Long-term change in the arid rangelands and the importance of time-sequential data

Ian Watson

30/11/08

www.csiro.au

CSIRO

Managing natural resources

- Understand where we've come from, what change has occurred, how much change and why it occurred?
- What is the potential for the landscape and can it be achieved?
- Adaptive management cycle – do, **observe**, review, plan, do

- Lindenmayer, Dovers, Olson and Morton (2008). Ten Commitments. Reshaping the Lucky Country's Environment. (page 228 & 229)

- *"Many contributors highlighted the serious lack of monitoring in many sectors. … It is clear that our nation is lagging woefully behind many others around the globe. A lack of monitoring affects our ability to assess the effectiveness of policy initiatives and management. For example, more than half the 100+ indicators for the national State of Environment Report have poor data or no data!"*

December 2000

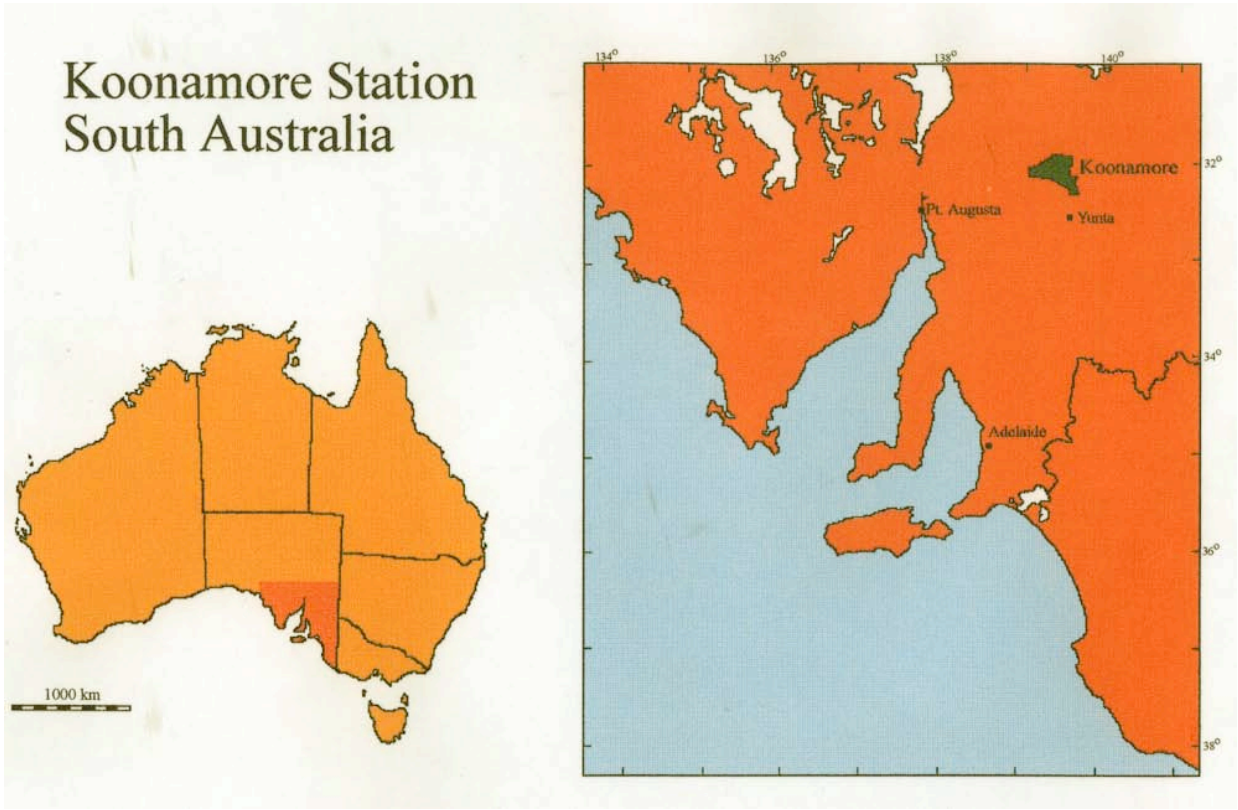
(Alive in 1925)

(Dead in 1925)

(Many mulgas, dead in 1925 are still standing today.
All 1925-dead mulgas can be found, standing or fallen)

But a one-off museum piece, only a few ha

Sinclair (2004) Persistence of dead trees and fallen timber in the arid zone: *The Rangeland Journal,* **26**, 111-122
Sinclair, R. (2005). Long-term changes in vegetation, gradual and episodic, on the TGB Osborn Vegetation Reserve, Koonamore, South Australia (1926–2002). *Australian Journal of Botany,* **53**, 283–296



A lot of good science from Koonamore but limited ability to actively use for natural resource management

Are the rangelands of Australia degrading or improving?
(Just one part of the adaptive management cycle)

