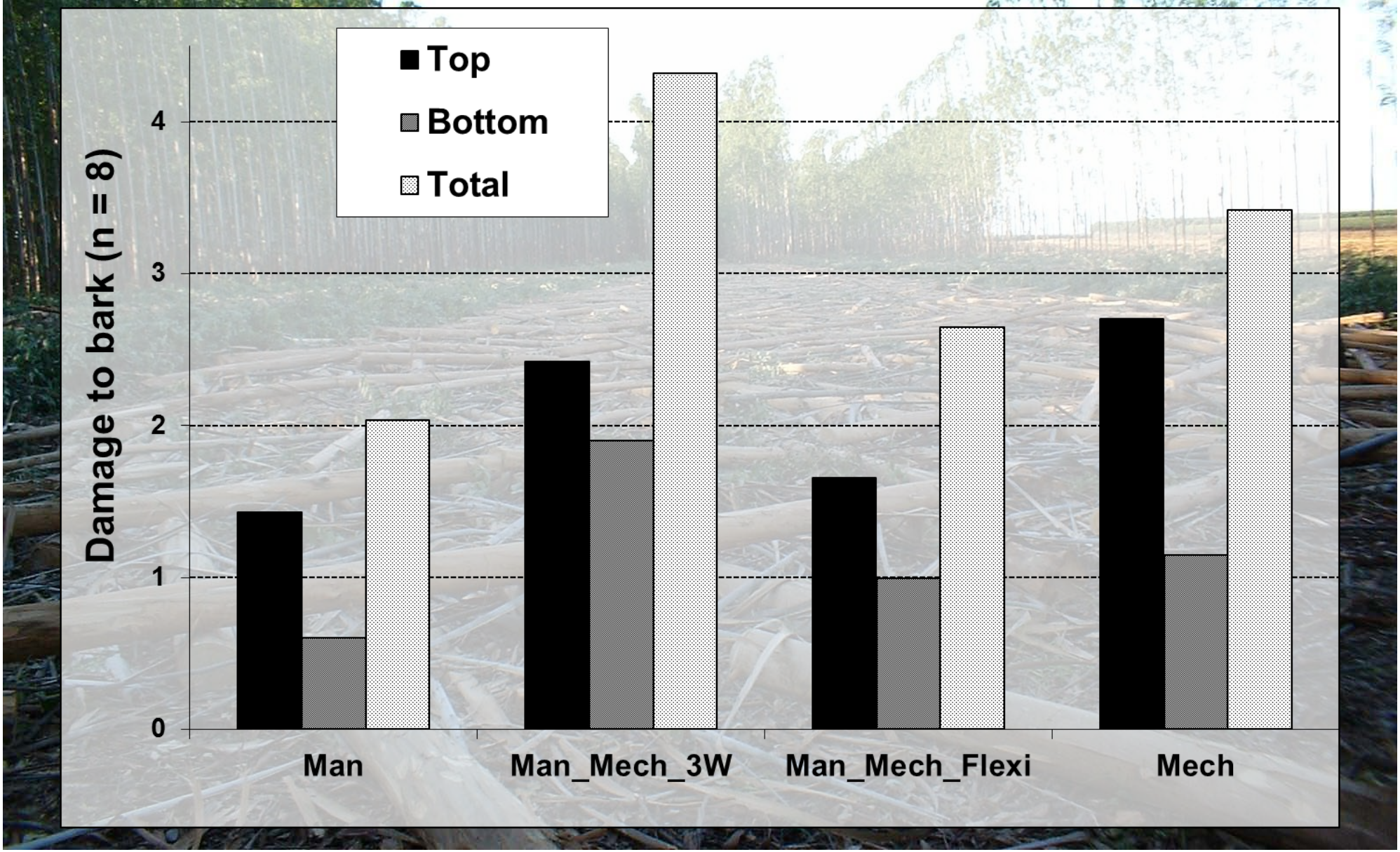


Stump and stem survival for different harvesting treatments

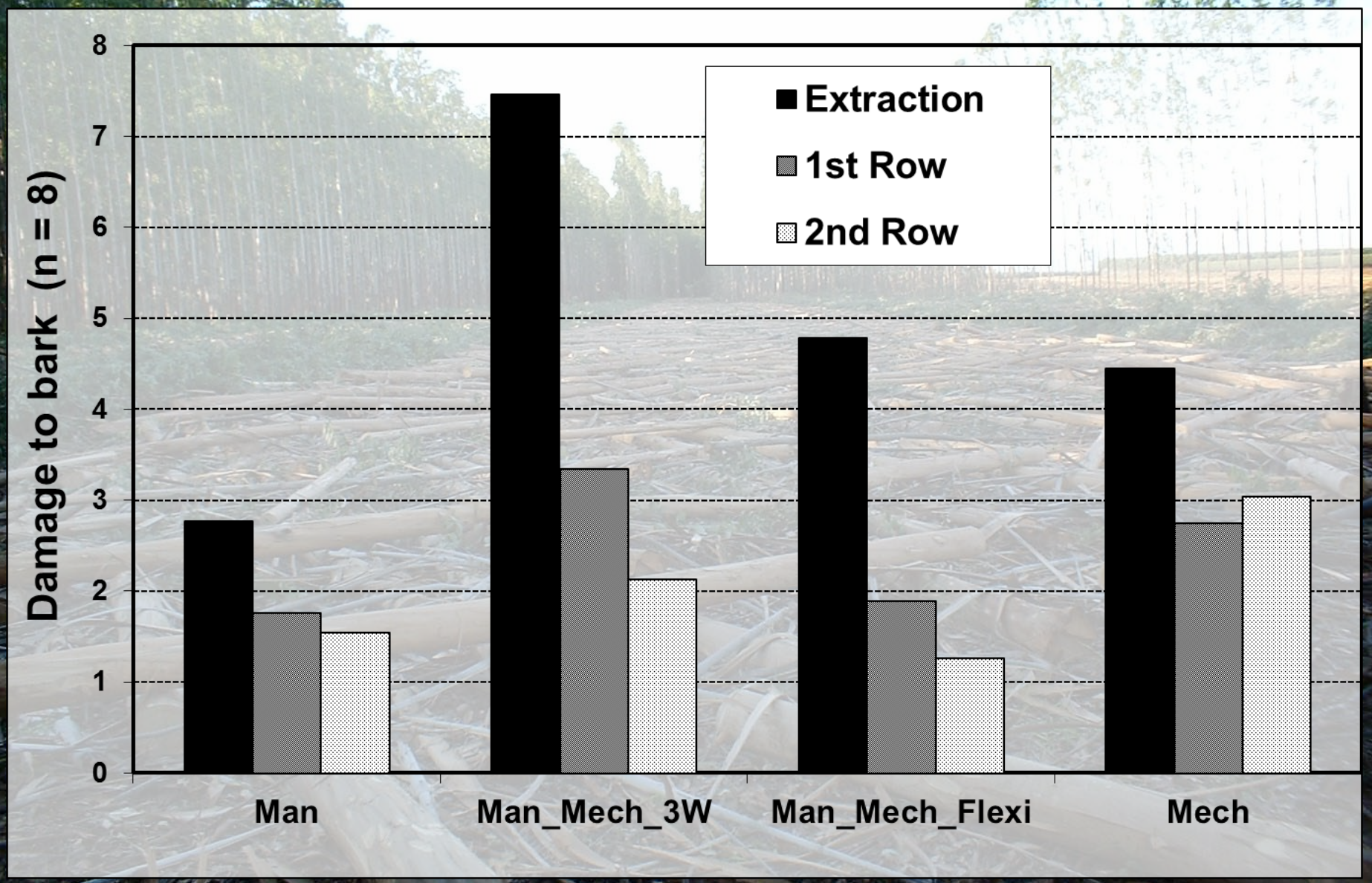
- Original stocking of planted trees (1R) = 1 333 stems ha^{-1}
- Stumps ha^{-1} when felled (1R) = 1 223 or 9.1 % mortality
- Stumps ha^{-1} after felling (2R) = 1 197 or 2.1 % mortality
- Stems ha^{-1} after final reduction (2R) = 1 308 or 98 % of original stocking



