Department of Agriculture and Fisheries

Frequent burning reduces Lantana density

Tom Lewis* & Valerie Debuse (DAF)

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*Presenter

Queensland Government

Lantana camara – a problem weed

- Pantropical environmental weed originating from South America.
- Present in over 70 countries.
- In the top 100 of IUCN 'World's Worst Invasive Alien Species'.
- Weed on national significance and Class 3 declared pest plant in Qld.
- Highly variable species with many cultivars.
- Approx. 30 biocontrol agents introduced since 1914.
- Dispersed by birds and regenerates readily from base.
- Forms dense clumps or thickets – excluding native species – impacts on biodiversity.
- Poisoning of livestock.

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Approx. 17 biocontrol agents have become established. Success of control is variable – but agents may reduce the vigour of the plant.

Large spreading root systems that can resprout after fire.

Has potential to alter local fire regimes.

Lantana and fire background

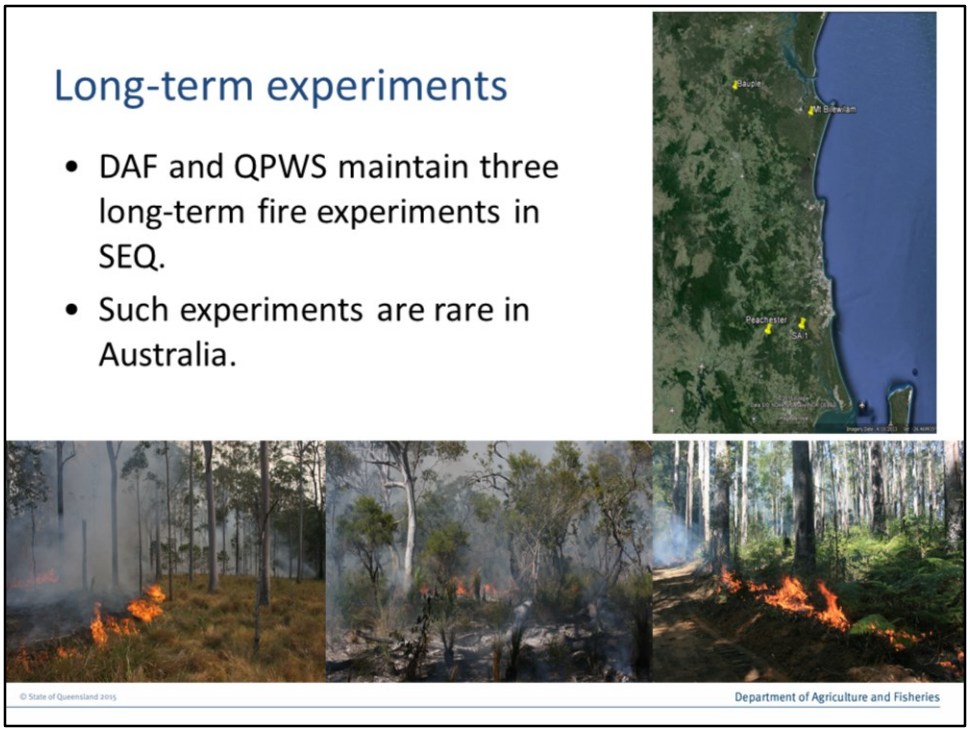
- Fire has been shown to encourage lantana invasion (Fensham et al 1994, Gentle and Duggin 1998).
- Published studies provide useful insight but limited in terms of: (1) fire regime; (2) multiple ecosystems; (3) long-term quantitative data.

Fire acts as a disturbance, modifying the soil and biomass – more light = more opportunity of invasion – particularly in rainforest environments.

Anecdotal evidence is more plentiful but inconsistent - dependent on variation in fire regime used, fire history of the site and the ecosystem.

