Vegetation community responses to weed invasion in floodplain riparian ecosystems of the Condamine River, southern Queensland

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Overview:

This research investigates the relative roles of landscape-scale (land- and water-use regimes), patch-scale (management regimes) and population-scale (inter-specific competitive regimes) change on the health and function of *Eucalyptus tereticornis* / *E. camaldulensis* riparian woodland communities of the Condamine floodplain, northern Murray-Darling Basin.

A key hypothesis of this research is that widespread tree decline within these woodlands may indicate that water availability in these water-dependent habitats is approaching critical levels, exacerbated by significant infestation by the introduced weed lippia *Phyla canescens*, a highly-efficient competitor.

The study takes a multi-factorial approach (including time-series streamflow and GIS-based spatial and temporal analysis, assessments of current community composition and condition, experimental manipulation to investigate mechanisms contributing to the competitive success of lippia, and an investigation of landholder responses to both eucalypt dieback and lippia infestation) aimed at developing an integrated understanding of the drivers and mechanisms of ecosystem decline and at deriving empirical information which will contribute to future land and water management decision-making..

This poster outlines a number of experimental investigations (field- and glasshouse-based) into the functional traits and invasive mechanisms underlying lippia's success in these habitats and species' responses to lippia abundance.

Upper Condamine Floodplain:

The floodplains of the Upper Condamine River represent some of the most fertile agricultural lands in Australia. These landscapes have undergone major land use change over the past 60+ years, resulting in significant reduction in the extent of native vegetation communities across the region.

Changes to groundwater levels, overland flow, and the flow regime (volume, frequency and duration of in-stream and flooding flows) of the river have also occurred. These changes, coupled with high inherent regional climatic variability and potential climate change, indicate significant decrease in water availability for natural (often water-dependent) systems and processes across the floodplain.

Riparian communities:

Eucalyptus tereticornis / *E. camaldulensis* riparian woodlands associated with the Condamine River (RE 11.3.25) are currently classified as 'of concern' (i.e. between 10 and 30% of pre-European extent remaining[1]). Declining condition of remnant patches within this vegetation type is evident, with progressive loss of tree cover due largely to dieback processes, and significant levels of weed invasion (eg lippia *Phyla canescens*)[2]

Fig 1: Lippia senescence during drought / winter. (Insets: close-up of lippia, and map of current and potential lippia distribution)

Fig 2: Lippia concentration at the tree base - a potential 'refuge' area under limiting environmental conditions

Lippia *Phyla canescens*:

Lippia exhibits many traits which contribute to its success as an invasive weed in floodplain landscapes[3,4]:

- fast-growing, mat-forming deep-rooted clonal perennial
- spreads vegetatively and by seed
- responds to clay soils, summer rainfall and bare ground
- tolerant of frosting, extended inundation and drought
- no known predators or pathogens, and rarely eaten by stock

Lippia is of significant concern in throughout the Murray-Darling Basin (Fig. 1):

- losses to the grazing industry due to lippia (reduced pasture quality and productivity) estimated at $38M per year.
- estimated environmental costs of $1.8B per year.

To date there has been little empirical testing of lippia's functional / competitive role in remnant ecosystems, within which it is has the potential to impact floristic composition, ecosystem condition and function, and ecological trajectories within native vegetation communities already threatened by extensive land use change.