2002

1963

CSIRO

1981

1984

1986

1991

1998

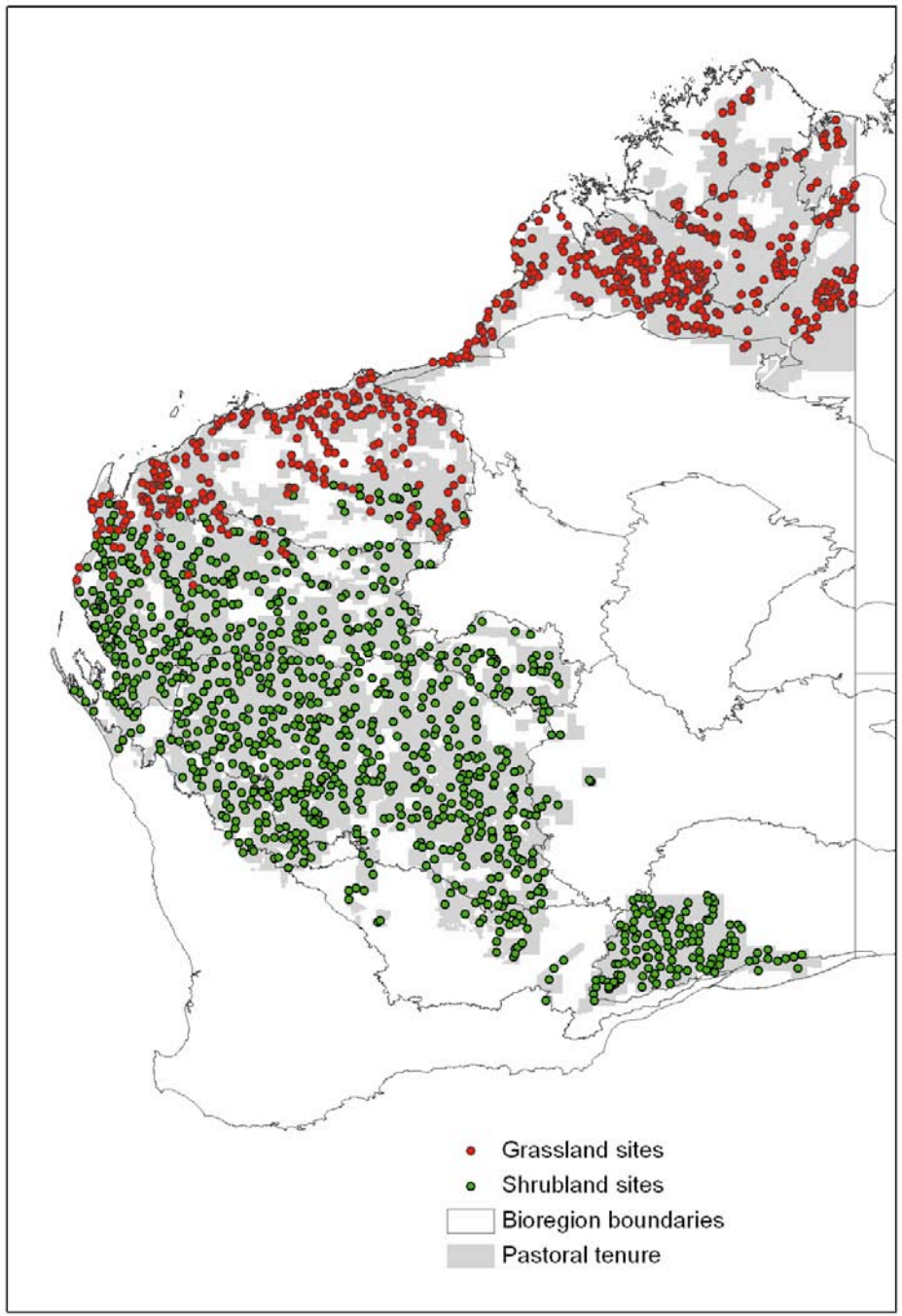
2002

Wouldn't it be nice …

if we could systematically record change, over time, on a large set of sites, across the rangelands

WARMS, WA Rangeland Monitoring System

- About 1600 permanent sites
- Two types of sites, grassland in the north, shrubland in the south
- Located on pastoral rangelands
- Aspects of perennial vegetation and landscape function (soil surface condtn)
- Three year cycle on grassland sites (94-96, 97-99, 00-02, 03-05, 06-08)
- ~ five year cycle on shrubland sites (93-99, 99-05, 06-10)
- **Not a perfect system!**