Fensham RJ, Fairfax RJ, Cannell RJ (1994) The invasion of *Lantana camara* L. in forty mile scrub National Park, north Queensland. Aust J Ecol 19:297–305

Gentle CB, Duggin JA (1997b) *Lantana camara* L. invasions in dry rainforest—open forest ecotones: the role of disturbances associated with fire and cattle grazing. Aust J Ecol 22:298–306



To help answer some of the questions regarding ecological resilience and the impacts of frequent (and infrequent) burning we can make use of long-term fire experiments.

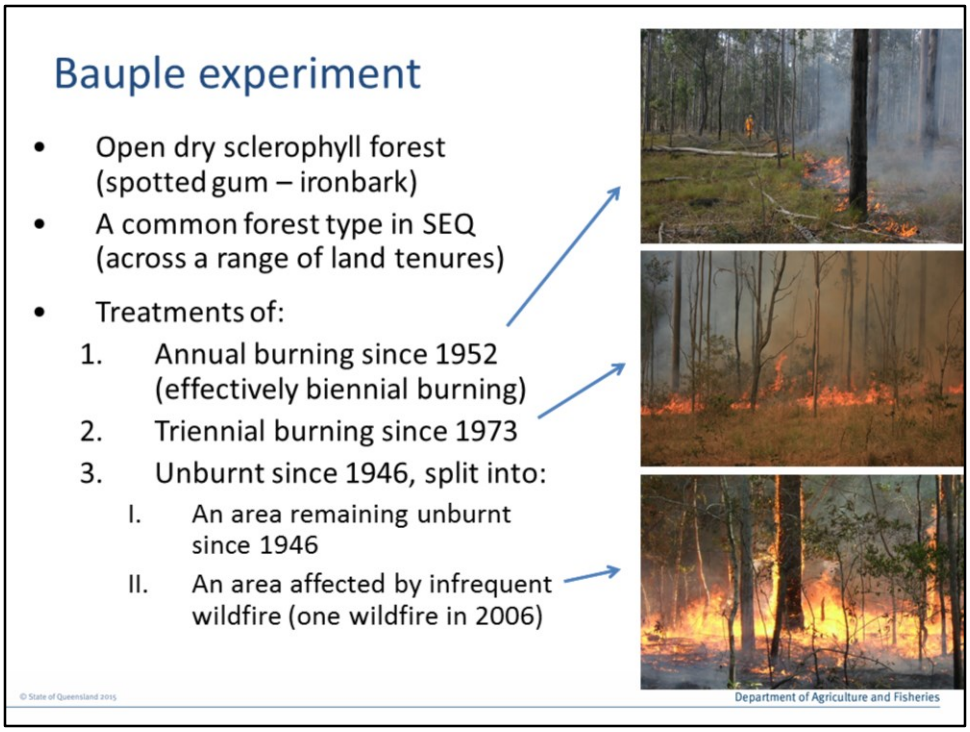
They are important for understanding:

Species dynamics and responses to fire regimes

The relative importance of fire versus other long-term factors (e.g. climate)

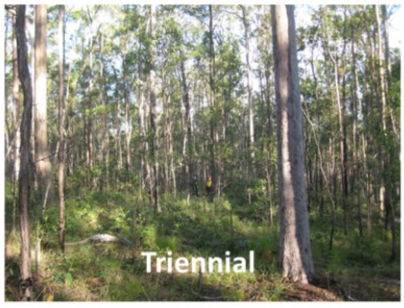
Experiments can look at the impact of frequent fire on managing understorey weeds.

Ecological impacts of prescribed burning.



Treatments cover large areas
Six monitoring plots in each treatment. Monitoring plots are 0.4 ha in size (100 x 40 m). The relatively high frequencies in this experiment are particularly relevant for landholders who manage this type of forest. Burning is conducted in winter and spring. We rely heavily on other government agencies and volunteers to carry out the burns.

