# Biogeographical Regions And Phytogeography Of The Eucalypts

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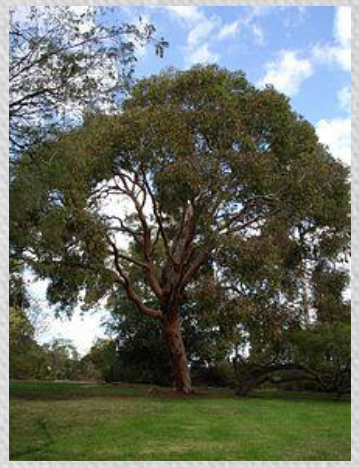
# The Eucalypts

- The most abundant group of canopy woody plants in the Australian continent
- Are comprised of three genera: *Angophora, Corymbia, and Eucalyptus*



- Consists of around 800 species
- High level of taxonomic and phylogenetic diversity

# Goals

- To generate a bioregionalization of the eucalypt phytogeographical regions in Australia and Malesia, and then assess the relationships of the phytogeographical regions to the environment
- Specifically
  - ① Map spatial patterns of species richness, species endemism and species turnover
    - Richness- number of different species represented
    - Endemism- species being unique to a defined geographical location
    - Turnover- change in species composition on islands resulting from some species becoming extinct and others immigrating in or replacing them
  - ② Propose a biogeographical regionalization of eucalypts based on species turnover
    - Biogeographical regions- geographical reference units for describing habitat types and species which live under similar conditions
  - ③ Assess the relationship of the phytogeographical regions to environment
    - Phytogeographical regions- a group of grid areas of similar floristic composition or a natural area with a characteristic flora

# Experiment Methods

- Analyzed 798 eucalypt species with distributions across Australia and Malesia using square cells with a resolution of 100 x 100 km
- Calculated species richness and endemism using software, and species turnover with beta dissimilarity metric
- Defined centers of species richness and endemism by selecting those grid cells with the highest 1% of scores
- Phytogeographical regions were identified using Simpson's beta dissimilarity values
  - Low value (low dissimilarity)- many taxa are shared between two grid cells

# Experiment Methods

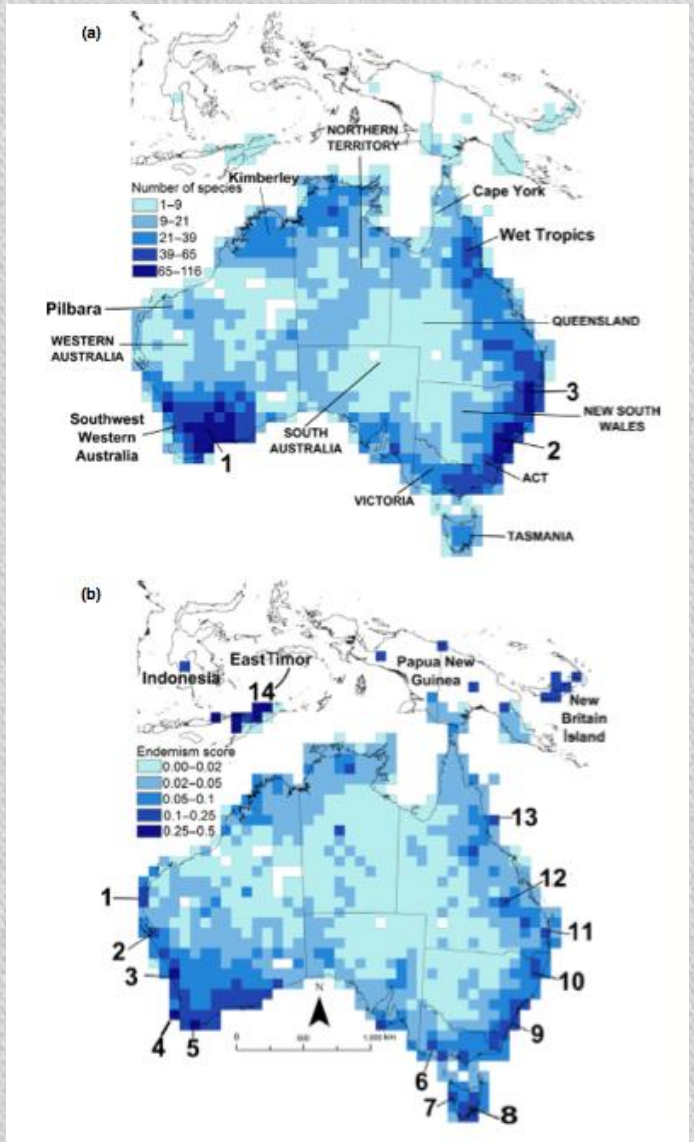
- Eleven environmental variables were used to analyze the environmental correlates of species turnover
- Investigation into the environmental drivers at the continental level and for each of the phytogeographical regions using multidimensional scaling and spatial statistics