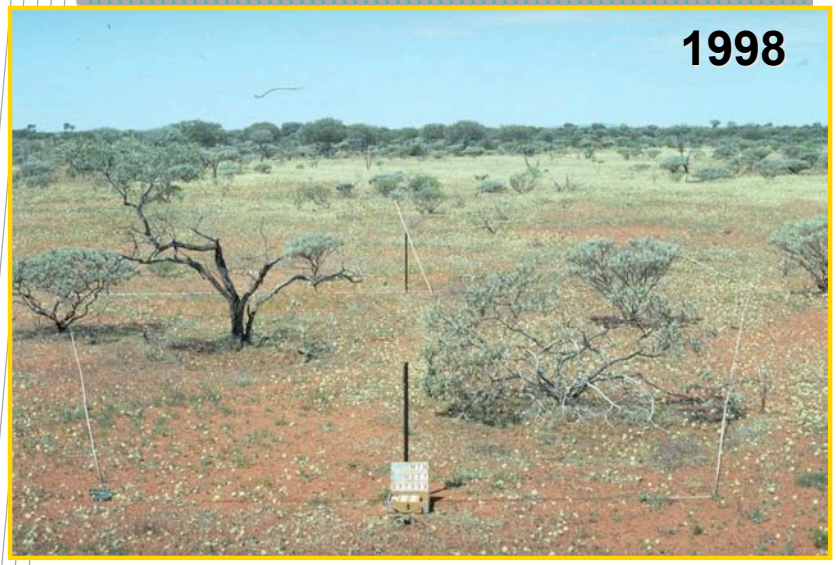


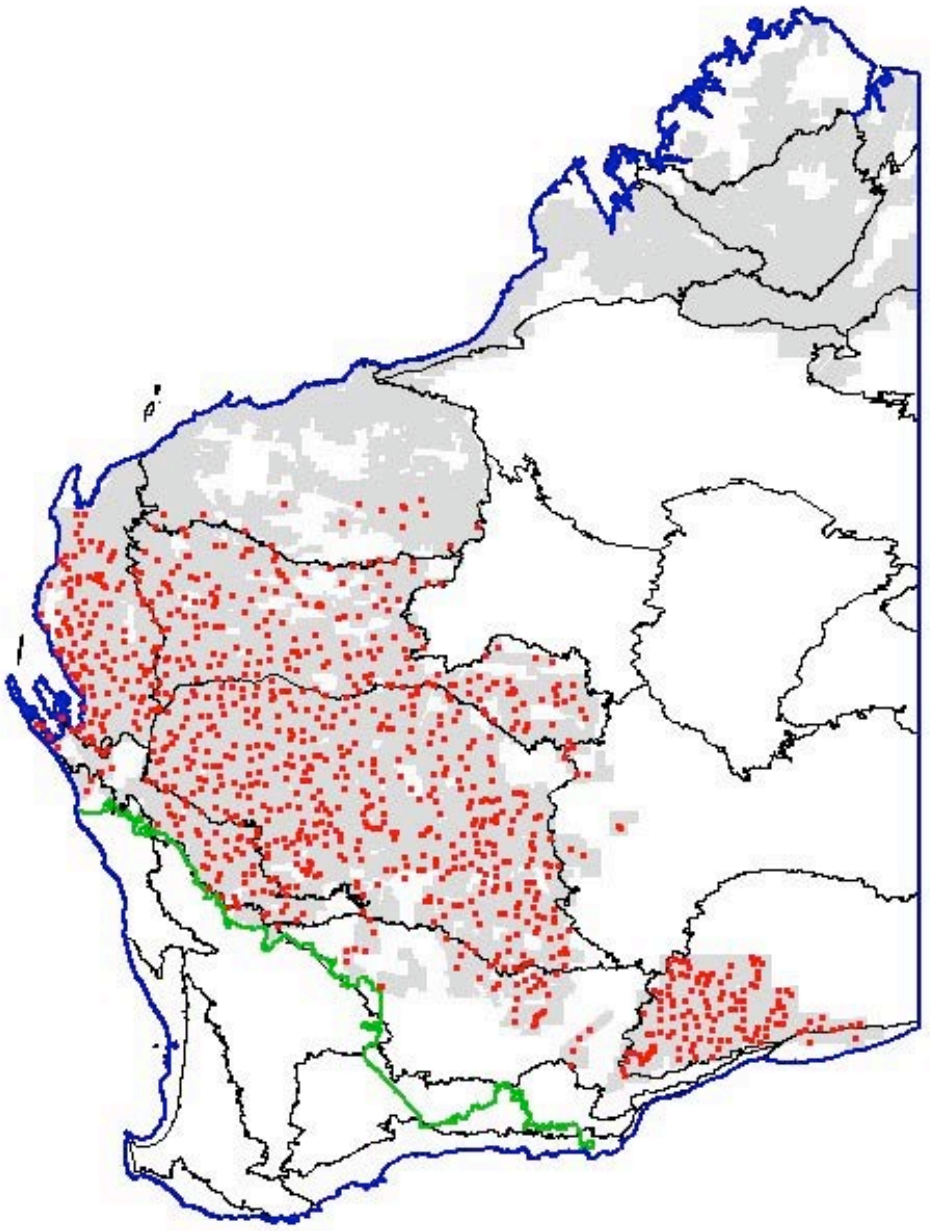
$Popn_{Date1}$ - Deaths + Recruits = $Popn_{Date2}$

- **Survivorship**
- **Recruitment rate**
- **Turnover rate**
- **Change in density**
- **Population growth rate**
- **Change in local distribution**
- **Canopy size (i.e. cover)**
- **Species richness**
- **All of the above by size (& eventually age) class**
- **Aggregated by species, funct'l group, site, region etc**

Watson, I. W., Thomas, P. W. E., and Fletcher, W. J. (2007*b*). The first assessment, using a rangeland monitoring system, of change in shrub and tree populations across the arid shrublands of Western Australia. *Rangeland Journal ,* **29**, 25–37.

