

## Developing control strategies for environmental weeds

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### Summary

Control strategies for environmental weeds need to be properly targeted and based on an understanding of weed ecology. It is important to control excessive disturbance to minimize weed invasion. Priorities for weed control programs should be based on the conservation significance of the land. Environmental weeds can be rated by considering a combination of factors including degree of aggressiveness, life-form, mode of dispersal and reproductive potential. There is the potential for new troublesome weeds with predicted climate change but this is balanced by the concomitant loss of other species. Guide-lines for the design and implementation of control strategies are discussed.

### Introduction

Australia held a unique position in the world until just over two centuries ago. Until then the technological and cultural revolutions that involved massive disruption of natural ecosystems, and had evolved and spread throughout much of the rest of the world, had not affected Australian ecosystems. However, with the arrival of European people and the influence of the agricultural and industrial revolutions (Adamson and Fox 1981), weed propagules were introduced, intentionally or otherwise, some of which subsequently flourished (Fox and Adamson 1986). It also meant the introduction of new types of disturbance and of alterations to existing disturbance regimes to Australian ecosystems (Fox and Fox 1986a). It is now widely accepted that there is no weed invasion without disturbance (Fox and Fox 1986b). The arrival of the first Europeans was therefore responsible for a series of weed introductions and disturbances that has continued unabated.

Much of the previous attention on weeds focused on agrestal weeds and troublesome weeds in human-modified ecosystems. More recently, there has been an increasing interest and concern about 'environmental' weeds; species that apparently contradict the assumption that invasion only accompanies disturbance as these weeds invade seemingly natural plant communities. Environmental weeds are of particular concern in areas dedicated for conservation purposes as the ecological integrity of natural areas is seen as somewhat impaired by the presence of exotic species.

### When and how should planning for environmental weed control begin?

Managers should be aware of potential problem species for the vegetation formations they control. This knowledge comes from observations on the same or similar vegetation types elsewhere, discussions with colleagues and literature. Planning for weed control should begin when the manager is aware that there is a potential problem, not after it is well established.

### How should priorities for control programs be determined?

Because of financial constraints and limited labour, priorities for weed control programs need to be developed. Generally the conservation status of the land should dictate the control priority. Land that has been dedicated for conservation purposes must be maintained in as pristine a condition as possible. Weed infestations near areas of high conservation value also should receive a high priority for treatment if the dispersal range of the weed overlaps areas of conservation significance. Amenity qualities of recreational land are also important and if potential weeds are irritating or spiny or poisonous priority for control may be required.

### Developing a rating system for environmental weeds

A number of factors need to be considered when rating environmental weeds. The degree of aggressiveness and life-form of the weed are important. Climbers can invade otherwise undisturbed communities from disturbed edges, while perennial shrubs or trees, once established, act as a point source for dispersal of propagules into adjacent habitat. The mode of propagule dispersal is also important. Fleshy-fruited weeds that are readily dispersed by birds and wind- or water-dispersed species can be particularly hard to contain. The reproductive potential of a species is also an important consideration, prolific seeders and species capable of vegetative spread are particularly troublesome.

### What criteria should reserve managers use to select environmental weed targets?

Some weeds are conspicuous because of their rapid growth and competitive interaction with native species, and therefore should be targeted for control. After the removal of conspicuous weeds the aesthetic and biological value of a plant community

is improved. If the species removed is a 'keystone' species its presence will have advantaged other weeds (Fox 1988) and its removal will result in the reduction of other weed species.

In invaded vegetation there is sometimes a number of conspicuous weed species, each with a different life-form or niche. In such cases it may be necessary to develop control programs for each species. For example, on the north coast of New South Wales a degraded community may contain camphor laurel (*Cinnamomum camphora* (L.) Nees) in the tree stratum, lantana (*Lantana camara* L.) in the shrub stratum and madeira vine (*Anredera cordifolia* (Tenore) van Steenis) as a climber. All are significant weed species but occur in different strata of the vegetation; a control program should target all three species.

### Importance of identifying and treating causes (potential and actual) of weed invasion in native vegetation

Weeds can only invade a plant community that has been disturbed (Fox and Fox 1986b). Some forms and levels of disturbance are natural components of all communities and, if weed propagules are available, invasion can occur. However, the degree of weed invasion can be minimized by managing disturbance regimes within the community. For example, fire is a natural disturbance in most Australian ecosystems, but altered fire regimes (principally frequency and intensity) can lead to changes in floristic and structural composition and affect both native and exotic species. It is possible to identify 'natural' fire regimes and managers should aim to emulate these.

