Chapter 4

Distribution and ecology of trees in east African drylands

Thomas A. Groen (Twente University)
Roeland Kindt (ICRAF)
Chapter 4

Set-up so far:

• What are the definitions of (to be defined in concordance with workshop attenders):
  – Aridity (Aridity indices, which one to use?)
  – Trees (structural, functional, ecological)
  – Tree lands/Shrublands (physiognomy...)

• What determines tree cover
  – Abiotic factors (rainfall, soil etc...)
  – Biotic factors (herbivory, fire)
  – Human interference with these factors

• Distinct vegetation types with trees in arid lands
  – Species composition of these types
  – Distribution in East Africa
  – Relative importance in the different countries
  – Usage by humans
Talking about tree cover

Next to tree cover:

• Total Biomass
• Tree Height
• Canopy density
• Number of trees
• Stem diameter
• Species type
What determines tree cover

• Abiotic factors
  – Rainfall +
  – Soil +/-
  – Temperature -
  – [CO2] C3 trees vs C4 Grasses +

• Biotic factors
  – Competition with grass -
  – Herbivory
    • Grazing +
    • Browsing -
      – Fire -

• Human interference
  – Harvesting -
    • Leaves
    • Fruits
    • Branches
    • Clear cut
  – Livestock raising +/-
  – Wildlife culling +/-
What determines tree cover

– Abiotic factors (rainfall, soil etc...)

Source: Sankaran et al. 2005

Source: Staver et al. 20
What determines tree cover

Source: Bertram and Dewar 2013
What determines tree cover

Africa

% tree cover

0 20 40 60 80

% sand

0 20 40 60 80 100

Source: Staver et al. 2012
What determines tree cover

- **Biotic factors (herbivory, fire)**

  A) Grazing
  - Increase in level of grazing
  - Increase in woody biomass
  - Decrease in grass biomass
  - Decrease in fire intensity

  B) Browsing
  - Increase in woody biomass
  - Decrease in grass biomass
  - Decrease in fire intensity
  - Increase in level of browsing

Source: Van Langevelde et al. 2003


Source: [http://www.fire.uni-freiburg.de/photos/za/za.htm](http://www.fire.uni-freiburg.de/photos/za/za.htm)
What determines tree cover

http://www.adventurecamps.tz.com/PHOTOGALLERIES/Ruaha/Ruaha%20Other%20Animals/pages/24%20Kudu%20horns,%20Ruaha_jpg.htm

What determines tree cover

High

Tree Cover

Low

Wetness (reversed)

Wet

Dry

Small shift in wetness

Perturbation

T2

Shift needed to restore cover

T1

Large shift in cover
What determines tree cover

Source: Staver et al. 2012
<table>
<thead>
<tr>
<th></th>
<th>PC1</th>
<th>PC2</th>
<th>PC3</th>
<th>PC4</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eigenvalues</td>
<td>$3.6 \times 10^8$</td>
<td>$8.7 \times 10^7$</td>
<td>$2.6 \times 10^7$</td>
<td>$4.8 \times 10^6$</td>
</tr>
<tr>
<td>% explained</td>
<td>80.1%</td>
<td>19.2%</td>
<td>0.6%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Cumulative</td>
<td>80.1%</td>
<td>99.3%</td>
<td>99.9%</td>
<td>100.0%</td>
</tr>
<tr>
<td>(b)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Variable</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>var_4</td>
<td>Temp, seasonality</td>
<td>-0.11</td>
<td>-0.09</td>
<td>0.95</td>
</tr>
<tr>
<td>var_12</td>
<td>Growing degree-days on 0 °C base</td>
<td>0.98</td>
<td>0.18</td>
<td>0.13</td>
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<tr>
<td>var_36</td>
<td>Aridity index</td>
<td>-0.19</td>
<td>0.98</td>
<td>0.07</td>
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<tr>
<td>var_37</td>
<td>PET seasonality</td>
<td>-0.01</td>
<td>-0.05</td>
<td>0.27</td>
</tr>
</tbody>
</table>

PET, potential evapotranspiration.