Data set – 964 sites

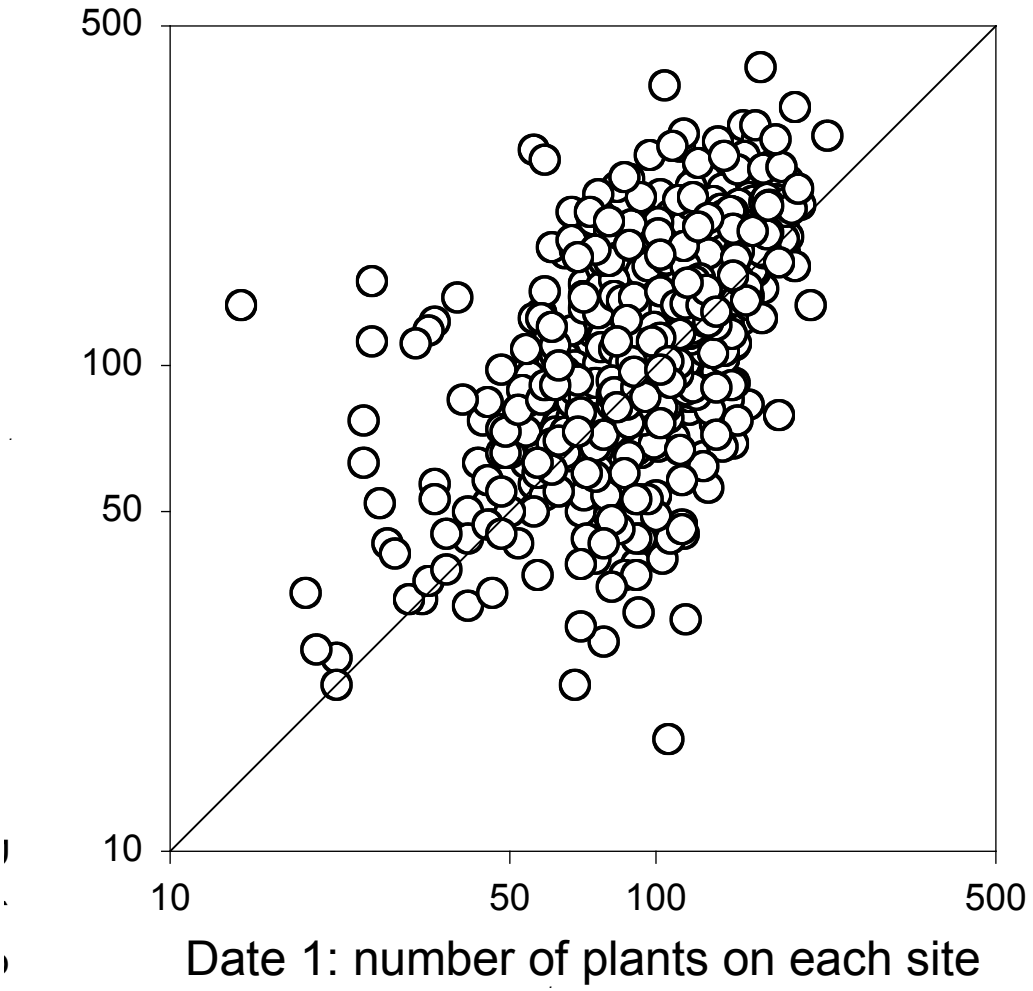




Shrub density by **site** (n=964)

PGR = population growth rate = Density at Date2 / Density at Date1

- Density increased on 69% of sites
- Average population growth rate was 1.26
- PGR less than 0.5 on 2.5% of sites
- (Similar results for canopy size, i.e. cover)