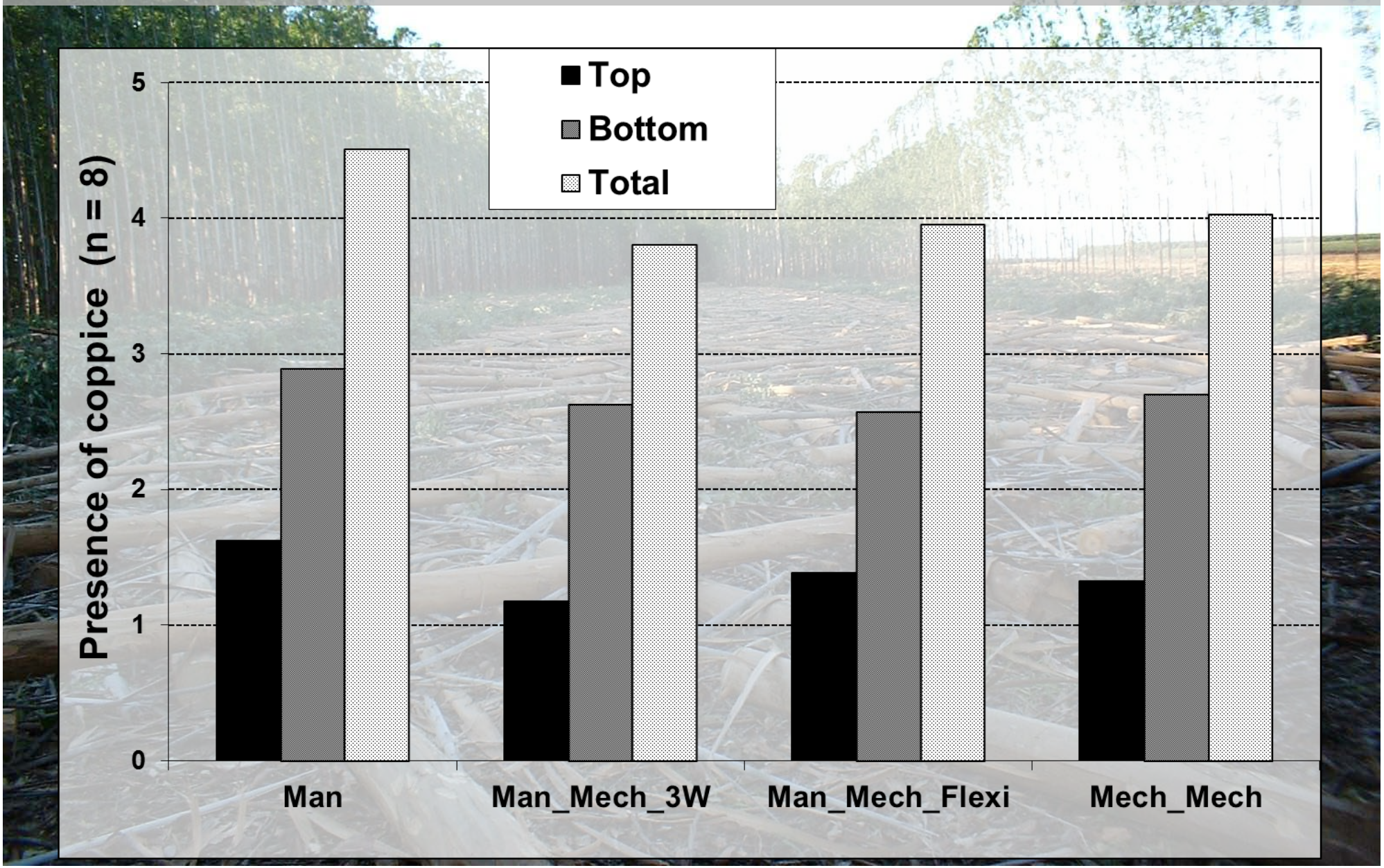
Stump quarters with evidence of bark damage relative to position on stump