**Table 1** Environmental variables used in our analyses.

| Environmental variable | Description |
|---|---|
| Annual precipitation | Monthly precipitation estimates (mm) |
| Annual mean temperature | The mean of the week's maximum and minimum temperature (°C) |
| Annual mean radiation | The mean of all the weekly radiation estimates (Mj $m^{-2}$ $day^{-1}$) |
| Precipitation of coldest quarter | Total precipitation over the coldest period of the year (mm) |
| Radiation seasonality | Standard deviation of the weekly radiation estimates expressed as a percentage of the annual mean (Mj $m^{-2}$ $day^{-1}$) |
| Precipitation seasonality | Standard deviation of the weekly precipitation estimates expressed as a percentage of the annual mean (mm) |
| Temperature seasonality | Standard deviation of the weekly mean temperatures estimates expressed as a percentage of the annual mean (°C) |
| Ridge top flatness | Metric of the topographic flatness derived from a 9 arc-second resolution raster digital elevation model (dimensionless; Gallant & Dowling, 2003) |
| Rock grain size | Lithological property of the bedrocks related to the mean grain size (0–10 units) |
| Percentage of sand | Content of sand (%) in the top 30 cm of soil layer estimated from soil maps at a resolution of 1 km (%) |
| Percentage of clay | Content of clay (%) in the top 30 cm of soil layer estimated from soil maps at a resolution of 1 km (%) |

# Results- species richness and endemism

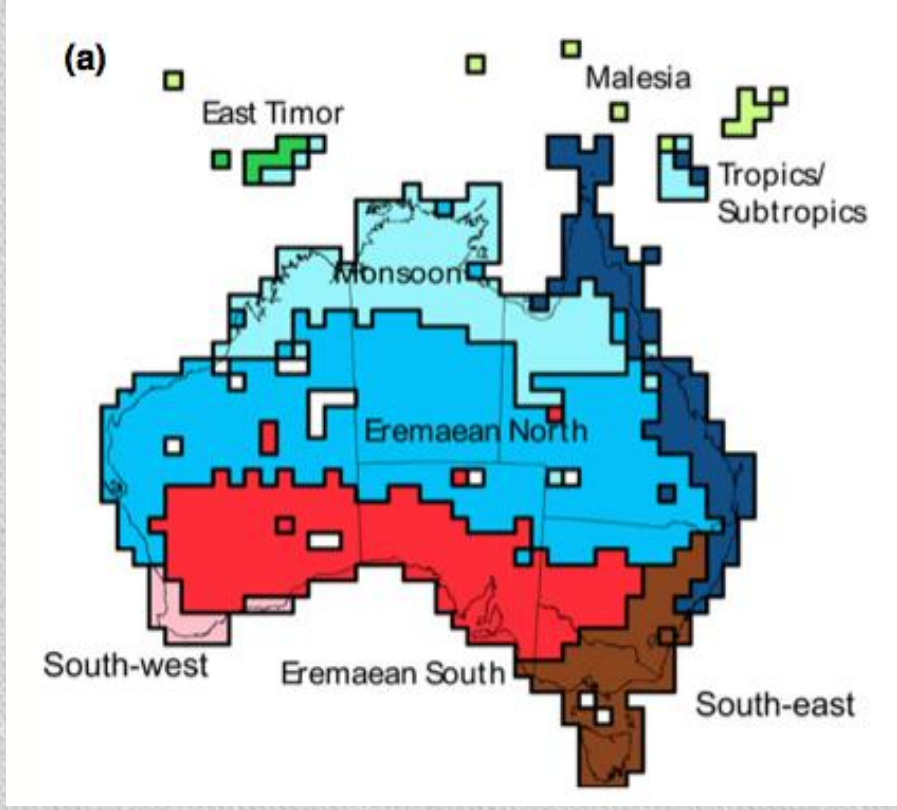
- The most species rich and endemic regions of eucalypts were located south of the Tropic of Capricorn
- They identified three main centers of species richness (Fig. a)
- Fourteen centers of high eucalypt endemism were identified (Fig. b)
- The highest scores were located in Western Australia and East Timor
- Five of these endemism centers are in eastern Australia and were newly identified