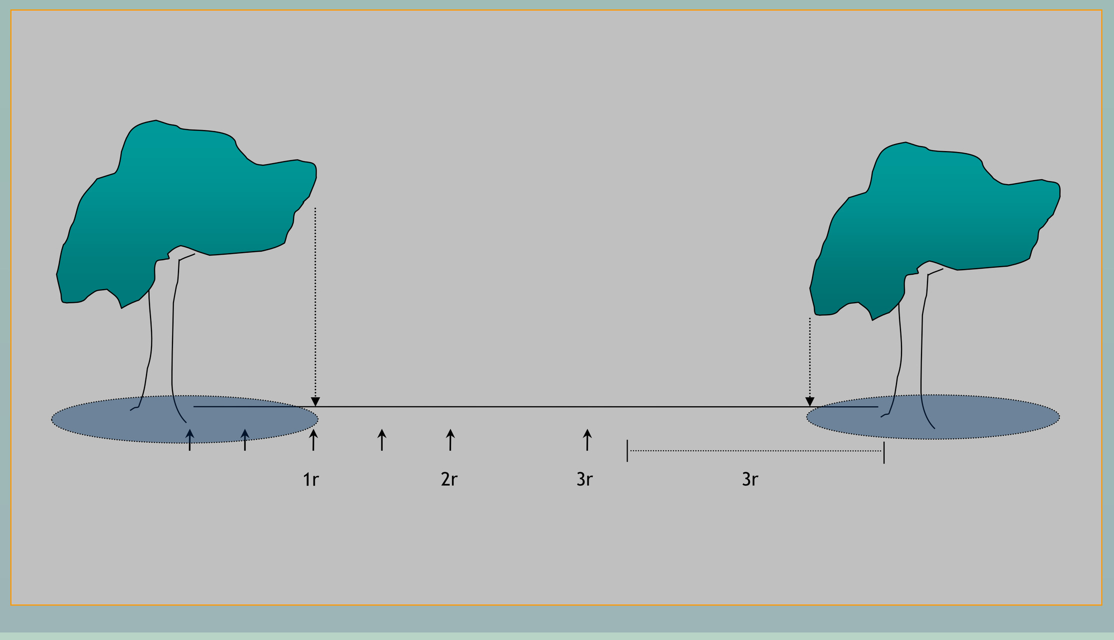

Fig 3: Diagram showing sampling points in relation to tree radius (and stopping rules relating to proximity of neighbouring trees) along a transect (see Experimental components #1). Shading indicates under-canopy region.

Key questions:

- **limiting resources** - which resources (space / light, moisture, nutrients) are critical to the success of lippia in these habitats?
- **refugia** - how important are refuge areas for lippia survival under limiting environmental conditions (eg during drought)?
- **resurrection** - to what extent is inter-ramet connectivity important to lippia ramet survival / recovery?
- **interactions** - what effect do mycorrhizae/competitors have on lippia ramet survival and growth under controlled conditions?
- **community response** - what is the community composition response to lippia removal in these habitats?

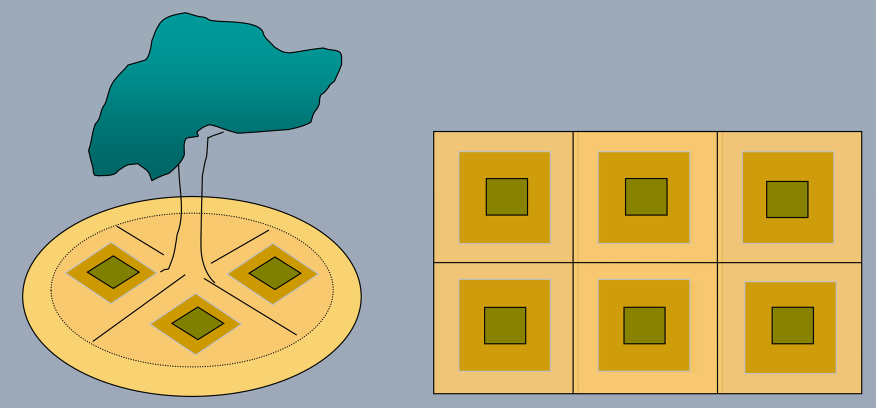

Fig 4: Schematic of treatment blocks (see Experimental components #2,3). Colours indicate buffer (yellow), treatment (gold) and sampling (green) areas.

Experimental components:

1. **refugia investigation -** transects extending from tree-bases (12); sampling at multiples of canopy radius (r) to determine the biophysical conditions associated with lippia refugia under drought and frost conditions (Fig.2, 3).
2. **simulated grazing trial** - replicated (x8) randomised block design with sampling before and after treatment (modified BACI design); treatments include two levels of groundcover height +/- density reduction (60% and 90%). Lippia response to increased levels of light, space and bare ground will be monitored (Fig.4).
3. **lippia control trial** - randomised block design replicated (x8) across the landscape in grazed and ungrazed remnants; treatments include physical and chemical removal of lippia. Groundcover response will be monitored to determine vegetation response to removal of a functional weed (Fig.4).
4. **glasshouse trials** - investigation of lippia response to a number of biophysical parameters (eg moisture availability, nutrients, mycorrhizal associations, competitors) under controlled conditions; ramets pairs will be used to investigate the importance of inter-ramet connectivity to lippia survival.

References:

1. Sattler, P & Williams, R (eds.) (1999) *The conservation status of Queensland's bioregional ecosystems*. Environmental Protection Agency, Brisbane
2. McCosker. RO (1996) *An environmental scan of the Condamine-Balonne River system and associated floodplain*. LANDMAX Natural Resource Management Services, Armidale NSW.
3. Earl, JE (2003) *The distribution and impacts of lippia (*Phyla canescens*) in the Murray Darling system*. Final report for the Lippia Working Group, October 2003.
4. Taylor, B & Ganf,GG (2005) Comparative ecology of two co-occurring floodplain plants: the native *Sporobolus mitchellii* and the exotic *Phyla canescens*. *Marine and Freshwater Research* **56**

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