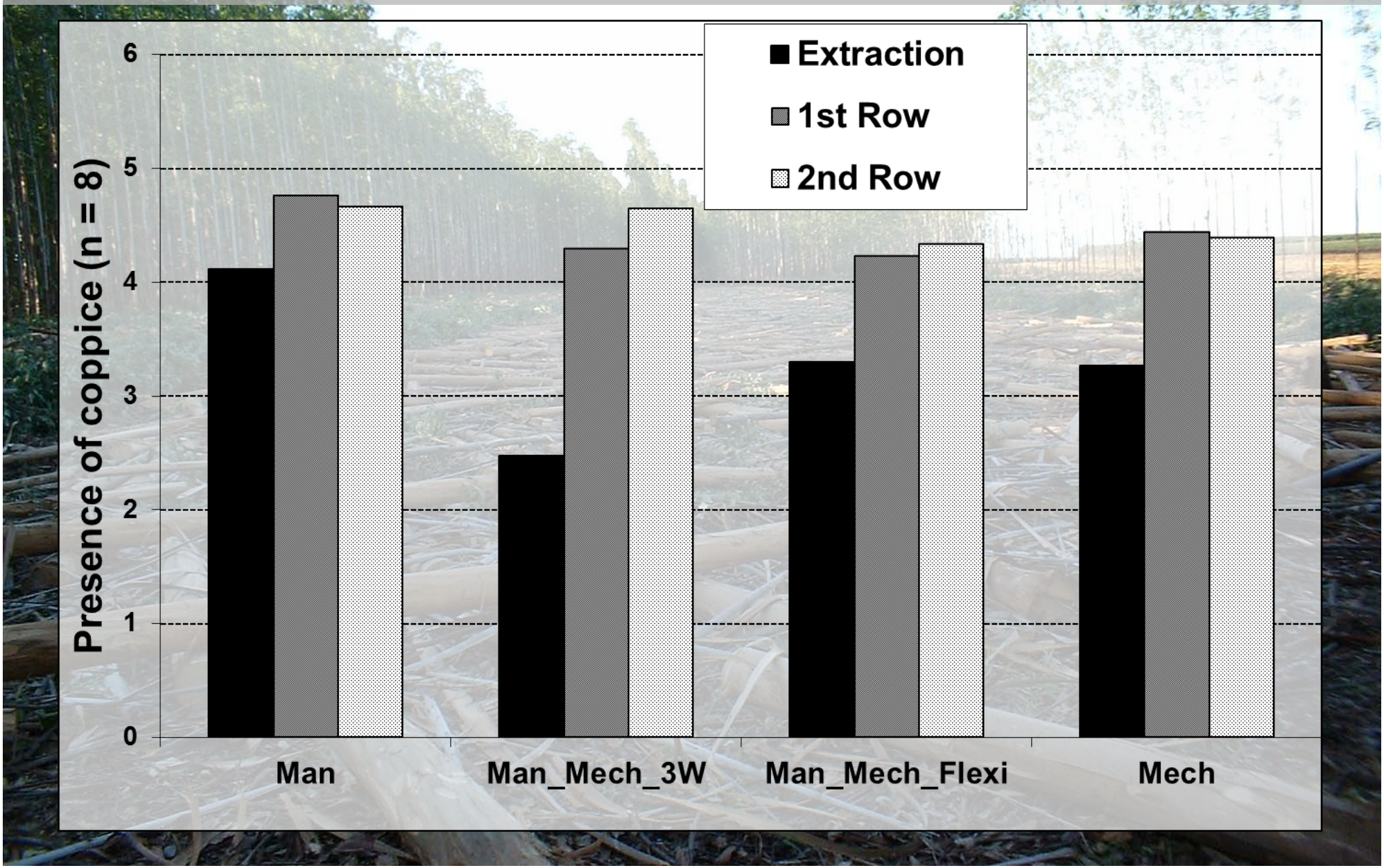
Total number of stump quarters with evidence of bark damage (maximum score of 8)