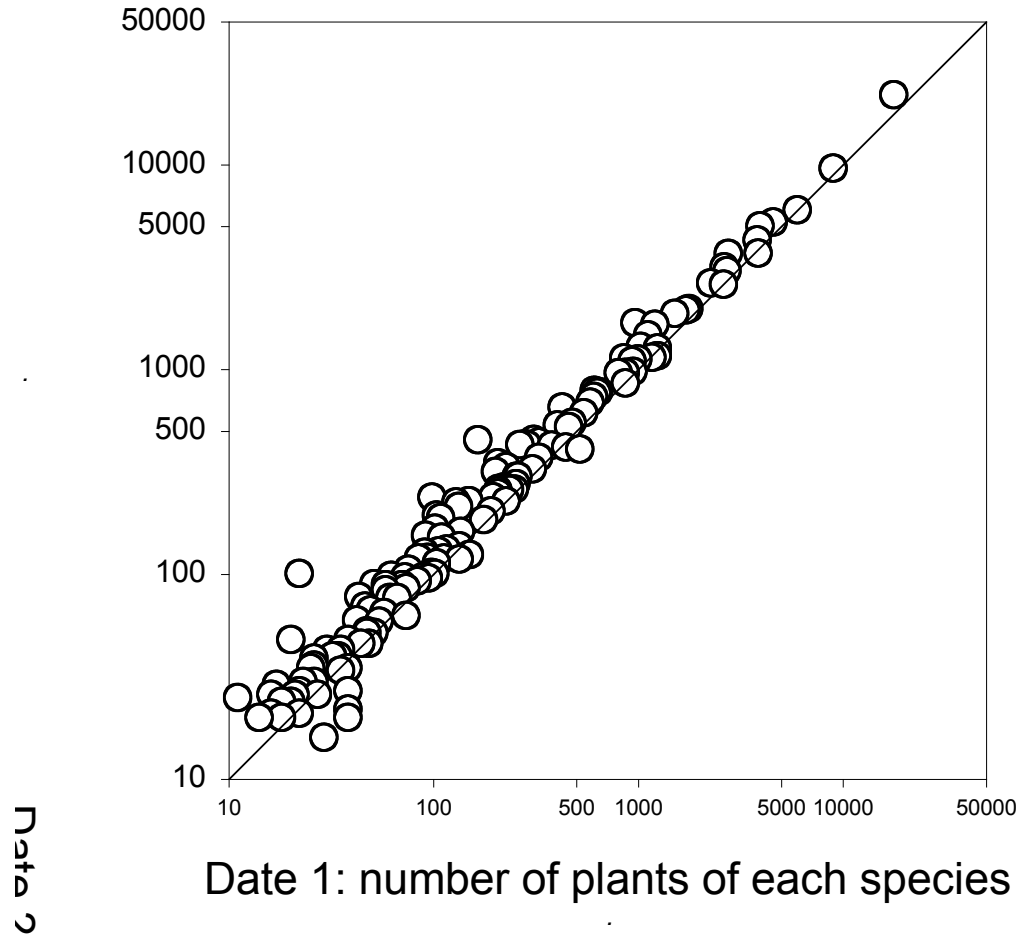


Shrub density by **species** (n=154)

PGR = population growth rate = Date2_density/Date1_density

- 86% of species had a PGR of at least 1.0
- Only 7% had a PGR of less than 0.9

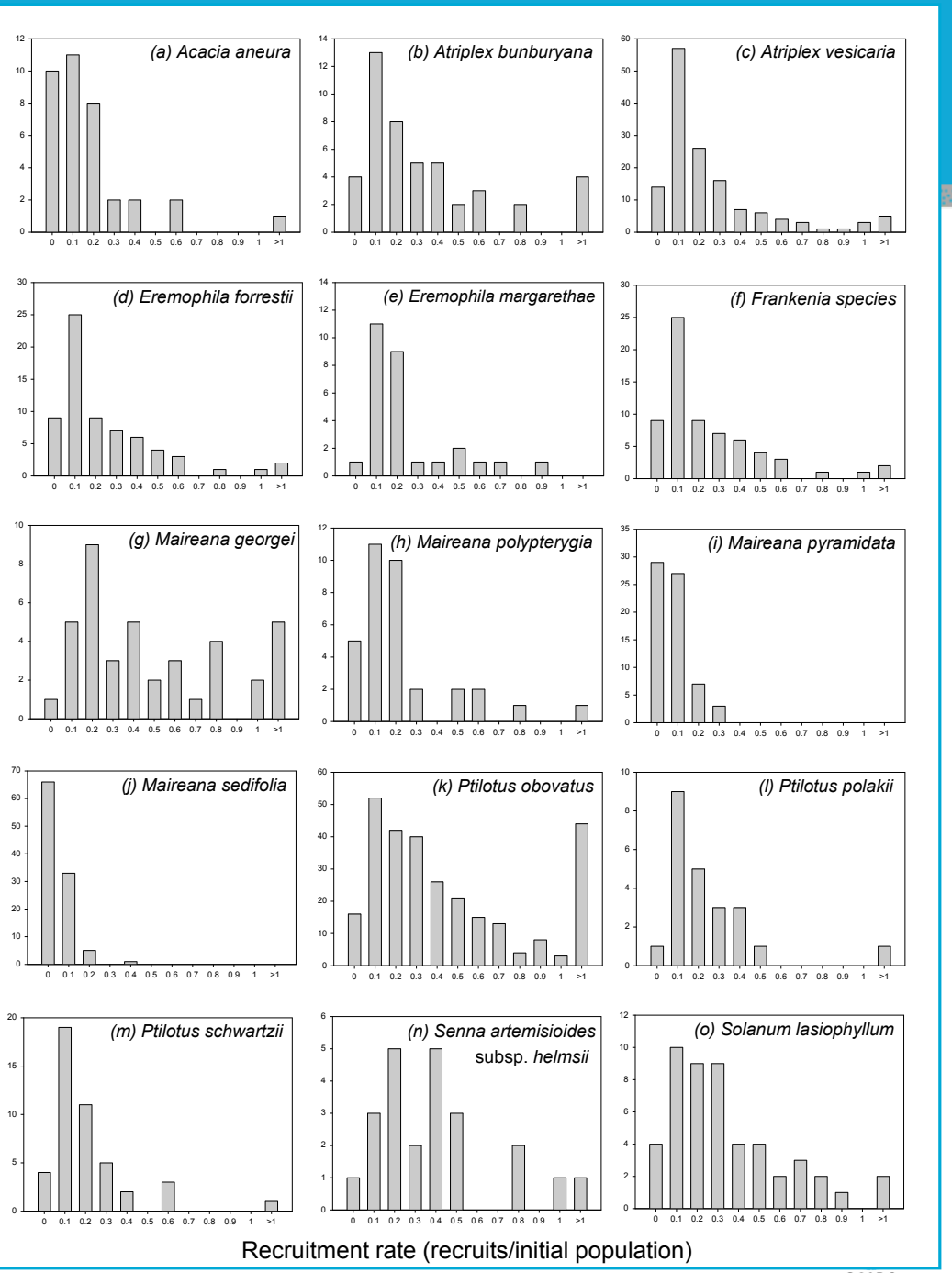
- Winners (10 popn:100 indiv)
  - *Acacia papyrocarpa (2.77),*
  - *Senna artemisioides (2.43)*
  - *Acacia sclerosperma (1.89)*
  - *Acacia victoriae (1.76)*
- Losers – (10:100)
  - *Atriplex amnicola (0.79),*
  - *Maireana thesioides (0.86)*
  - *Stylobasium spathulatum(0.89)*
- No individual species I would be particularly worried about (but not sampling restricted habitats and rare and threatened species)