# Results- Phytogeographical regions

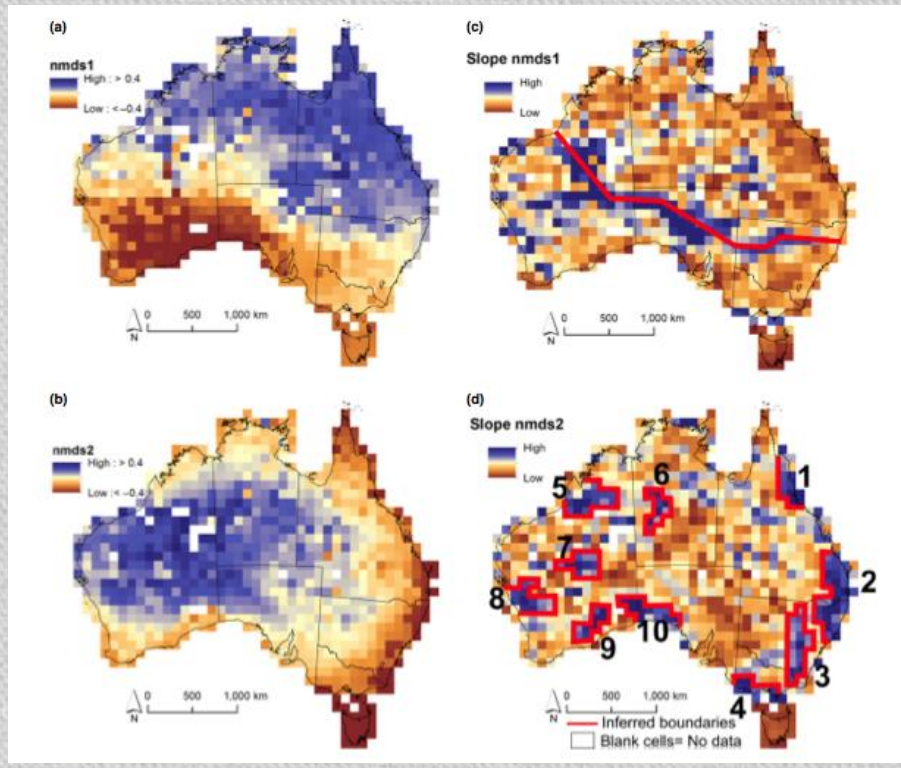
- Seven eucalypt phytogeographical regions are proposed based on the species turnover
- Six major regions are in continental Australia:

① Monsoon
② Tropical/subtropical
③ South-east
④ South-west
⑤ Eremaean north
⑥ Eremaean south



