Mesquite: Optimising management of core infestations across Australia

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(Tropical Invasive Plants)

Thank: PMMC, QDPI, NPBMG

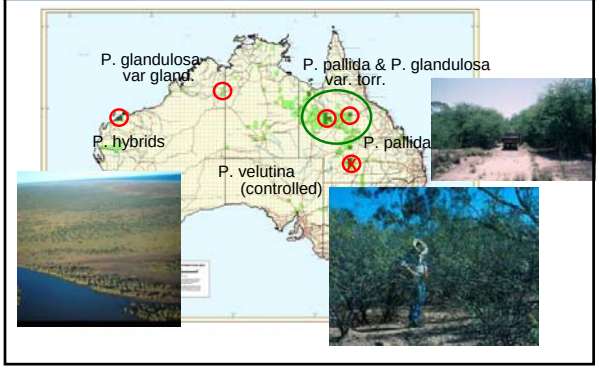
and

- **Andrew White (CSIRO)**
- **Jodi Graham, Linda Anderson (PMMC)**
- **Todd Robinson (Curtin Uni)**

What is the problem?

- Highly invasive, even without undue disturbance
- "keystone/transformer species"
- Can fundamentally alter way pastoralism is done

Where is the problem?



This talk

- CSIRO mesquite research of which the 07-8 LWA mesquite project was a continuation
- Focus on a few elements:
  - the "big picture"
  - population ecology
  - management

THE BIG PICTURE

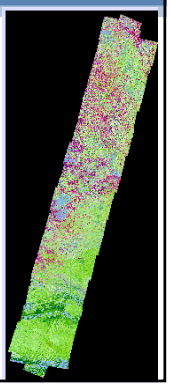
Mapping mesquite: remote sensing?

		Actual Mesquite	Snakewood	Eucs	Totals	Error of comission
Predicted	Mesquite	107	8	85	200	0.47
	Snakewood	51	770	39	860	
	Eucalypts	47	19	222	288	
		205	797	346	1348	
	Error of omission	0.48				
	Overall agreement				81%	

- can pick up 3m plants
- serious confusion with eucalypts and acacias
- no good for "surveying"
- good for "change detection" (with improvement)?
- hyperspectral image not much better

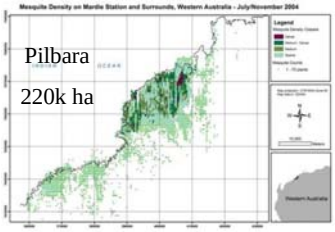
16 x 2.5 km (1.5x1.5m)

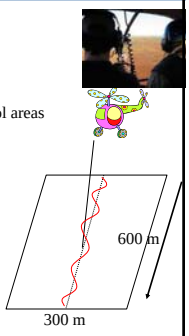
Todd Robinson



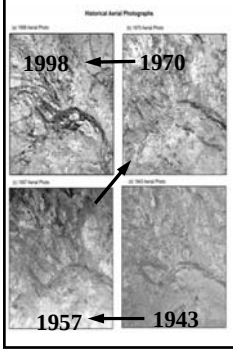
Mapping mesquite cost-effectively

- New method: quantitative chopper survey
- Relatively cheap (at a coarse, 15.5 ha scale) [< 50c/ha]
- Great at detecting low densities
- Future surveying will target invasions fronts and control areas



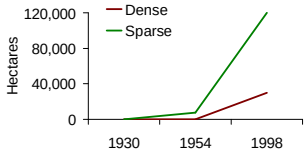


History of invasion (Pilbara)

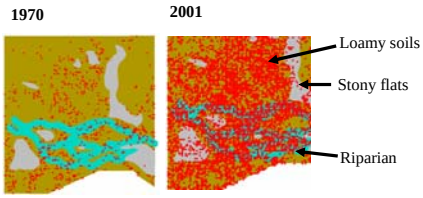


450 ha test area (aerial photographs)

- continual increase in density
- invasion rates fastest in riparian and red loam soils (c. 1.1%/year)
- no mesquite deaths