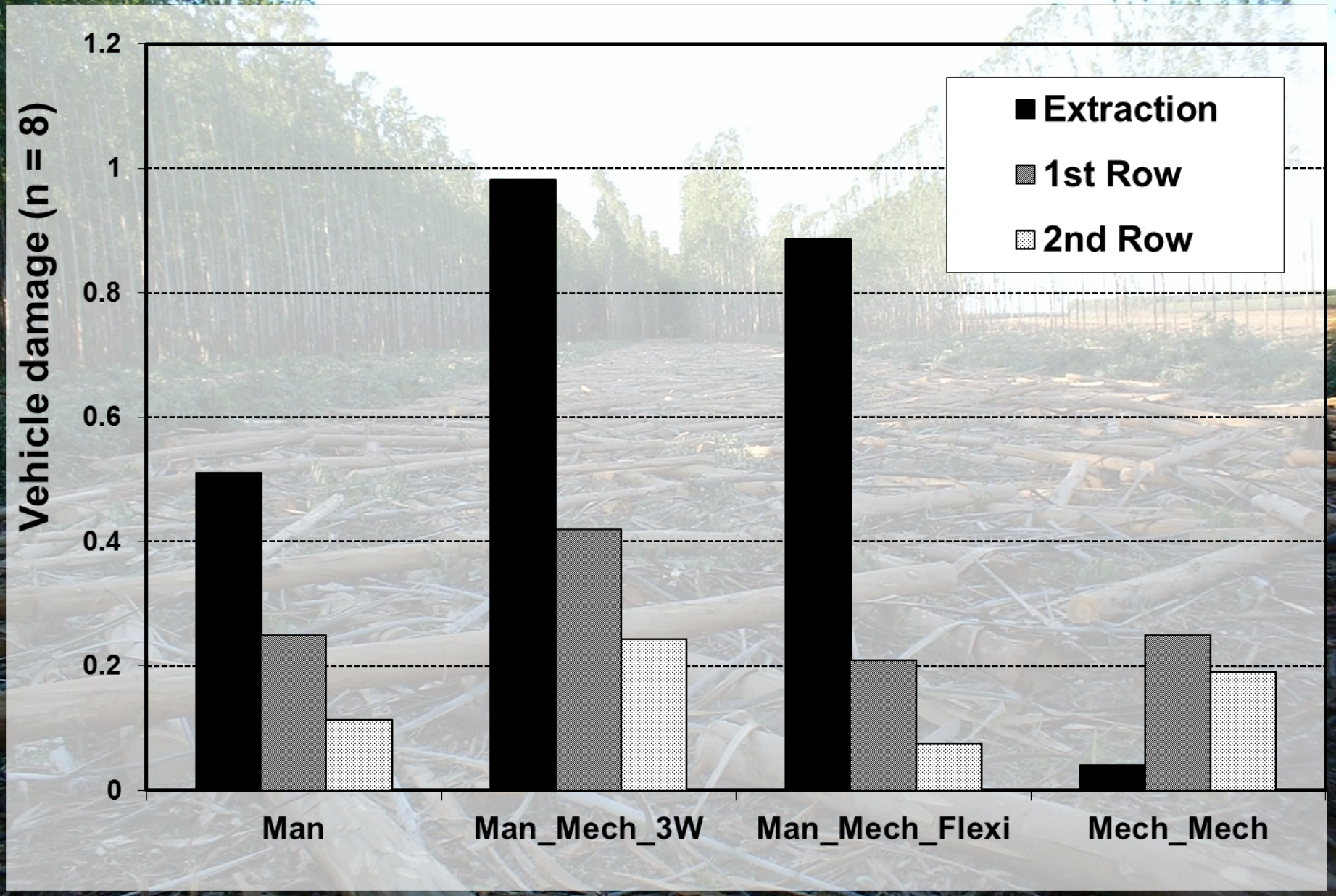
Stump quarters with presence of coppice relative to position on stump