The treatments



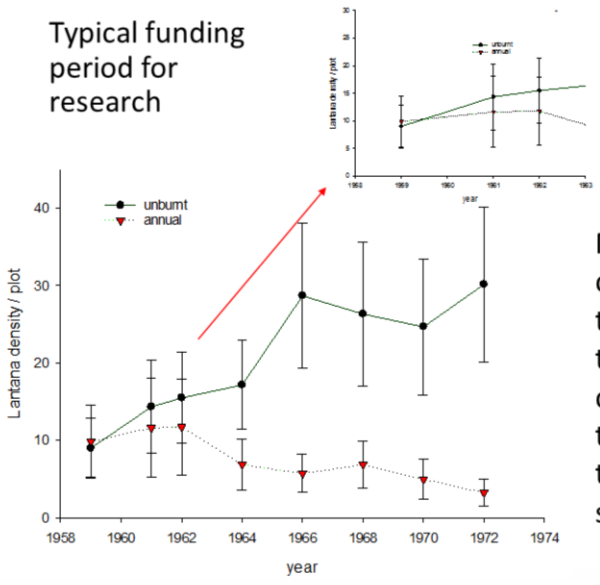
Analysis

1. Determine the impacts of frequency treatments on lantana density.
   - A logging event between 1972-1974 split the data into two periods:
     - Pre-logging (1959-1972)
     - Post-logging (1974-2007)
2. Determine the impact of other environmental variables on the change in lantana density:
   - Relative rainfall (mean annual rainfall in the preceding two years compared to long term average)
   - Tree basal area (canopy cover)
   - C:N ratio in topsoil
   - Distance to watercourse
   - Lantana density at previous measure
   - Understorey density

Lantana abundance was recorded within 100 x 1 m belt transects

Importance of long-term studies

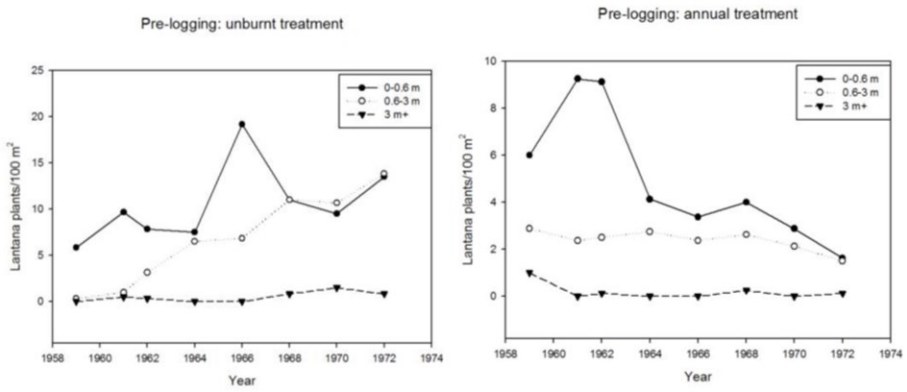
Typical funding period for research



Mean lantana density increased in the long unburnt treatment, but declined 3 fold in the annually burnt treatment over the same period.

