Department of Sustainability and Environment

Are land management activities such as grazing of woodland and rangeland impacting on vegetation cover?

Josh Dorrough, Arthur Rylah Institute, DSE, Victoria & CSIRO Sustainable Ecosystems, Canberra

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We have a fair idea of the impacts of overgrazing…….

Livestock grazing and associated management

- Impacts on vegetation cover/dynamics and existing research challenges
- How might climate change modify interactions between livestock management and vegetation cover and dynamics?
  - Effects of CC on spatial and temporal patterns of land use

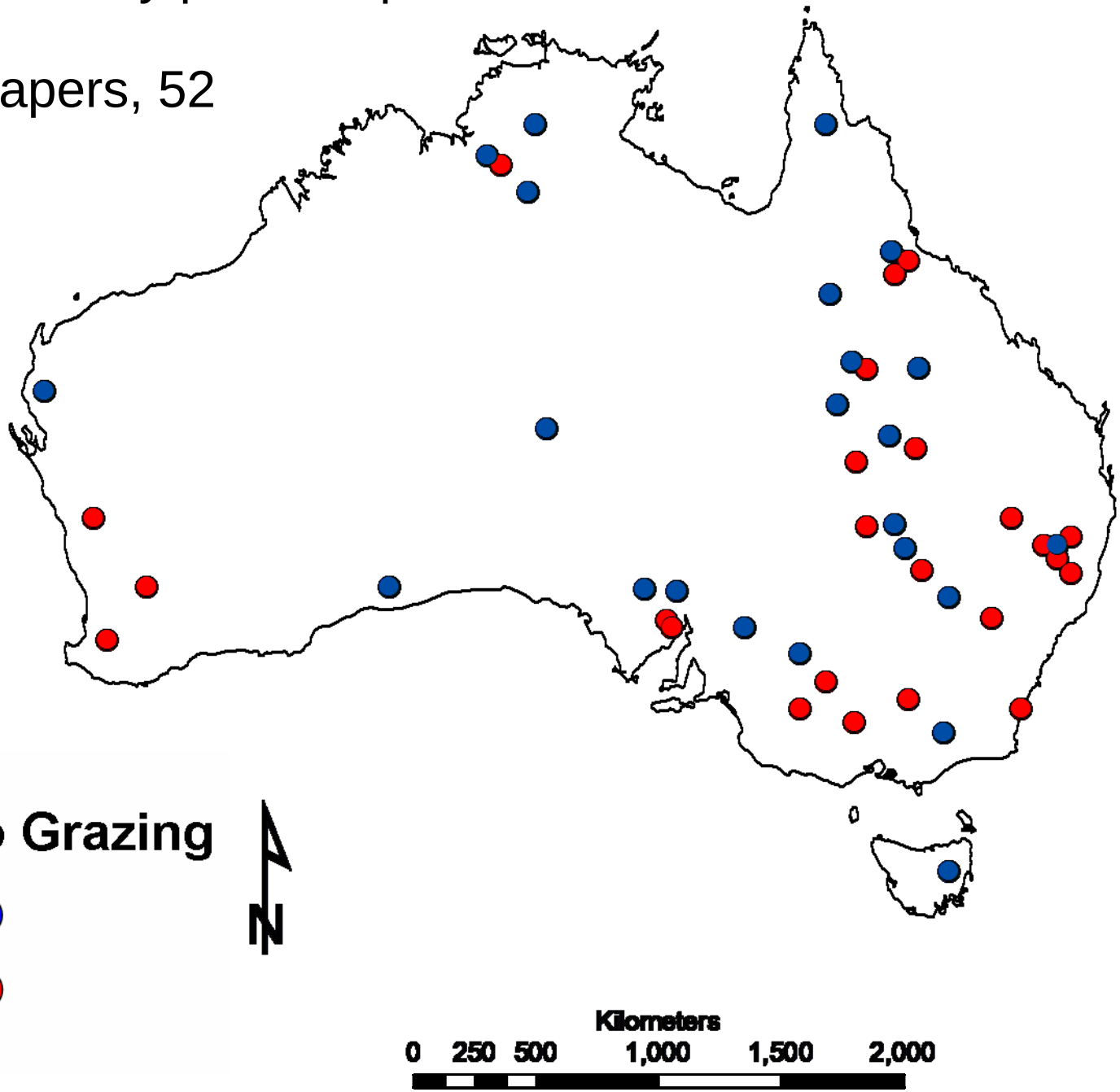
Major Structural groups – climate models and grazing response