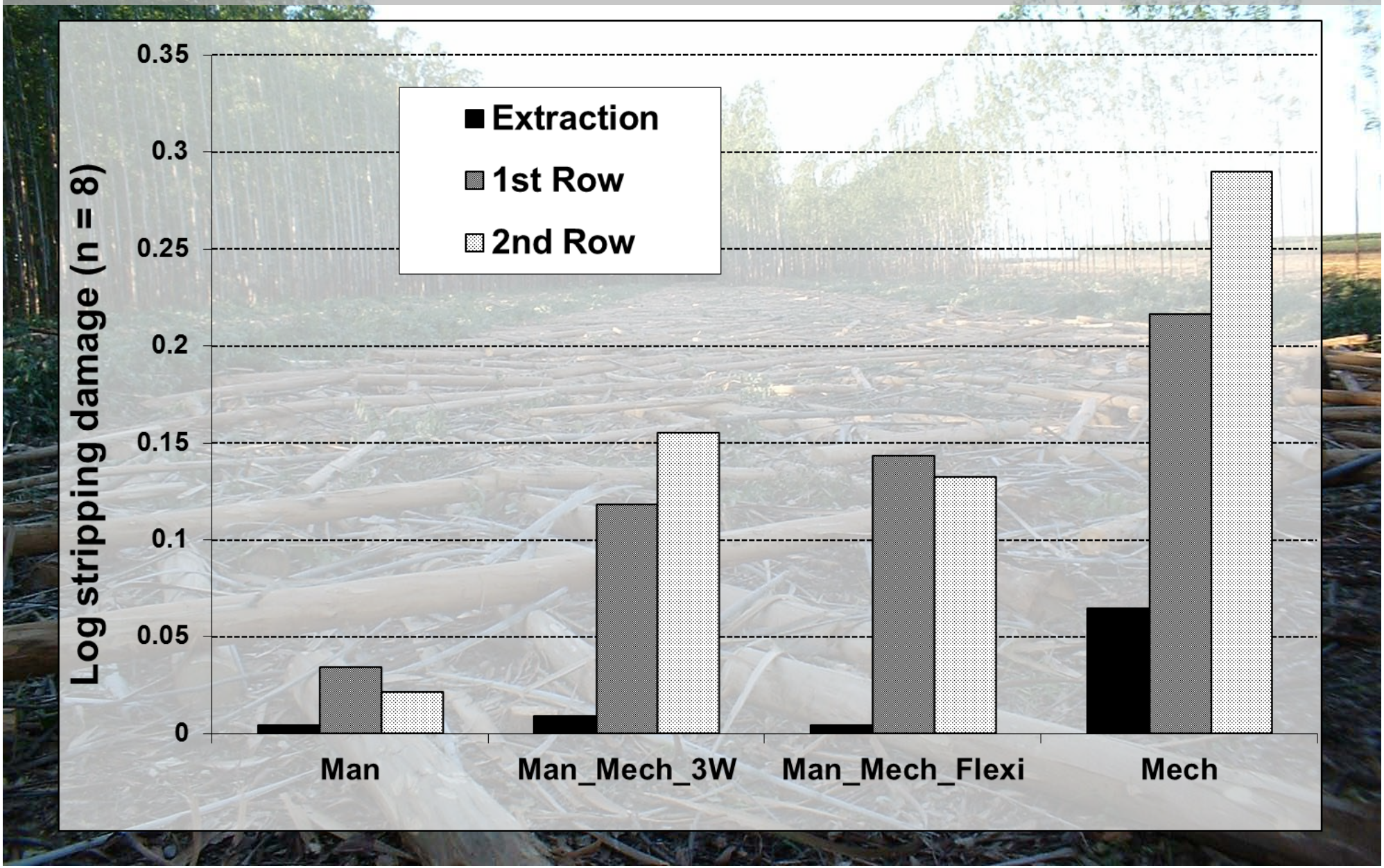
Total number of stump quarters with presence of coppice (maximum score of 8)