### Importance of integrated control programs

Over the past two or three decades we have become increasingly aware of the environmental and health cost of indiscriminate use of agricultural chemicals. Now the responsible manager uses chemicals judiciously and only as an ancillary agent to other control measures. Careful removal of weed species and their propagules, together with management of the disturbance regime, go a long way to minimizing the impact of weed invasions. Both actions promote native species and disadvantage exotics (Fox 1987a). Restoration of a healthy and diverse community with its full complement of predatory insects, soil microorganisms and fungi will also minimize subsequent infestation.

### The relationships between disturbance and persistence of environmental weeds

Many weed species existed in Australia before they became troublesome. The tropical weed *Mimosa pigra* L. occurred

near Darwin for over a century before it dominated riparian communities (Braithwaite *et al.* 1989). It is possible that environmental weeds require a population threshold that must be exceeded before their invasion potential is realized. Disturbed sites may be the incubation ground in which the weed persists and gradually builds up numbers. Alternatively, environmental weeds may require an environmental trigger, such as a sequence of favourable seasons, before its population expands and disperses dramatically (i.e. population explosion). Groves (1986) estimates that the number of introduced, naturalized plant species in Australia is 1500-2000, or 10-15% of the total flora. With the possibility of rapid climate change associated with global warming, it is possible that new suites of weed species will establish as changes in the environment occur. Some general trends can be predicted. In southern Australia, where there is winter-dominated rainfall, weeds originate predominantly from the Mediterranean Basin or from other parts of the world with similar climates (Fox 1987b, 1990a). If, as predicted, climate change in Australia leads to a southward shift of the summer-dominated rainfall there may be a decrease in the dominance of Mediterranean-type-climate weeds. In their place would be species that require summer rain. Serious environmental weeds in summer-rainfall regions of Australia, e.g., *L. selloana*, *A. cordifolia*, *Ligustrum* spp., are grown as horticultural plants in temperate southern Australia. These plants could serve as a source of propagules for the invasion of native vegetation with the onset of climate change.

#### How can reserve managers reduce weed invasion by managing disturbance?

The principal disturbances that affect plant communities in southern and eastern Australia are altered fire regimes, altered drainage, eutrophication (addition of nutrients), disruption of existing vegetation and soil, and grazing by introduced animals. Each of these disturbances requires different methods of management. Fire can be controlled by fire-breaks and vigilance over visitor activities in or near native vegetation. Infrequent fire, a form of disturbance in some situations, can be managed by control burns; however, the season, intensity and the extent of burning need to be managed to suit the ecological requirements of the area being treated. Altered drainage systems are often costly to rectify as redirection of storm-water drainage in urban areas or major projects for rural land may be required. Loss of vegetation, especially of the dominant stratum, is a massive disturbance but one that can be reversed. If natural regeneration is facilitated and further disruption prevented, then disturbance by vegetation removal may prove to

be a transient one. The loss of soil on the other hand is mostly irreversible. Rehabilitation may re-establish some vegetation on eroded, salinized or acidified soils but reconstruction of original vegetation communities is difficult or impossible. However, an assemblage of native species without weeds may be possible if subsequent disturbance is controlled. Finally, grazing can be controlled by the simple but costly expedient of fencing reserves. With some introduced grazers such as rabbits, feral goats and pigs shooting and poisoning programs are also required. With each disturbance, or combinations of them, a variety of methods of management may be available. In the rehabilitation process it is imperative that the effects of past artificial disturbance regimes and potential causes of future disturbance are treated and natural disturbance regimes emulated.

#### The importance of preventative weed control measures. What steps should be taken?

'Prevention is better than cure' – and for managing large and significant areas of land with high conservation or recreational value it is also cheaper and more desirable scientifically. Preventative weed control measures involve the following basic stages:

- awareness – of existing and potential problems,
- enquiry – about the basic ecology of the weed species and management options,
- planning – of the control program,
- implementation – in a cost-effective manner,
- monitoring – to determine success and direct future actions.

A realistic assessment of some sites may mean accepting a community that includes some exotic species, particularly in urban settings where new mixes of native and introduced species have occurred (Fox 1990b). However, for land that has been dedicated for biological conservation, management objectives should aim to maintain it in as near to pristine condition as possible. This can be achieved if natural disturbance regimes are allowed to operate combined with control of exotic species by an integrated program that may involve chemical, biological and physical agents.

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