ENHANCED SUSTAINABLE FOREST MANAGEMENT OF THE BRAZILIAN SECONDARY ATLANTIC FOREST BY INNOVATIVE AND ADAPTED TECHNOLOGIES

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INTRODUCTION & RELEVANCE OF THE RESEARCH

Original forest cover

Current forest cover

Forest Area
Amazon Forest = 5.5 Mi Km²
Atlantic Forest = 1.5 Mi Km²

Remnant Forest Area
Amazon Forest = 83 %
Atlantic Forest = 12 %

(Quote: Ricardo Zerrener/ www.g1.com.br)
INTRODUCTION & RELEVANCE OF THE RESEARCH

Is it possible to manage the Atlantic Forest in a sustainable way?
OBJECTIVES

Assessed and compared timber-harvesting impact of a conventional method (CM) with an alternative and improved method (AM).
METHODOLOGY

RESEARCH AREA

Santa Catarina state

Research area

Plot area

40 m

40 m

07.10.2019
FORMEC 2019
METHODOLOGY

RESEARCH AREA

Full pre-harvesting inventory
METHODOLOGY

Timber Harvesting

Conventional Method

Alternative Method

[Images of harvesting equipment and methods]
METHODOLOGY

Harvesting Assessment
# METHODOLOGY

Post-harvesting inventory

Damage assessment

## Classification criteria for harvesting damage to remnant trees

<table>
<thead>
<tr>
<th>Category of damage</th>
<th>Intensity of damage</th>
<th>Rating value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crown damage</td>
<td>Minor: X &lt;1/3 of crown</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Moderate: 1/3 &lt; X &lt; 2/3 of crown</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Severe: X &gt;2/3 of crown</td>
<td>3</td>
</tr>
<tr>
<td>Bole damage</td>
<td>Bark damage</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Superficial wood damage (cambial tissue)</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Deep wood damage (sub cambial tissue)</td>
<td>3</td>
</tr>
<tr>
<td>Tree leaning</td>
<td>Slight leaning</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Partially uprooted</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Fully uprooted</td>
<td>3</td>
</tr>
<tr>
<td>Dead Trees</td>
<td></td>
<td>9</td>
</tr>
</tbody>
</table>
METHODOLOGY

Cartesian coordinates (X, Y) into UTM coordinates (WGS 1984, Zone 22 South)

“Triangulated irregular network” (TIN) - Damage Maps

Highly damaged trees

No damaged trees
RESULTS

Main stand characteristics among plots

<table>
<thead>
<tr>
<th></th>
<th>Stand A</th>
<th>Stand B</th>
<th>Stand C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CM</td>
<td>AM</td>
<td>CM</td>
</tr>
<tr>
<td>Tree density (N ha⁻¹)</td>
<td>1600.0 aA</td>
<td>1331.3 aA</td>
<td>1456.3 aA</td>
</tr>
<tr>
<td>Mean DBH (cm)</td>
<td>14.8 aA</td>
<td>15.1 aA</td>
<td>12.7 aB</td>
</tr>
<tr>
<td>Mean tree height (m)</td>
<td>9.7 aA</td>
<td>9.6 aA</td>
<td>10.0 aA</td>
</tr>
<tr>
<td>Basal area (m² ha⁻¹)</td>
<td>39.5 aA</td>
<td>37.6 aA</td>
<td>24.7 aB</td>
</tr>
<tr>
<td>Volume (m³ ha⁻¹)</td>
<td>313.0 aA</td>
<td>259.3 aA</td>
<td>187.0 aB</td>
</tr>
</tbody>
</table>

Terrain slope (%)      ≈ 40-50          ≈10-25          ≈ 5-10

High tree density and heterogeneity
RESULTS

The majority of damaged or dead trees (65%) were small dimensional trees.
RESULTS

Damage were not well distributed along the plot area

Most of the damage were caused by felling

<table>
<thead>
<tr>
<th></th>
<th>CM method</th>
<th>AM method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stand A</td>
<td>350 (a)</td>
<td>363 (a)</td>
</tr>
<tr>
<td>Stand B</td>
<td>394 (a)</td>
<td>475 (a)</td>
</tr>
<tr>
<td>Stand C</td>
<td>394 (a)</td>
<td>475 (a)</td>
</tr>
<tr>
<td>Number of damaged trees (N ha⁻¹)</td>
<td>56 (b)</td>
<td>88 (b)</td>
</tr>
</tbody>
</table>

Trees damaged by felling
Trees damaged by winching

07.10.2019 FORMEC 2019
RESULTS

AM showed a lower high damaged plot area

<table>
<thead>
<tr>
<th>Stand A</th>
<th>CM method</th>
<th>AM method</th>
</tr>
</thead>
<tbody>
<tr>
<td>234.3 m²</td>
<td>206.0 m²</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stand B</th>
<th>CM method</th>
<th>AM method</th>
</tr>
</thead>
<tbody>
<tr>
<td>194.5 m²</td>
<td>160.0 m²</td>
<td></td>
</tr>
</tbody>
</table>

* Plot area = 1600 m²
RESULTS

AM showed a lower disturbed winching area

<table>
<thead>
<tr>
<th></th>
<th>Stand A</th>
<th>Stand B</th>
</tr>
</thead>
<tbody>
<tr>
<td>CM</td>
<td>200.6</td>
<td>184.2</td>
</tr>
<tr>
<td>AM</td>
<td>140.5</td>
<td>113.4</td>
</tr>
</tbody>
</table>

Estimated winching disturbed ground plot area (m²)
The high stand density may limit the effectiveness of the efforts to reduce harvesting damage.

Most of the damaged trees were small dimensional trees.

Most of the damage were caused by felling.

Damaged areas were not well distributed along the plot area.

Small improvements can significantly reduce damage to residual trees.
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THANK YOU...