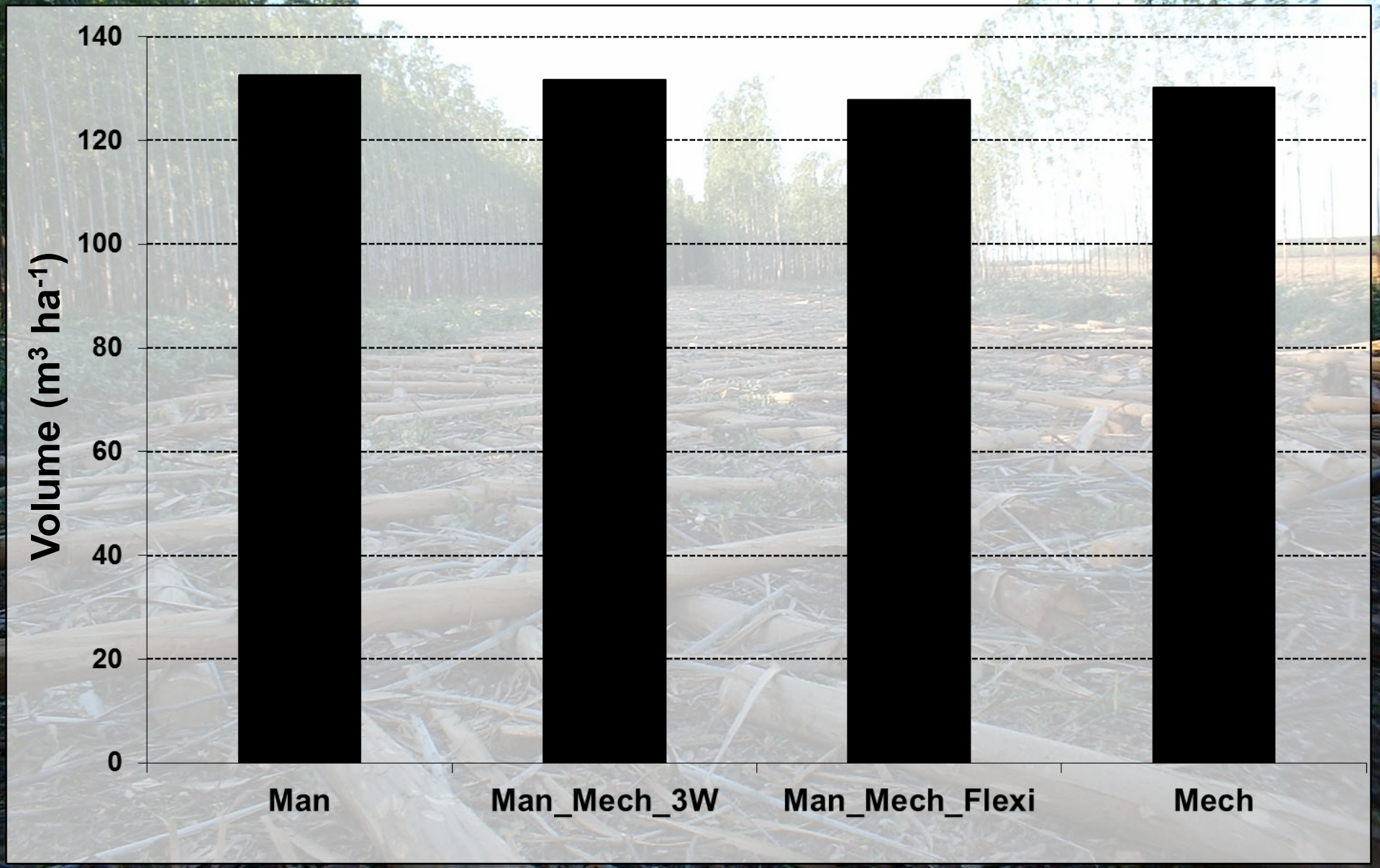
Evidence of vehicle damage to bark on stumps



Evidence of damage to bark on stumps during the felling of trees and by log stripping