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**A high-resolution bioclimate map of the world: a unifying framework for global biodiversity research and monitoring**

Marc L. Metzger*, Robert G. H. Bunce², Rob H. G. Jongman³, Roger Sayre⁴, Antonio Trabucco⁵ and Robert Zomer⁶

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*Global Ecology and Biogeography (Global Ecol. Biogeogr.) (2013) 22, 630-638*
Impacts of climate change on the vegetation of Africa: an adaptive dynamic vegetation modelling approach

SIMON SCHEITER* and STEVEN L. HIGGINS†

*Lehrstuhl für Vegetationsökologie, Technische Universität München, 85350 Freising-Weihenstephan, Germany, †Institut für Physiogeographie, Johann Wolfgang Goethe-Universität Frankfurt am Main, 60438 Frankfurt am Main, Germany
Major natural vegetation types in the Horn of Africa
Somalia-Masai *Acacia-Commiphora* deciduous bushland and thicket
Somalia-Masai *Acacia-Commiphora* deciduous bushland and thicket
Somalia-Masai semi-desert grassland and shrubland
Somalia-Masai semi-desert grassland and shrubland
Somalia-Masai East African evergreen and semi-evergreen bushland and thicket / secondary (biotic) *Acacia* wooded grassland
Somalia-Masai East African evergreen and semi-evergreen bushland and thicket / secondary (biotic) *Acacia* wooded grassland
Drier Zambezian miombo woodland (yellowish)
Wetter Zambezian miombo woodland (greenish)
Drier Zambezian miombo woodland
Wetter Zambezian miombo woodland
Sudanian undifferentiated woodland
Sudanian woodland with abundant *Isoberlinia*
Sudanian undifferentiated woodland
Sudanian woodland with abundant *Isoberlinia*
ICRAF have a nifty new tool out called Useful Tree Species for Africa. I’ve been playing around with it and I have to say it’s impressive.”

Luigi Guarino
http://agro.biodiver.se/
VECEA: A higher resolution map for 7 countries in eastern Africa (Ethiopia, Kenya, Malawi, Rwanda, Uganda, Tanzania and Zambia)

http://www.vegetationmap4africa.org

A map of the potential natural vegetation of eastern Africa

The map gives the distribution of potential natural vegetation in Ethiopia, Kenya, Tanzania, Uganda, Rwanda, Malawi and Zambia. The map distinguishes 47 vegetation types, divided in four main vegetation groups: 15 forest types, 15 woodland and wooded grassland types, 5 bushland and thicket types and 12 other types. Furthermore, a number of compound vegetation types are mapped, which include vegetation mosaics, catenals and transitional zones.

The potential vegetation map of east Africa is available as a Google Earth layer. You can open the layer by clicking the image below. The floristic, physiognomic and other characteristics of the different PNVs are documented in a series of reports which you can find on the documentation page. The map is furthermore linked to the species selection tool, which provides information about the suitability of woody species within the different vegetation types.

Please note, if you utilize or want to refer to the vegetation map, we ask that you cite it as follows:
VECEA: A higher resolution map for 7 countries in eastern Africa (Ethiopia, Kenya, Malawi, Rwanda, Uganda, Tanzania, and Zambia)

http://www.vegetationmap4africa.org
VECEA: A higher resolution map for 7 countries in eastern Africa
(Ethiopia, Kenya, Malawi, Rwanda, Uganda, Tanzania and Zambia)

http://www.vegetationmap4africa.org
### Agroforestry Species Switchboard 1.0


Your results for the search term: 'acacia senegal'  

<table>
<thead>
<tr>
<th>Names found</th>
<th>Current Name (Click to show database links)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acacia senegal</td>
<td>Acacia senegal</td>
</tr>
</tbody>
</table>

### ICRAF Databases

- Agroforestry Database: View
- Tree Seed Suppliers Directory: Not Listed
- The African Wood Density Database: Not Listed
- The Tree Functional Attributes and Ecological Database: Not Listed
- The Useful Tree Species for Africa: Listed
- The VECA interactive vegetation map: Listed

### Other Databases

- Árboles de Centroamérica project: Not Listed
- Eco-crop Database: View
- Plant Resources of South East Asia: Not Listed
- Plant Resources of Tropical Africa: View
- Tropical Forages: Not Listed
- TRY Database: Not Listed
- Global Wood Density Database: Not Listed
- The Plant List: Search
- Tropicos: Search
- Royal Botanic Gardens, KEW: Search

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*Note: The content displayed is a screenshot of the Agroforestry Species Switchboard interface.*
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