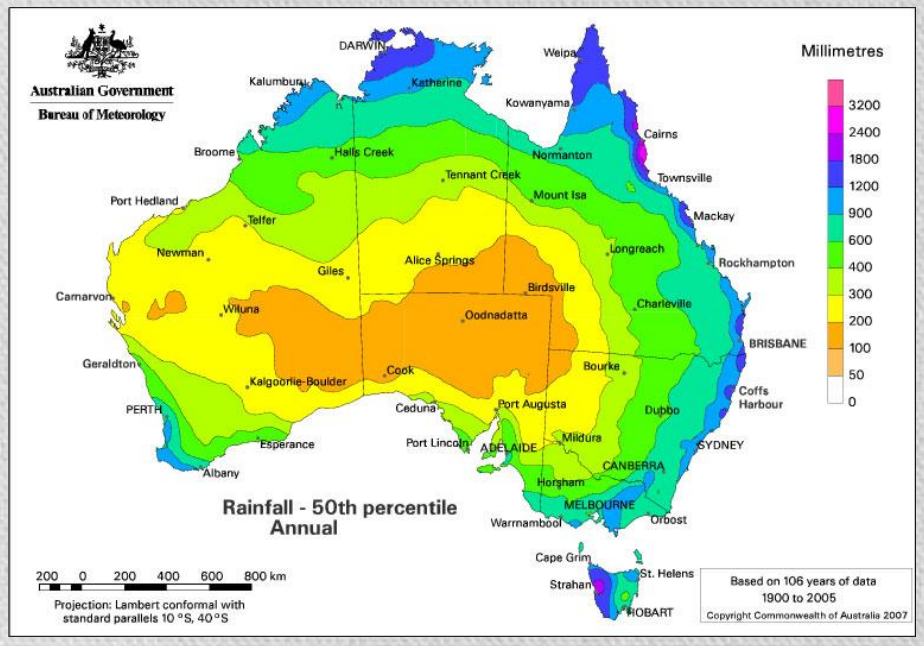
# Results- relative environmental turnover

- The findings are supported by significant environmental differences of the NMDS (non-metric multidimensional scaling) vectors and other statistics
- Major geographical break oriented north-west to east, aligned with the summer-winter rainfall line (Fig. a and c)
- Pattern matches the division of arid central Australia (has less eucalypt diversity) and the mesic zones on the east coast (Fig. b)
- Areas with high slope values are regions with abrupt changes of species turnover



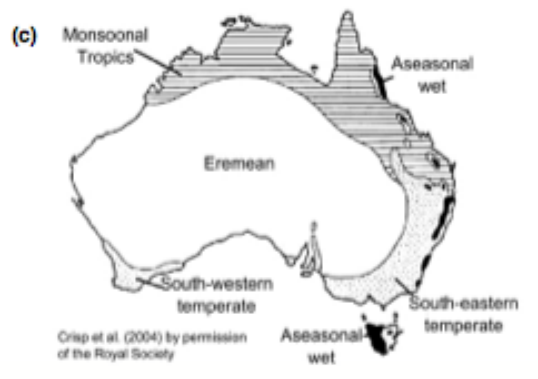
# Results

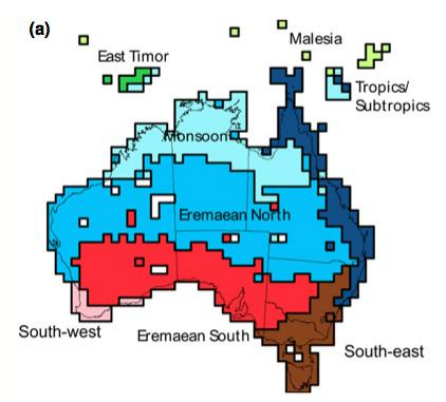
- The environmental drivers of species turnover are broadly consistent with the continental patterns of summer and winter rainfall below and above the Tropic of Capricorn




# Conclusions

- The proposed phytogeographical regions are similar to the Australian biomes




- Climate is the main driver of phytogeographical regions, varying from region to region
- Bioregionalization frameworks and phytogeography updates are fundamental for enhancing our understanding of the spatial distribution of biodiversity and benefit global biogeography and help identify regions of high conservation

# References


- González-Orozco, Carlos E., et al. "Biogeographical regions and phytogeography of the eucalypts." *Diversity and Distributions* 20.1 (2014): 46-58.