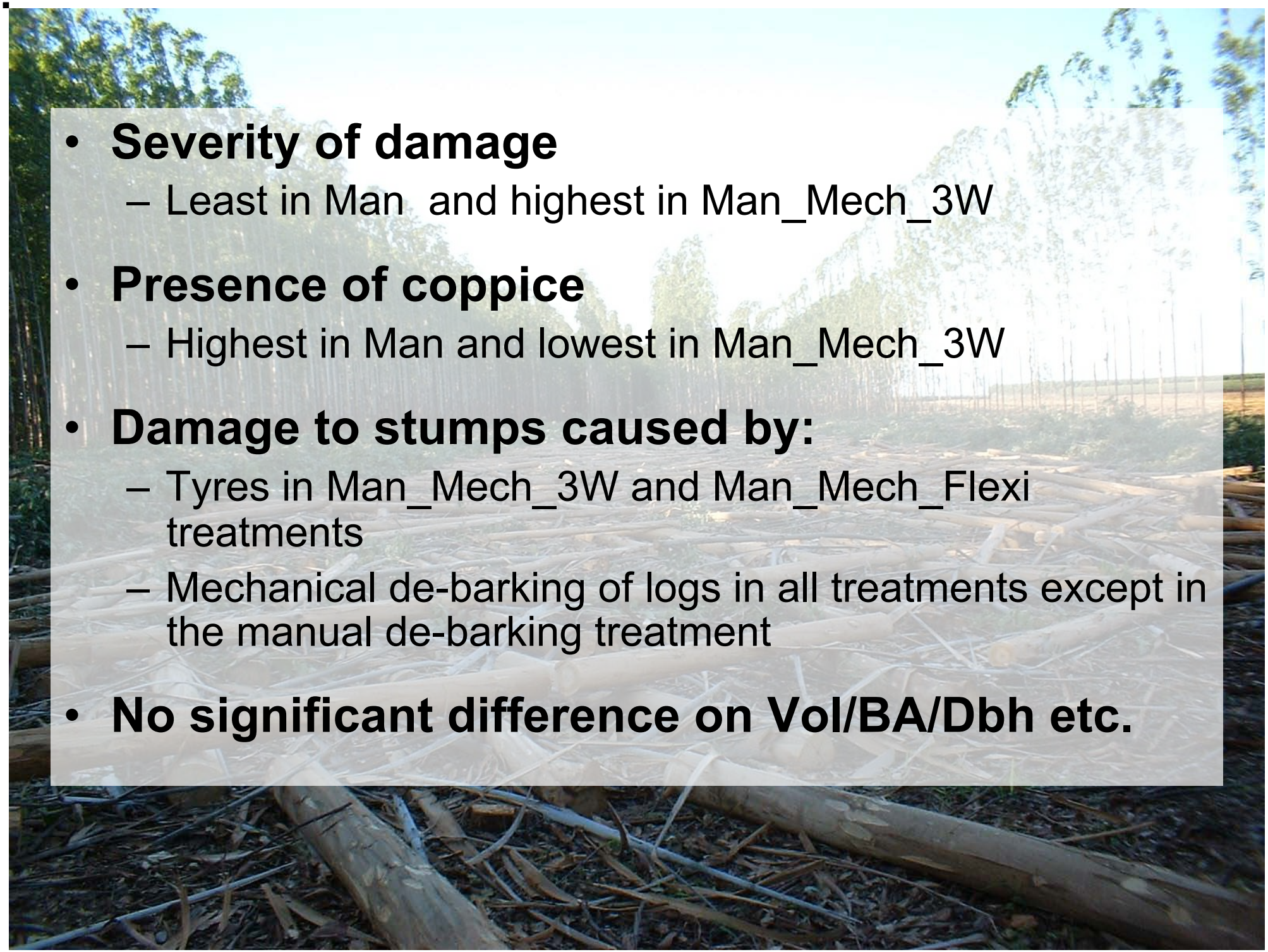


Coppice performance as affected by different felling operations



Conclusions

- Stump height is influenced by distance from extraction route
  - higher stumps further away
- Methods of harvesting and extraction had no impact on stump survival, or the number of stems after the final reduction operation
- Irrespective of the method of harvesting or extraction, there was more damage and less coppice on:
  - the upper half of the stump than the lower half
  - the stumps in the extraction route or immediately adjacent



- **Severity of damage**
  - Least in Man and highest in Man_Mech_3W
- **Presence of coppice**
  - Highest in Man and lowest in Man_Mech_3W
- **Damage to stumps caused by:**
  - Tyres in Man_Mech_3W and Man_Mech_Flexi treatments
  - Mechanical de-barking of logs in all treatments except in the manual de-barking treatment
- **No significant difference on Vol/BA/Dbh etc.**

So what?

- GU A380 coppice's exceptionally well
- What about other species?
  - May be a problem where stocking of stand to be coppiced is low, or in weakly coppicing species
- After felling, 20 species in two site-species were assessed for their ability to coppice. *E. benthamii, E. smithii, E. macarthurii* and *E, quadrangulata* = +90 % stumps coppiced.
- Species such as *E. dunni, E. saligna, E. elata, E. badjensis, E deanei* and *E. andrewsii* = 80 % stumps coppiced, or only coppiced well on one site, may be affected by damage to stumps

Thanks !!!!

Team effort between Industry, Contractors and ICFR

With special thanks to:

- Sappi Forests and in particular Andrew King and Mark Hitchings
- Piet Rheeder of Melann Forestry
- Denis Oscroft, Gert van den Berg, Paul Viero, Greg Fuller, Carol Rolando, Musa Mkwanazi + Victor from the ICFR

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