- Woody versus herbaceous (tree - grass dynamics)
  - carbon storage, climate, habitat and production implications, C3 v C4 in tropics

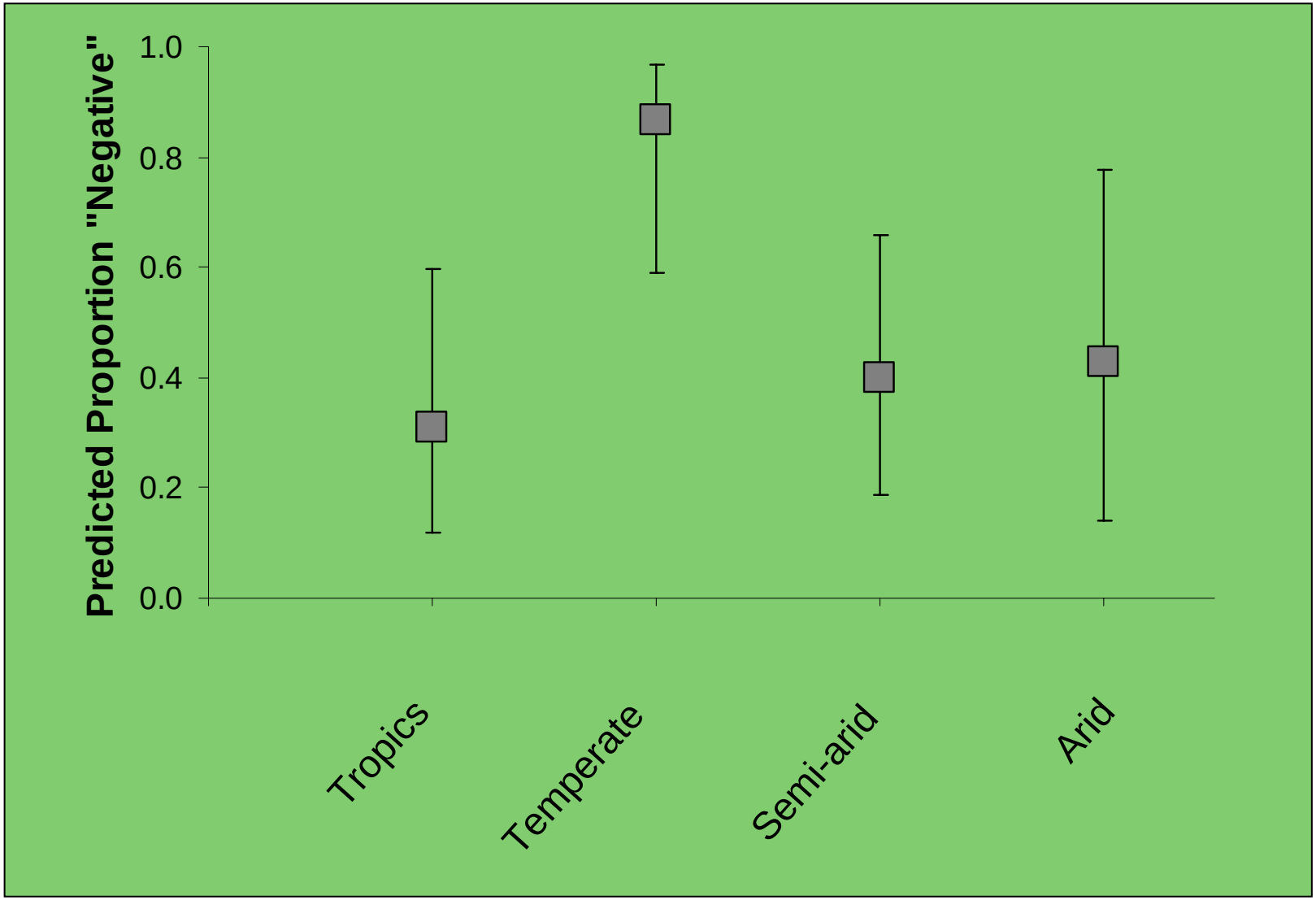
- Perennial vs Annual
  - a global response to grazing (Diaz et al 2007), varying climate risk, C4/C3 v C3 in temperate Australia

