Ecological attributes determining tree species richness and basal area in the subtropical and tropical forests of Queensland, Australia

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Queensland Herbarium
Australia
Highest point 2379m
Lowest -29m
Land area 7,000,000 km²
Population 20 Million

China
Highest point 8752m
Lowest -152m
Land area 9,600,000 km²
Population 1.3 Billion
Figure 1. The ecoregions are categorized within 14 biomes and eight biogeographic realms to facilitate representation analyses.

Olson et. al 2001 Biosciences 51:933-38
Vegetation ranges from rainforest to arid ephemeral grasslands.

Rainfall ranges from >8000mm in Wet Tropics to <200mm in Simpson Desert in SW.
Rainforests in the northeast Wet Tropics
Tropical eucalypt woodlands in the north on Cape York Peninsula
Temperate eucalypt woodlands in the New England Tablelands
Hummock grasslands in arid southwest channel country
Regional Ecosystem Framework

RE 11.4.3 Brigalow-belah shrubby open forest

BIOREGION (11)  LAND ZONE (4)  VEGETATION COMMUNITY (3)
Landscapes within bioregions are classified into 12 land zones.

Land zones represent a significant difference in geology and associated landforms and soils.
Marine tidal clay plains

Coastal sand dunes and swales

Near-level alluvial plains with riverine patterns, wetlands and lakeside dunes

Gently undulating clay downs

Near-level uniform sand plains

Inland dunefields
Bajool 1:100,000
Pre-clearing
Regional Ecosystems

Remnant 2015
Regional Ecosystems
Broad Vegetation Groups

1:5M scale 16 BVGs
1:1M scale 98 BVGs

Vegetation communities combined on the basis of floristic, structural and landscape criteria.
Forests of Queensland

Australia's definition of forest specifies:
- a minimum existing or potential crown cover of 20% and,
- a minimum mature or potentially mature stand height of two metres

Pre-clearing area = 93.6 million hectares

Remnant 2015 = 62.7 million hectares

Of the 3420 recognised vegetation communities, 2325 meet the definition of forest
4797 CORVEG FOREST SITES

- Standard Methodology
- Floristic data
- Structural data
- Environmental data
Access to remote areas is mainly by 4WD, but also helicopter in savannas.
CORVEG sites 50 x 10 m$^2$

Eucalyptus chlorophylla woodland.
Lakefield National Park, 15° 22' S, 144° 26' E.
Multiple linear regression modelling

<table>
<thead>
<tr>
<th>Response variables</th>
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<tbody>
<tr>
<td>Tree basal area (m²/ha)</td>
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<tr>
<td>Tree species richness</td>
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</table>

<table>
<thead>
<tr>
<th>Soil variables</th>
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<tbody>
<tr>
<td>Soil organic carbon %</td>
</tr>
<tr>
<td>Soil total nitrogen %</td>
</tr>
<tr>
<td>Soil total phosphorus %</td>
</tr>
<tr>
<td>Soil clay content %</td>
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<tr>
<td>Soil available water mm³/mm³</td>
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</tbody>
</table>
### Annual Climatic variables (derived from 128 years)

- Mean annual rainfall
- Max annual rainfall
- Min annual rainfall
- Mean annual evaporation
- Max annual evaporation
- Min annual evaporation
- Mean annual moisture index
- Max annual moisture index
- Min annual moisture index
- Mean Foley Index
- Max Foley Index
- Min Foley Index
- Mean of annual mean Maximum temperature
- Max of annual mean Maximum temperature
- Min of annual mean Maximum temperature
- Mean of annual mean Minimum temperature
- Max of annual mean Minimum temperature
- Min of annual mean Minimum temperature

### Monthly Climate (1536 months)

- Max monthly rainfall
- Min monthly rainfall
- Max monthly evaporation
- Min monthly evaporation
- Max Foley Index (any month, any year)
- Min Foley Index (any month, any year)
- Max of monthly maximum temperature
- Min of monthly maximum temperature
- Max of monthly minimum temperature
- Min of monthly minimum temperature
Fire frequency – number of years in the past 23, where a fire has occurred in a pixel. Goodwin and Collett (2014). Derived from analysis of Landsat imagery archive.
### All Queensland forests basal area model

- 4779 sites
- 13 variables; $R^2$ 53.3%

<table>
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<tr>
<td>Fire frequency</td>
</tr>
<tr>
<td>Min annual mean max temperature</td>
</tr>
<tr>
<td>Min annual maximum rainfall</td>
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<tr>
<td>Max annual mean min temperature</td>
</tr>
<tr>
<td>Max annual evaporation</td>
</tr>
<tr>
<td>Max monthly minimum temperature</td>
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<td>BVG_1M</td>
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<td>LANDZONE</td>
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### Eucalypt forests basal area model

- 3542 sites
- 6 variables; $R^2$ 51.7%

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<td>Fire frequency</td>
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<td>Min annual rainfall</td>
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<td>BVG_1M</td>
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<td>LANDZONE</td>
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</tbody>
</table>
All Queensland forests species richness model

4779 sites
4 variables; $R^2$ 54.2%

Eucalypt forests species richness model

3542 sites
6 variables; $R^2$ 31.0%

Fire frequency
Mean annual rainfall
BVG_1M
LANDZONE

Soil organic carbon
Fire frequency
Min annual rainfall
Mean annual rainfall
Min annual moisture index
Min Foley index (monthly)
BVG_1M
LANDZONE
Conclusions

• Queensland’s forests covered 93.6 million hectares ha (54.1% of Qld) preclearing, and 67% was in remnant condition in 2015.

• Measures of extreme temperatures, rainfall and evaporation, together with soil fertility attributes, are important explanatory variables of tree basal area.

• Fire frequency, land zone and broad vegetation group are highly significant attributes for both tree basal area and tree species richness.
For Eucalypt:

- Linear equation: $y = 0.0546x + 4.196$
- $R^2 = 0.0163$

For Melaleuca:

- Linear equation: $y = 0.0046x + 5.3425$
- $R^2 = 0.0002$
Conclusions

• This study found no clear relationship between the tree species richness and basal area in Queensland forests.
Available resources

- Queensland Herbarium section of the Environment, Land and Water website

- Queensland’s Regional Ecosystems Database

- For Regional Ecosystem Technical descriptions visit

- Broad vegetation groups

- CORVEG data is available through AEKOS

- Mapping coverages and publications relating to regional ecosystems are available at
25a *Acacia harpophylla* (brigalow) open-forests to woodlands sometimes with *Casuarina cristata* (belah).

Defines the Brigalow Belt bioregion: 24% of bioregion, with 15% BVG 17a *Eucalyptus populnea* woodlands

Only 13% remnant vegetation

Open-forests in the east, ranging through to woodlands in the west.

*Acacia harpophylla* is dominant tree. *Casuarina cristata* is often co-dominant

Shrubs: *Eremophila mitchellii, Geijera parviflora, Alectryon oleifolius, Carissa ovata*

Grasses: *Aristida, Paspalidium, Sporobolus spp.*

Forbs: *Atriplex, Einadia, Sclerolaena, Sida spp., Trianthema triquetra*

EPBC listed EC for Brigalow Belt
25a  *Acacia harpophylla* (bragalow) open-forests to woodlands sometimes with *Casuarina cristata* (belah).