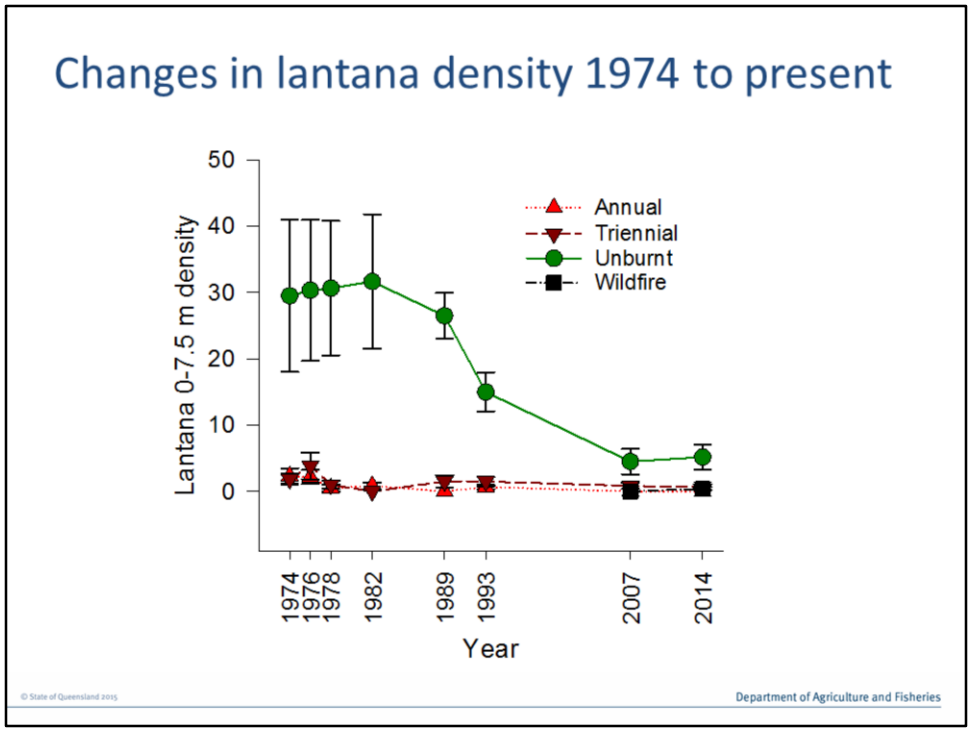
Unburnt plot 1962

Changes over time 1959-1972

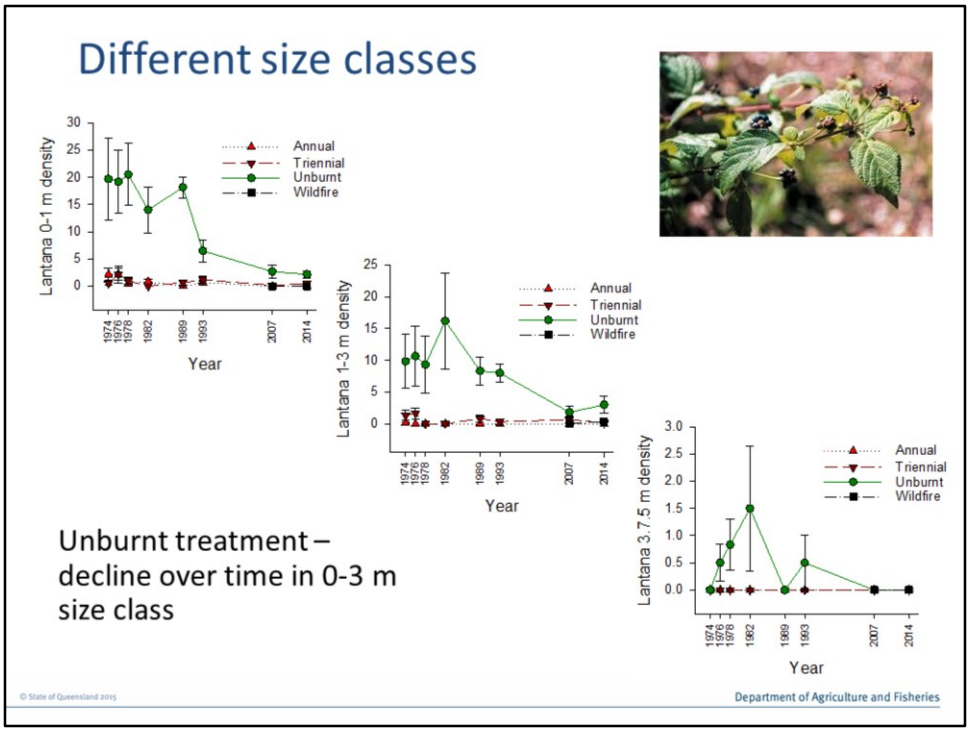


Most change in the smaller size classes


Long unburnt
Annually burnt



Lantana camara densities in the annual and triennial burn treatments remained low at <=2 plants 100 m-2 during 1974–2007. Density decreased in the unburnt treatment over this time.



Lantana camara regeneration (0-1 m) was generally the dominant height class.