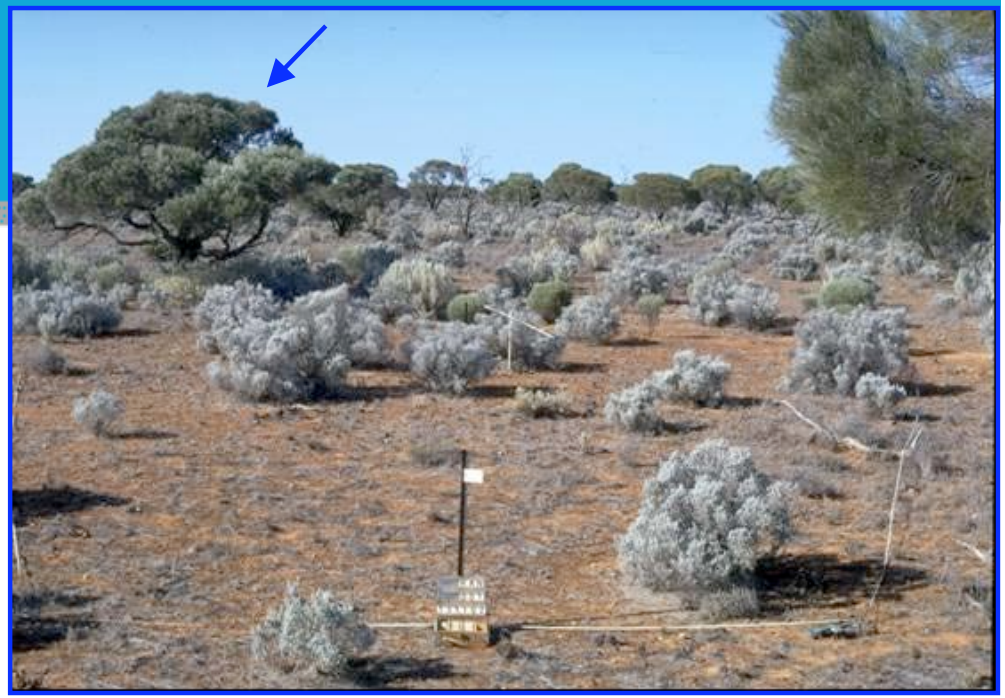
Recruitment

Number of recruits / initial numbers

- Common among species
  - 80% when all individuals considered
  - 98% species with reasonable numbers (≥20)
- Widespread spatially
  - observed on 99% of sites

