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2006

## Impacts of plant invaders and management techniques on native communities : ecological and social perspectives at regional and global levels

Tanya J. Mason

*University of Wollongong*

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**Impacts of plant invaders and management  
techniques on native communities: ecological and  
social perspectives at regional and global levels**

A thesis submitted in fulfilment of the requirements for the award of the degree of

Doctorate of Philosophy

from the

University of Wollongong

by

**Tanya J. Mason B. Sc. (Hons)**

School of Biological Sciences

**2006**

## Thesis Certification

I, Tanya J. Mason, declare that this thesis, submitted in fulfilment of the requirements for the award of Doctor of Philosophy, in the School of Biological Sciences, University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualifications at any other academic institution.

Tanya Mason

November 2006

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## Abstract

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Plant invasions of natural communities threaten biodiversity and ecosystem processes across many biomes and trophic levels. Understanding and managing invader impacts are therefore significant steps in achieving conservation. Both causes and management of invasion are dependent on human behaviour and ecologists must consider this human dimension in developing management protocols. While control of invaders is routine in many conservation reserves, assessment of ecological outcomes following control is rarely enacted. Management is itself a disturbance and the compounding effects of both invasion and management on biodiversity merit rigorous assessment. While species-level responses to plant invasion have been widely reported, functional group and seed bank responses to invasion and management are rarely investigated. Generalisations about invader impacts are urgently required for targeted restoration. In this thesis, I used qualitative review, field study and meta-analysis to address ecological, social and land management issues of invasion biology.

Firstly, I reviewed policy instruments and asked: are government, land managers and the scientific community using available social levers to achieve optimal invader management? I found that while important policy principles have been developed, they require greater enactment. Release of significant funds will be required to resource long-term invader control and restoration activities. Education and voluntary incentives require a strong extension service to maintain involvement and standards of control. Rigorous monitoring systems are an under-utilised but important tool in achieving adaptive invader management.

I then used the invasive shrub bitou bush, *Chrysanthemoides monilifera* ssp. *rotundata*, to analyse invasion and management impacts in coastal dune communities of

eastern Australia. I compared the effects of intensive, manually-based invader control with those of extensive control (mainly herbicide spraying from aircraft) across fore dune communities. I examined one management regime, which was typically intensive, in hind dune communities. My main aim was to test the prediction that intensive methods would achieve better biodiversity outcomes than extensive approaches in fore dune communities. I found that extensive management created native species complements that diverged from non-invaded sites while intensive management approached non-invaded site conditions. However, intensively managed sites were also richer in other exotic species than extensively managed sites. Thus, while biodiversity outcomes were better under intensive management, the risk profile of such sites was increased by the greater array of exotics that could potentially replace the original invader. The positive effects of management evident on some fore dunes were not found in hind dunes, where managed sites had the highest exotic species richness and similar bitou bush seedling abundance as both non-invaded and bitou-invaded sites. Hind dune managed sites were also compositionally distinct from non-invaded sites. For all sites, even after intensive management, follow up control is required to avoid substitution of the primary invader by other aggressive invaders.

In order to characterise invader impacts beyond species-level comparisons, I compared bitou bush impacts on vegetation structure, richness of both native and exotic growth forms and community variability in fore and hind dunes. I found that bitou bush impacts were context specific: in fore dune shrublands, functionally distinct graminoid, herb and climber rather than shrub growth forms had significantly reduced species richness following bitou bush invasion. However, in forested hind dunes, the functionally similar native shrub growth form had significantly reduced species richness following bitou invasion. Density of vegetation structure increased at the shrub level in

both fore and hind dune bitou-invaded, relative to non-invaded communities. Fore dune ground-level vegetation density declined at bitou-invaded sites compared with non-invaded sites reflecting significant reductions in herb and graminoid species richness. Hind dune canopy-level vegetation density was reduced at bitou-invaded compared with non-invaded sites. Bitou bush invasion also affected fore dune community variability with significant increases in variability of species abundances observed in bitou-invaded compared with non-invaded sites. In contrast, there was similar variability among all hind dune sites. The results suggest that effects of bitou bush invasion are mediated by the vegetation community.

In addition to standing vegetation dynamics, I investigated soil-stored seed banks affected by bitou bush invasion and management, to further elucidate levels of community resilience. While management of bitou bush may have reduced the density of bitou bush seeds in the soil, it did not reduce the richness of other exotic species. Native tree seed richness was significantly higher in seed banks of sparsely-invaded than either heavily-invaded or managed hind dune sites, perhaps indicating a permanent shift in community structure following invasion. However, remaining indices of native seed bank diversity were similar across all invasion categories, indicating that seed banks of many native species were unaffected by both invasion and management. While examination of seed banks is informative in assessing past and potential community dynamics, low similarity between the standing vegetation and seed bank at all sites indicated that many hind dune species had other storage or regeneration modes and seed banks cannot be relied upon for comprehensive dune restoration.

Finally, I used meta-analysis to contextualise my field studies of bitou bush invasion using 20 international invasion studies. I hypothesised that plant invaders act as biotic filters and more strongly affect representation of some plant traits over others



in the resident community. I analysed the effects of graminoid and woody invaders on species richness for native growth form, longevity, seed mass and flowering phenology traits. I found that graminoid invaders disproportionately affected species with graminoid and herbaceous growth forms, perennial strategies and small seed masses. Woody invaders disproportionately affected graminoid or shrub species and perennials. Woody invaders had a consistently greater negative effect on native species than graminoid invaders, perhaps due to pre-emption of light resources. In contrast, it made no difference to native richness as to whether species flowered at the same time as the invader, indicating little interaction between invader and native pollination dynamics.

Plant invaders non-randomly affect resident species in turn changing community attributes. Current management of invaders may not re-instate pre-invasion conditions. Restoration is dependent on recognising the impacts of an invader and both supplementing native traits adversely affected by invasion and enacting long-term follow-up control of primary and secondary invaders.

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---

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