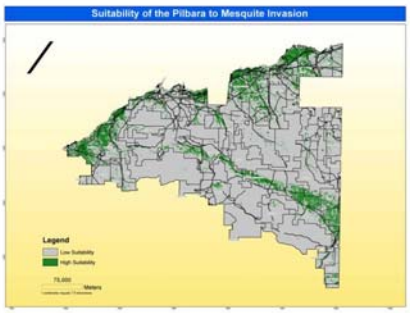


The dispersal mechanism



- widely dispersed patches by 1970
- subsequently "in-filled" (fastest in "good" habitats)
- pattern is consistent with dispersal by sheep/macropods
- these are very poor vectors vs cattle!

Landscape predictions – Pilbara Region

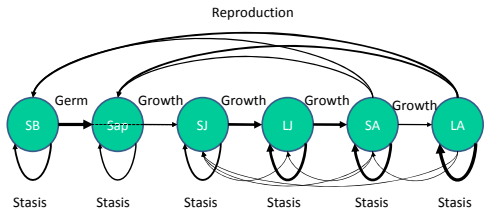


Ordered Weighted Averaging + fuzzy membership

- pasture potential
- land tenure
- moisture

POPULATION ECOLOGY

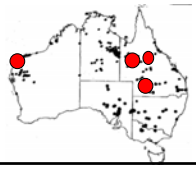
Lifecycle slide



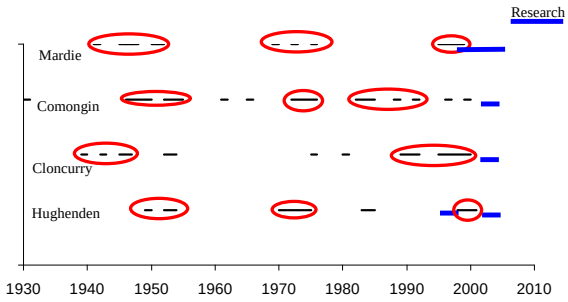
Mesquite ecology: a national perspective

- How does mesquite ecology differ across Australia (what is normal?)
- 15 permanent sites:

- seed banks
- growth rates
- recruitment and deaths
- effects on herbaceous layer
- effects of biocontrol agents



Periods with successive wet years



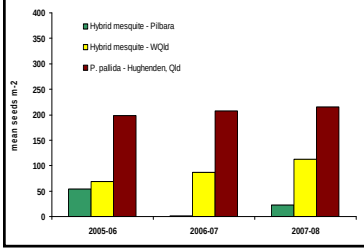
Biocontrol is working in the Pilbara

Leaf-tying moth
- tested 1996-8
- released 1998-00

Dramatic impacts in the Pilbara (2000-8)

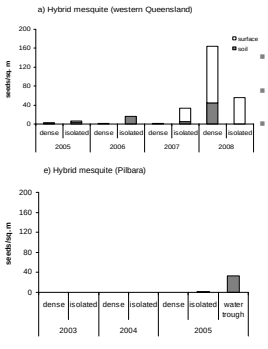
Reproduction

Low seed production in Qld and WA, but coincided with drought years

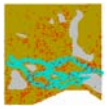


June 2009: already seeding?; 09-10 likely to be a bumper crop in Qld

Seed bank



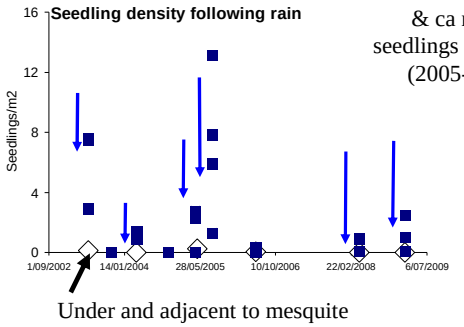
- Typically 10-100 seeds m^{-2} under mesquite trees
- Most seeds pass through gut of animal before entering the seed bank
- Therefore seeds accumulate where dung accumulates:
  - Can be very high around e.g. watering points
  - Low (but potentially important) seed densities are scattered over large areas