Australia-wide woody plant responses

39 published papers, 52 responses



Woody Plant Responses to Grazing



*Temperate incorporates mediterranean landscapes

Tree and Shrub Encroachment or Decline

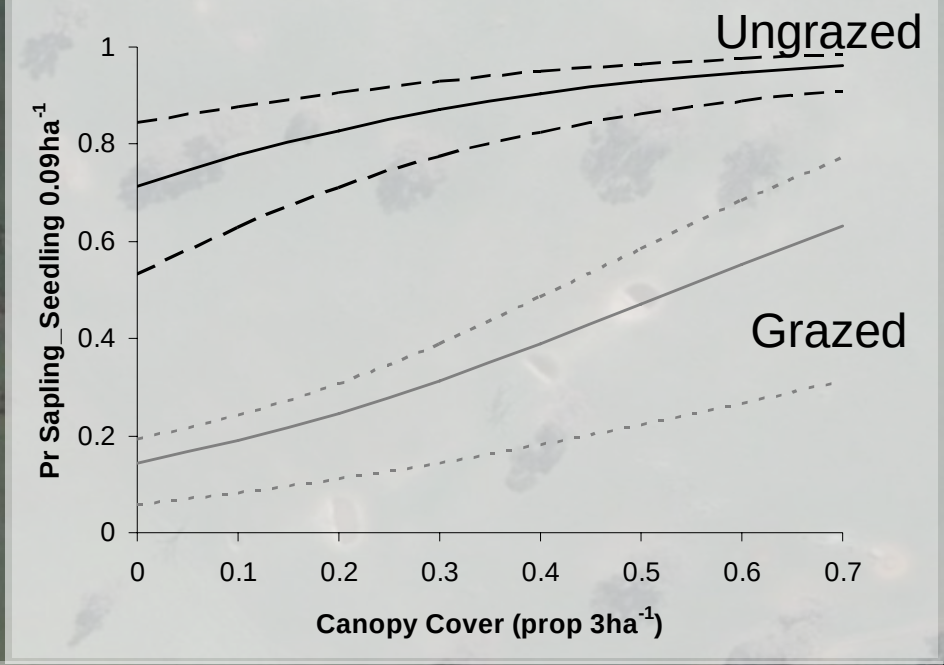
- Within and among region variation
  - climate, soils, topography
  - interaction with fire
  - livestock utilisation & other management
- Regional models of the “problem” (eg. Hodgkinson, 1991)
- National synthesis required, in many cases data is poor
  - Episodic responses – spatial and temporal replication required

Tree decline in the temperate zone

Eucalypt decline estimated at 0.5% to 2.5% annum^{-1}

Total loss of mature trees in 150-250 years under current management

Eucalypt regeneration in low fertility native pasture



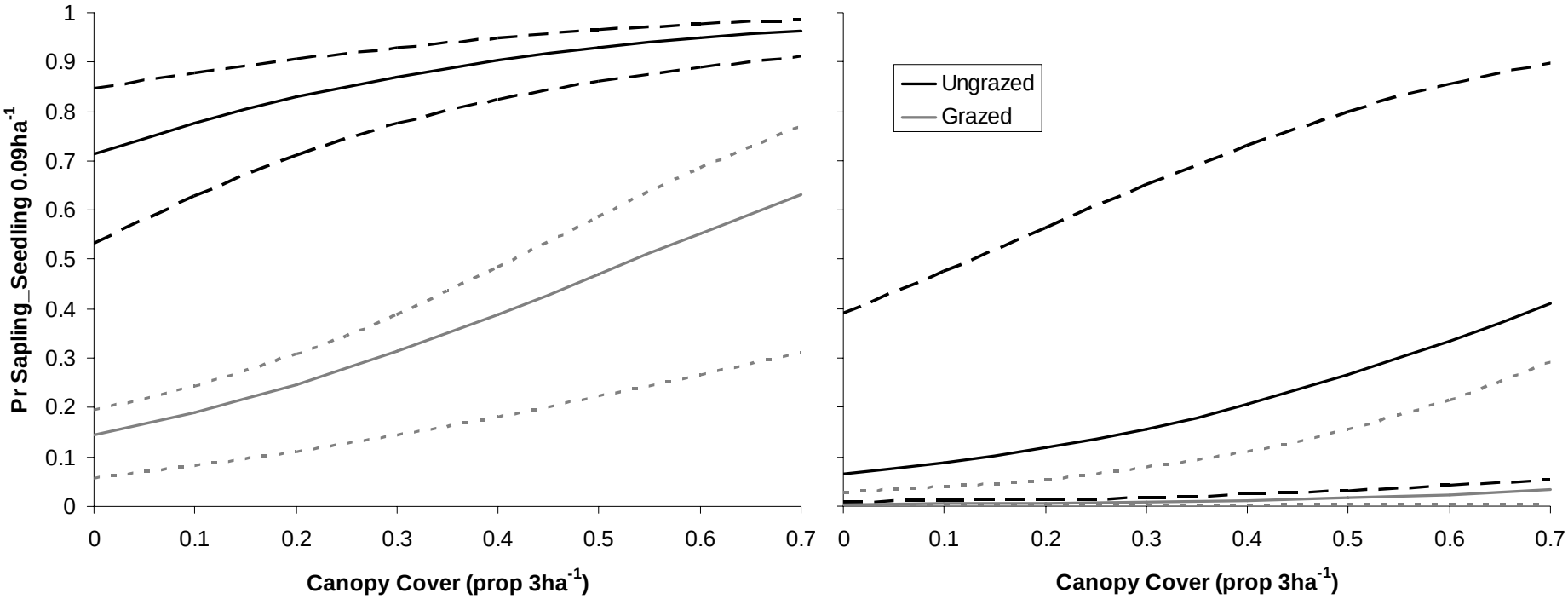
Adapted from: Dorrough and Moxham 2005 Biol. Cons. 123:55-66