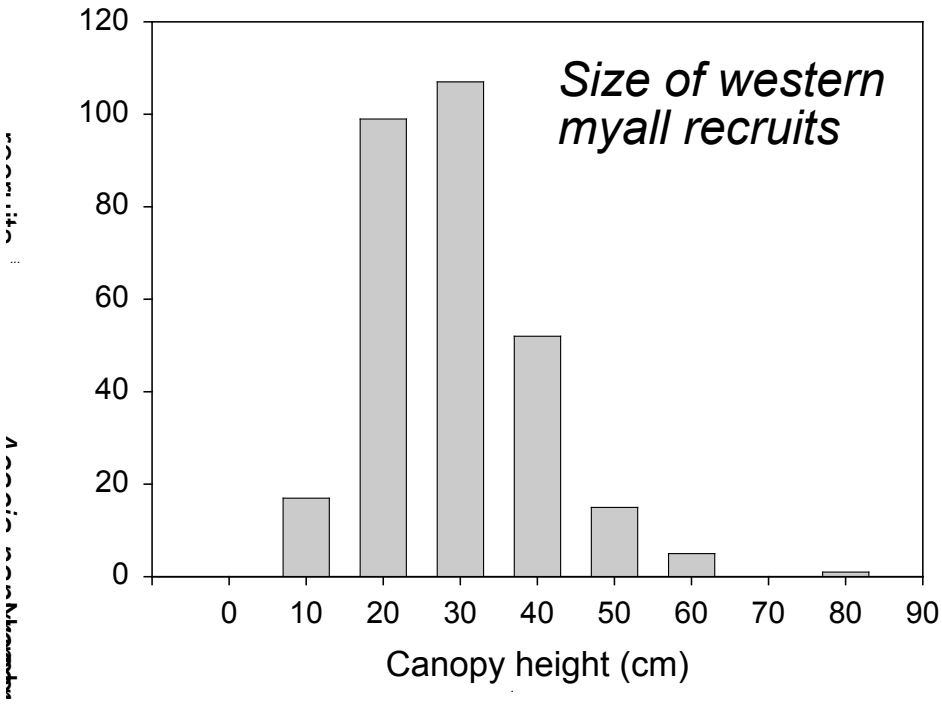


Acacia papyrocarpa (western myall)

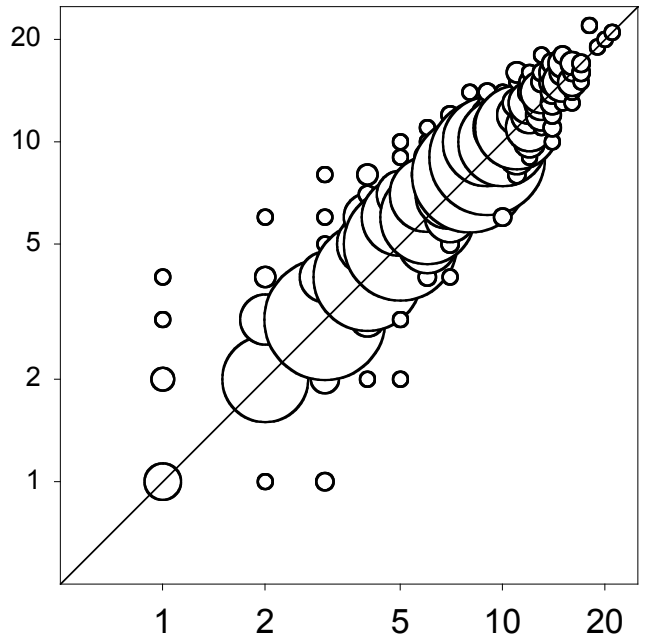


- 14 sites at Date 1
- 16 sites at Date 2
- Initial population = 164
- Number of deaths = 6
- Number of recruits = 296 (on 13 sites)
- Final population = 454
- Population Growth Rate (PGR) = 454/164 = 2.77

