The Response of the Tree Layer to 60 years of Fire Manipulation: disentangling the effects of fire, elephants and CO₂

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BUSH ENCROACHMENT
CAUSES OF WOODY COVER CHANGE

• Multiple drivers
  • Fire
  • Herbivory
  • Rainfall
  • CO₂

• Challenge:
  • Distinguish effects of management actions (local) from climatic changes (global)
  • Long-term datasets highly valuable
EXPERIMENTAL BURN PLOTS - KRUGER NATIONAL PARK

- 1954-57 onwards
  - 14 fire treatments
  - 4 Sites (Landscapes)
    - 4 Blocks (Strings)
      - 1 replicate
Structure of the woody layer

BUI TENWERF et. al. (2011) Global Change Biology, 18, 675-684
EXPERIMENTAL BURN PLOTS

Structure of the woody layer

BUITENWERF et. al. (2011) *Global Change Biology*, 18, 675-684
EXPERIMENTAL BURN PLOTS

Structure of the woody layer

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## EXPERIMENTAL BURN PLOTS

<table>
<thead>
<tr>
<th>Survey</th>
<th>Method</th>
<th>Duration (years)</th>
<th>Area sampled (ha)</th>
<th>Heights</th>
<th>Stems diameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950s</td>
<td>Transects</td>
<td>3</td>
<td>0.09</td>
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<td>X</td>
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<td>1970s</td>
<td>Grid</td>
<td>8</td>
<td>0.5</td>
<td>√</td>
<td>√</td>
</tr>
<tr>
<td>1990s</td>
<td>Transects (wider)</td>
<td>3</td>
<td>0.12</td>
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<tr>
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<td>0.1 / 0.5</td>
<td>√</td>
<td>√</td>
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<tr>
<td>2010s</td>
<td>Circles</td>
<td>1</td>
<td>0.06 / 0.25 / 1</td>
<td>√</td>
<td>√</td>
</tr>
</tbody>
</table>
Woody plant density

450mm

Mopane

Satara

500mm

600mm

Skukuza

Pkop

750mm
Woody plant density

- **Mopane**
  - 450mm
  - 600mm

- **Satara**
  - 500mm

- **Skukuza**
  - 600mm

- **Pkop**
  - 750mm
Elephant damage

Proportion damaged

Mopane  Satara  Skukuza  Pkop

a  a  b  c
Mopane

Plants per hectare

No fire | 3 Year Fire | Annual Fire


Graph showing the number of plants per hectare over time for different fire regimes (No fire, 3 Year Fire, Annual Fire).
Mopane – elephant damage

Proportion damaged

Annual Fire  3 Year Fire  No fire

a  a  b
Satara – grazing x fire interaction
Skukuza

![Graph showing plants per hectare under different fire regimes.](graph-image-url)
Pretoriuskop

No fire | 3 Year Fire | Annual Fire

Plants per hectare

15000
10000
5000
0

1950 1970 1990 2010

1950 1970 1990 2010

1950 1970 1990 2010
Pretoriuskop

The graph shows the number of plants per hectare over time for three different fire regimes: No fire, 3 Year Fire, and Annual Fire. The x-axis represents the years from 1950 to 2010, and the y-axis represents the number of plants per hectare from 0 to 15,000. Each fire regime has distinct patterns of plant growth, with no fire showing a higher initial growth rate compared to the fire regimes, which maintain a lower but consistent growth throughout the years.
Structure at Pretoriuskop

Proportion of all woody species

Height class (m)

Decade
- 2002/3
- 2016
Implications for Management

- Woody layer dynamics differ fundamentally across KNP
- **Semi-arid, on basalts**
  - Elephants the primary driver
  - Fire is a substitute
  - No evidence for CO\(_2\) effect
- **Semi-arid, on granites**
  - ?
- **Transitional, on granites**
  - Interactive effects of fire x grazers x elephant?
- **Mesic, on granites**
  - Fire important, but not only factor
  - CO\(_2\) : not important / saturated / superseded by elephant impacts?
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  – Scientific Services
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• SAEON staff