Seed bank longevity

- Under natural conditions most are gone from soil within 1-3 years
- Seeds may germinate much faster if passed through animals first
- Some seeds may last much longer under buffered conditions (e.g. deep shade, deep burial)

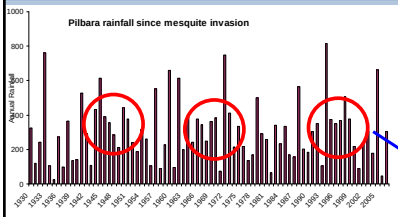
Seedling in Pilbara through time



& ca no seedlings in Qld (2005-8)

Under and adjacent to mesquite

Recruitment and climate



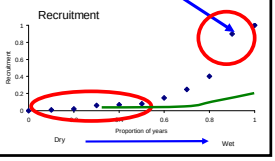
Pilbara invasions

- most rapid in 1940s, 1960s and 1990s

- Recruitment possible all years

-A series of high RF years are required for rapid invasions

- management should make the most of dry years!



Seedling recruitment

- Most seedlings become adults if they survive their first dry season
- It takes at least 2 years to become "visible" to e.g. spray teams, could be greater than 5 years
- If conditions aren't ideal for growth (e.g. if heavily shaded) seedlings can remain dormant indefinitely (= a "seedling bank")

Mass recruitment after March 2005 rains (Pilbara, 4 years later)

Population structure and the sapling bank

Hybrid (Pilbara)

Size class	Density (/ha)
Seedlings	1,138
Juveniles	9,776
Adults	4,859
Total	15,773

P. pallida (Qld)

Size class	Density (/ha)
Seedlings	477
Juveniles	9,273
Adults	886
Total	10,636

Seedlings bank:

- very high density of dormant seedlings/juveniles under a dense mesquite stand

- doesn't occur in the native range for some reason

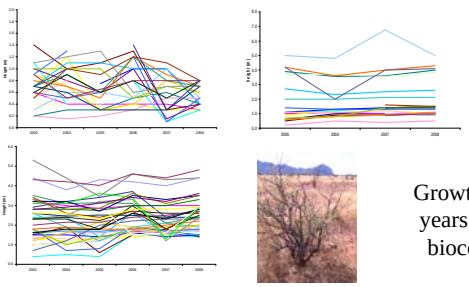
- expect the same dormancy potential under native shrubs

= a serious management challenge

Juvenile and adult growth rates

Pilbara hybrids

West Qld hybrids

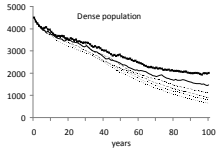


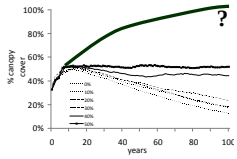
Growth in wet years & if no biocontrol?

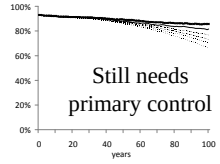
Population dynamics (Pilbara) [work in progress]