$$164 - 6 + 296 = 454$$



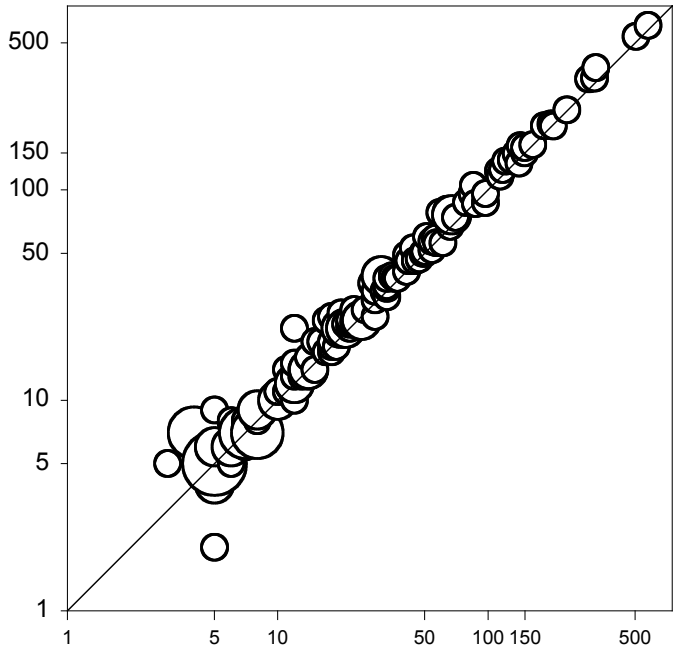
Shrub species richness



Date 1: number of shrub species per site

On 80% of sites, the number of species remained the same or increased

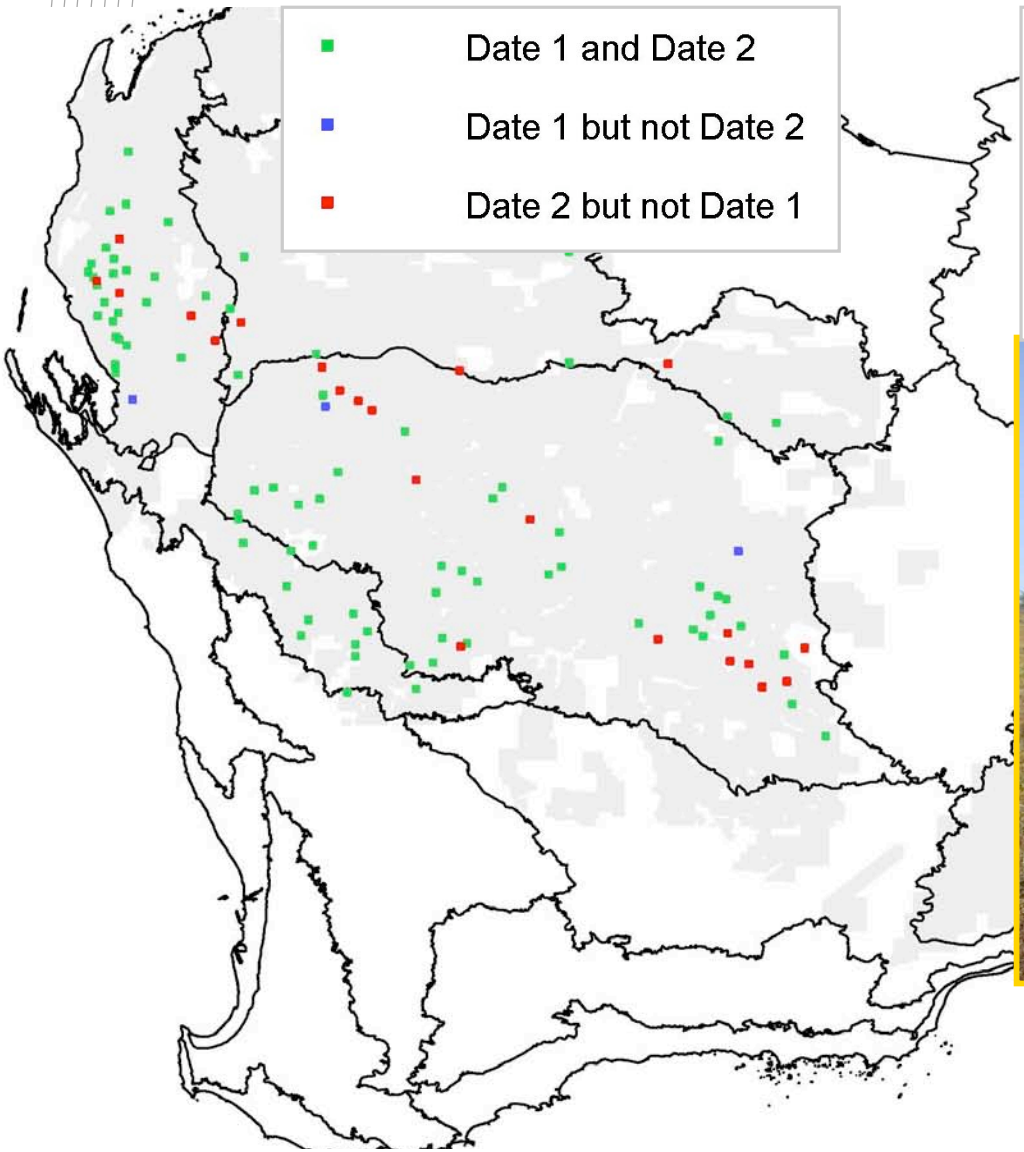
Change in local distribution



Date 1: number of sites each species was found on

81% of species were found on more sites at Date 2 than Date 1

Hakea preissii (needle bush)



- Change in local distribution
- 85 sites at Date 1
- 105 sites at Date 2

CSIRO

Rainfall and grazing

On 11% of sites, we saw a decline despite above average seasonal conditions – this suggests an adverse impact from grazing

Under below average seasonal conditions we saw Decreaser species decline more than Increaser species – suggesting an adverse impact from grazing

On 34% of sites, we saw an increase despite below average seasonal conditions – this suggests benign grazing

One data set – many questions

- Are the changes occurring in some habitats and not others?
- Are the changes occurring to some species and not others?
- What are the patterns to the changes and what is causing them?
- Are some species being disadvantaged, even to the point of local extinction?
- Is the vegetation getting thicker/woodier?
- Are the same things happening to decreasers, intermediates and increasers?
- What are the relative impacts of rainfall and grazing?
- Are species distributions changing?
- Are there regional differences and if so, why?
- Is there a climate change signal?

Acknowledgements

- Dr Russell Sinclair, of Adelaide University generously provided the photos of Koonamore Vegetation Reserve.
- The WARMS data come from the Department of Agriculture and Food Western Australia which is a core-funded activity of that Department.

Rangelands and Savannas Program, CSIRO Sustainable Ecosystems
Ian Watson

Phone: 0438 122 512
Email: ian.watson@csiro.au
Web: www.csiro.au/cse

www.csiro.au

Thank you

Contact Us
Phone: 1300 363 400 or +61 3 9545 2176
Email: enquiries@csiro.au Web: www.csiro.au