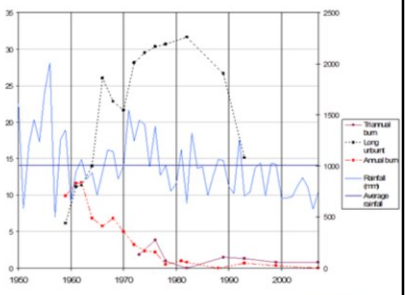
What other factors were important?

Variable	*β*	P
plot stratum		
Fire treatment		0.021
Covariates		
Previous Lantana density	-6.6	<0.001
C:N ratio	3.2	0.011
Soil pH	3.0	0.010
Tree basal area		NS
Density of understorey		NS
Distance to watercourse		NS
plot.time stratum		
Rainfall		0.073
Rainfall x fire treatment		0.003

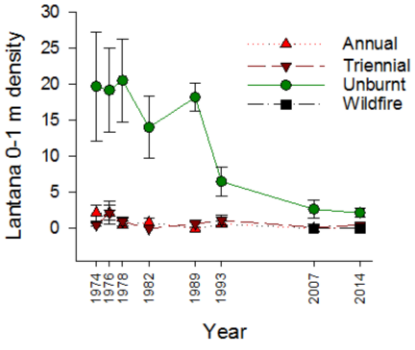
Factors influencing *Lantana camara* regeneration density.

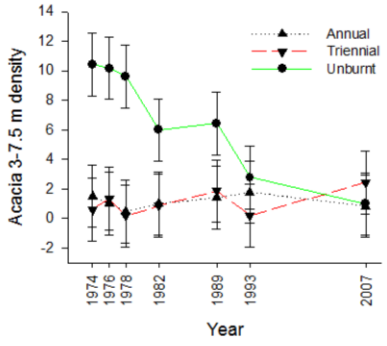
Other factors - summary

- Conspecific interactions.
- Rainfall had a positive influence on lantana regeneration in the unburnt treatment.
- Canopy cover not so important in open forest.
- Positive relationships between lantana regeneration and soil C:N and pH.
- Allelopathic chemical influence on pH?
- Higher C:N related to higher moisture content?
- Other drivers?



Temporal drivers?





Related changes in C:N?

Discussion

- Decline in density of recruits in the annual treatment from 1959-1972.

- Contrary to findings from short-term studies in other ecosystems where increased disturbance from fire facilitates lantana recruitment.
- Sources of propagules (seed banks, resprouting, dispersal by frugivores) insufficient to counterbalance effect of frequent fire.

repeated fire steadily reduces the density of *Lantana camara* and may suppress population growth, through its impact on plant mortality.
Contrary findings – mainly due to the nature of the different ecosystems studied.
Rainforest more sensitive to fire, whereas dry eucalypt forest is quite resilient.

Management implications

- Fire has a potential role in managing lantana densities in dry sclerophyll eucalypt forest.
- Impacts of frequent fire on local native plant species (i.e. diversity) in these systems are minimal.
- Where such frequent fire cannot be applied, fire is could still a useful management tool for lantana control:
  - Easy access for other weed control techniques.
  - Herbicide treatment on lantana re-sprouting after fire.

Care required on rainforest margins and around watercourses – often where the lantana is.

Summary

- Long-term annual burning significantly reduced lantana density.
- Triennial burning maintained low densities of lantana.
- Relative rainfall and soil C:N ratio, pH were significant correlates of changes in lantana density.
- Considerable long-term variability in lantana density in unburnt treatment only partially accounted for by model.
- Repeated burning reduced temporal variation in lantana dynamics.

Lantana camara populations undergo large temporal fluctuations in the absence of anthropogenic disturbance.


Questions?
Acknowledgments:
Past and present research staff that have measured and maintained the experiments, university collaborators, SEQ Fire and Biodiversity Consortium, QPWS, DAF Forestry, HQ Plantations and Rural Fire Service Queensland.
More detail see:
Debuse and Lewis (2014) Long-term repeated burning reduces *Lantana camara* regeneration in a dry eucalypt forest. *Biological Invasions* 16, 2697-2711.