MODERATE

DENSE



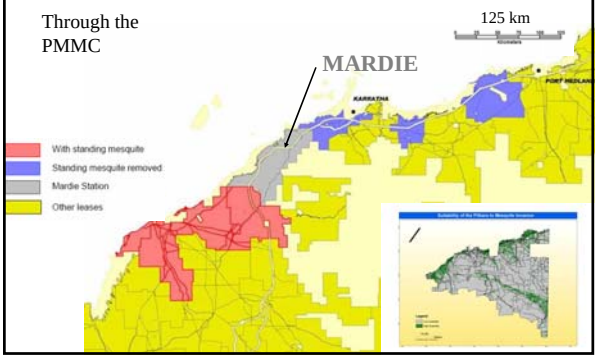




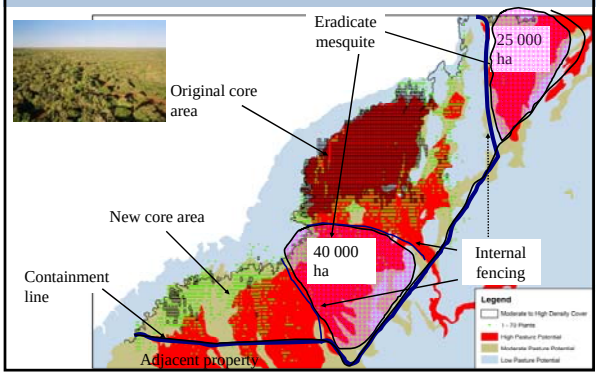
Still needs primary control

MANAGEMENT

Incorporating research into management: regional



Incorporating research into management: core



Use of fires for hybrid mesquite?

- Needs “canopy fires” to kill dense populations
- Fuel loads are constrained (Pilbara)
  - Relatively low
  - Not every year
  - Discontinuous
- Conditions for hot fires
  - Not every year
  - High labour
  - Permits difficult

Hybrid mesquite: control is costly and challenging

- 144 ha trial
- Fuel manipulation: mechanical treatments and grazing management
- First fire in late 2006

Pre-treatments

Conclusions for fire and fire-tolerant mesquite

- **Generally not practical in arid areas**
  - Mechanical pre-treatments insufficient to stimulate herbaceous growth
  - Wet years for good herbaceous growth unpredictable (both pre and post burn)
  - Hot, dry, windy conditions for canopy fires rare
  - Difficult to coincide burn times with permits/crews
- **May have uses in wetter areas**
  - Lower intensity fires for saplings (e.g. USA)

45ºC, < 10%RH, >30km/hr winds

Species differences in management

	P. pallida	The rest (*P. velutina*, *P. glandulosa*, hybrids)
Invasiveness	✔ ✔ ✔	✔ ✔ ✔ ✔ ✔
Treatment success		
Fire	✔ ✔ ✔ ✔ ✔	✔
Dozing	✔ ✔ ✔ ✔ ✔	✔ ✔ ✔ ✔
Chaining	✔ ✔ ✔	✔
Leaf-tying moth	✔ ✔ ✔	✔ ✔ ✔ ✔

- *P. pallida* is generally less invasive and more easily managed

Recruitment after control work: Qld 2009 floods

Under dense mesquite, following dry years

Where	Last seeding plants	Seedling density (seeds/m^2)
McKinlay area	Still seeding	1.1
	Still seeding	2.3
	2004-5	0
Hampden Downs	2005-6	0.07
Marooka	Still seeding	2.9
	1998-9	0
Burketown area	1998-9	0-0.08

Management challenges: life cycle

- Adults are long-lived
- Most seeds pass through animals (predictable, but dispersed)
- Seed banks not dense and relatively short-lived
- Seeds are dispersed far and wide (problematic!)
- Seedling banks (problematic!)
- Can take a long time to reproduction
- Most population activity only during wet phases (good and bad)

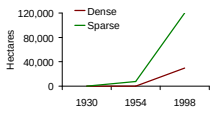
Management challenges: management tools

- Are ok
- Good kill rates if applied correctly (machinery, basal bark)
- Cheaper & less labour would be better
  - Machinery the only way to kill dense fire-tolerant mesquite
  - Basal-barking the main way to kill isolated plants
  - Labour is often limited (e.g. Pilbara)
- Greatly assisted by biological control (esp. Pilbara, possibly NQld) [+ new agents?]

Management challenges: isolated plants

Management success will depend on our ability to:

- Deal with isolated plants over large areas
  - South-west Qld (Comongin +++)
  - North Qld (100s of properties?)
  - Pilbara (120 000 ha +++)



- Manage mesquite through wet-dry cycles
  - High seed production + high recruitment + high growth

Some ongoing work

- What is the outcome of the February 2009 rains?
- Mesquite genetics: is it hybridising into a “super weed”? (PhD scholarship with Plant Industry)
- Optimising control strategies: what is the optimal type, timing and frequency of primary and secondary control efforts? (Pichancourt)
- Managing Pilbara mesquite through biogeneration (CPMining)