ACT
NSW
N
Image © 2007 DigitalGlobe
© 2007 Europa Technologies
©2007 Google
Pointer 35°11'03.57" S 149°12'27.22" E elev 728 m
Streaming 100%
Eye alt 1.53 km

Eucalypt regeneration in grassy woodlands

Low phosphorus, native groundlayer

High phosphorus, exotic groundlayer



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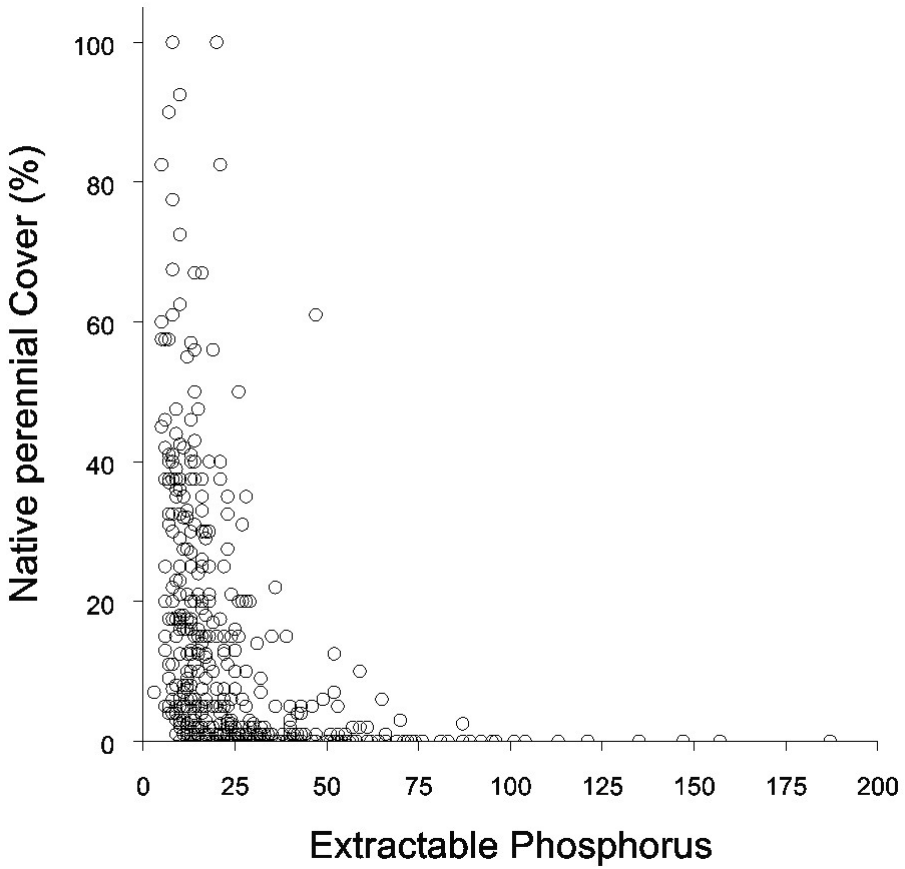
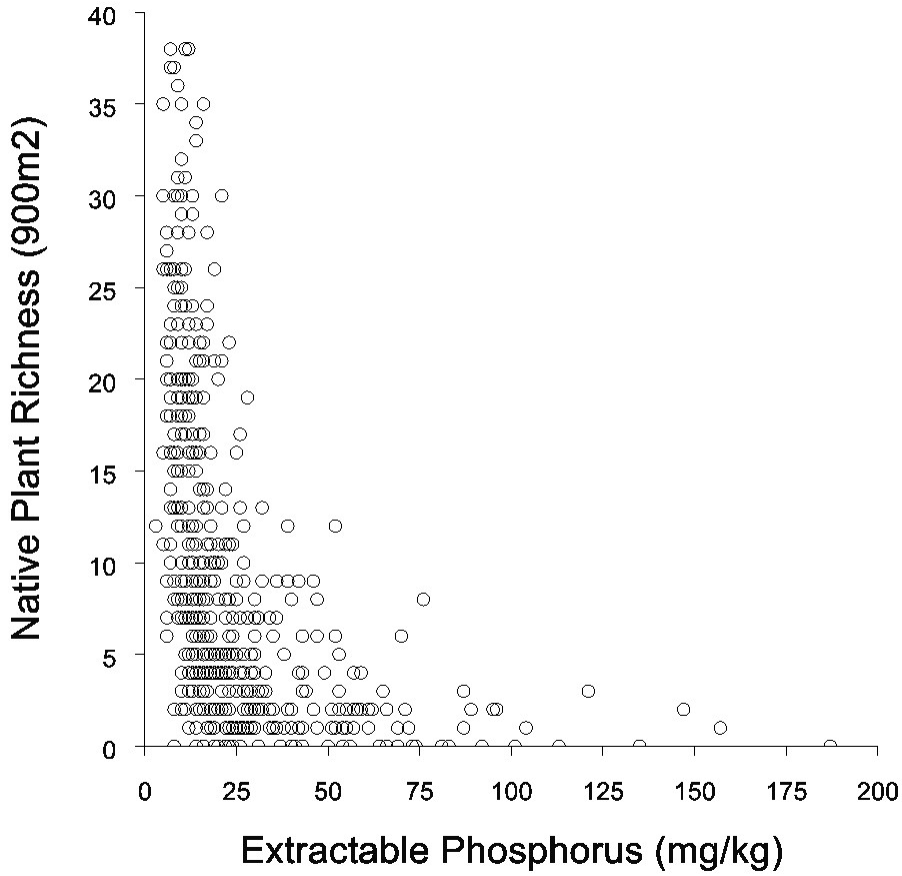
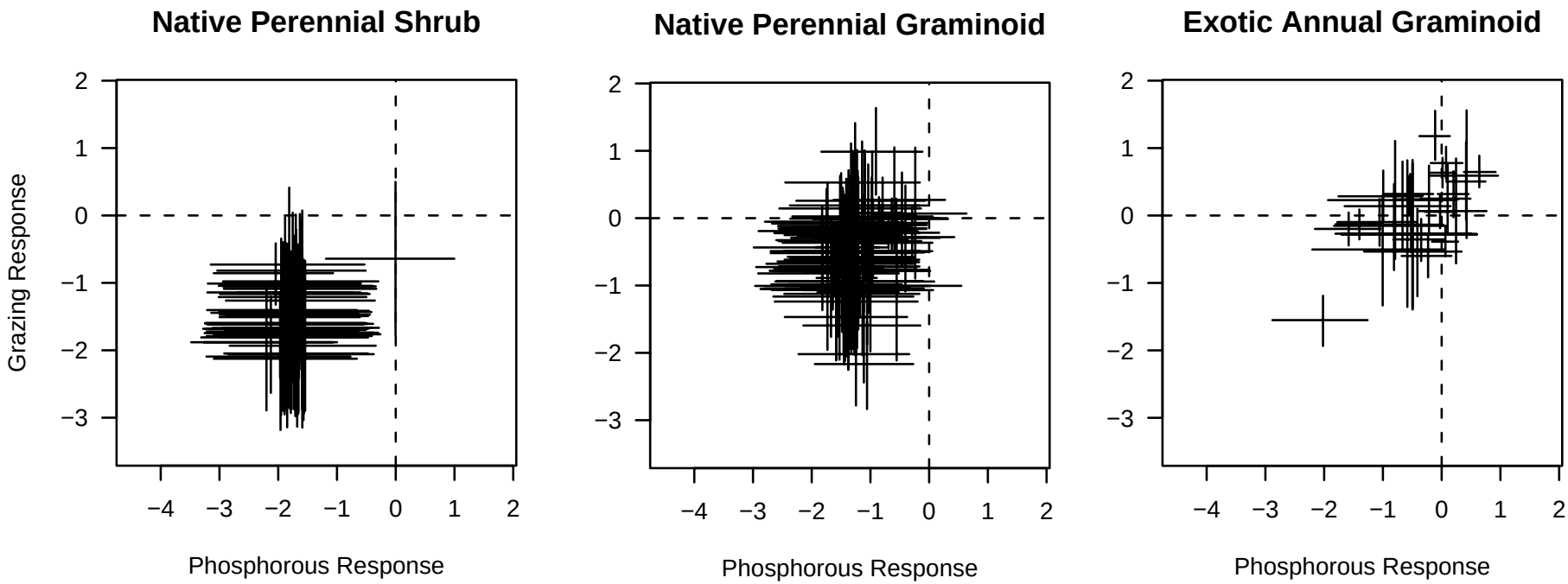
Soil enrichment and native perennial groundlayer in grazed woodlands





Dorrough et al (2006) Biological Conservation, **130**, 394-405

Plants in temperate woodlands: Response to Phosphorus and Grazing



Dorrough and Scroggie, submitted

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Reconstructing temperate woodlands

- Mineral nutrient enrichment – tree mortality, regeneration failure and highly modified understorey vegetation
- Evidence for nutrient/disturbance driven stable annual vegetation states (eg. Yates, Prober et al)
- Recruitment of groundlayer and overstorey – nutrient run-down, grazing strategies, spatial variability
- Year to year variation large (can overwhelm management interventions) - recruitment events rare and data poor
- Can significant change occur at broad scales and over what timescales?

Pasture Introductions

- Pasture/forage introductions
  - nitrogen fixers eg. *Leucaena*
  - Pasture grass eg. *Andropogon gayanus, Cenchrus*
- Large impacts on veg dynamics (eg. grass-fire cycles, nutrient cycling, acidification, competition) BUT
  - Data often scarce, predictions of long-term impacts may be difficult
- A massive research and management challenge to reverse impacts

Alternative Grazing Management Systems

- Rotational grazing systems are being increasingly adopted throughout grazing lands
- Regimes variable, ecological outcomes possibly also
- ↑ perennials and palatable woody vegetation ?
- Much anecdotal information
- Little data to support claims

Interactions : Climate change, grazing management and vegetation


CSIRO SE OZFACE Experiment

- Complex interactions
  - CO_2, temp, moisture
  - Differential plant responses
  - Interactions with grazing: selection, tolerance, competitive response and effect
- Likely to influence Tree-grass dynamics, understorey structure and composition
- Spatial replication and scale limited

Changes in frequency and duration of rare events

- Recruitment and mortality episodic in response to extreme rain/drought events
  - ⇨ rapid long-term vegetation shifts
  - 🡅 Variation under CC, 🡇 predictability
- Current management systems often fail to manage existing variability - will this be exacerbated?
- CC will alter the likelihood and predictability of rapid vegetation change
- Models needed BUT data not good
  - few replicated extreme events

Interactions with changing land management

- Changing land use a primary driver of vegetation
  - play out over varying times-scales
  - difficult to distinguish CC impacts
- Intensification →Abandonment
  - Varying ability to predict outcomes
- Shifts in enterprise mix
  - dramatic eg. livestock to bluegums/pine
  - subtle but significant implications eg. sheep to goats or wool to meat
- How will climate change influence these land use changes ?

Research Priorities - A rough summary

- Australia-wide synthesis of tree-grass dynamics - compilation of existing data and new data if required
- Better models and data of recruitment/mortality in response to extreme events and impacts of grazing on subsequent outcomes
- Reconstruction of perennial woodland systems in temperate zone
- Impact of introduced pasture/forage on vegetation dynamics and strategies to reverse trends
- LUC and CC interactions

Acknowledgements

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Errors, misinterpretation and shortcomings I claim as mine